Non- and Semiparametric Volatility and Correlation Models

- Economic Sources of Volatility, Risk Decomposition and Financial Crises

24.-26.7.2014
University of Paderborn

Book of Abstracts

DFG

UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

WiWi

CIE Center For International Economics

Contents

All abstracts are divided into Invited Lectures and Keynote Talks, Invited Sessions, Contributed Sessions and Contributions to the Poster Session. Those within each of the first three parts are arranged according to the time schedule in the programme.

Throughout this Book of Abstracts the name of the presenting author of each contribution is printed in bold.

TEDAS-Tail Event Driven ASset Allocation *

Wolfgang Karl Härdle ** Sergey Nasekin †
David Lee Kuo Chuen ‡ Phoon Kok Fai §

Portfolio selection and risk management are very actively studied topics in quantitative finance and applied statistics. They are closely related to the dependency structure of portfolio assets or risk factors. The correlation structure across assets and opposite tail movements are essential to the asset allocation problem, since they determine the level of risk in a position. Correlation alone is not informative on the distributional details of the assets. By introducing TEDAS -Tail Event Driven ASset allocation, one studies the dependence between assets at different quantiles. In a hedging exercise, TEDAS uses adaptive Lasso based quantile regression in order to determine an active set of negative non-zero coefficients. Based on these active risk factors, an adjustment for intertemporal correlation is made. Finally, the asset allocation weights are determined via a Cornish-Fisher Value-at-Risk optimization. TEDAS is studied in simulation and a practical utility-based example using hedge fund indices.

Keywords: portfolio optimization, asset allocation, adaptive lasso, quantile regression, value-at-risk

JEL Classification: C00, C14, C50, C58

*This research was supported by the Deutsche Forschungsgemeinschaft through IRTG 1792, SFB 649 and Lee Kong Chian School of Business, Sim Kee Boon Institute for Financial Economics, Singapore Management University

**C.A.S.E.- Center for Applied Statistics & Economics, Humboldt-Universitt zu Berlin, Berlin, Germany. Lee Kong Chian School of Business, Singapore Management University, Singapore

†C.A.S.E.- Center for Applied Statistics & Economics, Humboldt-Universität zu Berlin, Berlin, Germany

‡Lee Kong Chian School of Business, Singapore Management University, Singapore

§Lee Kong Chian School of Business, Singapore Management University, Singapore

On estimation of cross-sectional dependence for strongly dependent time series

Jan Beran

Department of Mathematics and Statistics

University of Konstanz

One of the key issues in assessing risk is how to model multivariate dependence between high quantiles or extremes. This question leads to the notion of extreme value copulas and related depedence measures. Various estimators for extreme value copulas and Pickands' dependence function have been proposed in the recent literature. We briefly discuss some of the simpler methods, in particular in view of obtaining models that are flexible with respect to achievable dependence functions. The definitions are then extended to strongly dependent time series, and limit theorems for nonparametric and parametric estimators are derived. As it turns out, long memory leads to fundamentally different asymptotic processes compared to the iid or short-memory situation. Detailed results differ however, depending on exact specifications of the model and parameters to be estimated.

Specification and Testing of Multiplicative Time-Varying GARCH Models with Applications *

Timo Teräsvirta

CREATES, University of Aarhus, Denmark

In this paper we develop a specification technique for building multiplicative time-varying GARCH models of Amado and Ter?svirta (2008, 2013). The variance is decomposed into an unconditional and a conditional component such that the unconditional variance component is allowed to evolve smoothly over time. This nonstationary component is defined as a linear combination of logistic transition functions with time as the transition variable. The appropriate number of transition functions is determined by applying a sequence of specification tests. For that purpose, a coherent modelling strategy based on statistical inference is presented. It is heavily dependent on Lagrange multiplier type misspecification tests. The tests are easily implemented as they are entirely based on auxiliary regressions. Finite-sample properties of the strategy and tests are examined by Monte Carlo simulations. The modelling strategy is illustrated in practice with two real examples, an empirical application to daily exchange rate returns and another one to daily coffee futures returns.

*This abstrat is based on a joint work with Cristina Amado

Long Term Component Dynamics Models for Realized Covariance Matrices

Luc Bauwens

CORE, Université catholique de Louvain, Belgium

We evaluate the out-of sample forecast performance of several component dynamic models for realized covariance matrices. We propose a set of multivariate models that include a long-run component to capture the changing levels of realized variances and correlations. This component is specified either as a nonparametric function or as a MIDAS term, and evolves around a short-run component. Estimation is done by QML. Using the the Model Confidence Set (MCS) approach, we compare the models based on one-step ahead conditional covariance forecasts over a period of six years.

Multivariate Variance Ratio Statistics

Seok Young Hong **Oliver Linton** Hui Jun Zhang
University of Cambridge

We propose several multivariate variance ratio statistics. We derive the asymptotic distribution of the statistics and scalar functions thereof under the null hypothesis that returns are unpredictable after a constant mean adjustment (i.e., under the Efficient Market Hypothesis). We do not impose the no leverage assumption of Lo and MacKinlay (1988) but our asymptotic standard errors are relatively simple and in particular do not require the selection of a bandwidth parameter. We extend the framework to allow for a smoothly varying risk premium in calendar time, and show that the limiting distribution is the same as in the constant mean adjustment case. We show the limiting behaviour of the statistic under a multivariate fads model and under a moderately explosive bubble process: these alternative hypotheses give opposite predictions with regards to the long run value of the statistics. We apply the methodology to three weekly size-sorted CRSP portfolio returns from 1962 to 2013 in three subperiods. We find evidence of a reduction of linear predictability in the most recent period, for small and medium cap stocks. We find similar results for the main UK stock indexes. The main findings are not substantially affected by allowing for a slowly varying risk premium.

Keywords: Bubbles; Fads; Martingale; Momentum; Predictability
JEL Classification: C10; C32; G10; G12

Dependence and Nonstationarity in Time series and Spatial Data

Peter M. Robinson*

London School of Economics and Political Sciences

Recent work on modelling and inference in time series, spatial and spatio-temporal data in the presence of dependence and nonstationarity is reviewed.

*p.m.robinson@lse.ac.uk

The Empirical Similarity Approach for Volatility Prediction

Vasyl Golosnoy RU Bochum
Alain Hamid Uni Augsburg
Yarema Okhrin Uni Augsburg

In this paper we adapt the empirical similarity (ES) concept for the purpose of combining volatility forecasts originating from different models. Our ES approach is suitable for situations where a decision maker refrains from evaluating success probabilities of forecasting models but prefers to think by analogy. It allows to determine weights of the forecasting combination by quantifying distances between model predictions and corresponding realizations of the process of interest as they are perceived by decision makers. The proposed ES approach is applied for combining models in order to forecast daily volatility of the major stock market indices.

Detecting financial contagion in a multivariate system

Hans Manner Uni Köln
Dominik Blatt Maastricht
Bertrand Candelon IPAG Business School

This paper proposes an original three-part sequential testing procedure (STP), with which to test for contagion using a multivariate model. First, it identifies structural breaks in the volatility of a given set of countries. Then a structural break test is applied to the correlation matrix to identify and date the potential contagion mechanism. As a third element, the STP tests for the distinctiveness of the break dates previously found. Compared to traditional contagion tests in a bivariate set-up, the STP has high testing power and is able to locate the dates of contagion more precisely. Monte Carlo simulations underline the importance of separating variance and correlation break testing, the endogenous dating of the breakpoints and the usage of multi-dimensional data. The procedure is applied for the 1997 Asian Financial Crisis, revealing the chronological order of the crisis events.

Efficient Iterative Maximum Likelihood Estimation of High-Parameterized Time Series Models

Ostap Okhrin HU Berlin
Nikolaus Hautsch Uni Wien
Alexander Ristig HU Berlin

We propose an iterative procedure to efficiently estimate models with complex log-likelihood functions and the number of parameters relative to the observations being potentially high. Given consistent but inefficient estimates of sub-vectors of the parameter vector, the procedure yields computationally tractable, consistent and asymptotic efficient estimates of all parameters. We show the asymptotic normality and derive the estimator's asymptotic covariance in dependence of the number of iteration steps. To mitigate the curse of dimensionality in high-parameterized models, we combine the procedure with a penalization approach yielding sparsity and reducing model complexity. Small sample properties of the estimator are illustrated for two time series models in a simulation study. In an empirical application, we use the proposed method to estimate the connectedness between companies by extending the approach by Diebold and Yilmaz (2014) to a high-dimensional non-Gaussian setting.

Dynamics of Natural Rate of Unemployment: A Structural Approach *

Wei Cui ** Wolfgang K. Härdle † Weining Wang‡

Estimating natural rate of unemployment (NAIRU) is important for understanding the joint dynamics of unemployment rate and inflation. However, existing literature falls short in endogenizing inflation expectation together with NAIRU in a model consistent way. We develop and estimate a structural model with forward and backward looking Phillips curve. Inflation expectation is treated as a function of state variables and we use its noisy observations. Our result shows that the NAIRU is very precisely estimated and persistent. Unemployment gap is transitory but particular significant in recession times.

