Annual Report 2019

Institute for Operations Research and Computational Finance
Organization

The Institute for Operations Research und Computational Finance adjusts its structure to the requirements and opportunities in research, business, and teaching. The interdisciplinary development and application of mathematical optimization unites the team. The diverse backgrounds, on the other hand, enrich the perception of and approach to the tasks.

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1 Principal Investigator of CREST
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3 Core Member of CREST
1. The Institute in 2019

Within the University of St. Gallen, ior/cf-HSG is part of the School of Finance and offers courses from the bachelor level to specialized lectures in various doctoral programs. Our teaching activities emphasize quantitative methods and models with focus on applications. One full and three assistant professors as well as several lecturers cover a diversity of topics and research questions. The courses in the HSG trading room, for which ior/cf-HSG has taken over the lead management, were substantially expanded in the past year. In this way, the university’s curriculum has been enriched by innovative types of learning on the bachelor, master and doctorate level as well as in the executive education.

With its activities, the Institute for Operations Research and Computational Finance (ior/cf-HSG) has supported project partners, clients and students likewise to achieve their aims or to take a big step forward in mastering the challenges of their professional daily business. Moreover, with a number of published scientific papers in top journals we have demonstrated the quality and relevance of our research activities.

We share our knowledge in different forms of advanced education. The institute’s Competence Center for Energy Management offers CAS programs (“Certificate of Advanced Studies”) on the management of utility companies that has established itself in the corresponding fields. The center also organizes the annual conferences on electricity, gas and heat supply that continuously attract large attention among practitioners.

Additional spillover of ideas occurred due to our presence at seminars, congresses, and conferences. Several institute members presented their latest research results at international conferences and workshops. The institute is also strongly anchored in Switzerland’s energy research by participation in the “Competence Center for Research in Energy, Society and Transition” (SCCER CREST) and a project within the National Research Program “Energy Turnaround” (NRP 70).

Ior/cf-HSG’s technical expertise also attracts the attention of companies, which allows us to share our competences in projects with the industry. The usefulness of our applied software finances the implementation of new ideas. Cooperations with the energy sector adapted the existing packages for power contracts to firm-specific requirements and inspired new applications. Software for algorithmic trading in the intraday market for electricity implement consistent and efficient orders within defined limits for the associated risks. Software tools and consultancy projects are also offered for the banking industry with applications in asset and liability management, risk management and forecasting.

The Institute for Operations Research and Computational Finance continues to concentrate on its core competences, stochastic optimization and the simulation of market dynamics. Based on accumulated experience and endorsed by our supporters, we are tackling our ongoing and upcoming projects as a team.

For my part, I owe my thanks in turn to the people supporting me. The academic board members paved the way for promising business activities. My team members proved their willingness to perform and demonstrated flexibility whenever needed, and our project partners continued respectively started to trust our institute with their business decisions.

Prof. Dr. Karl Frauendorfer
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2. Management Summary of Business Activities

A result of ior/cf-HSG’s activities in applied research are various software tools for market participants in the energy and financial industry. In addition, the institute estimates distributions of future spot prices and price forward curves for electricity and gas that are provided to subscribers. Details of the products and services that are offered, also in cooperation with partners, are described in section 4.

Automated Intraday Trading for Power Traders

The institute developed an automatic trading algorithm that seamlessly integrates into the trading system at energy exchanges and performs algorithmic intraday trading at electricity spot markets. Varying forecasts of electricity production by wind, photovoltaic and hydropower plants lead to open energetic net positions after the day-ahead market has been closed. The implemented algorithm calculates the optimal tranches of energy and the related prices that should be traded at a certain time – based on the observed current (and historical) market prices and the inherent forecast risks. It automatically places trade orders on the market to ensure a continuous cost-effective closing of open positions, considering limits on maximum risk.

Price Prognoses and Data Analyses for Electricity Markets: BIT@EPI.Dynamics

The ior/cf-HSG offers an information service that includes long- and short-term prognoses as well as analyses of related volatilities. For the electricity markets Germany, Austria, Switzerland and France, hourly price forward curves (HPFCs) and corresponding confidence bands are generated for a long-term horizon of up to six years. This information is complemented by short-term spot price prognoses, analyses of volatility structures, spot and forward risk profiles as well as intraday price limits. The provided information is consistent with the respective market. Subscriptions are received by e-mail or may be downloaded from a special website or web service. On the sales level, this information service is supported by Powel AG, Basel.

Regime-Dependent Natural Gas Price Forward Curves: BIT@GAS.PFC

Supply contracts of natural gas mostly consist of longer delivery periods of up to several years. Thus, a reliable valuation of such contracts requires price forward information for the respective market/hub and for the entire contract period under consideration. The institute offers such price forward information with daily granularity for the market area of the Dutch Title Transfer System (TTF) as well as for the two German market areas operated by Net-Connect Germany (NCG) and by Gaspool Balancing Services (GPL). Throughout all market areas, the provided information consists of two price forward curves (PFCs) representing two regimes: A cyclical and an anticyclical regime which influence the shape of the respective PFC. The first regime leads to a strong seasonal price pattern that stresses mainly the temperature dependency of natural gas spot prices. Such an expectation can be thought of as the product of rather low future storage levels compared to the expected demand. The second regime, presumably a situation of high future storage levels, is characterized by a spot price expectation that shows almost no seasonality. A mechanism for generating these regime dependent PFCs has been implemented in the software module BIT@GAS.PFC. For the above-mentioned markets/hubs, a corresponding cyclical and anticyclical gas PFC is automatically generated daily. Subscriptions to the information service may be received by e-mail and are downloadable from a special website (www.iorcf.eu/dynamics).

Benchmarking of Replication Strategies for Non-Maturing Assets and Liabilities

The ior/cf-HSG has vast experience in modeling non-maturing assets and liabilities (NoMALs) from research as well as practical projects with industry partners that go back to 1993. Activities in this field include the assessment of standard approaches for the construction of replicating portfolios, modeling the evolution of client rates and product volumes as well as the design of a dynamic replication model.
based on multistage stochastic optimization methods. This experience is offered to banks for an assessment of their current approaches for managing NoMAL positions.

**Margin Optimizer**

Margin Optimizer is software for the control and quantification of the potential risk of non-maturing assets and liabilities in a bank's balance. By analyzing a large number of representative scenarios for the evolution of future interest rates and volumes, the tool calculates dynamic replicating portfolios that take into account the risk inherent to changes in these factors. Compared to static approaches that are currently still standard in the banking industry, the dynamic replication allows a substantial increase and stabilization of the margins of variable positions.

**Modelling Volumes and Client Rates of Retail Banking Products**

The volumes of retail banking products show significant variations over time that can be attributed to changes in clients' demand depending on the level of interest rates, offered product rates or other economic factors. The identification of the relations of product volumes on these factors provides valuable information for various applications like risk management, budget planning etc. The institute develops corresponding models, provides updated parameter estimates and consultancy services for partners in the financial industry.

**Best Execution Analysis of Order Books**

SIX and ior/cf-HSG have continued their Research Cooperation. The focus has been set on refinements of the cost-liquidity metrics and its application to the order books. These refinements allow for estimating trading costs across SLI titles in SIX and its competing European Multilateral Trading Facilities. In addition, we have analysed the impact of loss of EU Equivalence on preselected SLI titles by July 1st, 2019.

**Perspective Pro**

The primary objective of an asset and liability analysis is to determine whether the respective investment strategy, the performance targets (contributions, benefits, interest) and the risk-bearing capacity of the pension fund are coordinated. To this end, an asset and liability study first examines, evaluates and compares the links and interdependencies between the assets and liabilities of a pension fund. The design of pension schemes requires a long-term assessment not only of the development of liabilities but also of capital market risks (e.g. impact of low interest rates, crisis scenarios and their recovery period, possible development paths).

For this purpose, in close cooperation invalue ag and the ior/cf-HSG have developed an application „Perspective Pro“ which enables the scenario-based simulation and assessment of the development of investments and liabilities and thus the risk capacity (structural and financial) over a perspective time horizon (e.g. 10 years). The Perspective Pro enables the Board of Trustees to make a realistic, comprehensible assessment of the possible development of the pension funds (investments, liabilities, risk capacity, reserves, target return vs. realised return, ...) and its balance sheet (Swiss Gap, HGB) under various interest and inflation rate and capital market scenarios.

The development of investments, obligations, reserves, risk-bearing capacity and the required and achieved return over a longer time horizon is dynamically simulated and presented. Transparent scenario paths show the effects of stress phases and their recovery.
3. Research Program

Sophisticated solutions to practical problems embody ior/cf-HSG’s maxime. Theoretical achievements lead to new algorithms whose implementation in turn may raise research questions. This chapter summarizes the institute’s research activity and lists both projects and publications.

According to ior/cf-HSG’s affiliation to the University of St. Gallen, research is a commitment for the institute. Its activities promote applied research aiming at effective contributions for solving challenging and complex problems in the financial and energy industry. In addition, the problems often require preliminary conceptual and theoretical work attributed to basic research.

Many real problems are subject to dynamic decision processes whose handling depends decisively on uncertainties with respect to the development of relevant factors. The interaction of time and uncertainty in connection with regulatory and corporate requirements leads to complex decision-making problems that generally overstrain human intuition. Stochastic optimization concepts provide a systematic solution to such questions and constitute the methodological link among ior/cf-HSG’s research activities. Theoretical insights allow the development of software solutions; corresponding training courses establish their application and knowledge about the inherent model risks.

