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Empirical risk analysis of pension insurance – the case of Germany

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Abstract

With this paper we seek to contribute to the literature on pension insurance systems. The financial literature tends to focus exclusively on the US pension insurance system. This is the first major empirical study to address the German occupational pension insurance (PSVaG) plan in Germany.

The study is based on a Merton-type one-factor model, in which we determine the credit portfolio risk profile of the occupational pension insurance plan and compare two alternative pricing plans. We find that there is a low, yet non-negligible risk of very high losses that may threaten the existence of the occupational pension insurance plan (PSVaG). While relating risk premiums to firms' default probabilities would cause them to diverge widely, a marginal risk contribution method would produce less pronounced differences compared to the current, uniform pricing plan.

Keywords: Pension insurance, Risk-adjusted premiums, Credit portfolio risk

JEL-Classification: G18, G22, G23, G28, C15

Non-Technical Summary

The book reserve system is the most widespread method of financing occupational pension plans in Germany. Pension liabilities are insured by the Pensions-Sicherungs-Verein VVaG (PSVaG) against bankruptcy. The PSVaG is a mutual insurance association with compulsory membership for all firms running unfunded pension plans. The insurance premiums are currently independent of individual default probabilities. The PSVaG recently stated that the insurance system needed to be reformed, especially due to a gradual shift from the book reserve system to funded pensions that can create adverse selection problems. In the future, risk-adjusted premiums as foreseen for the newly established Pension Protection Fund in UK could become feasible.

We perform credit portfolio analyses to determine the risk profile of the PSVaG. We use the Deutsche Bundesbank's extensive balance sheet database, which gives us direct access to 70% of all pension provisions. What we find is a highly skewed risk distribution. The magnitude of a potential tail loss event suggests that there is an upper threshold for the ability and willingness of the PSVaG's members to bear this risk. Under an expected loss pricing plan which accounts for individual default probabilities, insurance premiums would vary greatly. However, in a marginal risk contribution approach the variation of the premiums would be less pronounced.

Nichttechnische Zusammenfassung

Der wichtigste Durchführungsweg der betrieblichen Altersvorsorge in Deutschland ist die Direktzusage, für die Pensionsrückstellungen zu bilden sind. Im Fall der Insolvenz sind Pensionszusagen durch den Pensions-Sicherungs-Verein VVaG (PSVaG) versichert. Der PSVaG ist ein Versicherungsverein auf Gegenseitigkeit. Es besteht eine Zwangsmitgliedschaft für alle Unternehmen, die Direktzusagen gewähren. Dabei ist die Versicherungsprämie unabhängig vom individuellen Insolvenzrisiko. Der PSVaG selbst sieht die Notwendigkeit, das Finanzierungssystem zu reformieren. Hintergrund ist eine Strukturverschiebung in der betrieblichen Altersvorsorge zu Gunsten kapitalgedeckter Durchführungswege, woraus ein Problem adverser Selektion resultieren kann bei der sich Unternehmen mit geringem Risiko aus diesem System der Alterssicherung zurückziehen. In der Zukunft könnten risikoadjustierte Prämien, wie sie für den neu gegründeten Pension Protection Fund in Großbritannien vorgesehen sind, eingeführt werden.

Wir untersuchen das Risikoprofil des PSVaG mittels portfolioanalytischer Verfahren, die auf Insolvenzrisiken abzielen. Grundlage ist die Jahresabschluss-Datenbank der Deutschen Bundesbank. Diese ermöglicht, rund 70% aller Pensionsrückstellungen direkt zu erfassen. Dabei zeigt sich eine extrem schiefe Verlustverteilung. Das Ausmaß möglicher Extremschäden legt nahe, dass es eine obere Grenze für die Bereitschaft und Fähigkeit der Mitglieder gibt, das derzeit mit Elementen der Quersubventionierung behaftete Sicherungssystem des PSVaG zu finanzieren. Risikoadjustierte Prämien, die vollständig auf individuelle Insolvenzwahrscheinlichkeiten abstellen, würden allerdings zu einer sehr hohen Beitragsspreizung führen. Würde hingegen der marginale Risikobeitrag im Portfoliokontext bei der Beitragsbemessung berücksichtigt, ergäbe sich eine geringere Spreizung.

Content

Empirical Risk Analysis of Pension Insurance – The Case of Germany*

1 Introduction

Occupational pension plans vary widely in design and importance across countries. However, specific institutions to insure pensions against bankruptcy of the sponsoring company exist only in a few countries. Sweden and Finland were the first to establish pension insurance systems in the early 1960s, followed by the USA and Germany in 1974 and Japan in 1989. In the UK, the first such insurance system was introduced in 1995 as a consequence of the Maxwell scandal, in which 30,000 employees lost their pensions when the pension fund assets were pledged as collateral. As a result of the severe underfunding of many pension plans and several large bankruptcies, the UK government established the Pension Protection Fund (PPF), which became operational in April 2005.

The UK's PPF is consequently based on risk-adjusted premiums according to the default probabilities and the insured firms' funding status. The PPF system reflects the fundamental shift in risk management toward greater risk-sensitivity. The Pension Benefit Guarantee Corporation (PBCG) in the USA charges a flat premium per insurant, to which a supplemental variable premium for underfunding was only added in 1987. In Germany, the Pensions-Sicherungs-Verein VVaG (PSVaG) premiums are based on the annual cost of the pension insurance plan. They are independent of individual default probabilities.

The financial literature is almost exclusively focused on the PBGC. Since its inception, several authors have pointed out the moral hazard problems created by non risk-sensitive premiums and the pricing problem which can be linked to a conditional put option (Sharpe 1976 and Treynor 1977). Several articles apply the option pricing framework developed by Black and Scholes (1973) and Merton (1973) to approximate the cost of insurance under numerous simplifications. They provide illustrative solutions for hypothetical pension plans (Bodie and Merton 1993, Lewis and Pennacchi 1994, Seow 1995) or apply their models to a small sample of insured plan sponsors (Marcus 1987, Hsieh et al. 1994, Lewis and Pennacchi 1999). VanDerhei (1990) uses a large sample of plans and sets premiums directly equal to the product of the risk of an insufficient termination times the amount of exposure. Many of the risks involved are exemplified by the savings and loan crisis of the late 1980s (Bodie and Merton 1993, Bodie 1996).

* We thank Klaus Düllmann, Frank Heid, Thilo Liebig and Christoph Memmel for their valuable comments.

In Germany, the PSVaG has almost been completely ignored in financial research. The only empirical study has been carried out by Grünbichler (1991), who exemplarily calculated risk adjusted insurance premiums for a sample of 22 large listed corporations using a Merton-type approach (Merton 1973, 1977). He found a highly skewed distribution of risk-based insurance premiums.

Attempts to measure the overall long-term risk of the PBGC were made by Estrella and Hirtle (1988) and Lewis and Cooperstein (1993). The full conceptual complexity of the pension insurance system is addressed within an integrated framework by Boyce and Ippolito (2002), who use the stochastic Pension Insurance Modeling System (PIMS) introduced by the PBGC in 1998 to analyze the risk profile as well as a variety of pricing plans. By contrast, the PSVaG currently does not use any stochastic modeling techniques to capture its counterparty risk.

In this paper, we use credit portfolio techniques to analyze the PSVaG's risk structure. We focus on two central questions:

First, how risky is the current portfolio of the PSVaG in terms of expected and unexpected losses? We directly relate the risk faced by the PSVaG to the riskiness of the individual members. Our empirical research is based on the Deutsche Bundesbank's extensive balance sheet database, which allows us to directly cover 70% of all pension provisions. What we find is a highly skewed loss distribution. There is a small, yet non-negligible probability for the occurrence of portfolio losses that substantially exceed historical levels. Given the magnitude of such a potential tail loss event, it can be assumed that there is an upper threshold for the ability and willingness of PSVaG's members to bear this risk.