*The financial support from the Deutsche Forschungsgemeinschaft via CRC 649 "Ökonomisches Risiko", Humboldt-Universität zu Berlin, IRTG 1792, and the Research Grants Council of Hong Kong via G-HK012/10 is gratefully acknowledged. We also gratefully acknowledge the funding from DAAD ID 50746311.

**Wei Cui: Assistant Professor (Lecturer in UK) at University College London. Email: w.cui@ucl.ac.uk.

†Professor at Humboldt-Universität zu Berlin and Director of C.A.S.E. - Center for Applied Statistics and Economics, Humboldt-Universität zu Berlin, Spandauer Straße 1, 10178 Berlin, Germany. Singapore Management University, 50 Stamford Road, Singapore 178899. Email: haerdle@hu-berlin.de.

‡Hermann-Otto-Hirschfeld Junior Professor in Nonparametric Statistics and Dynamic Risk Management at the Ladislaus von Bortkiewicz Chair of Statistics of Humboldt-Universität zu Berlin, Spandauer Straße 1, 10178 Berlin, Germany. Email:wangwein@cms.hu-berlin.de.

Normality test of standardized daily return in the simultaneous presence of microstructure noise and jumps

Mengmeng Guo * Shaoyu Li **

Previous studies already show that the daily return standardized by the realized volatility is approximately standard normal distribution. However, it is easily rejected by the normality test. Meanwhile, the microstructure noise and jumps may play an important role in the estimation of realized volatility using high frequency intraday returns. Some literature may take either of them into consideration to calculate integrated volatility. In this paper, we introduce several approaches to standardize the daily return, such as realized bipower variation, range volatility, which are estimators for integrated volatility. Moreover, we estimate these volatility measures in the scenario of the simultaneous presence of microstructure noise and jumps. The result shows that the daily return standardized by our proposed volatility is more consistent with the standard normal distribution. Further, the results show that both microstructure noise and jumps should be included in the stock price model.

Key words: Bipower Variation; Jumps; Microstructure Noise; Integrated Volatility; Normality Test

*Southwestern University of Finance and Economics, Chengdu, China. Email: gmm@swufe.edu.cn
**Southwestern University of Finance and Economics, Chengdu, China. Email: lsyu@swufe.edu.cn

Beyond dimension two: A test for higher-order tail risk*

Melanie Schienle

Department of Economics, University of Hannover

In practice, multivariate dependencies between extreme risks are often only assessed in a pairwise way. We propose a test to detect when tail dependence is truly high–dimensional and bivariate simplifications would produce misleading results. This occurs when a significant portion of the multivariate dependence structure in the tails is of higher dimension than two. Our test statistic is based on a decomposition of the stable tail dependence function, which is standard in extreme value theory for describing multivariate tail dependence. The asymptotic properties of the test are provided and a bootstrap based finite sample version of the test is suggested. A simulation study documents the good performance of the test for standard sample sizes. In an application to international government bonds, we detect a high tail–risk and low return situation during the last decade which can essentially be attributed to increased higher–order tail risk. We also illustrate the empirical consequences from ignoring higher-dimensional tail risk.

*joint with Carsten Bormann and Julia Schaumburg

Non- and semiparametric modeling of volatility and correlation components in financial returns*

Yuanhua Feng **

Department of Economics, University of Paderborn

Estimating volatility and correlation dynamics of financial return series is a crucial topic in quantitative financial risk management and option pricing. The volatility and cross-correlations of financial return series may all exhibit conditional dynamics caused by past information and slow changes (local dynamics) over time in a long period caused by changing macroeconomic environment. Different models was introduced in the literature to capture this phenomenon. The development in this context is first summarized briefly. We then focus on the proposal of a multi-step local dynamic conditional correlation model for simultaneously modelling these components. In particular, the local and conditional correlations are jointly estimated by multivariate kernel regression. A multivariate k-NN method with variable bandwidths is developed to solve the curse of dimension problem. Asymptotic properties of the estimators are discussed in detail. Practical performance of the model is illustrated by applications to foreign exchange rates. Finally, a brief discussion on further topics for research in this direction is given.

Key Words: Slowly changing volatility, constant conditional correlations, dynamic conditional correlations, smooth correlation changes, semiparametric approaches.

*This talk is mainly based on Feng, Y. and Härdle, W. (2014). A local dynamic conditional correlation model. Forthcoming preprint, University of Paderborn and Humboldt University of Berlin.

**Yuanhua Feng, Warburgerstr. 100, University of Paderborn, 33098 Paderborn, Germany.
Email: yuanhua.feng@wiwi.upb.de

Local slope estimation in partial linear models under Gaussian subordination

Sucharita Ghosh

Statistics Lab, Swiss Federal Research Institute WSL

We address estimation of trend functions and time-dependent slope in a partial linear model with non-Gaussian errors. Specifically, the regression errors are assumed to be time-dependent one-dimensional transformations of unobserved stationary Gaussian processes. Note that, although the latent Gaussian processes are stationary, due to the transformations, the resulting error processes may be non-stationary in the sense that the marginal distributions and in particular the error variances may vary with time. We consider both short-memory and long-memory correlations in the latent Gaussian processes and derive asymptotic properties of nonparametric curve estimates under suitable regularity conditions. This work generalizes previous research on estimation for partial linear models where the regression slope is assumed to be a constant (Speckman 1988 (JRSS-B), Beran and Ghosh 1998 (Scand. J. Stat)) and the regression errors are stationary processes.

Autoregressive conditional duration and FIGARCH models: origins of long memory?*

Liudas Giraitis

Oueen Mary University of London, United Kingdom

Although properties of ARCH(∞) model are well investigated, existence of long memory solutions to FIGARCH and IARCH equations was not established, causing theoretical controversy that other solutions besides the trivial zero one, do not exist. Since ARCH models with non-zero intercept may have only a unique stationary solution and exclude long memory, existence of finite variance FIGARCH and IARCH models and, thus, possibility of long memory in ARCH setting was doubtful. The present paper solves this controversy by showing that FIGARCH and IARCH equations have a non-trivial covariance stationary solution, that always exhibits long memory. Existence and uniqueness of stationary Integrated AR(∞) processes is also discussed, and their long memory feature established. Summarizing, we show that covariance stationary IARCH, FIGARCH and IAR(∞) processes exist, their class is wide, and they always have long memory.

*This talk is based on a joint work with D. Surgailis and A.Škarnulis

Modelling and Forecasting Short-Term Interest Rate Volatility: A Semiparametric Approach

Ai Jun Hou * Sandy Suardi **

This paper employs a semiparametric procedure to estimate the diffusion process of short-term interest rate. This method is compared in its ability to capture the dynamics of short rate volatility to a class of one-factor diffusion models where the conditional variance is serially correlated and levels dependent. The Monte Carlo study shows that the semiparametric approach produces more accurate volatility estimates than models that accommodate asymmetry, levels effect and serial dependence in the conditional variance. The empirical evidence based on U.S. three-month Treasury bill rates further indicates that the semiparametric procedure is better than the widely used single-factor diffusion models in forecasting the future volatility of interest rate changes. The improvement in modelling short rate volatility using the new procedure has implications for pricing interest rate derivatives.

Key Words: Interest Rates; GARCH modelling; Semi-parametric method; Volatility estimation; Volatility Forecasts

JEL Classification: E43; C22; C53

*Ai Jun Hou is at the Business School, Stockholm University, Sweden. E-mail: ajh@sbs.su.se.

**Sandy Suardi is at the School of Economics and Finance, La Trobe University, Australia. E-mail: s.suardi@latrobe.edu.au

Option implied risk measures: a generalized empirical likelihood approach

Xiao Xiao Chen Zhou

Erasmus Research Institute of Management, Netherlands

This paper proposes a nonparametric method to estimate the implied volatility and risk neutral distribution of stock returns from option prices. The proposed method follows the generalized empirical likelihood approach, in particular, the empirical likelihood (EL) and empirical tiltering(ET) methods. Compared to parametric methods such as the Black-Scholes (BS) model, the proposed method is free of parametric assumption. Compared to model-free methods, such as that in Breeden and Litzenberger (1978), the proposed method does not require various options covering a large scope of exercise prices. Instead, our method can involve multiple liquidly traded options simultaneously. Simulation studies show that the ET estimates of implied volatilities are more accurate than the BS and EL approaches, if the options have longer duration and if the underlying risk neutral distribution exhibits heavy tails and non-zero skewness. When estimating the risk neutral distribution, the ET approach outperforms the model-free methods under heavy tails and non-zero skewness. In an empirical application, we estimate implied volatility and risk neutral density from options on the S&P500 index by the proposed ET approach.

