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Welfare implications of product choice regulation during the payout phase of funded pensions

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Abstract

In many countries, governmental support for funded old-age programmes comes at the cost of at least partial mandatory annuitisation of accumulated assets in retirement. We survey regulatory frameworks for the payout phase of funded pension systems in seven European countries and the US and study the influence of mandatory annuitisation on the welfare of both rational and behaviourally influenced individuals using a dynamic life-cycle model. We show that mandatory immediate full annuitisation of retirement assets will reduce rational individuals' certainty equivalent pension wealth by up to 54%. Softening the strict immediate annuitisation requirements along the line of regulatory realities in some of the surveyed countries reduces utility losses considerably. Behaviourally restricted individuals can benefit from full annuitisation at retirement, but generally they will also prefer more flexible regulation.

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1 Introduction

In most industrialised countries, statutory pension systems are under pressure due to demographic changes, and policymakers around the world recognise the need to supplement the pay-as-you-go systems with funded employment-based or personal schemes. In most countries, incentives to save for retirement take the form of tax reliefs for contributions to eligible old-age programmes. In return for support during the accumulation phase, most programmes impose restrictions on how to draw down accrued funds in retirement. These restrictions typically take the form of compulsory annuitisation, enforced either by legislative or regulatory means, or by tax disadvantages, and usually they are independent of the total amount of retirement capital available or the level of pre-existing pension income from other sources.

There are three main arguments for requiring retirees to annuitise funds from tax-sheltered retirement accounts. First, paternalistic states, especially those in continental Europe, aim at preventing old-age poverty resulting from moral hazard in social security systems or from retirees' myopia. Moral hazard arises when retirees deliberately exhaust their savings too early, expecting the government to bail them out at advanced ages. Consequently, governments impose regulation that prevents individuals from double dipping statutory support, first through deferred taxation during the saving phase and later through tax-financed social security payments. In case of myopia, individuals underestimate their life expectancy and their financial needs in retirement due to a lack of information or financial literacy, and again spend too much too early. Mandatory annuitisation is a potent instrument to prevent both moral hazard and myopia.

Second, governments also worry that individuals spend too little for too long. Old-age saving schemes are regularly supported by means of deferred taxation, where contributions and investment returns are tax exempt while withdrawals in retirement are taxed. Delaying withdrawals will delay tax payments. Moreover, allowing for discretionary withdrawals from retirement accounts results in an unpredictable stream of income taxes. Mandating the purchase of annuities, however, guarantees a timely and predictable tax flow.

Third, governmental support for funded pension schemes aims at helping individuals build up supplemental retirement income. By contrast, it is not intended to sponsor bequests. Annuities provide lifelong income for the retiree and typically prevent wealth from being transferred to the next generation.

While retiree protection is one of the central arguments put forward by those who favour tight restrictions with respect to admissible withdrawal patterns, little is known about the impact of those restrictions on retired individuals' utility. Among the few papers that explicitly analyse the implications of regulatory restrictions on rational individuals are Mitchell *et al.* (1999) as well as Horneff *et al.* (2008b). This study aims at shedding more light on this issue.

Our work extends prior literature in several ways. We present an extensive survey of regulatory environments for private and occupational pension systems in several European countries, including those with a high share of second pillar savings, as well as in the USA. We develop a classification system for restrictions imposed on product choice during the payout phase. Based on this system, we derive stylised payout regulations that we integrate into a dynamic life-cycle model along the lines of Horneff *et al.* (2010). Using this model, we study the welfare implications of alternative levels of mandatory annuitisation for both fully rational individuals as well as retirees that exclude annuities from their investment menu for behavioural reasons.

In line with prior studies, we find that for fully rational individuals it is optimal to annuitise gradually, even in the absence of bequest motives. Hence, stipulating full annuitisation at retirement substantially reduces individuals' wellbeing, while other forms of mandatory annuitisation result in considerably smaller utility losses. By contrast, behaviourally restricted individuals can benefit from being required to fully annuitise retirement wealth. Yet, even those individuals will generally prefer more flexible regulation.

The remainder of this paper is organised as follows. Section 2 provides a brief overview of the related literature. Section 3 describes tax-supported funded pension schemes in seven European countries as well as the USA and presents and classifies the regulatory restrictions imposed during the payout phase. Section 4 derives optimal investment and consumption strategies in absence of any regulatory restrictions on payout product choice and examines welfare losses from enforced immediate, partial, and deferred annuitisation. Section 5 concludes.

2 Related literature

Previous literature on funded pensions within the rational decision-making framework can broadly be divided into four main strands. The first concentrates on the properties, advantages, and disadvantages of particular retirement products and their modifications, e.g., annuities or withdrawal plans. Yaari (1965), for example, shows that under restrictive assumptions, such as actuarially fair pricing of annuities, rational retirees lacking bequest motives should fully annuitise available wealth. Davidoff *et al.* (2005) relax some of Yaari's restrictive assumptions. They conclude that, while partial annuitisation will be optimal for those wanting to bequeath wealth to their heirs, full annuitisation is still advantageous in absence of any bequest motive if the net return on annuities is greater than that on a reference asset. James and Song (2001) provide an international comparison of money's worth ratios, a measure of actuarial fairness in annuity pricing introduced by Mitchell *et al.* (1999). Dus *et al.* (2005) analyse shortfall risks of phased withdrawal plans with respect to benefits provided by life annuities, while Milevsky (2002) compares the risk/return characteristics of variable annuities with their fixed and escalating counterparts.

A second group of papers focuses on retirement strategies with one or more payout products and studies the optimal timing for purchasing those products. Milevsky and Young (2007) analyse the optimal timing of annuitisation within a dominance framework. Horneff *et al.* (2008b) derive optimal consumption and saving strategies with fixed life annuities, stocks, and bonds in a realistically calibrated life-cycle model, allowing for gradual annuitisation, and later – in Maurer *et al.* (2013) – expand their work to variable annuities.

The third strand of literature examines regulation and supervision of retirement products, particularly focusing on product quality. This area of research includes, among others, papers by the OECD (2009) on principles for the regulation of private occupational pension schemes, by Dus and Maurer (2009) on capital requirements for the payout phase of funded pensions in Germany, as well as descriptive country studies on available pension programmes and their regulation (e.g., Palme and Svensson, 1999; Queisser and Vittas, 2000; Hülsmann *et al.*, 2001; Bateman and Thorp, 2008).