The subsequent subsections report on the institute’s research projects. They cover topics, which are either part of ior/cf-HSG’s business activities or part of the research focus of the University of St. Gallen. Dissertation projects enhance the knowledge about specific topics, and collaborations with external researchers support the implementation.

3.1 Swiss Competence Center for Research in Energy, Society and Transport

The Swiss Competence Centers for Energy Research (SCCERs) financed by Innosuisse, the Swiss Innovation Agency, bundle the national research efforts in the field of the energy transition. The Centre for Research in Energy, Society, and Transition (CREST), as one of those SCCERs is led by the University of Basel.

CREST as one of the eight SCCERs contributes to the energy transition in Switzerland by evidence-based recommendations on policies that reduce energy demand, foster innovation and increase the share of renewables efficiently. It covers economy, environment, law and behavior, and it develops concepts for energy policy, provides analyses of drivers and barriers to energy efficiency, produces strategies for firms and regions adjusting to the new energy system and develops assessment tools for policies and technological solutions. Work packages bundle these research efforts.

In 2019, the ior/cf-HSG contributed with white papers on the performance in energy trading within the 2009-2018. Furthermore, a procurement software package is under development, which includes the energy-feedback from energy storages. Additionally, the ior/cf-HSG continued to undertake research regarding flexibility options in the light of new roles of DSO, balancing group manager and TSO in the future energy system of decentralized energy production. In the second phase of this research program, ior/cf-HSG focuses on the management of energetic portfolios in order to achieve adequate levels of risk and return on the distributional level, especially for flexibility. Price forward curves in quarter hour granularity, educational modules with specific use of the new trading room at the University of St. Gallen and cooperation within the work package, across those of CREST and political institutions, improve the modeling and optimization of managing energy production and delivery.

Project staff: Prof. Dr. Karl Frauendorfer, Ass. Prof. Robert Gutsche PhD, Ass. Prof. Dr. Thomas Walther, Dr. Gido Haarbrücker, Dr. Michael Schürle, Dr. Christian Opitz, Claus Liebenberger
3.2 Analysis of Annual Risk Reports of European Energy Utilities

Energy utilities are exposed to all sorts of risk, especially to market and credit risks. Therefore, it is not surprising that also energy utilities have had to overcome difficulties during and after a financial crisis. This study investigates how and to which extent energy utilities disclose market, credit, liquidity and operational risks in their financial reports.

Based on an automated text analysis, the risk reports of major European energy utilities are evaluated to which extend their coverage of different risk types, risk quantification tools, and risk management helps to mitigate asymmetric information in the stock market. The analysis comprises risk reports for the years 2009-2017.

Project staff: Ass. Prof. Robert Gutsche PhD

3.3 Analysis of Risk and Performance Characteristics of Securities

In times of rising uncertainty, increasing market volatility, changing market environment with shifting correlation structures within equities, as well as across different asset classes, the identification of fundamental risk in growth and return of investments becomes a key challenge to the active management of equity portfolios.

In bullish times like in 2019, when stock prices are gaining over a long period, diversification through adding a large number of securities or even buying all constituents of a market index might appear to provide sufficient protection against risk. However, this approach to investing is primarily a protection against idiosyncratic (unsystematic) risk in equities. Nevertheless, shifts in market sentiment and undiversifiable (systematic) risk might prevail. Today equity prices are increasingly exposed to trades of passive funds, such as ETFs, which might buy and sell all constituents of a market index or industry at once, resulting in market panic and a huge overreaction to otherwise weak indicators of systematic risk. Consequently, prices might deviate strongly from fundamentals.

We acknowledge that idiosyncratic and systematic risk of companies are the risk of fundamentals (e.g., sales and earnings of firms) being affected by both, the firm’s strategy (business model of the firm in contrast to business models of other firms) as well as macroeconomic paradigm shifts. This helps the investment decision, even in volatile times, with huge exposure to certain sectors/industries. It supports the timing of investments, as well as the assessment of the risk of paying too much for a stock or selling it too late for too little.

Most so-called value funds usually search for underpriced equities by applying simple price-to-fundamental metrics and trends in fundamentals. They screen for underpriced individual components of value, such as sales, ebitda, cash flow, profit margin, earnings or book value, but not value itself. They might find, for example, that current earnings or book value is mispriced, while ignoring that the appropriate combination of all components and their leverage considered together matter, and not just one or more single component. Intrinsically, they might oversee the possibility that equities are “cheap” because they are risky. In this respect in this research project, we investigate alternative approaches with the goal of defining robust investment strategies.

Project staff: Ass. Prof. Robert Gutsche PhD
3.4 Publications

This section lists selected basic and applied research work of the past three years and supervised theses of the previous two years, respectively. Readers interested in other publications, presentations, or working papers are welcome to contact the institute or to visit www.ioref.unisg.ch.

Research


Institute for Operations Research and Computational Finance (ior/cf-HSG), Annual Report 2019


Working Papers


Selected Bachelor Theses


Mann, T. (2019): Anomalies in rational behavior under different economic conditions.


**Selected Master Theses**

- **Barth, Ch.** (2019): *Blockchain Transfroming Traditonal Financial Exchanges - Adapting Capabilities to Operate in Digital Token Trade.*
- **Hampl, Ph.** (2018): *Determinants of M&A transactions in the UK wind energy market.*
- **Möhr, A.** (2018): *IFRS 12 - A disclosure analysis of interests in other entities for selected companies listed on the Swiss Stock Exchange (SIX).*
- **Sadighi, B.** (2018), *Computing Risk Sensitivities for Swing Options.*
- **Zhang, W.** (2018): *Do sustainable index funds outperform sustainable mutual funds?*
Presentations


Opitz, Ch. (2019): Positionierung von Energieversorgern. Strategieworkshop erweiterte Geschäftsleitung StWZ. Menznau


Opitz, Ch. (2019): Strategische Positionierung. Strategieworkshop Geschäftsleitung EKT AG. Arbon

Opitz, Ch. (2019): Siedlungsabfallkonzept ZH. Strategieworkshop Entsorgungslogistik ERZ. Zurich

Opitz, Ch. (2019): Entwicklung eines Siedlungsabfallkonzepts Stadt ZH. Strategieworkshop Entsorgungslogistik ERZ. Zurich

Opitz, Ch. (2019): Entwicklung eines Siedlungsabfallkonzepts Stadt ZH. Strategieworkshop Entsorgungslogistik ERZ. Zurich

Optiz, Ch. (2019): Entwicklung einer Vision Kreislaufwirtschaft ZH. Visionssworkshop Tiefbau- und Entsorgungsdepartement Stadt ZH. Zurich


Walther, Th. (2019): Forecasting negative electricity prices. ENERDAY. Dresden, Germany

Walther, Th. (2019): Asset classes and portfolio diversification: Evidence from stochastic spanning approach. 10th International Research Meeting in Business and Management. Nizza, France
4. Business Activities

The transfer of results from fundamental and applied research carried out at ior/cf-HSG has led to the development of customized software applications. Based on the expertise and experience gained from diverse research and project activities, the institute offers a broad scope of services and products in the fields of energy and finance. The following sections present the software applications and related services that are provided by ior/cf-HSG, partially in cooperation with partner companies. In addition, also ongoing consultancy projects are described.

4.1 Energy

The ior/cf-HSG has established the software family BIT@EPI (Business Information Technology at Electric Power Industry) providing solutions for operational tasks and managerial decision problems situated in this energy sector. During the past years, BIT@EPI has been steadily developed further according to enhanced methodologies as well as due to new or changing practical needs. Its modular concept is suitable to handle the heterogeneous problems arising in the respective application fields and to overcome the challenge of dedicated quantitative analyses.

The modules cover the modeling of price forward curves and of spot price dynamics (BIT@EPI.Dynamics), portfolio optimization of utilities (BIT@EPLPFO), and the valuation of virtual power plants (BIT@EPI.VPP). A supplementary module BIT@GAS.PFC allows an automated generation of regime-dependent PFCs with a daily granularity for several trading hubs of natural H-gas.

Intraday trading algorithms have been developed further due to changes in market rules and regulations. These algorithms are aligned with the requirements of TSOs trading renewal energy on the electricity intraday market or of asset-backed traders like operators of pumped-storage hydropower assets.

An Order Placer Application provides the possibility to fill simulation environments of intraday markets with own orders and order books. This allows to work with self-designed order book and market situations when testing and analyzing the behaviour of intraday trading algorithms.

4.1.1 Automated Intraday Trading for TSOs

Given the stochastic nature of renewable energy sources like wind, photovoltaics, and water, these types have a strong impact on the volume and prices on the intraday market for electricity at the EPEX SPOT power exchange. German transmission system operators (TSOs) must market this electricity on the day ahead as well as on the intraday market. In cooperation with the TSO TransnetBW, Stuttgart, the ior/cf-HSG developed automated trading algorithms which incorporate the price and volume probabilistics and which take the relevant risk management guidelines into account. The algorithms are embedded into a commercial energy trading system and automatically place orders on the intraday market aiming at an effective management the TSO’s net position which varies due to changing generation prognoses and own intraday market transactions.

German TSOs are obliged to forecast and to market the available renewable energy of those wind generators, photovoltaic units, and small hydro plants which have not opted for the so-called method of ‘direct marketing’ at the EPEX SPOT power exchange. In a first step, the respective predicted renewable energy is traded by the TSO on the day-ahead auction market. However, the prognosis at day-ahead market closure is not perfect, and new prognoses of power production arrive periodically up to the actual time of delivery. The discrepancies between the new prognoses and the already traded amounts lead to open positions: the latter have to be traded on the intraday market in order to minimize the residual energy for which the cost of balancing energy will become effective.
From the operational point of view, the monitoring of all tradable products (hour contracts, 30-minute contracts, and quarter hour contracts – not even taking into account configurable block products) cannot be managed continuously and effectively by single human traders. The complexity has increased even more due to newly designed specific contracts which are tradable separately within each delivery area up to 5 minutes before delivery. In this challenging setting, the utilization of automated trading algorithms may ensure a continuous, consistent, and cost-effective manner of closing the changing open positions while assuring compliance with imposed risk management directives and trading guidelines.

