Short- versus Long-term Risks – Arguments in Favor of PAYG Social Security

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I. Introduction: Incomplete markets and their consequences

The starting point for this presentation is the current debate regarding Social Security privatisation (or at least partial privatisation). Here Social Security is, more than anzthing, an insurance mechanism, insuring participants against longevity risk (i.e. the risk of an abnormal long life), disability and health risk, and in particular market risk, and insuring participants` dependents against the loss of financial support. Thus, we are modeling the problem as a system of risk-sharing contracts.

This in turn means, that financial markets, financial institutions, insurers and other financial intermediaries make for risk allocation. For an optimal functioning of this risk allocation, perfect competitive markets as well as a complete system of markets are needed: Subject to well-known general conditions a competitive equilibrium does exist and is Pareto optimal. However, this beautiful and ideal world of Arrow-Debreu-McKenzie (ADM) leaves several factors out of consideration, which are becoming increasingly important in the contemporary economic discussion:

- Transaction costs, which prevent the existence of many contracts and thus of markets, which are required by the ADM-model.
- Searching costs, for example for a supplier and the appropriate good, outweigh the potential utility gain.
- The difficulties on markets due to informational asymmetries.
- The incentive problems that arise between employers and employees, managers and share holders, financial institutions and their clients.
- The absence of perfect competition, resulting from the existence of long-term financial relationships or from the existence of market dominating financial institutions.
- Non marketable assets such as the psychic costs of a loss or the loss of one’s own human capital.
- ”Social risks”, such as war, earthquakes or nuclear hazards.

- General market risk or systematic risk that cannot be diversified away, in other words, there are macroeconomic, political and technological factors that commonly affect market performance.
- The “generational sequence” points to the problem that the living generation cannot sign contracts with the future or the unborn generation.

The question then is how these factors influence the system of risk sharing contracts which exists. Let me mention two important consequences of this imperfection and incompleteness of markets (Eisen 2004). First, different risks are treated on institutionally devided groups of markets, in which the exact delimitation is fluid or rather fuzzy. The abundance of existing financial and insurance markets such as stock, future, option and insurance markets etc., constitute a large and complex set of markets for the intertemporal allocation and the substitution of risks. Nevertheless they are insufficient in number compared to the set of possible risks, dates and events, which affect usually the plans of economic subjects, and insufficiently connected with each other.

A second important consequence of this incompleteness of markets is that investors are exposed to a market risk, i.e. the competitive price mechanism does no more eliminate the information differences of the market participants. Furthermore, models with a full set of markets have the property that multiperiod contracts are not needed. This conclusion is altered with the introduction of *in*complete markets or with private (*asymmetric*) information. Therefore, there isa need for institutions and intermediaries, which should try to eliminate these risks by intertemporal smoothing. In other words, as markets are incomplete, there will be no complete intertemporal risk adjustment, in fact a decision has to be taken by the intermediaries about the building of a capital buffer. Indeed as Allen and Gale (2000, p. 11) emphasise, this intertemporal smoothing implies that, in some periods, the investors must accept lower returns, compared to what is offered by the market, in order to get higher returns in other periods. This implies that these institutions have to be protected against competition, otherwise it will not be possible to offer this welfare increasing insurance against the macroeconomic fluctuations of market returns.

In the following I will take up this problem: Markets and institutions (or intermediaries) are alternatives performing almost the same functions, but in different manners and with very different results, too. And as a subordinate problem, the question about long run solutions is posed, for which insurances represent the conventional (traditional) alternative. To do this I will proceed in three steps. Firstly, there will be presented some results with respect to long-run insurance contracts which try to cope with the changing environmental conditions and the risk situation, known as "insurance technical risk", and here in particular as "risk of changing conditions". In the second step, the question is taken up how to make such long run insurance contracts safe. To do this, there are two alternatives: On one side, the spot allocation by markets and, on the other side, (a) the intertemporal risk sharing by the accumulation of reserves, as it is generally done by the private insurance, up to (b) the point of mutual solutions or (c) the "generational contract" of social insurance.

II. Short-term Insurance Contracts

II. 1 Short-term contracts and changes of risks

Insurance is called the „business with uncertainty". Then it is natural to cope with this business and the inherent risk and uncertainty with the methods of probability calculus. This is done very succesfully, cf. Beard et al. (1984) and Cummins and Derrig (1989). Insurance, however, is more. It is „by its very nature" (Pfeffer, 1956, p. 5) a dynamic phenomenon: „Any analysis which ignores the changes wrought over time necessarily precludes an adequate treatment of the economics of insurance" (ibid, p. 77).

According to Hicks (1965, p. 28) different methods of dynamic economics are available, of which two will be considered her. Firstly, the classical or static method, and secondly, the temporary equilibrium method. The *static method* starts from the static equilibrium which depends upon parameters of the running period. It is „the single period theory of the dynamic process ... The process is reduced to a sequence of static equilibria" (Hicks, 1965, p. 31).

