# Utility implications of the product choice regulation during the payout phase of funded pensions

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**Abstract**

In all industrialised countries traditional pension systems are under pressure due to demographic change, and policymakers worldwide recognise the need to supplement their pay as you go systems by funded employment-based or personal schemes. In most countries, incentives to save for retirement are provided by granting tax relieves for contributions into eligible old age programs. In return for support during the saving phase, restrictions are being imposed with regard to the use of accumulated capital after retiring. Those restrictions typically enforce immediate annuitisation of retirement funds without accounting for the level of lifelong pension income from other sources, e.g. statutory or occupational pensions. Little prior analysis has explored the influence of enforced annuitisation within the framework of dynamic lifecycle optimisation models. Our paper fills the research gap. After reviewing main motives and goals for regulating the product choice in the payout phase of funded pensions we give a brief description of pension systems in eight surveyed countries and classify the regulatory restrictions applied there for tax-supported funded pension schemes. Based on these observations, we investigate into the influence of the enforced annuitisation on the utility of rational individuals. Specifically, we look at the effects of softening the strict immediate annuitisation requirements on the wellbeing of the individual, using simplified regulatory examples, inspired by the regulatory reality observed in seven surveyed European countries and the USA.

We find that utility maximising retirees will invest considerable parts of their wealth in risky stocks at the beginning of the retirement to profit from the capital market returns and from the diversification effects between his pre-existing annuity-like pension income and the risky investment portfolio. In line with prior studies, we find that the retirement funds will be annuitised gradually, full annuitisation being deferred to around age of 90. We show that enforcement of a full immediate annuitisation will considerably reduce the utility level attainable with the existing funds. This will be the case independent of the bequest motives or the level of endowment with retirement capital, as compared to the pre-existing pension. Softening strict annuitisation requirements, however, will lead to considerable reduction of utility losses, while preserving the protective goals of the regulators.

JEL Classification:
G11, G28, H24, H55

## Introduction: Regulation of the product choice in the payout phase of funded pensions

In all industrialised countries the statutory pension systems are under pressure due to demographic changes in the society, and the policymakers worldwide recognised the need to supplement the pay as you go systems by funded employment-based or personal schemes. In most countries, the incentives to save for retirement are provided as tax relieves for contributions into eligible old age programs. In return for support during the saving phase, for most of the programs enjoying it, there are restrictions with regard to the use of accumulated retirement capital after the retirement date. Those restrictions mostly take the form of enforcing immediate annuitisation of retirement funds accumulated within a particular program, without taking into consideration the total amount of retirement capital available from different funded programs or the level of pension income, offered by other sources such as statutory or company pensions. Little prior analysis has explored the influence of enforced annuitisation within the framework of dynamic lifecycle optimisation model. Our paper fills the research gap by investigating the influence of the enforced annuitisation on the utility of rational individuals. Specifically, we look at the effects of softening the strict immediate annuitisation requirements using simplified regulatory examples, inspired by the regulatory reality observed in seven surveyed European countries and the USA.

We proceed as follows: First, we offer a brief literature overview on the payout instruments, strategies as well as regulation for funded pensions, and present the operating modes, advantages and drawbacks of basic products. Next, we introduce the main motives and goals for regulating the product choice in the payout phase of funded pensions and, after a brief description of pension systems in eight surveyed countries, present and classify the regulatory restrictions applied there for tax-supported funded pension schemes. Subsequently, we derive and discuss the optimal investment and spending strategy in absence of any regulatory restrictions on product choice, and examine the welfare losses from enforced immediate, partial and deferred annuitisation, as compared to the optimal strategy. A final section concludes.

## Prior studies on payout phase of funded pensions

Existing literature on funded pensions can be divided into three main groups: First group concentrates on the properties, advantages and disadvantages of single retirement products and their modifications, such as annuities or withdrawal plans. *Yaari* (1965) showed that under restrictive assumptions such as actuarially fair pricing of annuities, a rational retiree lacking a bequest motive should annuitise all available assets. Later, *Davidoff/Brown/Diamond* (2005) relaxed some of the restrictive assumptions of Yaari's analysis. They concluded that, while partial annuitisation could be optimal if a retiree wants to bequeath the heirs, full annuitisation is still advantageous in absence of any bequest motives, if the net return on annuities is greater than on a reference asset. *Mitchell et al.* (1999) introduced money's worth ratio as a measure of actuarial fairness in annuity pricing. An international comparison of money's worth ratios was conducted by *James and Song* (2001). A comparison between the shortfall risk of life annuities and phased withdrawal plans was performed by *Dus/Maurer/Mitchell* (2005), while *Milevsky* (2002) compared the risk/return characteristics of variable annuities with their fixed and escalating counterparts.

The second literature group puts an emphasis on the retirement strategies, combining one or more payout products and the possibility to decide about the timing of their purchase once or repeatedly during the retirement. *Milevsky/Young* (2007) performed the analysis of annuities' timing. *Cairns et al*. (2006) and *Koijen et al*. (2006) included labour and pre-existing pension

income in their analysis, but forced the investor to fully annuitise the retirement wealth at the beginning of retirement. *Horneff/Maurer/Mitchell/Dus* (2007) integrated risky asset allocation and annuitisation in dynamic retirement portfolios. *Horneff/Maurer/Stamos* (2008) derived the optimal consumption and saving strategy with constant life annuities, stocks and bonds in a realistically calibrated lifecycle model with gradual purchase of annuities and later – in *Horneff/Maurer/Mitchell/Stamos* (2009) – expanded their work on variable annuities.

The third direction of research literature concentrates on the regulation and supervision of retirement products, mainly focusing on regulation and supervision of the retirement product's quality. To this group belong the papers by *OECD* (2001) on principles for the regulation of private occupational pension schemes as well as by *Dus/Maurer* (2009) on capital requirements for the payout phase of funded pensions as well descriptive works about the available pension programs and applied regulation in individual countries (*Bateman/Thorp* 2007, *Rinaldi et al*. 2005, *Hülsmann/Schmid/Schöll* 2001, *Queisser/Vittas* 2000, *Palme/Swensson* 1997). The other research strain – focussing on the regulation and supervision of the retirement product's choice available to retirees, is considerably less well represented. The regulatory research altogether has so far provided little inputs for the research on optimal retirement products and retirement strategies. *Mitchell et al*. (1999) as well as *Horneff/Maurer/Stamos* (2008) are among those introducing the methods and explicitly analysing the individual implications of the regulatory restrictions.

In what follows, we extend prior literature in several ways. First, we use the approach introduced by *Horneff/Maurer/Mitchell/Stamos* (2007) and permit the dynamic and gradual purchase of annuities (asset location) as well as dynamic optimisation of endogenous asset allocation in liquid financial portfolio for a retiree with and without a bequest motive. Second, we explicitly estimate the utility implications of the regulatory requirement to fully annuitise available retirement capital at the beginning of retirement. Finally, we review the regulatory framework for tax-supported employment-linked and personal pensions in seven European countries and in the USA and assess the utility effect of softening the strict immediate annuitisation requirement on examples of simplified regulatory rules observed in those countries.