Automated intraday trading for TSOs: client GUI

The ior/cf-HSG has developed and implemented automated trading algorithms which are embedded into a commercial energy trading system as a Java plugin. Via this commercial energy trading system, the algorithms are supplied with all relevant historic and current prognosis information and market data, e.g., the order book for every single tradable contract. Newly placed orders on the intraday market are immediately received and the algorithm can react instantaneously by placing matching orders on the market itself. The placing of orders is also done through the trading system, thereby enabling the user to manually interfere in exceptional situations.

New prognoses for the relevant renewable energy production entail the algorithmic calculation of optimal energy amounts which shall be traded on the market according to the currently observed order book for every single contract. Additionally, arbitrage possibilities may be considered for overlapping contracts, like an hour contract and its contained 4 quarter hour contracts. The calculations are based on fitted probability distributions of the observed intraday trade prices, prognoses of the renewable energy generation, and on parameterizable directives and preferences. The placement of own original or aggressive orders on the market is enhanced by a precalculation of own potential trade orders which allows instantaneous reactions to new visible orders in the exchange order book.

The trading algorithms are complemented by monitoring, signalling, and reporting functionalities.

Project staff: Dr. Gido Haarbrücker, Claus Liebenberger
4.1.2 Automated Intraday Trading for Asset-Backed Traders

Asset-backed trading on the electricity intraday market is generally understood as acting on the market itself (i.e. buying and selling the currently tradable products) simultaneously having the possibility of steering a flexible asset – or a whole portfolio of assets (turbines and or pumps, power storages, etc). Referring to the Black-Scholes option price theory, such flexible assets may be priced as classical put or call options. But instead of ‘selling’ the flexibility of an asset and receiving the monetary option premium, one may use a so-called replication strategy in order to generate the option premium by efficient intraday trading, e.g. using a delta-hedge approach.

Having in mind a utility with a physical asset in form of pumped-storage hydropower (PSH), the option premium for the assets’ inherent flexibility may be obtained by applying a replication strategy, i.e. replicating the option by efficiently trading at the intraday market and taking the respective counterposition of an own matched order by increasing or reducing the assets’ schedule accordingly.

Using this flexibility in the assets’ schedule, one is physically ‘backed’ and does not have to close entered open positions at potentially extremely unfavourable prices – a severe risk which ‘prop traders’ without physical assets are faced with and which is typically encountered by an appropriate margin to be deposited at the market clearing entity.

The Institute developed conceptual approaches and implemented algorithmic solutions aimed at efficient asset-backed trading on electricity intraday markets. Special attention has been laid on the accurate consideration of the technical asset flexibility and of further peculiarities like, e.g., so-called locked hours (a violation of which would entail severe penalty payments) or maintenance plans. The products, one is willing to trade on the electricity intraday market, and the order placing approach should be consistent with the type of the PSH reservoir (day, week, or seasonal storage) and the thereby related opportunity cost information. The economic success strongly relies on adequately determined trigger prices, reacting on order book changes, and sound price expectations.

An encapsulating software manages and schedules all relevant information processing – imports of natural inflows, short term unit availabilities, planned maintenance windows etc. – such that further operative necessities, e.g., unit commitment of the PSH or dispatch announcements for the balance responsible party, are periodically fulfilled in a timely manner.

Project staff: Prof. Dr. Karl Frauendorfer, Dr. Gido Haarbrücker, Claus Liebenberger

4.1.3 Order Placer for Simulated Intraday Markets

Systematic evaluation of algorithmic trading behaviour strongly relies on the possibility to test the algorithm against ‘all’ possible – even rare or extreme – events or market situations. The simulation environments offered by EPEX SPOT are not sufficient for these purposes: Due to arbitrary and sparse order books and low ‘traffic’, they serve rather for technical or communication testing than for the analysis of the trading algorithm’s behaviour itself.

The iotcf-HSG has developed and implemented an Order Placer application which serves for simulating the intended market situations and evolutions: Using an editable script language, sequences of actions may be defined, stored and executed, like single order placements, deletions of all orders, or placing complete order books.

Whenever implementing or just testing an intraday trading algorithm, it is of utmost importance for a sustainable success to ensure the intended rational algorithmic behavior: and this not only in ‘normal’ market and order book situations, but also in unusual market evolutions and even in rare or extreme events.

Although EPEX SPOT offers so-called simulated intraday market environments with some arbitrary orderbook situations and trade actions, these simulation settings can barely provide what in fact is necessary for a sound testing of algorithmic trading behavior: namely the full spectrum between normal and atypical order books, stable or erratic order books, empty or deeply filled order books, and so
on. Thus, what in fact is needed is the possibility to use the simulation environment as a container for complete self-designed market and order book situations. Utilizing the genuinely provided simulation platform for the conduct of such tests ensures a test environment which is as close as possible to the productive intraday market trading system.

Automated intraday trading: GUI of the Order Placer application

The developed application can place a wide order spectrum, ranging from single orders up to long order sequences for multiple products traded on a simulation environment of an electricity intraday market. All orders, order books and sequences of actions can be created and modified by predefined GUI functionalities or by editing the respective script file. Likewise, complete order books may be generated by using predefined functions, by manual setting, or by copy and paste from external spreadsheet applications, and then be placed automatically on the simulation environment.

This allows for the creation of any desired order book situation and even sequential order book changes, such that the behavior of the own trading algorithm (which has to be run in parallel producing the relevant logging information) against this 'laboratory' order book evolution may be observed and evaluated systematically. All created order books, actions and sequences can be stored and reused to reproduce the intended situation in the simulation environment whenever wanted.

Currently, the Order Placer can be connected to either of the two simulation environments of the EPEX SPOT. But in principal, after appropriate changes to the API calls used, the Order Placer may be connected to other simulated intraday markets, too. The Windows .NET application is self-contained and can be installed via copy and paste. Together with the provided documentation, a user-friendly GUI facilitates the entry into operation of the application.

Project staff: Dr. Gido Haarbrücker, Claus Liebenberger
Trading and hedging within physical or financial electricity markets demand a sophisticated valuation of various contract types as well as a profound risk analysis and management. All these tasks strongly depend on the quality of the underlying HPFC. Additionally, the stochastic price dynamics (volatility etc.) has to be taken into account. Otherwise, the analyses would disregard relevant risk sources.

With regard to the generation of HPFCs, special attention has to be paid to the absence of arbitrage, to the correct modeling of cyclical price components (the seasonality over different time spans, e.g. of one year, one week, and one day), and to the consistency of forward price and spot price dynamics. The latter consistency holds when the current expectation of the uncertain prospective spot prices (over the respective maturities) matches the currently observed futures' prices. In this sense, an HPFC does not contain the 'most likely' values of the spot prices in the future but rather represents the expected values of the probability distributions of the hourly spot prices. Furthermore, the neighbouring geographical regions Germany, Austria, and Switzerland and cross-border auctions require a consistency among the respective market HPFCs.

For the following markets, HPFCs are generated for every trading day of the respective energy exchange: Germany (Phelix DE), Austria (Phelix AT), Switzerland (Swissix), and France, the futures of which are all traded at the European Energy Exchange EEX; furthermore, for Austria which is traded at the Energy Exchange Austria EXAA. Every HPFC covers a time horizon of 5 years +, i.e. the remaining period of the current year plus the 5 subsequent calendar years. The calculation is carried out overnight in an automated way for the very next exchange’s trading day, always based on the then available market data.

The HPFCs are generated in form of a so-called EE variant ('Erneuerbare Energien'): This variant reflects the marketing potential for power producers of renewable energy, as with the begin of 2010 the German transmission system operators are obliged, by the 'Erneuerbare Energien Gesetz', to trade the amount of renewable energy at the respective electricity exchange, for which the producers did not opt for the 'direct marketing' method.

We take into account these new marketed energy amounts in an implicit manner: our studies based on historical data revealed that the classical way of assuring the resulting HPFC to be free of arbitrage (going along with a kind of shifting a scaled shape curve over small time windows according to the underlying base and peak futures products) may lead to 'price anomalies' within the HPFCs in the following sense: the price relation of neighboring hours does not reflect the respective price relation of the observed spot price. Particularly, this behavior could be observed at the transitions from peak to off-peak periods. In order to overcome such inconsistencies, a supplementary constraint set is used within the optimization problem which ensures the arbitrage freedom of the HPFCs: Based on historic price differences over a rolling time window of approximately 3 months, specific ranks of the ordered differences are taken as proxies for upper and lower confidence bands; these bands serve as upper and lower limits for the absolute price differences of neighboring hours within the HPFCs to be generated.

The EE HPFC family, with hourly granularity, is enriched by a supplementary quarter-hour HPFC (QHPFC) for Germany (EEX Phelix DE): The QHPFCs incorporate quarter-hourly price patterns, are consistent with the respective HPFC, and cover the same time horizon '5 years +' as the hourly HPFCs do.
So-called ‘Spike HPFCs’ complement the offered spectrum of electricity price forward curves: these spike based HPFCs reflect the incompleteness of the power markets. They are available for the markets Germany (Phelix DE), Austria (Phelix AT), Switzerland (Swissix), and France at the EEX and enable, e.g., a consistent stress testing for energy supply companies.