Finally, a substantial literature has developed around the so-called *annuity puzzle*, i.e., the phenomenon that the empirically observable voluntary annuity take-up is low[1], despite the theoretical appeal of annuitisation. Rational arguments put forward

[1] See Johnson *et al.* (2004) for evidence from the HRS, Schaus (2005) for a survey of annuity intake in 450 large 401(k) plans, Boardman (2006) for a comparison between the UK and US annuity markets, and Inkmann *et al.* (2011) for the voluntary annuity market in the UK.

to explain the reluctance to annuitise include actuarially unfair annuities (Mitchell *et al.*, 1999; Finkelstein and Poterba, 2004), incomplete annuity markets (Horneff *et al.*, 2008a; Peijnenburg *et al.*, 2010a), crowding out by Social Security (Dushi and Webb, 2004), bequest motives (Friedman and Warshawsky, 1990; Bernheim, 1991; Lockwood, 2012), intra-family hedging (Kotlikoff and Spivak, 1981; Brown and Poterba, 2000; Hubener *et al.*, 2013), as well as health shocks and the resulting medical expenses (Peijnenburg *et al.*, 2010b; Ameriks *et al.*, 2011). These arguments, however, fail to fully solve the annuity puzzle.

Other studies analyse the annuity puzzle from a behavioural perspective. Benartzi *et al.* (2011), for example, point out that the same behavioural factors that explain saving behaviour, such as self-control problems, inertia, and lack of financial sophistication, help to understand how individuals approach the task of asset decumulation. At the same time, several studies find evidence that framing has substantial impact on the annuitisation decision, e.g., among others, Hu and Scott (2007), Agnew *et al.* (2008), Behaghel and Blau (2012), and Brown *et al.* (2008, 2013). Further behavioural explanations for the reluctance to annuitise include choice bracketing (Read *et al.*, 1999), the persistence of default options during the payout phase (Bütler and Teppa, 2007), the complexity of the annuitisation decision (Brown *et al.*, 2011), and time-inconsistent preferences (Schreiber and Weber, 2013).

3 Regulating payout product choice in funded pensions

3.1 Countries surveyed and their funded pension schemes

Our study of product choice regulation in the payout phase of funded pensions draws on a survey of seven representative European countries: Austria, France, Germany, Italy, Sweden, Switzerland, and the UK. For comparison, we also look at the USA. In all surveyed countries, the vast majority of the population is covered by some form of statutory pension[2]. In Austria, France, Germany, and Italy, statutory pension programmes still provide rather high replacements rates and represent the main source of retirement income. At the same time, participation in occupational or personal pension schemes is either voluntary or individuals have the possibility to opt out. Consequently, the amount of assets accumulated within funded pension schemes is still small compared to the countries' GDP and gross debt.

By contrast, statutory pension systems in Switzerland, the UK, and the USA provide relatively low benefits, resulting in high individual responsibility for generating retirement income from other sources[3]. Switzerland and Sweden mandate participation in employment-linked old-age programmes, either through legislation, in the case of Switzerland, or through collective agreements between trade unions and employers, in the case of Sweden. In both countries, employees do not have the chance to opt out of the system. Consequently, second pillar savings in these two

[2] Following the classification developed by the OECD (2005), we refer to private pension programmes as those administered by an institution other than the government; these may be personal or employment-linked. In contrast to employment-linked (occupational) programmes, access to personal pension programmes does not have to be linked to an employment relationship.

[3] OECD (2005).

countries are significant, and the resulting payouts are high enough to substantially contribute to financing the cost of living in retirement. On top of the second pillar, Sweden is the only country in which the statutory pensions system is partially funded (so-called premium pension scheme).

In the UK and the US, despite the lack of mandatory participation, funded pension schemes have also accumulated a substantial amount of assets.

For each country surveyed, Table 1 provides an overview of the funded pension programmes currently open to new members, including information on the amount of assets accumulated. To put these numbers into perspective, we also relate them to the country's GDP and general government gross debt.

3.2 Overview and classification of product choice restrictions

Having presented the alternative funded pension schemes in the previous section, we now turn to discussing the main features of the associated restrictions with respect to product choice in the payout phase. Table 2 summarises our findings.

In the European countries surveyed, funded pension programmes predominantly require at least some form of annuitisation. The bulk of existing funded programmes, in terms of accumulated assets, are of the defined benefit variety, which implies a pooled payout solution at retirement. At the same time, most European defined contribution programmes are still at the beginning of the saving phase, and they have not yet accumulated as much assets as the older defined benefit programmes. Moreover, some defined contribution programmes also require pooled payout solutions at retirement, such as *PERP* in France, *Riester* plans in Germany, or the *Pensionskasse* in Austria. Thus, traditional pooled products, particularly fixed nominal annuities, remain the predominant payout solution, depriving retirees of financial flexibility but giving them guaranteed lifelong retirement income. Among the few programmes that allow unrestricted use of alternative payout solutions are *PERCO* in France, individual pension accounts in Sweden, and pillar 3a restricted accounts in Switzerland, all of which are still relatively small.

We also find that regulation for old-age saving programmes in Europe is quite complex. Even within a single country, regulations regarding the use of accumulated assets in retirement typically vary between different schemes. The only exceptions are the UK and occupational schemes in Italy, where one set of regulations applies to all tax-supported funded pension payout schemes, independent of the origin of funds. In both countries, however, this simplified regulation only applies to new pension schemes. To date, the US is the only country among those surveyed that does not impose restrictions on the choice of payout instruments, leaving retirees with a lot of freedom and flexibility regarding the use retirement funds. Recently, however, a political debate emerged over mandating at least partial annuitisation, driven by the low voluntary annuity take-up.

Restrictions on the use of capital in retirement can be imposed in two ways. Either regulators rely on outright restrictions, directly prescribing the use of funds at retirement, or they employ implicit restrictions, e.g., tax penalties as well as legal or regulatory uncertainties, as a means to channel the demand for payout products into

Table 1. *Overview of representative funded pensions programmes*

Programme name	Accumulated assets (€ bn)	In % of GDP (%)	In % of general government gross debt (%)
Austria			
Pensionskasse	16.36	5.3	6.2
Prämienbegünstigte Zukunftsvorsorge[1]	5.71	1.8	2.2
Mitarbeiter-Vorsorgekassen[2]	5.28	1.7	2.0
France			
Article 83 of Code General des Impôts	39.60	1.9	1.8
Article 39 of Code General des Impôts	32.56	1.6	1.5
Madelin-Law	23.95	1.2	1.1
PERP[3]	7.47	0.4	0.3
PERCO[4]	6.70	0.3	0.3
Germany			
Pensionskasse	123.44	4.7	5.2
Occupational life insurance	55.58	2.1	2.4
Riester-Programme	29.21	1.1	1.2
Rürup-Programme	11.08	0.4	0.5
Pensionsfonds	23.22	0.9	1.0
Italy			
Closed funds	30.17	1.9	1.4
Retirement insurance policies	16.09	1.0	0.7
Open funds	10.08	0.6	0.5
Sweden			
Occupational	49.64	12.1	24.9
PPM[5]	59.98	14.7	30.1
Individual pension account	77.39	18.9	38.8
Switzerland			
Occupational	250.82	51.1	116.8
Pillar 3a insurance	113.76	23.2	53.0
Pillar 3a restricted accounts	38.77	7.9	18.0
UK			
Occupational (all types)	2,365.27	122.8	118.2
USA			
Total IRA[6]	4,336.13	35.5	33.4
Total 401(k)	2,397.35	19.6	18.5

Notes: Programmes open to new participants (excl. government employees). Programme size based on the latest information available (ranging from 2009 to 2013). For non-Euro countries: Exchange rates as published by the Financial Times on 18th July 2013.