**Pooled and non-pooled payout solutions as tools to finance retirement**

Theoretically, there are two basic possibilities to manage the payout phase, both of which can be combined with each other, thus creating the third option:

1) Purchase of a payout life annuity
2) Following a systematic income drawdown plan
3) Building a portfolio of life annuities and income drawdown plans (hybrid solutions)

In its basic form, a life annuity is a financial contract that entitles the investor (annuitant) to a series of regular payments contingent on survival of one or two individuals. In the private market these life-contingent assets are typically offered by *life insurance companies* or, in case of occupational retirement schemes, also by pension funds. The annuity provider collects non-refundable premiums from the annuitants and invests them in financial assets backing the life contingent payment promise. If the number of annuitants is sufficiently high and mortality risks are independent, the insurer can hedge its liabilities by pooling longevity risk across a group of annuity purchasers. Surviving annuitants receive the funds of other pool members who die: Such redistribution of funds among surviving members can generate an extra return, which is higher than the capital market return of assets with similar risk profile. This extra

return is often referred to as the *survival credit* (sometimes also named mortality drag)[1]. For that reason, life annuity is a *collective* (*or pooled*) *product*.

Despite important advantages of annuities such as the entitlement to a regular income stream over the remainder of retiree's life and an extra return resulting from pooling of longevity risk by the insurance company[2], empirical evidence indicates that very few retirees voluntary purchase annuities with their disposable wealth[3]. This empirical low demand for annuitisation is in contrast to theoretical economic analysis on the demand for life annuities in the context of standard life-cycle models such as *Yaari* (1965), *Davidoff* et al. (2005). The discrepancy between theory and empirical behaviour of households is called the "*annuity market participation puzzle*". Efforts to explain the low demand for annuities – either by using an empirical framework or with a normative stetting by extending traditional life-cycle models - have stressed a number of important disadvantages of annuitisation, among them loss of liquidity and of flexibility[4], loss of bequest possibilities and control over the retirement assets[5], as well as low money's worth ratios[6]. Another strain of research on annuity puzzle focuses on behavioural obstacles such as mental accounting and cumulative prospects theories.[7]

It should be mentioned that annuity-like payments are also offered by the public sector, since the benefits of mandatory state pensions can also be characterised as lifelong annuities from a financial perspective. The key difference, however, is that state pension annuities are in most countries financed on a pay-as-you-go basis, while annuities in the private market are funded by setting aside financial assets.

Should the retiree choose an income drawdown product in retirement, this will result in periodic withdrawals, which can be either based on the specified spending rules, or be in form of lump sum payments. In such case, the retiree has the freedom to decide on how to invest available wealth among the various asset categories (stocks, fixed income, cash, real estate) and how to generate the income streams in retirement. This *individual, non-pooled* method of financing retirement allows for bequest, provides liquidity, control over assets, and may lead to a higher consumption, as compared to the purchase of an annuity. However, the retiree cannot earn an extra return in form of the survival credit and is exposed to the risk of running out of money, as he might outlive his assets before his uncertain time of death.

A financial strategy in retirement need not involve a simple one-time choice between annuitising all retirement funds versus selecting a specific income drawdown plan. Rather the retiree may optimise his retirement portfolios by simultaneously selecting combined portfolios that include both annuities and mutual fund investments, i.e. pooled and non-pooled products. The retiree has several options regarding when and to what extent include a life annuity in his financial retirement strategy: he can use immediate or deferred annuitisation, full or partial annuitisation or gradual purchase of annuities as retirement progresses. Intuitively, it could be expected, that a rational person seeking to optimise his future retirement consumption pattern, who relies on funds accumulated during the working career

[1] See *Stamos* 2008 for description of survival credit.
[2] *Mitchell* et al (1999).
[3] See *Boardman* 2006 for comparison between the UK and US annuity markets, *Inkmann/Lopes/Michaelides* (2007) for the voluntary annuity market in the UK.
[4] *Brugiavini* 1993 and *Horneff/Maurer/Mitchell/Stamos* 2008, *Milevski/Young* 2002, *Horneff/Maurer/Mitchell/Dus* 2007.
[5] *Cogan/Mitchell* 2003, *Hurd/Smith* 1999 and *Bernheim* 1991.
[6] *Mitchell* et al. (1999), *James/Song* (2001).
[7] *Read/Löwenstein/Rabin* (1999), *Hu/Scott* (2007).

to provide income for the rest of his life, would choose a combination of non-pooled financial products as well as life annuities. In what follows next, we show what payout products can be used during the retirement phase of tax-supported funded pensions in selected European countries and the USA, and explain fundamental reasons for restricted product choice. Then, we develop the optimal retirement strategy using a lifecycle model.

**Motives and goals for regulation of product choice during the payout phase**

For many retirees, the payout product choice is not broad and free, as the vast majority of the surveyed countries restrict the use of wealth accumulated within the designated pension schemes. Mostly, the restriction takes the form of compulsory annuitisation which can be enforced either by legislative or regulatory means, or by tax disadvantages applying to non-annuitising retirement products. There are four main arguments explaining why the restrictions on the use of payout funds in general and those favouring the annuitisation in particular are needed.

The first argument is the necessity to ensure a stream of incoming tax payments from the retired individuals: This is a very straightforward reason for the regulation of the payout phase. For many funded old age saving schemes, the statutory support takes the form of tax relieves during the saving phase; thus during the payout phase, the state has the right to get the deferred taxes in a way it sees fit. Obviously, the guaranteed periodic lifelong tax payments originating from an annuity contract are the most favoured form of receiving taxes from the retirees.

The second argument in favour of restricting the use of funds in the payout phase of funded pensions to the advantage the pooled solutions is that the primary aim of the supported funded old age programs to finance the personal income of the saver and not to sponsor bequests. Annuitising products ensure both the lifelong income and absence of any bequest potential from the annuitised funds.

The other two fundamental reasons are protecting the citizens from poverty and protecting the caring state from being unduly exploited by its citizens. They are more complicated and both grounded in the paternalistic attitude of the state to its citizens, which is widely spread especially across continental European countries. Paternalism applied to the payout phase of the funded pensions aims to prevent the old age poverty, which can result either from the moral hazard and subsequent attempts to double dip the statutory support or from the supposed myopic behaviour of the retirees.

The phenomenon of moral hazard and double dipping arises, when the retirees deliberately spend their savings too early in the retirement because they expect the governments to rescue them in their advanced old age. With the widespread social safety net usual for continental Europe, even the forward-looking individuals might be enticed to the early spending and risky investment of the funded pension wealth. In such situation, the governments cannot credibly commit to leave imprudent pensioners destitute. Instead, they must rely on the regulation to prevent the situation, where the statutory support is used twice by the same individual: Once in the form of the deferred taxation during the saving phase, and later in the form of tax-financed social security payments after all accumulated wealth was spent.

In case of myopic behaviour, the retirees underestimate their life expectancy and financial needs during the remaining life span and, left to their own, spend too much at the beginning of

the retirement phase. Sometimes, the retirees are thought to be generally forward-looking, but lacking the information and financial skills to make adequate payout choices by themselves.

**Description of pension systems in surveyed countries**

In this section, we look at the current environment for retirement payout solutions in representative European countries, with a particular emphasis on the regulatory framework. The seven European countries we examine are: Austria, Germany, France, Italy, Sweden, Switzerland and UK. For comparison, we also look at the United States of America. In all surveyed countries, the vast majority of the population is covered by some form of statutory pension. Yet, the importance of payments from statutory pensions as a source of retirement income differs from country to country. In such four countries of continental Europe as France, Italy, Germany, and Austria, payments from statutory pension programs still provide rather high replacements rates and represent the main source of income for retired people. In contrast to that, the statutory pension systems in the UK, the USA, and Switzerland provide relatively low social security old age benefits, therefore placing a high responsibility for the old age provisions directly in the hands of the individuals.[8] The lifelong income streams from the statutory sources during the retirement can be compared to the inflation–linked joint life annuity: Usually the benefits from state pension programs are in some way related with inflation. In some countries, it is done directly by indexation of benefits with respect to some pre-specified consumer price index (e.g. in the USA). In other countries it is done indirectly by indexing the amount according to the development of salaries and wages (e.g. Germany), which, in turn tend to develop in line with inflation. Most statutory pensions have a dependant's benefit component, paying a certain pension to the surviving spouses and under age children.

