Richter, Andreas; Ruß, Jochen

Working Paper

Tax arbitrage in the German insurance market

Working Papers on Risk and Insurance, No. 5

Andreas Richter, Jochen Ruß

Tax Arbitrage in the German Insurance Market

Working Papers on Risk and Insurance
Hamburg University

No 5
December 2001

Andreas Richter[1], Jochen Ruß[2]

Tax Arbitrage in the German Insurance Market

No 05
December 2001

ISSN 1617-8653

[1] Dr. Andreas Richter, Universität Hamburg, Institut für Versicherungsbetriebslehre, Von-Melle-Park 5, 20146 Hamburg, Tel.: +49 40 428384016, Fax: +49 40 428385505, Email: richter@rrz.uni-hamburg.de.

[2] Dr. Jochen Ruß, Institut für Finanz- und Aktuarwissenschaften, Helmholtzstr. 22, 89081 Ulm, Tel.: +49 731 50 31233, fax: +49 73150 31039, Email: j.russ@ifa-ulm.de.

Tax Arbitrage in the German Insurance Market

Abstract

In this paper we analyze the attractiveness of a so called "mortality swap", which combines an immediate annuity and a whole life insurance contract, in the German insurance market. The analysis follows a methodology introduced by Charupat and Milevsky (2001). Using theoretical products based on actuarially fair calculation, we find that depending on the level of interest rates there exist significant arbitrage opportunities in particular for elderly and high income people which can mainly be explained by an inadequate and unsatisfactory tax legislation. Empirical results based on products offered in the market confirm these findings.

1. Introduction

In a recent paper, Charupat and Milevsky (2001) analyze arbitrage opportunities in the Canadian insurance market. They compare the rates of return from a risk free investment to those from a certain type of insurance product that has essentially the same cash flow structure. It is shown that this insurance product, which combines an immediate annuity and a life insurance contract, is more attractive than the risk free investment on an after-tax basis. Furthermore, Charupat and Milevsky give empirical evidence showing a significant magnitude of differences in the rate of return for certain cases of age and tax rate. Their empirical results also suggest that the discrepancy increases in age and tax rate.

The insurance transaction considered, which is called a “mortality swap”, is constructed as follows: The income from an immediate life annuity is partly used to pay the premiums for a life insurance contract. Let, e.g., the annuity investment as well as the sum insured in the life insurance contract be € 100. Then, this transaction has the same cash flow structure as a € 100 bank deposit or a bond that yields constant periodic interest payments and pays back the nominal at the time of death.

In our paper we present results concerning arbitrage opportunities involving mortality swaps in the German insurance market under German taxation rules.

The German life insurance market has only been deregulated since 1994. That is why innovative products such as unit-linked insurance contracts still have rather small (but strongly increasing) market shares. For what follows, we focus on traditional (i.e. non-linked) products. Such products have a guaranteed rate of interest (currently at 3.25%). Furthermore, the policies earn some surplus. For single-premium immediate annuities, this means that there is some guaranteed annuity and an annuity resulting from surplus. The latter is not guaranteed but calculations based on expected future surplus rates are used when the product is marketed. For this reason insurance companies have a strong interest in keeping surplus rates stable. This is achieved by accumulating hidden reserves in “good” years (i.e. years in which the return on invested assets is above average) and using these reserves to preserve the surplus in years where the insurance companies earn less.

In our empirical analysis, we assume that the promised annuity including surplus will be paid throughout the life of the contract. This will be justified in section 4.

Following Charupat and Milevsky, we use the term “arbitrage” in a broad sense meaning the existence of economically equivalent investments that lead to significantly different returns. In competitive markets, different investments with exactly the same payoff characteristics should be valued identically. So, the existence of largely equivalent investment opportunities distinctly varying in returns can only be explained by market frictions.

As Charupat and Milevsky argue, their results are mainly due to the way annuities are taxed in Canada: The mortality swap is treated by tax law in a very different way compared to the bank deposit. This, in essence, remains true for our results. The basic principle according to which annuities are taxed in Germany is the same as in Canada: Tax authorities consider an annuity payment as consisting of two portions. One part is used to pay back the invested amount of capital. This part is not subject to taxation, since the invested capital stems from after-tax income. The second portion is considered as interest and thus taxable.

The taxable portion depends on the age of the annuitant when the annuity payments start (which in our case of an immediate annuity means the age when the annuity is purchased) and is given in a certain table in the tax law.[1] The computation method upon which this table is based assumes that a temporary annuity is paid for the period of a male person's expected remaining lifetime, using an interest rate of 5.5 %.[2, 3] Note that here the German method of calculating the taxable portion differs from what Charupat and Milevsky quote for the Canadian market.

Our paper is organized as follows: After the methodology is presented in section 2 and some basic calculations are carried out in section 3.1, we focus on the impact of the described taxation method on arbitrage opportunities in section 3.2: We consider insurance products, which are priced actuarially fair, neglecting any cost and assuming that the market interest rate equals the effective pre-tax yield of the insurance products.

Data from the German insurance market indicate that the return of life insurance products does not fluctuate with market rates. Insurance companies tend to smooth the return of their policies and keep it rather stable. This leads to the effect that – depending on the current interest rate level – the tax-induced arbitrage opportunities can be increased, decreased or even disappear at all. This is taken into consideration in our analysis in section 3.3, where

---

1 See appendix, table 10.

2 See Schmidt (1998), p. 1776. Before 1994 the law was based upon older mortality tables usually including shorter expected remaining lifetimes and thus implying smaller taxable portions.

3 It has to be mentioned that the way annuities are treated by the German tax law has been heavily criticized, as it favors people receiving an annuity as a pension as compared to former civil servants whose pensions are more or less entirely taxed. Effectively an old age pensioner who receives nothing but an annuity of about € 25000 per year would have to pay no taxes if the annuity starts at the age of 65, since then the taxable portion would be 27% and thus below a level considered a non taxable existential minimum. At the moment a decision from the Federal Constitutional Court is expected in this context.

we assume the insurance return to stay on a long term average and calculate the return a bond has to generate to outperform the mortality-swap on an after-tax basis.