[1] Prämienbegünstigte Zukunftsvorsorge – Sponsored Retirement Provision.

[2] Mitarbeiter Vorsorgekassen – Employee Provision Funds.

[3] PERP (Le **P**lan d'**É**pargne **R**etraite **P**opulaire) – People's Retirement Savings Plan.

[4] PERCO (Le **P**lan d'**É**pargne pour la **R**etraite **C**ollectif) – Group savings plan for retirement.

[5] PPM (**P**remie**p**ensions**m**yndigheten) – Premium Pension Agency.

[6] IRA – **I**ndividual **R**etirement **A**ccount (ranging from 2009–2013). (see note above).

Sources: OECD (2013); Austria: ÖNB (2013a), FMA (2012), ÖNB (2013b); France: FFSA (2011), AFG (2012); Germany: BaFin (2011), BaFin (2012), Schwind (2013), GDV (2012); Italy: Covip (2012); Sweden: OECD (2012), SPA(2012), Statistics Sweden (2013); Switzerland: BFS (2011), SVV (2009), Schweizerische Nationalbank (2013); UK: ONS (2013); USA: DOL (2012), ICI (2013).

Table 2. *Funded pension programmes restricting payout product choice*

Programme name	Description of restriction	Classification of restrictions
Austria		
Pensionskasse	Annuitisation required by regulation.	Total annuitisation
Prämienbegünstigte Zukunftsvorsorge	Annuity payouts not taxed, all other payout arrangements taxed. All other payout arrangements trigger partial refund of state subsidies received during the saving phase.	Tax/subsidy advantages of annuitisation
Mitarbeiter-Vorsorgekassen	Annuity payouts not taxed, all other payout arrangements taxed.	Tax advantages of annuitisation
France		
Article 83 of Code General des Impôts	Annuitisation required by regulation.	Total annuitisation
Article 39 of Code General des Impôts	Annuitisation required by regulation.	Total annuitisation
Madelin-Law	Annuitisation required by regulation.	Total annuitisation
PERP	Annuitisation required by regulation.	Total annuitisation
Germany		
Pensionskasse	Annuisation required for older contracts, some new contracts allow for partial lump sum payments. *Riester* contracts available.	Restricted availability of non-annuitising solutions
Pensionsfonds	Payout restrictions as for the *Riester* contracts (§3Nr. 63 EStG, Riester).	Age-connected partial annuitisation
Riester-Programme	Annuitisation of funds at age 85 at the latest. Non-decreasing periodic payouts before annuitisation. 30 % of the capital can be paid out as a lump sum. (Alterseinkünftegesetz, Altersvermögensgesetz)	Age-connected partial annuitisation
Rürup-Programme	Annuitisation required by regulation.	Total annuitisation
Italy		
Closed funds	50 % of the funds annuitised at the beginning of retirement.	Partial annuitisation
Retirement insurance policies	50 % of the funds annuitised at the beginning of retirement.	Partial annuitisation
Open funds	50 % of the funds annuitised at the beginning of retirement.	Partial annuitisation

Table 2. (*cont.*)

Programme name	Description of restriction	Classification of restrictions
Sweden		
PPM	Annuitisation 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.	Partial annuitisation
UK		
Occupational (defined contribution)	25 % of the funds can be paid-out as a tax-free lump sum. From 6 April 2011, no requirement to buy an annuity at the age of 75. Minimum Income Requirements (currently: secure pension income for life of at least GBP 20,000 a year) determine whether withdrawal cap applies. Cap is determined by an equivalent annuity the drawdown pension fund would buy. Annuity is calculated by using specified GAD tables. Revision every three years up to the age of 65, afterwards annual revision.	Drawdown tied to annuity factors if Minimum Income Requirements are not met

Source: Austria: FP (2013), VVÖ (2013), BMSVG (2010), Uniqua (2013); France: CGI (2013), FFSA (2013); Germany: FRG (2013); Italy: Pensplan (2012); Sweden: SPA (2012); Switzerland: SE (2013); UK: TPR (2013), TPAS (2013), HMRC (2013).

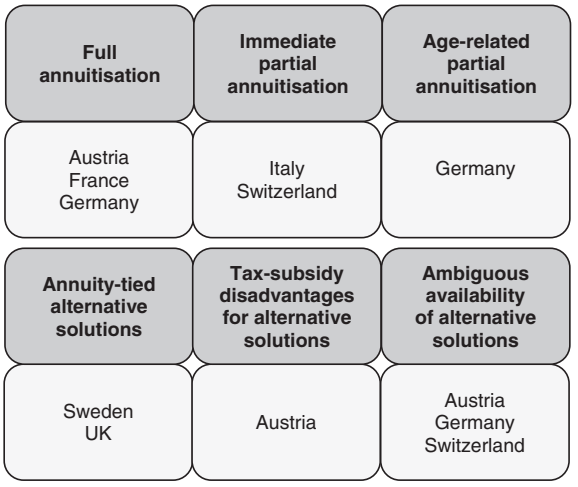

Figure 1. Classification of payout product choice restrictions.
Source: Authors' compilation based on the sources referred to in Table 2.

the desired direction. The majority of countries surveyed use outright restrictions, mostly mandating the purchase of traditional pooled products (annuitisation) in retirement. Restrictions employed in the surveyed countries can be classified as outlined in Figure 1[4].

Several pension schemes mandate full annuitisation of accumulated funds directly at retirement (Box 1 in *Row 1*). Among those programmes are the Austrian *Pensionskasse*, several French programmes (*Article 83*, *Article 39*, *Madelin-Law*, and *PERP*), as well as German *Rürup* plans. Some countries impose less strict annuitisation requirements (Boxes 2 and 3 in *Row 1*): Immediate *partial* annuitisation is mandated in Swiss occupational saving plans as well as under the new regulations for funded pension programmes in Italy. Partial annuitisation of funds may not be required immediately, but may be tied to reaching a certain age, such as age 85 in case of the German *Riester* programme. Annuity-tied alternative payout solutions are available in Sweden for the funded part of the statutory pension system and in the UK for all tax-supported funded pension plans (Box 1 in *Row 2*). Here, the maximum periodic payout for a non-pooled solution is determined by the amount the retiree would have received, had he converted the savings into annuity.