Second, how can pension insurance pricing reflect the discrete risk contribution by individual corporations to the PSVaG? In an expected loss pricing plan similar to that of the PPF, insurance premiums would vary widely. However, the current practice of cross-subsidization appears to be less distinctive in a marginal risk contribution approach.

This paper is organized as follows. In section 2, we briefly outline the German pension insurance system. Section 3 and 4 describe our method and our data. In section 5, we analyze the loss distribution faced by the PSVaG. In section 6 we show the effects of the different pricing plans. Section 7 concludes.

2 The German pension insurance system

Germany is one of the few countries where the internal funding of pension obligations via book reserves is an accepted standard. The German system of internally financed pension plans emerged in the aftermath of the Second World War. Like all other economic sectors, the banking industry was devastated and the capital market defunct. External financing was hardly available. In addition, the Allied forces imposed marginal tax rates of up to 90 percent on company profits. By disclosing a liability for future pension payments, taxation (as well as wages) could be deferred and the retained funds could be used for reconstruction. In many cases, pension plans were negotiated with work councils and established through collective agreements. Thus, from today's perspective, the internal financing of pensions can be regarded as an important component of the "Wirtschaftswunder".

When pensions are internally financed, the companies accrue book reserves corresponding to the present value of pension commitments as liabilities in their balance sheets and write off the accruals from their taxable income. For tax purposes, the pension liabilities are calculated using a uniform discount rate of six percent and standardized biometric assumptions. Income tax does not fall due until the pensions are actually paid and the book reserves are drawn down. The German book reserve system thus integrates the pension plan into the sponsor's corporate financial structure. This system may be interpreted as a form of funding with an extreme asset allocation. This makes it comparable to a pension fund which only holds bonds issued by the sponsoring company.

Today, the accrual of book reserves is still the most widespread method of financing occupational pension plans in Germany, accounting for almost 60 percent of total pension liabilities in 2004. In our sample, book reserves make up an average of 10.8 percent of the firm's assets. Large firms tend to have a higher portion of book reserves in their balance sheets, reaching as much as 25 percent in some cases.

For many years, pension entitlements were not protected in the event of bankruptcy. In theory, funding insures against this risk as, in the event of bankruptcy, the pension fund is used to pay out what is due to the pensioners. In a book reserve system, only the remaining assets can be used to serve pension obligations. Therefore, in 1974 an obligatory insolvency insurance system was set up and institutionalized through the PSVaG. The insurance system was a way to maintain the necessary public support for book reserve funding.

The PSVaG is the German counterpart to the Pension Benefit Guarantee Corporation (PBGC) in the United States.[2] The PSVaG was founded in the same year when extensive new legislation governing occupational pension plans was passed in both countries. Like the United States, events in Germany were very much influenced by the failure of a car manufacturer (Studebaker in the USA and Borgward in Germany). However, the PSVaG is not a federal agency. It was established by the Confederation of German Employers' Associations (BDA), the Federation of German Industries (BDI) and the Association of German Life Insurance Corporations. The PSVaG operates as a private mutual insurance association with compulsory membership for all firms running pension plans which might be adversely affected in the case of insolvency.[3] About 90 percent of all insured pension liabilities are related to book reserves.[4] The PSVaG is regulated by Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin), the German federal financial supervisor.

In an insolvency, the PSVaG purchases annuities from a consortium of private life insurance companies covering the present value of all pensions which are already paid. In 2004 the consortium was made up of 59 insurance companies. Entitlements are not pre-financed until they are due. The original idea of not pre-financing entitlements was to keep the assets as long as possible within the companies, where they could be used more efficiently. The present value of entitlements to be financed in the future amounts to approximately one percent of all insured pensions. The cost of a bankruptcy case is thereby smoothed over up to 30 years. Additionally, the PSVaG operates an emergency fund with a target funding level of the moving five-year average cost of annual pension insurance. It is drawn on in years with exceptionally high pension insurance costs.

The PSVaG is financed by insurance premiums which do not reflect individual insolvency risks but are instead based on pension liability-weighted rates relative to the annual cost of the pension insurance plan.[5] There is no cap on annual premiums. It is generally assumed that taxpayers provide no implicit hedge function and that a catastrophic loss can be smoothed out in the long run as pension liabilities could also be met on a pay-as-you-go basis (see e.g. Heubeck 1985).

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2 From 2002 on, some companies from Luxembourg have also been covered by the pension insurance plan. They account for less than one percent of all insurants.

3 The insured event is insolvency. The Employee Retirement Income Security Act of 1974 in the United States originally used a termination insurance concept.

4 The PSVaG also insures support funds which are often only partially funded and, in principle, allow for reinvestment in the sponsoring company. Life insurance contracts which are pledged as collateral or revocable are also insured but play nearly no role.

5 At the beginning of each year a rough estimate based on recent experience is made and an initial premium is charged in advance.

In 2004, the PSVaG insurance covered 8.5 million beneficiaries and the notional value of insured pensions was €243 billion. From 1975 to 2004, the annual insurance premiums ranged from 0.03% to 0.69%, averaging 0.22% (Table 1). With some exception, most claims involved small and medium sized companies (SMEs).

Table 1: Descriptive statistics on the PSVaG for the period 1975-2004[6]

	Mean	Median	Min	Max	Std. dev.
Insurance premium	0.22%	0.20%	0.03%	0.69%	0.14%
Defaults	333.4	330.0	154	705	143.8

The PSVaG tries to limit the risk of moral hazard by several measures. The maximum pension in 2004 is limited to €7,245 per month or a lump sum of €869,400. Increases granted within two years prior to insolvency are generally not insured, and the insurance can be withdrawn if benefits were committed during a period of impending bankruptcy. In this way, business owners, although generally allowed to use the book reserve system to finance their own pension, are usually not covered.

Throughout its history, the PSVaG has always maintained a low profile. To the general public its existence is almost unknown, even to those who receive their pension through the consortium of life insurance companies. The safety of occupational pension plans is generally not questioned by the public. This might be attributed to the PSVaG's successful and inconspicuous mode of operation, which has given companies ongoing and unquestioned access to internal financing via the book reserve system in the past.

However, most recently the legislation governing occupational pension plans and private pension contracts was reformed comprehensively, mainly to reduce dependency on the public pay-as-you-go pension system, which is being increasingly strained by an aging population. In addition, pension funds were introduced in 2002 as an alternative financing source. They allow a maximum underfunding of five percent, and only five percent of their assets may be invested in the sponsoring corporation. If properly funded, book reserves can be outsourced to pension funds non-taxably. Pension funds are also covered by the PSVaG, but the premiums are reduced to one-fifth of those of pension provisions. Many cash-rich companies have declared themselves willing to at least partially fund their pension liabilities. Currently, pension funds are primarily used only for new commitments often financed by employees

6 Source: Pensions-Sicherungs-Verein (2005a).

themselves who can convert parts of their wages into pension entitlements utilizing tax advantages. The main reason is a discount rate for future obligations, which was originally 2.75 percent, as in the insurance industry. Since mid-2005, however, it has been possible to apply a discount rate in line with international accounting standards. Meanwhile, several firms have established contractual trust agreements (CTAs) to fund their pension liabilities and cancel them in their balance sheets according to US-GAAP or IAS/IFRS.[7] Within the changing institutional environment, adverse selection effects can be expected, as firms that can afford funding will tend to do so, leaving the other group to deteriorate in quality.