Short-term prognoses are determined for the markets Germany (Phelix DE), Switzerland (Swissix), and France at the EEX. These prognoses are delivered in the form of five confidence bands which represent an approximation of the real probability distribution of the hourly spot prices for the next three days (seven days for the EE variant, respectively). The determination relies on the seasonality within the respective HPFC, on the 24-hour term structure of the volatility (on a week-ahead basis), and on the stochastic dynamics of the clearing prices. Every confidence band is given by pairwise quantile information, thus coping with the fact of asymmetric spot price distributions. In particular, the volatility at the ‘short end’ (i.e. for the very near future) plays a significant role for the 3-day and 7-day prognoses: because historically, electricity markets exhibit the same behavior of volatility clustering as financial markets do, i.e. a phase of high volatilities with high price amplitudes is followed by a phase of low volatility with minor price amplitudes and vice versa.

Furthermore, a point forecast for the next 24 hours is provided together with supplementary information on the term structure over the same time span: the forecast is given by the mode of the probability distribution of the spot price, i.e. that price which will most likely occur – with an accuracy of +/- 1€; the term structure is determined on a day-ahead basis reflecting the magnitude of the short-term price fluctuations.

For the markets Germany (Phelix DE), Switzerland (Swissix), and France at the EEX as well as for Austria at the EXAA, hourly spot risk profiles are determined daily. The calculation of these risk profiles takes the respective spot price dynamics into account, based on the difference of the 95% quantile and the respective HPFC. All spot risk profiles cover the next seven days; due to the asymmetric price dynamics, the risk profiles have to be provided separately for long and short positions. The hourly granularity of the profiles supports a RAROC (Risk Adjusted Return on Capital) driven trading and allows a quantitative risk assessment of open positions within trading books.

The intraday markets are covered by the information category ‘price limits’ for the markets Germany (Phelix DE), Austria (Phelix AT), and France at the EEX. These price limits are provided numerically and graphically in form of up to five price intervals per hour. Depending on the respective price range in which the current intraday price lies, a recommendation can be derived which intraday trade action is more promising; either to close or to hold an open long or short position.

More information on this service provided by the ior/cf-HSG is available on www.iorfceu/dynamics.

Project staff: Prof. Dr. Karl Frauendorfer, Dr. Gido Haarbrücker, Claus Liebenberger

4.1.5 Risk-Adjusted Contract and Portfolio Management: BIT@EPLPFO

BIT@EPLPFO (Portfolio Optimization) has been developed as a state-of-the-art and multitasking decision support system. It supports participants within the energy sector to cope with today’s challenging business processes and tasks involved. Various types of delivery contracts and the own net position can be investigated, going along with an optimal value-oriented or quantity-oriented procurement strategy. The remaining risk exposure is split into separable categories according to the respective risk sources; corresponding risk premia are quantified which are in line with the market under consideration. Special reports and export functions provide the information which is typically required by the different business units like sales department, (risk) controlling, or procurement. Due to its broad functionalities, BIT@EPLPFO addresses likewise utilities, trading firms, and electricity producing companies.

Traditionally, the focus of utilities – and thus as well of the software applications used in the respective field – had been primarily directed at a low-cost and preferably safe coverage of the predicted
load. This limited perception fades out other important aspects which are affected by a load forecast and a corresponding procurement: the quantification of residual risks, their implications for pricing one’s own delivery services, and influences of a single procurement/hedging strategy for the overall net position. In response to these broader practical requirements, the ior/cf-HSG concentrates on further developing a decision support system which covers the tasks of procurement, sales, and risk management in an integrated way. Modern, liberalized electricity markets with both physical and financial electricity trading define the frame conditions for an effective decision support system.

To give an example of a typical situation, utilities face industrial customers who want to get an offer for the electricity supply over a specific time period according to their business needs. Formerly, two types of supply contracts existed for this purpose: a schedule delivery, where the customer gets his electricity following exactly a pre-specified load prognosis, or a full delivery which permits the customer to deviate from the load prognosis, i.e. the electricity actually delivered can be higher or lower than has been predicted. In either case, in order to evaluate a fair offer price, one must distinguish between the price for the electricity itself and the price for the remaining risks within the contract offer which are implicitly taken by the utility. BIT@EPLPFO supports the user by solving these different pricing problems.

The traditional supply contracts are augmented by two additional categories: (i) pure feed-in contracts, where the ‘customer’ in fact produces energy (mostly from renewable energy sources) and sells this energy to the utility, and (ii) combined supply and feed-in contracts, i.e. the customer receives (scheduled or flexible) energy from the utility and simultaneously may produce own energy to be fed back into the grid. In particular, the latter combined-type contracts exhibit an increased risk in case the expected supply and production are not provided as separate data but only in a netted way: Because then, the effective volume and related price risks may be underestimated substantially for the separate supply and feed-in side.

All procedures mentioned above also apply – with some slight adaptions – to the related problem of investigating the utility’s own net position and analyzing the inherent risks. Additionally, specific restrictions, which are characteristic for managing a utilities’ net position, can be imposed for the analysis: in particular, limits for the acceptable peak and off-peak long or short net position (still remaining after having optimally hedged) for specific time intervals.

As far as the hedging strategies are concerned, two alternative approaches can be pursued: either a quantity-oriented or a value-oriented one which fit best the expected energy quantity to be delivered (received, respectively) or the expected value of the energy to be delivered/received (obtained by valuing the predicted load with the current HPFC), respectively. Depending on the pursued hedging strategy of the utility, a purchase list at optimal cost can be calculated.

Ideally, such a purchase list directly leads to deals which should have to be performed. Intended and performed deals may be entered – together with relevant information for internal accounting purpose – and administered within BIT@EPLPFO; just the trades themselves have to be executed in an external trading system. Special functionalities, which are related to trade products or to accounting periods, allow the review of former procurement situations and the monitoring of the completion of pending procurement activities.

Even after having performed the procurement/hedge – irrespective of the chosen procurement strategy –, several risks may remain which have to be assumed by the utility. These risks are due to still existing imponderables: price risks (prices of hedge products may change during the contractual offer period or during the period which is necessary to buy the hedge products) as well as conjoint quantity and price risks caused by an imperfect hedge (any residual open position has to be closed lateron at the cost of the uncertain future price) or by a price/load correlation in the case of full deliveries (typically, the customer’s demand is higher than predicted in those periods where the spot prices are higher than ‘normal’ and vice versa).
For these and further risk categories, BIT@EPLPFO quantifies the contract-specific risk such that adequate risk premia may be imposed to the intrinsic electricity price. Along with the provided profit&loss distributions and corresponding statistical indicators, a sophisticated risk analysis can be carried out by the user. Offer reports support the sales department in its activities: these customizable reports may be generated in an automated way and rely on the fair price for the electricity and on the evaluated risk premia.

BIT@EPLPFO is enhanced by a supplementary workflow module which incorporates the operative workflow process into the software: Triggered by inquiries of the sales department and other incidents, the relevant steps within the interaction of the back office, sales department and procurement department can be carried out in a transparent and retraceable way. Recurring tasks as, e.g., contract valuations based on newly arrived HPFCs, can be scheduled and run in an automated, event driven way.

BIT@EPLPFO: clippings of the multitasking system

On the technical and operational level, the software BIT@EPLPFO represents a powerful and flexible decision support system by an integrated provision of the following features: a graphical user interface, multitasking capability, export/import and filtering features, tabular and graphical representations, pdf report generation, and user management as well as archiving and managing functions for all types of relevant data (contracts, calculations, load predictions, HPFCs, historical spot prices, etc.) in an attached database.

Project staff: Dr. Gido Haarbrücker, Claus Liebenberger
### 4.1.6 Valuation and Hedging of Energy Contracts: BIT@EPI.VPP

| BIT@EPI.VPP (Virtual Power Plant) provides a stand-alone solution for the valuation of energy contracts. The spectrum of possible contracts covers the whole range between simple products without flexibility – like e.g. futures – and complex virtual power plants which are characterized by inherent rights and/or duties. Explicitly designed for the valuation of such sophisticated contracts with inherent flexibilities, BIT@EPI.VPP solves multistage optimization problems which incorporate the uncertain future prices in form of an hourly price forward curve and a forward price model. The provided results contain the fair contract value, the optimal expected exercise strategy and the therewith involved profit and loss distribution. Supplementary statistical indicators may serve as a basis for advanced risk analyses, and numerical data allow the implementation of a delta-hedging strategy both for a weekly and monthly granularity. The software package BIT@EPI.VPP offers a graphical user interface for the parameterization of energy contracts and for the management of the optimization runs and results. |

In general, standardized futures are liquidly traded on the energy exchanges. Conversely, the trade volumes of options are rather negligible, for example the trade of the (European style) Phelix options at the European Energy Exchange EEX. This fact may be seen as an indication that market participants prefer to negotiate sophisticated energy contracts (i.e. more complex than just the standard futures) on a bilateral basis. Thus, OTC arrangement of price, maturity, rights and duties particularly gain more importance. To manage the design and to control the risk of these types of ‘flexible’ energy contracts turn out to be key success factors in an increasingly competitive situation.

BIT@EPI.VPP is a powerful valuation tool which meets the relevant functional requirements: various parameterization possibilities for standardized and complex energy contracts, numerical valuation of the specified contract, quantification of important statistical indicators, and reporting on hedging strategies. The numerical results are clearly structured and contain the following information: the fair contract value, the optimal expected exercise strategy, the profit and loss distribution at the horizon of the contract period, and corresponding hedging strategies on a weekly and monthly basis. Results are provided both in table form and in graphic representations. Furthermore, well established statistical (risk) indicators of the profit and loss distribution and of the distribution of exercised energy are stated: the expected value, variance, value at risk, etc.