Within the *temporary equilibrium method* the single periods (in which there is equilibrium) are connected by expectations. To secure an equilibrium over the periods, the expectations must be consistent with themselves and with the processes within the single period, i.e. they must be *ex ante* and *ex post* compatible. In other words, the expectations must (on average) realize – this is the concept of rational expectations of Muth (1961). Taken this complication into account it seems understandable that in insurance economics almost only the static, one-period method is applied. We could speak, euphemistically, of „short-term insurance contracts". There should then, however, exist also „*long-term insurance contracts*", which are (at least in Germany) the rule in life- and health-insurance but exist also in non-life-insurance (e.g. in automobile insurance).

Taken this intertemporal aspect into account, one must realize that the individual risk situation as well as the societal framework are changing, which both comprise the risk-theoretical model (cf. Pentikäinen, 1989). These changes are behind the so called „risk of changing conditions“ which is part of the insurance risk, meaning that „the total loss distribution is not stable in the course of time“ (Pentikäinen, 1989).

Then, however, the question can be posed, who will bear these changes of the risk situation, or otherwise, which risks are insured and which are not insured? The answers to these questions then determine whether „the market“ or other institutions (insurance, banks etc.) are better equipped.

In principle, two extremes can be distinguished: On the one hand, long-term insurance contracts can be modeled as a *sequence* of short-term insurance contracts, on the other hand, only some very specific changes or no changes or adaptations at all are allowed during the total term of the insurance contracts. In the first case, changes of the risk situation are reflected in the short-term (one-period) insurance contracts. In the second case, certain special rules for adapting the premium or the benefit formula are necessary, taking into account also the aim of insurance.

The introduction of multi-period insurance contracts poses some serious problems all of which could not be discussed here: time horizon, discounting, commitment of insurance parties, myopic behavior, re-contracting or re-negotations, „under reporting“ of claims or damages, and the question whether only a monopoly insurer or also competition can support such insurance contracts.

II.2 Sequences of contracts and adverse selection

The starting point be the case of adverse selection (asymmetric information and different risk classes, characterized by different loss probabilities, cf. Dionne/Doherty/Fombaron, 2000). Hence, the insurer will offer a bundle of contracts so that the insured allocate themselves in buying a contract, and the „good“ risks (those with the lower loss prohability) bear the signaling costs. However, after this contract choice is made, the insurer knows the contract type of the insured. As usual, the insured is risk averse and the insurer risk neutral, then the good risks as well as the insurer can gain *ex post* by re-negotation.

This, however, leads to efficiency losses *ex ante*, because the high risks (those with the highest loss probability) can anticipate these re-negotiations and will break-up this self-selection mechanism. Dionne/Doherty (1994) take this argument into account by introducing a time-delay in the revelation of information, and by the commitment of the insurer not to re-negotiate. This model with „semi-commitment contracts“ is shown only graphically[1] in Figure 1.

[Here Figure 1]

Figure 1 shows the following – under the assumption that the high risks decide with a certain probability to choose one or the other combination of contribution (cf. Dionne/Doherty, 1994, p. 217 and Figure 2):

- In the first period a pooling contract (P) is offered, in the second period only separating contracts; here the pooling contract offers only partial coverage.
- In the second period the high risks get full insurance (along the security line), the low risks only partial insurance (coverage).
- The second period contract for the low risks is „experience-rated“, i.e. low risks without a loss in the first period get more coverage in the second period (L_N) than those with a loss, they get only the Rothschild-Stiglitz contract (L_S) in the second period.
- The high risks without a loss get a subsidy in the second period (H_N) in order to induce them to take part in this contract bundle; high risk with a loss get the Rothschild-Stiglitz contract (H_S); insofar, also the high risks are „experience rated“.
- In the first period, the insurer makes a (positive) expected profit used to as a subsidy for the loss-free contracts in the second period.

The continuation of this contract sequence by the insured is guaranteed by the fact that the premiums in the second period are lower than in the first period, called „*high balling*“. However, the decision of the high risks for or against this contract sequence depends upon the interest rate which the insurer offers on the excess premium of the first period: If the interest rate is low, it is expensive for the high risks to pay for the positive transfer in the first period to extend the insurance possibilities in the second period. Hence, there is a *critical interest rate* below which the optimal insurance sequence with semi-commitment cannot dominate the sequence of one-period Rothschild-Stiglitz contracts (Dionne/Doherty, 1994, p. 218).

[1] The mathematics can be found in Dionne/Doherty (1994, Appendix A).

II.3 Sequence of contracts and changes of risks

It is clear that the sequence of contracts in the sense of Dionne/Doherty (1994) does not insure changes of the risk situation of the parties. The semi-commitment of the insurer allows him to receive better (or even complete) information with respect to *the given risk* situation. A change in the risk situation would imply mandatory insurance and full-commitment or other restrictions to competition.The first example here is illustrated by the „guaranteed renewability“ of Pauly/Kunreuther/Hirth (1995).