In Switzerland and Sweden, the participation in employment-linked old age programs is obligatory without any opting-out possibilities and is enforced either by legislation (Switzerland) or by comprehensive collective agreements between the trade unions and the employers (Sweden). Sweden is also the only country, where the statutory pensions system contains a funded part (so-called premium pension scheme). In all other countries, the participation in employment-linked or personal pension plans is either voluntary, or has opting-out possibilities.

**Description of the current regulatory environment for personal and employment-linked pension programs[9]**

In the surveyed European countries, funded pensions remain dominated by programs requiring at least some form of annuitisation. The explanation for this is twofold: On the one hand, the majority of the existing funded programs, as measured by the corresponding assets, are of the defined benefit type, which mostly implies a pooled payout solution at retirement. On the other hand, the European defined contribution programs are predominantly still in the beginning of the saving phase, they have not accumulated as much assets as the older defined benefit programs and have not commenced any mass payouts yet. Further, not all programs of the defined contribution type allow for non-pooled payout solutions at retirement either. Thus, traditional pooled payout solutions (predominantly nominal fixed annuities) still remain the

[8] OECD (2005).

[9] Following the classification developed by OECD (OECD 2005), we refer to private pension programs as those administered by an institution other than the general government, and may be personal or employment-linked. Access to personal pension programs does not have to be liked to an employment relationship, in contrast to employment-liked (occupational) programs.

most used ones, depriving the retirees of the financial flexibility but giving them a guarantee for lifelong payments.

The regulation for old age saving programs in European countries is quite complicated, and often, even within one country, many different requirements and regulations as to the use of capital at retirement exist. Those programs, enjoying statutory support during the saving phase in the form of tax relieves or direct subsidies, are subject to payout restrictions in the majority of the surveyed countries. Individuals who save for their retirement outside of tax-supported programs are, in all surveyed countries, free to use their funds as they see fit. Statistics show, however that on average, funds invested in the supported programs are, by far, bigger than the funds accumulated without such support. The exceptions from the observed multitude of regulations and requirements during the payout phase are the UK, where the same regulations apply to the tax-supported funded pensions payout phase independently of the origin of funds, and Italy (for new schemes in both countries, however).

Table 1 shows representative funded pensions programs for each surveyed country, provides information on the scheme's size, the actual payouts and any payout restrictions. It can be seen that in each country, there is a number of designated old age pension schemes currently open to the new members. The schemes in the table are sorted by country and within a country by the scheme's size, as measured by the respective assets. As a benchmark in terms of size, the relation of the program's assets to the assets of the country's life insurance sector is given. The life insurance sector was chosen as a size benchmark for a simple reason that, especially in the countries of the continental Europe, life insurance contracts were traditionally seen as a means to provide for the old age. They were available before the introduction of supported funded old age programs and currently include many of them, both in the employment-linked and private area. For example, this is the case in France (Article 83, Article 39, Madelin, PERP), Germany (occupational life insurance, parts of the Riester-program, Rürup-program), Italy (retirement insurance policies) and Switzerland (pillar 3a insurance).

In four countries – Austria, France, Germany and Italy, the assets of all designated old age pension schemes are quite small as compared to the country's life insurance sector. In the USA, the UK and Switzerland, the assets of at least one program are comparable to the size of the life insurance sector. In Sweden, the assets of the occupational pension schemes are approximately of the same size to those in the life insurance sector. The bulk of corresponding assets, however, belong to the pension obligations of the old type, allowing only traditional pooled products in the payout phase. Especially small for their respective countries, are the funds allowing unrestricted use of alternative payout solutions such as PERCO in France, individual pension accounts in Sweden and pillar 3a restricted accounts in Switzerland. The majority of the schemes are still in the saving phase. Scheduled mass payouts are taking place for all types of programs in the USA, UK and Switzerland. In Sweden, the mass payouts from the occupational schemes of the old type, allowing only lifelong pooled solutions during the payout phase, are taking place. The payouts also take place from the non-regulated individual pension accounts, whereas the funded statutory part of Swedish old-age system (PPM) is still in the saving phase. Of all surveyed countries, only the USA has no restrictions on the use of the payout instruments during the retirement. Rather, the potential pensioners have a lot of freedom regarding the use retirement payout products and only a minority of them purchase annuities.

*Table 1: Overview of representative funded pensions programs in selected countries*

| Name of representative old age saving program [a)] | Scheduled retirement payouts in 2007 | Size of the program [b)], billion of assets / relation to life insurance sector [c)] | Annuity payout enforced / encouraged | Payout restricted by means of |
|---|---|---|---|---|
| **Austria** | | | | |
| Pensionskasse | Yes | EUR 13 bn / (24%) | Yes | Regulation |
| Prämienbegünstigte Zukunftsvorsorge | No | EUR 2 bn / (4%) | Yes | Taxation, regulation, refund of subsidies |
| Mitarbeiter-vorsorgekassen | No | EUR 1 bn / (2%) | Yes | Taxation |
| **France** | | | | |
| Article 83 of Code General des Impôts | Yes | EUR 28 bn / (3%) | Yes | Regulation |
| Article 39 of Code General des Impôts | Yes | EUR 19 bn / (2%) | Yes | Regulation |
| Madelin-Law | No | EUR 9 bn / (1%) | Yes | Regulation |
| PERP | No | EUR 1.3 bn / (0,1%) | Yes | Regulation |
| PERCO | No | EUR 0.6 bn / (0,05%) | No | None |
| **Germany** | | | | |
| Pensionskasse | Yes | EUR 89 bn / (13%) | Yes | Regulation, articles of association |
| Occupational life insurance | Yes | EUR 45 bn / (7%) | No | Working agreement |
| Riester-Program | No | EUR 16 bn / (2%) | Yes | Regulation |
| Rürup-Program | No | EUR 2.5 bn / (0,4%) | Yes | Regulation |
| Pensionsfonds | Yes | EUR 1.2 bn / (0,2%) | Yes | Regulation |
| **Italy** | | | | |
| Closed Funds | No | EUR 9.3 bn / (2%) | Yes | Regulation |
| Retirement insurance policies | No | EUR 4.5 bn / (1%) | Yes | Regulation |
| Open Funds | No | EUR 3.5 bn / (1%) | Yes | Regulation |
| **Sweden*** | | | | |
| Occupational | No (for new schemes) | EUR 156 bn / (90%) | Yes | Collective agreement |
| PPM | No | EUR 18 bn / (10%) | Yes | Regulation |
| Individual pension account | Yes | EUR 5 bn / (3%) | No | None |
| **Switzerland*** | | | | |
| Occupational | Yes | EUR 310 bn / (220%) | Yes | Regulation |
| Pillar 3a insurance | Yes | EUR 97 bn / (69%) | No | None |
| Pillar 3a restricted accounts | Yes | EUR 0.26 bn / (0,2%) | No | None |
| **UK*** | | | | |
| Occupational (all types) | Yes | EUR 937 bn / (55%) | Yes | Regulation, articles of association |
| **USA*** | | | | |
| Total IRA | Yes | EUR 2,384 bn / (76%) | No | None |
| Total 401(k) | Yes | EUR 1,625 bn / (52%) | No | None |

*Notes: data on exchange rates as per 23.03.2008 as published by the Financial Times.

a) Programs open to the new entrants participants, without government employees.

b) The data on size of the programs is based on the latest available information ranging 2003-2006.

c) Figures in brackets show the assets of the respective program as percentage of the assets in the life insurance sector.

