CeRP
CENTER FOR RESEARCH ON PENSIONS AND WELFARE POLICIES

Annual conference

Financial Security in Retirement

18-19 September 2008
Collegio Carlo Alberto, Moncalieri (Turin)

Conference organized within the Forward Look programme "Ageing, Health and Pensions in Europe", funded by the European Science Foundation

PROGRAMME

Thursday 18 September 09:15 – 18:30

9:15	*Welcome and opening* **Elsa Fornero** (University of Turin and CeRP)
9:30	**MORNING SESSION: ADEQUACY OF SAVING FOR OLD AGE**
	Michael Hurd, Susann Rohwedder (RAND) **The Retirement-Consumption puzzle: Changes in Spending in Panel Data** *Discussant*: Margherita Borella (University of Turin and CeRP)
10:20	***Ernesto Villanueva*** (Bank of Spain) **The effects of the introduction of tax incentives on retirement saving** (with Juan Ayuso and Juan F. Jimeno) *Discussant*: Tetyana Dubovyk (CeRP and Collegio Carlo Alberto)
11:10	*break*
11:30	***Carole Bonnet*** (French National Institute of Demographic Studies) **Changes in the economic well-being following the death of a spouse: are public survivor pensions sufficient ? The case of France** (with Jean-Michel Hourriez) *Discussant*: Christine Hauser (CHILD and Collegio Carlo Alberto)
12:20	***Sarah Smith*** (University of Bristol and IFS) **What do defined contribution pensions mean for retirement? Evidence from the UK** (with Gemma Tetlow) *Discussant*: Giovanni Mastrobuoni (Collegio Carlo Alberto and CeRP)
13:15	*lunch*
14:40	**AFTERNOON SESSION: CHANGES IN PENSION DESIGN AND PRODUCTS**
	Salvador Valdes-Prieto (Pontificia Universidad Católica de Chile) **A Theory of Noncontributory Pension Design** *Discussant*: Esteban Jaimovich (Collegio Carlo Alberto)
15:30	***Henriette Prast*** (Tilburg University) **Rational Pension Products for Irrational People** (with Zvie Bodie) *Discussant*: Theodoros Diasakos (Collegio Carlo Alberto)
16:20	***Mario Padula*** (University of Venice and CSEF) **Pension Reforms and the Allocation of Retirement Saving** (with Renata Bottazzi and Tullio Jappelli) *Discussant*: Filippo Taddei (Collegio Carlo Alberto)

17:10	*break*
17:30	*Onorato Castellino Lecture*: ***Mario Monti*** (Bocconi University) **" Riflessioni su stato e mercato"***
18:30	*end of conference*

* English translation will be provided

Friday 19 September 09:00 – 14:30

9:00	**FORWARD LOOK SESSION: AGEING, HEALTH AND PENSIONS IN EUROPE** Presentation of the FL programme **Arthur Van Soest** (Tilburg University)
9:10	***Annamaria Lusardi*** (Dartmouth College and CeRP) **Adequacy of saving for old age** (with Elsa Fornero and Chiara Monticone) *Discussant*: Michael Hurd (RAND)
10:00	***Christian Gollier*** (Toulouse School of Economics) **Asset returns volatility and investment horizon: the French case** *Discussant*: Giovanna Nicodano (University of Turin and CeRP)
10:50	***Theo Nijman*** (Tilburg University) **Financial institutions and innovative financial products** (with Lans Bovenberg) *Discussant*: Riccardo Calcagno (Free University Amsterdam and CeRP)
11:40	*break*
12:00	**SESSION: THE CONTRIBUTION OF ANNUITIES TO FINANCIAL SECURITY** ***Monika Bütler*** (Universität St. Gallen) **The Role of the Annuity's Value on the Decision (Not) to Annuitize: Evidence from a Large Policy Change** (with Stefan Staubli and Maria Grazia Zito) *Discussant*: Elena Vigna (University of Turin)
12:50	***Pietro Tommasino*** (Bank of Italy) **The annuity market in an evolving pension system: lessons from Italy** (with Giovanni Guazzarotti) *Discussant*: Laura Piatti (Intesa Sanpaolo)
13:40	***John Piggott*** (University of New South Wales, Sidney) **"Notional Defined Contribution Pensions with Public Reverse Funds in Aging Economies: An Application to Japan"** (with Lu Bei and Olivia Mitchell) *Discussant*: Luca Beltrametti (University of Genoa)
14:30	*end of conference – buffet lunch*

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Adequacy of Saving for Old-Age in Europe*

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PRELIMINARY DRAFT– DO NOT QUOTE

Contents

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1 Conceptual issues and policy questions

According to the intertemporal model of consumption, individuals plan their consumption by taking into account the entire path of (expected) lifetime income, plus initial assets. In the stylized life cycle version of the model (LCM), individuals save during their working life to provide for consumption in the old-age.[1] Although saving for retirement is probably the single most important reason prompting individuals to accumulate wealth, other motives for saving are also relevant and can be accommodated into the standard model (Browning and Lusardi, 1996); differences in preferences and "taste for saving" (farsightedness, risk aversion, prudence, preference for bequest etc.) can also be incorporated.

With these modifications, the intertemporal model is better suited to explain why saving rates and wealth levels are so heterogeneous among the population – varying not only with respect to age (cohort/time), but also education, family size (and number of children), health and so on – and why wealth is so low for some groups (e.g. the young). Given these large differences, in which sense can we ask whether people have accumulated/are accumulating an *adequate* amount of retirement savings? And on which grounds is the question *relevant*?

The concept of (saving) adequacy should, in our view, combine two dimensions: a) sensible individual behavior with respect to the intertemporal allocation of resources in a given market and institutional context, and b) a well structured institutional design for an efficient sharing and diversification of risks, given individual preferences. This last point is also crucial, because even rational individuals can accumulate wealth poorly/inefficiently if they do not have the proper instruments and markets to do so.

The theory typically *assumes* that individuals are rational and able to plan their saving decisions over their lifetime horizon; this is the *normative* benchmark of many papers on savings (Scholz and Seshadri, 2008, p. 4). A vast amount of empirical literature, however, has documented departures from such an ideal standard due, for example, to myopia, inertia, and lack of financial literacy. Thus, the degree of saving inadequacy depends on how distant individual behaviour is from that benchmark. Moreover, saving decisions can be influenced by both the financial and insurance markets and by public policies. In particular, the provision of information on the mechanisms regulating the pension system and the improvement of financial literacy among the population are instruments that can stimulate individuals' *preparedness* for retirement and strengthen the adequacy of their saving. Whether these policies aiming to encourage greater individual responsibility should be preferred to imposing mandatory participation in a pension scheme is still an open issue. Thus the question about the adequacy is relevant for shaping policy measures and for targeting them to specific goals/groups.

For every individual, saving decisions entail some knowledge and/or expectations about the future evolution of compulsory retirement savings, to be withdrawn in retirement as a pension/annuity (Jappelli and Modigliani, 2003), as well as of goods and services provided by the state in the form of in-kind health services and other benefits such as long term care (LTC), if available.

[1] The provision of resources for the future is carried out not only by adjusting the saving/consumption margin but also through variation in the labour supply.

This brings into the picture institutional features, which are perhaps more difficult to characterize in a single model. With respect to the individual lifetime planning, the institutional setting defining scale and features of pension and health care systems is – to some extent – exogenous; from the point of view of the government, however, the provision of public benefits/services depends on factors such as: sustainability of public expenditure (intertemporal budget constraint); confidence in the ability of individuals to provide for their old-age; extent of market imperfections; public concern about poverty and redistributive preferences.

Even restricting our attention to Europe, a wide variety of arrangements for retirement provisions are in place, with countries varying widely according to the degree of state intervention, the provision of inter and intra-generational insurance, the amount of redistribution, and other characteristics (Kim and Lee 2007). Given these differences, individual behaviour is expected to differ not only because of preferences and individual resources but also due to the level of state-mandated saving and the access to private insurance. The degree of substitutability between "discretionary" and "mandatory" saving should also be considered (Borsch-Supan Brugiavini, 2001; Disney, 2000; Jappelli, 1995). Ideally, the assessment of the adequacy of household savings should be done in combination with the assessment of the adequacy of public pension provisions.

Health and LTC risks are also a very important motive to save, for example for precautionary reasons due to the lack of formal insurance, while housing equity is normally considered the best hedge against future catastrophic health care expenses (Skinner, 2007). In the analysis that follows, however, we will not consider health care and LTC provisions, mainly because the health risks of the elderly are generally taken care of in Europe and provided by national health care systems. Out of pocket health expenditure is also less relevant in Europe than in countries like the US. Finally it is less clear whether a public versus private provision of heath care increases efficiency, as it is normally assumed in a pension system. We will furthermore concentrate our attention to income risk in retirement and therefore on pension provisions, partially neglecting other risks connected to participation in the labour market (such as unemployment, disability, and so on) even though a lack of resources in retirement is typically the direct consequence of a poor working career.

The role of uncertainty should not be underplayed and it is related to other aspects of the economic environment. Pension reforms – by shifting pension formulae from Defined Benefits (DB) to Defined Contribution (DC) systems – substantially increased workers' uncertainty with regards to their replacement rates. When there was one major source of retirement income (i.e., a public mandatory pension) and the pension formula was of the DB type, determining the amount of pension benefits was a relatively easy task.[2] Reforms made pension systems more difficult to understand and demanded greater efforts to both collect and process information. This greater complexity also introduced an element of uncertainty over future benefits, thus increasing the costs (and reducing the incentives) to plan ahead.

[2] In the case of Italy, in the old system, pension benefits were determined by simply multiplying the number of years of "seniority" by 2 per cent of an average of the last wages; workers could thus anticipate a replacement ratio within the range 70 (for 35 years of seniority) and 80 per cent of "last" wages.

1.1 Adequacy from the individual/ household perspective

To assess adequacy of saving for retirement, one can refer directly to optimization theory or to measures which are somehow related (sometimes in a weaker way) to an optimizing model. In order to compare them, we will use the key equations of each approach: i.e. the Euler equation and the replacement rates.

1.1.1 The optimization principle

According to Engen et al. (1999, p. 70): "*a household is said to be saving adequately if it is accumulating enough wealth to be able to smooth the marginal utility of consumption over time in accordance with the optimizing model of consumption*". The Euler equation is the optimality condition implied by the model:

$$\max E_t \sum_{j=0}^{T-t} \beta^j U(C_{t+j}, Z_{t+j})$$
$$s.t. A_{t+j+1} = A_{t+j}(1+R_{t+j}) + Y_{t+j} - C_{t+j}$$

where $\beta = 1/(1+\delta)$ and δ indicates the individual intertemporal discount rate, $U(.)$ is a utility function depending on consumption C, as well as on the household demographic characteristics Z (e.g. household composition), and where A represents the stock of assets that grow from one period to the next according to the interest rate R, and Y is labour income.

From the first-order conditions, the following Euler equation is obtained:

$$U'(C_t, Z_t) = E_t\left[U'(C_{t+1}, Z_{t+1})\beta(1+R_{t+1})\right]$$

where the marginal utility of consumption at time t is equal to the expected (discounted present value of the) marginal utility of consumption in period $t+1$. The inclusion of household composition is relevant both because of the particular risk placed on singles (e.g. survivors) in retirement and because changes in the family composition help explaining why a lower consumption in retirement can be optimal (Scholz and Seshadri, 2007) .

This simple framework has been enriched by adding real life complexities such as labour supply decisions; uncertainty over future earnings and interest rates, the length of life and the health status; borrowing constraints; bequest and other motives for saving etc. (the most ambitious attempt is provided by Scholz, Seshadri and Khitatrakun, 2006). The main lessons to be drawn from this model are that the optimal intertemporal allocation of consumption requires the smoothing of marginal utility over time, and that low savings may be related with a number of individual "characteristics" (for instance, the young may save little or nothing or may be borrowing; older individuals may have little "discretionary" savings because the amount of "mandatory" saving is considered adequate to their retirement needs). Thus, the model helps thus distinguishing between an "inadequate" versus a low level of saving/wealth, which can be perfectly consistent with optimizing behaviour.

1.1.2 Uncertainty and market imperfections

Retirement risks are of paramount importance and models that ignore risk can provide, at best, only illustrative examples. When considering retirement provisions, *earning risk* is one of the most important risk to consider; conversely, at retirement, the main risks facing an individual are longevity and health risks. There are also other risks to be considered, such as political risks and interest rate risks. These risks can be diversified to a different degree, both depending on their nature and the market structure; while insurance can be bought in the market and/or is provided by the state, it is often imperfect, incomplete and costly.

Borrowing constraints. According to the model, individuals' wealth reaches its peak at the time of retirement. Thus, borrowing constraints are typically not biding in the old age. However, for those individuals that accumulate primarily via Social Security and pensions, wealth may be rather illiquid.

Wealth (il)liquidity. Individuals enter retirement not only with very different levels but also with different composition of wealth; social security (plus private pension) wealth is typically a substantial fraction of total wealth, competing with housing for the largest share in total wealth. While the first is annuitized by definition, and often delivers indexed benefits, housing wealth is rather illiquid. However, the house is often an attractive investment because it combines a flow of services with an investment good and it provides scope for portfolio diversification, given the low correlation between housing value and financial investments' return. Because of this illiquidity, it is sometimes excluded in empirical work on savings adequacy because households do not appear to draw down housing wealth after retirement (Venti and Wise 1990, 1991; Bernheim and Scholz, 1992).

Financial markets, however, have developed instruments to extract equity from home and to transform it into a more liquid form: mortgage equity withdrawals, reverse mortgages and flexible refinancing practices, offering a variety of cash flow profiles, enhancing households' ability to manage their financial position. Muellbauer (2007) focuses on the implications of easier access to credit for the housing wealth effect. In principle the relationship between house prices and aggregate consumption can be either positive or negative. Indeed higher prices increase homeowners' consumption but, on the other hand, lead renters and young potential first-time buyers to save more. Credit market's development lowers down-payment ratios and eases the access of homeowners to collateralized loans and, in turn, makes the aggregate effect of rise in price on consumption more likely to be positive. Muellbauer supports this theoretical argumentation with an empirical analysis that exploits cross-countries differences and the consequences of credit market liberalizations. He finds no evidence of housing wealth effect in the UK before 1980 but, after the liberalization that started in the Eighties, the positive link between consumption and housing wealth strengthened as credit supply conditions improved. Similar results are shown for countries with sophisticated financial systems like the US and South Africa. Different findings are obtained for Japan, characterized by inefficient credit markets and where no liberalization took place during the last decades. The negative housing wealth effect in Japan seems driven by higher saving by the young as house prices rise. Calcagno et al. (2008) study the effect on Italian households' saving behaviour of a change in real estate wealth using the Bank of Italy's Survey of Household Income and Wealth

(SHIW). They relate annual household saving to capital gains in housing, controlling for other characteristics such as age, and find the oldest households (less touched by the higher costs of future rents) to be the most affected by an increase in real net housing wealth.

In any case, new instruments are still scarcely used: many households still maintain a preference for living in their home, at least until a health shock force them to move, and hardly plan to use their housing wealth to finance consumption in retirement (Lusardi and Mitchell 2007).

Annuities. Economic theory advocates that, because of the "mortality premium", annuities dominate the return offered by financial assets; individuals should thus annuitize their wealth upon retirement to remove the risk of outliving their resources (Yaary, 1965). Davidoff et al (2003) show however that, when markets are incomplete, the arbitrage-like dominance argument does not hold any more, and full annuitization is not the best decision. While the theory can hardly answer questions about the "optimal fraction" of annuitized wealth, and while uninsurable risks may add to or subtract from it, depending on the nature of the risk, many simulations show that annuities are quite valuable to agents even when the optimal consumption trajectories differ substantially from the time paths of annuity payouts.

In practice, despite their high utility value, annuity markets are thin, as many problems limit individuals' propensity to annuitize: while the potential need to pay for uninsured medical expenses or for a nursing home provides a rationale for limiting/delaying the demand or for preferring lump sums (Turra & Mitchell 2004; Sinclair & Smetters 2004; Kifmann, 2008), risk pooling within couple/family decreases the value of annuitization for married couples (Brown & Poterba 2000, Dushi & Webb 2004).

Selection effects - estimated by the difference between the money's worth ratios[3] (MWR) calculated from annuitant and from population wide mortality tables - and administrative costs could also restrain the demand by making annuities too *expensive*. Researchers have calculated the MWR of annuities: although not equal to one (corresponding to the actuarial fair price), MWR are not very far from it, suggesting that expensiveness is hardly the main reason for the limited demand.

Finally, psychological factors - i.e. a preference for lump sums *as such* and other forms of "irrational" or bounded rational behavior like the hyperbolic discounting - could be at work, while the complexity and riskiness of the product act as further disincentives. Given the relevance of *mortality risk* for the consumption path, there is room for government intervention, for instance in the definition of default options, in increasing transparency, in specifying that the standard type of annuity be inflation indexed, and possibly also in capping administrative costs.

1.1.3 Demographic issues

As long as consumption data are (collected and) used at the household level, demographic issues become important in assessing saving adequacy. In particular,

[3] The ratio of the expected present value of the future payment stream associated with an annuity to its purchase price.

household composition has to be taken into account both because the number of household members varies across time and because of economies of scale in consumption. From a practical point of view, the application of an equivalence scale is a way of weighting each household member (depending on age and household size) to covert family expenditure into "adult equivalent" consumption[4].

Miniaci et al. (2003) compare household and per-adult equivalent age- consumption profiles in Italy, and show that even after this adjustment, non-durable consumption drops steadily after retirement, while it is almost flat at younger ages. Skinner (2007) suggests that having children helps in moderating pretentions so that accumulation needs are lower for families with children than for families without. Hurd and Rohwedder (2008), after adjusting for demographic factors, find that "*on average and for most of the distribution, couples have adequate resources to finance their consumption in retirement*" (p. 16), while singles (in particular those lacking a high school education) are more at risk of inadequate resources.

Endogeneity issues should be taken into account if we consider that the very number of household members depends on income and wealth. In this spirit, Scholz and Seshadri (2007) examine the effect of children on wealth accumulation of US households, accounting for the endogenous fertility decision. Their simulated model is able to match well the actual wealth and fertility heterogeneity and shows that variation in family size plays an important role in understanding wealth dispersion and that children have a substantial negative effect on wealth accumulation.

1.1.4 Proxy measures: replacement rates

As implementing an optimization model is not an easy task, less demanding approaches to individual choices or shortcuts have frequently been adopted, like using income levels as a proxy for consumption levels. A few conceptual steps allow to go from a rigorous conceptual framework as the above to the simplified measure of replacement ratios. First, smoothing of consumption levels instead of smoothing of marginal utility of consumption is required; then consumption levels are substituted with income levels in the typical RR below:

$$RR_i = \frac{y_i^r}{y_i^a}$$

where the replacement rate of individual *i* is computed as the ratio of income when retired to her earnings when active. This measure can be made more refined by considering comprehensive after-tax measures of income and take several dimensions (one can look at current or prospective RR or compare individuals in different cohorts), but the main point is that RR are a rather unsatisfactory method to analyze individuals' ability to maintain their living standards, mainly because they entirely neglect retirement risks (Hurd and Rohwedder, 2008).

[4] For instance, poverty studies in Italy use the Carbonaro equivalence scale, that assigns a unitary weight to a 2-members household, a weight of .599 to a 1-member household, and then weights of 1.335, 1.632, 1.905, 2.150 and 2.401 to households of 3, 4, 5, 6 and 7 or more members, respectively (Inquiry Commission on Poverty, 1997).

Moreover, as we move away from theory the idea of adequacy itself becomes looser. For instance, it is difficult to identify the "optimal" RR (should it be 100% or is 80% reasonable on the grounds that needs in retirement are less than in working life and that their composition changes with age towards state provided health and care services?). Further, given the diversity of individual circumstances it is very unlikely that a "one size fits all" measure will work. As a result, the target living standard to be maintained after retirement is normally rather arbitrarily fixed.

Ultimately, both dimensions of adequacy – as "optimizing behaviour" and as "maintenance of an income level" – are relevant. Policymakers are worried if a non-optimal saving behaviour is leading to too little saving for retirement, not if it entails too large resources during retirement and too little during working life. Therefore, the idea of adequacy as optimization provides a rigorous and theoretically-based benchmark to evaluate individual behaviour (assuming we have all the relevant information to assess it) but it is implicitly assumed that only some types/directions of non-optimization constitute a problem.

1.2 Adequacy from the point of view of the pension system

As argued in the previous paragraph, a proper understanding of household savings cannot ignore the issue of pension systems' adequacy. This requires a more macro perspective, with the focus on the government's role in delivering or promoting adequate saving for retirement.