In May 2005, the management board of the PSVaG declared that the financing system needed to be changed. The proposed reforms include the immediate pre-financing of all entitlements in the case of insolvency, an enforced pre-financing of existing entitlements and an additional mechanism to smooth annual premiums. In the long run, the reformed system could be the basis for risk-adjusted premiums. The management board has justified the proposed reforms by pointing to the risk of declining contributions and to the fact that pre-funding of pensions is now widely accepted in Germany.[8]

3 Method

In this section, we will outline the underlying methodology for measuring the portfolio risk of the PSVaG and the risk contribution by each firm.

We regard the PSVaG's members as counterparties, which may default.[9] Unlike a typical credit portfolio, the recovery of PSVaG's exposure is usually negligible, and the severity of losses hence considerable, thereby underscoring the importance of carefully monitoring the risk structure of the PSVaG portfolio. The portfolio can be regarded as a cross-sectional credit portfolio of the German industry. However, the exposure distribution of the PSVaG portfolio is substantially more heavily concentrated than a typical credit loan portfolio, as there is no upper size limit for the exposure.

In order to monitor the inherent risk of a credit portfolio, financial institutions usually refer to an ex-ante forecast of the portfolio loss probability distribution function (Loss PDF). For our study, we refer to a Merton-type one-factor model. We calculate the expected loss (EL) and

7 The most prominent example is the Siemens Pension Trust, with assets in excess of ten billion Euro. In the case of CTAs, the pension liabilities still appear on the pension sheet under German accounting rules.

8 See Pensions-Sicherungs-Verein (2005b) as well as Gerke and Heubeck (2002).

9 We define default as insolvency. In the banking industry, payment that is over 90 days past due is often considered to be in default.

unexpected loss (UL) for the PSVaG portfolio. While the first ratio reflects the average portfolio loss to be expected ex ante, the UL represents the difference between the Value-at-Risk (VaR) and the EL. The UL is usually measured in terms of the VaR or the expected shortfall (ES), relative to a specific confidence level and time horizon (see figure 1).[10] We refer to confidence levels similar to those used in the banking and insurance industries.

Let PD_i denote the annual default probability of an insured PSVaG firm and LGD_i (loss given default) the portion of the pension provisions (EAD_i, exposure at default) lost in a default event. Then the expected loss of the portfolio (EL_p) may be written as the sum of the firms' expected losses:

$$EL_p = \sum_{i=1}^{n} PD_i \bullet LGD_i \bullet EAD_i \tag{1}$$

The EL_p is by definition not affected by credit correlations and can therefore be determined analytically. The unexpected loss of a credit portfolio, by contrast, depends on the correlations of the exposures in the portfolio. We will determine the PSVaG's UL by means of Monte Carlo simulation. This allows us to determine the risk contribution of each firm j, $\mathrm{RCB}_j(x)$, as[11]

$$\mathrm{RCB}_j(x) = \frac{\partial RM(x)}{\partial x_j} \bullet x_j,\ j = 1,...,n \tag{2}$$

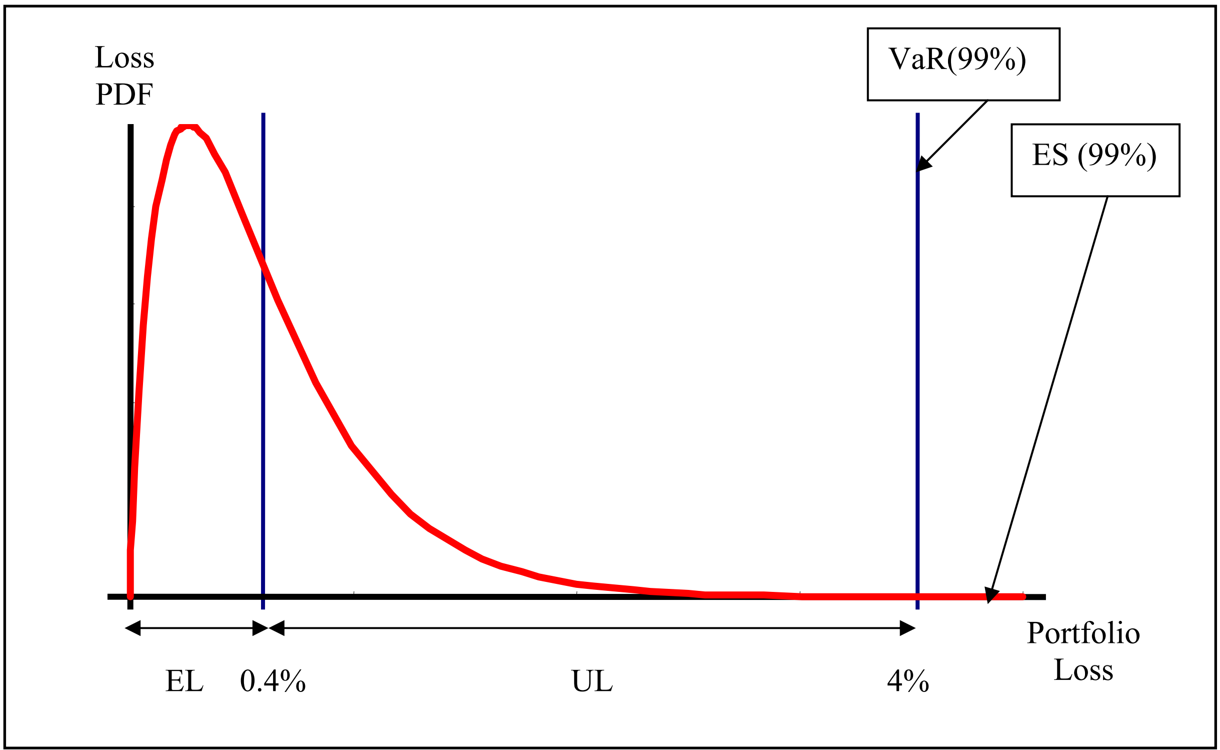
where RM(x) is the portfolio risk measure and x_j represents each j firm's pension provisions.[12] We will use the VaR and the ES as measures of the portfolio risk.

10 The 99.9% VaR, for example, measures what will be the maximum loss over *one year*, if one assumes that the *one year* period will not be one of the *(100-0.1)% one year* periods that are the worst under normal conditions. The ES measures the expected loss conditional on exceeding a certain confidence level and has been suggested by Artzner et al. (1999) as a coherent risk measure.

11 A formal development of the risk contribution can be found in Theiler (2004), for example.

12 We use the Euler allocation principle to determine the premium that should be paid by each firm. This is the only loss allocation principle that generates additive representations of the overall portfolio risk, which is risk-adjusted but simultaneously takes all diversification effects into account (see e.g. Tasche (2004)).

Figure 1: Loss probability distribution function (Loss PDF) of a credit portfolio



The x-axis shows actual losses as a percentage of the portfolio exposure. Accordingly, the EL is the average expected portfolio loss and UL the loss referring to the difference between a tail quantile, usually the VaR or the ES, and the EL. On the y-axis, the loss frequencies are shown.

The credit risk default process is modeled based on a stylized Merton-type asset value model (Merton 1974) with one common systematic risk factor and the remaining disturbance being idiosyncratic. We assume that each firm's creditworthiness is represented by its asset value, which fluctuates over time and reflects the actual state of the firm's creditworthiness. Asset returns are normally distributed (Bluhm et al. 2003). We use a one-year horizon and control for asset values falling below a certain barrier (usually the liabilities of a firm), what implicates a default event. The asset values of larger firms have a higher correlation with the systematic factor, i.e. implying that they are more strongly influenced by macroeconomic developments. Rather than using a continuous relationship between the firm size and the correlation with the systematic factor, we refer to three discrete size groups.

