

# Klaus Sandmann



## Academic career

1987 - 1990	Research Assistant, University of Bonn
1990	PhD, University of Bonn
1990 - 1996	Assistant Professor (C1), University of Bonn
1996	Habilitation, Bonn
1996 - 2002	Professor (C4), University of Mainz
2008 - 2009	Visiting Professor, University of Technology (UTS), Sydney, NSW, Australia
2009 - 2010	Vice Dean, Faculty of Law and Economics, University of Bonn
2010 - 2014	Dean, Faculty of Law and Economics, University of Bonn
Since 2002	Professor (C4), University of Bonn
Since 2015	Vice Rector, Planning and Development, University of Bonn

## Honours

1991	GEFFRUB-Preis (Gesellschaft von Freunden und Förderer der Rheinischen Friedrich-Wilhelms-Universität zu Bonn)
1992	Promotionspreis der GMÖOR (Gesellschaft für Mathematik, Ökonomie und Operations Research)

## Research Projects and Activities

Bonn Graduate School of Economics

DFG Research Training Group GRK 1707 "Heterogeneity, Risk, and Dynamics in Economic Systems"

DFG Research Training Group GRK 629 "Quantitative Economics"

DFG Research Project "Risk Management of Equity Linked Life and Pension Insurance"

## Research profile

The arbitrage theory of the term structure of interest rates serves as the main tool for the pricing and hedging of interest rate dependent derivatives. It provides the basis for the risk management of banks and financial institutions with regard to interest-rate-dependent derivatives such as options on bonds, financial futures and interest rates (caps, floors and swaptions).

The stochastic modeling of the dynamics of a financial market and the understanding of risk management is an important subject within the education program in economics and mathematics. Strengthening the ability of economic students to understand the basic concepts in probability theory and their knowledge of stochastic process up to martingale properties is a difficult task. On the other side the knowledge about financial products, the trading motives and restrictions within a financial market are usually not considered within the mathematical education program. Emphasizing these aspects the textbook [4] serves as an attempt to combine these different areas.

Non-standard financial products with broken compounding periods, time delayed payment dates, barrier conditions or individual exercise opportunities are frequently offered by financial institutions. The valuation of these products is derived by numerical procedures. A more robust approach relies on super hedging ideas. The research agenda is to extent the ideas of super hedging and uncertain volatility to interest rate dependent claims.

Equity linked life and pension insurance contracts are related to financial risk (interest rate, price, index) as well as to non-financial risk (e.g. death and survival risk, premature exercise). The valuation and hedging of these contracts is related to the diversification technique within a cohort of insured persons and to the dynamic duplication by the financial market. Periodic

premium and long time to maturity complicates the hedging problem. The research project considers robust contract specifications in the sense of super hedging strategies and model independency. The solution involves the contract design as well as the construction of the underlying financial portfolio.

The public debate has pushed compensation policy like Executives Stock Options (ESOs) at the forefront. An on-going discussion is whether ESOs have in fact encouraged the managers to take on too large risks which might improve their own benefits but jeopardize the firm. Sustainability and incentive compatibility are the main qualitative keywords. The approach is to consider non-traditional performance-based ESOs which discourage managers from excessive risk taking.

**Research Area G** The valuation and the hedging of complex financial products involves price risks and interest rate risks at the same time. Complex contract situations can only be approximated by numerical methods or simulations. Prominent examples are average options. An extremely robust super hedging approach has been developed in [10] and [8]. Applying these results to Executives Stock Options (ESOs) we advocate in [ two executive non-traditional performance-based stock option schemes which discourage managers from excessive risk taking. Both options have a criterion on the terminal value similar to a call option, but in addition impose a restriction on the path of the firm's assets process. Both schemes make the exaggerated risk taking through the executives less likely. Another example is the time shift of the payment. The financial consequence as well as the valuation and hedging are determined in [6]. Combining price and interest rate risks [5] have determined the valuation of chooser options. Furthermore, as demonstrated in [2] for in-arrear term structure products well established practitioner rules like the convexity adjustment yields stunningly good model independent bounds for the pricing and hedging of in arrear contracts.

**Research Area H** Continuous time stochastic models of the term structure of interest rates serves as basic tools for the pricing and hedging of interest rate dependent derivatives. For the stochastic dynamics of nominal instead of continuously compounded rates [12] showed that expected roll over returns are finite for log-normal models and developed the LIBOR-Market Model in [11]. Beside LIBOR or EURIBOR rates the futures market is very important. [7] extends the existing modeling framework to the futures market and by this develop new and testable no-arbitrage conditions on the volatility surface and determine model independent martingale properties of future rates.