Source: Own calculations, data from Österreichische Finanzmarktaufsicht (2006), Fédération française des sociétés d'assurances (2006), GDV (2007), Covip (2006), Statistics Sweden (2006), Schweizerische Nationalbank (2007), GAD (2004).

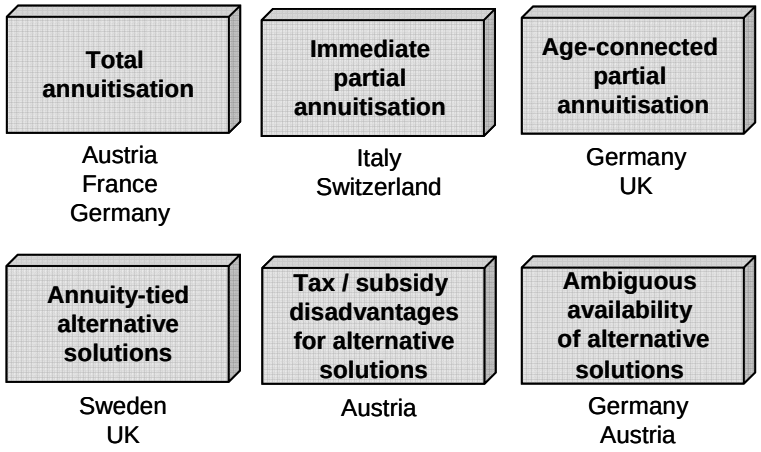
**Classification of restrictions on the use of funds in the payout-phase**

The constraints on the use of capital in the retirement phase can be imposed by using either of the following two instruments:

- Outright restrictions, prescribing the use of funds at retirement
- Implicit restrictions, using taxation, other penalties, legal or regulatory uncertainties as a means to channel the demand for payout products in the desired direction

The outright restrictions are used by the majority of the surveyed countries, mostly prescribing the use of traditional pooled products (annuitisation) during retirement and such restrictions may take many forms. Implicit restrictions also play an important role, but are not as obvious. The restrictions on the use of funds during the payout phase found in the surveyed countries can be classified as outlined in figure 1[10].

*Figure 1: Classification of the restrictions on the use of funds during the payout phase of funded pensions*




The first box in the first row of figure 1 describes the situation where the regulation of the corresponding scheme requires full annuitisation of funds directly at the beginning of retirement. Examples of countries having such regulations are Austria (Pensionskasse), France (pension programs by Article 83, Article 39, Madelin-Law, PERP) and Germany (Rürup-programs). In some countries, the strong total annuitisation requirement is softened (boxes two and three in the first row): Immediate *partial* annuitisation is for example the case for occupational savings in Switzerland or for funded pension programs under new regulation in Italy. Partial annuitisation of the funds may not be required immediately, but when a certain age is achieved by the retiree, such as 75 or 85 (box age-connected partial annuitisation). This type of restriction on the use of funds at retirement can be found in Germany (Riester-programs) and in the UK (for all tax-supported funded pensions). Usually, the age-associated partial annuitisation complements additional rules on the spending of funds and the qualities of the non-pooled solutions employed before the enforced annuitisation. This is done to ensure that funds are available for annuitisation at the required age, most often by tying the

[10] *Maurer/Somova 2009 (EFAMA).*

drawdown rule to an annuity factor[11]. The authorised annuity factors may either vary annually with the progressing age of the retiree, or be fixed at the beginning of retirement. The resulting periodic payments required from the non-pooled products are either calculated using the relevant annuity factor, or may vary between specified fractions of it (for example, between 30% and 90% of the relevant annuity factor). The first box in the second row of the figure 1 (annuity-tied alternative solutions) represents such type of restriction. In their pure form they can be found in Sweden (funded part of the statutory pension system) and in the UK (for all tax-supported funded pensions).

The next box in the second row of the figure 1 describes the situation, where the use of non-annuitising solutions is not prohibited, but explicitly and deliberately discouraged by taxation. The best example of such approach is found in Austria (prämienbegünstigte Zukunftsvorsorge, Mitarbeitervorsorgekasse): Alternative payout solutions (especially lump-sum payments) are not prohibited, but they are subject to taxation, while annuity payments are largely tax-free. Only very high annuity payments from the abovementioned programs are partially subject to taxation. In addition, when alternative payout solutions are chosen for prämienbegünstigte Zukunftsvorsorge, 50% of the direct state subsidies, received during the saving phase, must be returned to the state. An example of the exemption from this rule is the UK, whereby 25 percent of the accumulated assets in pension plan can be withdrawn as a lump sum on a tax free basis and till the age of 75, all payout instruments enjoy the same tax treatment. The last box in the second row stands for the ambiguous, unclear status of alternative payout solutions, especially of periodic withdrawals, in the regulatory and institutional landscape of the surveyed countries. While not explicitly prohibited, they are not explicitly allowed as well. The lack of regulatory information on the status of non-pooled products prevents potential retirees from asking for them and as a result they are not offered. A good example of such hurdles is the German Pensionskasse, which may or may not allow lump sum payments at the beginning of retirement. Currently, the existing legislation does not require the complete and outright annuitisation of funds, saved within the Pensionskasse. However, out of nearly 160 existing Pensionskassen, almost all require outright annuitisation, and only a small number allow partial lump sum payment at the beginning of the retirement. Only recently, some Pensionskassen have begun to offer Riester-program tariffs, which per legislation allow a one-time lump sum payment up to 30% of the existing funds.

Similarly, in Austria and Switzerland, there is no official definition of retirement withdrawal products. In the absence of direct restrictions or allowances, traditional thinking seems to limit the choice of the old age products at least in the saving phase. While in the tax-supported third pillar of the Swiss old age saving system (pillar 3a savings) the savers are free to choose between the insurance and bank products, the pillar 3a insurance assets are four times larger than the non-pooled restricted old age accounts[12] The latter, however, do not offer standardised drawdown products and are mostly paid out as lump sum.

Table 2 classifies the representative funded pension programs, introduced in table 1 by the type of applied restriction, as explained in figure 1 and summarises the main features of the restrictive requirements.

[11] Annuity factor here and afterwards is a rate, at which an initial amount of EUR 1 can be transformed into a series of fixed periodic lifelong payments by applying principles of insurance mathematics: *Dus/Maurer* (2007), pp. 17-18.

[12] *Schweizerische Nationalbank* 2007 pp. 31, 73; *Schweizerischer Versicherungsverband* 2007 pp. 12-14.

