World Risk and Insurance Economics Congress, Singapore July 2010

A Traffic Light Approach to Solvency Measurement of Swiss Occupational Pension Funds

Alexander Braun, Przemysław Rymaszewski, and Hato Schmeiser
Institute of Insurance Economics, University of St. Gallen, Switzerland

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Introduction

Comprehensive solvency regulation is currently not present for Swiss occupational pension funds

Background

- Great importance of occupational pension funds in Switzerland
- Supervision of Swiss pensions is conducted at the cantonal level (pension expert report)
- Comprehensive solvency regulation is not present for Swiss occupational pension funds
- Common pension fund models have not been considered for solvency measurement yet

Contributions

- Proposition of a compact solvency framework for occupational pension funds
- Stochastic pension fund model and traffic light approach instead of regulatory capital
- Sensitivity analysis identifies important drivers of the traffic light probabilities
- Supervisory review process and notes with regard to an introduction in Switzerland

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The model framework (I/IV)

Under the assumption of normally distributed asset returns, a closed form solution can be derived

A: Assets
L: Liabilities
C: Contributions
RC: Regular Contributions
AC: Additional Contributions
B: Benefits
r: Return on Asset Portfolio
σ: Volatility of Asset Returns

see, e.g., Cairns and Parker, 1997; Dufresne 1988, 1989,1990

$$\tilde{A}_1 = \exp(\tilde{r}_1)\,(A_0 + C_0 - B_0)$$

$$L_1 = \exp(i_{tec})\,(L_0 + RC_0 - B_0)$$

$$E\left[\tilde{A}_1\right] = E\left[\exp\left(\tilde{r}_1\right)\left(A_0 + C_0 - B_0\right)\right],$$
$$= \exp\left(E\left[\tilde{r}_1\right] + \frac{\sigma^2\left[\tilde{r}_1\right]}{2}\right)\left(A_0 + C_0 - B_0\right)$$

$$\operatorname{var}\left[\tilde{A}_1\right] = \operatorname{var}\left[\exp\left(\tilde{r}_1\right)\left(A_0 + C_0 - B_0\right)\right],$$
$$= \left(A_0 + C_0 - B_0\right)^2 \exp\left(2E\left[\tilde{r}_1\right] + \sigma^2\left[\tilde{r}_1\right]\right)\left[\exp\left(\sigma^2\left[\tilde{r}_1\right]\right) - 1\right]$$

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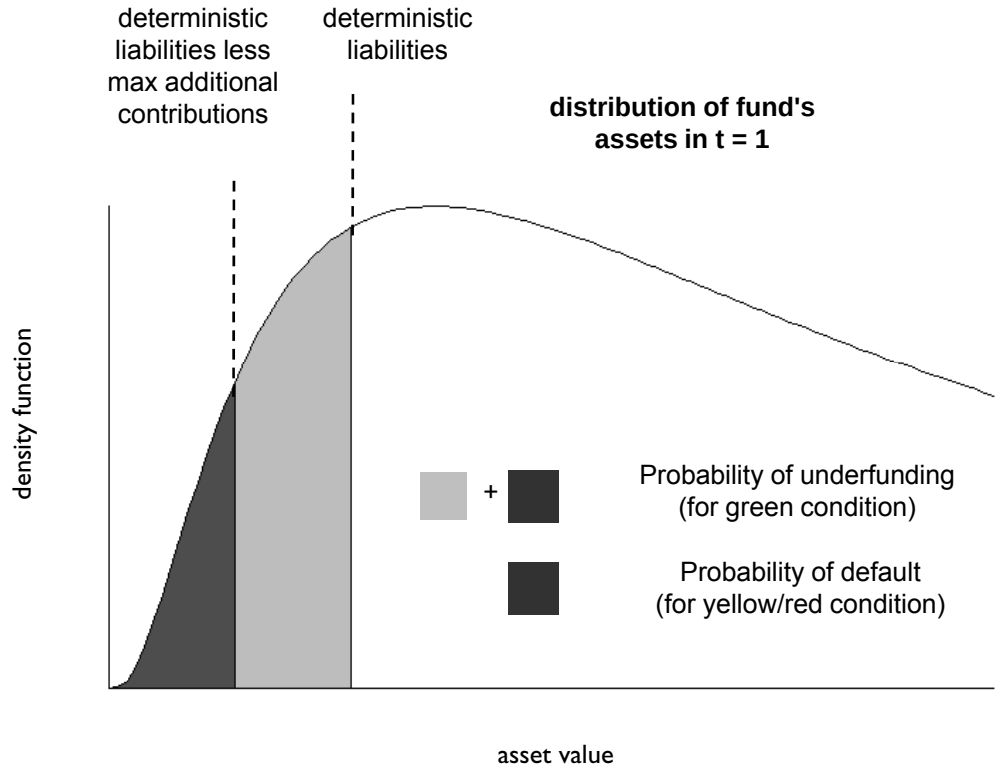
Traffic light signals can be derived with regard to underfunding / default probabilities