The idea of the „guaranteed renewability“ starts with semi-commitment of the insurer: Then there is a sequence of premiums so that over the total term of the insurance contract the sum of the premiums (i.e. the total premium) is actuarially equivalent, the insurer commits himself, and the insured have no incentive to denounce the contract. The insured knows that his risk situation can get worse (or better), the insurer has only (sure) statistical information.

To make it as simple as possible, start with an actuarially fair premium, so that $P_i = E_i(L) = p_i L$, i.e. the premium P_i of individual i is equal to the expected loss (fixed L) with probability p_i. Every change in p_i, the probability, induces a change in P_i, the premium. However, unexpected changes in P_i result in variations of life income of the (risk averse) individual. If this potential loss of premium is sufficiently important (measured according to wealth), then the individual wants to insure against this loss of permanent wealth. Neglecting adverse selection, moral hazard, and the cost of insurance, „the existense of some type of optimal competitive equilibrium should not be in question“ (Pauly/Kunreuther/Hirth, 1995, p. 145).

Pauly/Kunreuther/Hirth (1995) develop their idea within a simple three-period model: A loss in one period signals a change of the loss probabilities for the following period(s). Without interest it results: In the first period all risks are the same, namely good risks with p_L. If a loss happens, both the individual and the insurer know that for the next two periods the probability of loss will be p_H. Without a loss the probability will be p_L. A possible equilibrium is therefore a contract for the total (3-period) lifespan, whose premium will be paid in the first period and all losses in later life will be reimbursed.

The share of high risk insured in the second period is p_L, and the share remaining good risks is $(1-p_L)$; the probability of loss in the second period is $p_L\, p_L + (1-p_L)$; in the third period the share of good risks is $(1-p_L)^2$ and the probability of loss is then $p_L p_H + (1-p_L) p_L p_H + (1-p_L)^2 p_L$.

This expression signals three different classes of insured: The proportion p_L having a loss in the first period and classified high risks; the proportion p_L $(1-p_L)$ having a loss in the second period only (and classified hence as high risks); and the proportion having no loss in the 3 period and, hence, still having a loss probability in the third period of p_L.

A possible *equilibrium* is, therefore, a life-long premium P_{LT} which covers changes in the risk (i.e. of expected losses):

$$P_{LT} = \{[(p_L + p_L p_H + (1-p_L)p_L] + [p_L p_H + (1-p_L)p_L p_H] + (1-p_L)^2 p_L\} \cdot L.$$

„Such a policy would obviously fully protect each person against any period-to-period change in probability, which being financially feasible for a competitive insurer whose expected profits under this system of premiums would be zero“ (Pauly/Kunreuther/Hirth, 1995, p. 146).

Even when – for whatever reason – the individuals prefer to pay the premium of this guaranteed-renewable contract (GRpremium) period-by-period, the sequence of premiums $P_1 = p_L \cdot L[1+(p_H - p_L) + (1-p_L)(p_H - p_L)]$, $P_2 = p_L \cdot L[1+(p_H - p_L)]$ and $P_3 = p_L \cdot L$ is a *competitive equilibrium* and *Pareto-optimal* (ibid, p. 147). The GR-premiums of the low risks are equivalent in each period to the expected loss, and there is no subsidization of high risks, therefore, a change of the insurer by the low risks has no effects on the profits of the insurer. In fact, all insured have paid enough premium to accomodate for all possible deteriorations of the risk situation.

The authors find a sequence of premiums which follows a descending path („*high balling*“or front loaded). The longer, therefore, the term of the insurance contract, the higher the excess GRpremium in the first period and the higher the capital fund in the first period to be used to pay for the (increasing) benefits in the second phase.

The second example in this stage is given by the model of Cochrane (1995), called „time consistent health insurance“, published at the same time! Here, explicitely „*high balling*“ is assumed, and besides a pure health insurance contract an „insurance of the premium risk“ is introduced. The idea is that – if the risk situation of the insured deteriorates (by pure ageing or by getting heavy illnesses, e.g. „dread disease“) – these raising premiums are insured. Furthermore, the contract must fulfil a „participation constraint“. For this, one needs only two contracts or securities, i.e. one-period insurance and riskless savings (bank accounts). For insurance, the insured pays the premium P_t in the first part of the period, and the insurer then pays this period’s health expenditures x_t plus a potentially state-contingent severance payment

y_t (Cochrane, 1995, p. 451). If insurers are risk neutral and operate on competitive markets, the insurance premium must equal the expected value of these payments:

$$P_t = E_t(x_t + y_t).$$

To secure the participation constraint, Cochrane (1995, p. 453) introduces a „*health account*“: The insured pays an amount q_t in the first (part of the) period into the account. From this account health insurance premiums, $P_t = E_t(x_t)$ are paid as well as severance payments are paid or received, depending on whether the health (or risk) situation of the individual gets better or worse. The health account evolves as follows:

$$A_{t+1} = (1+r)(A_t + q_t - P_t + y_t).$$

Assuming constant income[2], also the out-of-pocket payment is constant: q_t=q. Since the health account is used only to pay health care or insurance payments, the present value of these payments q_t must equal the present value of health expenses:

$$q = r\beta E_0 \sum_{j=0}^{\infty} \beta^j x_j .$$

Since income and health expenses typically rise with age, „it might make sense to specify a rising schedule of out-of-pocket expenses“ (Cochrane, 1995, p. 454). (In the formula r represent the interest rate, β=1/(1+r) the discount factor in the utility function and x_i the yearly health expenses.) These payments make sure that the health account is always nonnegative. Hence, the fact that health expenses typically rise with age does not matter. The contract combined with this health account can be thought of as a bond, b_t, and therefore, the insured pays a premium equal to one-period expected health costs, $E_t(x_t)$, plus the bond. Therefore, both sides are interested in the continuation of the contract. Dropping the distinction between the individual and the account, the insured pays a premium equal to the current wealth in the account plus q, and this is equal to expected health expenses plus a bond, b_t:

$$P_t = q + A_t = E_t(x_t) + b_t .$$

This bond is so large that the severance payment, y_t, always goes from insurer to insured. Given that there is no change in health, the total amount b_t is returned, „to be posted as a bond again in the next period“ (Cochrane, 1995, p. 456). If in the course of life the difference

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[2] This contant and sure value of income is received in Cochrane’s model by contingent claims or Arrow-certificates on complete contingent/claims markets (1995, p. 451).

between the expected value of health costs of a high risk and that of a low risk decreases (because also the expected life time decreases), the necessary bond decreases.

A comparison between the *guaranteed renewable contract* à la Pauly/Kunreuther/Hirth (1995) and the *time-consistent health insurance* à la Cochrane (1995) reveils the importance of the *severance payments*. According to Pauly/Kunreuther/Hirth all insured of the same age must pay the same premium: „To keep the healthy from defecting to a compeeting insurer, the premium charged to all must be the same as that charged to a healthy person. Therefore, consumers must *prepay* the expected value of the rise in premiums that will occur if they become sick“ (Cochrane, 1995, p. 457). The sick insured depend on the long-term commitment of his/her current insurer, and in case even must enforce it. With time-consistent health insurance à la Cochrane (1995), the sick insured are free to change the insurer. However, in both models the time path of premiums – without taking into account interest rates – is falling („*high balling*“ or front loaded, cf. Nickel, 2003)[3].

III. Security of long-term contracts: Different concepts

III. 1 Pointing the problem: non-insured risks

In all the discussed models of Dionne/Doherty (1994), Pauly/Kunreuther/Hirth (1995) as well as Cochrane (1995) the assumption is made that insurance markets, but also these markets where the (other) income risks are traded, are complete and competitive.

In the Introduction, however, several reason were mentioned why a market system is incomplete and hence only imperfectly competitive. Insofar one observes the division of markets, the question can be posed which risks are insured in the mentioned contracts. It is easy to see that in Dionne/Doherty (1994) only *experience rating within a given risk situation* is present. Both, the *guaranteed renewability* as well as the *time-consistent health insurance* assume that the (probabilistic) changes in risks follow the law of large numbers. Consequently, non-diversifiable shocks and unexpected improvements in medical technology are outside those contracts. Problems could arise because of the extreme experience rating for those individuals who are ill at the start, or were born with genetic defects or come from families with bad case nedical histories (anamnese). Here the question arises whether these risks get subsidized by the state (or are provided with initial health accounts) or whether

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[3] As shown by Hendel´and Lizzeri (2003) this is a spezial case of a much more complicated contract structure. However, the results generally are the same, cf. Proposition 1 (p. 310). They show, however, that the income growth is important.

mandatory insurance for all is the better solution. Within mandatory insurance also other risks could be insured (cf. Eisen, 2005).

Particularly interesting is, however, the following aspect: Long-term insurance contracts, whether as guaranteed renewability or as time-consistent health insurance need long-run security. Even when they are constructed as sequences of short-term (one-period) contracts, the initial higher premiums („*high balling*“) as well as the wealth in the health accounts have to be invested safely! This then poses the questions, how this security can be achieved and at what costs.

III. 2 Security of long-term contracts and the rate of return

If we recognize the long term nature of the investments and the risks emerging in the course of time – an interesting problem arises. Consider the following table.

Table 1: Range of Stock Returns (1926-1974).

Holding Period	Best Return	Worst Return
1 year	+ 53,9 %	- 43,3 %
5 years	+ 23, 9 %	- 12,5 %
10 years	+ 20,1 %	- 0,9 %
15 years	+ 18,2 %	+ 0, 6 %
20 years	+ 16,9 %	+ 3,1 %
25 years	+ 14,7 %	+ 5,9 %

Source: Ibbotson/Sinquefield (1976).