A graphical user interface and a wide variety of administrative functions facilitate the management of the energy contracts and their analyses. All contracts and calculations are stored in an attached database such that contract specifications and results are permanently available for an actualization or further processing; required price forward curves can be imported from text or Excel files. Even for complex energy contracts, computation times on a standard PC lie in the range of minutes, thus fulfilling the typical operational requirements in daily business.

In order to ensure the consistency of the ‘fair’ contract value with the market under consideration, the applied valuation method must meet two core demands: an appropriate modeling of the uncertain future spot prices and the determination of an optimal exercise strategy within the remaining contract period. BIT@EPI.VPP overcomes these challenges in an integrated way using a multi-stage stochastic optimization problem: the evolution of the uncertain spot prices is driven by a parameterized stochastic process which exhibits the typical characteristics (mean reversion, seasonality, jumps, etc.). The exercise strategies are determined on an hourly basis in such a way that exercises of subsequent stages – i.e. in the more distant future – may depend on the exercise in previous stages.

Jointly with the attached database, BIT@EPI.VPP enables its users in the fields of energy trading, procurement, and supply to evaluate and manage manifold energy contracts. The provided results support the analysis and implementation of hedging strategies against price or load variation. In addition, the risks of a speculative trading can be quantified. The software comes as a stand-alone solution which is easily set up by an installer package.

**Project staff:** Dr. Gido Haarbrücker, Claus Liebenberger

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*Institute for Operations Research and Computational Finance (ior/cf-HSG), Annual Report 2019*
4.1.7 Regime-Dependent Natural Gas Price Forward Curves: BIT@GAS.PFC

The valuation of natural gas supply contracts requires price forward information for the respective market/hub and for the entire contract period under consideration. The ior/cf-HSG offers such price forward information with daily granularity for the market area of the Dutch Title Transfer System (TTF) as well as for two German market areas, operated by Net-Connect Germany (NCG) and by Gaspool Balancing Services (GPL). The provided information for each market area consists of two price forward curves (PFCs) which represent two regimes determining the shape of the respective curve: a cyclical and an anti-cyclical regime. The first regime results in a strong seasonal price pattern stressing mainly the temperature dependency of natural gas spot prices; such an expectation can be thought of as being the product of rather low future storage levels compared to the expected demand. The second regime, presumably a situation of high future storage levels, is characterized by a spot price expectation that shows almost no seasonality. A mechanism for generating these regime-dependent PFCs has been implemented in the software module BIT@GAS.PFC. For the above-mentioned market areas, a respective cyclical and anti-cyclical gas PFC are automatically generated on a daily basis. Subscriptions to the information service may be received by e-mail and are downloadable from a special website.

A price forward curve (PFC) is supposed to be free of arbitrage possibilities with respect to traded forward or future contracts and to feature typical seasonal price patterns if applicable. Due to limited storage capacity, its primary use for heating purposes, and the fact that natural gas is traded on regional markets (versus a global market like for heating oil), a certain degree of seasonality can be expected to be present in natural gas spot prices. Therefore, this seasonality also needs to be incorporated into the PFC for natural gas deliveries. Comparable to electric power HFPCs, assumptions about seasonality are especially crucial if the availability of traded contracts with respect to future delivery periods diminishes. If for example, only a single future price is available for a longer future time period, the shape of daily forward prices of the respective period is completely determined by the applied seasonality assumptions.

The ior/cf-HSG offers PFCs with daily granularity for three continental European natural gas trading hubs: TTF, NCG, and GPL. The futures prices, which are used to ensure the PFCs to be free of arbitrage, and the spot prices are taken from European Energy Exchange EEX Group. When turning to typical spot price patterns, it can be stated that prices for the three market areas move closely together and that there is no stringent historical price pattern. Several of the past years were characterized by periods of detectable temperature dependency and by periods of rather sideways or flat price development in accordance with the development of storage levels. Based on these observations, we deem it appropriate to speak of two regimes: one that leads to detectable temperature dependency, and a second one that implies only slight seasonality. We name these two regimes cyclical and anti-cyclical, respectively. The degree, to which gas storages were filled at a certain point in time in comparison to actual demand, is one explanatory factor.

Forward risk profiles are determined for all three trading hubs. These profiles cover the same period as the respective PFC; their calculation takes the respective forward price dynamics into account which is based on the difference of the 95% quantile and the respective PFC. Due to the asymmetric price dynamics, the risk profiles have to be provided separately for long and short positions. The daily granularity of the risk profiles supports a RAROC (Risk Adjusted Return on Capital) driven trading and allows a quantitative risk assessment of open positions within the trading book.

Subscribers to the information service are supplied with two PFCs per trading hub: the PFC corresponding to the cyclical and to the anti-cyclical regime. Convex combinations of these two PFCs are again free of arbitrage and represent the continuum of possible seasonality effects. The subscriber may use several convex combinations of the two regimes (or PFCs) for scenario analyses and/or can choose a single combination in accordance with his subjective assessment of future evolutions.

Project staff: Dr. Gido Haarbrücker, Claus Liebenberger
4.2 Finance

The ior/cf-HSG also offers software products and services for the financial industry. It provides solutions for the following applications: The software tool “Margin Optimizer” determines improved replicating portfolios based on dynamic strategies for variable banking products (also known as non-maturing assets and liabilities), e.g., savings and sight deposits or variable-rate mortgages. Benchmarking analyses of replicating strategies for non-maturing products are also offered in form of consultancy projects. In a collaboration with a retail bank, forecasts of relevant balance positions are generated, based on a thorough econometric analyses of their dependencies on interest rates. Finally, parameters of client rate and volume models are estimated that are needed as input for internal risk models.

4.2.1 Margin Optimizer

| Margin Optimizer is a software for the control and quantification of the potential risk of non-maturing assets and liabilities in a bank’s balance. Based on the analysis of a large number of representative scenarios for the evolution of future interest rates and volumes, the tool calculates dynamic replicating portfolios that take into account the risk inherent to changes in these factors. Compared to static approaches that are currently still standard in the banking industry, the dynamic replication allows a substantial increase and stabilization of the margins of variable positions. |

Usually, a bank’s balance consists to a large extent of assets and liabilities without contractually defined maturity. This includes in particular savings and sight deposits as well as variable mortgages. The characteristic feature of these so-called non-maturing assets and liabilities (NoMALS) is that the bank may always adjust the client rate – at least partially – to the current level of market rates. On the other hand, clients have the option to withdraw their investments or repay their mortgages, respectively, anytime at no penalty. It can often be observed that customers react to changes in market rates, e.g., by substituting their variable mortgages by fix-rate mortgages when interest rates are below their long-term average. Likewise, investors shift their savings deposits during periods of high rates into bonds with long maturities. Therefore, significant fluctuations in the volumes of these positions result on both sides of the balance. This makes the management of these accounts particularly difficult.

Although clients may withdraw or repay the corresponding volumes anytime, the money usually remains in the accounts over longer periods. From the bank’s point of view, it would be inappropriate to designate them as daily maturing positions because in reality the funds are available much longer. It is therefore required to assign a realistic “term profile” to an account without contractually defined maturity. To this end, the bank defines a so-called replicating portfolio that mimics the cash flows of the original position. In this way, uncertain cash flows are transformed into (apparently) certain ones and managed as such. However, this transformation depends strongly on assumptions and requires an adequate modeling of the problem.

The software tool “Margin Optimizer” is based on a multistage stochastic programming model. It uses stochastic models for the dynamics of the relevant risk factors: Market rates, client rates and volume of the underlying position. The market rates are currently described by a term structure model with factors for the level of the yield curve and the spread between its short and long end. The model for the client rates reflects their characteristic tardiness. Finally, the volume model takes the dependency on interest rates into account.

The software generates a large number of representative scenarios for the future outcomes of the risk factors in such a way that their relevant statistical properties (i.e., certain moments) are preserved. Then the optimal transactions along each scenario are determined. The resulting decision on the replication of the variable position exhibits not only an optimized risk profile. It is also more efficient since the multistage dynamic optimization of the portfolio anticipates a future reinvestment or refinancing risk (and the corresponding profits or losses for different future rates).
The experience made so far indicates that the margins of non-maturing assets and liabilities may be substantially increased and stabilized by the implementation of future investment or refinancing strategies.

Project staff: Dr. Michael Schürle

### 4.2.2 Benchmarking of Replication Strategies for Non-Maturing Assets and Liabilities

The ior/cf-HSG has vast experience in modeling non-maturing assets and liabilities (NoMALs) from research as well as practical projects with industry partners that go back to 1993. Activities in this field include the assessment of standard approaches for the construction of replicating portfolios, modeling the evolution of client rates and product volumes as well as the design of a dynamic replication model based on multistage stochastic optimization methods. This experience is offered to banks for an assessment of their current approaches for managing NoMAL positions.

Since the future cash flows of NoMAL positions are uncertain due to their inherent options, banks usually determine a replicating portfolio to transform uncertain payments into apparently certain ones. On this basis, the associated interest rate risk is managed, and transfer prices are determined that split the margin into a compensation of the retail business unit which acquired the funds and the contribution of the treasury for a possible term transformation. The determination of an “accurate” replication is therefore of utmost strategic importance for a retail bank.