Finally, in section 4, we use insurance policies offered in the market to provide empirical evidence for the existence of the arbitrage opportunities suggested by our theoretical analysis.

Our findings confirm to a great extent the results of the paper mentioned above. In the German insurance market, significant arbitrage opportunities can indeed be observed. Possible advantages from purchasing a mortality swap are clearly increasing in the tax rate, and in general also in age. Thus the combined insurance product would be particularly interesting for older people with high income.

Of course, the taxation rules as described above at first raise the question of why two different investment alternatives which behave fairly similarly on a pre-tax basis are treated differently by tax law. But even if regulators choose to set up tax laws in favor of the one or the other type of investment the question remains: Why do both alternatives then survive in the market? Charupat and Milevsky give several reasons for the existence of this arbitrage opportunity. The most important reason is the fact that not everybody can buy the mortality swap, since the whole life insurance requires a good health condition, which is a particular drawback for older people. Secondly, many people may not have enough knowledge of life insurance products to find out how to construct such a mortality swap. Additionally, although the two investment strategies are very similar, there remain certain differences that are explained in detail in section 2. These differences might cause investors to value the strategies differently from our approach.

2. Methodology

The analysis is based on comparing two different investment strategies that yield essentially equivalent return patterns. First, we look at investing an amount N in a coupon bond with a term of T years yielding a constant coupon of c. The cash flow of this product is shown in table 1.

Time	0	1	2,...,T-1	T
Cash flow	$-N$	c	c	$c + N$

Table 1: Cash flow of a coupon bond.

Secondly, we create a portfolio consisting of two different insurance contracts: The first insurance contract is a single premium lifelong annuity, where the insured person pays a premium *P* at time zero and then each year receives a constant annuity payment *A* until he dies. The second insurance contract is a whole life insurance where the insured person pays an annual premium *Q* as long as he lives. Upon death, he receives a death benefit *D*. If we denote the policy birthday after the (stochastic) time of death of the insured person by θ, and assume that all premiums are paid in advance and all benefits are paid in arrear, the cash flow of the portfolio of insurance policies is given in table 2.

Time	0	1	2,...,θ−1	θ
Cash flow annuity	*-P*	*A*	*A*	0
Cash flow whole life	*-Q*	*-Q*	*-Q*	*D*
Sum of cash flows	*-P-Q*	*A-Q*	*A-Q*	*D*

Table 2: Cash flow of the investment strategy involving two insurance contracts.

For *P+A=D*, this structure is equivalent to the coupon bond described above.

Such a portfolio of insurance policies is often called a mortality swap, since the effect of mortality on the effective yield is eliminated by buying one product that pays upon death and another that pays until death. The annuity is often referred to as “pay death/get life”, whereas the whole life insurance is called “pay life/get death”.

Although the structure of the two payoff patterns is essentially equivalent, there are several significant differences. First, of course, the coupon bond has a deterministic, prefixed term whereas the term of the insurance portfolio is stochastic.[4] We will come back to this issue at the end of this section. Furthermore, one might argue that the default risk of the different investment strategies is not the same. It should however be possible to find a bond that matches any given default risk. Additionally, an individual’s health status may make it impossible for him to buy a whole life policy or may lead to an increasing premium. This implies that our strategy only works for people who are healthy enough to get into a whole life contract. Finally, cancellation of insurance products often leads to a significant financial

[4] Of course, one could also look at a bank deposit rather than a coupon bond. This would eliminate the problem of the fixed term of the investment, since the money could be deducted from the deposit at the time of death. On the other hand, however, the effective yield would usually be lower.

loss, in particular with respect to annuities that often pay no surrender value at all. This lack of availability may make the mortality swap less attractive for some people.

In our analysis in sections 3 and 4, we will compare the return after tax of the different strategies. The return of the coupon bond depends on the coupon and the tax rate of the investor. The return of the insurance product depends on the amount of the annuity, the premium for the whole life policy, the age of the insured person and his tax rate. Note that age not only influences the premium for the whole life policy and the amount of the annuity but also the taxable portion of the annuity, cf. section 1.

If the coupon bond has an effective pre-tax yield of $r = \frac{c}{N}$, the effective yield after tax is given by

(1) $$y_{bond} = r(1-t),$$

where t denotes the tax rate of the investor.

For $P+A=D$, the effective yield before tax of the combination of insurance products is given by $\frac{A-Q}{P+Q}$. If we denote the taxable portion of the annuity payment by τ, the effective yield after tax is given by

(2) $$y_{insurance} = \frac{A(1-\tau \cdot t)-Q}{P+Q}.$$

3. Quantification of arbitrage opportunities

In this section, we calculate the effective yield of both investment strategies for different combinations of age and tax rate. For our calculations, we assume that the market interest rate, r_m (the yield of the bond), as well as interest credited to the involved insurance policies, r_i, are deterministic and flat. We furthermore assume all insurance contracts to be calculated net of costs. All our calculations are based upon the mortality table DAV 1994 T (male) of the German Society of Actuaries.[5] Hence – in order to focus on the effect of the tax legislation – these are theoretical insurance products that are not offered in the market.

[5] Note, that we assume the annuity and the whole life insurance to be calculated based on the same mortality table.

In section 3.2, we first consider the case $r_i = r_m$, such that any difference in the effective yield of our different investment strategies results from tax effects. We perform our analysis for different values of $r_i = r_m$.

In section 3.3, we let these rates differ, keeping r_i constant on a long term average suggested by historical market data. The reason is that in Germany, insurance companies tend to keep the surplus of their policies very stable whereas the return of the bond depends directly on current market interest rates. Therefore, we define a critical level of interest rates, r^*, which is the return a bond has to yield before tax, such that the return after tax is the same for both strategies. Thus, for $r_m > r^*$, investing in bonds yields a higher return after tax than buying the insurance contracts, whereas for $r_m < r^*$ the return of the insurance policies is higher. In general, r^* will depend on age and tax rate of the investor.