Estimating stochastic volatility models with high-frequency data: A Monte Carlo investigation

Yang Zu

City University London

In Monte Carlo simulations, we compare the finite-sample performance of two methods of estimating continuous-time stochastic volatility models us- ing high-frequency data, namely, the integrated variance-based Generalized Method of Moments estimator and the newly proposed spot variance-based least squares estimator by Kanaya and Kristensen (2010). Under various realistic financial market scenarios, Monte Carlo results show that the spot variance-based least squares estimator performs better in many of the scenarios.

Key Words: stochastic volatility models, high-frequency data, Monte Carlo simulations
JEL Classification: C14, C32, C58

Inference on the Long-Memory Properties of Time Series with Non-Stationary Volatility

Matei Demetrescu * Philipp Sibbertsen **

Many time series exhibit unconditional heteroskedasticity, often in addition to conditional one. But such time-varying volatility of the data generating process can have rather adverse effects when inferring about its persistence; e.g. unit root and stationarity tests possess null distributions depending on the so-called variance profile. On the contrary, this is not the case in stationary autoregressions, and correctly sized inference is guaranteed if taking protective actions as simple as using White standard errors (which are employed anyway to deal with conditional heteroskedasticity). The paper explores the influence of time-varying volatility on fractionally integrated processes. Concretely, we discuss how to model long memory in the presence of time-varying volatility, and analyze the effects of such nonstationarity on several existing inferential procedures for the fractional integration parameter. Based on asymptotic arguments and Monte Carlo simulations, we show that periodogram-based estimators, such as the local Whittle or the log-periodogram regression estimator, remain consistent, but have asymptotic distributions whose variance depends on the variance profile. Time-domain, regression-based tests for fractional integration retain their validity if White standard errors are used. Finally, the modified range-scale statistic is only affected if the series require adjustment for deterministic components.

Key Words: Time-varying variance, Heteroskedasticity, Persistence, Fractional integration, Modulated process

JEL Classification: C12 (Hypothesis Testing), C22 (Time-Series Models)

*Institute for Statistics and Econometrics, Christian-Albrechts-University of Kiel, Olshausenstr. 40-60, D-24118 Kiel, Germany, email: `mdeme@stat-econ.uni-kiel.de`

**Department of Economics, University of Hannover, Königswörther Platz 1, D-30167 Hannover, Germany. E-mail address: `sibbertsen@statistik.uni-hannover.de`

Model Selection in Seasonal/Cyclical Long Memory Models

Christian Leschinski *

Philipp Sibbertsen

Institute of Statistics, Faculty of Economics and Management,

Leibniz University Hannover, D-30167 Hannover, Germany

Existing approaches for model order selection in seasonal/cyclical long memory models (SCLM) rely on grid search procedures that quickly become infeasible in applications with multiple periodic poles in the spectrum. We propose an automatic model selection procedure for k-factor GARMA processes that overcomes this problem. The procedure is based on sequential tests of the maximum of the periodogram and semiparametric estimators of the model parameters. As a byproduct, the generalized version of Walker's large sample g-test suggested for this procedure allows to test for persistent periodicity in stationary ARMA processes. Our simulation studies show that the procedure performs well in identifying the correct model order under various circumstances. Applications to Californian electricity load data and intraday volatility series illustrate its value for the empirical analysis of high frequency time series that potentially exhibit multiple seasonalities.

Key Words: Seasonal Long Memory · k-factor GARMA processes · Model selection · Electricity loads

JEL Classification: C22, C52

*Phone: +49-511-762-5636; Fax: +49-511-762-3923; E-Mail: leschinski@statistik.uni-hannover.de

Fractionally Integrated VAR Models with a Fractional Lag Operator and Deterministic Trends: Finite Sample Identification and Two-step Estimation*

Rolf Tschernig ** Enzo Weber † Roland Weigand ‡

Fractionally integrated vector autoregressive (VAR) models have become a valuable extension of VAR models with integer orders of integration since the former allow to capture persistence in time series data in a much more flexible way. Additional flexibility for the short memory properties of the model can be attained by using the fractional lag operator of Johansen (2008, Econometric Theory) in the vector autoregressive polynomial. It allows to avoid certain shortcomings in impulse response analysis under long-run identification restrictions (Tschernig, Weber and Weigand, 2013, JBES). However, the additional modeling flexibility due to the fractional lag operator makes maximum likelihood estimation more difficult, in particular if deterministic components are included.

In this paper we first identify parameter settings for univariate and bivariate model versions that suffer from weak identification in finite samples and may therefore lead to estimation problems. Second, we propose to investigate the extent of weak identification by use of expected log-likelihoods and variations thereof which are faster to simulate than multivariate finite sample distributions of parameter estimates. Third, we provide a line of reasoning that explains the finding from several univariate and bivariate simulation examples that the two-step estimator suggested by Tschernig, Weber and Weigand (2013, JBES) can be more robust with respect to estimating the deterministic components than the maximum likelihood estimator. Within the maximum likelihood approach the estimator of the deterministic components and its properties depend on the simultaneously estimated fractional parameters. If the latter are subject to weak identification, the deterministic components may be poorly estimated which adds to the difficulties of estimating the fractional parameters. We

*A somewhat outdated version of the paper is available as Nr. 471 of the Regensburger Diskussionsbeitr?ge zur Wirtschaftswissenschaft from http://epub.uni-regensburg.de/27269/.

**University of Regensburg, Department of Economics, D-93040 Regensburg, rolf.tschernig@ur.de

†University of Regensburg, Department of Economics, D-93040 Regensburg & Institute for Employment Research (IAB), D-90478 Nuremberg

‡Institute for Employment Research (IAB), D-90478 Nuremberg

therefore suggest to apply the two-step estimator in practice.

Key Words: fractional integration, long memory, maximum likelihood estimation, fractional lag operator

An optimization-based empirical mode decomposition scheme to decompose financial data with a comparison to statistical models

Boqiang Huang * Yuanhua Feng ** Angela Kunoth † Chen Zhou ‡

The empirical mode decomposition (EMD) was introduced by N.E. Huang et al. as a method to analyze given nonlinear and nonstationary time series data [1]. Combined with the Hilbert transform, the resulting so-called Hilbert-Huang-Transform (HHT) typically provides a much finer time-frequency spectrum of the signal when compared to other well-known methods such as the Fourier transform, the wavelet transform, or the Wigner-Ville transform.

The EMD provides an additive decomposition of the data into its relevant, so-called intrinsic mode functions (IMFs) which turn out to be orthogonal to each other. An essential characteristic of the EMD over Fourier or wavelet decompositions is that it does not work with an a-priorily defined basis. In fact, the decomposition is computed numerically in a data-adapted fashion. Based on repeatedly interpolating local maxima and minima, starting with the given time series, one sequentially extracts the IMFs which exhibit possibly instantaneous frequencies each. This process may be viewed as a recursive filtering operation, extracting generalized time-dependent Fourier components and a monotone trend. Since it does not rely on pre-defined bases on a certain grid, the method can be applied even to data on nonuniform grids for which traditional methods require local approximations. Moreover, white noise decomposition tests show that the EMD acts as a dyadic filter bank from a statistical point of view. By now, the EMD has increasingly gained reputation in different disciplines and evolved itself into several branches. To overcome some deficiencies of the original method, several improvements have been proposed, like the optimization based EMD (OEMD) [2], and the noise-assisted EMD [3].

In financial econometrics, a semiparametric multiplicative error model (Semi-MEM) is usually employed to decompose a non-negative financial time series into two multiplicative components, the smooth (nonstationary) trend times another stationary process, which can

*Institut für Mathematik, Universität Paderborn, Germany; bhuang@math.upb.de
**Fakultät für Wirtschaftswissenschaften, Universität Paderborn, Germany; yuanhua.feng@wiwi.upb.de
†Mathematisches Institut, Universität zu Köln, Germany; kunoth@math.uni-koeln.de
‡Fakultät für Wirtschaftswissenschaften, Universität Paderborn, Germany; chenzhou@mail.upb.de

be further studied separately for different research interests, such as the trend or the error process analysis [4]. Another idea is to analyze the logarithmic transformation of a non-negative financial time series using a semiparametric regression model. For instance, the (first type) Log-ACD (logarithmic autoregressive conditional duration) model introduced by [5] is indeed just an ARMA model for the log-data. If an additional nonparametric trend is introduced into the Log-ACD, we obtain a Semi-Log-ACD model. In other words, this model can also be called a Semi-EARMA (exponential ARMA). For more details see the closely related ESEMIFAR (exponential semiparametric fractional autoregressive) approach in [6].