An alternative approach to restricting payout product choice in retirement is to explicitly and deliberately discourage using non-pooled solutions through taxation (Box 2 in *Row 2*). The Austrian *Prämienbegünstigte Zukunftsvorsorge* and *Mitarbeitervorsorgekasse* are good examples for this approach. Alternative payout solutions, particularly lump sum payments, are not prohibited per se, but they are subject to taxation, while annuity payments are largely tax-free. Only very high annuity payments from the abovementioned programmes are subject to partial taxation. Additionally, when alternative payout solutions are chosen for

[4] Maurer and Somova (2009).

Prämienbegünstigte Zukunftsvorsorge, 50% of direct state subsidies received during the saving phase must be returned to the state.

A final approach to restricting product choice is more subtle (Box 3 in *Row 2*). While not explicitly prohibiting non-pooled solutions, several countries do not explicitly allow them either. The lack of regulatory information on the status of non-pooled products prevents potential retirees from demanding them and, as a result, they are not offered. The German *Pensionskasse* is a good example. Current legislation does not require complete and outright annuitisation of funds saved within the *Pensionskasse*. Yet, almost all of the nearly 160 *Pensionskassen* require outright annuitisation, and only a small number allow partial lump sum payments at retirement. Only recently, some *Pensionskassen* have begun to offer *Riester* plans, which by law allow a one-time lump sum payment of up to 30% of accumulated funds. Similarly, there is no official definition of permissible withdrawal products in Austria and Switzerland. In the absence of explicit restrictions or permissions, traditional thinking seems to limit product choice at least in the saving phase. While savers are free to choose between insurance and bank products in the tax-supported third pillar of the Swiss old-age saving system (pillar 3a savings), insurance assets are four times larger than those in the non-pooled, restricted old-age accounts[5]. The latter, however, do not offer standardised drawdown products and are mostly paid out as a lump sum.

4 Dynamic portfolio choice in retirement under regulatory restrictions

4.1 Motivation and research design

Regulation of payout products has its merits, but it also comes at a price. Rules have to be defined, implemented, and supervised, resulting in additional fees and duties. While these costs are measurable, the bulk of regulation costs are not directly observable. This particularly includes the utility losses suffered by those prevented from purchasing the desired payout products and thereby from structuring retirement cash flows in accordance with their preferences. Hence, in order to balance advantages and costs of regulation, it is vital to develop a framework that helps quantifying the utility impacts of product choice restrictions.

To this end, we implement a dynamic portfolio choice model and derive optimal consumption and investment patterns for a risk-averse male retiree that faces uncertain lifetime and stochastic capital market returns[6]. The retiree is endowed with a certain level of savings, accumulated during the active working life (pre-existing wealth), and an exogenous pension income in form of life-long, inflation adjusted fixed annuity benefits. This pre-existing pension income may be drawn from the statutory pension system, other social security arrangements, or from occupational pension systems of the defined benefit variety. This income is assumed to be at least

[5] Schweizerische Nationalbank (2007, pp. 31, 73); Schweizerischer Versicherungsverband (2007, pp. 12–14).

[6] We do not account for consumption shocks, e.g., resulting from uncertain medical or nursing expenses. This can be justified by the relatively high level of medical insurance coverage, especially in continental Europe. In addition, we do not analyse the interaction between the accumulation and decumulation phase.

equal or above the subsistence level. At the beginning of every year, the retiree has to decide how much to consume and how to invest his liquid wealth into risky stocks, risk-free bonds, and new illiquid fixed-payout life annuities in order to maximise his (expected) utility.

We first derive optimal policies in an unrestricted world, in order to have a benchmark against which we can evaluate the utility implications of preventing the retiree from following the optimal strategy by mandating annuitisation. Then, we quantify the utility losses from restricting product choice in retirement by integrating the three stylised restrictions defined in the previous section, i.e., immediate full annuitisation at retirement, immediate partial annuitisation at retirement, and deferred annuitisation. Finally, we look at the impact of mandating annuitisation on individuals that, for behavioural reasons, exclude annuities from their investment menu.

4.2 The model

Following Horneff *et al.* (2008*a*), we assume that the retiree maximises expected utility drawn from consumption and bequest, based on a recursively defined, additively time-separable utility function of the constant relative risk aversion (CRRA) type:

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

with terminal utility

$$V_T = \frac{(C_T)^{1-\rho}}{1-\rho} + \beta \cdot E_T\left[k \cdot \frac{(B_{T+1})^{1-\rho}}{1-\rho}\right]. \tag{2}$$

Here, C_t denotes the consumption level at time t, subject to being alive at that point in time. B_t represents the remaining financial wealth to be bequeathed, in case the retiree dies at time t. The retiree's subjective probability of surviving from t to $t+1$ is represented by p_t^s and calibrated to the German population male mortality table (2004/2006). The curtailed lifetime T is set to age 100, i.e., $p_{100}^s = 0$;. The parameter ρ represents the coefficient of relative risk aversion that also reflects the retiree's willingness to engage in intertemporal substitution of consumption. We set ρ to 5, a standard value in the life-cycle literature representing a retiree with moderate risk aversion (see, for example, Horneff *et al.*, 2008*a*). The parameter β, which we set to 0.96, reflects the retiree's time preference and k the strength of his bequest motive. For $k > 0$, the retiree has a bequest motive and will always keep some liquid wealth. For our analysis of investors with bequest motive, we set k to a moderate level of 2, which is comparable with calibrations in Cocco *et al.* (2005).

Each year, the retiree has to decide how to distribute current cash on hand W_t to consumption C_t, financial wealth S_t, i.e., stock and bond investments, and the purchase of additional inflation-indexed life annuities A_t. Hence, the budget constraint at time t is given by:

$$W_t = S_t + A_t + C_t, \tag{3}$$

resulting in next period's cash on hand of:

$$W_{t+1} = S_t \cdot (R_f + \pi_t \cdot (R_{t+1} - R_f)) + L_{t+1} + Y, \tag{4}$$

where π_t denotes the fraction of financial wealth invested in risky stocks, R_f denotes the real bond growth rate, and R_{t+1} the risky stock return. The annual income from all previously purchased annuities is L_{t+1}, and $Y_t = Y$ represents the constant real lifelong annual pension income. If the retiree perishes at $t+1$, pension and annuity payments cease, and the remaining estate is given by $B_{t+1} = S_t \cdot (R_f + \pi_t \cdot (R_{t+1} - R_f))$. Moreover, the retiree is prevented from borrowing against future pension income and annuity payouts, as well as from short-selling stocks, bonds, or annuities.

In our base case, we set the annual real return on the risk free asset to 2%. Furthermore, we assume that the annual real return on stocks is i.i.d. log-normally distributed with an expected return of 8% and a volatility of 25%. To study the sensitivity of our results with respect to the capital market calibration, we also use a more pessimistic parameterisation in line with Gomes *et al.* (2008). Here, the real annual risk-free return is set to 1%, the expected real return on stocks is reduced to 5%, and the volatility of stock returns is set to 20.5%.