Within the EU agenda, the idea of "adequacy of a pension systems" embeds three objectives: i) preventing social exclusion; ii) enabling people to maintain living standards; iii) promoting solidarity[5]. In a similar vein, a World Bank report on pension reforms (Holzmann and Hinz 2005) define as "adequate" a pension system "*that provides benefits to the full breadth of the population that are sufficient to prevent old-age poverty on a country-specific absolute level, in addition to providing reliable means to smooth lifetime consumption for the vast majority of the population*"[6].

Expanding on this framework, a pension *design* can be said *adequate* when, under the constraint of financial sustainability[7]:

a) it reduces the idiosyncratic uncertainty, i.e. it provides efficient ways to broaden the scope for risk pooling and sharing, not only through direct public provision of pensions (and other benefits for the elderly) but also through a good regulation/supervision of the market provisions. It is to be noted that risk diversification and sharing provides the main rationale for a mixed system

[5]See EC, Synthesis report on adequate and sustainable pensions (SEC(2006)304, 27/02/2006). In December 2005, the European Council adopted a (new) framework on social protection and social exclusion, establishing a series of common objectives, following those agreed in Laeken in 2001 (EC, 2005).

[6]Often this classification is referred to as the first and second tiers of the pension systems, with the first aiming at maintaining above the poverty level the absolute standard of living, and the second at providing an adequate income relative to previous earnings.

[7]Financial sustainability is interpreted here as the capability of the pension system to finance expenditure with contributions in the steady state. Adequacy should always be viewed within a context of financial sustainability, given that it is always possible to increase benefit levels by ignoring – at least for a certain period – the government's intertemporal budget constraint.

(Shiller 1998, Lindbeck and Persson 2003), partly public, PAYGO and redistributive and partly private, funded (either occupational or individual based) and actuarial;

b) it encourages individual awareness of retirement needs and their capacity to take informed and farsighted decisions. This includes providing financial literacy and/or designing schemes appropriately (Madrian Shea, 2001; Holzmann et al., 2005, Lusardi 2007);

c) it reduces inequality and, more specifically, poverty among the elderly.

Note that points a) and b) can be thought of as "providing means for individual consumption smoothing" as stated in the definitions above, while point c) has more to do with the redistributive features of pension schemes.

From this macro perspective, adequacy has rather to do with the *ex ante* diversification of risks that is implied by the pension design than with pension levels *per se*. Ideally, what matters is the ability to provide a framework that is as close as possible to a complete and perfect market setting.

In an overlapping generations economy, a source of markets incompleteness comes from the impossibility of individuals to engage in intergenerational risk sharing, with not yet born generations. In the absence of such markets, governments can substitute for them by providing appropriately designed pension systems: a PAYG mechanism is exactly a vehicle to set up such an intergenerational contract (Shiller, 1998; Ball and Mankiw, 2007). Risk diversification however, requires more than just this. It demands a good combination of public and private choices as well as a good regulation/supervision of market provisions, thus providing a rationale for the set up of a mixed system (Lindbeck and Persson, 2003). Moreover, also the choice between DB or DC systems should be carefully considered in the pension system design, as it bears important implications in terms of social welfare (Gomes and Michaelides, 2003). Some degree of state intervention is also justified by intragenerational risk sharing, with poverty prevention as another way to look at the provision of "adequate" pensions. Even though the scope for intragenerational risk pooling might be reduced by issues such as moral hazard and prior income inequality, there are many practical limitations to the ability of the elderly to diversify their incomes by themselves, hence emphasizing the government's role in providing this kind of risk sharing (Shiller, 1998).

Further, we have claimed above that even though the theory assumes that individuals are perfectly able to plan their saving, they may not be able to do so, or not entirely. Hence, government intervention should also aim at providing individuals instruments to make if not the "best" at least a sensible choice. This can be done by fostering individual responsibility (i.e. encouraging the individuals' awareness of retirement needs and improving their capacity to take informed and farsighted decisions via financial literacy programmes), or by choosing in a satisfactorily way on workers' behalf (i.e. appropriate design of pension schemes' default options) (Madrian and Shea, 2001; Holzmann et al., 2005; Lusardi 2007; OECD, 2008).

A*ssessing* the adequacy of a pension system *in practice* is, however, very difficult. On the one hand, one has to recognize the absence of suitable indicators, capable of offering a benchmark degree of efficient risk diversification, against which compare actual data. On the other, these indicators would be difficult to implement, in any case,

because pension systems are never in a steady state, and the transition costs imposed by reforms would have to be taken into account. Typically reforms imply high costs and a long term process, as for most countries, for example, the problem is not to decide whether to create *ex novo* a funded public scheme, but whether to favour the birth, or the growth, of funded schemes side by side with an already existing, and developed, PAYG one.

This applies in particular to European countries, whose welfare systems are almost invariably undergoing transitions (Castellino and Fornero, 2006). *First*, since most of the recent reforms are negatively impacting (or will in the future) on the replacement rates offered by the first pillar, they have been accompanied by measures aiming at encouraging the growth of the second and third pillars. Indeed, most recent pension reforms are designed with the implicit idea that household saving is too scarce, at least for a part of the population (Borsch-Supan and Brugiavini, 2001). As the growth of funding is seen as a countermeasure for the reduction of the PAYG coverage, the transition problem can be very severe: if young workers are told that they will receive lower pensions for the same payroll tax rate, and encouraged to contribute to a funded pillar as an offsetting measure, they are asked to save more for the same replacement ratio.

Retrenchment of past promises would seem shrinking the adequacy of the pension systems; however, by restoring financial sustainability, it could indeed reinforce it, because all future generations would benefit from a system that does not create additional public debt.

Second, another important feature of pension reforms is the move from Defined Benefits (DB) to Defined Contributions (DC) type of formulae, which implies both a stronger dependence of benefit on contributions and a closer proximity (when not a strict correspondence, as in the NDC system) of the internal rate of return to the equilibrium rate represented by the growth of the wage bill (Italy, Sweden, Poland and Latvia have adopted actuarially fair types of formulae). This is in sharp contrast to the history of PAYG, where workers had been accustomed to higher pay-offs. The shift from DB to DC is also occurring in the private sector, induced by the increasing, and in some instances destabilizing, cost of DB plans to employers.

The expansion of DC formulae within both PAYG and pension funds clearly implies an increase in the uncertainty surrounding the replacement rate at any given age of retirement and a transfer of risks onto the workers. Again, these greater risks would seem to undermine the adequacy, but if the overall design should attain - although with transition costs, whose incidence should not be ignored - a better diversification of risks the opposite could be true.

Third, reforms are also, in general, implementing a greater flexibility of retirement, instead of the traditional “mandatory” retirement ages, differentiated rather arbitrarily by gender and categories. This introduces an important adjusting margin, as workers are not forced to leave at a certain age, neither induced to leave as they reach the minimum requirements by pension formulae which contain high implicit taxes on the continuation of the activity.

Given the difficulties in assessing the overall adequacy of pension systems, approximations are frequently used, in particular poverty rates and aggregate replacement rates.

1.2.1 Poverty rates

The *poverty rate* among the retired – the ratio of the number of retired individuals whose income is below a minimum level (the "poor") to the total number of retired individuals ($p^r = n^r_p / n^r$) – is commonly adopted because the adequacy-poverty threshold is fixed in an absolute way. Moreover, since the government does not know if households are saving optimally given their preferences, incomes, assets, demographics, etc, then aiming at low income individuals might be a good *ex post* solution. Even though poverty and adequacy are different concepts, from a practical point of view inadequate saving behaviour is typically found among the less educated households at the bottom of the income distribution, who are also those more likely to fall below poverty lines.

Indeed, one could say that the capacity to perform *ex post* redistribution so that the income of the elderly is in any case above a minimum threshold (i.e. poverty line) is a crucial aspect of a good welfare system. However, it is also rather arbitrary and it bears very little correlation to the degree of risk sharing and diversification carried out by the pension systems; it also neglects the fact that poverty in retirement may have to do with pre-retirement poverty status rather than with the fact of retiring and does not allow to distinguish whether inadequacy is due to individual behaviour (this may happen when retirement is chosen at too young ages) or context constraints (e.g. market incompleteness).

1.2.2. (Aggregate) replacement rates

At an aggregate level, replacement rates are used to assess the ability of a pension system to allow the maintenance of pre-retirement living standards. Again, they are only marginally related to the notion of pension systems adequacy as risk diversification and may suffer from a lack of representativeness when computed for some – supposedly – typical figures in the context of an evolving pension system. In fact, new systems often incorporate different incentives to saving/retirement with respect to the old ones – especially when reforms strengthen actuarial fairness and neutrality – and individual adjustments to the new rules cannot be easily predicted.

To overcome the problem of a reference RR target, the NRRI computes RRs *targets*, i.e. the replacement rate needed to allow households to maintain in retirement their pre-retirement standard of living (Munnell et al., 2007). In addition, analogously to other studies, the Index also tries to look at the adequacy issue from a broader perspective by including in the definition of wealth housing, social security benefits and private pensions; it's a good attempt to provide an index, which suffers however from all the shortcomings of measures derived from *ad hoc* methodologies and not from tight theories.

From the point of view of an adequate pension system design, it is also important that retirees maintain a certain level of living standards also with respect to the working population in younger cohorts. To this end replacement rates after 10 years of retirement are computed *as the ratio of the value of an individual's pension 10 years after retirement, divided by the income of another worker retiring 10 years later the previous one* (ISG, 2006). These are meant to provide an assessment of the evolution of the relative position of the individual, typically reflecting pension indexation. Indeed,

indexing pension benefits to wages or prices can produce great differences in the relative position of the elderly with respect to the active population. Typically, pension reforms have de-indexed pensions from wages to prices, meaning that at best retirees can maintain the purchasing power of their pensions, but not progress along with the increase of workers' productivity.

2 Major progress in understanding

The vast majority of empirical works directly aimed at assessing adequacy of household retirement saving refer to the United States[8]; less is known therefore about European countries. Indirectly, though, works studying the so called "consumption drop" or "retirement consumption puzzle" provide some evidence about European countries (Germany, Italy, UK). This represents indeed the same problem looked at from a different perspective, as it entails assessing whether the household is choosing optimally its intertemporal consumption/saving plan. However, as it has been pointed out in the literature (Banks et al., 1998; Bernheim et al., 2001; and Miniaci et al., 2003), optimal saving does not necessarily means *smooth consumption*, so the drop itself can be "optimal" from the point of view of the individual. Retirement is typically an anticipated (or even chosen) event which doesn't come as an unforeseen shock, and there are reasons that justify a fall in consumption even safeguarding the smoothing of marginal utilities (e.g. the cessation of work related expenses). Moreover, the occurrence of unexpected shocks inducing earlier-than-expected retirement and the possibility of non-separability between consumption and leisure within the per-period utility function amount to other explanations of the drop within the standard LC/PI framework (Hurd and Rohwedder, 2006; Haider and Stephens, 2007; Smith, 2006). Finally, other works claim that measurement problems dispute the existence of the drop itself on the grounds that the proper object to look at is not "expenditure" as is currently done but true "consumption" (as measured for instance by food intake) as retirement provides ample scope to economize (Aguiar and Hurst, 2007).

Before analyzing the empirical evidence, a brief outline of the literature on the saving behavior around retirement age and on the "preparedness" to retirement is presented.

2.1 Saving behaviour near retirement age

Given the diversity in pension and health care provisions in the various European countries, (discretionary) saving for retirement has to be analyzed on a country-specific basis, rather than with a pan-European perspective, as it inevitably responds to national institutional characteristics, such as mandated saving and state-provided in-kind services.

A comparison of the saving age profiles of a few European countries is carried out in Börsch-Supan and Lusardi (2003). This shows some remarkable differences, as age-saving profiles are pronouncedly hump-shaped in the Netherlands and moderately hump-shaped in Germany, while they are almost flat in Italy and increasing at all ages

[8] An exception is Khoman and Weale (2006), who study the household saving in the UK using an aggregate approach.

in the UK. In none of this cases there seems to be dissaving in old-age. Some of the variation reflects the different pension systems setup: the more generous public social security system present in both Italy[9] and Germany reduces the need to save for retirement in the working age, while the Dutch flat rate pension benefits – with rather lower replacement rates – are at the root of the marked hump-shaped profile. Another force driving some of the difference between the countries is the stringency of borrowing constraints (measured here with the average down payment for housing). This appears to drive up savings in young age in Germany and Italy, and also increases aggregate saving in general, with respect to Anglo-Saxon countries and the Netherlands.

2.2 "(In)adequate" outcomes

Evidence on saving (in)adequacy can be grouped according to the methodology adopted, moving from rougher to more rigorous approaches. Most works take into account, to some extent, the two dimensions of saving adequacy considered above – sensible individual behaviour and efficient risk sharing of the pension systems – by including the institutional framework in which agents operate within the assessment of individual ability to plan optimally or to maintain living standards.

2.2.1 Synthetic indicators based on an implicit model

Butrica, Iams and Smith (2003) use the SSA Model of Income in Near Term (MINT) to project comprehensive measures of income up to age 67 and then compare poverty rates and income replacement rates (income at 67 to lifetime earnings) at retirement for various age-of-birth cohorts. Similarly, Smith (2002) projects replacement rates and poverty rates up to 2040 and Munnell and Soto (2005) compute RR, using an income measure that includes housing.They all find a decline in prospective RR. Butrica et al. (2003) and Munnell and Soto (2005) conclude that future retirees are less likely than current ones to have enough post-retirement income to maintain their pre-retirement living standards. However, also poverty rates for individuals at or above the normal retirement age will fall. Munnell and Soto (2005) indicate that households with (private) pensions fare better.

A number of papers examine the issue of individual adequacy having in mind optimal life-cycle behaviour but using reduced forms or just having a loose theoretical framework. Most of these works project households' lifetime assets and income paths and derive from them implications for saving adequacy. Kotlikoff, Spivak, Summers (1982) pioneered by comparing consumption in old-age that can be financed with resources in old-age, with lifetime consumption financed with lifetime resources. Gustman and Steinmeier (1999), Mitchell and Moore (1997), Love, Smith, McNair (2008) use a somewhat similar methodology: they project resources pre and post retirement and use them to compute replacement rates. Mitchell and Moore (1997) make reference to the level of wealth necessary to maintain the pre-retirement level of income (income smoothing), while Gustman and Steinmeier (1999) and Love et al.

[9] The absence of an hump-shaped age-saving profile in Italy – where the household saving literature concentrated on the substitutability between mandatory and discretionary saving for retirement – is reported also by Brugiavini and Padula (2001) and Jappelli and Modigliani (2003).

(2008) don't have a clear adequacy benchmark. Haveman et al. (2006) compute annuitized net wealth only over the remaining lifetime after retirement and compare it with adequacy targets (the "maintenance of living standard" targets are defined as an average of pre-retirement consumption level and as an income RR of 70%, while the "meeting of basic needs" target is defined as a poverty threshold). Khoman and Weale (2006) take a macroeconomic approach to the UK saving gap. Haveman et al. (2006) focus on consumption rather than on resources. They estimate potential consumption over the remaining lifetime after retirement and compare it with targets (the first defined as maintenance of living standard and the second as meeting of basic needs). Hurd and Rohwedder (2008) estimate consumption paths from the time of retirement onward and evaluate whether the value of wealth at retirement is greater than the "present value of spending in excess of annuities" (i.e. "necessary wealth"). If so, the consumption path is optimal in the sense that the level and shape of consumption are consistent with economic resources and spending in HRS/CAMS data.

As for results, Kotlikoff, Spivak, Summers (1982), Love et al. (2008) and Hurd and Rohwedder (2008) agree that there is no systematic undersaving. On the contrary, according to Haveman et al. (2006) about half of retirees will not have enough resources in retirement to meet their pre-retirement consumption level and Mitchell and Moore (1997) find that the median household needs to increase its saving rate substantially until the age of retirement to obtain an "adequate" level of wealth for retirement (additional 16% saving rate to retire at 62, additional 7% to retire at 65).

2.2.2 Comparisons between actual and (simulated) optimal savings

Bernheim and Scholz (1992), Engen et al. (1999), Scholz et al. (2006) and Scholz & Seshadri (2008) generate optimal household consumption and wealth accumulation profiles by simulating a life-cycle model (model characteristics differ across works) and compare them to actual data. Munnell et al. (2006) present their results (the National Retirement Risk Index, NRRI) in terms of (annuitized) income RRs but the underlying methodology is not far from those described above[10].

Bernheim and Scholz (1992) conclude that only households without a college degree do not behave in a manner consistent with the optimal life-cycle planning. Engen et al. (1999) suggest that saving may be adequate for the majority of households but there is some mixed evidence of inadequate saving among households with low wealth-earnings ratios. Scholz, Seshadri and Khitatrakun (2006) find that 15.6% of older households in 1992 are below the optimal wealth target and that undersavers are in the lower part of the earnings distribution. Scholz and Seshadri (2008) updates the previous work by exploiting all waves of HRS and thus including all older Americans born before 1954. Preliminary results indicate that overall only 3.6% of the sample has accumulated less than the target as of 2004 (10% among Early Baby Boomers households).

Dissimilar results are found by Munnell et al. (2006), who find that 43 percent of households are at risk of not being able to maintain their standard of living in retirement. This is quite at odds with the finding by Scholz et al. (2006) and Scholz and

[10] They obtain "optimal RR targets" by simulating a life-cycle model and actual RRs by projecting pre- and post-retirement resources to retirement age. Households with replacement rates that fall more than 10 percent below the benchmark are considered "at risk".

Seshadri (2008) showing that the extent of undersaving is much more limited. Much of the difference, however, seems to be attributable to the different methodologies and different data used[11].

A couple of remarks can be drawn from the review of (in)adequate outcomes. The first has to do with the empirical evidence. According to most studies the issue of inadequate retirement saving does not appear to be as serious as one might expect, since only relatively small percentages of the US population seem to save poorly. Moreover, studies following different approaches to the problem typically identify less educated households and households at the bottom of the wealth or earnings distribution as the groups facing the most severe saving inadequacy problem. If this is indeed the case, then targeted actions to those population segments could be sufficient to tackle the issue.

Second, from the methodological point of view, both approaches where the optimization model is implicit and those where it is modelled explicitly show the great heterogeneity in saving adequacy (i.e. some over save, some under save…) and yield fairly similar results. The most complete findings certainly come from the far-reaching methodology experimented in Scholz et al. (2006), because it is the only one that combines the rigour of an optimization framework with the full distribution of household saving behaviour. However, its implementation is fairly complex and remarkably similar results have been obtained by other simpler techniques, such as the one used in Hurd and Rohwedder (2008). On the contrary, methods reviewed in the first category are too simplified to give sufficiently precise answers.

2.3 An alternative approach: retirement planning, information about pensions, and financial literacy

2.3.1 Do individuals plan for retirement?

One simple and direct way to examine whether, consistent with the predictions of theoretical models of saving, individuals look ahead and make plans for the future is to study the extent of retirement planning. Lusardi (1999) looked at that evidence using data from the 1992 U.S. Health and Retirement Study (HRS), which surveys respondents 51 years or older. She found that as many as one-third of respondents have not thought about retirement at all. While some of this behavior may be perfectly

[11] The work by Scholz et al. (2006) is based on the Health and Retirement Study (HRS), which covers Americans aged 51 to 61 in 1992, while the NRRI is based on the 2004 Survey of Consumer Finances. A comparable sample is constructed by calculating the NRRI on the population aged 51-61 in 1992 surveyed in the SCF. In this case, the NRRI takes on the value of 19 percent, meaning that percent of households are at risk of not being able to maintain their standard of living in retirement. This is to be compared with the result by Scholz et al. (2006) that 16 percent of US households had less wealth than their optimal targets.
Methodological differences include:

- The life-cycle model used to compute target RR in the NRRI is more simplified than the one used by Scholz et al. (2006) to simulate optimal wealth targets.
- Targets in the NRRI are computed for some typical figures while Scholz et al. (2006) compute targets fro every household in the sample
- Households in the NRRI are assumed to purchase annuities and reverse mortgages while they are simply assumed to decumulate total wealth in Scholz et al. (2006)

rational, it is nevertheless surprising that the majority of older respondents have not given any thought to retirement, even when they are only five to ten years away from it. Lack of planning is concentrated among specific groups of the population, such as those with low education, African-Americans, Hispanics, and women. These are potentially vulnerable groups, who are less likely to save for retirement.