Some easy calculations show that for given *A, P, Q,*[6] *t,* and τ, r^* is given by

$$(3) \qquad r^* = \frac{A(1-\tau t) - Q}{(P+Q)(1-t)}.$$

Since investing in bonds bears a reinvestment risk due to the prefixed term, r^* can also be interpreted as follows: If an investor has the choice of either investing in the mortality-swap strategy or in bonds (reinvesting upon maturity), then the mortality-swap strategy is preferable, if the average return of the bonds bought is below r^*.

3.1 Basic Calculations

Without loss of generality let P=1. Hence

$$(4) \qquad A = \frac{1}{\sum_{k=1}^{\infty} {}_k p_x (1+r_i)^{-k}}$$

and

$$(5) \qquad Q = (1+A) \frac{\sum_{k=0}^{\infty} {}_k p_x \; q_{x+k} (1+r_i)^{-(k+1)}}{\sum_{k=0}^{\infty} {}_k p_x (1+r_i)^{-k}},$$

[6] Note , that in our model, *A, P* and *Q* can be determined immediately from r_i and the insured's age, *x*, cf. section 3.1.

where x denotes the insured's age when the product is purchased, q_z denotes the probability that a z year old man dies within the next year and ${}_k p_z = \prod_{\upsilon=0}^{k-1}(1-q_{z+\upsilon})$ the probability that an z year old man survives the next k years.

Thus, using (1) and (2), we can compare the post-tax yields of our investment strategies.

3.2 The Case $r_i = r_m$

We first analyze the return of the strategies for given values of market rates and under the assumption that $r_i = r_m$. The relative "outperformance" of the insurance portfolio is given by $\Delta = \frac{y_{insurance}}{y_{bond}}$ and depends on r_i, x and t. Table 3 gives the value of Δ for different values of r_i and x, where we fix the tax rate at 50%. Table 4 shows the value of Δ for different values of t and r_i, for a given age of 50 years. Figures 1 and 2 visualize these results.

x	2,0%	3,0%	4,0%	5,0%	6,0%	7,0%	8,0%	9,0%	10,0%
0	1,0101	1,1458	1,2010	1,2271	1,2404	1,2477	1,2520	1,2546	1,2562
10	0,9916	1,1488	1,2160	1,2494	1,2675	1,2779	1,2842	1,2882	1,2908
20	0,9715	1,1528	1,2336	1,2758	1,2999	1,3145	1,3237	1,3297	1,3338
30	0,9305	1,1424	1,2403	1,2936	1,3255	1,3457	1,3592	1,3684	1,3748
40	0,9047	1,1467	1,2618	1,3268	1,3672	1,3939	1,4125	1,4257	1,4355
50	0,8626	1,1398	1,2746	1,3527	1,4028	1,4370	1,4615	1,4797	1,4935
60	0,8550	1,1593	1,3094	1,3979	1,4557	1,4961	1,5257	1,5482	1,5657
70	0,8727	1,1951	1,3554	1,4509	1,5141	1,5588	1,5920	1,6176	1,6378
80	1,0099	1,3094	1,4589	1,5484	1,6079	1,6503	1,6820	1,7066	1,7262
90	1,2125	1,4600	1,5837	1,6578	1,7072	1,7425	1,7690	1,7895	1,8059
100	1,3031	1,5294	1,6425	1,7104	1,7557	1,7880	1,8122	1,8311	1,8461

Table 3: Outperformance of the insurance product for different combinations of age and interest rate and a fixed tax rate of 50%

t	2,0%	3,0%	4,0%	5,0%	6,0%	7,0%	8,0%	9,0%	10,0%
0,0%	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
10,0%	0,9847	1,0155	1,0305	1,0392	1,0448	1,0486	1,0513	1,0533	1,0548
20,0%	0,9656	1,0350	1,0687	1,0882	1,1007	1,1093	1,1154	1,1199	1,1234
30,0%	0,9411	1,0599	1,1177	1,1512	1,1726	1,1873	1,1978	1,2056	1,2115
40,0%	0,9084	1,0932	1,1831	1,2352	1,2685	1,2914	1,3077	1,3198	1,3290
50,0%	0,8626	1,1398	1,2746	1,3527	1,4028	1,4370	1,4615	1,4797	1,4935

Table 4: Outperformance of the insurance product for different combinations of tax rate and interest rate and a fixed age of 50 years