Table 1 shows the extreme rates of return of *a diversified portfolio of US-shares* with respect to the holding period. It seems evident that the span of return decreases with the length of the holding period. Even more: the yearly rates of return get positive for a 15 year or longer horizon. In the background lies the „time diversification“ argument, in the sense of a law of large numbers: If the following returns are independent from one another then the volatility of returns follows the square root of time if the expected returns are a linear function of time! Hence, if the time horizon of investment increases (i.e. the holding period), long-term investment in equities are less risky. However, this is, on the one hand, a *misinterpretation* of the law of large numbers (cf. e.g. Samuelson, 1963, 1969,1994): if $\tilde{x}_1, \tilde{x}_2, \ \ldots \ ,$ are independent and identically distributed random (wealth) variables, $\tilde{x}_1, \tilde{x}_2, + ... + \tilde{x}_n$ has a variance n times as large as the variance of each of these variables. On the other hand, the argument is based on the „*survival bias*“ (cf. Brown et al., 1995): Periods of illness are followed by periods of health – if you do not die in between. In a simulation model, Shiller (2005) estimates the probability distribution of returns of a portfolio based on long-term historical experience (US stockmarket, bond market and money market data 1871-2004 are used). „Assuming that future returns behave like historical data, it is found that a baseline personal account portfolio after offsets will be negative 32% of the time on the retirement date“ (ibid, abstract)[4].

Some years ago, Zvi Bodie (1995) looked at the measurement of risk of a stock portfolio: Considering only the „downside“ risk, he defined the risk of a stock portfolio as the price of an European put option, which – if added to the portfolio – generates the risk-free rate of interest as the (minimum) rate of return of the stock portfolio, insofar the maturity date of the put option is equal to the horizon of the investment. The put option can be considered as an insurance contract, which guarantees the fixed wealth position of the investor. But the price of this put option *increases* with maturity. Not considering that Bodie (1995) took the risk-free interest rate as the floor rate, his result seems relatively sure, if one substitutes the European put by an American put: Bodies' put is not a good insurance against low returns – when the „floor rate“ is below the risk-free interest rate –, because the portfolio is protected only at the maturity date of the put and not before. If the investor goes out of the market before the maturity date, the rate of return can be far lower than the insured rate. This is not the case when the floor rate is equal the risk-free-rate. In order to improve the insurance provided by Bodies' put, consider an American put such that the floor rate is insured at every date. And Roger (2000) proves exactly this: The price of the American put contract is increasing with respect to maturity.

To summarize: Against inspection (as shown by Table 1), long-term security (e.g. via an American put option) can only be arrived at increasing costs[5].

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[4] “Offset“ means that the investor has borrowed from the government to invest in a personal account, and must eventually pay the loan back with a 3 % real interest rate on the loan.

[5] Not taken into account the administration costs of pension funds as well as the “costs” of transition to more capital funding.

III. 3. Non-diversifiable shocks and intergenerational risk allocation

Normal portfolio and hedging strategies cannot eliminate macro-economic shocks and non-diversifiable risks, because – as Allan/Gale (2000, p. 155) observe – they can perform only „cross-sectional risk sharing“, i.e. exchange of risks between individuals at a fixed point of time. Long-term risks, however, need for intertemporally risk smoothing either capital accumulation (with the mentioned problems, cf. III.2) or intergenerational risk sharing.

As written in the Introduction, a systematic reason for incomplete markets is the *incompleteness of market participants*: The private sector cannot allow people to make contracts with children or even unborn future children. To cope with these problems, there are special institutions. Bhattacharya et al. (1998) compare three institutional mechanisms: *intra*generational banking (B), *inter*generational banking (IB), *inter*generational stock and security markets (SM). They show that the choice of a PAYG system (such as B or IB) – in their framework with long-lived capital stock and stochastic life times – may also depend upon a significant degree of relative risk aversion of agents and their low likelihood of „early liquidity“ needs[6]. Furthermore they show that in the steady-state the capital market allocation (SM) is *always suboptimal* compared to IB, even when in certain cases „the SM institutional arrangement ... becomes the unique subgame ... perfect equilibrium of the intergenerational proposal games“ (ibid, p. 295). However, their model – and hence the comparison between alternative intertemporal liquidity sharing or insurance mechanisms – treats only ideosyncratic or individual risks resulting from the uncertainty regarding the preferences („preference shocks“) for their intertemporal allocation of consumption.

What is missing is to take into account *macroeconomic shocks* with respect to certain state variables such as demographic changes and rate of returns on capital.