In addition to stocks and bonds, the retiree has access to real fixed payout life annuities. Based on the actuarial principle of equivalence, at age x, the price of a payout annuity with fixed lifelong payments of $L_t = 1$ is given by:

$$A_t = \sum_{t=1}^{T} \frac{{}_t p_x^a}{(R_f)^t}. \tag{5}$$

Here, ${}_t p_x^a = \prod_{i=0}^{t-1} p_{x+i}^a$ is the cumulative conditional probability for an individual aged x to survive until age $x+t$, according to the mortality table used by the insurer to price the annuity. These annuitants' survival rates may differ from the subjective survival probability p_t^s, reflecting adverse selection in the annuity markets (see Brugiavini, 1993). In our base case, we price annuities using survival probabilities from the German DAV 2004 R male annuitants' mortality table with base year 2008. We incorporate the DAV's first-order mortality trend to account for future mortality improvements. Moreover, we do not curtail the lifetime to age 100 for pricing the annuity but calculate with a maximum age of 121, i.e., the final age in the DAV table. Consequently, annuity prices include substantial implied cost loadings; about 37% at age 65 when compared with prices calculated using the population table. To evaluate the impact of these loadings on our findings, we also conduct our analysis under the assumption that annuities are priced using the population mortality table.

To analyse the influence of the level of pre-existing pension income on the utility implications of product choice restrictions, we study three alternative levels of retirement wealth relative to the exogenous annual pension income. We set this financial wealth-to-pension income ratio (*WPR*) to 2, 5, and 10. Retirees with a *WPR* of 2 already have a high exposure to annuities compared with their other assets, for example due to a generous pre-existing pension, whereas those with a *WPR* of 10 only receive a comparably small pension income. For the 17 countries of the Euro area, Eurostat (2013) reports a median equivalised net income of € 15,758 for the population age 65 and older in 2011 (the last year available). Based on this pension income,

our *WPR* calibrations lie within the range of the lower three quintiles of the total wealth distributions of retirement-aged European households (see Börsch-Supan *et al.*, 2005, Table 4A.5).

We solve the 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. Based on the optimal consumption and investment policies derived, we conduct an extensive Monte Carlo simulation of 10,000 independent life-cycles to evaluate how the retiree's consumption, investments in liquid assets, and annuity purchases are expected to evolve over time. For further details on the numerical solution technology, we refer the reader to Horneff *et al.* (2010).

4.3 Optimal unrestricted investment and consumption strategies in retirement

We begin our quantitative evaluation of the utility implications of restricting product choice in retirement plans by analysing the optimal consumption and investment patterns for male investors that live in an unrestricted world. Figure 2 presents the expected evolution of key parameters as well as the expected asset allocation throughout the retirement phase for a retiree with a moderate wealth-to-pension ratio ($WPR = 5$) and without bequest motives for our baseline calibration of capital market parameters. *Panel A* of Figure 2 illustrates expected consumption, pension and annuity income, annuity wealth, the amount of new annuity purchases, and liquid wealth in each year, starting at retirement age 65 and ending at age 100. All parameters are normalised by pre-existing annual pension income. *Panel B* of Figure 2 shows the corresponding expected allocation to stocks, bonds, and annuities over time, where the investment in annuities, i.e., the annuity wealth, is measured by the actuarial present value of previously purchased life annuity claims.

At retirement, the investor receives a pre-existing, external pension income of 1 and holds financial wealth of 5. At this point in time, he withdraws approximately 1.5 for consumption purposes, spending the entire income from pre-existing pensions as well as about 10% of financial wealth. The largest fraction of remaining wealth, approximately 4.25, or 92%, is invested in stocks. Bonds only account for about 8% of the retiree's wealth, while voluntary annuity purchases, and hence annuity wealth, are virtually zero. In subsequent periods, consumption, although slightly falling, remains well above periodic pension income, resulting in decreasing financial wealth. While the amount invested in risky stocks is slowly reduced, the retiree starts purchasing additional annuities from age 67 and continues to do so until the mid-80s. Consequently, the retiree's periodic income increases as does annuity wealth. By the mid-70s, annuities have completely crowded out the equally risk-less bonds due to the extra return generated through the mortality credit. At this point in time, the individual holds 84% of his total wealth in stocks and 16% in annuities. Annuity wealth reaches its maximum around age 80 and declines thereafter, as diminishing annuity purchases cannot overcompensate the reduction in present value, which is due to progressing payments and increasing mortality. With liquid financial wealth being exhausted by the mid-90s, the retiree is fully invested in annuities and can no

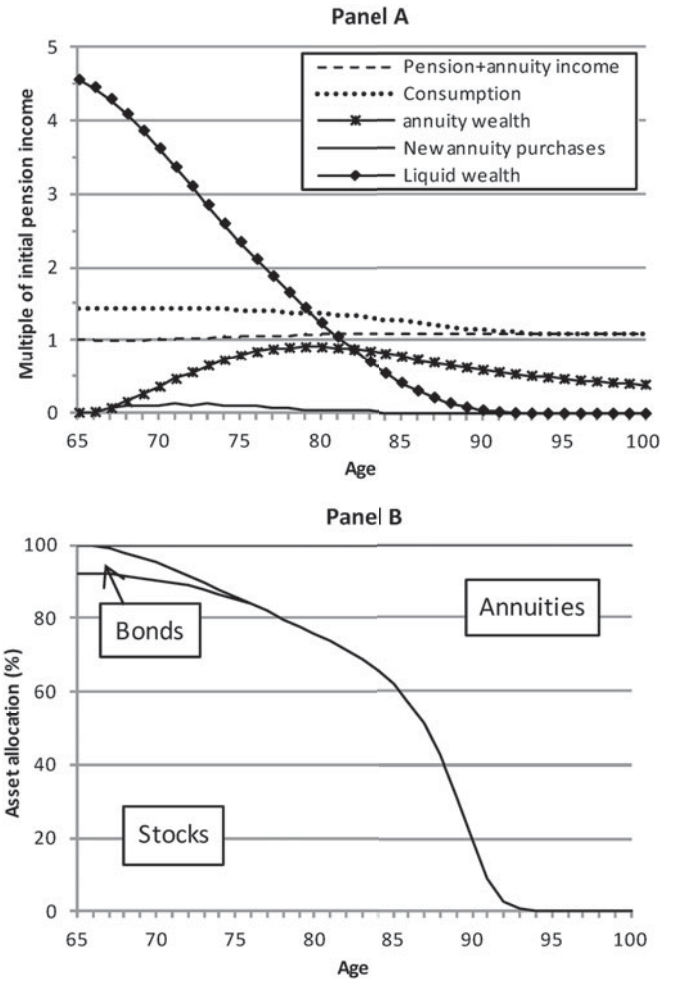

Figure 2. Expected life-cycle profiles and asset allocation – no bequest motive. Notes: Male retiree age 65. Moderate wealth/pension ratio ($WPR = 5$). No bequest motive ($k = 0$). Expected stock (bond) returns: 8 % (2 %), return volatility stocks (bonds): 25 % (0 %). Mortality assumptions for annuity pricing: DAV 2004 R (year 2008) plus trend.
Source: Authors' calculation.

longer afford consumption in excess of periodic income. Due to the purchase of additional annuities earlier in retirement, however, this periodic income, and therefore consumption, exceeds the initial pre-existing pension income for the rest of the retiree's lifetime.