In this talk, we discuss to which extent one can compare the results for such statistical models to findings obtained by the OEMD and some of its noise-assisted variations to noisy data, and whether these very different analysis models can profit from each other. For the statistical model, we assume that the logarithmic transformation of a non-negative financial time series follows a nonparametric regression with a smooth trend and a stationary error term. From the OEMD, we can compute the trend as the sum of a few low-frequency OEMD components. The remaining parts are higher oscillating local terms which may even be considered as noise. We will discuss whether the OEMD method can be used to fit such statistical models, employing both simulated signals and real financial data. The results are compared with those of a data-driven Semi-Log-ACD model.

References

[1] N.E. Huang, Z. Shen, S.R. Long, M.C. Wu, H.H. Shih, Q. Zhang, N.-C. Yen, C.C. Tung and H.H. Liu, *The empirical mode decomposition and the Hilbert spectrum for nonlinear and non-stationary time series analysis*, Proc. R. Soc. London A, vol. 454, pp. 903-995, 1998.

[2] B. Huang, and A. Kunoth, *An optimization-based empirical mode decomposition scheme*, J. Comp. Appl. Math., vol. 240, pp. 174-183, 2013.

[3] D.P. Mandic, N.U. Rehman, Z. Wu, and N.E. Huang, *Empirical mode decomposition-based time-frequency analysis of multivariate signals*, IEEE Signal Process. Magazine, vol. 30,

pp. 74-86, 2013.

[4] R.F. Engle, *New frontiers for ARCH models*, Journal of Applied Econometrics, vol. 17, pp. 425-446, 2002.

[5] L. Bauwens, and P. Giot. *The logarithmic ACD model: An application to the bid/ask quote process of two NYSE stocks*, Ann. d'Econ. et de Stat., vol. 60, pp. 117-149, 2000.

[6] J. Beran, Y. Feng, and S. Ghosh, *Modelling long-range dependence and trends in duration series: an approach based on EFARIMA and ESEMIFAR models*, Statistical Papers (published online), 2014.

Nonparametric spot volatility estimation under microstructure noise*

Johannes Schmidt-Hieber

Department of Mathematics, University of Leiden

Assume that high-frequency observations from a semimartingale X are recorded under additive measurement noise. In finance, the quantity of interest is the spot volatility of X measuring the local variability of the process. In this talk, we study nonparametric estimation of the spot volatility. Minimax rates and adaptive estimators are derived. We discuss the performance of the estimators on simulated and real data.

*This is joint work with Marc Hoffmann (Paris), Axel Munk, and Till Sabel (both Göttingen).

Discontinuous Dynamic Semiparametric Factor models

Weining Wang

Department of Economics, Humbold University Berlin

We consider high dimensional time series that can be decomposed to low dimensional time series and time invariable functions of covariates. Our framework could incorporate both discontinuity (structural breaks) in space and in time. The discontinuity in space is to account for possible known regression discontinuity design e ects, while the structural time breaks model regime switching e ects introduced by exogenous shocks. We developed an estimation procedure which can estimate and make inference on the break points in time. The procedure is demonstrated via a simulation study. Finally we show an application on modelling the dynamics of real estate prices in UK.

Semiparametric Conditional Quantile Models for Financial Returns and Realized Volatility*

Filip Žikeš** **Jozef Baruník** †

This paper investigates how the conditional quantiles of future returns and volatility of financial assets vary with various measures of ex-post variation in asset prices as well as option-implied volatility. We work in the flexible quantile regression framework and rely on recently developed model-free measures of integrated variance, upside and downside semi-variance, and jump variation. Our results for the S&P 500 and WTI Crude Oil futures contracts show that simple linear quantile regressions for returns and heterogenous quantile autoregressions for realized volatility perform very well in capturing the dynamics of the respective conditional distributions, both in absolute terms as well as relative to a couple of well-established benchmark models. The models can therefore serve as useful risk management tools for investors trading the futures contracts themselves or various derivative contracts written on realized volatility.

Key Words: conditional quantiles, Value-at-Risk, quantile regression, realized measures

*We are indebted to Karim M. Abadir, Torben G. Andersen, Walter Distaso, Marcelo Fernandes, Simone Manganelli, Sergio Pastorello, anonymous referees and seminar participants at the 17th Annual Symposium of the Society for Nonlinear Dynamics and Econometrics (Atlanta, April 2009), North American Summer Meeting of the Econometric Society (Boston, June 2009), and Conference on Financial Econometrics and Realized Volatility/Vast Data (London, June 2009) for useful comments, suggestions and discussions. The first version of this paper was written while Žikeš was at Imperial College London; financial support from ESRC under grant RES-062-23-0311 is gratefully acknowledged. Baruník gratefully acknowledges financial support from the the Czech Science Foundation under project No. 13-32263S. The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England.

**Corresponding author: Bank of England, Financial Stability, Threadneedle street, London EC2R 8AH. Phone: +44 20 7601 5092. Email: filip.zikes@bankofengland.co.uk.

†Institute of Economic Studies, Charles University, Opletalova 21, 110 00, Prague, CR and Institute of Information Theory and Automation, Academy of Sciences of the Czech Republic, Pod Vodarenskou Vezi 4, 182 00, Prague, Czech Republic.

Additive modeling of realized variance: tests for parametric specifications and structural breaks

Matthias Fengler
University of St. Gallen

For an additive autoregression model, we study two types of testing problems. First, a parametric specification of a component function is compared against a nonparametric fit. Second, two nonparametric fits of two different time periods are tested for equality. We apply the theory to a nonparametric extension of the linear heterogeneous autoregressive (HAR) model. The linear HAR model is widely employed to describe realized variance data. We find that the linearity assumption is often rejected, in particular on equity, fixed income, and currency futures data; in the presence of a structural break, nonlinearity appears to prevail on the sample before the outbreak of the financial crisis in mid-2007.

Keywords and phrases. Additive models; Backfitting; Nonparametric time series analysis; Specification tests; Realized variance; Heterogeneous autoregressive model
AMS 1991 subject classifications. 62G08, 62G10
Journal of Economic Literature Classification. C14, C58

Asymmetric connectedness of stocks: How does bad and good volatility spills over the U.S. industries?

Jozef Baruník * Evžen Kočenda ** **Lukáš Vácha** †

Asymmetries in volatility spillovers are highly relevant to risk valuation and portfolio diversification strategies in financial markets. Yet, a large literature studying information transmission mechanism ignores the fact that bad and good volatility may spill over with different magnitudes. The paper fills this gap and contributes to the literature in two ways: (i) we suggest how to quantify asymmetries in volatility spillovers due to bad and good volatility and (ii) we provide ample evidence for the asymmetric connectedness of stocks. Using high frequency data covering most liquid U.S. stocks, we reject the hypothesis of symmetric connectedness at disaggregate level for all seven studied sectors. The bad and good volatility is being transmitted at different magnitudes in different sectors, and the asymmetry changes in time substantially. Whereas negative spillovers are often of substantial magnitudes, they do not strictly dominate positive spillovers. In contrast, we document symmetric transmission of information in aggregated portfolio. Moreover, we find that the overall intra-market connectedness of the U.S. stocks increased substantially with the increasing uncertainty of stock market participants during the recent crisis.

Key Words: Volatility; Spillovers; Semivariance; Asymmetric effects; Financial markets
JEL Classification: C18; C58; G15

*Institute of Economic Studies, Charles University, Opletalova 21, 110 00, Prague, CR and Institute of Information Theory and Automation, Academy of Sciences of the Czech Republic, Pod Vodarenskou Vezi 4, 182 00, Prague, Czech Republic. Phone: +420 776 259 273. Email: barunik@utia.cas.cz

**Corresponding author: CERGE-EI, Charles University and the Czech Academy of Sciences, Politickych veznu 7, 11121 Prague, Czech Republic; CESifo, Munich; IOS Regensburg; The William Davidson Institute at the University of Michigan Business School; CEPR, London; and the Euro Area Business Cycle Network. Email: evzen.kocenda@cerge-ei.cz

†Institute of Economic Studies, Charles University, Opletalova 21, 110 00, Prague, CR and Institute of Information Theory and Automation, Academy of Sciences of the Czech Republic, Pod Vodarenskou Vezi 4, 182 00, Prague, Czech Republic. Email: vachal@utia.cas.cz

Misspecification Testing in GARCH-MIDAS Models

Christian Conrad

University of Heidelberg

We develop a misspecification test for the multiplicative two-component GARCH-MIDAS model suggested in Engle et al. (2013). In the GARCH-MIDAS model a short-term unit variance GARCH component fluctuates around a smoothly time-varying long-term component which is driven by the dynamics of a macroeconomic explanatory variable. We suggest a Lagrange Multiplier statistic for testing the null hypothesis that the macroeconomic variable has no explanatory power. Hence, under the null hypothesis the long-term component is constant and the GARCH-MIDAS reduces to the simple GARCH model. We provide asymptotic theory for our test statistic and investigate its finite sample properties by Monte Carlo simulation. Our test statistic can be considered as an extension of the Lundbergh and Teräsvirta (2002) test for evaluating GARCH models.