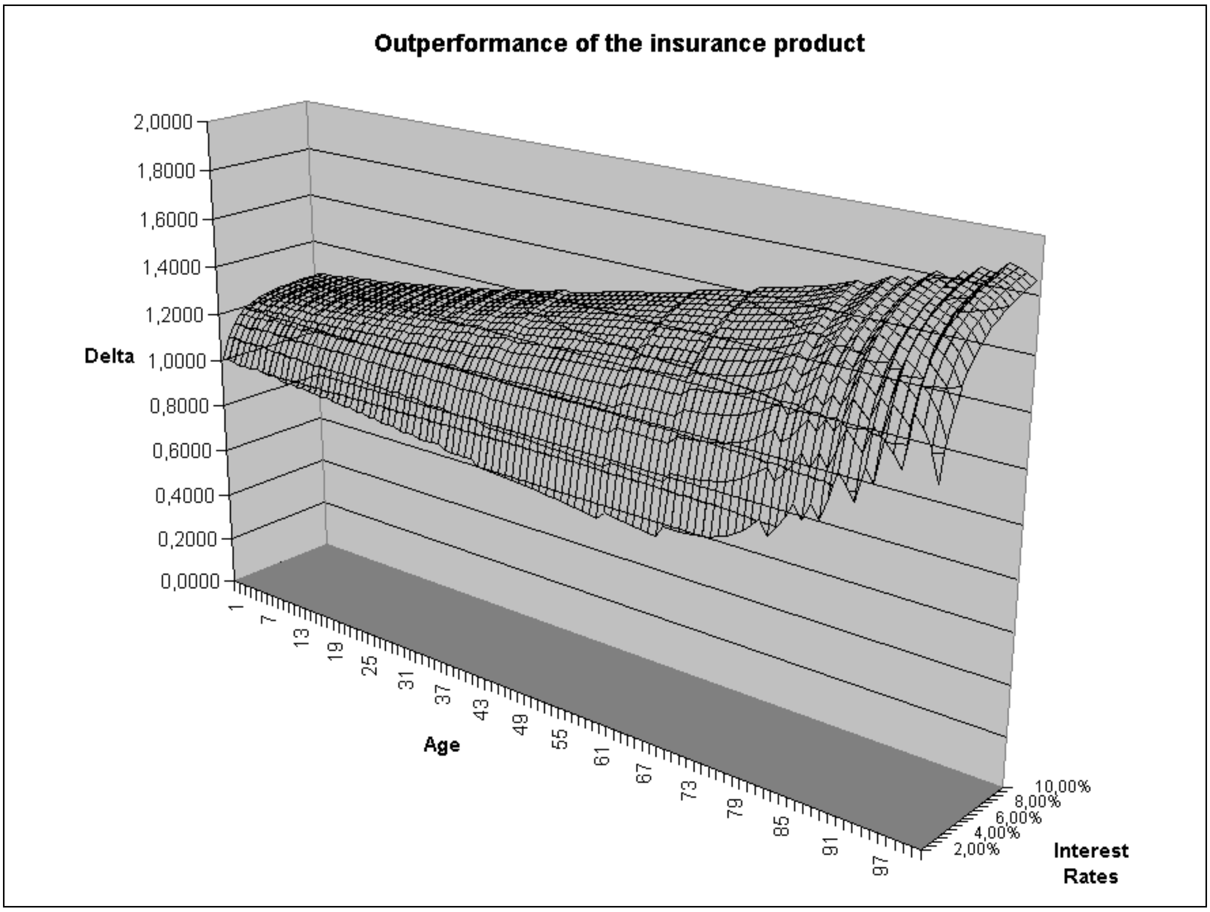

Fig. 1: Outperformance of the insurance product for a tax rate of 50%

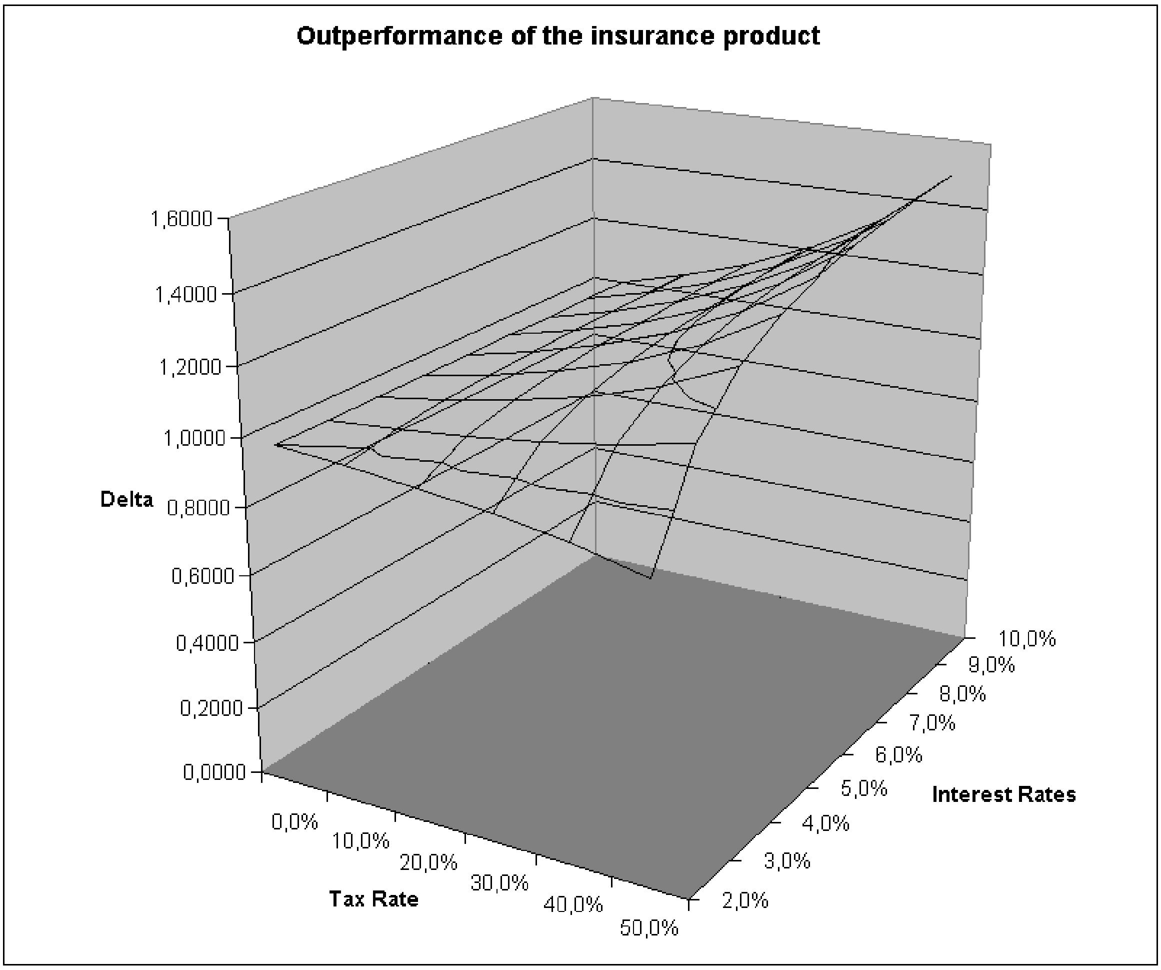

Fig. 2: Outperformance of the insurance product for age 50 years

Insurance is preferable to the bond – i.e. Δ>1 –, for almost any combination of parameters. Since the tax law assumes a constant taxable portion, the outperformance level increases in the interest rate. Furthermore, our calculations suggest that the advantage of the mortality swap also increases in age. An explanation could be that the law – if on purpose or not – favors the elderly. An exception from this can be observed for very low interest rates, where the interaction of Δ and x is given by a u-shaped function. This is due to the fact that in these cases most of the after-tax annuity is used as the life insurance premium.