*Table 2: Classification of funded pension programs by payout restrictions*

| Name of representative restrictive old age saving program | Brief description of restrictions applying to the payout phase | Short classification of annuity-related restrictions |
|---|---|---|
| **Austria** | | |
| Pensionskasse | Annuity payout required by the regulation. | Total annuitisation |
| Prämienbegünstigte Zukunftsvorsorge | Annuity payouts are not taxed, all other payout arrangements are taxed.<br>All other payout arrangements trigger partial refund of state subsidies, received during the saving phase. | Tax / subsidy advantages of annuitisation |
| Mitarbeiter-vorsorgekassen | Annuity payouts are not taxed, all other payout arrangements are taxed. | Tax advantages of annuitisation |
| **France** | | |
| Article 83 of Code General des Impôts | Annuity payout required by the regulation. | Total annuitisation |
| Article 39 of Code General des Impôts | Annuity payout required by the regulation. | Total annuitisation |
| Madelin-Law | Annuity payout required by the regulation. | Total annuitisation |
| PERP | Annuity payout required by the regulation. | Total annuitisation |
| **Germany** | | |
| Pensionskasse | Annuity payout required for older contracts, some new contracts allow for partial lump sum payments. Riester-program contracts available. | Restricted availability of non-annuitising solutions |
| Pensionsfonds | Payout restrictions as for the Riester-programs. | Age-connected partial annuitisation |
| Riester-Program | Annuitisation of the funds at 85 at the latest. Non-decreasing periodic payouts before the annuitisation. 30% of the capital can be paid out as a lump sum. | Age-connected partial annuitisation |
| Rürup-Program | Annuity payout required by the regulation. | Total annuitisation |
| **Italy** | | |
| Closed Funds | 50% of the funds should be annuitised at the beginning of retirement. | Partial annuitisation |
| Retirement insurance policies | | |
| Open Funds | | |
| **Sweden** | | |
| PPM | Annuity payout or an annually re-calculated drawdown based on the relevant annuity factor. | Drawdown tied to relevant annuity factors |
| **Switzerland** | | |
| Occupational | 25% of the funds can be paid-out as a lump sum by legislation, the remaining conditions are ruled in the articles of association of the relevant scheme. | Partial annuitisation |
| **UK** | | |
| Occupational (defined contribution) | 25% of the funds can be paid-out as a tax-free lump sum by legislation. Effective compulsion to annuitise the funds at 75 at the latest. Alternative to annuitisation (ASP) disadvantaged in terms of tax treatment and payout mode. | Age-connected partial annuitisation. Drawdown tied to relevant annuity factors |

Source: Own research

Every regulation per se is costly. The *costs of regulation* are incurred to the affected individuals and to the society as a whole by creating the regulatory rules, by implementing them and by supervising their implementation. They can be directly observable in the form of additional fees and duties which should be paid by the subjects to regulation and which finance the regulating apparatus. The bulk of the regulation costs is, however, not directly observable. For members of funded pension programs, it is the inability to purchase the desired payout products and to structure the retirement cash flows in accordance with their preferences and the perceived optimum. Naturally, the actual preferences of retirees cannot be observed if their options are restricted due to regulation. By observing the behaviour of retirees in countries and programs where regulation on payout solutions is less strict, however, some indication of such preferences can be provided: namely, that not many households do voluntary purchase life annuities. Judging by such actions it is obvious that the disadvantages of annuities represent considerable costs to the retirees.

It is important to carefully balance the advantages of the regulation against the cost incurred to the affected individuals and the society as a whole. Thus, starting from the above outlined need to find an economically reasonable solution for the regulation of the funded pension payout phase in order to reduce the total economic costs, in what follows next we introduce the model enabling us to measure one aspect of the total cost of regulation – the costs incurred to the affected individuals by inability to follow the optimal spending and investment strategy in retirement.

## Retirement optimisation model

### Structure description

We build and implement a dynamic portfolio choice model by assessing the optimal consumption and investment behaviour of a risk-averse retired male household facing an uncertain lifetime and stochastic returns from capital markets.[13] In such a setting the retiree must decide in each period how much to consume and how to support the envisaged consumption by appropriate investment strategy. The household is endowed with a certain level of savings already accumulated during the active working life (pre-existing wealth). In addition, the retiree possesses a recurring stream of pre-existing pension income in the form of life long, inflation adjusted fixed annuity benefits. The pre-existing pension income may be composed of a statutory pension benefits, other social security transfer payments, or corporate pension benefits of the defined benefit variety.[14] After the age of 65, the retiree has to decide at the beginning of every year how much to consume and how to invest his liquid wealth into stocks, bonds and new life annuities in this period. We implicitly assume that the pre-existing pension income is above some minimum standard, enabling the retiree to cover the major recurring costs.

We proceed as follows: In a first step, we (numerically) solve the model to gain the optimal consumption pattern and portfolio holdings in annuities, stocks, and bonds as a function of both wealth and age. In the next step, we run Monte Carlo simulations of 10,000 life cycles, and calculate the expected range of consumption and portfolio patterns over time, taking into

[13] We do not take into account consumption shocks, e.g. resulting from uncertain medical or nursing expenses. This simplification can be justified due to the relative high level of medical insurance coverage, especially in continental Europe. In addition, we do not analyse the interaction between the accumulation and decumulation phase and consider a certain level of retirement funds at the beginning of retirement as given.

[14] If the pension income comes from defined benefit plans, the level of the income is a function of the salary history and the duration of the previous employment. Same factors also influence the level of statutory pension.

account the consumer's optimal portfolio rebalancing. Then, we quantify the utility implications in case that the retiree is prevented from following the optimal strategy by the requirement to annuitise. We distinguish between three different forms such as immediate full annuitisation at retirement, immediate partial annuitisation at retirement and deferred annuitisation.

**Investor's optimisation problem**

In modelling the dynamic portfolio choice problem we use the approach introduced by *Horneff/Maurer/Mitchell/Stamos* (2007). Our investment universe consists of liquid risky stocks, riskless bonds, and illiquid fixed payout annuities. In this setting, the retiree must make both the choice regarding how much to hold in liquid assets versus fixed payout annuities, and how much of the liquid funds to invest in risky stocks versus riskless bonds.

We assume that at the beginning of the retirement phase (set at the age of 65) the retiree has a certain amount of financial assets $S_0$. In addition he is endowed with a constant lifelong yearly pension income (adjusted for inflation) of $Y_t = Y$. In our analysis, we look at three levels of initial financial wealth to pension income relation (WPR). This enables us to obtain results for any absolute combination of pre-existing financial wealth and annual pension income which produces the surveyed relations:

- WPR=2 means that financial wealth is relatively low and just twice the pre-existing annual pension
- WPR=5 means that financial wealth is moderate, five times the pre-existing annual pension
- WPR=10 means that financial wealth is relatively high and amounts to ten times the pre-existing annual pension

To model preferences we adopt an additively time-separable utility function of the Constant Relative Risk Aversion (CRRA) class defined over consumption and bequest, a standard assumption in financial economics. The retiree's subjective survival probability to survive until date t+1, given he is alive at t, is denoted by $p_t^s$. In this case, the retiree's preference function is then recursively defined by:

$$V_t = \frac{C_t^{1-\rho}}{1-\rho} + \beta E_t\left[ p_t^s V_{t+1} + \left(1 - p_t^s\right) k \frac{\left(B_{t+1}\right)^{1-\rho}}{1-\rho} \right], \qquad \text{(F1)}$$

with terminal utility $V_T = \frac{C_T^{1-\rho}}{1-\rho} + \beta E_T\left[ k \frac{\left(B_{T+1}\right)^{1-\rho}}{1-\rho} \right]$.

Here, $C_t$ denotes consumption level at time t in the case the retiree is alive; T is given by the curtailed lifetime (set to age 100); ρ is the coefficient of relative risk aversion (RRA) and also reflects the retiree's willingness to engage in intertemporal consumption substitution. This parameter is of key interest in assessing the different financial retirement strategies when payouts are uncertain. In the special case ρ= 0 the retiree is called risk neutral, and for ρ >0 risk averse. We set for our base case ρ= 5: This is a standard value in the life cycle literature and represents according to the classification of *Horneff/Mauer/Mitchell/Dus* (2007) a retiree with moderate risk aversion.[15]

[15] See for example *Horneff/Mauer/Stamos* (2007). This is a higher value than in *Feldstein/Ranguelova/Samwick* (2001), who consider a reasonable range for the coefficient of relative risk aversion to be between 2 und 3.