Unbiased QML Estimation of Log-GARCH Models in the Presence of Zero Returns

Genaro Sucarrat * Alvaro Escribano **

A critique that has been directed towards the log-GARCH model is that its log-volatility specification does not exist in the presence of zero returns. A common "remedy" is to replace the zeros with a small (in the absolute sense) non-zero value. However, this renders Quasi Maximum Likelihood (QML) estimation asymptotically biased. Here, we propose a solution to the case where actual returns are equal to zero with probability zero, but zeros nevertheless are observed because of measurement error (due to missing values, discreteness approximisation error, etc.). The solution treats zeros as missing values and handles these by combining QML estimation via the ARMA representation with the Expectation-maximisation (EM) algorithm. Monte Carlo simulations confirm that the solution corrects the bias, and several empirical applications illustrate that the bias-correcting estimator can make a substantial difference.

Keywords: ARCH, exponential GARCH, log-GARCH, ARMA, Expectation-Maximisation (EM)

JEL Classification: C22, C58

*Corresponding author. Department of Economics, BI Norwegian Business School, Nydalsveien 37, 0484 Oslo, Norway. Webpage: http://www.sucarrat.net/. Email: genaro.sucarrat@bi.no

**Department of Economics, Universidad Carlos III de Madrid (Spain); alvaroe@eco.uc3m.es

On weak diffusion limits of dynamic conditional correlation models

Christian M. Hafner * Sebastien Laurent ** **Francesco Violante** †

In this paper, a class of diffusion approximations is derived based on dynamic conditional correlation (DCC) models. A modified version of the classical DCC model admits a degenerate diffusion limit characterized by a diffusion matrix of reduced rank. The degeneracy is due to perfect collinearity between the innovations of the volatility and correlation dynamics. For the special case of constant conditional correlations a non-degenerate diffusion limit can be obtained. Alternative sets of conditions are considered for the rate of convergence of the parameters which allow to recover degenerate diffusion limits with time varying but deterministic variances and/or correlations. A Monte Carlo experiment provides numerical evidence for the results.

*Université catholique de Louvain, ISBA and CORE, B-1348 Louvain-la-Neuve, Belgium. Christian.hafner@uclouvain.be. Corresponding author

**Aix-Marseille University (Aix-Marseille School of Economics), CNRS & EHESS, IAE (France). sebastien.laurent@univ-amu.fr

†Aarhus University, Department of Economics and Business and CREATES, Aarhus, Denmark. fviolante@creates.au.dk. Correspondence to Francesco Violante, Department of Economics and Business - CREATES, Aarhus University, Fuglesangs All 4 DK-8210 Aarhus V, Denmark. Tel.: +45 8716 6076.

Modelling Returns and Volatilities During Financial Crises: a Time Varying Coefficient Approach *

Menelaos Karanasos ** Alexandros Paraskevopoulos †
Faek Menla Ali ‡ Michail Karoglou § Stavroula Yfanti ¶

We examine how the most prevalent stochastic properties of key financial time series have been affected during the recent financial crises. In particular we focus on changes associated with the remarkable economic events of the last two decades in the mean and volatility dynamics, including the underlying volatility persistence and volatility spillovers structure. Using daily data from several key stock market indices we find that stock market returns exhibit time varying persistence in their corresponding conditional variances. Furthermore, the results of our bivariate GARCH models show the existence of time varying correlations as well as time varying shock and volatility spillovers between the returns of FTSE and DAX, and those of NIKKEI and Hang Seng, which became more prominent during the recent financial crisis. Our theoretical considerations on the time varying model which provides the platform upon which we integrate our multifaceted empirical approaches are also of independent interest. In particular, we provide the general solution for low order time varying specifications, which is a long standing research topic. This enables us to characterize these models by deriving, first, their multistep ahead predictors, second, the first two time varying unconditional moments, and third, their covariance structure.

Key Words: financial crisis, stochastic difference equations, structural breaks, time varying coefficients, volatility spillovers.

*Address for correspondence: Menelaos Karanasos, Economics and Finance, Brunel University, West London, UB3 3PH, UK; email: menelaos.karanasos@brunel.ac.uk, tel: +44(0)1895265284, fax: +44 (0)1895269770. The order of the authors names reflect their contribution. Menelaos Karanasos and Alexandros Paraskevopoulos are joint first authors, having defined the theoretical and empirical models, and having derived the theoretical results (Sections 2 and 3). Faek Menla Ali is second author, having estimated the various univariate and bivariate models in Sections 5 and 6. Michail Karoglou, by applying Karoglou (2010) tests, incorporated the break detection procedure into the empirical analysis (Section 5.1). Stavroula Yfanti derived the autocorrelations in Section 3.1.2 and the unconditional variances in Section 3.2.1.

**Economics and Fiance, Brunel University, London, UK

†CRANS, Mathematics, University of Patras, Patra, Greece

‡Economics and Fiance, Brunel University, London, UK

§Aston Business School, Birmingham UK

¶Economics and Fiance, Brunel University, London, UK

JEL Classifications: C53; C58; G15

We gratefully acknowledge the helpful comments of a referee and the helpful correspondence we had with L. Giraitis, G. Kapetanios and A. Magdalinos in the preparation of this paper. We would also like to thank R. Baillie, L. Bauwens, M. Brennan, D. van Dijk, W. Distaso, C. Francq, C. Gourieroux, E. Guerre, M. Guidolin, A. Harvey, C. Hommes, S. Leybourne, P. Minford, A. Monfort, C. Robotti,W. Semmler, R. Smith, T. Terasvirta, P. Zaffaroni, and J-M Zakoian for suggestions and comments on a closely related work (see Paraskevopoulos et al., 2013), which greatly improved many aspects of the current paper as well. We are grateful to seminar participants at CREST, Erasmus University, London School of Economics, Queen Mary University of London, Imperial College, University of Essex, Birkbeck College University of London, University of Nottingham, Cardiff University, University of Manchester, Athens University of Economics and Business, and University of Piraeus. We have also benefited from the comments given by participants (on the closely related work) at the 3rd Humboldt-Copenhagen Conference on Financial Econometrics (Humboldt University, Berlin, March 2013), the SNDE 21st Annual Symposium (University of Milan-Bicocca, March 2013), the 8th and 9th BMRC-QASS conferences on Macro and Financial Economics (Brunel University, London, May 2013), the 7th CFE Conference (Senate House, University of London, December 2013), and the 1st RASTANEWS Conference (University of Milan-Bicocca, January 2014).

Predicting Large Covariance Matrices Using a Characteristic-based Conditionally Heteroskedastic Factor Model

Enno Mammen **Uta Pigorsch**

University of Mannheim

We are interested in predicting the covariance matrix of excess returns, y_{it} with $i = 1, \ldots, n$ and $t = 1, \ldots, T$, of a large number of financial assets ($n >> T$). To this end, we extend the characteristic-based factor model of Connor, Hagmann and Linton [Econometrica, 2012] by introducing conditionally heteroskedastic factors. The model is given by:

$$y_{it} = f_{ut} + \sum_{j=1}^{J} g_j(X_{ji}) f_{jt} + \varepsilon_{it} \tag{1}$$

where f_{ut} denotes the returns of a factor that is relevant to all assets and has unit factor loadings. The factor returns f_{jt}, $j = 1, \ldots, J$, instead, are related to J asset characteristics via the characteristic-based betas $g_j(X_{ji})$,where X_{ji} denotes the time-invariant and continuously distributed characteristic j of asset i. The function g is a smooth and time-invariant function of the jth characteristic. The asset-specific returns, ε_{it}, are assumed to have zero mean and to be cross-sectionally and temporally uncorrelated. We incorporate conditional heteroskedasticity into this model by assuming that the factors follow a multivariate GARCH process. We provide some asymptotic results and present an empirical application of the model using data on US securities.

Matrix Box-Cox Models for Multivariate Realized Volatility

Roland Weigand *

We propose flexible models for multivariate realized volatility dynamics which involve generalizations of the Box-Cox transform to the matrix case. The matrix Box-Cox model of realized covariances (MBC-RCov) is based on transformations of the covariance matrix eigenvalues, while for the Box-Cox dynamic correlation (BC-DC) specification the variances are transformed individually and modeled jointly with the correlations. We estimate transformation parameters by a new multivariate semiparametric estimator and discuss bias-corrected point and density forecasting by simulation. The methods are applied to stock market data where excellent in-sample and out-of-sample performance is found.