These findings are not specific to a particular time period. Notwithstanding the many changes in the economic environment, including the increased supply of financial products to facilitate planning, lack of planning is still prominent among the current population of older respondents. Using data from the 2004 HRS and concentrating on respondents who are 51 to 56 years old, Lusardi and Mitchell (2007a) find that close to 30% of respondents also have not given any thought to retirement. Moreover, Lusardi and Mitchell (2006) devised a special module on planning that was added to the 2004 HRS. This module has the advantage of measuring different types of planners, from those who merely tried to calculate their saving needs to those who were able to develop and carry through on their plans. Findings are not much different when using this alternative, and perhaps more appropriate, measure of planning: As many as 31% of older respondents in the HRS module do not plan for retirement. However, the percentage of planners decreases significantly when restricting to those who were able to develop a saving plan and stick to it: only 18% of respondents were able to do so. This finding underscores the fact that not only have many families never attempted to devise a saving plan, but even among those who do plan, many did not follow through.

These findings regarding lack of planning have been confirmed in other surveys. For example, using data from a representative sample of U.S. workers from the Retirement Confidence Survey (RCS), Yakoboski and Dickemper (1997) report that only 36% of workers have tried to determine how much they need to save to fund a comfortable retirement. However, many of the workers who have done the calculation could not give a figure when asked. Thus, according to this survey, as many as three-quarters of workers have little idea how much money they need to accumulate for retirement. While planning is strongly correlated with education, a sizable fraction of non-planners is present even among respondents with high educational attainment (Ameriks, Caplin, and Leahy, 2003).

Lack of planning has been documented not only in the United States. The 2006 “Attitudes toward pensions” survey undertaken by the UK Department of Work and Pensions shows that most people recognized the importance of saving and setting money aside for retirement, even though many people had concerns about their retirement income and the recognition of the need to save did not always match intentions. This was particularly true of younger respondents, those with low incomes and those with self-perceived lower life expectancies. For instance, only half of respondents contacted a source of information and advice on planning for retirement, and of those who received a State Pension Forecast, very few people had undertaken any action. Levels of worry about retirement income were significantly higher among older age groups, women and those with fewer financial resources (Clery et al., 2007). Although comparisons are difficult, the picture looks slightly better than it was a decade earlier, when a qualitative survey carried out on behalf of the Department of Social Security documented fears about the very existence of a State Pension in the future (Hedges, 1998).

2.3.2 How much do individuals know about their pensions?

Another way to examine whether and how much individuals prepare for retirement and plan for the future is to look at how much they know about crucial components of a saving plan. For example, two very important elements of total wealth holdings are pension and Social Security wealth. For households around the median of the wealth distribution, those two components account for about half of total wealth, and even for households at the top of the wealth distribution, the percentage of wealth accounted for by Social Security and pensions is sizable (Gustman and Steinmeier, 1999). This is the case not only for the United States, but also for European countries, such as the Netherlands (Alessie, Kapteyn and Lusardi (1995)).

Earlier studies indicated that workers were woefully uninformed about their pensions and the characteristics of their pension plans (Mitchell, 1988, and Gustman and Steinmeier, 1989). Given that most pensions in the past were DB pensions and workers had to make few or no decisions about their pension contributions, lack of knowledge is perhaps not surprising. However, recent data from the HRS show that workers continue to be uninformed about the rules and the benefits associated with their pensions, despite the shift from DB to DC pensions, which has given more retirement savings responsibility to workers (Gustman and Steinmeier, 2004). The calculations underlying pensions and Social Security wealth are certainly very complex and—as for private savings—individuals do not seem to engage in these calculations. However, Gustman and Steinmeier (2004) simply compare the types of pensions that workers report they have (whether DB, DC, or a combination of both) with the reports of employers. Results are striking: Only half of older workers are able to correctly identify the plan they have. Because errors can abound not only from the reports of workers but also from the reports of firms, Gustman, Steinmeier and Tabatabai (2007) use different sources of data, including data from Watson Wyatt, where it is possible to correctly identify the pension type from firms' data. They also study different time periods, from the 1980s (when DB plans were prevalent) to the recent period (when DC plans gained popularity). They show that it is workers who are most often erroneous and confused about the type of pensions they have.

Findings about the UK seems less worrisome, albeit not entirely comforting. Results from ELSA data show that 40% of individuals aged 50-59 with a DB employer pension do not know the accrual rate of their pension plan, 30% cannot tell how much they expect to receive from this pension, and 30% do not know whether their pension benefit will go up by more or less than prices after their retirement. However, they do not feel a major lack of information, as about 70% report of having received enough information (Banks and Oldfield, 2006).

Knowledge about Social Security is also scanty. Only 43 percent of respondents in the sample of older workers used by Gustman and Steinmeier (2004) even ventured a guess about their expected Social Security benefits, and many respondents knew little about the rules governing Social Security. Moreover, only a little more than a quarter of older respondents in the HRS have ever asked Social Security to calculate their retirement benefits (Lusardi, 2004). As noted in the Employee Benefit Research Institute report after conducting the 2007 RCS, even though it has been 24 years since legislation was passed that increased in increments the normal retirement age for Social Security, and despite 8 years of annual mailings of individual benefit statements from

the Social Security Administration, only 18% of workers knew the correct age at which they would be entitled to full Social Security benefits.

Lack of knowledge and confusion are also found in regards to other, equally important financial decisions. Bucks and Pence (2007) document that households with adjustable rate mortgages, which are potentially more complex contracts to understand than fixed-rate mortgages, are either incorrect or simply do not know about the terms of their contracts. These are disconcerting results, since mortgages are important and often onerous contracts. Again, those displaying low knowledge about mortgages are disproportionately those with low education, low income, and minorities—those who may benefit the most by knowing the terms of their contracts. These findings are also consistent with the evidence on "mistakes" provided by Campbell (2006). He shows that many households failed to refinance their mortgages during a period of declining interest rates. Lack of knowledge may have contributed to that behavior since lack of refinancing was particularly pronounced among those with low education and low income. Moore (2003) also documents that households that engage in onerous mortgages are less likely to be knowledgeable and financially skilled.

2.3.3 How much do individuals know about economics and finance?

One reason individuals do not engage in planning or are not knowledgeable about pensions or the terms of their financial contracts is that they lack financial literacy. Bernheim (1995, 1998) was one of the first to emphasize that most individuals lack basic financial knowledge and numeracy. Several surveys covering the U.S. population or specific sub-groups have consistently documented very low levels of economic and financial literacy. The National Council of Economic Education (NCEE) periodically surveys high school students and working-age adults to measure financial and economic knowledge. Adults scored rather poorly on these questions with an average score of C, while the high school population fared even worse, with most earning an F. These findings are confirmed by the Jump$tart Coalition for Personal Financial Literacy survey, which also documents very low levels of basic literacy among U.S. high school students (Mandell, 2004). Hilgert, Hogarth and Beverly (2003) examine data from the 2001 Survey of Consumers, where some 1,000 respondents (ages 18–98) were given a 28-question true/false financial literacy quiz, covering knowledge about credit, saving patterns, mortgages, and general financial management. Again, most respondents earned a failing score on these questions, documenting widespread illiteracy among the whole population. Similar findings are reported in smaller samples or among specific groups of the population (Agnew and Szykman, 2005, and Moore, 2003).

Lusardi and Mitchell (2006) devised a special module on financial literacy for the 2004 HRS.[12] Adding these types of questions to a large U.S. survey is important not only because it allows researchers to evaluate levels of financial knowledge but also and, most importantly, because it makes it possible to link financial literacy to a very rich set of information about household saving behavior. The module measures basic financial knowledge related to the workings of interest rates, the effects of inflation, and

[12] For a detailed discussion of the importance of financial literacy, see Lusardi (2007b).

the concept of risk diversification.[13] Findings from this module reveal an alarmingly low level of financial literacy among older individuals in the United States (50 and older). Only 50% of respondents in the sample were able to correctly answer two simple questions about interest rates and inflation, and only one-third of respondents were able to answer correctly these two questions and a question about risk diversification. Financial illiteracy is particularly acute among the elderly, African-American and Hispanics, women, and those with low education (a common finding in the surveys of financial literacy).[14]

Lusardi and Mitchell (2007a) have also examined numeracy and financial literacy among the Early Baby Boomers (age 51-56), who should be close to the peak of their wealth accumulation and who should have already dealt with many financial decisions (mortgages, car loans, credit cards, pension contributions, etc.). While more than 80% of respondents were able to do a simple percentage calculation, only about half could divide $2 million by 5. Moreover, only 18% were able to perform an interest compounding calculation. These are uncomforting findings, especially considering that these respondents had already dealt with many financial decisions during their lifetimes.

Similar modules on financial literacy have been added to some European surveys, such as the Italian Survey of Households Income and Wealth (SHIW) and the Dutch DNB Household Survey (DHS). On average, only 47% percent of Italian families answer correctly to some basic financial literacy questions and only 27% are able to cope with the interest compounding question (Fornero, Lusardi, Monticone, 2008). On the contrary, Dutch households do much better, as at least 70% answer correctly to any basic question and on average answer correctly about 4 quizzes out of 5 (van Rooij, Lusardi, Alessie, 2007).

Lack of knowledge may be inconsequential, if, for example, individuals rely on the help of others to make decisions, or if knowledge or the type of precise knowledge derived from the above questions has little effect on behavior. In fact, as illustrated in Lusardi (2008) very few respondents rely on the advice of experts to make financial decisions. Most importantly, lack of financial literacy has important consequences for wealth accumulation. Those who are not literate are less likely to plan and less likely to accumulate wealth (Lusardi and Mitchell, 2006). Similarly, Stango and Zinman (2007) show that those who are not able to correctly calculate interest rates out of a stream of payments end up borrowing more and accumulating lower amounts of wealth. Moreover, those who are less literate are more likely to borrow using high-costs instruments and are more likely to have problems with debt (Lusardi and Tufano, 2008). Hilgerth, Hogarth, and Beverly (2003) also document a positive link between financial knowledge and financial behavior. Van Rooij, Lusardi and Alessie (2007) and Kimball and Shumway (2006) find that financially sophisticated households are more likely to participate in the stock market. Agarwal, Driscoll, Gabaix and Laibson (2007) show that financial mistakes are most prevalent among the young and elderly, who are also those displaying the lowest amount of financial knowledge.

[13] For a discussion of the measurement of financial literacy and the extent of measurement error in financial literacy data, see van Rooij, Lusardi and Alessie (2007).
[14] See Lusardi and Mitchell (2007b) for a review.

2.3.4 Ways to help people save

Acknowledging that saving for the long-term is often problematic has led economists to devise ways to help individuals perform complex calculations or commit to saving plans.[15] Below, we report some examples:

- **Planners**. Devising optimal saving plans requires complex and lenghty computations. Hence, several tools have been developed to make this task less cumbersome. Some of these softwares combine advice on lifecycle planning and portfolio choice (e.g. Mornigstar[16] and Financial Engines[17]). Some are very simplified (e.g. Ballpark E$timate.[18] Morningstar computes the target saving rate using as inputs only age, the amount of retirement savings and annual income) while others are more detailed (e.g. Financial Engines). One notable planner is ESPlanner[19] – developed by Laurence Kotlikoff – which takes into account not only social security benefits and pension plans, but also savings accounts, housing and other real estate, and taxation.

- **Planning Aids**. Lusardi, Keller and Keller (2008) devised a 7-step planning aid that describes to new hires in a large non-for-profit institution what they have to do to open a supplementary retirement account. In addition to breaking down the enrolment process into simple steps, the aid provides information about the pension scheme, such as the minimum and maximum amount that employees can contribute, the three pension providers employees have to choose from and the rules of the on-line enrolment process. Consistent with the fact that many employees lack even basic information about pensions and often claim they do not know where to start when considering retirement saving decisions, this program resulted in a sharp increase in supplementary retirement accounts. After the implementation of the program, the election rate more than doubled.

  - Automatic enrollment into pensions. One way to stimulate participation and contribution to pensions is to automatically enroll workers into employer-provided pension plans. Thus, rather than let workers choose whether or not to *opt in*, employers enroll workers and let them choose whether or not to *opt out* of a pension plan. This simple but ingenious method has been proven to be very effective in increasing pension participation. For example, according to Madrian and Shea (2001), after a company implemented a change in its 401(k) plan and automatically enrolled its new hires in the plan, pension participation went from 37% to 86%. Not only has the increase been very large but participation rates have remained high for several years (Choi et al. 2004, 2006). Even legislators took notice of this remarkable success, and the 2006 Pension Protection Act made it much easier for firms to automatically enroll their workers in pension plans.

[15] Allen and Carroll (2001) show that, even assuming that individuals are solving the optimal consumption problem by approximation, pure trial-and-error learning requires an enormous amount of experience, far more experience than any one consumer would have over the course of a single lifetime.
[16] http://www.morningstar.com/Cover/PersonalFinance.html
[17] https://www.financialengines.com/
[18] http://www.choosetosave.org/ballpark/
[19] http://www.esplanner.com/

- **Save More Tomorrow**. Similar to the automatic enrolment program described earlier, in this program workers commit themselves to automatic increases of their pension fund contributions every time they obtain a pay rise (Thaler and Benartzi, 2004). As in the automatic enrolment, the idea behind this mechanism is to overcome self-control problems and inertia faced by many workers. The increase in contribution is usually set to be slightly smaller than the increase in earnings, so that workers do not suffer from a reduction (in absolute terms) in their paychecks.

3 Remaining gaps in knowledge: main challenges

3.1 Gaps in the theoretical framework

Recent research has marked quite substantial progress in our understanding of what drives households' saving behaviour. Advances in the theoretical framework have been made possible by progress in both the modelling of intertemporal choices and in the methodological strategy, i.e. looking at the whole life cycle rather than just at the few years around retirement; using an optimization criteria to establish adequacy targets; simulating life-cycle patterns for each household rather than looking at mean/ median households.

However, from the little we know about individual adequacy in terms of outcomes, we learnt that there is a concrete possibility that at least a part of the population behaves "inadequately", i.e. not according to the predictions of the LCM. This demands a deeper understanding of the reasons of this behaviour. Behavioural economists emphasized overconfidence, lack of self-control, mental accounting, dynamically inconsistent time preferences and so on as "anomalies" of individual behaviour that invalidate the standard life-cycle framework and that are particularly relevant for the issue of retirement saving adequacy (Thaler, 1994; Laibson, 1998). Therefore, a greater effort could be made in explaining drivers and constraints on how individual saving choices are made.

Furthermore, another large gap relates to the efficient risk diversification and to its link with individual optimization.

3.2 Gaps in the empirical evidence

A dichotomy seems to characterise our empirical knowledge: quite a lot is known about the adequacy of retirement saving as far as the United States are concerned; conversely, very little is known for Europe. As most of empirical evidence relates to the US, we have a relatively clear picture of what the problems are in that country (i.e. we know that most households save "adequately" and that those who fail to do so belong to the least educated households at the bottom of the lifetime income distribution). Almost no evidence is there for European countries, therefore we ignore whether there is inadequacy at all and who are the groups faring worst in this sense. (Moreover, it would very difficult to generalize among European countries given the very different public – mandatory – provisions and the institutional setting for voluntary pension saving).

Another gap is given by the difficulty to obtain a unified and consistent message from the different strands of literature concerning saving adequacy on one side and financial education and planning on the other. Most works on the ability to finance retirement adequately seem to agree that serious concerns are limited to a segment of the US population, namely the poorest and least educated. According to Scholz et al. (2006) about only 16% of older Americans were undersaving in 1992.

However, evidence on economic and financial education shows that ignorance is widespread and that even graduates often fail on basic questions. Lusardi and Mitchell (2006) find that among US population aged 50 or older only 50% were able to correctly answer two simple questions about interest rates and inflation.

Hence, it appears that many households manage to plan fairly adequately without knowing much about their own finances. This can be explained by a massive resort to financial advise external to the family, but the evidence on planning, again, shows a that as much as 30% of the US close-to-retirement population has never thought about retirement and that only 18% were able to develop a saving plan and stick to it (Lusardi and Mitchell, 2007a). Not surprisingly, lack of planning is present in the same vulnerable groups that display poor ability to save.

Therefore, further evidence is needed to reconcile these findings and gain a better insight of households' saving behaviour.

4 Current state of play of European research infrastructures and networks

Among the leading independent infrastructures that have carried out quality research on household saving in the last years there are:

- **CASE**: the Center for Social and Economic Research is an independent non-profit institute founded in Warsaw in 1991.
- **CeRP**: founded in 1999 as a joint project of the University of Turin and the Compagnia di San Paolo, the Center for Research on Pensions and Welfare Policies has a specific focus on pension economics and the economics of ageing.
- **IFS**: the Institute for Fiscal Studies, based in London, carries out quality research in various fields, including household consumption and saving.
- **MEA**: the Mannheim Research Institute for the Economics of Aging analyzes the micro- and macroeconomic aspects of demographic change. MEA is part of the Faculty of Law and Economics, Department of Economics of Mannheim University. Its funding consists of basic funds (financed in equal shares by the state of Baden-Württemberg and the German Insurance Association) and competitive third-party funds.
- **Netspar**: it is an independent network for research and education in the field of pensions, aging and retirement and is located at Tilburg University.
- **NIESR**: the National Institute of Economic and Social Research is an independent research institution founded in 1938 and located in London. It undertakes, among others, research on pensions and ageing.

- **OEE**: The European Savings Institute/Observatoire de l'Epargne Européenne was launched as a non-profit association in September 1999 with two main objectives: collect European savings-related information (including the establishment of a statistical and regulatory database covering the behaviour pattern of the various agents: households and corporates, banks, insurance companies, fund managers and other financial intermediaries), and encourage studies and research contributing to the public debate.

Other research infrastructures are public research centres or are part of international organizations:

- **European centre for social welfare policy**, based in Vienna, is a UN-affiliated intergovernmental organization concerned with all aspects of social welfare policy and research.
- **SCP**: the Netherlands Institute for Social Research is a government agency which conducts research into the social aspects of all areas of government policy. The main fields studied are health, welfare, social security, the labour market and education, with a particular focus on the interfaces between them.

Most research networks are created under the drive of an international organization (most often the EU) providing funding:

- **RTN**: the Research Training Networks – financed under the Research Framework Programmes of the European Union – provide the means for research teams of recognised international stature to link up, in the context of a well-defined collaborative research project, in order to formulate and implement a structured training programme for researchers in a particular field of research[20]. (http://cordis.europa.eu/mariecurie-actions/rtn/home.html)
- **TMR** are Training and Mobility of Researchers programmes financed under the Research Framework Programmes of the European Union.
- **ENEPRI**: the European Network of Economic Policy Research Institutes brings together twenty-four economic policy research institutes from most of the EU-27 countries. The goals of the network are to foster the international diffusion of existing research, coordinate research plans, conduct joint research and increase public awareness of the European dimension of national economic policy issues. ENEPRI was created in 2000 at the initiative of the Centre for European Policy Studies (CEPS).
- **MIPAA:** The Madrid International Plan of Action on Ageing promoted by the United Nations Population Fund (UNFPA) gathers the international community to respond to the challenges of population ageing. The implementation of the MIPAA involves: the setting-up of new bodies focused on ageing; policy guidelines and legislation; research and education; and awareness raising. At the

[20] As an example of an RTN we mention the "Microdata Methods and Practice", supported by the EU 6th Research Framework and Marie Curie Research Training Actions. Main partners: Centre for Microdata Methods and Practice (cemmap), Institute for Fiscal Studies, London; Centre for Applied Microeconometrics (CAM), University of Copenhagen; Centro de Estudos Monetarios y Financieros (CEMFI), Madrid; Centre National de la Recherche Scientifique (CNRS-EUREQua), Université Paris 1; Tinbergen Institute, Eramus University Rotterdam, University of Amsterdam and Vrije Universiteit Amsterdam; Institute for Labour Market Policy Evaluation (IFAU), Uppsala University

European level, the main activities undertaken by Member States of the European Commission for Europe (ECE) include the mainstreaming of ageing issues, the integration of older persons in society, the reform of social protection systems (financial sustainability, poverty prevention, provision of adequate benefits), the increase in employment rates of older workers, the provision of life-long learning, and support towards a better quality of life and independent living (UNFPA, 2008). Within this framework the European centre for social welfare policy develops and collects indicators to monitor the implementation of the MIPAA.

5 Required research infrastructures, methodological innovations, data, networks etc and consequences for research policy

Data

According to Campbell (2006), the ideal data set for household finance analysis should have at least the following characteristics:

- cover a representative sample of the entire population, especially by age and wealth
- for each household the data set would measure both total wealth and an exhaustive breakdown of wealth into relevant categories. These would be sufficiently disaggregated to distinguish among asset classes, and ideally would capture specific individual assets so that one could measure household diversification within asset classes
- the data would be reported with a high level of accuracy
- it should be a longitudinal dataset

We can add other characteristics to this "wish list", such as the inclusion on information regarding consumption, income, transfers (from family and friends as well as from the government), bequests, expectations, and on the extent of financial literacy.