The common approach applied by most banks in Switzerland (and other European countries) is the construction of a replicating portfolio using simple money and capital market instruments. This method is also explicitly supported by the Swiss Financial Market Authority (FINMA). The total volume is split into time buckets that consist of several tranches with the same initial maturity. In each time bucket, every month one tranche matures and is renewed by an instrument with the same initial maturity. When the product volume changes, all tranches are proportionally increased or decreased. Thus, the non-maturing position is translated into a portfolio with constant duration.

However, this approach has several deficiencies both from a theoretical and a practical point of view. The assumption of constant durations is problematic as usually the product volumes are highly sensitive to changes in interest rates and may vary significantly over time. This can be critical in the current market situation, as interest rates are historically low. In case they rise in the near future, it must be expected that clients withdraw liabilities. Then, positions in the replicating portfolio must be squared, which can lead to the realization of losses when these are originated from times of low market rates.

As an alternative, which is also suggested by the FINMA, the bank’s option to adjust the client rate and the clients’ option to add or withdraw volume can be modeled directly. This means that stochastic models for the dynamics of market rates, client rates and volumes must be defined and calibrated to the available data. Then, client rates and volumes are projected into the future by Monte Carlo simulation over a certain time horizon. Specific characteristics of the client rate dynamics like caps, floors or asymmetric adjustments may easily be taken into account as well.

The simulation of the client rate cash flows and volume changes over the time horizon allow a valuation of the non-maturing position. In general, the value of an asset product is above and that of a liability product below par. This reflects the fact that mortgage or loan rates are higher than the level of market rates while deposit rates are lower, i.e., the marketing of non-maturing products provides an additional value over investment or refinancing in the interbank market. In particular, a stochastic pricing method allows the derivation of a transfer price directly.

This approach allows that the management of the non-maturing products and the marketing policy is guided by the outlook for the bank. For instance, expected changes in the client rates and/or volumes may lead to a negative indicated margin under the current pricing regime (i.e., the present value of an asset product is below and that of a liability product above par). In this way, a required change in the client rate of the corresponding product is indicated, or the current pricing strategy must be reconsider-
ered in general. Furthermore, the interest rate sensitivity of the non-maturing product can be determined by passing stressed yield curves to the valuation model. Retail and treasury departments can therefore coordinate their pricing and hedging strategies to produce stable incomes.

Both methods require a deep understanding of the underlying assumptions and a careful application of the apparently simple standard replication model because of its pitfalls, the stochastic modeling approach due to its complexity. The ior/cf-HSG offers interested banks an assessment of their currently used methods for the replication and management of NoMAL positions. This allows potentials for increased margins and reduction of risks to be unlocked. Both have become a challenge of strategic importance for retail banks in the current low interest rate environment.

Project staff: Dr. Michael Schürle

4.2.3 Modelling Volumes and Client Rates of Retail Banking Products

The volumes of retail banking products show significant variations over time that can be attributed to changes in clients’ demand, depending on the current level as well as the expected evolution of interest rates, offered product rates or other factors. The identification of the relations of product volumes on these factors provides valuable information for various applications like risk management, budget planning etc.

Over many years, the ior/cf-HSG has built competences for the modeling of retail banking products in the context of its activities of developing decision models for non-maturing assets and liabilities. These types of accounts offer bank clients the possibility to add or withdraw money anytime and are therefore characterized by significant volume fluctuations. On the other hand, the bank may adjust the client rate of such products at discretion.

One result of these research activities are models that allow the verification and quantification of observed or suspected dependencies of product volumes on market rates, the corresponding client rate and other (macro-) economic variables. Furthermore, specific characteristics of the client rate dynamics like delayed or asymmetric adjustment to changes in market rates can be explained. Beside the use for the valuation and hedging of the risk of variable banking products, models of this type may also be exploited for the budget planning of banks, and the methodology might be extended to explain the volumes of fix-rate positions as well.

In an ongoing collaboration with a retail bank, the econometric tools that emerged from this research are used to analyze the dependency of product volumes on market and client rates as well as the relations between different complementary products. The results are used to calculate forecasts of the future volumes of the relevant balance positions that are consistent with the bank’s expectation of future interest rates. These forecasts provide valuable information for the budget planning.

Another subproject conducted with the partner bank consists of the analysis of volume flows between different asset and liability positions that are caused by clients’ reaction to changes in the level of interest rates. The bank uses risk management software that requires the specification of transition matrices for these volume flows where a large number of parameters must be specified for different interest rate regimes. A sophisticated estimation approach was developed for this purpose and implemented as a software tool.

An important aspect of the bank’s risk management is the evaluation of the impact of interest changes on earnings, which is quantified by a measure called earnings-at-risk. This requires models that reflect the dependency of client rates for the various retail banking products on market interest rates. The development of such models is not trivial due to the specific characteristics of client rates for typical products like delayed, incomplete and asymmetric adjustment to market rate changes.
In the reporting period, various approaches were investigated that reflect these properties better than the standard models in the bank’s risk management software. The project partner will use an approach proposed by the institute in its future earnings-at-risk calculation for selected products.

Project staff: Dr. Michael Schürle

4.2.4 Report on “pkcockpit”

In close cooperation the ior/cf-HSG and the invalue AG have developed the tool “pkcockpit”. It supports managing directors, pension fund experts and foundation board members in steering the balance of the financial obligations and the funding in a comprehensive way. Fundamentals of this tool are a huge amount of data clusters and financial market data for revealing key drivers and dependencies between these data as well to provide peer assessments.

The increasing financial requirements of pension funds and the fragmentation of available data and parameters make it more difficult for managing directors and foundation board members to have a full overview of all relevant data clusters to steer the financial balance sheet and the challenges resulting from this. That is why the tool “pkcockpit” was developed, in cooperation with three Swiss pension funds.

The tool provides a wide range of data clusters to give a full overview of what the status quo of a pension fund is and what this status is in comparison to the relevant peer group. The dashboard comprises clusters for the following nine subcategories: financial status (e.g. economic cover ratio), portfolio strategy (e.g. performance ratio, volatility), funding (e.g. target return, net cash flow ratio), capability to restructure (e.g. demographic ratio), performance (e.g. return, performance ratio), compliance (e.g. spectrum of portfolio strategy, limitation of categories), risk trend (e.g. benefit cases, new cases of disability), cost (e.g. management cost, TER cost in %) and market (e.g. increase of insured person and retirees, demographic ratio of new contracts). In addition, an interactive tool shows the board of trustees the possibilities of intervention and their effects. The integrated document management system provides central administration of the documents of the foundation board and other management bodies.

The “pkcockpit” provides not only the current status of each data cluster but also an evaluation and trend analysis by bar charts. Furthermore, these data clusters are analyzed regarding their dependencies among each other and their key drivers (endogenic and exogenic). The main question here is e.g. why a pension fund can fall into a critical area within a data cluster even though the market for shares is successful. Finally, using real financial market and balance sheet input data a peer analysis completes the significance of this tool.

Project staff: Prof. Dr. Karl Frauen dorfer, Ass. Prof. Robert Gutsche PhD, Dr. Gido Haarbrücker, Claus Liebenberger

4.2.5 Report on the Cooperation with SIX

In last four years, the ior/cf-HSG has been exposed to a variety of research topics in financial market-microstructure. This experience has mainly been driven by our long-lasting research cooperation with the Swiss stock exchange SIX. Together, we have worked on several issues that are becoming more important for all exchanges alike. This document intends to break down the experience of ior/cf into two main components: Measurement of liquidity during continuous trading and price formation in the closing auction.
Measurement of liquidity during continuous trading

With the increasing level of fragmentation in financial markets, Assessment of liquidity becomes more difficult. In 2016, SIX approached us in order to precisely assess the level of order-flow competition for Swiss stocks, namely the 30 Blue Chips in the Swiss Leadership Index (SLI). In order to enable all of the analyses, ior/cf partnered up with BMLL in London as a leading data provider for microstructure data. Their services are completely cloud-based, allowing for enhanced computational power needed for our analysis. BMLL continuously extended the services offered over their cloud-solution.

Throughout the duration of the project with SIX, there have been a lot of developments in terms of the measures used. In the beginning, the main competitive gauge was the Average Relative Spread (ARS), which essentially measures the quoted bid-ask spread as measured on each platform individually. In a next step, we added the European Best Bid and Offer (EBBO) to our measures of interest, which we implemented in both dimensions of clock-time and event-time.

While ARS and EBBO quantify the quoted prices, we extended the analysis with more execution-relevant aspects. For the EBBO, we added additional weighting schemes that would emphasize the minimum amount of volume available at the top of the book, which is of particular importance for the execution of large trades. Moreover, we implemented a best-execution measure named Best Liquidity Score (BLS). This measure aims to quantify the persistence of the best quotes across multiple markets. The BLS is counting the number of domestic market orders, that could have been executed at more favorable conditions on a competing platforms. This methodology entailed the comparison of all competing order books at different times: Simultaneous to the market order and with lags of 10/20/50 milliseconds. The lags were introduced in order to identify the adjustment of quotes on competing exchanges based on executions on SIX.

In addition, the ior/cf-HSG has independently designed and implemented algorithms which allow for the aggregation of pre-selected MTFs. In this manner we are able to assess the total liquidity and EBBO for each tradable security which ultimately reveals information about competitiveness among MTFs.