*Institute for Empoyment Research (IAB), D-90478 Nürnberg roland.weigand@iab.de

Discriminating between fractional integration and spurious long memory

Niels Haldrup * **Robinson Kruse** **

Fractionally integrated processes have become a standard class of models to describe the long memory features of economic and financial time series data. However, it has been demonstrated in numerous studies that structural break processes and processes with non-linear features can often be confused as being long memory. The question naturally arises whether it is possible empirically to determine the source of long memory as being genuinely long memory in the form of a fractionally integrated process or whether the long range dependence is of a different nature. In this paper we exploit a particular feature of stationary fractionally integrated Gaussian processes to suggest a testing procedure that helps discriminating these processes from spurious long memory processes. Our testing procedure is designed such that even non-stationary fractionally integrated processes are permitted under the null hypothesis. The idea is that nonlinear transformations of stationary fractionally integrated Gaussian processes decrease the order of memory in a specific way determined by the Hermite rank of the transformation. In principle, a non-linear transformation of the series can make the series short memory I(0). We suggest using the Wald test of Shimotsu (2007) to test the null hypothesis that a vector time series of properly transformed variables is I(0). The test is shown to have good size and power against a broad range of level shift and smoothly trending processes.

*Aarhus University & CREATES
**Leibniz University Hannover & CREATES

Testing for Spurious Multivariate Long Memory

Marie Holzhausen Christian Leschinski **Philipp Sibbertsen** *

It is well established that level shifts and slowly varying trends can cause spurious long memory. Therefore, tests for the null of no spurious long memory are of major importance. Additionally, multivariate series such as inflation rates in the Euro area or interest rates of different maturities which exhibit long memory are highly correlated and might also exhibit correlated shifts. Consequently, large potential power gains could be realized if suitable multivariate methods were applied.

This is why we propose a multivariate extension of Qu's (2011) test against spurious long memory. The null hypothesis of a multivariate long-memory process is tested against the alternative of spurious long memory. The test is based on the derivatives of the multivariate local Whittle likelihood function. Its implementation is easy as no prior specifications under the alternative are necessary. The limiting distribution of the test is derived as well as its consistency without assuming Gaussianity. Building on the approximation of Shimotsu (2007) allows us to realize significant power gains since this procedure takes not only the correlation of the multivariate series into account, but also phase shifts around the origin of the periodogram that are induced by different fractional exponents for the different elements of the q-dimensional time series X_t. In extensive Monte Carlo studies satisfactory finite sample size and power properties are shown and empirical examples to the aforementioned interest rates and inflation series prove the usefulness in practical applications.

*Institute of Statistics, Faculty of Economics and Management, Leibniz University Hannover, D-30167 Hannover, Germany

Nonparametric tests for constant tail dependence with an application to energy and finance

Axel Bücher * Stefan Jäschke ** **Dominik Wied** †

The present paper proposes new tests for detecting structural breaks in the tail dependence of multivariate time series using the concept of tail copulas. To obtain asymptotic properties, we derive a new limit result for the sequential empirical tail copula process. Moreover, consistency of both the tests and a break-point estimator are proven. We analyze the finite sample behavior of the tests by Monte Carlo simulations. Finally, and crucial from a risk management perspective, we apply the new findings to datasets from energy and financial markets.

Keywords: Break-point detection, Multiplier bootstrap, Tail dependence, Weak convergence

JEL classification: C12, C14, C32, C58, G32

*Université catholique de Louvain & Ruhr-Universität Bochum
**RWE Supply & Trading GmbH
†Technische Universität Dortmund

A new approach to high-dimensional volatility modelling

Christian Hafner

Université catholique de Louvain

A new approach to model multivariate volatilities based on a Kronecker decomposition of the conditional covariance matrix is proposed. We discuss properties of the model, suggest an estimation algorithm, and illustrate the performance by applying it to a high-dimensional financial time series.

Multiplicative GARCH-X Model

Heejoon Han[*] Dennis Kristensen [**] Sung Yong Park [†]

This paper investigates a multiplicative GARCH-X model, which has a nonparametric long run component induced by an exogenous covariate and a GARCH short run component. Compared to the usual additive GARCH-X model that includes an additional exogenous covariate in the GARCH model, this model contains a nonlinear function of an exogenous covariate that is multiplied to the GARCH model. When the covariate is nonstationary, i.e. integrated, near-integrated or fractionally integrated, the model can explain various stylized facts of financial time series. The asymptic results show that 1) the unconditional variance of time series is allowed to be time-varying, 2) the long-memory property in volatility is generated, 3) the sample kurtosis of time series is larger than that of the GARCH(1,1) model. We suggest a kernel-based estimation procedure for the parametric and nonparametric components and derive related asymptotic properties. For an empirical application of the model, we study three daily European stock index series; FTSE, CAC and DAX. We use the VIX index as the covariate. It is shown that the model performs reasonably well both in within-sample and out-of-sample forecasts.

To better model and forecast the volatility of economic and financial time series, empirical researchers and practitioners often include exogenous regressors in the specification of volatility dynamics. One particularly popular model within this setting is the so-called GARCH-X model where the basic GARCH specification of Bollerslev (1986) is augmented by adding exogenous regressors to the volatility equation. The inclusion of the exogenous regressors often helps explaining the volatilities of stock return series, exchange rate returns series or interest rate series and tend to lead to better in-sample fit and out-of sample forecasting performance.

Recently, multiplicative volatility models are proposed and their important features are that the unconditional variance of time series is time-varying while the short run volatility is driven by a GARCH model. Examples include the spline GARCH model by Engle and Rangel

[*]Kyung Hee University. E-mail: `heejoon@khu.ac.kr`.
[**]University College London. E-mail: `d.kristensen@ucl.ac.uk`.
[†]Chung-Ang University. E-mail: `sungpark@cau.ac.kr`.

(2008), its multivariate generalization made by Hafner and Linton (2009) and time-varying GARCH model by Amado and Teräsvirta (2013) and Amado and Laakkonen (2013).

The multiplicative GARCH-X model have benefits from both the GARCH-X and multiplicative volatility models. If the covariate is nonstationary, i.e. integrated, near-integrated or fractionally integrated, and its funtional transformation is asymptotically homogeneous as defined by Park and Phillips (2001), the model can explain various stylized facts of financial time series; 1) The asymptic limit of the sample variance is time-varying, 2) the asymptotic limit of sample autocorrelation of squared process decreases exponentially first but converges to a positive random limit, 3) the asymptotic limit of the sample kurtosis is larger than that of the GARCH(1,1) model.

One important advantage of the multiplicative GARCH-X model is that the functional form of the exogenous covariate is allowed to be flexible and its nonparametric estimation is relatively easy. If one allows the furnctional form of the exogenous covariate be flexible in the usual additive GARCH-X model, estimation of the model tends to be numerically very difficult. We adopt a kernel-based semiparametric estimation procedure for our model, which is similar to the procedure by Hafner and Linton (2009). To prove consistency of the kernel estimate, we extend the asymptotic results of nonstationary nonparametric regression by Wang and Phillips (2009).

For empirical application, we study three daily European stock index return series for last 10 years (2004.01.02-2013.12.30); FTSE (n=2457), CAC (n=2492) and DAX (n=2474). Considering the influence of the US stock market, the exogenous covariate is chosed to be the VIX index, which can be modeled as an integrated or near-integrated process. Since we consider stock return series, we adopt the GJR-GARCH model to accommodate the leverage effect. Fitting the GJR-GARCH(1,1) model, the persistence measure exhibits the IGARCH. However, IGARCH disappears in the multiplicative GARCH-X model.

We conduct within-sample and out-of-sample forecast evaluation of the model. We produce one-step ahead out-of-sample forecast based on the rolling window forecasting procedure with window of 1008 days (4 years). For forecast evaluation, we use realized kernel as the proxy for actual voaltility and adopt the QLIKE loss function and the Diebold-Marinao (1995) and West (1996) test. Within-sample and out-of-sample forecast evaluations show that our model performs better than the benchmark models.

Semi-parametric Bayesian Partially Identified Models based on Support Function

Yuan Liao*
University of Maryland

Anna Simoni‖
CNRS and THEMA

We provide a comprehensive semi-parametric study of Bayesian partially identified econometric models. While the existing literature on Bayesian partial identification has mostly focused on the structural parameter, our primary focus is on Bayesian credible sets (BCS's) of the unknown identified set and the posterior distribution of its support function. We construct a (two-sided) BCS based on the support function of the identified set. We prove the Bernstein-von Mises theorem for the posterior distribution of the support function. This powerful result in turn infers that, while the BCS and the frequentist confidence set for the partially identified parameter are asymptotically different, our constructed BCS for the identified set has an asymptotically correct frequentist coverage probability. Importantly, we illustrate that the constructed BCS for the identified set does not require a prior on the structural parameter. It can be computed efficiently for subset inference, especially when the target of interest is a sub-vector of the partially identified parameter, where projecting to a low-dimensional subset is often required. Hence, the proposed methods are useful in many applications.

The Bayesian partial identification literature has been assuming a known parametric likelihood function. However, econometric models usually only identify a set of moment inequalities, and therefore using an incorrect likelihood function may result in misleading inferences. In contrast, with a nonparametric prior on the unknown likelihood function, our proposed Bayesian procedure only requires a set of moment conditions, and can efficiently make inference about both the partially identified parameter and its identified set. This makes it widely applicable in general moment inequality models. Finally, the proposed method is illustrated in a financial asset pricing problem.