At the European level some surveys focusing on households' income and wealth already exist:

- **ECHP / EU-SILC**. The European Community Household Panel (ECHP) is a panel survey running for 8 years from 1994-2001 in the EU15. It has currently been replaced by the European Union Statistics on Income and Living Conditions (EU-SILC). The EU-SILC was launched in 2004 in 13 Member States (BE, DK, EE, EL, ES, FR, IE, IT, LU, AT, PT, FI and SE) and in NO and IS. This first release of the cross-sectional data mainly refers to income reference year 2003 with a fieldwork carried out in 2004. The EU-SILC reached its full scale extension with the 25 Member States plus NO, IS in 2005. It will be completed by TR, RO, BG and CH.
- **LIS**. As an attempt to put together all European sources, the Luxembourg Income Study (LIS) is a cross-national data archive on household income from a large number of European and non-European countries. An effort has been made

to harmonize and standardize the micro-data from the different surveys in order to facilitate comparative research. From 2007 the Luxembourg Wealth Study (LWS) has been created to collect household wealth micro-data (from a smaller set of countries compared to LIS).

- **SHARE**. The only dataset collected at the European level is the Survey of Health, Ageing and Retirement in Europe (SHARE). It is a longitudinal dataset collecting data on the population aged 50 + of 10 EU countries plus Switzerland and Israel.

A recent initiative is underway to respond to the need for truly comparable European micro-data on households' income and wealth. A project promoted by the European Central Bank (ECB) aims at creating a comprehensive survey on households' finances and consumption (HFC) for the Euro area. Should this be implemented, it would have some advantageous characteristics with respect to the already available datasets:

- cross-country comparability (this is to be achieved via harmonization of exiting surveys, such as SHIW or SAVE, and via implementation of new surveys in the countries that don't have one yet, and therefore do not appear in the LIS/LWS);
- representative of the entire population (while SHARE is representative only of the population aged 50+);
- covers wealth, income, consumption and employment (ECHP does not cover consumption);

At the currant stage of the project, the HFC survey would also have some potential drawbacks, such as the non-synchronization between different countries and the lack of information on financial literature (mainly in order to minimize monetary costs and the burden to respondents).

Methodological innovations

A major required methodological innovation has to do with the link between different – but related – disciplines. As we have seen, the driving forces of household saving are far from being fully explained and there many unresolved issues, including the link between the so-called optimizing and behavioural approaches, the latter drawing many insights from the psychological literature. This is just an example, but it draws the attention on how important a stronger relationship between economics, sociology, psychology and other social sciences could be in achieving a better understanding of households' behaviour.

6 What (and when) can we deliver on policy questions?

6.1 Financial Education Programs

Aware that workers display limited financial literacy and know little about their pensions, employers, policy makers and not-for-profit institutions have undertaken financial education programs. The evidence on the effectiveness of these programs is, so

far, rather mixed.[21] There is evidence of some positive effect of financial education on savings and pensions, but the type of education seems to matter. For example, Bernheim and Garrett (2003) find that programs that rely on print media (newsletters, plan descriptions, etc.) have generally no effect on pension participation or contributions, even though the quality of financial information does matter (Clark and Schieber, 1998). Only a few studies find that those who attend a retirement seminar are much more likely to save and contribute to pensions.[22] Clearly, those who attend seminars are not necessarily a random group of workers. Because attendance is voluntary, it is likely that those who attend have a proclivity to save, and it is hard to disentangle whether it is seminars, per se, or simply the characteristics of seminar attendees that explain the higher savings of attendees that are shown in the empirical estimates. However, Bernheim and Garrett (2003) argue that seminars are often remedial, i.e., offered in firms where workers do little or no saving. In their work, they find that the effect of seminars is concentrated in the first two quartiles of wealth and decreases or disappears at higher values of wealth holdings, a finding difficult to rationalize simply by appealing to tastes for saving. Lusardi (2004) uses data from the Health and Retirement Study and confirms the findings of Bernheim and Garrett (2003). Consistent with the fact that seminars are remedial, she finds that the effect of seminars is particularly strong for those at the bottom of the wealth distribution and for those with low education. Estimated effects are sizable for the least wealthy, for whom attending seminars appears to increase financial wealth (a measure of retirement savings that excludes housing and business equity) by approximately 18 percent. Note also that seminars affect not only private wealth but also measures of wealth that include pensions and Social Security wealth, perhaps because seminars provide information about pensions and encourage workers to participate and contribute. While these studies were able to single out the effects of financial education, one should also note that a only small fraction of workers ever attend retirement seminars or work at firms that offer such seminars. Thus, many workers are left untouched by such initiatives.

Other papers find rather modest effects of education programs. Duflo and Saez (2003; 2004) focus on non-faculty employees at a large university who where given financial incentives to participate in an employee benefits fair. The authors compared pension participation and contributions in that group with that of employees not induced to participate. Overall, they found that the program had fairly small effects: attending the fair did induce more employees to participate in the pension, but the increase in contributions was negligible. And good intentions do not always translate into desired behavior. For instance, Clark and d'Ambrosio (2008) report that exposing workers to retirement seminars does influence workers stated desire to save more. However, intentions did not always translate into actions. When interviewed several months later, many of those workers who had intended to make changes had not yet implemented them, a finding reported in other papers, including Choi, Laibson, Madrian and Metrick (2004) and Madrian and Shea (2001). Notably, the study by Clark and d'Ambrosio (2008) study highlights rather pronounced gender differences in saving behavior. Before attending the seminars, women displayed less confidence in their ability to attain their retirement goals than men. But women were substantially more likely than men to

[21] See Lusardi (2004) and Lusardi and Mitchell (2007b) for a review of the effectiveness of financial education programs.

[22] See Bernheim and Garrett (2003) and Lusardi (2004).

increase their expected retirement age and to alter their retirement goals. Thus, evaluating the effects of seminars on the whole population of participants may understate its impact on specific groups.

It is not surprising that a hand-full of retirement seminar does little to change behavior; widespread financial illiteracy cannot be "cured" by a one-time benefit fair or a single seminar on financial economics. This is not because financial education is ineffective, but because these programs are too small with respect to the size of the problem they are trying to address. Evidence from financial education sessions offered in programs aimed to promote Individual Development Accounts (IDAs), which are subsidized savings accounts targeted at the poor, show that multiple education sessions are effective in stimulating saving (Schreiner and Sherraden, 2007).

The finding that people have difficulty following through on planned actions suggests that education alone many not be sufficient. Rather, it is important to give consumers the tools to change their behaviors, rather than simply delivering financial education. As this paper clearly illustrates, people differ widely in their degree of financial literacy and saving patterns are very diverse (Browning and Lusardi, 1996). Accordingly, a "one-size-fits-all" education program will do little to stimulate saving and could even be a disincentive to participate in a financial literacy effort. For instance, in the Washington Financial Literacy survey, most respondents stated that they would prefer personalized ways to learn how to manage money, rather than attending information sessions (Moore, 2003).

6.2 The OECD's Recommendation on Principles and Good Practices for Financial Education and Awareness

As reported by Stewart and Smith (2008), in 2005 the OECD Council approved its *Recommendation on Principles and Good Practices for Financial Education and Awareness* (OECD 2005b). The principles and good practices were designed to provide guidance on improving financial education and awareness in OECD and non-OECD countries. They were drawn from the financial literacy and behavior finance studies, as well as surveys of financial education programs and experience in OECD member countries. The principles and good practices listed in the paper by Stewart and Smith are reported below:

> -- *Financial education programs should focus on high priority issues, which, depending on national circumstances, may include important aspects of financial life planning, such as basic savings, private debt management, or insurance, as well as prerequisites for financial awareness, such as elementary financial mathematics and economics. The awareness of future retirees about the need to assess the financial adequacy of their current public or private pension schemes and to take appropriate action when needed should be encouraged.*
>
> -- *National campaigns should be encouraged to raise awareness of the population about the need to improve their understanding of financial risks and ways to protect against financial risks through adequate savings, insurance, and financial education. Specific websites should be promoted to provide relevant, user-friendly financial information to the public. Warning systems by consumer, professional, or other organizations on high-risk issues that may be detrimental*

to the interests of the financial consumers (including cases of fraud) should be promoted. Financial education should be provided in a fair and unbiased manner. Programs should be coordinated and developed with efficiency.

-- Financial education should start at school. People should be educated about financial matters as early as possible in their lives.[23] *Financial education should be regarded as a lifelong, ongoing, and continuous process.*

-- Financial institutions' accountability and responsibility should be encouraged not only in providing information and advice on financial issues, but also in promoting financial awareness in their clients, especially for long-term commitments and commitments that represent a substantial proportion of current and future income. Financial institutions should be encouraged to provide information at several different levels in order to best meet the needs of consumers. Financial institutions should be encouraged to train their staff on financial education and develop codes of conduct for the provision of general advice about investment and borrowing. Financial institutions should be encouraged to clearly distinguish between financial education, financial information, and commercial financial advice.

-- International cooperation on financial education should be promoted, including the use of the OECD as an international forum to exchange information on recent national experiences in financial education (see Stewart and Smith (2008) page XX).

[23] See the chapter by Mandell in this volume. Because evidence on the effectiveness of financial education offered in high school is limited, it might be important to start financial education as early as possible and to look for ways to increase its effectiveness.

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Assets returns volatility and investment horizon: The French case

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Abstract: This paper explores French assets returns predictability within a VAR setup. Using quarterly data from 1970Q4 to 2006Q4, it turns out that bonds, equities and bills returns are actually predictable. This feature implies that the investment horizon does indeed matter in the asset allocation. The VAR parameters estimates are then used to compute real returns conditional volatility across investment horizons. The results reveal the same kind of horizon effect as the one found in recent empirical studies using quarterly U.S. data. More specifically, the annualized standard deviation of French stocks returns goes down from 22% for a 1-year horizon to only 2.8% for a 25-year investment horizon. They suggest that long-horizon investors overstate the share of bonds in their portfolio choice when neglecting the horizon effect on risk of asset returns predictability.

Keywords: Asset return predictability, Investment horizon, Vector Autoregression.
JEL classification: G11.

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Introduction

The optimal management of an assets portfolio is dynamic by nature. This basic point was first made by Mossin [1968], Merton [1969] and Samuelson [1969]. However, they concluded that, under the commonly accepted assumptions of that time, the optimal assets allocation is myopic. This means that the investment horizon is irrelevant, or that the optimal dynamic allocation is equivalent to the static one. More generally, Merton [1973] has shown that variation in expected returns over time may induce horizon effects. However, closed-form solutions to Merton's intertemporal model are difficult to find except in the case where the investor has log utility of consumption, i.e., with unit constant relative risk aversion, which is a case of limited interest since it implies that Merton's model reduces to a static one. The lack of closed-form solutions for constant (but not unit) relative risk aversion coefficient explains why so few empirical work was devoted to the horizon effects until very recently. When assets returns are unpredictable, myopia becomes optimal in the more general case of constant relative risk aversion. Increasing the investment period raises both the expected final payoff and its volatility in such a way that these two effects counterbalance each others perfectly under these conditions.

This question of optimal myopia is particularly crucial for financial intermediaries in charge of the management of lifecycle saving programs. Most pension programs now take the form of Defined Contribution plans, which means that most of the financial risk is borne by the individuals contributing to the system. It implies that these financial intermediaries should manage their financial reserves by taking into account the long-term objectives of their customers, which is to accumulate enough wealth for their retirement. The European Union is however considering a new regulation of the solvency of (life) insurance companies in which their capital requirement would be based on the assets and liabilities risks measured on a 12-month basis. In this paper, we raise the question of whether this so-called "Solvency II" myopic rule is efficient from the viewpoint of the policyholders. If we accept the assumption that relative risk aversion is constant,[1] the answer to this question relies on whether assets returns are predictable or not.

Future assets returns are predictable if they are statistically related to some easily observable variables that are referred to as predictors. Fama and French [1988], Poterba and Summers [1988], Campbell [1996], Campbell, Lo and MacKinlay [1997], Barberis [2000], Cochrane [2001] and many others estimated significant predictability of US stocks returns. In particular, there is mean-reversion in stocks returns, in the sense that shocks in expected stocks returns are negatively correlated with shocks to realized stocks returns. For example, Barberis [2000] used a simple VAR setup for stocks returns with the dividend-price ratio as predictor. He showed that the implied standard deviation of ten-year U.S. stocks returns is 23.7 percent, much smaller than the 45.2 percent value implied by the standard deviation of monthly returns. Using a more sophisticated VAR analysis of bills, bonds and stocks returns with three predic-

[1] Gollier and Zeckhauser [2002] examine this question when relative risk aversion is not constant.

tors, Campbell and Viceira [2002] showed that mean-reversion of U.S. stocks returns cuts their standard deviation from 18% at a one-year horizon to 14% at a 25-year horizon.

Because mean-reversion implies that stocks are safer in the long run, the intuition suggests that a long horizon agent should have a larger demand for stocks early in his investment period. Campbell and Viceira [1999] and Barberis [2000] numerically estimated the sensitiveness of the demand for stocks to the investment horizon. The hedging demand for stocks is surprisingly large. For an agent with a relative risk aversion equaling 10 and a ten-year time horizon, the optimal investment in stocks is about 40% of current wealth without predictability. It goes up to 100% when mean-reversion is taken into account. This suggests that limiting the risk measurement to 12-month as in the Solvency II reform would inefficiently bias the insurers' assets portfolios towards bonds and bills. Given the large equity premium that has been observed over the past century both in the United States and in Europe (Dimson, Marsh and Staunton [2002]), this regulatory failure could have dramatic effects on the accumulated wealth and welfare of future retirees.

One important limitation to applying these ideas to make policy recommendations is that this literature is entirely based on U.S. data. It is a priori not clear whether these findings can be applied to other countries, as long as we don't have a general theory that would explain these serial correlations in assets returns. Our aim in this paper is to see whether the above-mentioned findings made on U.S. markets can be extended to France. We use quarterly data from 1970Q4 to 2006Q4 to perform a VAR analysis of real assets returns on French financial markets. We use the following list of predictors to determine the intensity of predictability: past real returns of stocks, bonds and bills, the nominal interest rate, the dividend-price ratio and the spread of interest rates. We closely follows the analysis that was used by Campbell and Viceira [2002], and we obtain very similar conclusions. Namely, stocks returns exhibit mean-reversion, whereas the returns of portfolios of bonds held to maturity exhibit some degree of mean-aversion. The intensity of mean-reversion of French stocks returns is stronger than the one reported by Campbell and Viceira on U.S. data. More specifically, the annualized standard deviation of French stocks returns goes down from 22% for a 1-year horizon to only 2.8% for a 25-year investment horizon.

The paper is organized as follows. Section 1 shows how conditional second-order moments of asset returns, i.e. their volatility, can be derived from a VAR setup. Section 2 describes the data used for the VAR model estimation presented in Section 3. In Section 4, French assets conditional volatilities are compared across investment horizons. The robustness of these results is then checked in Section 5 while Section 6 concludes.

1 Asset returns predictability and horizon effects from a VAR setup

A vector autoregressive (VAR) dynamics for U.S. asset returns is considered in e.g. Campbell [1991], Campbell [1996], Barberis [2000] or Campbell and Viceira [2002].[2] Beyond asset returns predictability considerations, Campbell and Viceira [2002] analysis emphasizes how well-suited the VAR framework is in order to evaluate investment horizon effects. Following their approach, our empirical study allows an arbitrary set of traded assets and state variables. More specifically, we consider a short-term interest rate together with excess stock returns and excess bond returns. Let R_{0t} denote the ex post real short rate and $r_{0t} = \log(R_{0t})$ the log (or continuously compounded) real return on this asset that is used as a benchmark to compute excess returns on other asset classes. Then, with r_{et} and r_{bt} the log real stock return and the log real bond return, let $x_{et} = r_{et} - r_{0t}$ and $x_{bt} = r_{bt} - r_{0t}$ denote the corresponding log excess returns.

We retain the same VAR(1) system as in Campbell and Viceira [2002] and Campbell et al. [2003][3]:

$$\mathsf{z}_t = \Phi_0 + \Phi_1 \mathsf{z}_{t-1} + \mathsf{v}_t, \tag{1}$$

where

$$\mathsf{z}_t = \begin{bmatrix} r_{0t} \\ \mathsf{x}_t \\ \mathsf{s}_t \end{bmatrix} \tag{2}$$

is a $m \times 1$ vector with x_t, the $n \times 1$ vector of log excess returns and s_t the $m - n - 1 \times 1$ vector of variables which have been identified as returns predictors in existing empirical analysis, such as the nominal short rate, the dividend-price ratio and the yield spread between long-term and short-term bonds. In equation (1), Φ_0 is the $m \times 1$ vector of intercepts and Φ_1 is the $m \times m$ matrix of slope coefficients. It is assumed that the roots of the characteristic polynomial $\Phi(z) = I_m - \Phi_1 z$ lie strictly outside the unit circle in absolute value, a condition which rules out nonstationary or explosive behavior in z_t. Finally, v_t is the $m \times 1$ vector of innovations in asset returns and return forecasting variables, which is assumed to be *i.i.d.* normally distributed:

$$\mathsf{v}_t \sim \mathcal{N}(0, \Sigma_v), \tag{3}$$

where Σ_v is the $m \times m$ covariance matrix.

[2] Under the assumption that asset returns are well described by such a VAR model, Campbell, Chan and Viceira [2003] show how to obtain approximate solutions to the multiperiod portfolio choice model they propose. In this model, the investor is infinitely-lived with Epstein-Zin utility and there are no borrowing or short-sales constraints on asset allocation.

[3] As emphasized by these authors, the analysis below can be easily extended to more than one lag. However, the number of parameters in a VAR model increases exponentially with the number of lags, which may significantly reduce the estimates precision.

As stressed in Campbell and Viceira [2004], the conditional $k-$period variance-covariance matrix obtains straightforwardly from the VAR model estimates. First, cumulative $k-$period log returns are obtained by adding one-period log returns over k successive periods. Then, under the assumption that Σ_v is constant over time[4], the conditional $k-$period variance is given by:

$$\begin{aligned} Var_t(\mathsf{z}_{t+1} + \cdots + \mathsf{z}_{t+k}) &= \Sigma_v + (I + \Phi_1)\Sigma_v(I + \Phi_1)' \\ &\quad + (I + \Phi_1 + \Phi_1\Phi_1)\Sigma_v(I + \Phi_1 + \Phi_1\Phi_1)' + \cdots \\ &\quad + (I + \Phi_1 + \cdots + \Phi_1^{k-1})\Sigma_v(I + \Phi_1 + \cdots + \Phi_1^{k-1})' \end{aligned} \tag{4}$$

In order to extract the conditional moments of real returns from the VAR, we use the following $(n+1) \times m$ selection matrix:

$$M_r = \begin{bmatrix} 1 & \mathbf{0}_{1\times n} & \mathbf{0}_{1\times(m-n-1)} \\ \imath_{n\times 1} & \mathbf{I}_{n\times n} & \mathbf{0}_{n\times(m-n-1)} \end{bmatrix}$$

in (4). Then, dividing both sides by the horizon in order to annualize, we get:

$$\frac{1}{k} Var_t \begin{bmatrix} r_{0,t+1}^{(k)} \\ r_{e,t+1}^{(k)} \\ r_{b,t+1}^{(k)} \end{bmatrix} = \frac{1}{k} M_r Var_t(\mathsf{z}_{t+1} + \cdots + \mathsf{z}_{t+k}) M_r'. \tag{5}$$

This approach will be applied to the French data described in the next section.

2 The French assets return data

The short term rate is the 3-month PIBOR rate, obtained from Datastream. The end-of-quarter values from this monthly series are retained to get quarterly observations, and r_{0t} denotes the real ex post short term rate, i.e. the difference between the log return on the 3-month PIBOR and the log inflation rate. The inflation series is calculated from the monthly Consumer Price Index series (source: INSEE) as $100 \times (cpi_t - cpi_{t-12})/cpi_{t-12}$. The log yield on this 3-month PIBOR is also used as the measure of the log short-term nominal interest rates, r_{0t}^{nom}.