Let us suppose that a firm defaults if its asset value x_i falls short of a specific default barrier y_i..

We then proceed as follows. First, we assume that each firm's default barrier can be inferred via its default probability (PD_i):

$$x_i \leq y_i = \Phi^{-1}(PD_i) \qquad (3)$$

Second, we randomly draw a systematic factor Z and an idiosyncratic shock ε_i for each firm and thereby determine the asset returns of the firms in the sample (x_i):

$$x_i = \rho_i Z + \sqrt{1-\rho_i^2}\,\varepsilon_i \tag{4}$$

where ρ_i is the correlation of the firm's asset return with the systematic factor.[13] We then apply a Monte Carlo simulation to determine the portfolio loss distribution.

4 Data

What sets the PSVaG apart from other financial institutions is that its portfolio can be observed "from the outside", as book reserves are on balance sheet and calculated in a uniform manner. In order to analyze the PSVaG's risk profile, we use the Bundesbank's balance sheet database. The original dataset has been edited in order to match the PSVaG portfolio as best as possible. The mapping is based on historical insurance losses over the 1975-2004 period, the annual total volume of insured pensions, and the size and default information structure of the PSVaG portfolio.

Our final dataset consists of 145,347 balance sheet datasets (subsequently referred to as *observations*) from the 1989-2002 period, including 839 insolvencies. About 70% of all book reserves of the PSVaG are directly accessible. Companies with book reserves of less than €100,000 are excluded from the analysis, as they represent less than one percent of the insured volume and contribute negligibly to portfolio risk.

5 The loss distribution faced by the PSVaG

We determine the annual default probability of each borrower (PD_i) with a binary logit model which is calibrated based on the sample dataset in a cross-sectional context, i.e. by using all data from 1989 to 2002.[14]

The binary logit model takes the common form:

[13] The asset correlation equals the squared correlation of the firm's asset returns with the systematic factor.

[14] We additionally run a panel regression. As this exercise revealed similar results, we neglected the longitudinal case.

$$PD_i = \frac{1}{1 + \exp(-a - \sum_j b_j x_{i,j})} \qquad (5)$$

where (PD_i) is the default probability of firm i. We use 6 regression variables ($x_{i,j}$): four financial ratios and two sector dummies.[15] With respect to the default definition, we use balance sheet data with a time gap of 12 to 24 months prior to default.

The outcome is shown below.

Table 2: Outcome of binary logistic regression

Variable	Coef.	Std. Err.	P>|z|
Constant	-3.4794***	.10002	0.000
Equity/Assets	-4.6610***	.3746	0.000
log Assets	-.11557***	.02699	0.000
Short-term assets/Short-term liabilities	-1.6456***	.11960	0.000
Result from ordinary operations	-5.6924***	.27496	0.000
Dummy Trade	-.50999***	.11001	0.000
Dummy Other	.51713***	.13569	0.000

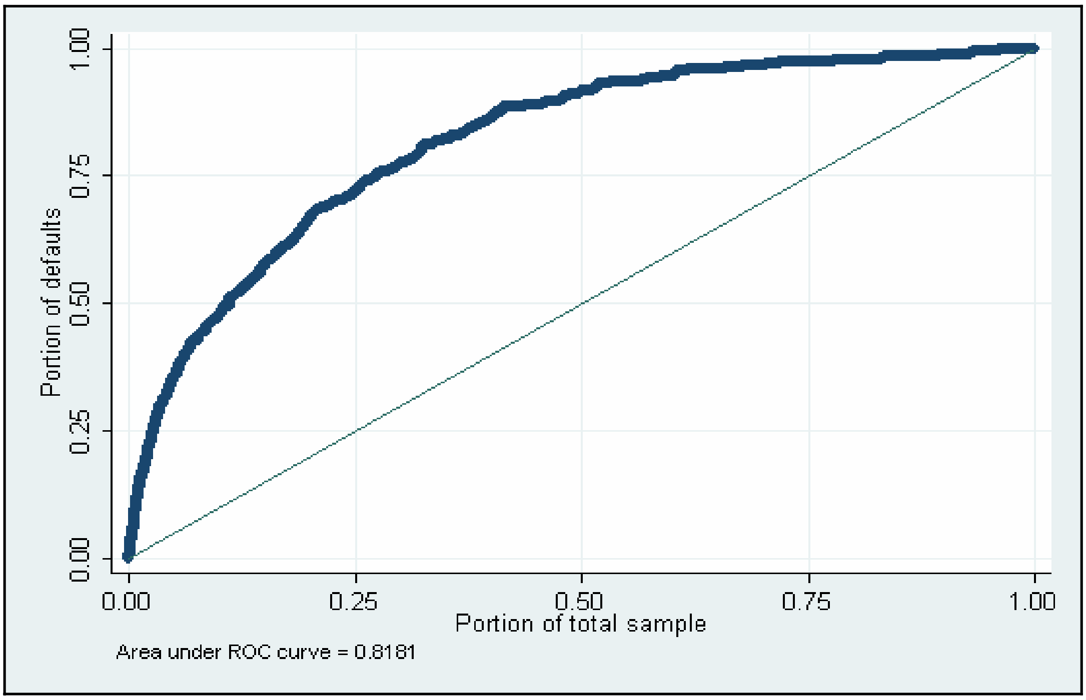
Note: The significance and robustness of the outcome is supported by the Pseudo R^2 (0.1622), the Wald test and the likelihood ratio test. ***/**/* indicate statistically significant results at the 1%, 5% and 10% level.

We observe that all variables are highly significant, that the signs of the variables are as expected, and that the discriminatory power of the calibrated logit model yields an area under the receiver operation characteristic (ROC) curve of 0.8181. An ROC curve to evaluate the outcome of the logistic regression model is shown below. The figure shows the cumulative percentage of the total sample according to the PD_i of our logistic regression model on the x-axis, estimated ex ante, and the cumulative percentage of the borrowers who have defaulted ex post on the y-axis.[16]

[15] It has been found that the sector *construction* has the same properties as the sector *other*.