green $Prob\left(\tilde{A}_1 \leq L_1\right) \leq \psi_{\text{underfunding}}$

yellow $Prob\left(\tilde{A}_1 + AC_1^{max} \leq L_1\right) \leq \psi_{\text{default}}$

red $Prob\left(\tilde{A}_1 + AC_1^{max} \leq L_1\right) > \psi_{\text{default}}$

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The model can be easily calibrated

Source of data	Data	Application
Public data	• Distribution of the specific asset classes • Correlation structures	• Determination of the joint asset distribution • Estimated either by the supervisor or by the pension funds themselves
Asset management	• Composition of the asset portfolio	• Determination of the joint asset distribution
Interior actuarial estimates	• Amount of the actuarial liabilities	• Determination of the pension fund's liabilities • Sensitivity analysis to minimize forecast error

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Potential supervisory actions given compliance with the respective underfunding / default probabilities

Signal	Definition		Supervisory activity
	Compliance with reference values for the …		
	… underfunding probability	…default probability	
	+	+	• No extra supervisory actions
	—	+	• Supervisory watch list • Restructuring plan required
	—	—	• In addition: Intense sanctions (e.g., a ban on signing new contracts)

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Numerical example (I/III)

- Based on 2007 average figures from the Swisscanto (2008) pension fund survey
- Analysis of 265 occupational pension funds in Switzerland

	Input		Asset Allocation
A_0/L_0	110%	Bonds (intl.)	13%
A_0	11'000	Bonds (CH)	27%
L_0	10'000	Stocks (intl.)	18%
C_0	1'000	Stocks (CH)	10%
RC_0	1'000	Real Estate	15%
AC_0	-	Alternatives	7%
B_0	750	Cash	10%
i_{tec}	4%		