This picture changes when the investor draws utility from leaving a bequest. Figure 3 again presents the expected evolution of key parameters as well as the expected asset allocation throughout the retirement phase for a retiree with a moderate wealth-to-pension ratio ($WPR = 5$) and our baseline calibration of capital

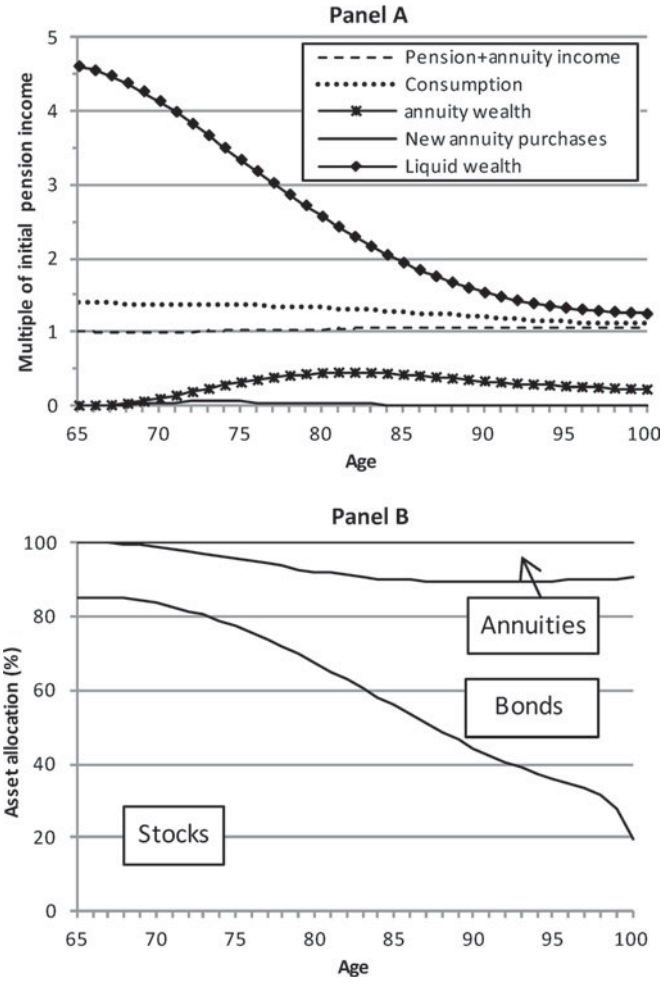

Figure 3. Expected life-cycle profile and asset allocation – moderate bequest motive. Notes: Male retiree aged 65. Moderate wealth/pension ratio ($WPR = 5$). Moderate bequest motive ($k = 2$). Expected stock (bond) returns: 8% (2%), return volatility stocks (bonds): 25% (0%). Mortality assumptions for annuity pricing: DAV 2004 R (year 2008) plus trend.
Source: Authors' calculation.

market parameters. This time, however, the retiree is assumed to have a moderate bequest motive of $k = 2$.

Early in retirement, pensioners with moderate bequest motives consume less and invest less in risky stocks than retirees that do not draw utility from leaving bequests. The initial asset allocation consists of 85% stocks and 15% bonds. Retirees with bequest motives are even more reluctant to voluntarily purchase additional annuities than their counterparts without any interest in bequests, as funds invested in annuities are irretrievably lost when the retiree dies. Annuity wealth only increases

slowly and stagnates at about 10 % of the retiree's remaining wealth from the mid-80s until age 100, despite the substantial mortality credits at later ages. As a result, periodic pension income only rises marginally, and the retiree primarily has to rely on bonds when investing risk-free. Even late in life, the retiree will hold a measurable fraction of his wealth in stocks. With annuities being undesirable due to a lack of bequest potential, only stocks will provide an expected return significantly above the risk-free bond return. Consequently, at age 100, the retiree will still hold 20 % of wealth in stocks, 70 % in bonds, and 10 % in annuities.

Our results are structurally robust with respect to changes in mortality assumptions as well as transaction costs on annuities. Pricing annuities with population mortality tables, i.e., higher mortalities will result in slightly earlier and higher annuity purchases. Introducing a front-end expense load on annuities leads to slightly lower and later purchases[7].

Summing up, we find that retirees with moderate *WPRs* postpone annuitisation and only gradually increase their annuity holdings. Even investors without a bequest motive will not be fully annuitised before the mid-90s. Instead, they use liquid wealth to finance both annuity purchases as well as consumption in excess of periodic income from pre-existing pensions and additionally purchased annuities.

4.4 Welfare implications of mandatory annuitisation

Using our analysis for retirees in an unrestricted world as a benchmark, we now study the utility impacts of mandating annuitisation. To this end, we evaluate three alternative regulatory frameworks that differ in the extent to which product choice in retirement is restricted. In *Case A*, we require the individual to fully annuitise available wealth at retirement age 65, which is in line with current regulations in, e.g., Austria, France, or Germany. For our less strict alternatives, we draw on simplified regulations from two other European countries. In *Case B*, we mandate immediate annuitisation of 50 % of the initial wealth at age 65, imposing no further restrictions on the use of the remaining half of retirement funds. Hence, the retiree may subsequently withdraw funds for consumption purposes or for purchasing additional annuities at any time. Such a set-up is comparable with regulation in, e.g., Italy. In *Case C*, the retiree has to fully annuitise all remaining wealth at age 75. Prior to that, withdrawals are limited to the annual benefit of an immediate annuity purchased at the respective age. This is comparable with regulation in the UK prior to 2011 and in the spirit of German *Riester* programmes.

To evaluate the economic costs of these regimes, we conduct a welfare analysis similar to Mitchell *et al.* (1999) and Horneff *et al.* (2009). For each of the three regulatory frameworks, we determine the expected utility for a given level of initial wealth. We then solve for the level of initial wealth in the unrestricted world that generates the same expected utility. This enables us to measure the utility loss in monetary units. Our findings are summarised in Table 3, which presents the utility impacts of alternative regulations as a percentage change in initial financial wealth

[7] Detailed results are available from the authors on request.