A retiree with a parameter ρ=2 has a low risk aversion and with a parameter ρ=10 – a high risk aversion. The parameter β reflects his time preference (set to 0.96); and $B_t$ represents the remaining financial wealth at death. The strength of the bequest motive is represented by the parameter k. Having a bequest motive k > 0 means that the retiree will always keep some wealth not annuitised, in order to be able to bequeath wealth to potential heirs. In the case of a (moderate) bequest motive we set k = 2, which is in the ballpark of values used by *Cocco/Gomes/Maenhout* (2005).

In this framework, each year the retiree must decide how to allocate the current cash on hand $W_t$, between consumption $C_t$, financial wealth $S_t$ (i.e. direct stock and bond investments), and new purchases of fixed life annuities $A_t$. Hence, the intertemporal budget constraint at time t is given by:

$$W_t = S_t + A_t + C_t . \tag{F2}$$

In the next period, cash on hand is then:

$$W_{t+1} = S_t\left(R_f + \pi_t^s\left(R_{t+1} - R_f\right)\right) + L_{t+1} + Y , \tag{F3}$$

where $\pi_t^s$ denotes the fraction of financial wealth $S_t$ invested in risky stocks, $R_f$ denotes the real bond growth rate, and $R_{t+1}$ the cumulative risky stock return. The sum of annual income which the retiree gets from all previously purchased annuities is $L_{t+1}$. If the retiree passes away at *t*+1, the remaining estate is given according to $B_{t+1} = S_t\left(R_f + \pi_t^s\left(R_{t+1} - R_f\right)\right)$.

Besides the intertemporal budget restriction, the retiree is restricted from borrowing against future pension income and annuity payouts, as well as from selling short positions in annuities.

**Investment universe**

For simplicity, the capital market provides only two assets: a riskless bond and risky stocks. We assume that the yearly return on the risk free asset (after inflation) is constant to 2 percent. Further, we assume that in any year the stochastic characteristic of the risky stock movements follows the same lognormal distribution, and that the return is independent of the movements in previous years. Risky stocks have an expected return (adjusted for inflation) of 6 percent per year (in other words a risk premium of 4 percent) and volatility of 18 percent per year. This choice of parameters for risky stock investments is in line with the recent portfolio choice literature, and reflects the anticipated risk/return assumption for a well diversified market portfolio of international stocks.

Besides traditional liquid assets, the retiree has access to fixed payout annuities. Fixed annuity is a financial contract between an annuitant and an insurer whereby the purchaser periodically receives a real fixed amount of money conditional on survival in each period.

We use the classical formula for pricing a payout annuity with fixed lifelong payments of $L_t = 1$:

$$A_t = \sum_{t=1}^{T} \frac{{}_t p_y^a}{R_f^t} . \qquad \text{(F4)}$$

where ${}_t p_y^a = \prod_{t}^{t+s-1} p_t^a$ is the cumulative conditional survival probability for an individual aged *y* to survive until age y+t according to the mortality table used by the insurance company to price the annuity.

The subjective year-by-year survival probability $p_t^s$ can differ from the assumptions made about mortality $p_t^a$ by the insurer, which is standard in the insurance industry.

Our numerical analysis takes survival probabilities from the German DAV 2004 R annuity male mortality table, trend-adjusted for the year 2008, to price the annuities. We compute the utility using the corresponding German population male mortality table. The difference between the two mortality tables reflects ongoing adverse selection in the annuity market (see *Brugiavini*, 1993).

### Numerical solution and simulation analysis

We solve the outlined optimisation problem by backward induction through a three-dimensional state space $\{W, L, t\}$, as analytical solutions to this type of optimisation problem do not exist. Cash on hand *W* cannot be omitted as a state variable because illiquid annuities are included in the analysis, despite the fact that we assume CRRA preferences. It is also necessary to include the sum of current annuity payouts *L* as a state variable, because once purchased, annuities can no longer be sold. Finally, the optimal policy depends on the retiree's age, because the price of newly purchased life annuities as well as the present value of his remaining pension income – which below we refer to as *pension wealth* – vary with her age. We refer the reader to *Horneff/Maurer/Mitchell/Stamos* (2007) for further details of the numerical solution technology.

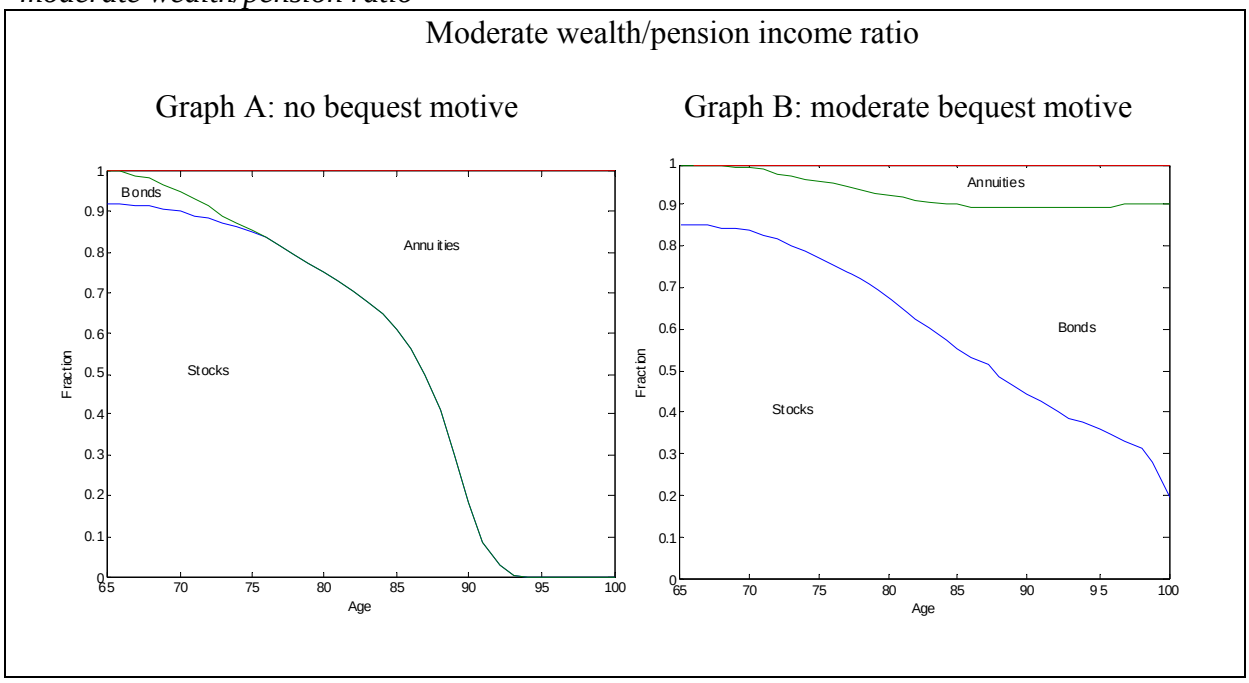
To evaluate how the retiree's annuity purchases, liquid wealth investment, and consumption, would be expected to evolve assuming he followed the optimal policy functions derived above, we undertake a stochastic analysis. To do so, we run Monte Carlo simulations of 10,000 life cycles.

## Optimal investment and spending strategy in retirement

The optimal expected asset allocation over time shows a similar "life-cycle-profile" as in the accumulation phase, i.e. starting with a high equity exposure early in retirement and shifting gradually into safer investments, such as government bonds. Yet, the key difference compared with the accumulation phase is that, in the decumulation phase life annuities with fixed real benefits play the role of the "safe asset", while stocks still play the role of the "return drivers". In addition, the survival credit (i.e. the excess return of annuities over the riskless bonds) rises with age, making annuities more attractive than bonds from the return perspective as the retirement progresses.