French data for equities prices and returns come from Morgan Stanley Capital International (MSCI) database and are available since December 1969. More precisely, quarterly stock market data are based on the monthly MSCI National Price and Gross Return Indices in local currency. From these data, a quarterly stock total return series and a quarterly dividend series

[4]Time variation in Σ_v could be incorporated in the model, but since the available empirical evidence suggests that the persistence of changes in risk is quite low, this should not affect too much the conclusions regarding long-term asset allocation.

are obtained following the methodology described in Campbell [1999][5]. Note that we depart from Campbell's approach by not including the tax credits on dividends which are applicable to France. Indeed, MSCI calculates returns from the perspective of US investors, so it excludes from its indices these tax credits which are available only to local investors. Campbell chooses to add back the tax credits quite roughly, by applying the 1992 rate of 33.33% to all the sample. Nevertheless, this rate hasn't remained fixed over the sample considered here (1970Q1—2006Q4). On top of this, the way dividends are taxed has also changed during that period. We couldn't find exact tax rate data for our sample, and guess that on average, the French tax credits system has increased the nominal stock returns by around 40%. Since applying this coefficient to all the observations would be neutral as long as volatility is concerned, we choose to work with data excluding tax credits. The quarterly log real return on the stock index is denoted r_{et} and defined as the difference between the log return on equities and the log inflation rate. The log excess return on equities is then $x_{et} = r_{et} - r_{0t}$. The log dividend-price ratio, denoted $ldmp_t$ is the log dividend less the log price index. Since the quarterly dividend series is calculated from the monthly dividend payments over the past year, this series starts in 1970Q4 only.

Regarding the bond market, the long term government bond yield is used as a proxy variable. The monthly observations come from Datastream, and an end-of-quarter yield has been computed by selecting the end-of-quarter values. Then, the long bond return is constructed from this series using the loglinear approximation technique described in Chapter 14 of Campbell et al. [1997]:

$$r^{nom}_{b,n,t+1} \approx D_{nt} y_{nt} - (D_{nt} - 1) y_{n-1,t+1}$$

where n is the bond maturity, D_{nt} is the bond duration and Y_{nt} is the bond yield from which the log bond yield obtains as $y_{nt} = log(1 + Y_{nt})$. The duration at time t is calculated as:

$$D_{nt} \approx \frac{1 - (1 + Y_{nt})^{-n}}{1 - (1 + Y_{nt})^{-1}}$$

where n is set to 10 years. Following Campbell and Viceira [2002], we approximate $y_{n-1,t+1}$ by $y_{n,t+1}$. The log real return on bonds, denoted r_{bt}, is the difference between r^{nom}_{bt} and the log inflation. The log excess return on bonds is then $x_{bt} = r_{bt} - r_{0t}$. The log real returns on PIBOR, bonds and equities are plotted in Figure 6, see Appendix.

Finally, the yield spread (spr_t) is the difference between the 10-year Treasury bond yield from Datastream and the 3-month PIBOR rate, again using end-of-quarter observations.

Table 1 reports sample means and standard deviations in annualized percentage points, except for the dividend-price ratio. To annualize the raw quarterly data, means are multiplied by 400 while standard deviations are multiplied by 200 since the latter increase with the square root of the time interval in serially uncorrelated data. The mean log returns are adjusted by

[5] See also Campbell's "Data Appendix for *Asset Prices, Consumption and the Business Cycle*", March 1998, downloadable from Campbell's homepage.

adding one-half their variance so that they reflect mean gross returns. These statistics are computed for the sample 1970Q4-2006Q4.

Table 1: Sample statistics for real asset log returns

	mean	standard deviation
r_0	2.34	2.67
x_e	6.94	23.03
x_b	0.73	3.39
r_0^{nom}	7.39	3.44
$ldmp$	-4.95	0.56
spr	1.02	1.39

Remind that the stock return here does not include tax credits. When adding back, say, a 40% tax credit rate, the stock excess return would reach more than 10% per year. By contrast the excess return of the 10-year Treasury bond is only 0.7%. Volatility is much higher for stocks than for bonds (23.03% and 3.39% resp.).

ADF unit root tests are reported in Table 2. The deterministic component includes at most a constant under the stationary alternative. The lag order of the ADF regression was selected as the smallest one succeeding in eliminating residuals autocorrelation up to order 8. The unit

Table 2: ADF Unit Root Tests

	r_0	x_e	x_b	r_0^{nom}	$ldmp$	spr
ADF stat	-2.65 (1)	-11.21 (0)	-8.19 (0)	-2.04 (1)	-1.50 (0)	-4.57 (1)
p-value	0.085	0.000	0.000	0.268	0.530	0.000

Number of autoregressive lags into parenthesis.

root null is strongly rejected for x_e, x_b and spr, whereas it is rejected only at the 8.5% level for r_0 and clearly not rejected for the dividend-price ratio and for the nominal short term rate.

3 The VAR model estimates

In the sequel, we will consider the same model as Campbell and Viceira [2002], i.e. $\mathsf{z}_t = (r_{0,t}, x_{e,t}, x_{b,t}, r_{0,t}^{nom}, ldmp_t, spr_t)$ in equation (1). The lag order of is set to one, according to both Akaike, Schwartz and Hannan-Quinn information criteria. Moreover, the null of no residuals autocorrelation up to order 8 is not rejected at the 23% level according to Box-Pierce statistics.

Due to the stock market data, our sample is 1970Q4–2006Q4, i.e. 145 observations. The VAR is thus estimated from 1971Q1 to 2006Q4. The results are reported in Table 3. The first column reports the real 3-month rate equation. The lagged 3-month rate and the lagged spread coefficients are significantly different from zero and hence help predicting the real 3-month return. The second column refers to the real stock log return equation. This variable is known to be hardly predictable, which is here confirmed by the R^2 value of 12%. Nevertheless, the lagged bond log return and the lagged dividend-price ratio coefficients are significantly different from zero. The third column shows that both lagged 3-month return, bond return and yield spread help predicting the log bond return. The R^2 of this equation is 21%. The last three columns reveal that the return forecasting variables are highly persistent, especially the nominal short rate and the dividend-price ratio. In order to check for the VAR model stability, we have computed the roots of its characteristic polynomial: it turns out that the modulus of the largest root is lesser than one, with a value of 0.97. Hence the VAR apparently satisfies the stability condition.

Table 4 reports standard deviations (multiplied by 100) of estimated residuals on the diagonal and their correlations off-diagonal.

The magnitude of real returns residuals standard deviations obtained here are somehow similar to those obtained on quarterly data by Campbell et al. [2003] and Campbell and Viceira [2005].[6] Indeed, these authors find 0.57, 8.06 and 2.69 for r_0, x_e and x_b respectively, to compare with our values of 0.93, 11.41 and 3.09. The residuals cross-correlations are also quite similar to those found by these authors, except for the log real short-term rate equation: contrary to their results, we find that unexpected real short-term returns are negatively correlated with log bond excess returns and yield spread innovations, and positively correlated with nominal short-term rate innovations. Unexpected log excess stock returns are highly negatively correlated with shocks to the log dividend-price ratio, and mildly positively correlated with unexpected log excess bond returns and yield spread innovations. Finally, unexpected log excess bond returns are negatively correlated with shocks to the nominal short-term rate and to a lesser extend with shocks to real short-term returns. They are weakly positively correlated to yield spread innovations.

The signs of these innovations cross-correlations may explain some results. As shown by Stambaugh [1999], the small-sample bias in such regressions has the opposite sign to the sign of the correlation between innovations in returns and innovations in predictive variables. Hence, one may suspect that for the 3-month return equation, where the spread innovations are negatively correlated with returns innovations, there is a positive small-sample bias which may in turn explain some apparent predictability. On the contrary, the positive correlation between bond return and yield spread innovations suggests that the predictability of bond returns is not overstated in our sample. Regarding the log excess stock returns equation, the

[6] Campbell et al. [2003] use quarterly US data from 1952Q2 to 1999Q4 while Campbell and Viceira [2005] extend the sample until 2002Q4.

Table 3: VAR estimation results

	$r_{0,t}$	$x_{e,t}$	$x_{b,t}$	$r_{0,t}^{nom}$	$ldmp_t$	spr_t
$r_{0,t-1}$	**0.923**	0.828	**0.394**	-0.0434	**-0.027**	-0.032
	(0.059)	(0.728)	(0.197)	(0.059)	(0.008)	(0.053)
	[15.54]	[1.14]	[2.00]	[-0.74]	[-3.29]	[-0.59]
$x_{e,t-1}$	0.005	-0.022	-0.027	0.004	-0.001	-0.002
	(0.007)	(0.093)	(0.025)	(0.007)	(0.001)	(0.007)
	[0.71]	[-0.24]	[-1.06]	[0.55]	[-0.39]	[-0.28]
$x_{b,t-1}$	-0.037	**0.667**	**0.274**	**-0.085**	-0.006	**0.055**
	(0.027)	(0.332)	(0.090)	(0.027)	(0.004)	(0.024)
	[-1.38]	[2.01]	[3.04]	[-3.17]	[-1.57]	[2.26]
$r_{0,t-1}^{nom}$	0.083	-1.037	-0.145	**1.010**	**0.013**	-0.006
	(0.048)	(0.585)	(0.158)	(0.047)	(0.007)	(0.043)
	[1.75]	[-1.77]	[-0.91]	[21.41]	[1.95]	[-0.14]
$ldmp_{t-1}$	-0.629	**8.805**	1.127	-0.323	**0.850**	0.188
	(0.331)	(4.068)	(1.101)	(0.328)	(0.046)	(0.298)
	[-1.90]	[2.16]	[1.02]	[-0.98]	[18.36]	[0.63]
spr_{t-1}	**0.287**	0.844	**0.829**	**0.219**	-0.017	**0.703**
	(0.075)	(0.926)	(0.251)	(0.075)	(0.010)	(0.068)
	[3.81]	[0.91]	[3.31]	[2.94]	[-1.59]	[10.36]
c	**-3.822**	**47.317**	5.378	-1.753	**-0.757**	1.304
	(1.856)	(22.769)	(6.163)	(1.836)	(0.259)	(1.669)
	[-2.06]	[2.08]	[0.87]	[-0.95]	[-2.92]	[0.78]
R-squared	0.88	0.12	0.21	0.93	0.95	0.65

Standard errors in ( ) and t-statistics in [ ].

Table 4: Standard deviations and correlations of residuals

	r_0	x_e	x_b	r_0^{nom}	$ldmp_t$	spr_t
r_0	0.930	0.285	-0.432	0.731	0.109	-0.707
x_e	—	11.409	0.288	-0.337	-0.799	0.234
x_b	—	—	3.088	-0.698	-0.245	0.238
r_0^{nom}	—	—	—	0.920	0.248	-0.857
$ldmp$	—	—	—	—	0.130	-0.147
spr	—	—	—	—	—	0.836

predictability due to the log dividend-price ratio may be overstated due to the quite strong negative correlation between stock returns and dividend-price ratio innovations.

4 Comparing French assets risk across investment horizons

The conditional k-period variance-covariance matrix of real returns is obtained from the VAR(1) estimates according to equation (4). The conditional standard deviation of the cumulative returns over investment horizon is divided by the square root of the horizon, so as to get annualized values. The annualized percent standard deviations of real returns for investment horizons up to 100 quarters, i.e. 25 years, are plotted in Figure 1.

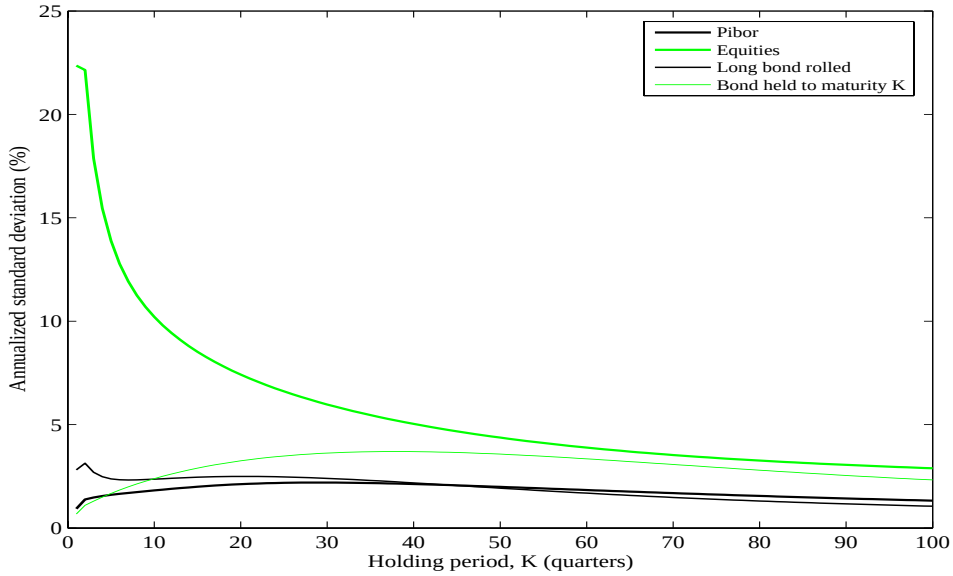

Figure 1: Annualized percent standard deviations of real returns

If returns were i.i.d., Siegel's measure of risk, i.e., the standard deviation of annualized returns, would be independent of the investment horizons. Hence, finding evidence that risk does not scale with horizon in this way would tend to confirm the predictability of returns. This is precisely the case here since the standard deviations plotted in Figure 1 depend on the investment horizon. Stock returns appear less volatile at longer horizons than at shorter ones. Hence, French stocks are *mean-reverting*. The same result is obtained for annual and quarterly US data by Campbell and Viceira [2002], Campbell et al. [2003] and Campbell and Viceira [2005]. However, French stock returns volatility decreases faster than its US analogue: here, it drops from 22% to 11% within eight quarters whereas the US stock returns volatility is divided by two after about 16 quarters. The initial steep decrease in French equities return volatility is then followed by a gradual decline, and the volatility is 2.8% at the 100-quarter horizon. By comparison, the US stock return volatility is still around 8% at this long horizon, according to Campbell and Viceira [2005] results.

This finding is a direct consequence of our VAR analysis. The mean-reversion of stocks return can be inferred from different channels. For example, we see in Table 3 that the autoregressive coefficient of the excess return of stocks is negative. But we also see that the dividend-price ratio is a good predictor of the future stocks return. Moreover, shocks to the excess return and to the dividend-price ratio are strongly negatively correlated, as seen in Table 4. It implies that a positive shock on the excess return of stocks yields a negative shock on the dividend-price ratio, which in turn yields an downwards revision of the expectation of future stocks returns.

Regarding bonds, two kinds of investment strategies are considered from the estimated model. The long bond rolled strategy is the one implicitly assumed in long-term bond returns time series: the maturity of the bond is held constant at, say, 10 years, buying a 10-year bond each period and selling it next period so as to buy a new 10-year bond. The second strategy consists in buying a bond and holding it until maturity. In this case, the standard deviation of the real return is given by the standard deviation of cumulative inflation from time t to time $t + K$, since this nominal bond held to maturity is riskless in nominal terms.

As in Campbell and Viceira [2005], we find that the long bond rolled strategy is also *mean-reverting*.[7] Starting from about 3% at short horizons, the long bond rolled real return volatility is a little bit more than 1% at the 25-year horizon. Even though the long bond rolled return volatility is always less than the one for stocks, the gap reduces to 1.8% at the 25-year investment horizon. By contrast, the real returns on both PIBOR and the variable-maturity bond are mean-averting. The volatility of the later becomes greater than the one of the PIBOR after five quarters and than the one of the long bond rolled after ten quarters. Campbell and Viceira [2005] reach the same conclusion, but for longer investment horizons. For instance, the return on the variable-maturity bond becomes riskier than the long bond rolled from the 8-year horizon on, while it becomes riskier than the stock return for horizons greater than thirty-two

[7] Using annual data, Campbell and Viceira [2002] find a mean-averting behavior for this return.

years. According to our data, the variable-maturity bond risk never exceeds the stock risk, whatever the investment horizon considered. Finally, their study reveals that the return on short term T-bills becomes riskier than the return on long bond rolled after around forty-five years, whereas our findings from French data point to the same phenomenon for investment horizons longer than eleven years only.

Overall, the stock real return is always riskier than the other assets considered here. For horizons longer than two years and a half, the return volatility of variable-maturity bond exceeds the ones of both the constant-maturity bond and the 3-month PIBOR. From the twelve-year investment horizon on, the constant-maturity long bond becomes the less risky asset. Nevertheless, the 3-month PIBOR (resp. stock) return excess volatility at the 25-year horizon is less than 0.3% (resp. 1.84%) compared to the constant-maturity bond.

From the conditional variance-covariance matrix given in equation (5), it is straightforward to compute the correlations of the real returns at all horizons. Figure 2 shows that the correlations of stocks return and both fixed and variable-maturity long bonds return are hump-shaped at the short and medium horizons. These correlations are positive at all horizons. At the one-quarter horizon, the correlation between stock and variable-maturity bond (resp. fixed-maturity bond) returns is around 10% (resp. 21%). It then peaks at 60% (resp. 58%) at the 5-year (resp. 4-year) horizon. At the 25-year horizon, the stock—variable-maturity bond correlation is still 42%, whereas the stock—fixed-maturity bond correlation decreases to 16%. This striking hump-shaped patterns are also present in Campbell and Viceira [2005]'s study. The main discrepancy in our findings is that the correlation between stock and bond held to maturity returns remains positive at all horizons, even for the 50-year horizon, while Campbell and Viceira [2005] find that this correlation becomes negative after 45 years. Accordingly, they claim that stocks are able to hedge inflation risk in the very long term. This feature is not shared by French data. However, as stressed by these authors, the very long horizons predictions of the model must be cautiously interpreted because of the size of the sample.

5 Robustness analysis

The conclusions drawn above rely entirely on the VAR(1) model estimates reported in Tables 3 and 4. We propose to check their robustness along three dimensions. Firstly, we will extend the methodology proposed in Campbell and Viceira [2002] by taking the standard errors of Φ_0, Φ_1 and Σ_v OLS estimates into account. Secondly, the stability of the coefficients estimates will be checked using the structural break analysis developed by Bai, Lumsdaine and Stock [1998]. Indeed, the Sup test developed by these authors allows to test the null of VAR parameters stability against the alternative of a structural change at unknown date. Thirdly, since the unit root hypothesis cannot be rejected at reasonable levels for the log nominal short-term rate and the log dividend-price ratio according to the univariate Augmented Dickey-Fuller tests, these variables will be removed from the information set.

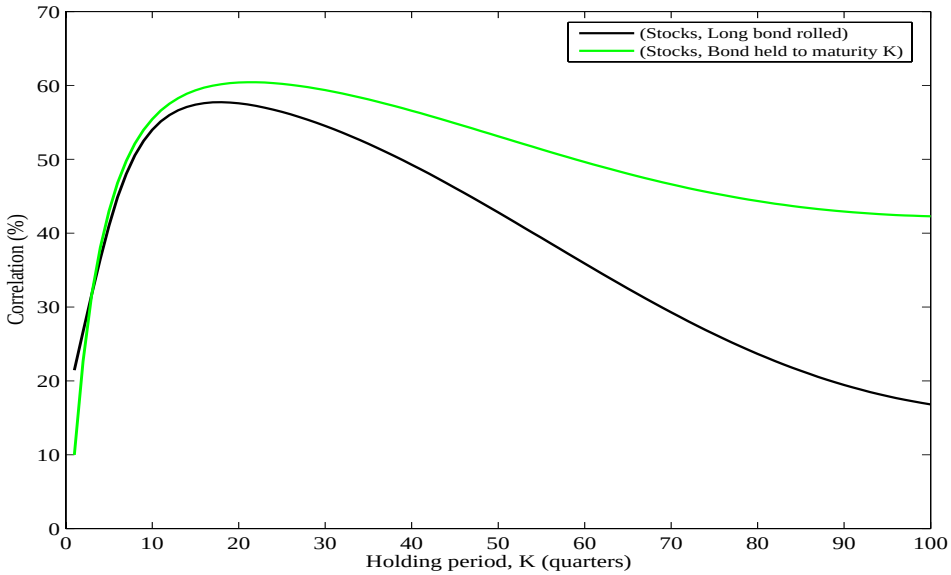

Figure 2: Correlations of real returns implied by VAR(1) estimates

5.1 Bootstrapped confidence intervals for the curves of annualized standard deviation

Rather surprisingly, the confidence intervals of the annualized standard deviation curves are neither reported nor commented in existing empirical work. Yet, since the OLS estimates of Φ_0, Φ_1 and Σ_v have of course a non-zero variance-covariance matrix, i.e. are measured with uncertainty, nothing ensures a priori that the difference between the curves in e.g. figure 1 is statistically significant.