Table 3. *Welfare implications of alternative product choice restrictions – Fully rational individual*

	No bequest motive			Moderate bequest motive		
Pension level	Case A (%)	Case B (%)	Case C (%)	Case A (%)	Case B (%)	Case C (%)
Panel 1: Base case capital market parameterisation/annuitant mortalities						
WPR = 2	−25.0	−9.9	−13.2	−53.8	−14.2	−38.8
WPR = 5	−24.8	−7.0	−13.7	−54.0	−9.6	−37.1
WPR = 10	−19.6	−3.3	−11.2	−43.7	−4.7	−31.1
Panel 2: Base case capital market parameterisation/population mortalities						
WPR = 2	−11.6	−3.9	−2.4	−46.6	−8.2	−28.8
WPR = 5	−10.0	−2.8	−3.0	−38.0	−3.3	−25.1
WPR = 10	−9.0	−2.9	−4.6	−27.7	−2.9	−22.8
Panel 3: Pessimistic capital market parameterisation/population mortalities						
WPR = 2	−8.2	−2.7	−2.7	−46.5	−7.5	−31.1
WPR = 5	−7.3	−2.6	−3.0	−35.5	−2.9	−26.6
WPR = 10	−6.9	−3.0	−4.6	−24.5	−3.0	−23.6

Notes: Change in utility equivalent wealth due to product choice restrictions in per cent of the initial wealth. Case A: Full mandatory annuitisation at retirement. Case B: Mandatory annuitisation of 50% of wealth at retirement, no further restrictions of use of remaining 50%. Case C: Mandatory annuitisation of remaining retirement funds at age 75, prior to that, withdrawals limited to the annual benefit of immediate life annuity purchased at the respective age. Male retiree age 65. No bequest motive: $k = 0$, moderate bequest motive: $k = 2$. Base case capital market parameterisation: Expected stock (bond) return: 8% (2%), return volatility stocks (bonds): 25% (0%). Pessimistic capital market parameterisation: Expected stock (bond) return: 5% (1%), return volatility stocks (bonds): 20.5% (0%). Mortality assumptions for annuity pricing: Annuitant mortalities: DAV 2004 R (year 2008) plus trend. Population mortalities: Population mortality table for German males 2004/2006.
Source: Authors' calculation.

relative to the unrestricted world for alternative bequest motive strengths, *WPRs*, and financial market parameterisations.

First, we turn our attention to *Panel 1* of Table 3, which presents utility impacts of restricting product choice for our base case capital market calibration, when assuming that annuities are priced using annuitant mortality tables. Independent of the level of pre-existing pension income, all forms of mandated annuitisation result in substantial utility losses, especially for retirees with bequest motives. We find that these losses are particularly high for *Case A*, i.e., full immediate annuitisation. For example, a retiree with a moderate *WPR* of 5 and no bequest motive suffers a utility loss equivalent to 24.8% of initial wealth. Stated differently, an individual with an initial endowment of € 100,000 in the most restrictive world is equally well off as his identical twin brother in an unrestricted world who is only endowed with € 75,040 at retirement. For retirees with moderate bequest motives, this loss in wealth even increases to 54%. Retirees with lower *WPR* tend to suffer higher utility losses. These individuals already have a comparably high, inflexible, annuity-like pension income.

Consequently, they appreciate the flexibility offered by liquid assets much more than the marginal increase in periodic pension income this small amount of liquid wealth is able to buy. Retirees with a high *WPR*, on the other hand, only have comparably little pre-existing pension income that can be measurably increased when the substantial endowment is used to purchase additional annuities. Hence, utility losses are slightly smaller than for those retirees with low *WPR*. Nonetheless, their reduction in utility equivalent wealth still amounts to almost 20% when they do not have a bequest motive and to more than 40% in case they are moderately inclined to leave a bequest.

Requiring individuals to only annuitise 50% of their wealth at retirement (*Case B*), considerably reduces utility losses across all *WPR* levels. For retirees without bequest motives, utility losses are cut by more than 60% for a *WPR* of 2 and by even more than 80% for a *WPR* of 10. In the presence of a moderate bequest motive and independent of the *WPR*, *Case B* results in the smallest utility reductions of all restricted cases, as the retiree at any point in time has the opportunity to retain some non-annuitised wealth for bequest purposes.

Now, we turn to our *Case C*, which mandates full annuitisation of remaining funds at age 75 and, prior to that, restricts the use of funds. While utility losses are generally lower than *Case A*, utility losses still exceed those of *Case B*, particularly for retirees with bequest motives. This comes as no surprise, since *Case C* imposes the same strict annuitisation requirements as *Case A*, just deferred by 10 years, during which the freedom of fund use is limited as well.

Next, we are interested in the sensitivity of our results with respect to the underlying assumptions concerning the parameterisation of capital and annuity markets. *Panel 2* of Table 3 presents utility implications of restrictive regulations under the assumption that annuities are priced based on population mortalities instead of annuitant mortalities. Mandating annuitisation reduces adverse selection in the annuity market and enables providers to price annuities using less conservative mortality assumptions, resulting in higher annuity payments. This considerably reduces the welfare losses of mandatory annuitisation, usually by more than half for all analysed restriction types if the individual does not have a bequest motive. Yet, even in this environment, welfare losses from full immediate annuitisation as well as full annuitisation at age 75 are substantial in the presence of moderate bequest motives, ranging from 23% for high-wealth individuals in *Case C* to 47% for low-wealth retirees in *Case A*. *Panel 3* of Table 3 presents the results for our more pessimistic capital market parameterisation and for annuity prices based on population mortality rates. Reducing expected returns on stocks and bonds makes holding liquid financial wealth less appealing. This increases the relative attractiveness of annuities, and utility losses of mandated early annuitisation are lower under pessimistic capital market assumptions than under the baseline calibration. Variations in capital market parameters, however, have substantially less impact on utility than changes in mortality assumptions.