The slight downward movements for certain ages in figure 1 mostly correspond to those areas where the taxable portion is held constant for subsequent ages. When, e.g., the taxable portion is 11% for x=80 as well as for x=81, the advantage decreases as there is no additional tax advantage that could compensate for the additional insurance premium for the older customer. One has to keep in mind, however, that especially older people that could profit the most from these taxation effects might be faced with major accessibility problems.

The mortality swap is the more attractive the higher the tax rate. Furthermore, for t=0 the two strategies yield the same return. This is not surprising: As we are discussing a tax arbitrage here, one would expect this arbitrage opportunity to increase with the tax rate and to cease in case of no taxation.

The main reason for the existence of arbitrage opportunities is that the assumptions made by the tax authorities for calculating the taxable portions are incorrect. Firstly, they assume an interest rate of 5.5%. Historically, the rates that were attributed to annuity contracts have always been higher. Secondly, the tax authorities assume that everybody lives exactly to his life expectancy. Hence, they systematically misestimate the taxable portion, by calculating the interest part of the annuity based on expected lifetime rather than calculating the expected interest portion. Moreover, the computations are based on values for male persons, ignoring the longer life expectancies of women.[7] The most important flaw in the calculation of the taxable portions, however, is the assumption that the relation between payback of principle and payment of interest is constant over time, whereas it is obvious that – as in a usual payback scheme for debt – the portion of interest should be decreasing in time.[8] This leads to a tax advantage by deferment of taxation.

In addition to the taxation rules for annuities, that allow for the tax free payback of the invested capital, the death benefit is tax free, too. This is another significant distortion in favor of the mortality swap: The entire interest earned on the whole life contract – i.e. the death benefit minus the premiums paid into the whole life policy – is not taxed.

3.3 Different Rates

In the German life insurance market, it can be observed that many insurers – in particular those with large hidden reserves – manage to keep their surplus rates and thus, in our context, r_i, very stable. Long-term experience suggests an average return on the gross premiums of $r_i = 0.062$.[9] In the following, we therefore keep r_i constant at this value, and we calculate r^*, as defined in (3). The insurance portfolio is favorable if $r_m \leq r^*$. The investment

7 Therefore, the values of Δ for female insured persons are even higher than the values for men considered in our analysis.

8 Of course, the taxation could be held constant over the life of the annuity. The calculation of this constant value should, however, take into account that the relation between payback of principle and payment of interest varies over time.

9 See *map-report online* Nr. 430-434 for a survey covering the period 1988-1999.

decision, thus, depends only on r_m. Note, that r^* depends on x and t and hence varies from investor to investor.

Table 5 gives the values of r^* for different combinations of x and t, figure 3 visualizes the results.

x	0%	10%	20%	30%	40%	50%
0	6,200%	6,367%	6,575%	6,844%	7,201%	7,702%
10	6,200%	6,386%	6,619%	6,918%	7,316%	7,874%
20	6,200%	6,409%	6,670%	7,006%	7,454%	8,081%
30	6,200%	6,428%	6,712%	7,078%	7,565%	8,248%
40	6,200%	6,457%	6,779%	7,192%	7,743%	8,515%
50	6,200%	6,483%	6,837%	7,291%	7,897%	8,746%
60	6,200%	6,520%	6,921%	7,435%	8,122%	9,083%
70	6,200%	6,561%	7,013%	7,593%	8,367%	9,450%
80	6,200%	6,625%	7,157%	7,841%	8,752%	10,029%
90	6,200%	6,693%	7,309%	8,100%	9,156%	10,634%
100	6,200%	6,726%	7,383%	8,227%	9,354%	10,930%