In order to check this, the parametric residual bootstrap method described in e.g. Hansen and Seo [2002] is used. From the model given by equation (1), assuming that v_t is *i.i.d.* from an unknown distribution, and for fixed initial conditions on z_t, the bootstrap distribution may be calculated by simulation. Random draws are made from the estimated residuals vector $\widehat{\mathsf{v}}_t$ and then the simulated vector series z_t^s are computed by recursion given model (1). 10,000 vector series z_t^s are created, with the same length as the sample size. The initial condition is set to the actual value. For each simulated z_t^s, $\widehat{\Phi}_0^s$, $\widehat{\Phi}_1^s$ and $\widehat{\Phi}_v^s$ are obtained from the OLS estimation of equation (1). From these matrices, the corresponding annualized standard deviations of simulated real returns are computed. For each kind of assets, figure 3 below reports the mean of the annualized standard deviations obtained from the 10,000 drawings (solid line), as well as the 5% and 95% associated quantiles (dashed lines). This figure reveals that once their 95% confidence intervals are taken into account, the risks corresponding to the short rate, the long bond rolled and the bond held to maturity are not significantly different from each other after

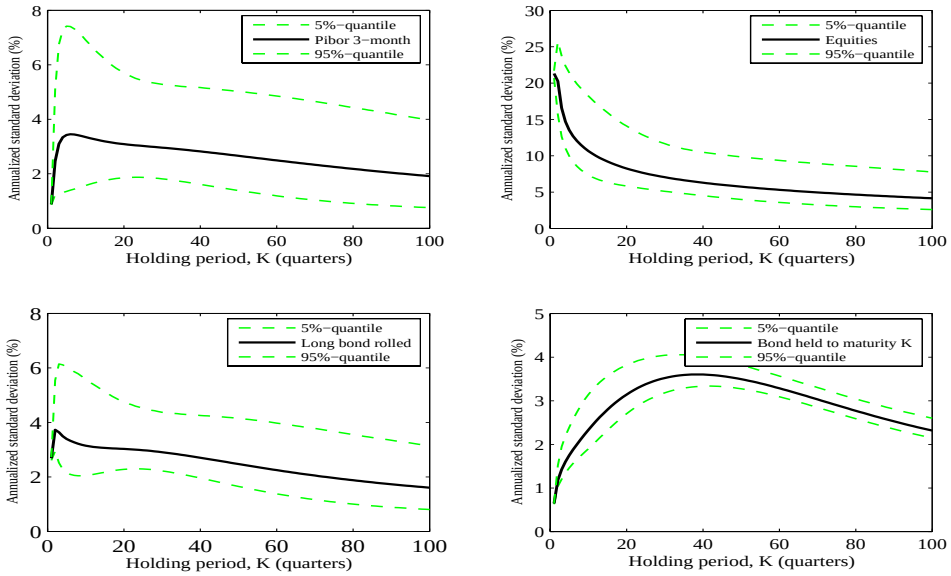

Figure 3: 95% Confidence Intervals for risks across horizons

the one-year horizon. Indeed, their confidence intervals intersect very quickly. Moreover, since the short term rate risk confidence interval is relatively large, it crosses the one of equities at the 6.5 years horizon (see figure 7 in Appendix, which gathers the four confidence intervals). From that horizon on, equities risk is not significantly higher than the one of the short term bills. The same conclusion holds for the equities risk compared to the long bond rolled after 11.5 years and to the bond held to maturity after 15.5 years.

5.2 Stability analysis

The liberalization of the French financial markets in the mid-eighties may have affected the returns dynamics over, say, the second half of our sample. If it were actually the case, then our conclusions would be biased since the VAR model given in equation (1) does not allow for a structural change. In order to allow for a general structural change at time $\tau = T\lambda$, with $\lambda \in (0,1)$, the VAR model can be generalized as follows:

$$\mathsf{z}_t = \Phi_0 + \Phi_1 \mathsf{z}_{t-1} + D(t > \tau)(\Gamma_0 + \Gamma_1 \mathsf{z}_{t-1}) + \mathsf{u}_t, \tag{6}$$

where Γ_0 and Γ_1 are respectively $m \times 1$ and $m \times m$ matrices, u_t is the $m \times 1$ vector of innovations assumed to be *i.i.d.* with $E(\mathsf{u}\mathsf{u}_t') = \Sigma_u$. $D(t > \tau)$ is a dummy variable such that $D(t > \tau) = 0$ for $t \leq \tau$ and $D(t > \tau) = 1$ for $t > \tau$. Under the null hypothesis that no break occurs, model (6) reduces to the VAR given in equation (1):

$$\mathsf{z}_t = \Phi_0 + \Phi_1 \mathsf{z}_{t-1} + \mathsf{v}_t$$

with $E(\mathsf{v}_t\mathsf{v}_t') = \Sigma_v$. Hence, the null hypothesis of no structural break at time τ corresponds to:

$$H_0 : \Gamma_0 = 0_{m\times 1} \text{ and } \Gamma_1 = 0_{m\times m}. \tag{7}$$

If the break point τ were known, then standard likelihood ratio (LR), Lagrange Multiplier (LM) or Wald (W) test statistics could be used to test H_0. If τ is unknown, the difficulty is that there is no estimate of τ under the null hypothesis: τ is a nuisance parameter under the null. The parameters μ_1 and B are also unidentified nuisance parameters under H_0. With τ unknown, we will follow the common practice initiated by Davies [1987] which consists in using sup tests of the type:

$$SupLR(\tau) = \sup_{\tau\in[\tau_{inf},\tau_{sup}]} LR_T(\tau) \tag{8}$$

where τ_{inf} corresponds to the initial fraction of the full sample T which is trimmed, in practice often set to $0.15T$ as suggested by Andrews [1993] and $\tau_{sup} = (1-\tau_{inf})T$. In our case, since the sample length is 145 and the number of parameters is 42, the trimming parameter is chosen so as to leave 42 observations before the first break date τ_{inf} and after the last break date τ_{sup}. Moreover,

$$LR_T(\tau) = (T - n_c)(log\det(\Sigma_v) - log\det(\Sigma(\tau))) \tag{9}$$

where n_c denotes the number of constrained coefficients involved by assumption (7). Note that the LR statistics depends on τ through the estimate of the variance-covariance matrix of residuals under the alternative (6). Equivalently, one could define SupLM and SupW statistics. As can be shown from Andrews [1993] and Bai et al. [1998], the asymptotic null distribution of $SupLR(\lambda)$ is free of nuisance parameter. Hence, the critical values for the test statistics can be tabulated. However, as the empirical use of it will involve a finite number of observations, we will rather use a residual bootstrap method calculated by simulation. For given initial conditions, random draws are made from the residual vectors under the null. From these bootstrap residuals, one can create a simulated sample of series using model (1), and for each sample, calculate the corresponding $SupLR$ statistic. The bootstrap p-value then obtains as the percentage of simulated statistics which exceed the actual statistics.[8]

For a set of break dates ranging from 1981Q1 to 1996Q4, the SupLR statistic is 68.80, and its bootstrapped p-value — computed from 5000 replications — is 52.74%. Consequently, the null of parameters stability cannot be rejected for our VAR(1) model.

5.3 Change in the information set

As stressed earlier, the estimation results given in Tables 3 and 4 must be cautiously considered since the univariate unit root tests do not reject the null hypothesis for the log nominal short-term rate and for the log dividend-price ratio. Even though the largest root of the VAR(1)

[8] A detailed description of the method can be found in e.g. Hansen [1996] or Hansen and Seo [2002].

characteristic polynomial is lesser than one, it is still very close to unity with a value of 0.97. Johansen's cointegration rank test further confirms that this value may not be significantly different from unity.[9]

Therefore, we propose to check the robustness of our conclusions in two ways: *i)* by substituting the first differences to the levels of these variables, and *ii)* by excluding these two variables from the analysis. These two alternative models lead to the same results regarding the conditional moments of the various assets across investment horizons. Indeed, the first differences of the nominal short rate and of the dividend-price ratio do not help predicting the real returns (see Table 7 in appendix). Hence, excluding them from the information set does not affect the conclusions. Consequently, we will only report the results obtained from the 4-dimensional vector $\mathsf{z}_t^* = (r_{0,t}, x_{e,t}, x_{b,t}, spr_t)$. The VAR estimates are reported in Table 5. Again, the information criteria point to a lag length of one and the Box-Pierce statistics

Table 5: VAR estimation results for z_t^*

	$r_{0,t}$	$x_{e,t}$	$x_{b,t}$	spr_t
$r_{0,t-1}$	**1.013**	-0.441	**0.232**	-0.059
	(0.035)	(0.437)	(0.117)	(0.032)
	[28.57]	[-1.01]	[1.99]	[-1.86]
$x_{e,t-1}$	0.009	-0.0791	-0.034	-0.003
	(0.007)	(0.090)	(0.024)	(0.006)
	[1.28]	[-0.87]	[-1.41]	[-0.48]
$x_{b,t-1}$	-0.046	**0.762**	**0.289**	**0.053**
	(0.026)	(0.324)	(0.086)	(0.023)
	[-1.77]	[2.35]	[3.34]	[2.28]
spr_{t-1}	**0.277**	0.897	**0.844**	**0.693**
	(0.074)	(0.908)	(0.243)	(0.066)
	[3.75]	[0.99]	[3.45]	[10.55]
c	-0.279	-1.171	-0.928	**0.404**
	(0.155)	(1.909)	(0.510)	(0.138)
	[-1.80]	[-0.61]	[-1.82]	[2.93]
R-squared	0.88	0.09	0.20	0.65

Standard errors in ( ) and t-statistics in [ ].

[9]The trace test concludes to four cointegration relations at most, at the 10% level, hence indicating two common trends.

does not reject the null of no residuals autocorrelation up to order 8. This VAR model in z_t^* is thus estimated using the same sample as the VAR in z_t, namely 1971Q1– 2006Q4. The largest root of the characteristic polynomial is now 0.94 in absolute value and Johansen's trace test allows to conclude that the cointegration rank is four at the 7% level, hence confirming the stationarity of z_t^*. The estimated equations of the four remaining variables are basically unchanged compared to the 6-variable system, except of course for the influence of the log dividend-price ratio on the log stock real excess return which is now neglected.

Table 6 reports standard deviations (multiplied by 100) of estimated residuals on the diagonal and their correlations off-diagonal. They are very similar to the ones obtained from the 6-variable model. The only change concerns the sign of the correlation between stock and real short rate returns innovations which is now negative. This should not affect the result that much since the short-term real rate does not help predicting the excess stock return. Since

Table 6: Standard deviations and correlations of residuals

	r_0	x_e	x_b	spr_t
r_0	0.935	-0.305	-0.439	-0.703
x_e	—	11.520	0.298	0.240
x_b	—	—	3.078	0.241
spr	—	—	—	0.833

the nominal short rate has been excluded from this model, the inflation rate dynamics cannot be recovered from the system. Consequently, it is now impossible to compute the conditional moments of the variable-maturity bond strategy. The annualized standard deviations of the real returns on the three remaining assets are reported in Figure 4. The pattern of the stock real return volatility is very similar to one obtained in the previous section: the standard deviation reaches 22.5% at the one-quarter horizon, then sharply decreases and is divided by two after 10 quarters. This volatility then slowly decreases and is only 4% at the 25-year horizon. Compared to the 6-variable model, the patterns of long bond and 3-month PIBOR real returns volatilities remain largely unchanged up to the 6-year horizon. Afterwards, the log long bond return volatility stays approximately 0.5% above the log 3-month real rate and at the 25-year horizon, their respective values are 1.92% and 1.56%. So, in this 4-variable model, the three curves do not intersect each other: at all horizons, the equities return is riskier than the long bond return which in turn is riskier than the 3-month PIBOR rate. However, as can be seen from Figure 4, the volatility differentials strongly decrease with the investment horizon, as in the previous model. The most striking discrepancy between the two models appears in the conditional correlations between stocks and long bond real returns — see Figure 5. From the four-variable model, it is always increasing with the investment horizon. Starting with a correlation of around 22% at the one-quarter horizon, similarly to the six-variable model, it

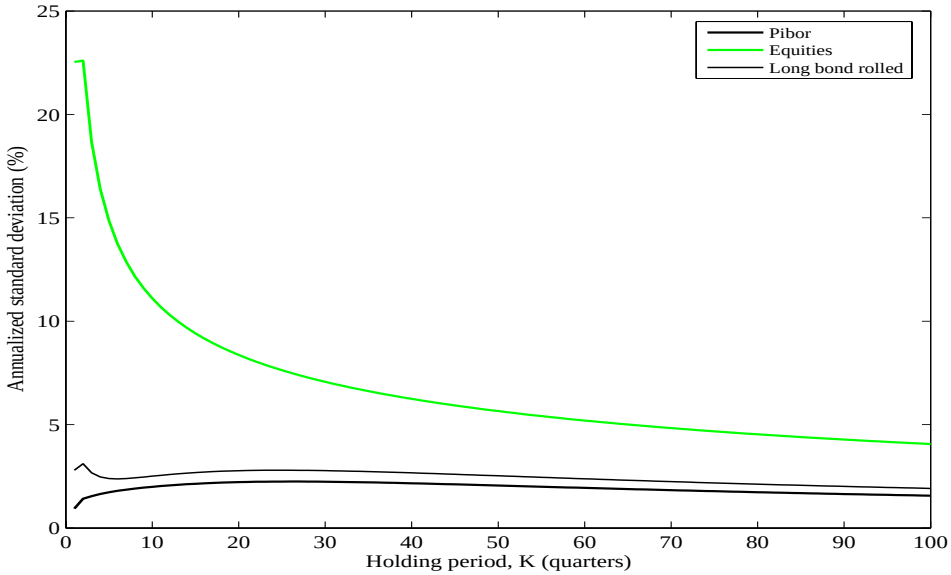

Figure 4: Annualized percent standard deviations of real returns (z_t^*)

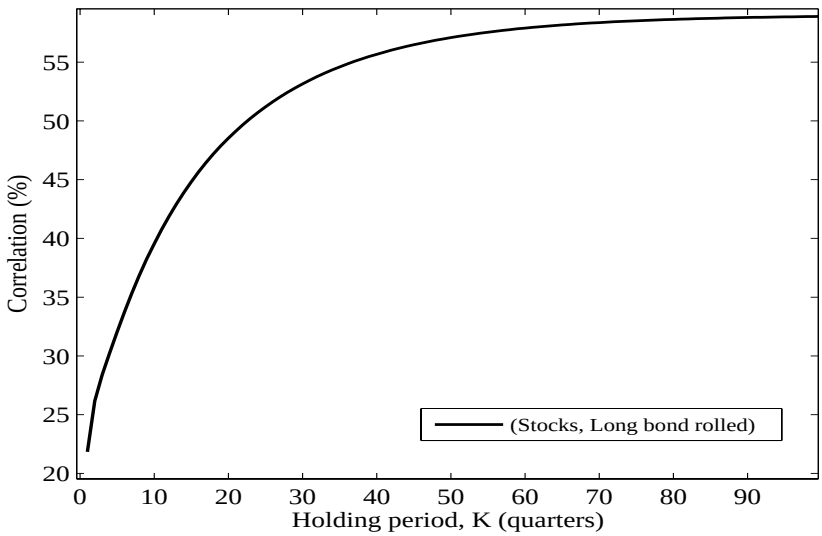

Figure 5: Correlations of real returns (z_t^*)

sharply increases to reach 50% at the 6-year horizon and then slowly raises until it stabilizes around 59% at the 25-year horizon.

6 Concluding remarks

The aim of this paper was to assess French assets returns predictability within a VAR setup. Using quarterly data from 1970Q4 to 2006Q4, it turns out that bonds, equities and bills returns are actually predictable, at least to some extend. This feature has important consequences in terms of multiperiod portfolio choice. It implies that the investment horizon does indeed matter in the asset allocation. Following the approach developed by Campbell and Viceira [2002], the VAR parameters estimates are used to compute real returns conditional moments of order two. From a six-variable VAR model similar to the one estimated by these authors, we find the same kind of horizon effect for French data as they do using quarterly U.S. data.

In particular, French stock market return is mean-reverting: its volatility quickly decreases as the holding period increases, even though stocks remain the riskiest asset for all horizons. Furthermore, the relative magnitude of the four kinds of assets considered here changes with the investment horizon. At the one-quarter horizon, stocks are riskier than constant-maturity bonds, which themselves are riskier than 3-month bills, which in turn are riskier than variable-maturity bonds. For horizons longer than fourteen years, variable-maturity bonds volatility becomes very close to the one of stocks: the volatility gap between these two assets is around 0.5% only. For these long horizons, constant-maturity bonds and PIBOR volatilities are almost identical: 1.32% for the latter and 1.05% for the former, at the 25-year horizon.

Compared to Campbell and Viceira [2002] and Campbell and Viceira [2005] results, French stocks returns seem more strongly mean-reverting than their US analogues. As a result, French stocks volatility is a little bit lesser than 3% at the 25-year horizon whereas US stocks volatility is still around 8% at the same horizon. It is also worth noting that the 25-year horizon volatility of the four French assets considered here ranks from 1% to 3%. By contrast, their US analogues lie between 3% and 8%. Regarding the conditional correlation between assets across investment horizons, French data reveal the same kind of patterns as the ones found by Campbell and Viceira [2005], namely an increasing correlation at the short and medium horizons.

Finally, our main conclusions seem rather robust to changes in the information set. To sum up, they suggest that long-horizon investors may well overstate the share of bonds in their portfolio choice when neglecting the horizon effect on risk of asset returns predictability.

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Appendix

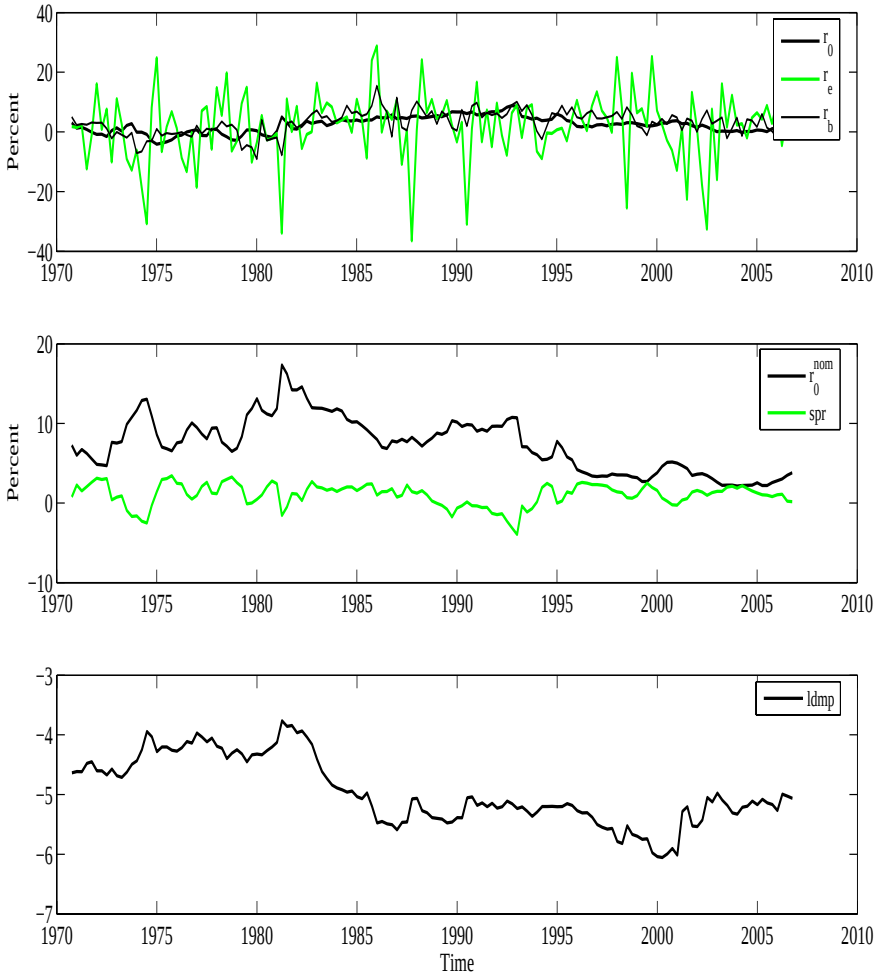

Figure 6: French data (1970Q4—2006Q4)