*Department of Mathematics, University of Maryland at College Park, College Park, MD 20742 (USA). Email: yuanliao@umd.edu

‖CNRS and THEMA, Université de Cergy-Pontoise - 33, boulevard du Port, 95011 Cergy-Pontoise (France). Email: simoni.anna@gmail.com

Key Words: partial identification, posterior consistency, concentration rate, support function, two-sided Bayesian credible sets, identified set, coverage probability, moment inequality models

Testing Symmetry of a Nonparametric Conditional Distribution

Xiaojun Song

Department of Economics, Universidad Carlos III de Madrid

This article proposes tests of symmetry of conditional distributions around a nonparametric location function, which are able to detect general non-parametric alternatives. The test is developed in a general serial dependence context, where innovations may exhibit an unknown higher order serial dependence structure. The test statistic is a functional of the joint empirical distribution of non-parametric residuals and explanatory variables, which is able to detect nonparametric alternatives converging to the null at the parametric rate root-n with n the sample size. Critical values are estimated with the assistance of a bootstrap technique easy to implement, and the validity of the resulting test is formally justified. A Monte Carlo studies the finite sample properties of the test. We also include an application of the proposed test to investigate whether losses are more likely than gains given the available information in stock markets.

Nonparametric statistical inference for extensions of GARCH models

Alexander Meister
Institute for Mathematics
University of Rostock, Germany

We consider extensions of the famous GARCH$(1,1)$-model where the recursive equation for the volatilities is not specified by a parametric link but by a smooth autoregression function. Our goal is to estimate this function under nonparametric constraints when the volatilities are observed with multiplicative innovation errors. We construct an estimation procedure whose risk attains the usual convergence rates for bivariate nonparametric regression estimation. Furthermore, those rates are shown to be optimal in the minimax sense.

References

[1] Meister, A. & Kreiß, J.-P. (2013). Nonparametric statistical inference for extensions of GARCH models. *Preprint*.

A Misspecification Test for Multiplicative Error Models of Non-negative Time Series Processes

Patrick W. Saart

School of Mathematics and Statistics, University of Canterbury

In recent years, analysis of financial time series focuses largely on data related to market trading activity. Apart from modeling of the conditional variance of returns within the generalized autoregressive conditional heteroskedasticity (GARCH) family of models, presently attention is also devoted to other market variables, for instance volumes, number of trades and financial durations. To this end, a large group of researchers focus their studies on a class of model that is referred to in the literature as the multiplicative error model (MEM), which is considered particularly suited for modeling non-negative time series processes. The goal of the current paper is to establish an alternative misspecification test for the MEM of non-negative time series processes. In the literature, several procedures are available to perform hypothesis testing for the MEM. The newly proposed testing procedure is particularly useful in the context of the MEM of waiting times between financial events since its outcomes has a number of important implications on the fundamental concept of point processes. Finally, the current paper makes a number statistical contributions, especially in making a head way into nonparametric hypothesis testing of unobservable variables.

A Semiparametric Conditional Duration Model

Mardi Dungey* Xiangdong Long** Aman Ullah† **Yun Wang**‡

We propose a new semiparametric autoregressive duration (SACD) model, which incorporates the parametric and nonparametric estimators of the conditional duration in a multiplicative way. Asymptotic properties for this combined estimator are presented. Empirical applications to the transaction duration of IBM stock and the U.S. 2-Year Treasury note show the outperformance of our SACD models over parametric ACD models.

Key Words: Duration, Nonparametric Estimator, Semiparametric Model.
JEL Classification: C3, C5, G0.

*Tasmanian School of Business and Economics, University of Tasmania, Australia; Centre for Financial Analysis and Policy, University of Cambridge, UK; Centre for Applied Macroeconomic Analysis, Australian National University, Australia; Email: mardi.dungey@utas.edu.au.

**Bank Of Communications Schroder Fund Management Co. Ltd;
Email: xiangdong.long2008@googlemail.com.

†Department of Economics, University of California, Riverside, CA, 92521, USA;
Email: aman.ullah@ucr.edu.

‡Corresponding Author: School of International Trade and Economics, University of International Business and Economics, Beijing, China, 100029; Email: wyuncolor@gmail.com.

Panel Data Models with Multiple Jump Discontinuities in the Parameters

Oualid Bada — University of Bonn
James Gualtieri — Rice University
Alois Kneip — University of Bonn
Robin C. Sickles — Rice University

In recent years, large panel data models have been considerably developed to make further use of the information available in such datasets. Despite the large number of contributions, there is an important issue that is scarcely discussed in the most of the existing literature –the risk of neglecting possible emergence of structural beaks in the data generating process, especially when the observation period is allowed to be large. While a vast literature on structural break change point analysis exists for univariate time series, a quite small number of researches have been developed for panel data models. This paper provides a new treatment to deal with the problem of multiple structural changes that occur at unknown date points in the panel model parameters. Our method is related to Haar wavelet technique that we adjust according to the structure of the explaining variables in order to detect the change points of the parameters consistently. Finite sample performance of the estimator is examined via Monte Carlo studies. In our application, we examine the impact of algorithmic trading on standard measures of market quality such as liquidity and volatility through a large time period. We propose to automatically detect jumps in regression slope parameters and alleviate concerns about ad-hoc subsample selection to examine the effect of algorithmic trading on market quality in different market situations.

A new nonparametric estimator of a panel varying coefficient model with fixed effects

Juan Manuel Rodriguez Poo
Universidad de Cantabria

In this paper, we consider the estimation of a panel data model where the heterogeneity term is arbitrarily correlated with the covariates and the coefficients are unknown functions of some explanatory variables. The estimator is based in a deviation from the mean transformation of the regression model and then a local linear regression is applied to estimate the unknown varying coefficient functions. It turns out that the standard use of this technique rends a non-negligible asymptotic bias. In order to avoid it, in the estimation procedure, we introduce a high dimensional kernel weight. As a consequence, the resulting estimator shows a bias that asymptotically tends to zero at usual nonparametric rates. However, the variance is enlarged, and therefore the estimator shows a very slow rate of convergence. In order to achieve the optimal rate, we propose a one-step backfitting algorithm. The resulting two step estimator is shown to be asymptotically normal and its rate of convergence is optimal within its class of smoothness functions. Furthermore, the estimator is oracle efficient. Finally, we show some Monte Carlo results that confirm the theoretical findings.

A Semiparametric Model for Heterogeneous Panel Data with Fixed Effects

Michael Vogt

Department of Mathematics and Statistics, University of Konstanz

In this talk, we develop methodology for semiparametric panel data models in a setting where both the time series and the cross-section are large. Such settings are common in finance and other areas of economics. We consider a panel model with a nonparametric regression function which may differ across agents, i.e., in the cross-section direction. To reduce the dimensionality of the model, the individual regression functions are supposed to have a sparse structure. In particular, they are assumed to be linear combinations of a small number of unknown (basis) functions which are the same across individuals. The project develops theory to estimate the unknown functions along with the parameters of the model. In addition, we apply the methodology to a question of recent policy interest, that is, the effect of trading venue fragmentation in equity markets on market quality.

A Quantile-Heterogeneous Autoregressive Model of Realized Volatility

Dirk G. Baur *
University of Technology Sydney

Robert Maderitsch **
University of Hohenheim

This paper introduces the so called Quantile Heterogeneous Autoregressive model of Realized Volatility (QHAR-RV). This extension of [4]'s Heterogeneous Autoregressive model of Realized Volatility (HAR-RV) allows us to provide new insights into quantile-specific long memory in realized volatility. Specifically, we detect interesting asymmetries in the dependence of realized volatility on volatility components, realized over different time horizons. Further, we find evidence for the presence of significant leverage effects that differ across quantiles of the realized volatility.

The Heterogeneous Autoregressive model of Realized Volatility (HAR-RV) according to [4] considers volatility components, realized over different time horizons. Its parsimony and tractability have made it a popular empirical model to capture persistence in volatility. In its simplest univariate form, this model can be written as:

$$RV_t^{(d)} = \alpha + \beta^{(d)} RV_{t-1}^{(d)} + \beta^{(w)} RV_{t-1}^{(w)} + \beta^{(m)} RV_{t-1}^{(m)} + \epsilon_t, \tag{2}$$

where $RV_t^{(d)}$, $RV_{t-1}^{(d)}$, $RV_{t-1}^{(w)}$ and $RV_{t-1}^{(m)}$ are realized volatilities over daily, weekly and monthly time horizons and ϵ_t is a serially independent zero mean innovation term. Specifically, $RV_t^{(d)}$ ($RV_{t-1}^{(d)}$) corresponds to the (lagged) daily realized volatility component. $RV_{t-1}^{(w)}$ is the lagged weekly volatility component, computed as $\frac{1}{5}(RV_{t-1}^{(d)} + RV_{t-2}^{(d)} + ... + RV_{t-5}^{(d)})$. $RV_{t-1}^{(m)}$ denotes the lagged monthly volatility component. It is obtained as $\frac{1}{22}(RV_{t-1}^{(d)} + RV_{t-2}^{(d)} + ... + RV_{t-23}^{(d)})$.