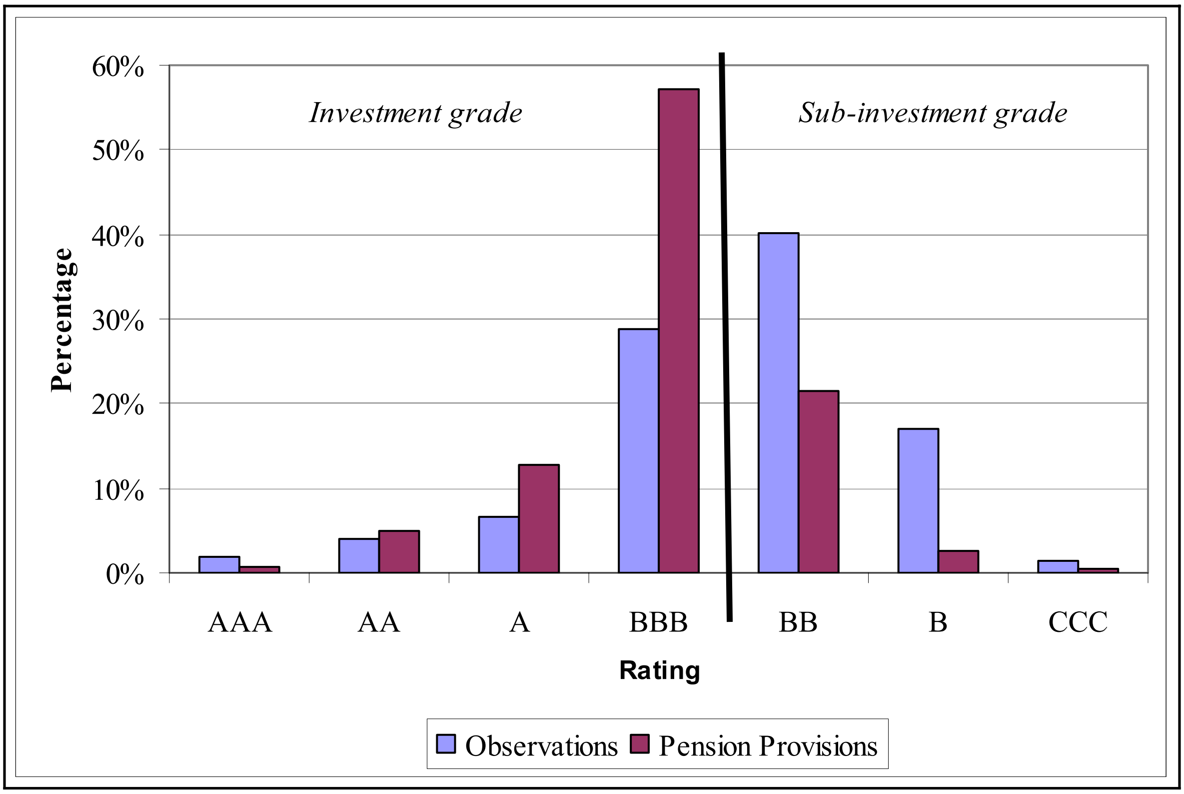
[16] The ROC methodology is explained in Sobehart et al. (2000), for example.

Figure 2: Performance measure of rating models: The ROC curve



We classify the firms into S & P's common rating categories, AAA, AA, A, BBB, BB, B and CCC. In line with international practice, firms are clustered into grade AAA if their regression-based PD is below 0.01%. For the AA segment, the upper bound is 0.04% and for the other segments (A, BBB, BB and B) the upper bounds are 0.1%, 0.5%, 2%, and 10%, respectively. A firm is assigned to the rating grade CCC if its PD exceeds 10%. The rating distribution for the PSVaG portfolio according to the number of observations and the pension provisions is shown in Figure 3 below.

Figure 3: Distribution of observations and pension provisions according to rating classes



42% of the observations and 75% of the pension provisions of the PSVaG refer to the investment grade segment. This indicates that PSVaG has a better risk structure than many bank credit portfolios.[17] The fact that a considerable share of large firms with high pension provisions tend to be rated above average has a visible impact on this outcome. Nevertheless, there is also a number of top-rated smaller firms. In the sub-investment grade we find predominantly small and medium-sized companies.

Table 3 compares the categories of predicted probabilities implied by the estimated coefficients against real default data of Standard & Poor's from 1981 to 2003.[18] The pattern of predicted insolvency rates follows historic default rates quite closely across rating classes.[19]

17 Moody's (2001, p. 6), for example, underlies average net loan provisions of 0.77% for German banks during the period 1989-1999 referring to OECD reports (Various editions of "OECD: Bank Profitability - Financial Statements Banks"), which is more than two times the average loss of the PSVaG during the same period.

18 See Standard & Poor's (2004).

19 The probability of insolvency is generally lower than the probability of default.

Table 3: Historical defaults and estimates insolvency probabilities

Rating	Historical Defaults in %	Estimated Insolvencies in %*	Observations
A	0.05	0.07	44
BBB	0.37	0.28	252
BB	1.36	0.92	131

*Companies with pensions provisions in excess of €500m

In a default event, we assume a fixed recovery rate of five percent of the pension provisions based on past experience of the PSVaG. Pension provisions are subordinated debt and the PSVaG does not follow a rigorous work-out process.[20] The credit exposure is equal to the firms' pension provisions.[21]

As to credit dependencies, we will use three different correlations of the firms' asset values with the single systematic risk factor. More specifically, we apply asset correlations of 20% for the largest firms (sales > €50m), 10% for SMEs (sales > €10m and < €50m) and 5% for retail firms (sales < €10m). The assumption that larger firms exhibit higher asset correlations considers empirical findings (e.g. Lopez 2004). The asset correlation levels are consistent with assumptions and estimates made by other authors and conservative, closely in line with the asset correlations applied in Basel II (BCBS 2004).[22]

As the reference case we use a confidence level of 99%, which could be interpreted as the worst loss occurring in 100 years. We additionally calculate portfolio risk for a confidence level of 99.9%, which refers to the regulatory capital level used in the Basel II framework and is commonly applied in the credit risk literature.

Next, we analyze the one-year credit risk of the current PSVaG for 2004.[23] The expected loss (EL) is 0.39% of the insured pension provisions at their actuarial value. The annual premium paid to the PSVaG was 0.36% in 2004 and is therefore very close to our sample EL.[24]

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20 The usage of a stochastic LGD will, given the low average recovery rate, only give the results marginally greater precision, if at all.

21 In the case of one large corporation we scaled down the exposure to 20%, as the pension liabilities were already funded in 2002. This is in line with the PSVaG's premium policy, which charges only one-fifth for pension liabilities financed through pension funds. At present, there is no empirical evidence available concerning the funding status in the case of insolvency. For convenience, we did not introduce a stochastic LGD in this specific case.

22 See Bluhm et al. (2003) and the Basel II IRB model (BCBS 2004), for example.

23 We use the portfolio of 2002 to distinguish between defaulted and non-defaulted firms. We consider the balance sheet 12 to 24 months prior to insolvency to be balance sheets related to default events.

24 The two figures cannot be directly compared for two reasons. One, the annual premium to the PSVaG did not fully reflect the cost of pension insurance, as financing was partly deferred to future periods. Another is that the expected loss is calculated based on the notional value of pension provisions. Due to lower discount rates in the insurance industry, the EL understates the true costs of pension insurance.

In order to determine the portfolio's UL, we perform a Monte Carlo simulation with 100,000 runs. We thereby check the sensitivity analyses of our credit risk parameters: the PD, the exposures and the asset correlations, while keeping the other parameters constant.

Table 4 shows the results for seven different credit risk parameter settings. The specific setting of the simulations with respect to the credit risk parameters is displayed in columns 2 to 5, and the portfolio risk in terms of expected loss (EL), value at risk (VaR) and expected shortfall (ES) are shown in the three last columns.

Table 4: Credit portfolio loss based on different settings

No.	Credit risk parameters				Outcome		
	Confidence	PDs	Expo-sures	Correlations	EL (%)	VaR (%)	ES (%)
Reference case	99.0%	Indiv.	Indiv.	5/10/20	0.39	4.1	6.2
1	99.9%	Indiv.	Indiv.	5/10/20	0.39	9	11.5
2	99.9%	Indiv. + 50%	Indiv.	5/10/20	0.58	10.9	13.3
3	99.9%	Flat (1.3%)	Indiv.	5/10/20	1.3	20	23.9
4	99.9%	Indiv.	1	5/10/20	1.09	7.3	8.8
5	99.9%	Indiv.	Indiv.	2.5/5/10	0.39	7.5	8.5
6	99.9%	Indiv.	Indiv.	0	0.39	7.3	7.7

At a confidence level of 99%, the VaR is 4.1% and the ES is 6.2% for the PSVaG portfolio at actuarial values. We label this case as the "Reference case", as this is likely to be the most relevant setting for the PSVaG's risk policy.