Table 5: Critical interest rate for different values of tax rate and age

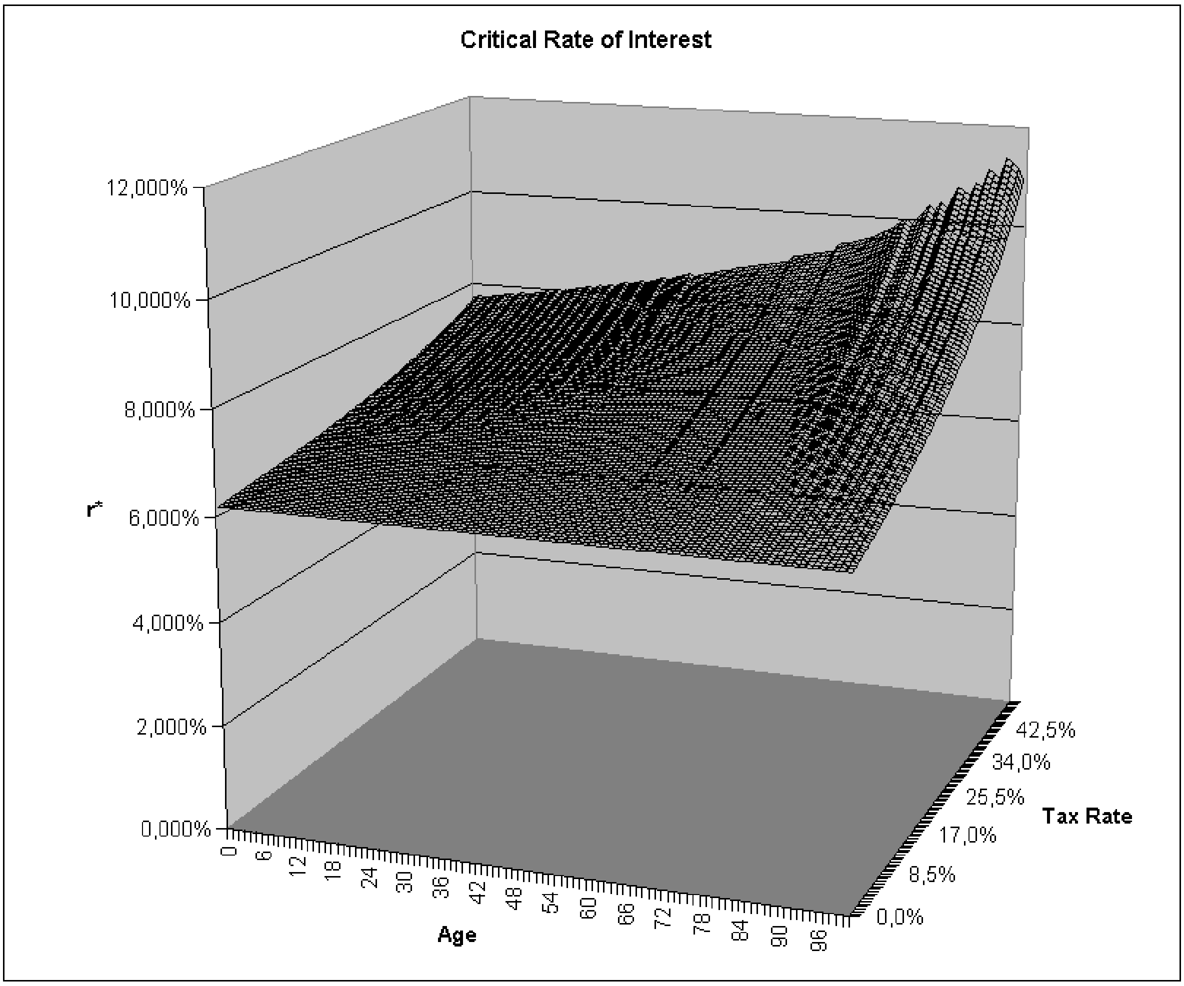

Fig. 3: Critical interest rate for different values of tax rate and age

Obviously, the critical interest rate is equal to r_i when there are no taxes at all. We can see that – as expected – r^* is generally increasing in the tax rate. Again, the results also show that the insurance product is the more attractive the older the customer who purchases the swap (with an exception where the taxable portion remains constant for subsequent years).

4. Empirical analysis

In what follows, we will analyze products offered in the German market and investigate whether the tax arbitrage effects described above can be observed.

4.1 Input Data

As mentioned before, the taxable portion of an annuity depends on the age of the insured person and is defined by tax law. The values for a person aged 30, 40, 50, 60, and 70 are given in table 6. Furthermore, the yearly annuity for a male insured person investing a premium of P=100.000 € is also given in table 6. These values were derived by comparing the offers of German life insurance companies and using the company that paid the highest annuity.[10] Furthermore, table 6 shows the premium for a whole life insurance paying $P+A$ upon death of the insured. Since pure whole life policies are not sold in the German insurance market,[11] we used products from the UK market instead. The premiums were the cheapest available guaranteed rates. They were provided by a provider for online insurance quotes. Finally, table 6 shows the value of A-Q, which is the "coupon" of our investment strategy.

x	τ	A	Q	A-Q
30	60	7152	128	7024
40	52	7656	290	7366
50	43	7944	612	7332
60	32	9168	1651	7517
70	21	11544	4280	7264

Table 6: Taxable portions, annuities and life insurance premiums for different ages.

For these input data, we performed the calculations described in sections 2 and 3.

4.2 Results

The effective yield of a coupon bond depending on the market interest rate and the tax rate can easily be calculated and is given in table 7 for certain combinations of market rate and tax rate. We consider a range of possible interest rates from 4% to 10% in 1% increments and possible tax rates from 0% to 50% in 10% increments.[12]

---

[10] The comparison was performed using the software tool LV-WIN by Morgen & Morgen. Note again, that the annuity is not guaranteed and that we assume future surplus to be stable. Although currently many insurers reduce their surplus due to persistently low interest rates and poor stock market performance, this assumption is fairly reasonable at least for some insurers with good financial strength: There are life insurers whose hidden reserves amount more than 20% of the book value of their assets. They use these reserves to smooth the yearly variations of the investment returns. Thus, the insured person not only invests in a well-diversified portfolio consisting of shares, bonds and other investments, he also receives approximately the same return every year. This return is – roughly speaking – the average return of this portfolio.

[11] There are, however, some similar products where the sum assured is payable upon death or some limiting age (mostly 80 years), whichever occurs first, or where the sum assured is payable upon death but the policy becomes a paid-up policy upon some limiting age of the insured person. Using such policies would still yield similar results, but in this case, the effective yield of the insurance portfolio would depend on the time of death.

[12] The current maximum income tax rate in Germany is 53%. It will be changed to below 50% in the near future.

	0%	10%	20%	30%	40%	50%
4%	4,00	3,60	3,20	2,80	2,40	2,00
5%	5,00	4,50	4,00	3,50	3,00	2,50
6%	6,00	5,40	4,80	4,20	3,60	3,00
7%	7,00	6,30	5,60	4,90	4,20	3,50
8%	8,00	7,20	6,40	5,60	4,80	4,00
9%	9,00	8,10	7,20	6,30	5,40	4,50
10%	10,00	9,00	8,00	7,00	6,00	5,00

Table 7: Effective yield of a coupon bond as a function of market return rate and tax rate.

The return from a coupon bond is compared to that from a mortality swap as described in section 2. The effective yield of the combined insurance product depends on the age of the insured and on the tax rate. It is calculated for the tax rates and the ages mentioned above. The results are shown in table 8 and visualized in figure 4.

x	0%	10%	20%	30%	40%	50%
30	7,02	6,60	6,17	5,74	5,31	4,88
40	7,37	6,97	6,57	6,17	5,77	5,38
50	7,33	6,99	6,65	6,31	5,97	5,62
60	7,52	7,22	6,93	6,64	6,34	6,05
70	7,26	7,02	6,78	6,54	6,29	6,05

Table 8: Effective yield of the insurance product as a function of age and tax rate.