In this direction Allen/Gale (2000) as well as Demange/Laroque (2000) are moving. Allen/Gale take into account risks that cannot be diversified at a given point in time but nevertheless can be *intertemporally smoothed*, such that the effects on individual welfare are reduced. One strategy involves asset accumulation, the other strategy is intergenerational risk sharing. Incomplete markets, so goes the argument, do not provide for effective intertemporal smoothing, but long-lived financial institutions such as banks can do so, „as long they are not subject to competition from financial markets“ (Allen/Gale, 2000, p. 156). They use a standard overlapping generations (OLG) model with two assets: a risky asset in fixed supply

[6] In particular they show that “the most desirable steady state outcome (the Golden Rule supported by IB) will be reached when people are sufficiently risk averse and are not too likely to require early utilization of their savings (or liquidity)“ (ibid, p. 315).

and a safe asset that can be accumulated over time. Agents, who are either investors or depositors, depending on whether they make investments through financial markets or through banklike intermediaries, face the risk („behind the veil of ignorance“, ibid, p. 158) that they do not know whether she/he will be born in a good state (where the return r_H is high) or a bad state (where the return r_L is low; $r_H > r_L > 0$). It is not possible to insure this risk (of the initial position), „since agents cannot trade before they are born and it is impossible to insure the risk after the uncertainty is resolved“ (Allen/Gale, 2000, p. 158). Allen/Gale (2000) show that the safe asset is never held in the market equilibrium, because it is dominated by the risky asset. The authors then show that intertemporal smoothing can lead to an elimination of the risk through a program of accumulating buffer stocks of the risk-free asset. This storage technology of the (monopoly) intermediary can lead to a higher level of average expected utility than is possible in a market equilibrium. The market equilibrium is not *ex ante Pareto efficient*: „There exist allocations with intertemporal smoothing that make all generations better off ex ante compared to the market equilibrium“ (ibid, p. 157). This inefficency may suggest that this intertemporal smoothing could be implemented by a long-lived intermediary (a bank, a mutual insurer or the state via a PAYG system). Establishing financial markets or intermediaries as different sets of institutions, place the economy on different trajectories. As a result, the combination of „the cross-sectional risk-sharing advantages of financial markets with the intertemporal risk-smoothing advantages of an intermediated system“ meets a significant obstacle (Allen/Gale 2000, p. 179).

However this intertemporal smoothing provided by a long-lived intermediary is fragile, because „competition from financial markets can lead to disintermediation, which causes the smoothing mechanism to unravel“ (ibid, p. 157).

It is interesting to note that intergenerational risk sharing by means of transfer between the old and young at each date does not eliminate the aggregate risk caused by the randomness of the aggregate endowment. Intertemporal smoothing, i.e. accumulating reserves of the safe asset, eliminates this uncertainty at no cost. This implies that there are problems in the first period, or intertemporal smoothing has to be introduced in two stages. In the first stage, the market allocation is altered by intergenerational transfers from the young to the old when the state of the economy is bad (or in other words, the risky asset pays no return), and from the old to the young, when the state is good. Therefore, the expected utility of the initial generation is slightly greater than the market equilibrium level. These amounts are then accumulated in the safe asset. If there are sufficient reserves, the second stage with intertemporal smoothing can be implemented.

In a series of papers G. Demange and G. Laroque (1999, 2000, 2001) have shown in a very similar line, „that a single asset, (which they call) pay-as-you-go social security suffices for the equilibrium to be interim optimal“ (2000, p. 15), such that expected utility at birth for the current living young and old generations and for all future born individuals is larger under all circumstances. However, the question must be answered, which are the characteristics such assets must have used here for the financing of (intergenerational) transfers – insofar as they are not only taxes on wages – and for the intertemporal accumulation. A quote from Paul A. Samuelson (1983) can shed light on this: „In public lectures, I used to complain that two out of the three features that I wanted in a retirement pension were just not avaiable. 1. Not knowing just when I should die, I wanted an *annuity for life*. 2. Not knowing what the future price level would do, I wanted *a real annuity for life* ... 3. Noticing that the average real level of consumption was rising in the modern mixed economies , ... my final unreasonable demand was for an *annuity* that would leave me for life *at the same percentile level* of the working age population’s real living ...“ (p. 279). „By now, you realize that Merton deduced by a stochastic optimal-control maximum that I was right to want my three-pronged pension“ (p. 280).

Furthermore,any change in assets will significantly change the „market portfolio“ and hence the allocation of aggregate risks over time and over generations. Here, the government can reallocate these risks by changing either its debt policy or by taxes and transfers. To secure these types of risk sharing (either at a given point in time or intertemporal or intergenerational), however, an innovative debt policy of government is necessary because differently indexed bonds generate different risk allocations (cf. Bohn, 2002):

1) A *sure government debt e.g.* reduces the fluctuations in consumption of pensioneers, increases however the effects of productivity and population shocks for the working generation and increases their volatility in consumption.

2) *Wage-indexed* pensions guarantee a fixed wage or income replacement rate, however, the contribution rate on wages fluctuates with the demographic developments but not with macro shocks. I. e. the contribution increases with increasing life expectancy (longervity) or shrinking population!