Price formation in the closing auction

The second assignment during our cooperation with SIX is not considering continuous trading, but rather diving into their own closing order book. More specifically, exchanges in Europe are apprehensive of the fact that their closing auctions get competition from other off-exchange institutions, such as investment banks or large brokers. The goal of the research is the investigation of whether such practices deprive price-setting closing order books from valuable volume. Particularly interesting is the question of how sensitive order books are to the removal of certain percentages of liquidity. To investigate this, we designed a new algorithm, that would recursively scan through all quotes and trades registered throughout the trading day. This allows us to reconstruct the full order book for the entirety of the closing auction. For the purposes of our research we created snapshots every 30 seconds, which allows us to track the evolution of the order book during the auction. It also enables the investigation of when information enters the closing action, i.e. with what rate the counter-factual closing price approximates the ultimate closing price. Moreover, this allows us to find clusters of informed trading over the course of the closing auction.

Furthermore, we implemented a framework that allows for the quantification of price discovery during the closing auction. By comparing the pre-close to the closing prices, we can make inferences about how much information is revealed inside closing auctions. We are currently analyzing whether those deviations are systematic and explainable or just random noise.

Project staff: Prof. Dr. Karl Frauendorfer, Dr. Giado Haarbrücker, Dr. Michael Schürle, Claus Liebenberger, Louis Müller
5. Teaching

The University of St. Gallen (HSG) covers the fields of Business Administration, Economics, International Affairs, Law, and Law and Economics. Academic degrees can be obtained at the bachelor, master, and doctoral level. The degree courses at HSG start with the Assessment Level of one year providing an introduction to the academic subjects, requirements, and objectives of the University of St. Gallen. In this first academic year, the students are familiarized with the requirements of studying and acquire their first academic competences. Teaching in this Assessment Year acquaints students with the basic knowledge of their respective disciplines as well as of scientific methods. It enables them to work on and solve theoretical as well as practical problems within an appropriate period of time. On the Assessment Level, all students pass through the same stages together in order to qualify for the Bachelor level.

Students who have passed the Assessment Year examinations as a whole will be able to proceed to the bachelor level and opt for one of the majors “Business Administration”, “Economics”, “International Affairs”, “Law”, and “Law and Economics”. As a rule, undergraduate courses extend to a total of 6 semesters, namely two semesters at the assessment level and four semesters at the bachelor level. The awarded degree “Bachelor of Arts (HSG)” is a first academic degree that qualifies the graduates for professional work and enables them to enter working life. After having obtained a bachelor’s degree, one may continue with studies at the master level. This level aims to carry out in-depth theoretical and practical work in certain fields with selected specialties. The University of St. Gallen offers eleven master programs in the fields of Business Administration, Economics, International Affairs, and Law. The programs take three or four semesters and end with the award of the degree “Master of Arts HSG”.

Three-level and three-pillar model forming the foundation for the studies at the University of St. Gallen (Source: www.unisg.ch)

The ior/cf-HSG offers courses on both the bachelor and the master level. With regard to teaching on the master level, the institute participates in the master programs “Banking and Finance” (MBF) and “Accounting and Finance” (MAccFin). All courses offered by the institute rank among the categories Contact Studies or Independent Studies. At the doctoral level, the institute contributes with the mandatory course “Asset Pricing” to the doctoral program “Ph.D. in Finance” (PIF).
5.1 Trading Room

As part of a rectorate project, the SoF Chair "Operations Research" and the institute ior/cf-HSG were commissioned with the project management in HS 2014 to set up a trading room and investment lab with 21 trading desks for the HSG.

In the past 5 years (HS 2015 - HS 2019), lectures have been designed for the trading room on the main topics of "Energy Finance" and "Equity Analysis & Security Trading", which were in great demand among the students.

From traditional stock and bond markets to complex energy trading, from plain vanilla products to complex derivatives, the HSG Trading Room opens up a virtually unlimited horizon in terms of simulating real market conditions.

The HSG Trading Room, has trading floor equipped with trading software, as well as Thomson Reuters and Bloomberg access. The HSG Trading Room significantly enhances active learning opportunities at the University of St. Gallen. Its objective is to support and promote sustainable and responsible learning and research in finance related fields. Located in the Tellstrasse building, it offers an experiential learning environment and space for 21 to 42 students per session.

Prof. Dr. Robert Gutsche, Assistant Professor of Finance and Accounting at the School of Management joined the ior/cf-HSG for this project in 2015. He was in charge of implementing the first trading course, “Asset-based Commodity Trading”. With the launch of the CC Security Analysis, the ior/cf in 2017 successfully implemented more courses to the Trading Room, enhancing the trading room’s role as a lab for trading and investment analysis.

The concept of the Trading Room was presented at the 2017 Annual Meeting of the American Accounting Association conference in San Diego by Robert Gutsche and Alexandru Rif. The presentation and subsequent discussion opened up new opportunities for the consolidation of the Trading Room as active teaching lab for trading and investment analysis.

In 2019, the teaching in the trading room reached a bottleneck situation. The demand for trading courses is extremely high, since it provides students with the opportunity to apply relevant concepts and principles of finance, accounting and business analysis so that the HSG has to decide about resources. Given a favorable decision by the rectorate, we will be able to increase the teaching resources for 2020 to expand the courses offered for students.

5.2 Bachelor level

5.2.1 Asset-based Commodity Trading

Lecturers: Prof. Dr. Karl Frauentorfer, Ass. Prof. Dr. Thomas Walther, Ass. Prof. Robert Gutsche, Ph.D., Ass. Prof. Dr. Sebastian Ulz, Dr. Michael Schürle, Prof. Dr. Florentina Paraschio, Alexandru Rif MA, HSG.

In the last years there has been a notable influx of energy trading by financial institutions and portfolio investors who view commodities in general, and energy in particular, as a distinct asset class which exhibits a low (or possibly negative) correlation with traditional equity and fixed-income investments, and therefore improves portfolio risk-return characteristics through the effects of diversification.

The course introduces students to the trading fundamentals of selected energy markets, energy investment concepts, as well as trading techniques and strategies for energy and energy derivatives. The course consists of three parts:

1. Introduction to markets and trading tools
2. Trading sessions and
3. Performance measurement and discussion

The focus lies on the risk-adjusted management of open positions with tradable instruments for consumption commodities in volatile markets.
5.2.2 Fundamental Business Analysis: Using Financial Statements

Lecturer: Ass. Prof. Robert Gutsche

The financial statements are the primary means of communication of corporate information to investors and at the same time also the primary source of information for investors. The information contained in the financial statements are highly relevant for investment decisions. For this reason, a competent evaluation and interpretation of financial statement information is of central importance for the allocation of resources. The aim of this course is to enable students to read financial statements, to understand and to be able to derive investment decisions based on this analysis. The course combines the analysis of financial statements and the evaluation of securities from the investor’s perspective.

The course has the very practical emphasis on methods for analyzing and valuing firms using financial statements. Several case studies are integrated. By completing this course, students will feel competent in writing a thorough, credible equity research report or investment analysis that meets the highest standards. The course is of interest to those contemplating careers in investment banking (particularly in equities), security analysis, equity hedge funds, private equity, consulting, public accounting, and corporate finance. In addition to that, it is also helpful with personal investing.

5.2.3 Bloomberg Seminars

Lecturer: Dr. Michael Schürle

The Bloomberg Terminal is an information system that provides price quotes, news and all kinds of economic key indicators which drive financial and commodity markets in real time. It has become a standard tool for the financial industry with hundreds of thousands of installations worldwide. The terminal offers also access to historical data and is therefore a valuable source for research in finance and economics. Particularly for students who strive for a career in the financial sector, knowledge of the Bloomberg Terminal is a marketable skill that will improve their chances on the job market.

The University of St. Gallen provides exclusively for its students and faculty members access to seven Bloomberg Terminals in the Dataroom 01-U206 (main building) plus an additional Terminal in the library. In order to promote this unique resource that is only available at few universities due to the high license fees, the institute offers a preparation course for the use of the Bloomberg Terminals for HSG students of all levels. This course is in high demand. With a total of more than 240 participants at several dates in the spring and fall semester 2019 it was fully booked.

5.2.4 Strategic Management of Utility Companies

Lecturers: Dr. Ivo Schillig, Dr. Christian Opitz

Nowadays, utility companies face far-reaching entrepreneurial challenges, because of the increasing liberalization of the Swiss energy market – especially in the areas of electricity and gas –, the integration of renewable energies, and the increasing convergence of different energy sources. Due to the market price development on the European energy exchanges and a reduction in the cost of capital for investments in the power grid, network operators are increasingly shifting activities to so-called energy services. The aim of the course is to show the students selected strategic challenges of the energy sector and to work out concrete implications for the strategic management of utility companies based on practical examples.

5.3 Master Level

On this level, the institute participates in the Master Program in Banking and Finance (MBF), in the Master Program in Quantitative Economics and Finance (MiQE/F) and in the Master Program in Accounting and Finance (MAccFin). The iorf-HSG teaches various compulsory courses, core electives, and independent electives. A major aim of these courses is to provide the program participants with a well-founded methodical competence in the respective subject matters.
5.3.1 Computational Finance

Lecturer: Dr. Michael Schürle

The valuation of financial derivatives cannot always be performed by closed-form solutions to the underlying pricing equations. In particular, more complex options require the application of advanced numerical methods. This course provides a solid introduction to financial option valuation and the numerical techniques applied by quantitative analysts to price options, assess risks and derive the required parameters from market data. Examples for the implementation of the individual concepts are given in Matlab code.

5.3.2 Energy Finance

Lecturer: Prof. Dr. Karl Frauendorfer

The objective of this course is to introduce characteristics of energy markets, ongoing changes due to the energy transition and the impact on price dynamics. Because of the recent widespread liberalization of the energy sector in Europe and the unprecedented growth of energy prices in international commodity markets, it is also important to look at their interdependencies. Using advanced quantitative methods, we answer questions like:

- How did electricity, gas, oil and coal price interdependencies change?
- How can we model particular characteristics of energy price dynamics such as spikes and jumps?
- Is there a common market model for energy prices in general?
- Can future prices be used to forecast accurately spot prices in energy markets?
- How are price-forward curves derived?
- What would be adequate stress testing techniques for extreme movements in energy prices?