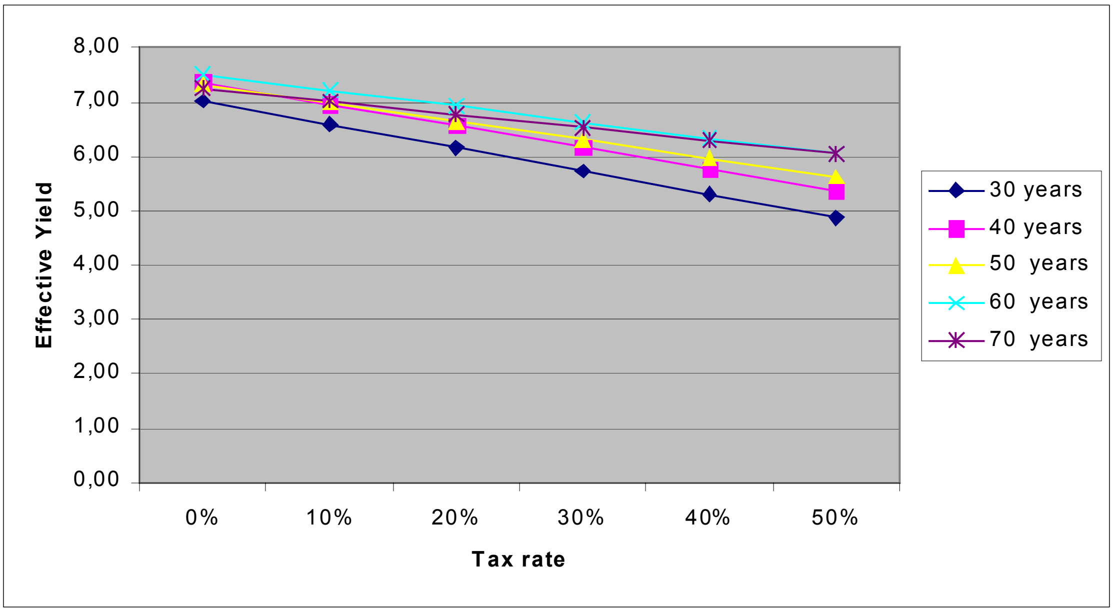

Fig. 4: Effective yield of the insurance product as a function of age and tax rate.

The effective yield of the mortality swap is of course decreasing in the tax rate. It is however decreasing more slowly than the yield of the bond (cf. Table 7). The sensitivity with respect to age is more complicated. On the one hand, since the taxable portion is decreasing in x – too strongly, according to our analysis in section 3 – the effective yield is increasing in x. On the safety margins in the insurance premiums are rising, in particular from age 60 to 70.[13] At this point the increasing price for the insurance products is not leveled out by the additional tax advantage and the increased annuity payment.

The rise in the premiums might be due to adverse selection: Abstracting from the idea of combining both products, a whole life contract is especially attractive for a person in bad health condition while a person in good health condition would favor an annuity contract,[14] given that the relevant information is not or only partly available for the insurer. It can be assumed, that on average a person has collected more accurate information on his or her individual condition the older he or she is, such that the adverse selection problem increases in x. This effect leads to increasing loadings for both contracts and might for high ages cause insurance companies to be particularly careful.

[13] The premium for the whole life policy for x=70 is about 160% higher than for x=60, whereas the theoretical premium according to (4) rises only by about 96%. Similarly, the increase of the annuity between x=60 and x=70 is approximately 26 %, whereas theoretical values would imply an increase of more than 40%.

[14] For evidence of adverse selection in the annuity market, see for example Finkelstein / Poterba (2000) and Doyle / Mitchell / Piggott (2001).

Naturally, as was argued before, the different taxation of the coupon bond on the one hand and the mortality swap on the other gets more important as the tax rate increases. This can easily be seen for any given market return and any given age by comparing the values from tables 7 and 8. But the effect is expressed more accurately by the critical level of interest rate as defined in (3). Table 9 gives the critical interest rate for different parameters. The results are also shown in figure 5.

x	0%	10%	20%	30%	40%	50%
30	7,02	7,33	7,71	8,20	8,85	9,76
40	7,37	7,74	8,21	8,82	9,62	10,75
50	7,33	7,77	8,31	9,01	9,94	11,25
60	7,52	8,03	8,66	9,48	10,57	12,10
70	7,26	7,80	8,47	9,34	10,49	12,10

Table 9: Critical level of interest rate as a function of age and tax rate.