3) *Price-indexed* pensions allocate the risk of longevity exactly as wage-indexed pension, differently however the risk correlated with wages. Promising sure pensions like promising safe debt shifts aggregate risks to future generations of workers.

4) *GDP-indexed bonds* eliminate the effects of productively and population shocks on the contribution of the working generation. However, this makes pensions more positively correlated with productivity and demograhic shocks.

That innovations in this field are necessary,but also possible is underlined by the Chilean UFs (Unidad de fomento) or by the increasing number of inflation-indexed bonds, and by the ideas gathered in R. J. Shiller (2003).

IV. Reform Options and Conclusions

It is interesting to relate the results of this paper to the large debate on social security reform (either social pension or health insurance schemes). Given a competitive equilibrium and a large enough interest rate, the allocation is Pareto optimal and one cannot increase the welfare of some generation without reducing that of others. However, there are other allocations that give a higher expected utility to every one in the long run, with a larger capital accumulation today financed at the expense of current generations. Given that the initial situation is not competitive because of distortions associated with social security contributions, this change toward funded pension plans improves welfare (cf. Homburg/Richter, 1990). However, most reform plans only assess the long-run benefits under plausible nonstochastic forecasts of the demographic trend (e.g. Feldstein/Samwick, 1996, 1997; Kotlikoff/Smetters/Walliser, 1996). However, these ideas are far away from the problems associated with the „crises of social security“: On the one hand, short-run problems connected with unemployment and macroeconomic shocks (oil prices, the fall of the „iron curtain“ etc.); on the other hand, long-term problems related to demographic random shocks, longevity and decreases in fertility. As shown above, capital markets can not cope with these risks in a „cross-section risk allocation“ mannor. Macroeconomic shocks and demographic random shocks, however, need other institutions for implementing efficient intergenerational transfers: the *intertemporal risk-smoothing* as discussed by Allen/Gale (2000) or some form of *pay-as-you-go system* as shown by Demange/Laroque (2000).

However, there are still some open questions. First, how to accumulate the buffer stock of the sure asset at the beginning. Some countries, as e.g. the USA and Sweden are happy enough to have such a capital stock to begin with. Second, it is also an open question, how this solution via a monopolistic intermediary can be protected against competition of (world) capital markets. It can be shown that (almost surely) a generation exists which is better off when investing on the capital market. This, however, destroys the dynamic equilibrium „from the beginning“. The same may happen also with a collective PAYG scheme, so the conjecture may be that a combination of an incomplete set of financial markets to share the risks of the living generations, and a PAYG scheme to provide intergenerational risk sharing (i.e. to allocate the demographic and macroeconomic risks) are in order. With uncertainty and incomplete markets the solutions are, however, only second-best and not longer interim optimal (cf. Demange/Laroque). However, at the end I have here one great caveat: Both „systems“ belong to different „cultures“ – and it is an open question whether the „mixture of cultures“ is a good solution , or will we get more risks by combining than we will eliminate?

Literature:

Allen, F. and D. Gale (2000), *Comparing Financial Systems*, Cambridge/Mass (MIT Press).

Beard, R. E.; T. Pentikäinen and E. Pesonen (1984), *Risk Theory*, London.

Bhattacharya, S.; P. Fulghieri and R. Rovelli (1998), Financial Intermediation versus Stock Markets in a Dynamic Intertemporal Model, in: *JInstitutional and Theoretical Economics* 154, 291-319.

Blake, D. (2003), Take smoothed risks when you are young, not when you are old, *Discussion Paper*, in: (www.lse.ac.uk/ubs/pdf/dp10.pdf).

Bodie, Z. (1995), On the Risk of Stocks in the Long Run, in: *Financial Analysts Journal* 51, 18-22.

Bohn, H. (2002), Retirement Savings in an Ageing Society: A Case for Innovative Government Debt Management, in: A. J. Auerbach and H. Herrmann (eds), „*Ageing, Financial Markets and Monetary Policy*", Berlin et al. (Springer) 2002, 139-181.

Boldrin, M. and A. Rustichini (1994), Equilibria with Social Security, *Core Disc Paper* 9460, Université Catholique de Louvain.

Brown, S. J.; W. N.Goetzmann and S. A. Ross (1995), Survival, in: *J of Finance*, 50, 853-873.

Cochrane, J. H. (1995), Time-consistent Health Insurance, in: *JPolEcon* 103, No. 3, 445-473.

Cummins, J. D. and R. A. Derrig (1989) (eds), *Financial Models of Insurance Solvency*, Boston.

Demange, G. and G. Laroque (1999), Social Security and Demographic Shocks, in: *Ecomometrica* 67 (No. 3), 527-542.

Demange, G. and G. Laroque (2000), Social Security, Optimality, and Equilibria in a Stochastic Overlapping Generations Economy, in: *JPublic Economic Theory* 2, 1-23.