Next, we test the sensitivity of the credit risk parameters by applying six additional specifications. While cases 2 and 5 may be regarded as scenarios that can occur if the macroeconomic situation changes, the purpose of the stylized (extreme) cases 3, 4 and 6 is to test the overall effect of the PD, the size distribution and correlation in order to determine their relative effect.

We underlie six hypotheses. First, we assume that the PSVaG's losses will rise disproportionately if we move to higher quantiles in the tails of the loss PDF. Second, we assume that, in a cyclical downturn the PSVaG's credit risk will increase substantially. Third, larger firms are supposed to exhibit lower default probabilities, which smoothens the occurrence of high portfolio losses; fourth, however, the inhomogeneous size distribution of the PSVaG firms substantially adds to credit risk. Fifth, we assume that the correlations increase and decrease with cyclical effects. Sixth, and finally, we assume that the effect of correlation in the PSVaG portfolio exceeds the portfolio risk caused by the size distribution.

In sum, we can conclude that for all specifications the VaR (and the ES) exceed the EL by a considerable amount, i.e. the PSVaG faces the risk of very high losses if losses accumulate in an unfavorable year. For a confidence level of 99% (reference case), the VaR is 10 times the EL (4.1% vs. 0.39%). On the 99.9% percentile (No.1), the VaR is even more than 20 times the EL (9% vs. 0.39%.). This result indicates that the occurrence of a tail risk event might threaten the existence of the PSVaG, as such a loss event would be more than 10 times higher than the highest historical losses incurred over the last 30 years. However, the probability of such high losses occurring is very low. We conclude that an insurance for all loss scenarios hardly seems possible, which calls for setting an appropriate target confidence level to cover the portfolio risk of the PSVaG.

We subsequently evaluate cases 2 to 6 and thereby test the corresponding assumptions. By default we assume a confidence level of 99%. For the rest of the simulations, we refer to a confidence level of 99.9%, which is commonly used in the financial literature. The marginal effects would, however, be similar for the 99% quantile as well. We generally refer to the results of the VaR, which is an upper threshold of the losses at a certain confidence level.

One of the most relevant issues for the PSVaG is the occurrence of cyclical up- and downturns, which lead to lower and higher average default probabilities. For instance, in an unfavorable cyclical scenario the default probability can exceed the average by 50%. In this scenario, and assuming that the cyclical effect hits all companies in the same way (i.e. all PDs increase by 50%), we observe that the EL increases from 0.39% to 0.58% and the VaR from 9% to 10.9% (case 2).

Next, we set all PDs to a flat level of 1.3% (case 3). By consequence, portfolio risk increases substantially and roughly doubles compared to the reference case. This result compared with the reference case shows that the larger PSVaG firms exhibit lower than average PDs, which reduces the fatness of the tail.

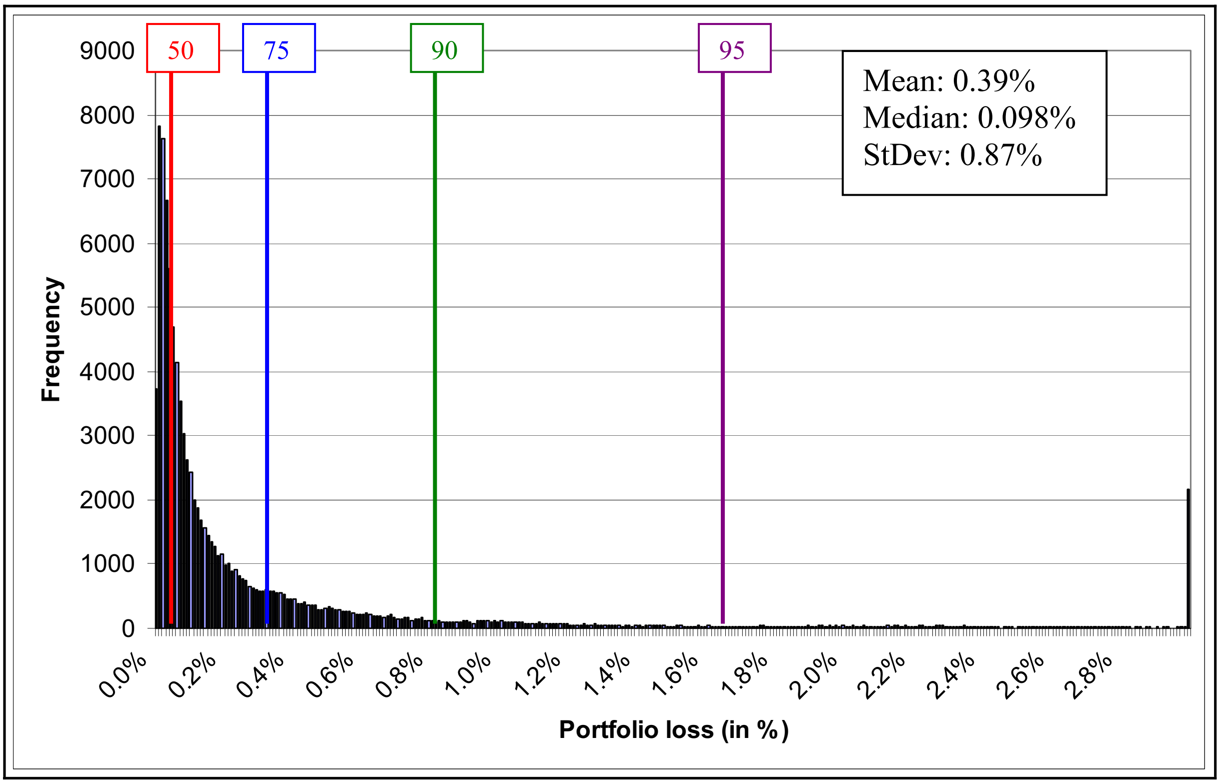
A test of the effect of the inhomogeneous size distribution by setting all exposures to one unit (case 4) results in a reduction of the portfolio risk by approximately 17%. However, the average expected loss would almost triple, which in the aggregate would have an even more negative impact on the PSVaG than the relatively lower reduction in the tail risk.

Nevertheless, the PSVaG exhibits a concentration risk by default, so that this outcome is an indicator of the extent of this effect rather than a scenario that may occur.

If the asset correlations are 50% lower than the correlations in the reference case (case 5), which might be caused by cyclical effects, the VaR falls by approximately 17% compared to the reference case, and would be only 0.2 percentage point higher than for the case in which all PSVAG firms are independent (case 6).

The following figure shows the loss probability distribution function (loss PDF) for the PSVaG (with the parameters as in the reference case) with all portfolio losses above 3% treated as a tail cluster.

Figure 4: Loss probability distribution function for the PSVaG portfolio



The vertical lines indicate the x% quantiles of the PSVaG losses; The red line, for example, refers to the median loss (“50”).

The loss PDF is highly skewed to the right, what indicates that there is a high probability of low losses around the EL and a low, yet non-negligible probability of very high losses (tail risk) that may threaten the PSVaG.

Although the premiums to the PSVaG are smoothed by its specific financing mechanism, which moves premiums to the mean of the loss distribution, a comparison with the historical premiums underpins the robustness of the loss distribution. Over the past 30 years, the historical premiums ranged from around the 15% loss quantile (0.03%) to the 87% loss quantile (0.69%) of the loss distribution.[25] Had AEG's looming insolvency not been averted by a private settlement in 1982, the corresponding loss of more than two percent would have exceeded the 95% quantile.