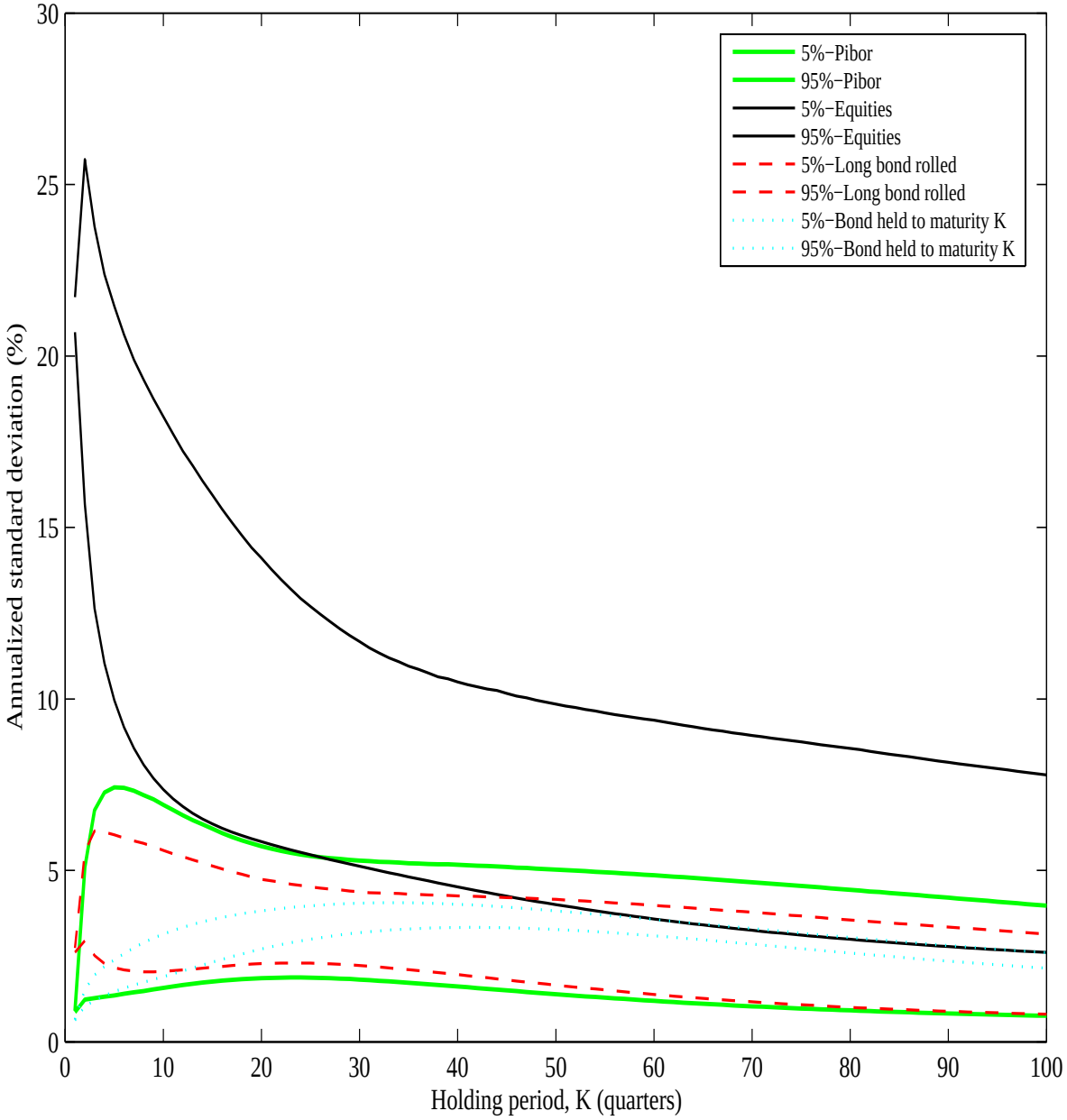

Figure 7: 95% Confidence Intervals for risks across horizons

Table 7: VAR estimation results for z_t^{Δ}

	$r_{0,t}$	$x_{e,t}$	$x_{b,t}$	$\Delta r_{0,t}^{nom}$	$\Delta ldmp_t$	spr_t
$r_{0,t-1}$	**1.032**	-0.647	**0.243**	0.000	-0.006	**-0.069**
	(0.036)	(0.457)	(0.122)	(0.000)	(0.005)	(0.032)
	[28.55]	[-1.42]	[1.99]	[0.35]	[-1.15]	[-2.14]
$x_{e,t-1}$	**0.026**	-0.262	-0.027	0.000	0.000	-0.013
	(0.012)	(0.147)	(0.039)	(0.000)	(0.002)	(0.010)
	[2.20]	[-1.78]	[-0.68]	[1.31]	[0.05]	[-1.21]
$x_{b,t-1}$	-0.015	**0.727**	**0.212**	-0.000	-0.006	0.021
	(0.029)	(0.370)	(0.099)	(0.000)	(0.004)	(0.026)
	[-0.53]	[1.96]	[2.14]	[-1.42]	[-1.44]	[0.80]
$\Delta r_{0,t-1}^{nom}$	18.377	-4.204	-54.132	**0.263**	0.181	**-20.312**
	(9.671)	(122.22)	(32.60)	(0.09)	(1.44)	(8.63)
	[1.90]	[-0.03]	[-1.66]	[2.76]	[0.12]	[-2.35]
$\Delta ldmp_{t-1}$	1.592	**-19.385**	**1.200**	0.007	-0.053	-0.840
	(0.974)	(12.306)	(3.283)	(0.010)	(0.145)	(0.868)
	[1.63]	[-1.57]	[0.36]	[0.75]	[-0.36]	[-0.97]
spr_{t-1}	**0.289**	0.840	**0.820**	**0.002**	-0.014	**0.682**
	(0.072)	(0.913)	(0.244)	(0.001)	(0.011)	(0.064)
	[3.99]	[0.92]	[3.36]	[3.53]	[-1.33]	[10.58]
c	**-0.323**	-0.795	-0.878	-0.002	0.030	**0.439**
	(0.153)	(1.936)	(0.516)	(0.001)	(0.023)	(0.137)
	[-2.11]	[-0.41]	[-1.70]	[-1.67]	[1.33]	[3.21]
R-squared	0.89	0.10	0.22	0.17	0.05	0.67

Standard errors in ( ) and t-statistics in [ ].

Innovative institutions and products for retirement provision in Europe

Lans Bovenberg and Theo Nijman[1]

FIRST PRELIMINARY DRAFT

Abstract

This paper outline the main challenges for academic research that are motivated by the search for optimal institutional arrangements for pension provision and efficient contracts for risk sharing in funded pension systems in Europe. The paper starts out by specifying the key policy questions and summarizing the base case academic models that offer guidance for policy. Issues such as optimal savings, investment and decumulation strategies and optimal insurance of longevity risk as well as issues such as adequate specifications of defaults and "nudges" are referred to. Subsequently some recent developments in the academic literature and the relevance of exploring these research directions further are indicated. Finally the paper surveys the existing research infrastructure that is relevant to address the key policy questions and proposals for extensions are formulated.

Key words:
JEL codes: J32, J10, J40, J24 [CHECK]

[1] Scientific Directors Netspar, Tilburg University. *This paper builds on Panel Paper XXt al. (2006) and Bovenberg and Nijman (2008).*

1. Introduction

In old age people are dependent on income and facilities provided by pension systems. The institutional settings related to pension provision differ widely within Europe. In some countries informal care is still very important while the pension provision in other European countries is delegated to large financial conglomerates. While in countries with Pay as You Go (PAYG) elements current workers pay for the income of the current pensioners, other countries have almost fully funded pension systems. Moreover a wide diversity of funded systems exists. Some European countries have DB (Defined Benefit) plans in which participation is mandatory, all risks are absorbed by the sponsor, pension entitlements come as annuities and uniform products are offered to all participants. In other countries the funded systems are of the individual DC (Defined Contribution) type in which participants take all savings and investment decisions and usually face substantial investment, inflation and conversion risk. The pension systems in different European countries not only differ widely but moreover the pension systems develop rapidly, in particular by moving from informal care and PAYG based systems to systems with more funded components. Because of the rapid aging of the population in all European countries as well as because of increased mobility and the impact of European legislation on national pension systems, analysis of the various European pension systems is of utmost importance.

This paper is part of a series of papers which aim to outline the main challenges for academic research that are driven by the key policy questions for European pension provision. This paper will focus on the analysis of optimal institutions and contracts for efficient risk sharing in funded pension systems. The outline of the paper is as follows: In Section 2 we will first of all outline the main policy questions related to risk sharing in pension system design. Section 3 will survey the current state of the literature. Section 4 will then be devoted to gaps in knowledge and challenges for research. Section 5 will review the current European research infrastructures and networks that contribute to the lines of research covered in this paper. Section 6 will be devoted to the infrastructure that would be required to address the research challenges most efficiently. Section 7 will formulate what academic research in this field can contribute to answering the pressing policy questions.

2. The main policy questions related to funded pension schemes.

Retirement schemes can be funded or PAYG. PAYG schemes pay the retirement benefits of the older generations by levying contributions on the younger, working generations. The retirement promise is thus not backed by financial assets but rather by the power of the government to force the younger generations to transfer resources to the elderly. In the larger continental European countries (including France, Germany, Italy, and Spain), the pension system relies almost exclusively on PAYG financing. This makes these countries especially vulnerable to lower fertility because PAYG schemes rely on human capital of the young to finance the pensions of older generations. The large continental European countries that rely almost exclusively on PAYG financing for the provision of retirement income have integrated the two main functions of pensions -- poverty alleviation and old-age insurance -- into a single comprehensive public pension system. These countries now consider focusing the public scheme on poverty alleviation by gradually reducing earnings-related PAYG benefits for those earning higher incomes. This yields a better-balanced portfolio between funded and PAYG schemes, as workers with middle- and higher incomes substitute private, funded pensions for public PAYG benefits.

The transition from a large PAYG system to a retirement system with a larger funded component is difficult. The generation that is retired when the transition is started will not have been able to anticipate lower public PAYG benefits. Moreover, this generation will not be able to adjust easily because it has already depreciated its human capital. Accordingly, a strong case can be made for changing the rules of the game (i.e. reducing PAYG benefits and increasing taxes on the elderly) only gradually.[2] Extensive grandfathering provisions protecting those who are currently old are expensive. Indeed, grandfathering implies that younger generations have to pay not only for their own funded benefits but also for the public benefits of the currently old. To enhance confidence and trust in a stable social contract while at the same time facilitating timely adjustments, governments should announce as early as possible any prospective changes in the social contract. This would allow the large baby-boom generations to anticipate reduced public transfers in retirement by starting to build up more funded pension provisions.

The need for more funding of pension schemes is widely recognized nowadays in many countries that at present rely almost exclusively on PAYG financing. Also Eastern European countries and several emerging economies are developing a funded pillar to supplement public PAYG systems. All of these countries have to develop efficient funded pension institutions that the population can trust. It constitutes a major policy challenge to arrange a timely switch to funding of pension schemes. Broadly speaking, two kinds of funded pension systems can be distinguished. In traditional defined-benefit (DB) plans, companies guarantee fixed pension benefits by absorbing all financial market and demographic risks. Years of service and a reference wage typically determine the benefit entitlement and participation in the scheme is mandatory for all employees. To illustrate, for every year of service, the scheme could offer a pension income of 2% of final salary after retirement until death. In defined contribution (DC) plans, individuals themselves are

[2] Relative PAYG benefits can be reduced gradually by indexing benefits to prices rather than wages.

responsible for planning how much to save for retirement, how to invest their savings in the capital market and benefit optimally from risk premiums, and how to insure individual longevity risk by converting pension capital into annuity income. A thorough understanding of the advantages and disadvantages of existing funded contracts as well as suggestions for innovative contracts are potentially quite valuable to address this policy challenge.

The policy questions related to the optimal characteristics of funded schemes can be classified in three groups: collective of individual decision making, optimal collective or individual risk taking and redistribution. These policy questions will be outlined below.

Collective versus individual decision making on retirement provision

Implementation of pension contracts requires a wide range of decisions. Decisions are to be made periodically on how much to contribute to the pension scheme and, during retirement, on how to decumulate the pension wealth, e.g. using drawn down strategies of some form of annuity. Decisions are to be made to insure specific risks, e.g. whether or not to insure disability risk and to provide survivor protection to partners and children. Moreover decisions are to be made on how the pension wealth is invested. All these decisions can be taken by individuals themselves (as is usually the case in DC schemes) or can be taken collectively and imposed on individuals (as is traditionally the case in DB schemes). It is well known by now that the financial literacy of individuals is quite low and that many decisions that are made are hard to rationalize. Many individuals also indicate that they require help in taking pension related decisions. Imposing decision rules on individuals implies that individuals loose control over a substantial part of their wealth. Moreover mandatory decision rules often ignore the heterogeneity in the population because individual characteristics such as current wealth, the nature of human capital, risk preferences etc. which can be important to determine the optimal decisions will often be unknown to the collective.

Striking the balance between individual and collective decision making is an important policy challenge. The recent literature suggests that the optimal solution could be to provide guidance for individual decision making using defaults and "nudges" which are set collectively. We return to this issue in the sequel.

Optimal collective and individual risk taking in retirement provision

Pension provision requires long term savings and investment strategies that are affected by many risk factors, investment risk, inflation risk, longevity risk and interest rate risk. In DC schemes individual wealth is invested in the accumulation phase, consequently the pension capital can be heavily affected by investment risks. If at some stage the pension capital is transferred to pension income using annuities there is sizable conversion risk because the conversion factor will strongly depend on the interest rate and life expectancies at that date. Unless real annuities are obtained the purchasing power of the pension income will also be affected inflation risk. If draw down strategies are used rather than annuities the individual (micro) longevity risk becomes a dominant risk factor: one could outlive ones assets. In DC schemes these risks are taken individually. The degree of risk taking can to as large extend be fine tuned to the preferences and characteristics of an individual by trading on

financial markets. A number of risk factors however cannot be traded. This is the case e.g. for macro longevity risks (changes in life expectancy) but also for specific inflation factors. Moreover the annuity markets are far from complete. Variable annuities which enable to benefit from mortality credits while investing in risky assets or real annuities which protect against inflation risk are very rare. In order to avoid conversion risk either very complex dynamic investment strategies are required which hedge the interest risk or deferred annuities would have to be offered which is typically not the case.

The central policy question is what the optimal strategy for risk taking is per individual and how it depends on characteristics such as age or wealth. Moreover the welfare losses of suboptimal strategies are to be determined. A closely related question is whether or not policy interventions that allow for trade of additional risk factors (such as macro longevity risk) is welfare improving.

In DB schemes risks are shared collectively. DB schemes arrange internal trade of risk factors which cannot be traded on financial markets such as longevity risk, conversion risk or specific inflation risk. If continuity of the scheme is assured e.g. through mandatory participation of all workers in a stable sector of the economy, risks can be shared with future generations which is welfare improving. Other risk factors are shared on financial markets, and often in a cost effective way. Often risks are also partly absorbed by a sponsoring company. This implies that workers invest their human capital and a part of their pension capital in the same firm which contrasts with optimal risk diversification. DB schemes offer guaranteed pension income, which can be costly. Another drawback of DB schemes is that the ownership of surpluses or deficits is usually ill defined and that usually only limited choice options are offered so that more or less the same pension contract is imposed on all participants, irrespective of their preferences or characteristics.

The relevant policy question related to DB schemes also start with an analysis of optimal risk taking per individual. Subsequently the question should be addressed when collectively shared risks are welfare improving and to what extent hybrid institutions can be developed which combine the advantages of DC and DB schemes and avoid their disadvantages.

Redistribution [PAST NOG NIET ERG IN GEHEEL ??]

Pension schemes often redistribute wealth from one group to another. First pillar pension schemes are often funded out of a fraction of labour income while providing flat or less progressive income streams during retirement until death. Such schemes redistribute wealth rich too poor and from people with lower life expectancy (low educated men) to people with higher life expectancy (high educated women). Second and third pillar pension schemes likewise are often not actuarially fair because these characteristics which affect the market value of the claim are not reflected in the premium.

Redistribution of wealth can be an explicit policy goal but can also generate unwanted distortions on markets. >>>>>>> The pressing policy question here is ….

3. **The base case view in the literature**

An extensive literature is available which relates to the policy questions raised in Section 2. We discuss the base case view in the literature from two different angles:

- What should people do (optimal accumulation and decumulation) ?
- What do people actually do (observed behaviour) ?
- IETS OVER GOVERNMENT ROLE ??
- REDISTRIBUTION ??

Optimal risk taking over the life cycle

The base case model to analyse optimal accumulation and decumulation is the model put forward by Merton (1971) and Merton and Samuelson (1974). This model is based on the following core assumptions on financial markets, labour markets and preferences:

Financial markets:

- Equity-market risk is the only aggregate risk factor, which is traded through equity.
- A risk-free asset (a bond) is available.
- The interest rate, inflation, the volatility of equity, and the equity risk premium are constant over time.
- Log stock returns are identically and independently distributed according to a normal distribution.
- Financial markets are dynamically complete in that stocks and bonds can be traded without constraints.
- Death is predictable or perfect insurance of individual longevity risk is available. Aggregate longevity risk is thus absent.

Labor markets:

- The after-tax wage during the working career is constant and riskless
- Labor supply is fixed and there is a fixed, exogenous retirement age.
- Wages are exogenous: pension premia thus reduce disposable incomes one for one.

Preferences

- Individuals aim to maximize lifetime utility, which is the weighted sum over time of expected utility at each point in time.
- Utility at a point in time depends only on consumption at that time.
- Preferences feature positive and constant relative risk aversion.
- Bequest motives are absent.

Optimal saving and risk taking in this model is well understood. The rate at which overall wealth is consumed depends on age. Since older people feature a shorter planning period, they consume a larger share of their overall wealth. If both a young and an old person get an additional euro, the old person will consume the euro more rapidly. However, if both agents obtain x% more wealth, both agents will increase their consumption by x% during the rest of their lives.

As far as risk taking is concerned, it is important to understand that the riskless labour income generates human capital which is equivalent to an investment in bonds. Total wealth consists of human wealth and financial wealth which can be invested in stocks or bonds. The share of total wealth invested in the risk factor does not depend on the investment horizon (i.e. not on age) but only on the risk premium, the volatility of the risky asset and the agent's risk aversion. Because human capital is not tradable, financial rather than human wealth should be allocated optimally to achieve the right exposure to the risk factor. This implies that the young should invest a larger fraction of their total wealth in risky assets than the old for two reasons. First, the absolute amount of wealth invested in equity (or risk-bearing assets) tends to fall with time as an individual consumes part of human wealth during the working life. Second, the stock of financial wealth tends to increase as the individual saves part of his human capital. The economic intuition why the young should hold a larger component of their financial wealth in stocks is that the young are less dependent on financial wealth for their consumption because they have an alternative income source in the form of labour income. They thus can afford to take more risk with financial wealth than elderly agents who depend almost entirely on this type of wealth for their livelihood.

This models recommendation that the young should invest a larger fraction of their financial wealth in equities is widely recognized in financial planning advice. The statement that one should invest a percentage equal to 100 minus ones age in equities is often found in the popular press. Life cycle funds and target date funds, which gradually reduce the equity exposure, are popular in a number of countries and have been recently added as approved defaults in American 401(k) plans. The Dutch financial supervisor recommends this type of investment strategy for DC schemes. In the next section we turn to the issue of the robustness of the recommendations of the base case model.

Optimal insurance of longevity risk

One of the most important simplifications in the model outlined above is the absence of longevity risk. The base case models which include longevity risk for individuals are the models proposed by Yaari (1965) and Davidoff, Brown and Diamond (2005). The core assumption in the Davidoff, Brown and Diamond (2005) model, which generalizes the Yaari (1965) model, is the presence of a complete set of annuity markets, such that every asset that is traded can also be traded in annuitized form such that only survivors benefit from the value of the asset and receive a mortality credit. Moreover their model assumes the absence of non-traded or insurable exogenous shocks (such as health costs), the absence of bequest motives and (sufficiently) fair annuity markets. In this setting it is known that full annuitization is optimal. This is a challenging recommendation because many people prefer lump sums and avoid annuities when they have the choice to do so. The model moreover raises the policy question whether institutional arrangements should be stimulated which impose annuities, such as Defined Benefit systems. We return to these issues in Section xx.

Individual behaviour, financial literacy and defaults

An extensive literature is available which analyzes actual behaviour related to both accumulation and decumulation of retirement wealth. It is well known by now that individuals spend little time and effort on planning for retirement. Lusardi (1999) reports that even in the US, where individuals have many pension related decisions to make, one-third of the workers had "hardly thought about retirement" only ten years before retirement.

The existing evidence indicates that in American DC schemes individuals undersave and that they experience unanticipated drops in consumption at retirement. Moreover a number of surveys have found that the vast majority of individuals thinks that they should be saving more for retirement (see e.g. Choi et al. (2002)). One explanation that is well documented in psychology is that people lack the self control that is required to implement a savings plan. People want to save for the future but they lack the capacity to carry out their intention. A convenient way to model actual behavior is hyperbolic discounting. This model assumes that nearby discount rates are much larger than long-term discount rates. As a consequence, consumers exhibit time-inconsistent behavior while actual behavior diverges from planned behavior.