Demange, G. and G. Laroque (2001), Social Security with Heterogeneous Populations Subject to Demographic Shocks, in: *Geneva Papers on Risk and Insurance Theory* 26, 5-24.

Dionne, G. and N. Doherty (1994), Adverse Selection, Commitment, and Renegotiation, in: *JPolEcon* 102, No. 2, 209-235.

Dionne, G., N. Doherty and N. Fombaron, Adverse Selection in Insurance Markets, in: G. Dionne (ed.), *Handbook of Insurance*, Boston et al. (Kluwer), 185-243.

Eisen, R. (1998), Rentenentwicklung und Altersvorsorge: Ein kritischer Beitrag zum 3- Säulen-Konzept der Zukunftsvorsorge, in: *Sozialer Fortschritt* 47, Heft 7, 174-180.

Eisen, R. (2004), Incomplete Markets, in: *Encyclopedia of Actuarial Science* (Wiley).

Eisen, R. (2005), Adverse Selection in the Health Insurance Market after Genetic Tests, to appear in: P.A. Chiappori (ed), *Insurance: Theoretical Analysis and Policy Implications,* Cambridge/Mass. (MIT Press).

Esteban, J. and T. Millan (1990), Competitive Equilibria and the Core of Overlapping Generations Economics, in: *Journal of Econ Theory 50*, 155-174.

Feldstein, M. and A. Samwick

Hicks, J. (1965), *Capital and Growth*, Clarendon Press, Oxford.,

Homburg, St. and W. F. Richter (1990), Eine effizienzorientierte Reform der GRV (An efficiency oriented reform of German social pension insurance), in: B. Felderer (ed.), *Bevölkerung und Wirtschaft*, SVSP 202, Berlin (Duncker & Humblot), 183-191.

Ibbotson, R.G. and Sinquefield, R. A. (1976), Stocks, Bonds, Bills, and Inflation: Year-by-Year Historical Returns (1926-1974), in: *Journal of Business* 49, 11-47.

Kotlikoff, L.; K. Smetters and J. Walliser (1996), Privatizing U.S. Social Security – A Simulation Study, World Bank Economic Development Institut’s November 1996 Conference.

Merton, R.C. (1983), On the Role of Social Security as a Means for Effcient Risk Sharing in an Economy where Human Capital Is Not Tradable, in: Z. Bodie and J. B. Shoven (Hrsg.), *Financial Aspects of the United States Pension System*, Chicago und London, S. 325-358.

Merton, R.C. and P.A. Samuelson (1974), Fallacy of the Log-Normal Approximation to Portfolio Decision Making over Many Periods, in: *JFinEcon* 1, 67-94.

Muth, J. (1961), Rational Expectations and the Theory of Price Morements, *Econometrica* 29, 315-335.

Nickel, A. (2003), *Grundlagen langfristiger Versicherungsverhältnisse,* Verlag Versicherungswirtschaft, Karlsruhe.

Pauly, M., H. Kunreuther and R. Hirth (1995), Guaranteed Renewability in Insurance, *J of Risk and Uncertainty* 10, No. 2, 143-156.

Pentikäinen, T. (1989), On the Solvency of Insurers, in: Cummins/Derrig (eds), 1- 48.

Pfeffer, I. (1956), *Insurance and Economic Theory*, Huebner Foundation for Insurance Education, Homewood/Illinois.

Roger, P. (2000), On the long-run Risk in Stocks: A West-Side Story, *WP*, University Louis Pasteur, Strasbourg.

Samuelson, P.A. (1963), Risk and Uncertainty: A Fallacy of Large Numbers, in: *Scientia* 98, 108-113.

Samuelson, P.A. (1969), Lifetime Portfolio Selection by Dynamic Stochastic Programming, in: *RevEcon&Stat* 51, 239-246.

Samuelson, P.A. (1983), Comment (to R.C. Merton, On Consumption Indexed Public Pension Plans), in: Z. Bodie und J. B. Shoven (Hrsg.), *Financial Aspects of the United States Pension System*, Chicago and London, 276-287.

Samuelson, P.A. (1994), The Long-Term Case For Equities or how it can be Oversold, in: *JPortfolio Management* 21, 15-24.

Schlesinger, H. and N. Doherty (1985), Incomplete Markets for Insurance: An Overview, in: *Journal of Risk and Insurance* 52, 402-423.

Shiller, R. J. (2003), *The New Financial Order* – Risk in the 21st Century, Princeton und Oxford (Oxf. Univ. Press).

Tyrell, M. and R. H. Schmidt (2001), Pension Systems and Financial Systems in Europe: A Comparison from the Point of View of Complementarity, in: *ifo studien* 47, 469-503.

Zweifel, P. and R. Eisen (2003), *Versicherungsökonomie*, 2nd ed., Heidelberg et al. (Springer).