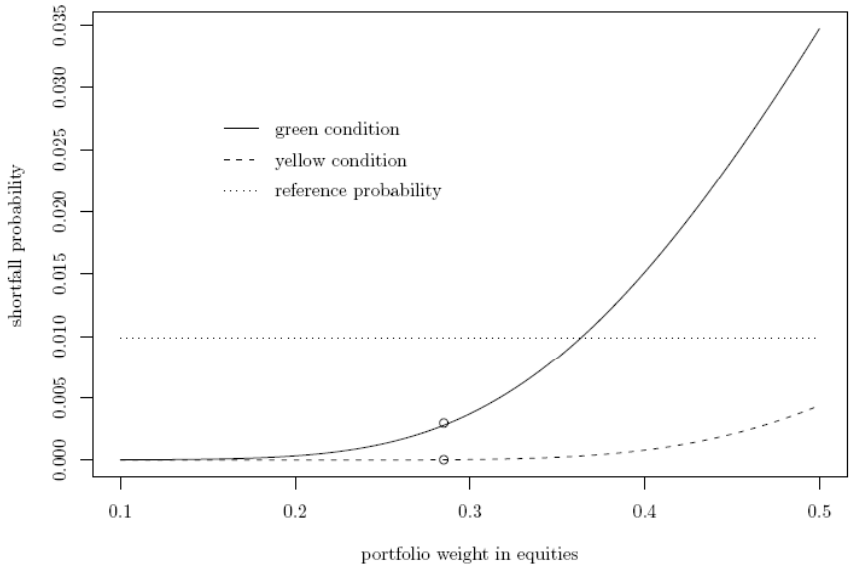

Figure 1: Sensitivity analysis for the asset allocation

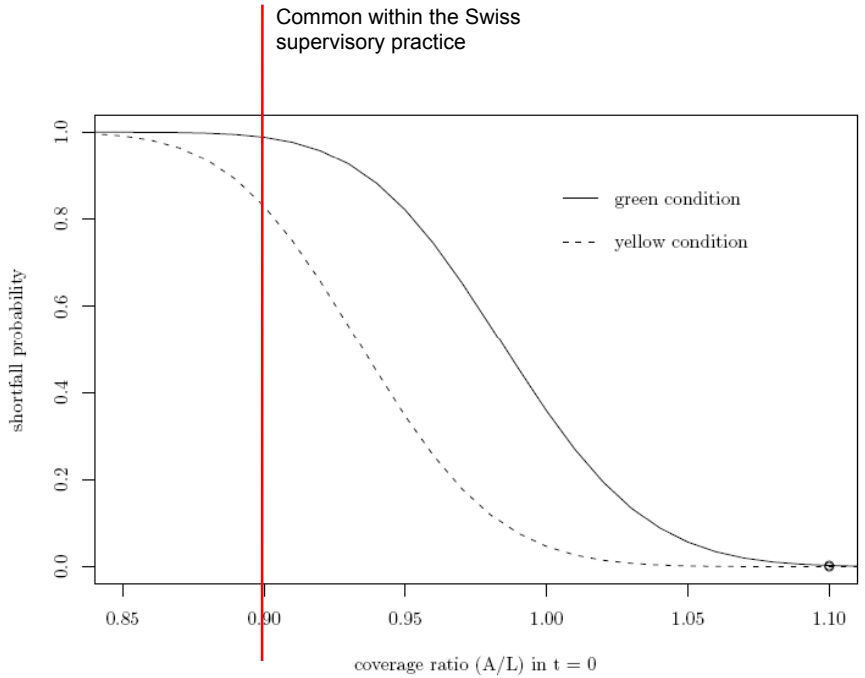

Figure 2: Sensitivity analysis for the actual coverage ratio

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Numerical example (II/III)

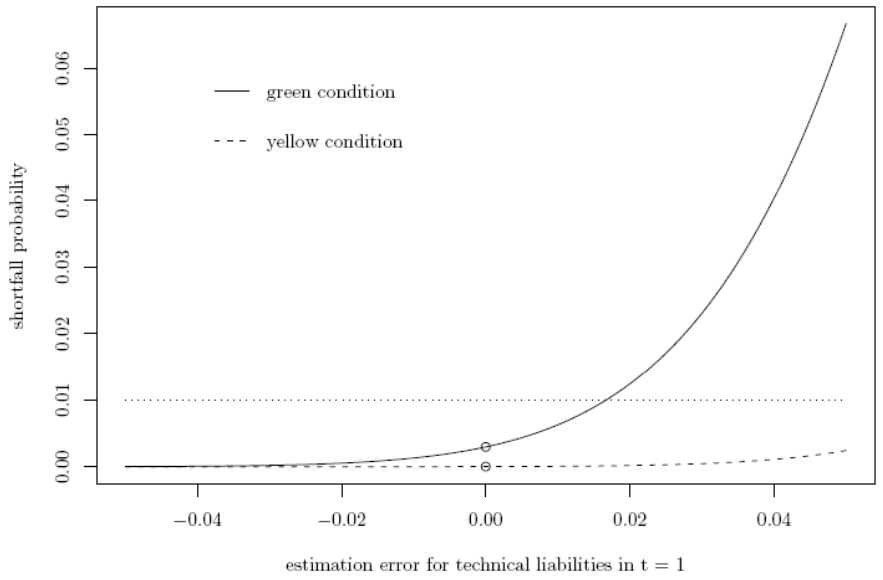

Figure 3: Sensitivity analysis for the technical liabilities

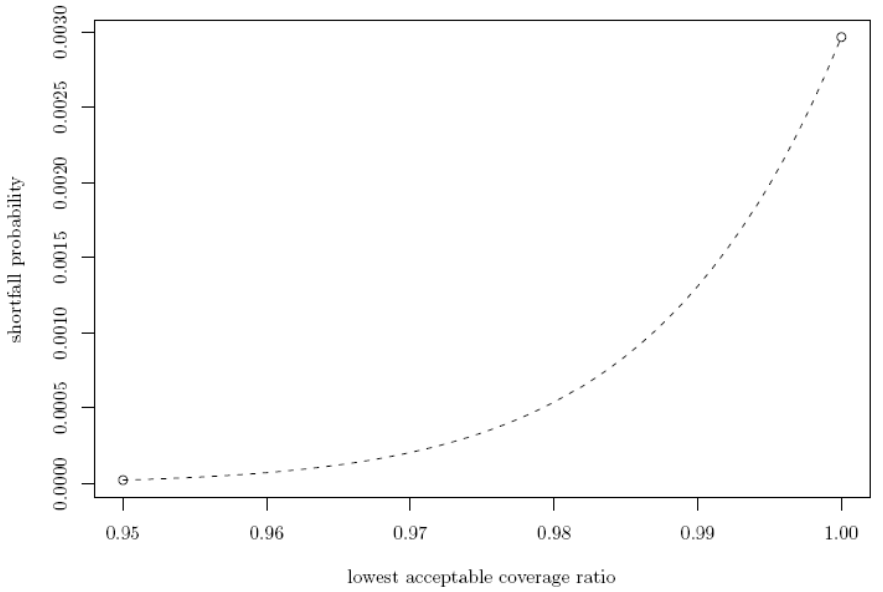

Figure 4: Sensitivity analysis for the lowest coverage ratio acceptable by the supervisor