6 Risk-adjusted premiums

The PSVaG's current uniform pricing plan cross-subsidizes firms and thereby distorts a fair competition, as pointed out by the Monopolkomission (2004). Furthermore, risk-adjusted premiums can mitigate adverse selection problems.[26] Such premiums can provide a strong incentive for those corporations having a high counterparty risk to the PSVaG to fund their pension obligations. A recent example of how risk-adjusted premiums can be implemented is the insurance plan of the cooperative banks in Germany.

We compare the non risk-adjusted, uniform pricing plan with two potential risk-adjusted pricing methods: EL-based pricing and pricing based on marginal risk contributions. One general difference between the PSVaG insurance premium and credit pricing is that the former is determined ex post, when the losses have occurred, whereas risk-adjusted credit pricing is based on ex ante expectations about potential losses.[27] Nevertheless, one might argue that it is reasonable to allocate the ex post losses in a risk-adjusted way to the PSVaG members in order to avoid cross-subsidization. [28]

In the case of EL-based pricing, the aim is to cover the average expected costs based on each firm's default risk. Marginal risk contribution-oriented pricing, instead, focuses on tail risk events within a portfolio context. Premiums are charged according to each firm's contribution to the catastrophic losses that can occur. An overview of the three different pricing options is given below.

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[25] If differences in discount rates of pension provisions and annuities are recognized, both bounds increase.

[26] Financial literature typically points to the moral hazard problems associated with uniform pricing. We have neither empirical nor anecdotal evidence of uniform insurance premiums for pension provision causing moral hazard problems.

[27] Credit risk pricing is usually based on standard risk costs to cover the expected losses and, additionally, to allocate the economic capital costs according to the marginal risk contribution of each exposure.

[28] Alternatively, a risk-adjusted pricing regime might require the firms pay premiums ex ante, which are then settled ex post according to the realized losses.

Table 5: Specification of the three pricing options and their properties

Approach	Risk-adjusted	Risk drivers
Uniform pricing	No	Exposure
Expected loss pricing	Yes	Exposure, Probability of Default
Marginal risk contribution based pricing	Yes	Exposure, Probability of Default, Correlation

6.1 Expected loss-based pricing

Applying EL-based pricing to the PSVaG portfolio rather than uniform pricing reveals that the premium for investment grade firms is reduced substantially, while the non-investment grade firms face much higher premiums than before. For the AAA segment, for example, the reduction would be 99%, while the premium for the CCC-rated segment would increase by more than 15 times as shown in Table 6 below.

Table 6: Uniform pricing vs. EL-based pricing

Rating	PD in %	Portfolio loss contribution in %		Change in %
		Uniform	**EL-based**	
AAA	**< 0.01**	0.65	0.007	**-99**
AA	**0.01 - 0.04**	3.46	0.24	**-93**
A	**0.05 - 0.1**	17.24	3.56	**-84**
BBB	**0.1 - 0.5**	58.07	34.26	**-36**
BB	**0.5 - 2**	18.75	44.08	**+156**
B	**2 - 10**	1.78	15.85	**+460**
CCC	**> 10**	0.05	1.99	**+1560**
		100.00	100.00	

The average impact of EL-based pricing is quite different for small and large firms. Small and medium-sized firms (SMEs) have an average PD of 1.38% while the largest 30 have an average PD of 0.41%.[29] The insurance premium for an average SME would increase by 195%, while the 30 largest firms would contribute 25% less than under the uniform pricing regime.

[29] Firms with a turnover of less than €50 million.

Grünbichler (1991) finds very similar results for a sample of 22 corporations. For two-thirds of the firms he calculates substantially lower premiums. In some cases, the risk-adjusted premium is reduced by more than 99%. However, the premium increases more than six-fold for the riskiest company. The pricing plan of the Pension Protection Fund in the UK is based on expected losses and uses 100 risk bands. The risk-adjusted premium for a firm in the highest risk band is 203 times that of a firm in the lowest, both pension plans having the same funding status.

6.2 Marginal risk contribution-oriented pricing

Risk-adjusted premiums based on the marginal risk contribution of each PSVaG firm take into account the creditworthiness of a firm as well as its size and the dependence structure in the portfolio. It is the most comprehensive pricing approach. We use a 90% confidence level here. We calculate the impact of marginal risk contribution based-pricing on the premium again for small and large firms in order to compare them to the EL-based pricing regime. This is done as follows. Given that the portfolio loss exceeds the 90% quantile, we calculate the average loss contribution of each firm. Subsequently, we estimate the average conditional loss contribution of each firm, which is then compared to the uniform pricing case. Accordingly, the average premium for the largest 30 corporations decreases by 31% relative to the uniform pricing plan (EL: minus 35%), whereas the premium paid by SMEs increases by only 46% (EL: plus 195%) as shown below.

Table 7: Comparison of the two risk-adjusted pricing plans

Pricing Plan	Pricing contribution (relative to uniform pricing)		
	SMEs	Larger firms	30 Largest firms
EL-based	+195%	+15%	-35%
Marginal risk contribution	+46%	+26%	-31%

7 Conclusion

In this paper, we analyze the portfolio risk structure of the PSVaG with a benchmark dataset provided by the Deutsche Bundesbank. Specifically, we compare the risk faced by the PSVaG as a mutual insurance organization directly to the riskiness of the individual members in its portfolio. This problem can be broken down into familiar components of contemporary credit analysis. We thus treat the counterparty risk of pension provision like that of standardized, unsecured loans. In line with Basel II and Solvency II, we estimate the cumulative loss distribution of PSVaG-insured members. With an average of more than ten thousand corporations per year we have direct access to about 70% of all insured pension provisions.

The loss distribution is highly skewed. We find that the expected loss is lower than in an average credit portfolio of a bank.[30] The reason is that many large firms have low default probabilities and high exposures, as the PSVaG does not set an upper limit to individual exposures. However, the PSVaG portfolio conversely faces a substantial tail risk. There is a small, but non-negligible probability of portfolio losses substantially in excess of historical levels occurring. In a catastrophic scenario, a large corporation (or a large number of corporations) defaults. Given the magnitude of such a potential tail loss event, it can be assumed that there is an upper limit to the risk-bearing ability and willingness of the members of the PSVaG, which can, at least in theory, be dissolved as an institution. In this case, the KfW Bankengruppe would, by law, assume responsibility for organizing an alternative pension insurance plan. In its more than 30-year history, the PSVaG's pension insurance system was only challenged when the premium reached an all-time high due to the restructuring of AEG in 1982. However, compared to the loss distribution empirically derived in this paper, that premium did not reflect a tail event. The general public does not doubt the safety of occupational pension plans.

We are currently seeing a shift in the financing of occupational pension plans. Many large corporations that can afford to do so are putting the outsourcing of pension provisions high on their agenda. If properly funded, pension provisions can be canceled out of their balance sheets. In 2002, the PSVaG reduced the insurance premium for the newly introduced pension funds to one-fifth due to the vastly different exposure given default. The long-term existence of the PSVaG as a mutual insurance organization crucially depends on how it is accepted by its members. An adverse selection problem may arise when cash-rich corporations fund their

[30] See Moody's (2001, p. 6), for example.

pension liabilities while the remaining corporations deteriorate in quality. Risk-adjusted premiums are one way to mitigate adverse selection effects and are consistent with a generally higher risk awareness among financial institutions. The newly established Pension Protection Fund in UK, for example, is currently implementing a risk-adjusted premium structure based on EL. Sweden is taking another approach: corporations which cannot maintain investment grade status are simply forced to fully cover their pension liabilities by buying annuities.