A well-established stylized fact in the literature is that only a small part of the population in countries like Italy (Guiso and Japelli (2005)) or the US (Haliassos and Bertaut (1995)) hold stocks, directly or indirectly. Participants in retirement saving plans rarely rebalance their portfolio or alter the allocation of their contributions over the life cycle. Many households do not diversify and hold only a few stocks, often with a local bias and in 401(k) schemes often even with a bias to the stock of their own employer, see e.g. Munnel and Sunden (2004). Participants in 401(k) plans display a tendency to split their contributions evenly among investment options, irrespective of the type of options that is offered (Benartzi and Thaler (2001)). Such a "1/n"-rule of thumb is clearly at odds with optimal diversification and adequate risk taking. Financial education could play a role. Evidence is available that more educated households diversify their portfolio more efficiently than less educated households do.

Strong evidence has been presented that individual behaviour in retirement plans can be strongly influenced by the specification of the default option (see Benartzi and Thaler (2007)). In case of automatic enrolment in pension schemes, where the default is that people will participate in the scheme but can opt-out, participation is far larger than would be the case if people have to actively opt-in to participate in the scheme. Likewise the specification of the default is important in the selection of the contribution rate, the asset allocation or the choice between a lump-sum and an annuity.

The evidence that people have a hard time making pension related choices raises important policy questions the advantages of improved information and/or financial education and whether or not its wise to offer a wide variety of choice options to individuals. The evidence on the impact of defaults moreover raises governance questions on who is best positioned to specify the defaults.

4. **Gaps in the literature**

The base case views outlined in the previous section are well established in the academic literature. In order to provide optimal input for the policy debate it would be very useful however to know how sensitive the implications of the base case models are for the various assumptions. Moreover it is important to have well structured research conclusions on a number of questions which are directly relevant to the design of pension systems in specific countries. This section lists a number of recent developments in the literature which call for further analysis and extensions. We will first of all address the sensivity of the base case model for optimal risk taking over the life cycle and longevity insurance. Subsequently we will address recent developments in the literature on individual behaviour and finally we will focus specifically on the cost and benefits of various pension schemes.

Optimal risk taking over the life cycle

As emphasized before, the conclusions of the base case model on optimal risk taking over the life cycle are based on strong assumptions with respect to human capital, to the properties of financial markets and to the specification of individual preferences. A rapidly developing literature analyzes to what extent the core conclusions are affected by deviations from the base case assumptions.

Optimal risk taking over the life cycle: alternative models of human capital

Many papers analyze the case where human capital is risky, because of uncertainties in the career path that may or may not be correlated with stock market returns. Often these papers also include borrowing constraints for the young as it will often be hard to borrow against future labour income. With borrowing constraints, the individual is not able to optimally diversify labour income risks over time. As a direct consequence of the reduced ability to smooth risks intertemporally, the individual will take less risk on its investment portfolio if the household owns positive financial wealth. The effects of background labor-income risks on investment behavior seems relatively minor but become more important if borrowing constraints limit intertemporal consumption smoothing of large transitory shocks. Indeed, the flexibility of intertemporal consumption smoothing is a key determinant of the risk that agents can afford to take on.

On the basis of numerical simulations, Gollier (2005) shows that this may cause young households with small financial reserves to invest less in equity than older households who are less constrained by borrowing constraints in diversifying risks over a longer period. In a similar vein, Cocco, Gomes and Maenhout (2005) find that young investors choose portfolios that are less tilted towards equity than the portfolios of middle-aged investors. Thus, the combination of labor-market risks and a steep career pattern preventing optimal intertemporal consumption smoothing (or the potential of large drops in labor income) thus turn around the result from unconstrained models that young households should hold substantial amounts of equity that exceed the amounts (both in absolute values and as a share of financial wealth) of older households. Indeed, the desire to hold a safe, liquid stock of precautionary savings has become one of the explanations for the equity premium puzzle and for why young households do not participate much in the stock market

(see Constantinides and Duffie (1996) and Brav, Constantinides, and Geczy (2002)). Social insurance that provide insurance of human capital risk can thus boost equity investments and thus increase the risk-bearing capacity of the economy. Hence, pension schemes can raise the demand for equity not only by relieving short-sale constraints but also by providing insurance against human-capital risks.

Liquidity constraints not only make investment behavior more conservative but also strengthen precautionary saving motives -- even if financial wealth is positive. Indeed, by investing conservatively and setting aside resources through saving, individuals ensure the presence of a financial buffer that helps them to optimally time diversify temporary risks. Precautionary motives rather than saving for retirement tend to be the main reason why young households save (see Cocco, Gomes and Maenhout (2005)). As a direct consequence of the additional saving, financial wealth will be higher later on in life, which will tend to increase equity exposure when old. Hence, precautionary saving further weakens the result that the young should have much more equity exposure than the old if idiosyncratic risk is combined with borrowing constraints and a steep career pattern preventing intertemporal consumption smoothing at young ages. A better understanding of optimal saving and risk taking and its dependence on individual characteristics under different assumptions is crucial for efficient pension provision. Bovenberg et. al (2007) have indicated that inadequate pension product design can imply substantial welfare loss.

A rather different but also crucial assumption on human capital in the base case model is that the supply of human capital is fixed. In reality people have the opportunity to reduce or increase labour supply, e.g. by working more or less hours per week or by adjusting the retirement date. Bodie et al. (1992) show that endogenous labour supply enhances the capacity to bear risk. With endogenous labor supply, human capital amounts to the discounted value of potential wage income (i.e. wage income if no leisure would be consumed) and is thus larger than the discounted value of actual wage income. Indeed, the stock of wealth is larger now because it finances consumption of not only produced goods but also leisure. Shocks can be absorbed by adjusting consumption of both produced commodities and leisure. This enhances the capacity of the economy to absorb risks and thus increases the demand for risk taking.

If labour supply is flexible, the share of financial wealth invested in risk-bearing assets varies even more with age (see e.g. Gomes, Kotlikoff and Viceira (2008)). This changes if labor supply is especially flexible around retirement because agents can adjust the time and speed with which they retire. In that case, also older workers can afford to invest in risk-bearing assets. This points to the importance of a flexible labor market for older workers to sustain the supply of risk-bearing capital in an aging economy. A formal analysis of the impact of flexibility of the retirement date on the optimal risk taking is provided by Farhi and Panageas (2007). As all European countries actively promote flexible labour markets and in particular flexible retirement dates, more analysis of the impact of this flexibility on optimal product design is very welcome.

Optimal risk taking over the life cycle: alternative models of financial markets

Apart from human capital risk, the main risk factors that individuals face are interest rate risk, inflation risk, equity risk and longevity risk. In the base case model longevity risk, interest rate risk and inflation risk are ignored and stock returns are assumed to be non predictable.

If (real) interest rates fluctuate over time, the investor is faced with an additional risk factor. Fluctuations in interest rates affect the value of the human capital as well as the value of the bond portfolio. Early in the life cycle, portfolios are to be held with long durations to hedge against the required consumption during retirement. The duration of human capital is typically shorter than required. If bonds or interest rate derivatives would be available with very long maturities, the part of financial wealth that is invested in fixed income can be invested in these assets to obtain the optimal duration for total wealth. In the more realistic case in which the maximum maturity of traded bonds and derivatives is limited, the fraction of financial wealth invested in bonds is increased at the expense of equity. In this way, the duration of the assets is more closely aligned with the duration of the consumption pattern while the remaining interest rate risk is balanced with equity risk. Campbell and Viceira (2001), Brennan and Xia (2000) and Munk and Sorensen (2005) have considered the implications of time varying interest rates on the optimal demand for long-term bonds and analyze the welfare gains of hedging variations in real rates.

A number of recent studies report that the expected bond returns are clearly time-varying, i.e. bonds are more attractive in some periods than in others, see e.g. Cochrane and Piazessi (2005). In particular, the real (as well as the nominal) bond risk premium is increasing in the real rate. Sangvinatsos and Wachter (2005) show that unconstrained long-term investors can realize large gains by exploiting these time variations in bond premia. Koijen, Nijman and Werker (2006b) consider the case of borrowing constrained life-cycle investors. They find that short-sell constraints reduce the potential gains associated with bond timing strategies because these gains can be obtained only at the expense of reduced equity exposure unless very long maturity bonds would be traded. The economic gains realized by bond timing strategies peak around the age of 50 (when agents have build up substantial financial wealth and are less constrained by borrowing constraints) and are hump-shaped over the life-cycle. If investors can avoid borrowing constraints through participation in mandatory collective pension schemes, they may be able to realize the larger benefits reported in Sangvinatsos and Wachter (2005).

So far we assumed that inflation risk is negligible or, equivalently, that all assets that have been considered are inflation indexed. In reality, inflation linked assets are rarely traded and inflation is an important risk factor for long term financial planning. Campbell and Viceira (2001) report that the certainty equivalent wealth effect of access to inflation indexed bonds for short-sell constrained investors can be as large as 10-30%. In reality, inflation linked assets are often not available to investors but inflation risk can be traded within collectives. Investors which do not have access to indexed bonds face the question to what extent indexed bonds can be replicated by nominal bonds. If investors are forced to bear inflation risk they will shorten the maturity of the bond portfolio (see Campbell and Viceira (2005)).This implies that the optimal duration of the fixed income portfolio is smaller than that of the consumption profile.

There is a lively debate in the literature as to whether the expected stock returns are time-varying. Many authors claim that the stock returns are mean reverting at low frequencies. If this is the case, stocks are less risky for long-term investors than for short-term investors so that young investors should invest an even larger over their financial wealth in equities. Among others, Campbell, Chan and Viceira (2003) analyze the optimal portfolio strategy that is to be implemented.

Under the assumption that institutional investors have better access to inflation indexed securities and can implement more sophisticated investment strategies than individual investors, an important policy question addressed by these studies is to what extent institutional implementation of pension schemes is advantageous for the participants.

Optimal risk taking over the life cycle: alternative models of preferences

The results of the base case model are dependent on the assumption of constant risk aversion. Two lines of research analyzed the implications of alternative assumptions on individual preferences. In a first stream of papers the assumption of habit formation is made, i.e. well being depends partially on current consumption relative to past consumption. Habit formation implies also that the ability to absorb an unexpected shock increases if the time horizon increases. This implies that younger agents with longer horizons can adjust more easily to shocks and thus should invest a larger share of their wealth in risk-bearing assets. Intuitively, they have more time to adjust their habits to unexpected shocks. In addition to human wealth that is not exposed to equity risk and mean-reversion of returns, internal habit formation is thus a third reason why young agents should optimally invest a larger share of their portfolio in equity than older agents do and why pension contracts may optimally get more of a defined-benefit nature when people grow older. Habit formation also explains why retirement benefits may be linked to earnings (and consumption levels) close to retirement.

A second stream of literature considers the implications of Tversy and Kahneman (1992)'s prospect theory and in particular of loss aversion. Prospect theory suggests a kink in the utility function, EXTEND >>

Health costs and longevity insurance

The base-case argument in favour of smoothed pension income (annuities) that was presented in the previous section is based on the absence of background risks. However, non-insured medical expenses can be an important source of idiosyncratic background risk, especially for older households. Hence, older households face idiosyncratic risk with implications for saving behavior (i.e. precautionary saving) and investment behavior (and also the willingness to take out annuities). In particular, these households will save for precautionary reasons, invest more conservatively and are discouraged from taking out illiquid annuities. An important topic for future research is to distinguish between liquid precautionary saving and illiquid retirement saving. The papers discussed do not distinguish between these two categories and assume that all saving is liquid.

Housing and longevity insurance

Heterogeneity

Because different agents have different characteristics and preferences the optimal pension contract will be individual specific. Welfare loss wrong parameters panel paper

Optimal institutions: defaults and nudging

A variety of ways can be thought of to tailor a pension contract to the characteristics and preferences of an individual. A first possibility could be to just offer a very wide range of choices e.g. with respect to the savings rate, the asset allocation and whether or not to take a lump-sum at retirement, and to leave it to the individual to select the most adequate strategy. As argued before, there is a lot of evidence nowadays that people are not able to make such choices adequately.

Thaler and Sunstein (2008) among others argue forcefully in favour of the use libertarian paternalism to stimulate (nudge) people to make adequate choices also in relation to choices in pension schemes. The term libertarian paternalism indicates that the freedom of choice is not restricted (libertarian) put that "choice architects" such as those that design a pension scheme try to influence people's behaviour in order to improve their well-being. In the pension domain this can be done e.g. by specifying adequate defaults. Thaler and Sunstein (2008) argue that it is a misconception to think that it is even possible to avoid influencing people's choices. In many situations some organization or agent must make a choice that will affect the behaviour of some other people, like e.g. the order in which alternatives are presented. Once the power of "nudges" to stimulate certain behaviour is appreciated a host of policy related issues of course arises as too what behaviour is preferred, how nudges can be used and how the governance of the "choice architect" is too be arranged.

More research is needed on how people can be stimulated optimally through specification of defaults. RECENT LITERATURE; *Madrian on individual specific defaults*

Optimal institutions: Defined Benefit or Defined Contribution

BOSTON PAPER

DB versus DC Boston; intergenerational solidarity panel + Ponds, Cui De Jong etc.l; kosetn; Solvency xxxx

Optimal institutions: Actuarial fairness

Differences in life expectancy; Doorsneepremie. Belang voor prikkels en voor portability

5. **European research infrastructures and networks**

European research on the many challenging questions that were outlined in the previous section does not have to start from scratch. A number of research centres in Europe have groups or visible individuals that focus their research efforts on issues related to optimal product design for an aging population. Example of universities that are active in this field are the universities of Toulouse, Paris, Turin, Frankfurt, Mannheim, Stockholm, Copenhagen, London School of Economics, London Business School, City University London (AANVULLEN ??), and a number of Dutch universities which participate in Netspar (Network for Studies on Pensions Aging and Retirement). The more senior researchers are well connected and meet at all kinds of conferences. Typically they are also well connected to the US scene. Networks like CES-Ifo, CEPR and Netspar play a crucial role in this interaction by organizing conferences, publishing papers and providing expert reports on preliminary drafts of discussion papers. The Survey of Health Aging and Retirement in Europe (SHARE) plays a vital role in providing consistent European data for analysis of individual behaviour. As potential reforms in pension systems are often motivated by reforms in other European countries and because European legislation is very often an important driving factor behind pension reforms, cross country contacts between researchers are of central importance.

Analysis of European pension systems not only requires excellent contact between academics in different countries, it moreover requires good contacts with the pension and insurance sector. In the European financial industry recently a number of successful attempts have been undertaken to improve the interaction with academia with the French Europlace Institute, the Swiss Finance Institute and the Dutch Duisenberg School as leading examples. These initiatives have a much wider scope than a focus just on pensions. Initiatives like the Mannheim Research Institute for the Economics of Aging, the Pensions Institute (London) and Netspar (Netherlands) focus specifically on pension related issues and benefit from excellent contacts with the local pension industry.

6. **Required research infrastructure**

(LINK MORE AAN EERSTE DEEL ??)

Research infrastructure is a multidimensional concept, consisting of at least

- Exchange of scholars
- Access to relevant data sources
- Facilities for experimental research
- Accessible information on and analysis of institutional arrangements per (European) country

- Networks for interaction with industry

We will discuss these items sequentially.

Exchange of scholars

While the contacts between a small group of senior researchers are good, more effort can be placed to provide exchange of PhD students and junior researchers as well as to stimulate participation from other universities and a wider range of European countries. Moreover the existing contacts tend to be dominated by disciplinary or even subdisciplinary boundaries. Micro-economists meet with micro-economists, financial economist with financial economists, psychologists with psychologists etc. Academic knowledge, but also the contribution to society, can be enhanced once we manage to combine all expertise from different disciplines that is needed to address certain question. A prime example here is the specification of defaults and nudges, which requires input from at least the three (sub)disciplines that were mentioned. Another example would be the analysis of the welfare effect of the intergenerational solidarity in Defined Benefit schemes. This requires input from macroeconomics, finance and microeconomics, but also from lawyers.

Access to relevant data sources

In order to analyze how individuals behave and how the availability of additional pension products and/or changes in institutional settings affect their behaviour, access to rich data-sources on individual behaviour is of vital importance. Ideally such data sources should combine information on past behaviour, current choice options and possible scenario's for the future. Data on labour market history and opportunities is as relevant as data on consumption patterns, health and wealth. Usually this implies that data from administrative records (tax filings, wealth) is to be combined with data from pension providers (pension entitlements, provision for early or partial retirement) and data from questionnaires on issues such as personal views, characteristics and preferences (life expectancy, perceived health, preference for specific consumption goals, ..). For many research projects it would moreover be very helpful if the data are consistent in definitions and availability of data across Europe.

Although in particular the availability of SHARE data has improved the access to micro-data that are relevant to address the many research questions that are generated by aging, improved data-sets are needed. SHARE hardly contains data on the specifications of an individual's pension contract, implying that it is hard to model the incentives for additional saving, adjustment of the asset allocation or the choice of a lump sum rather than a pension income. The data are moreover not linked directly to be checked or enriched with administrative records of governments, employers or pension providers. In the Netherlands Netspar is co-operating with Statistics Netherlands and with the pension providers to merge administrative data-sets with data from questionnaires and to make anonimized data available for research through Statistics Netherlands. Similar initiatives on a European scale would be extremely useful.

Facilities for experimental research

In order to offer successful innovative products, to define optimal institutional rules and to specify the rights defaults and nudges it is important to experiment before certain product specifications or institutional arrangements are offered on a wide scale.

Experimentation can take a variety of forms. Laboratory experiments where people are confronted with innovative choice options are one form. Experiments can also make use of questionnaires or internet-panels where items are added to existing surveys. Last but not least field experiments can be used, e.g. by offering specific choice options or products initially only to a subgroup or by offering different choice options, products or product and choice descriptions to different subgroups.

Small scale facilities for laboratory experiments are available at a number of universities and a number of questionnaires and panels offer useful opportunities to run experiments. These facilities should be extended and made more generally available. In Europe there seem to be very few examples of field experiments where e.g. employers, pension providers, government and knowledge institutions collaborate to improve understanding of individual behaviour related to pensions and retirement. Such facilities are quite relevant from an academic perspective and would moreover reduce the societal costs of too frequent changes in institutions and product specifications.

Accessible information on and analysis of institutional arrangements per (European) country

One of the crucial aspects of pension provision in Europe is the wide variety of institutions and legal structures across and within countries. Research interaction on the most policy relevant questions can be improved significantly by improved access and analysis of institutional arrangements per country. As a side effect, the mobility of workers within Europe can benefit if the implications for pension entitlements of a switch from one country to another are more transparent and better understood. Improved information and comparison of institutions in different European countries is also vital to specify optimal pension schemes all over Europe.
European legislation gets more important also in the pension and retirement domain. In order to be able to set adequate European legislation, a thorough understanding of the existing systems and their advantages and disadvantages is crucial.

Accessible information and analysis of the institutional arrangement for retirement provision is also one of the goals of the OECD. Too many researchers are hardly connected to information on institutional arrangements in other European countries and do not contribute to cross-country analyses. The knowledge institutions could collaborate with the OECD to improve cooperation, which should be beneficial both for research quality and for the policy relevance of the research output.

Networks for interaction with industry

For academic research to be able to be innovative and to contribute to the most urgent policy questions interaction with the pension industry (insurance companies, pension

funds, banks, government agencies…) is of significant importance. As outlined in section 4 some research centres have excellent links with the local pension industry. Stimulated by the recent legislation on Institutions for Occupational Retirement Provision (IORPs) and the increased mobility within Europe, pension provision is rapidly becoming an international rather than a local matter. A European network for research on aging and retirement provision that is set-up and run jointly by knowledge institutions, national and European government institutions and the pension industry could be mutually advantageous. Such a network could fund research projects that have combine pure academic research with contributions to policy relevant questions. Availability of such funding stimulates researchers to work on innovative pension institutions and products and improves the information flows on the specification of the most pressing research questions. It seems not unlikely that the pension industry would be willing to cover part of the costs of such research projects.

7. **Relevance for policy questions**

As discussed in Section 2 the main policy questions on innovative institutions and products for retirement provision in Europe can be classified in two groups: optimal risk taking and optimal decision making. The research program and infrastructure that were outlined in this paper can first of all help to provide answers on the issue of optimal risk taking by stimulating research and knowledge exchange on the many alternative pension products that can be thought of and by a thorough and independent analysis of the advantages and disadvantages of different institutions and products. Important sub-topics will be the proper balance between first, second and third pillar arrangements, the choice between Defined Contribution or Defined Benefit schemes (or one of many of hybrid forms between these extremes), the recommended savings, asset allocation and decumulation of pension wealth as well as integration of retirement provision with health insurance and housing.

The intended research program will be equally important to provide answers to policy questions on optimal decision making. Analysis of the behavioural impact of the diversity in institutions and products for retirement provision within Europe as well as analysis of the academic literature and focussed research projects will provide answers in particular to the adequate specification of defaults and nudges in European pension products and institutions.

OOK IETS MET REDISTRIBUTION ??

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