Supervisor's acceptance for underfunding is a central issue

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Numerical example (II/III)

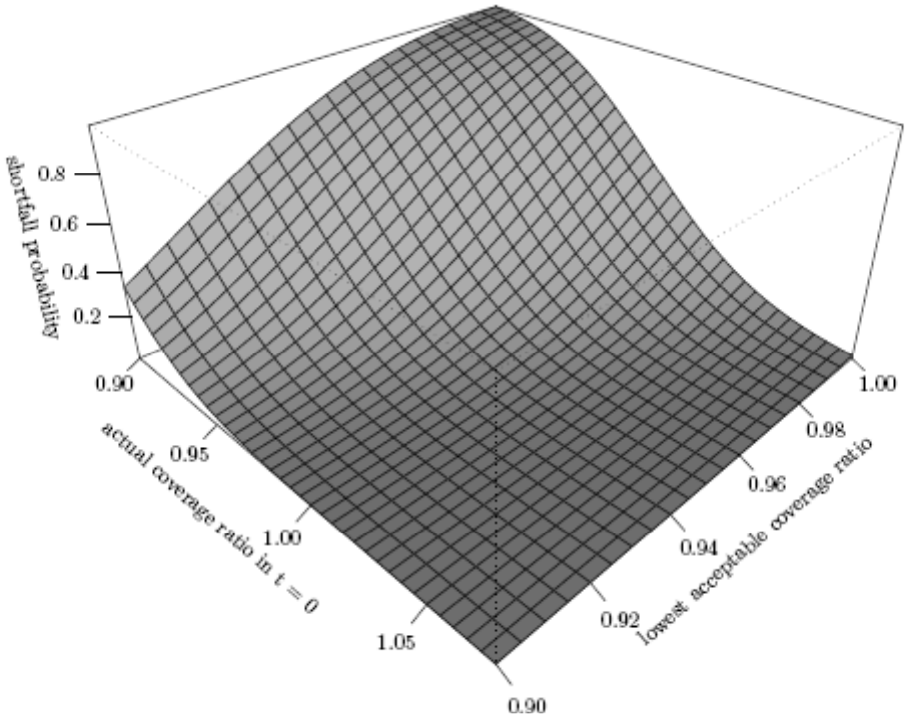

Figure 5: Sensitivity analysis for the actual and lowest coverage ratio acceptable by the supervisor (yellow condition)

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Summary and conclusion

Findings

- Closed-form solution can be derived for normally distributed asset returns
- Simple calibration and implementation of the model (illustrated with a small sample of funds)
- Asset allocation, coverage ratio, and the regulatory tolerance for uncovered liabilities are identified as important drivers of the probabilities for the traffic light conditions

Conclusion

- Due to its simplicity the model is well suited as a regulatory standard model
- Different distributional assumptions could be discussed for the modeled asset classes
- Credit risk could be additionally accounted using Basel II standard approach
- Implementation would need to be preceded by a comprehensive quantitative impact study

Thank you for your attention!

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References

Cairns, A. J. G. and G. Parker, 1997. Stochastic Pension Fund Modelling. Insurance: Mathematics and Economics, 21(1):43–79.

Dufresne, D., 1988. Moments of Pension Contributions and Fund Levels When Rates of Return are Random. Journal of the Institute of Actuaries, 115:535–544.

Dufresne, D., 1989. Stability of Pension Systems When Rates of Return are Random. Insurance: Mathematics and Economics, 8(1):71–76.

Dufresne, D., 1990. The Distribution of a Perpetuity, with Applications to Risk Theory and Pension Funding. Scandinavian Actuarial Journal, 9:39–79.

Swisscanto, 2008. Schweizer Pensionskassen. URL http://www.swisscanto.ch/ch/en.

Further Information/Contact

- The full working paper, A Traffic Light Approach to Solvency Measurement of Swiss Occupational Pension Funds, can be found online:

  http://www.ivw.unisg.ch/org/ivw/web.nsf/SysWebRessources/WP74/$FILE/WP74.pdf

- Contact:

– Alexander Braun	alexander.braun@unisg.ch	+41 71 243 4093
– Przemysław Rymaszewski	przemyslaw.rymaszewski@unisg.ch	+41 71 243 4091
– Hato Schmeiser	hato.schmeiser@unisg.ch	+41 71 243 4011

Institute of Insurance Economics (I.VW-HSG)
University of St. Gallen
Kirchlistrasse 2
CH-9010 St. Gallen
phone +41 71 243 40 43
fax +41 71 243 40 40
www.ivw.unisg.ch