The course takes place in the Trading Room and allows students practical experience with energy trading cases.

5.3.3 Dynamic Equity Analysis and Security Trading

Lecturer: Ass. Prof. Dr. Robert Gutsche

The aim of this course is to enable students to derive dynamic investment decisions based on financial and non-financial fundamental information. It combines valuation of equity and derivative securities as well as financial statement analysis with investment/trading decisions and hedging techniques.

The course is of interest to those contemplating careers in investment banking, particularly in equities, security analysis, equity hedge funds, private equity, consulting, public accounting, and corporate finance. The desired learning outcome is particularly supported by the experiential learning environment offered by the HSG Trading Room, which is a high-tech trading floor equipped with state-of-the-art trading software, Thomson Reuters, Datastream and Bloomberg access.

We have also adapted the course “Dynamic Equity Analysis and Security Trading” for students in the Master of Accounting and Finance (MAccFin), taking into account the different cohort-specific student profiles and program objectives.

5.3.4 Valuation for Accounting

Lecturer: Ass. Prof. Dr. Robert Gutsche

Every asset has a value. The accountants just have to find it...

...when a high degree of uncertainty is involved, the measurement of assets, liabilities or equity becomes complex and requires expert knowledge to determine their recognition and measurement in the
balance sheet according to the International Financial Reporting Standards (IFRS). This course addresses the most complex valuation topics in accounting from a theoretical and practical perspective. It provides a framework for valuation and illustrates valuation problems with case studies and high-profile guest speakers from practice.

Students who successfully complete this course will have the knowledge and skills to face even unusual valuation problems in accounting. They will be able to apply expert valuation techniques in the areas of business combinations, including the valuation for goodwill and intangibles, financial instruments, and investment property.

5.3.5 Applied Corporate Valuation

Lecturer: Ass. Prof. Dr. Robert Gutsche, Dr. Michael Kramer, Partner Deals Advisory, PwC

The focus of the course is on practical application and integration of corporate finance, valuation and accounting concepts to valuing companies, strategies, corporate assets, corporate debt or equity. The course uses case studies that students have to present in class. Students in the course “Applied Corporate Valuation” of the Master in Banking and Finance, MBF present their case studies to corporates from Standard & Poor’s, BlackRock, Julius Bär, Morgan Stanley, JP Morgan, Bain & Company, Vontobel, Rothschild, PriceWaterhouseCoopers and KPMG.

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5.4 Doctoral Program

The type of academic training of the doctoral studies at the University of St. Gallen enables doctoral students to employ a scientific approach both in theory and practice. On the level of doctoral studies, ior/cf-HSG contributes to the programs “Ph.D. Program in Finance” (PiF) and “Ph.D. Program in Management” (PMA). The PMA is the largest Ph.D. program of the University of St. Gallen and provides either preparation for a research-based professional career (standard track) or for an academic career (scientific track). Students may select one of five specialization areas: Accounting, International Business, Strategy & Management, Business Innovation, and Marketing, which are all offered by the university’s broadly oriented School of Management. The PiF started in the fall term 2013 and represents the School of Finance’s expertise.

5.4.1 Asset Pricing

Lecturer: Prof. Dr. Karl Frauendorfer

The course is a standard first-year PhD course with an introduction to the field, closely following in its structure Cochrane’s (2010) book “Asset Pricing”, also integrating concepts from Björk (2009) and Back (2010) It provides students with the theoretical foundations as well as the empirical methodology in asset pricing. The course consists of two parts:

1. Optimal Consumption and First-Order Implications

2. Complete Markets: The Turn to Incompleteness

This mandatory course covers both types of markets: physical markets and the markets of derivatives, including diverse aspects like, market structures, instruments, prices, risks, hedging and trading. In the applications, we focus on important energy commodities like electricity and natural gas. On the classical commodity markets, the physical delivery of the traded commodities is an integral part of the transaction. These “physical” commodity markets are complemented by purely financial markets where derivative instruments on the underlying commodity are tradable without entailing any physical transaction. The reason for the expansion of these finan-
cial markets is the necessity of hedging and reducing risk exposure with instruments like futures, options, swaps etc. However, speculative motivation may also contribute to the increase of financial commodity markets’ volumes.

6. Competence Center Energy Management

The Competence Center Energy Management (ior / cf-HSG) deals with strategic and quantitative issues in the field of conventional and renewable energies. It offers applied research, continuing education courses, congresses and conferences as well as various services related to energy. In addition to consulting projects, these may also include studies and reports integrating current research results.

6.1 Conferences

The ior/cf-HSG organizes conferences in the energy sector and related fields. The gatherings facilitate personal meetings, discussions and the launch of new projects. The range of topics cover natural and renewable gas, electricity and associated fields like heat or waste management.

6.1.1 Erdgastagung


6.1.2 Wärmetagung


6.1.3 Stromtagung

The electricity conference took place on Tuesday, October 29th, 2019 “Ausgewählte Themen für die nächste Legislatur” at the SIX Convention Point in Zürich. (www.stromtagung.ch)

6.1.4 Abfallsymposium

The waste symposium 2019 “lokal – global ... universal? Wie Abfallwirtschaft unterschiedlich praktiziert wird” took place on September 27th, 2019 in the city hall St. Gallen. (www.recyclingtagung.ch)
6.2 Executive Education

6.2.1 Program “Management of Utility Companies” (CAS)

The energy transition and digitization pose new challenges for managers. The value-added chains are being replaced by value-added networks, which in addition to their own basic training demands new and broader competences for efficient and effective management. The understanding of relevant energy-related topics and their interdependencies characterizes the qualification profile and increases one’s own competitiveness in the working world. In the foreground of the successively developed course, therefore, are the important strategic, regulatory and ecological issues in connection with the energy transition and digitization as well as their need for action. The program stands for a practice-oriented, tailored to the needs of the energy industry management education with a recognized university certificate (CAS).

- 10th implementation: September 12th, 2018 to February 22nd, 2019
- 11th implementation: September 11th, 2019 to February 14th, 2020

Structure:

The program consists of 6 modules (18 days). A proof of performance is provided in the form of a written project work. The aim of this thesis is the elaboration of specific problems of the participants’ daily work in an academic manner. It is assessed primarily according to its estimated benefits for operational implementation. For more information, please visit www.evu-manager.ch.

6.2.2 Program “Management of Disposal and Recycling Companies” (CAS)

The aim of the course is to build on the existing competences at the University of St.Gallen to provide the participants with the necessary business and regulatory tools to enable them to realize the fundamental change in the Swiss waste management industry triggered by the VVEA towards a circular economy local / regional / national level. The program stands for a practice-oriented management education with a recognized university certificate (CAS) tailored to the needs of the waste management and recycling industry.

- 4th implementation: April 03rd, 2019 to September 27th, 2019

6.2.3 Program “Business Manager”

The certificate course (VSE) provides practice-oriented, business-oriented and regulatory basic knowledge for managers and junior executives of energy supply companies. The cooperation with the Association of Swiss Electricity Companies (VSE) ensures that the training takes place at the right level. After successful completion, the participants of the program will receive a VSE certificate and a certificate of attendance from the University of St. Gallen.

- 3rd implementation: October 30th, 2019 to December 13th, 2019

6.2.4 Kompaktseminare

- Vertrieb 2.0 «Fit für den liberalisierten Markt»
- Die Wertschöpfungskette Erdgas – Ein Element der Sektorkopplung
7. Competence Center Security Analysis

Prof. Robert Gutsche, Ph.D. is an assistant professor for financial and management accounting and the vice director for equity research and head of the CC Security Analysis that the ior/cf-HSG implemented in 2015.

The CC Security Analysis aims at providing

- Practice-oriented solutions for the analysis of profitability, growth and risk
- Independent research and teaching in the area of
- Fundamental Analysis, Corporate Finance and Security Valuation
- Risk Management, Performance Management and Analysis of Risk and Return
- Financial Reporting, Regulation and Standard Setting

Bridging systemic and idiosyncratic risk analysis through the integration of fundamental risk analysis as well as behavioral aspects into quantitative risk analysis.

Foster critical reflection of investing and trading is not a “natural science”; it is driven by market dynamics, crowd behavior and fundamentals.

The CC Security Analysis is active in the executive education and offers executive courses, such as:

- Taktische Asset Allokation
- Value Investing & Active Investment Analytics: Tools für aktive Investitionsentscheidungen
- Finanzielle Führung von Pensionskassen – Zentrale Risiken identifizieren und überwachen

In 2019 in light of the new requirements of FIDLEG, FINIG, MIFID II, the CC Security Analysis together with the Association of Swiss Asset Managers (VSV-ASG) conducted a survey on the investment research of Swiss Asset Managers. More than 200 asset managers answered the survey. The respective publication is planned to be made available in 2020. The CC Security Analysis is also engaged in several projects to support active fund and asset management processes. As a result, Alean Capital supported the CC Security Analysis in the second year with CHF 30’000 in financing. The CC Security Analysis expanded the executive education and is now partnering with the Association of Swiss Asset Managers (VSV-ASG), taking over courses on investment analysis for the association from 2020 on.

The CC Security Analysis aims at expanding the practice-oriented research activities to develop independent, innovative and tailor-made solution for investment managers together with our partners.
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