Financial guarantees included in life and pension insurance contracts are related to financial risk as well as to non-financial risk. The non-financial risk is among others related to the death and survival risk of the insured and to early exercise by the insured for example due to unemployment. The pricing and hedging of these contracts is related to the diversification technique within a cohort of insured persons and to the dynamic duplication by trading in a financial market. However periodic premium and long time to maturity complicates the hedging problem for the insurer. The valuation and risk management of equity-linked life and pension contracts in an incomplete market is considered in [9]. Furthermore, we study in [3] the impact of contract design to early exercise by the insured for example due to unemployment or financial profitability.

### **Supervised theses**

Master theses: 10

Diplom theses: 163

PhD theses: 17

### **Selected PhD students**

An Chen (2007): "Risk Management Of Life Insurance Contracts with Interest Rate and Return Guarantees and an Analysis of Chapter 11 Bankruptcy Procedure",  
now Professor, University of Ulm

Simon Jäger (2008): "Non-linear and stochastically dynamics - Aspects of financial economics

in oil markets”

Xia Su (2008): “Essays on Basket Options Hedging and Irreversible Investment Valuation”

Michael Brandl (2009): “CPPI Strategies in Discrete Time”

Sven Balder (2009): “Handelsstrategien mit Mindestgarantien: Eine analytische Beschreibung”

Haishi Huang (2010): “Valuation of Convertible Bonds”,

now Lecturer, College of Business, Shanghai University of Finance and Economics, China

Manuel Wittke (2011): “Essays on Option Valuation under Stochastic Interest Rates”

Jing Li (2012): “Pricing and Risk Management of Basket FX Derivatives and Unit-Linked Insurance Contracts”

Filip Uzelac (2014): “Four Essays in Equity-Linked Life and Pension Insurance: Financial Analysis of Surrender Guarantees, Pension Guarantee Funds and pension Retirement Plans”

### Habilitations

Antje Mahayni (2006), now Professor, University of Duisburg-Essen

### Selected publications

- [1] An Chen, Markus Pelger, and Klaus Sandmann. New performance-vested stock option schemes. *Applied Financial Economics*, 23(8):709–727, 2013.
- [2] An Chen and Klaus Sandmann. In-arrears term structure products: no arbitrage pricing bounds and the convexity adjustments. *Int. J. Theor. Appl. Finance*, 15(8):1250054, 24, 2012.
- [3] J. Aase Nielsen, Klaus Sandmann, and Erik Schlögl. Equity-linked pension schemes with guarantees. *Insurance Math. Econom.*, 49(3):547–564, 2011.
- [4] Klaus Sandmann. *Einführung in die Stochastik der Finanzmärkte, 3rd Edition*. Springer Verlag, Heidelberg, 2010.
- [5] Klaus Sandmann and Manuel Wittke. It’s your choice: a unified approach to chooser options. *Int. J. Theor. Appl. Finance*, 13(1):139–161, 2010.
- [6] Antje B. Mahayni and Klaus Sandmann. Return guarantees with delayed payment. *Ger. Econ. Rev.*, 9(2):207–231, 2008.
- [7] J. Aase Nielsen, Kristian Risgaard Miltersen, and Klaus Sandmann. New no-arbitrage conditions and the term structure of interest rate futures. *Annals of Finance*, 2(3):303–325, 2006.
- [8] J. Aase Nielsen and Klaus Sandmann. Pricing bound on asian options. *Journal of Financial and Quantitative Analysis*, 38(2):449–473, 2003.
- [9] J. Aase Nielsen and Klaus Sandmann. The fair premium of an equity-linked life and pension insurance. In *Advances in finance and stochastics*, pages 219–255. Springer, Berlin, 2002.
- [10] J. Aase Nielsen and Klaus Sandmann. Pricing of asian exchange rate options under stochastic interest rates as a sum of options. *Finance Stoch.*, 6(3):355–370, 2002.
- [11] Kristian Miltersen, Klaus Sandmann, and Dieter Sondermann. Closed form solutions for term structure derivatives with log-normal interest rates. *The Journal of Finance*, 52(1):409–430, 1997.
- [12] Klaus Sandmann and Dieter Sondermann. A note on the stability of lognormal interest rate models. *Mathematical Finance*, 7(2):119–125, 1997.