Figure 2 shows the expected asset allocation for a representative German male household with moderate WPR (savings are 5 times the yearly pension income) and moderate risk aversion.

*Figure 2: Expected asset allocation for a household with moderate risk aversion and moderate wealth/pension ratio*



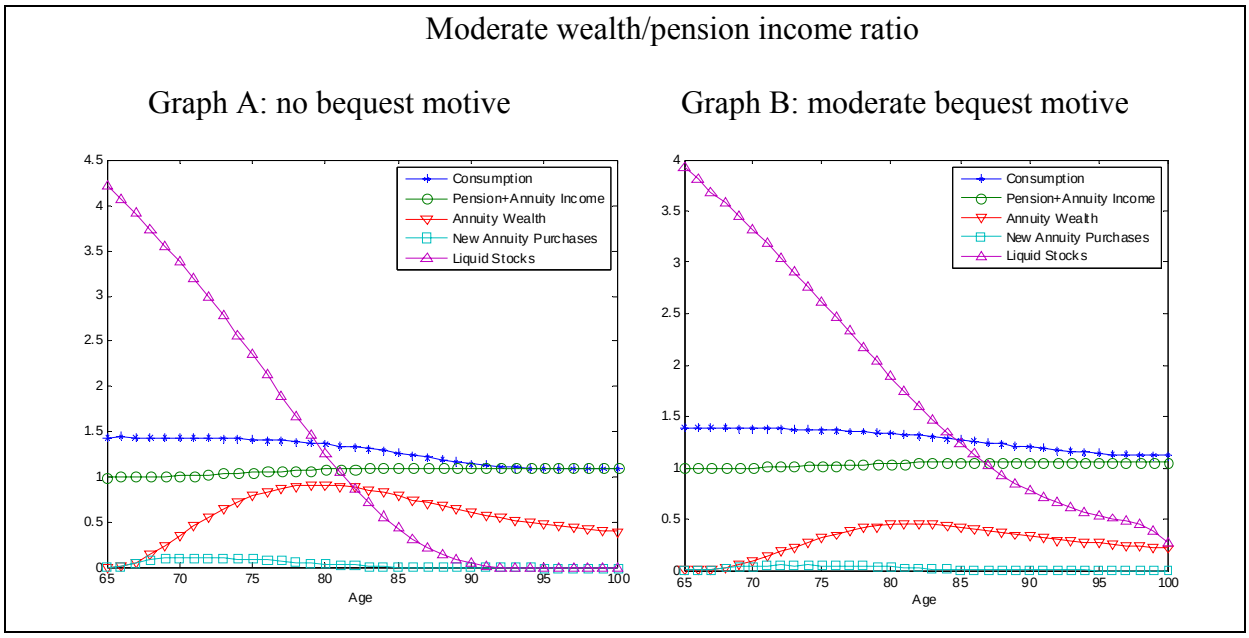

Source: Authors' calculation.

Graph (A) of Figure 2 shows the expected life cycle profile of a household without bequest motives. The lines show the staggered relative weights of the liquid stocks, bonds, and life annuities in the retirement portfolio for each retirement year.[16] At the age of 65, financial wealth is to more that 90% composed of stocks. The bonds are held in the investment portfolio for a period of approximately ten years, from the beginning of the retirement. Bond holdings never become more than ten percent of the overall investment portfolio and after that period, are fully crowded out by annuities, which, due to increasing survival credit, offer a better investment return. The household remains mostly invested in stocks until the age of 87 in order to profit from the equity return while the survival credit is not yet sufficiently high to fully crowd out stocks. At the age of 94, the household has finally completely replaced stocks with life annuities.

Graph (B) of Figure 2 displays the expected asset allocation for a retiree with a moderate bequest motive. In this case, annuity holdings never become more than 10 percent of the retirement portfolio. While bonds are quickly and fully crowded out when there is no desire to bequeath the heirs, they become increasingly important for the case with a moderate bequest motive. Successively, bonds replace stocks as the likelihood of dying becomes more pronounced. For cases both with and without the bequest motive, the investment portfolios similarly exhibit considerable equity holdings at the beginning of retirement. In presence of the bequest motive, however, even at the age of 100, the retiree has 20% of wealth invested in equity, 70% in bonds and only 10% in annuities, while without the bequest motives, the stocks are fully crowded out by annuities before the age of 95 and the bonds are crowded out already at the age of 77. Figure 3 represents how the optimal retirement strategy evolves over time.

[16] To specify the market value of the annuities we calculate the actuarially fair premium (using the annuitant mortality table) for all annuity benefits the retiree holds in a certain point in time. Liquid stocks and bonds are priced according to their current market values in the model.

*Figure 3: Expected optimal life cycle profile for a household with moderate risk aversion and moderate wealth/pension ratio*




Source: Authors' calculation.

In Figure 3, the expected year-to-year investment and consumption decisions can be seen in more detail. It shows the life cycle profile of a household without (Graph A) and with (Graph B) bequest motives. Both graphs illustrate the expected consumption, pension and annuity income, annuity wealth, the amount of new annuity purchases, the overall level of retirement wealth and liquid stock holdings for each year starting with the beginning of retirement and ending with the age of 100. All parameters are reported as a multiple of the yearly pre-existing pension income.

We can infer from Graph A that the expected consumption level is the highest at the beginning of retirement and is still above the level of pre-existing pension income at the end of the lifecycle. The consumption is financed from the pension and annuity income, which consists of the pre-existing pension payments and periodic payments from the purchased annuity stock. New annuity purchases take place predominantly between the ages of 67 and 77. Annuity wealth, which is defined as the present value of life annuity stock, so far purchased, is at its maximum at the age of 80. It declines thereafter in the absence of new purchases and as a result of the reduction of the present value of existing annuity stock due to progressing payments and increasing mortality. The amount of wealth invested in liquid stocks declines continually and becomes a negligible fraction of pre-existing pension income before it reaches zero at the age of 90. Liquid wealth is used to fund the purchase of new annuities and in that way to finance consumption.

The household with bequest motives, as shown in graph B, decumulates the liquid assets more slowly and shifts less wealth into life annuities at any stage of the lifecycle as compared to the case without a bequest motive. Financial wealth is not exhausted at the end of the lifecycle.

**Utility loss of compulsory annuitisation**

To estimate the utility loss of a mandatory annuitisation and to evaluate the economic cost of the different regulatory frameworks we conduct a welfare analysis similar to *Mitchell et al.* (1999), and *Horneff/Maurer/Mitchell/Stamos* (2007). While preserving the main settings of our existing retirement optimisation model, we look at the utility implications for both the extreme situations where the full annuitisation of the funds is enforced and a full freedom is given to combine drawdown and fixed annuity options, as well as for the cases where the strict annuitisation requirements are relaxed (*soft restriction cases*). To measure the utility loss in monetary units we compare the pairs of alternatives by equating the expected utility in the unrestricted (or less restricted) case with that of the fully restricted case (compulsory annuitisation) but with a higher initial financial wealth at the age of retirement.

To model the soft restriction cases, we use some of the regulatory suggestions from two European countries: Italy and the UK. We borrowed the regulatory ideas from those countries, because they are the only in our survey to apply the same payout regulation to a bulk of the funded and tax-supported old age schemes, and to went beyond a simple prohibition of non-annuitising solutions. For the purposes of our analysis and to facilitate comparability, we simplified the respective regulations to form three cases which we all compare to the unrestricted world, were the retiree is free to act in order to achieve the optimal investment and spending pattern as described above. We again consider a male household with a moderate risk aversion, with and without bequest motives.