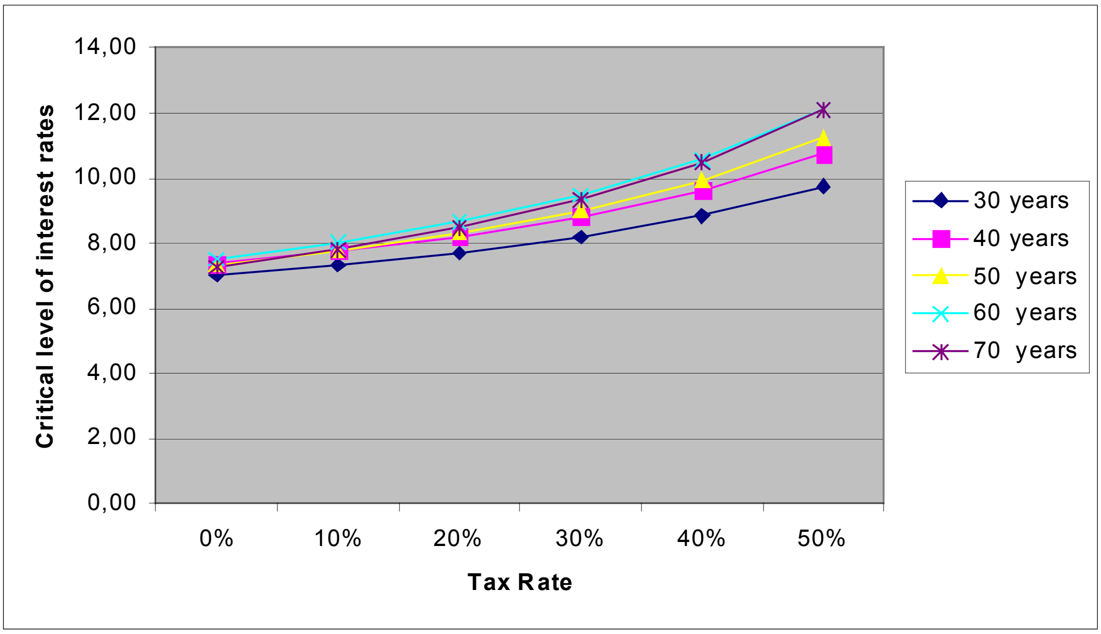

Fig. 5: Critical level of interest rate as a function of age and tax rate.

We observe that, as expected, r^* is increasing in the tax rate. Furthermore it is increasing in x (with the exception of x=60 and 70 for the same reasons as described above). It is interesting that the absolute values of r^* are rather high, exceeding 10% for many combinations of age and tax rate.

6. Conclusions

In the present paper, we analyzed the attractiveness of tax arbitrage strategies by the use of mortality swaps in the German market. Our theoretical analysis indicates that German taxation rules create a bias towards mortality swap investments as opposed to bond investments with essentially equivalent payoff patterns. Empirical results confirmed these findings.

We can conclude that the mortality swap turns out to be an interesting investment opportunity for many cases. It is extremely attractive for people with high tax rates, meaning that it should be taken into consideration especially by high income people.

Our empirical analysis for the German insurance market shows basically the same results as found by Charupat and Milevsky for Canada. Arbitrage opportunities are clearly increasing in the tax rate, and – with the exceptions mentioned above – age.

The attractiveness of the mortality swap can mainly be explained by an inadequate and unsatisfactory method of taxation: Obviously a multitude of flaws entered the formula for the determination of the taxable portion of an annuity, the most serious being the simplification according to which the interest portion of an annuity remains constant over time. Furthermore, the fact that an insured person receives tax free benefits from both contracts enhances this effect.

In terms of future research, analyzing the combination of a temporary annuity and an endowment policy could be of particular interest since this “temporary mortality swap” has an upper bound for the maturity and is hence more comparable to a coupon bond.

References

Schmidt, L. (1998): EStG Einkommensteuergesetz Kommentar, 17th ed., Munich.

Charupat, N. and M.A. Milevsky (2001): Mortality Swaps and Tax Arbitrage in the Canadian Insurance and Annuity Market, *The Journal of Risk and Insurance* 68: 277-302.

Doyle, S., O.S. Mitchell and J. Piggott (2001): Annuity Values in Defined Contribution Retirement Systems: The Case of Singapore and Australia, NBER Working Paper No. W8091.

Finkelstein, A. and J. Poterba (2000): Adverse Selection in Insurance Markets: Policyholder Evidence from the U.K. Annuity Market, NBER Working Paper No. W8045.

Appendix

Annuitants age when annuity payments start	*Taxable portion in %*	*Annuitants age when annuity payments start*	*Taxable portion in %.*	*Annuitants age when annuity payments start*	*Taxable portion in %.*
0 – 3	73	44	49	68	23
4 – 5	72	45	48	69	22
6 – 8	71	46	47	70	21
9 – 11	70	47	46	71	20
12 – 13	69	48	45	72	19
14 – 15	68	49	44	73	18
16 – 17	67	50	43	74	17
18 – 19	66	51	42	75	16
20 – 21	65	52	41	76	15
22 – 23	64	53	40	77	14
24 – 25	63	54	39	78	13
26 – 27	62	55	38	79	12
28	61	56	37	80 – 81	11
29 – 30	60	57	36	82	10
31	59	58	35	83	9
32 – 33	58	59	34	84 – 85	8
34	57	60	32	86 – 87	7
35	56	61	31	88	6
36 – 37	55	62	30	89 – 91	5
38	54	63	29	92 – 93	4
39	53	64	28	94 – 96	3
40	52	65	27	≥ 97	2
41 – 42	51	66	26		
43	50	67	25		

Table 10: Taxable percentage of an annuity according to Par. 22 *Einkommensteuergesetz* (income tax law).

Working Papers on Risk and Insurance

No 5: **Andreas Richter, Jochen Ruß**, Tax Arbitrage in the German Insurance Market, December 2001.

No 4: **Martin Nell**, Staatshaftung für Terrorrisiken?, Dezember 2001, erscheint in: ifo Schnelldienst.

No 3: **Andreas Richter**, Moderne Finanzinstrumente im Rahmen des Katastrophen-Risk-Managements – Basisrisiko versus Ausfallrisiko, September 2001.

No 2: **Martin Nell**, Managed Claims: Zur Notwendigkeit einer vertikalen Integration von Versicherungs- und Reparaturleistungen, August 2001, erschienen in: Zeitschrift für betriebswirtschaftliche Forschung, 53. Jg. (2001), 47. Sonderheft, S. 207-231

No 1: **Martin Nell, Andreas Richter**, The Design of Liability Rules for Highly Risky Activities – Is Strict Liability the Better Solution?, June 2001, forthcoming: International Review of Law and Economics.

For orders please contact / Kontaktadresse für Bestellungen:

Prof. Dr. Martin Nell
Geschäftsführender Direktor des
Instituts für Versicherungsbetriebslehre
Von-Melle-Park 5
D-20146 Hamburg

Tel.: +49-(0)40-42838-4014
Fax: +49-(0)40-42838-5505
E-mail: martin.nell@rrz.uni-hamburg.de
http://www.rrz.uni-hamburg.de/IfVBL/wp.htm

Mit freundlicher Unterstützung des
Vereins zur Förderung der Versicherungswissenschaft in Hamburg e.V.