In 2005, the management board of the PSVaG expressed the need to change the financing system. In the long run, the reformed system could be the basis for risk-adjusted premiums. The management board justifies the reform with the risk of a shrinking insurance volume and the fact that nowadays the pre-funding of pensions is widely accepted.

We analyze two risk-adjusted pricing methodologies. First, we apply an expected loss pricing that recognizes each firm's default risk and the volume of pension provisions. The results show that for investment grade corporations the premiums would substantially decline. For some top-rated companies they would almost vanish. However, for sub-investment grade firms they would multiply. For the 30 largest corporations the premium would decline by an average of one-quarter. For small and medium-sized the premium would more than double.

Second, we calculate risk-adjusted premiums based on marginal risk contributions, thereby taking into account the fact that pension provisions and asset correlations increase with firm size, leading to an increasing severity of the highest losses. Within this pricing regime, variation of premiums would be less pronounced than under expected loss pricing.

The ultimate solution might include elements of both pricing plans, in order to ensure a fair loss-sharing policy among different interest groups.

8 References

Artzner, P., F. Delbaen, J.-M. Eber, and D. Heath, Coherent Measures of Risk, Mathematical Finance 9/3, pp. 203-228, 1999.

Basel Committee on Banking Supervision (BCBS), International Convergence of Capital Measurement and Capital Standards: A Revised Framework, June 26, 2004.

Blache, R., and C. Bluhm, Die Steuerung von Kreditrisiken mit Hilfe der RAROC-Methodik, in: Rolfes, Schierenbeck (eds.), Ausfallrisiken: Quantifizierung, Bepreisung und Steuerung, Frankfurt, pp. 207-260, 2001.

Black, F. and M. Scholes, The Pricing of Options and Corporate Liabilities, in: Journal of Political Economy, Vol. 81, pp. 637-659, 1973.

Bluhm, C., L. Overbeck, and C. Wagner, An Introduction to Credit Risk Modeling, Chapman & Hall, 2003.

Bodie, Z. and R. Merton, Pension Benefit Guarantees in the United States: A Functional Analysis, in: Schmitt, R. (ed.): The Future of Pensions in the United States, Philadelphia: University of Pennsylvania Press of the Pension Research Council, pp. 194-234, 1993.

Bodie, Z., What the Pension Benefit Guaranty Corporation Can Learn from the Federal Saving and Loan Insurance Corporation, in: Journal of Financial Services Research, Vol. 10, pp. 83-100, 1996.

Estrella, A. and B. Hirtle, Estimating the Funding Gap of the Pension Benefit Guarantee Corporation, in: Federal Reserve Bank of New York, Quarterly Review, Autumn, pp. 45-59, 1988.

Gerke, W. and K. Heubeck, Gutachten zur künftigen Funktionsfähigkeit durch den Pensions-Sicherungs-Verein VVaG, in: Betriebliche Altersvorsorge, pp. 433-491, 2002.

Grünbichler, A., Zur Ermittlung risikoangepaßter Versicherungsprämie für die betriebliche Altersvorsorge, in: Zeitschrift für Betriebswirtschaft, 60. Jg., pp. 319-341, 1991.

Heubeck, G., Finanzierungsverfahren der Insolvenzsicherung und ihre Auswirkung im Zeitablauf, in: Pensions-Sicherungs-Verein (ed.): 10 Jahre Insolvenzsicherung der betrieblichen Altersvorsorge in Deutschland, Köln, pp. 56-72, 1985.

Hsieh, S. J., A. H. Chen and K. R. Ferris, The Valuation of PBGC Insurance Premiums Using an Option Pricing Model, in: Journal of Financial and Quantitative Analysis, Vol. 29, pp. 89-99, 1994.

Ippolito, R. A., How to Reduce the Cost of Federal Pension Insurance, Cato Institute, Policy Analysis No. 523, Washington 2004.

Lewis, C. M. and R. L. Cooperstein, Estimating the Current Exposure of the Pension Benefit Guaranty Corporation to Single-Employer Pension Plan Terminations, in: Schmitt, R. (ed.): The Future of Pensions in the United States, Philadelphia: University of Pennsylvania Press of the Pension Research Council, pp. 247-276, 1993.

Lewis, C. M. and G. G. Pennacchi, Valuing Insurance for Defined-Benefit Pension Plans, in: Advances in Futures and Options Research, Vol. 10, pp. 135-167, 1999.

Lopez, J., The Empirical Relationship between Average Asset Correlation, Firm Probability of Default and Asset Size, Journal of Financial Intermediation 13, pp. 265-283, 2004.

Marcus, A. J., Corporate Pension Policy and the Value of PBGC Insurance, in: Bodie, Z., J. Shoven and E. Wise (eds.): Issues in Pension Economics, Chicago: University Press, pp. 49-76, 1987.

Merton, R. C., Theory of Rational Option Pricing, in: Bell Journal of Economics and Management Science, Vol. 4, pp. 141-183, 1973.

Merton, R. C., On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, in: Journal of Finance, Vol. 29, pp. 449-470, 1974.

Merton, R. C., An Analytical Derivation of the Cost of Deposit Insurance and Loan Guarantees, in: Journal of Banking and Finance, Vol. 1, pp. 3-11, 1977.

Monopolkomission, Fünfzehntes Hauptgutachten der Monopolkomission, Wettbewerbs-politik im Schatten „Nationaler Champions“, Baden-Baden 2004.

Moody’s Investor Services, Moody’s RiskCalc™ for private companies: The German Model, Rating Methodology, May 2001.

Niehaus, G. R., The PBGC’s Flat Free Schedule, Moral Hazard, and Promised Benefits, in: Journal of Banking and Finance, Vol. 14, pp. 55-68, 1990.

Pennacchi, G. G. and C. M. Lewis, The Value of Pension Benefit Guaranty Corporation Insurance, in: Journal of Money, Credit and Banking, Vol. 26, pp. 735-753, 1994.

Pension Protection Fund, The Pension Protection Levy Consultation Document, December 2005.

Pensions-Sicherungs-Verein, 2005a, Geschäftsbericht 2005.

Pensions-Sicherungs-Verein, 2005b, PSVaG sieht die Notwendigkeit, das Finanzierungsverfahren auf vollständige Kapitaldeckung umzustellen, press release of May 17, 2005, www.psvag.de.

Seow, G., A Contingent Claims Model for Corporate Pension Obligations, in: Decision Science, Vol. 26, pp. 145-173, 1995.

Sharpe, W. F., Corporate Pension Funding Policy, in: Journal of Financial Economics, Vol. 3, pp. 183-193, 1976.

Sobehart, J., Keenan, S. and R. Stein, Validation Methodologies for Default Risk Models, www.moodyskmv.com/research/whitepaper/p51p56.pdf, 2000.

Standard & Poor's, EU 2003 Annual Default Study & Rating Transitions, February 2004.

Tasche, D., Allocating Portfolio Economic Capital to Sub-portfolios, in: Dev, A. (ed.), Economic Capital: A Practitioner Guide, Risk Books, pp. 275-302, 2004.

Theiler, U., Risk Return Management Approach for Bank Portfolios, in: Szegö, G. (ed.), New Risk Measures for Investment and Regulation, John Wiley & Sons, New York et al., 2004.

Treynor, J. L., The Principles of Corporate Pension Finance, in: Journal of Finance, Vol. 32, pp. 627-638, 1977.

VanDerhei, J. L., An Empirical Analysis of Risk-Related Insurance Premiums for the PBGC, in: Journal of Risk and Insurance, Vol. 62, pp. 240-259, 1990.

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