The three regulatory cases are as follows:

**Case A** (full immediate annuitisation): The retiree is forced to convert all funds into a fixed (inflation-adjusted) annuity at the beginning of retirement (aged 65).

**Case B** (based on simplified Italian regulations; similar idea governs the regulation for Swiss occupational pensions): Mandatory annuitisation of 50% of the initial wealth at the age of 65. No restriction on the disposition and use of the remaining funds at any time: fixed annuities can be bought and withdrawals arranged annually during the remaining lifetime of the retiree.

**Case C** (based on simplified UK regulations, German regulation for Riester plans resembles that from the UK, with different annuitisation age limits and rules governing the drawdowns): Mandatory annuitisation of the remaining funds at the age of 75. No restriction on the disposition or use of funds before that age: fixed annuities can be bought and withdrawals arranged annually.

Based on the results of optimal retirement strategy analysis, it could be expected, that retirees living in the restricted world would suffer utility losses as compared to the unrestricted world. In our analysis, we translate them into the reduction of the initial financial wealth.

The following table shows the relative utility impacts on the inhabitant of the unrestricted world who is forced into more restrictive regulatory environment. The utility impacts are measured as a loss in percent of the pre-existing financial wealth.

*Table 3: Relative utility impacts of enforced full annuitisation and softened restrictions vs. the free world: Utility losses as percentage of the initial wealth*

| Compensation, % of the initial wealth | **No bequest** | | | **Bequest** | | |
|---|---|---|---|---|---|---|
| **Pension Level (S)** | **Case A** 100% annuitisation at 65 | **Case B** 50% annuitised at 65 | **Case C** Remaining funds annuitised at 75 | **Case A** 100% annuitisation at 65 | **Case B** 50% annuitised at 65 | **Case C** Remaining funds annuitised at 75 |
| Low wealth/pension ratio (WPR=2) | -24,96% | -9,89% | -6,10% | -53,80% | -14,19% | -38,80% |
| Moderate wealth/pension ratio (WPR=5) | -24,84% | -7,06% | -7,97% | -54,00% | -9,58% | -37,07% |
| High wealth/pension ratio (WPR=10) | -19,57% | -3,32% | -7,61% | -43,67% | -4,67% | -31,12% |

Source: Own calculation.

It can be seen that, in the world with enforced annuitisation, retirees across all groups suffer utility losses, independently of the absolute amount of initial wealth available. These utility losses are expressed as a percentage reduction of the initial financial wealth in the world without any restrictions. For example, for a person with a moderate WPR and no bequest motive, having EUR 100,000 financial wealth at the beginning of retirement, the requirement to annuitise all funds at the age of 65 (would translate into a reduction of this wealth by 24,84% to EUR 75,040.

In absence of bequest motives, the biggest losses occur, when total annuitisation is enforced (case A), independently of the wealth to pension ratio. Individuals with low WPR (WPR=2) are the most affected however: Given that the major recurring costs of living are covered by pre-existing pension and available retirement funds are relatively small, the requirement to annuitise deprives such individuals from a highly valued chance to further enhance consumption by investing their funds on the capital market and potentially receiving high returns. The negative impact of full annuitisation on individuals with moderate WPR is slightly less pronounced. The utility loss for retirees with high WPR is about five percentage points less, is still more than a fifth of initial wealth.

The softening of the strict annuitisation requirement, represented by cases B and C without bequest motive, considerably reduces utility losses across all WPR levels, to less than 10% of initial wealth, as compared to 20-25% in case of the full immediate annuitisation. The influence is, however, not straightforward. For low WPRs (WPR=2) the smallest utility losses are observed for the case C regulation, when the remaining funds have to be are annuitised at the age of 75. Moderate and high WPRs (WPR=5, WPR=10) are slightly better off when the type B regulation (50% of the funds are annuitised at the retirement) is applied. The utility differences between both cases of soft regulation, however, are relatively small, ranging from approximately 4 percentage points to one percentage point.

We explain the observed slight difference in preferences by the timing of the major annuity purchases in the unrestricted world for different WPR ratios. While retirees within all surveyed WPR categories do completely switch to annuities well beyond the age of 75, there are differences regarding the optimal new annuities purchase time, depending on the WPR. The retirees with low WPR (WPR=2) conduct the major new annuity purchases within 75-85 age span anyway – and for that reason the restriction of type C does less severely interfere

with the optimum strategy. The retirees with moderate and high WPR, on the other hand, start with the annuity purchases shortly after the retirement and proceed gradually doing this for a longer time span – the restriction of type B are perceived to be less burdensome by them.

An important implication of our analysis is that the softening of restrictions allows the retiree to noticeably reduce utility losses, while enabling the policymakers to achieve such regulatory goals as prevention of old age poverty resulting from mismanagement of retirement funds by the retiree.

The presence of a bequest motive multiplies utility losses, compared to the situation without any bequest. The largest utility losses across all restriction cases are incurred to those with low wealth to pension ratio, ranging from 53.80% for case A to 14.19% for case C. In presence of a moderate bequest motive, the case B restriction (immediate annuitisation of 50% of retirement funds) unanimously leads to the smallest utility reductions for all WPRs, as all the non-annuitised funds can be at any time passed over to the heirs independently of the retiree's final age and no additional bequest saving strategy is needed. In case of annuitisation at the age of 75, the retiree has an additional task of purposely building up a bequest potential in complementary to his own consumption.

**Discussion and conclusions**

Those Europeans facing the challenge to efficiently manage their money in retirement soon find out, that the majority of funded old age schemes which enjoy statutory support during the saving phase have restrictions on the use of accumulated funds during the retirement. Such restrictions mostly take the form of prescribing annuitisation of retirement funds. This paper shows what types of regulatory rules limit the product choice of the retiree by looking at the funded pension programs in seven selected European countries and in the USA, and sheds some light on fundamental reasons behind. It develops an optimal investment and spending strategy for retirees with different risk aversions and wealth levels, with and without bequest motives. The CRRA utility function is then used to quantify the influence of regulatory restrictions.

Our work advances prior studies by combining research in the regulatory area regarding the payout product choice, with recent research on appropriate retirement products and retirement strategies.

Regarding the asset allocation decision, we find that the utility maximising retiree will invest considerable part of his wealth in risky stocks at the beginning of the retirement to profit from the capital market returns on one hand, and from the diversification effects between his pre-existing annuity-like pension income and the risky investment portfolio, on the other hand. In line with prior studies, we find that the retirement funds will be annuitised gradually, full annuitisation being deferred to around age of 90.

The enforcement of a full immediate annuitisation will considerably reduce the utility level attainable with the existing funds, or call for sizeable compensations. This will be the case independent of the bequest motives or the level of endowment with retirement capital, as compared to the pre-existing pension. The softening of strict annuitisation requirements will lead to considerable reduction of utility losses, while preserving the protective goals of the regulators.

It is very unlikely however, that, even in absence of regulatory hurdles, an average individual would be in a position to self-reliantly develop a dynamic lifecycle optimisation model for retirement and adequately implement it. It is primarily the task of financial institutions to create affordable products for the major characteristic retiree groups, based on and monitored to according the dynamic lifecycle models.

Our findings, therefore, are consequential for policymakers, retirees as well as suppliers of retirement payout products, since we identified a considerable potential for improvement in consumer wellbeing. This improvement may originate from the adjustments in the regulatory environment and availability of cost-efficient standardised retirement products, which provide dynamic access to both annuities and liquid investments such as equities and bonds.

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