So far, our analysis has solely focused on fully rational individuals, which were shown to suffer substantial welfare losses from mandatory annuitisation. Yet, the discussion in Section 2 showed that real-world individuals may refrain from

Table 4. *Welfare implications of alternative product choice restrictions – behaviourally restricted individual*

	No bequest motive			Moderate bequest motive		
Pension level	Case A (%)	Case B (%)	Case C (%)	Case A (%)	Case B (%)	Case C (%)
Panel 1: Base case capital market parameterisation/annuitant mortalities						
WPR = 2	−25.0	−9.9	−13.2	−53.8	−14.2	−38.8
WPR = 5	−24.7	−6.8	−13.7	−54.0	−9.5	−37.1
WPR = 10	−18.6	−1.5	−10.7	−43.6	−4.1	−31.0
Panel 2: Base case capital market parameterisation/population mortalities						
WPR = 2	−10.0	−2.2	−1.3	−46.6	−7.6	−28.5
WPR = 5	−2.1	5.0	2.3	−36.8	1.4	−22.7
WPR = 10	9.5	13.2	7.6	−20.0	9.8	−13.7
Panel 3: Pessimistic capital market parameterisation/population mortalities						
WPR = 2	−6.7	−0.9	−2.3	−46.5	−7.1	−31.0
WPR = 5	2.6	6.1	2.6	−34.4	2.2	−24. 6
WPR = 10	15.1	14.2	8.7	−15.2	10.6	−14.0

Notes: Change in utility equivalent wealth due to product choice restrictions in per cent of the initial wealth. Case A: Full mandatory annuitisation at retirement. Case B: Mandatory annuitisation of 50% of wealth at retirement, no further restrictions of use of remaining 50%. Case C: Mandatory annuitisation of remaining retirement funds at age 75, prior to that, withdrawals limited to the annual benefit of immediate life annuity purchased at the respective age. Male retiree age 65. No bequest motive: $k = 0$, moderate bequest motive: $k = 2$. Base case capital market parameterisation: Expected stock (bond) return: 8% (2%), return volatility stocks (bonds): 25% (0%). Pessimistic capital market parameterisation: Expected stock (bond) return: 5% (1%), return volatility stocks (bonds): 20.5% (0%). Mortality assumptions for annuity pricing: Annuitant mortalities: DAV 2004 R (year 2008) plus trend. Population mortalities: Population mortality table for German males 2004/2006.
Source: Authors' calculation.

voluntarily purchasing annuities for behavioural reasons, despite the well-understood benefits of annuitisation. This raises the question as to whether mandated annuitisation can actually be utility-increasing for those individuals and as to how the alternative regulatory regimes perform in such an environment. In what follows, we seek to tackle this question within our rational decision making framework. To this end, we repeat our welfare analysis positing that the individual excludes annuities from the investment menu for behavioural reasons, but is fully rational otherwise. Consequently, in all cases A–C, annuities are only purchased to the extent required by our stylised regulation, and welfare is then benchmarked against an unrestricted world without annuitisation. Results are summarised in Table 4.

In *Panel 1* of Table 4, annuities are again priced using annuitant mortality tables. In this scenario, welfare losses are almost equal to those presented in Table 3 for individuals that include annuities in their investment menu. The differences only range between 0 and 2 percentage points. The reason for this can be seen when again looking at Figures 2 and 3. Due to high annuity prices, even fully rational investors

will purchase only a small amount of annuities and only later in life. Hence, there is little difference to an individual that does not purchase any annuities.

This picture changes when assuming that annuities are priced using population mortality tables (*Panels 2* and *3* of Table 4). Welfare losses for behaviourally restricted individuals with low wealth ($WPR=2$) are still comparable with those of their fully rational counterparts. With increasing *WPRs*, however, the utility impact of mandated annuitisation strongly depends on the type of restriction and on whether the individual is willing to leave a bequest. Those with a bequest motive and with higher *WPRs* still suffer substantial welfare losses ranging between 14 and 37% under full immediate and deferred annuitisation (*Cases A* and *C*). With mandated immediate annuitisation of only 50% (*Case B*), however, individuals in fact benefit from regulation, with welfare gains reaching 10% for a *WPR* of 10. Wealthier individuals without a bequest motive enjoy welfare gains under all regulatory regimes. Yet, *Case B* again generates the highest benefits for most scenarios. Here, welfare gains range from 5% for the baseline parameterisation to around 14% in the more pessimistic capital market scenario. Full immediate mandatory annuitisation (*Case A*) will only be preferred if individuals are very wealthy ($WPR=10$) and returns in the capital market are low.

Overall, we can conclude that mandated annuitisation may be beneficial for those that exclude annuities from their investment menu. Yet, as in the case of fully rational individuals, utility implications strongly depend on the type of regulation. Here, our results suggest that, in most cases, fully rational as well as behaviourally restricted individuals have similar preferences regarding the extent to which annuitisation is mandated.

5 Conclusions

In Europe, the majority of funded old-age provision schemes that enjoy statutory support during the saving phase include restrictions on the use of accumulated monies in retirement. Typically, these restrictions take the form of mandatory annuitisation of retirement funds. Looking at seven European countries and the USA, this paper surveys and classifies the types of regulatory rules that limit product choice in the payout phase of funded private and occupational pension programmes.

Subsequently, we integrate stylised payout regulations into a dynamic life-cycle consumption and portfolio choice model and study their impact on the welfare of fully rational individuals as well as of individuals that exclude annuities from their investment universe for behavioural reasons. In line with prior studies, we find that fully rational individuals will only gradually annuitise retirement funds, even in the absence of bequest motives. Liquid wealth will be held at least until around age 90 and mostly in equities. Consequently, mandating investors to fully annuitise at retirement substantially reduces individuals' wellbeing. Wealth-poor individuals without bequest motives may lose up to 25% in utility-equivalent wealth when being required to fully annuitise at retirement. Softening strict annuitisation requirements, however, results in considerable reductions in utility losses. Behaviourally restricted individuals, on the other hand, may actually benefit from being required to annuitise

their retirement funds. Wealth-rich individuals may gain up to 15% in utility-equivalent wealth when being required to buy cheap annuities. But even those individuals will generally prefer less-strict annuitisation requirements.

Central parameters driving the welfare implications of mandated annuitisation are the level of accumulated retirement wealth in relation to pre-existing retirement income as well as the annuity prices. The lower the individual's accumulated retirement wealth the higher the utility losses that result from strict annuitisation rules. This is particularly pronounced in the case of behaviourally restricted individuals, where those with high wealth enjoy substantial welfare increases while those with little wealth in fact suffer measurable welfare losses. This highlights the necessity for regulation to account for the individual's economic circumstances instead of imposing undifferentiated rules for all retirees. With respect to the second factor influencing welfare outcomes, mandated annuitisation has to be discussed in light of the actuarial assumptions underlying the annuity prices. If these are based on highly conservative annuitant mortality tables, welfare losses will be substantial. Yet, if mandated annuitisation reduces adverse selection in the annuity markets and if insurers are able and willing to pass the resulting gains on to the annuitants, welfare outcomes of mandated annuitisation will be much more favourable.

Our findings have implications for both policymakers as well as suppliers of retirement payout products. Policymakers should be aware of the potentially substantial burden they impose on investors and, therefore, should strive to achieve their legitimate regulatory goals at the lowest possible utility cost. On the other hand, it is more than unlikely that average individuals will be able to self-reliantly derive and implement optimal annuitisation and withdrawal policies. Consequently, financial institutions are called on to develop cost-efficient, standardised retirement products, which provide dynamic access to both annuities and liquid investments, while accounting for central characteristics of the targeted retiree group.

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