Using Ordinary Least Squares regression techniques, [4] estimates the conditional mean of the realized volatility, given the three right-hand-side volatility components, realized over different time horizons. For the S&P 500 Index Future, for example, he finds a decreasing dependence from the daily, to the weekly, to the monthly volatility component ($\beta^{(d)} > \beta^{(w)} > \beta^{(m)}$). Being confined to the analysis of the conditional mean of the realized volatility,

*Corresponding author. Tel.: +61 2 9514 7747. Email: dirk.baur@uts.edu.au
**r.maderitsch@uni-hohenheim.de

however, he is not able to draw conclusions on the particular structure of dependence on different volatility components across different quantiles of the realized volatility.

We, by contrast, widen the perspective, using quantile regression techniques according to [4] and [6]. These techniques allow us to model the dependence of specific conditional quantiles of the realized volatility, given the volatility components, realized over different time horizons. We are hence able to provide a more detailed description of the tails of the distribution of the realized volatility.

As our baseline specification, we use the following Quantile Heterogeneous Autoregressive model of Realized Volatility (QHAR-RV):

$$Q_{RV_t^{(d)}}(\tau|X) = \alpha(\tau) + \beta^{(d)}(\tau)RV_{t-1}^{(d)} + \beta^{(w)}(\tau)RV_{t-1}^{(w)} + \beta^{(m)}(\tau)RV_{t-1}^{(m)}, \tag{3}$$

where X denotes the regressor matrix and $Q_{RV_t^{(d)}}(\tau|X)$ is day t's τth quantile of the realized volatility, conditional on X. $\alpha(\tau)$, $\beta^{(d)}$, $\beta^{(w)}$ and $\beta^{(m)}$ are quantile-specific parameters. The dependence parameters $\beta^{(d)}$, $\beta^{(w)}$ and $\beta^{(m)}$ are of central interest to us. We interpret them as the quantile-specific persistence parameters with respect to the volatility components, realized over different time horizons. We contrast them to the corresponding parameters from an Ordinary Least Squares regression.

In addition to the baseline specification, we consider an extended model, taking a potential leverage effect into account. Specifically, this model has the following form:

$$Q_{RV_t^{(d)}}(\tau|X) = \alpha(\tau) + \beta^{(d)}(\tau)RV_{t-1}^{(d)} + \beta^{(w)}(\tau)RV_{t-1}^{(w)} + \beta^{(m)}(\tau)RV_{t-1}^{(m)} + \gamma(\tau)r_{t-1}, \tag{4}$$

where r_{t-1} stands for the lagged return and $\gamma(\tau)$ measures the quantile-specific effect of the lagged return on the realized volatility on day t.

Using a high-frequency dataset, obtained from Olsen Financial Technologies, for the S&P 500 Index between 2000 and 2011, we follow [1] and [3] and estimate daily log-realized volatilities from approximately continuously sampled intra day data:

$$ln(\sigma_t) = ln\sqrt{\sum_{j=1}^{M} r_{t,j}^2}, \tag{5}$$

where $r_{t,j}^2$ are the 5-minute squared intraday log-returns and M is the number of intra day returns available throughout one trading day. We use the 5-minute frequency due to the fact that this frequency has empirically been shown to be most adequate to solve the trade-off between bias and variance in the realized volatility estimator (see e.g. [2]). The log-transformation is common in the literature. It improves the statistical properties of the realized volatilities (see e.g. [1]). Estimating Equation 4 based on the resulting quantities, leads to the following results, depicted in Figure 1 . Most apparently, the sequences of the

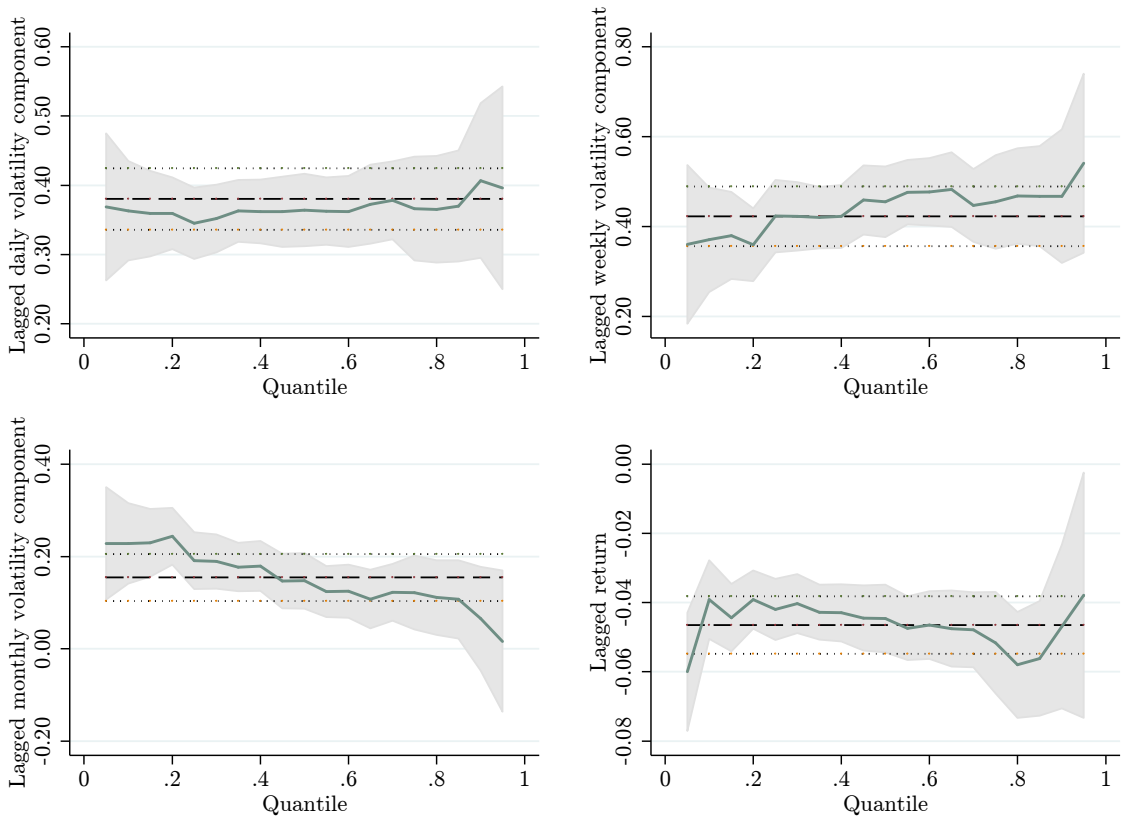


Figure 1: Green lines: estimated parameters $\beta^{(d)}(\tau), \beta^{(w)}(\tau), \beta^{(m)}(\tau)$ and $\gamma(\tau)$ (model according to Equation 4). 95% confidence bands given in grey. Dashed line: OLS-estimate with 95% confidence bands (dotted).

estimated parameters $\beta^{(d)}$, $\beta^{(w)}$ and $\beta^{(m)}$ across quantiles reveal that the parameters vary considerable. Differences, compared to the OLS-estimates, are obviously apparent. In particular for the dependence on the weekly and the monthly volatility component ($\beta^{(w)}$ and $\beta^{(m)}$), the parameters differ across quantiles. Upper realized volatility quantiles exhibit stronger posi-

tive dependence on the weekly volatility component than lower realized volatility quantiles. By contrast, regarding the monthly volatility component, the positive dependence is more pronounced for lower realized volatility quantiles than for upper realized volatility quantiles. The leverage effect $\gamma(\tau)$ is negative and significantly different from zero over all quantiles. From approximately the 10% to the 80% quantile, however, it tends to become more pronounced, suggesting an increase in the realized volatility's dependence on the previous day return from lower to upper quantiles.

So far, these first results are very promising. For the future, we plan to conduct numerous additional estimations, based on high-frequency data for various further assets. Finally we want to provide a comprehensive overview on quantile-specific volatility persistence across different assets.

Keywords: Realized volatility, long memory, HAR, quantile regression.

JEL Classification: C22, C51, C58.

References

[1] Andersen, T.G., Bollerslev, T., Diebold, F.X., Ebens, H., 2001. The distribution of realized stock return volatility. Journal of Financial Economics 61 (1), 43-76.

[2] Andersen, T.G., Bollerslev, T., Frederiksen, F., Nielsen, M. O., 2010. Continuous-time models, realized volatlities, and testable distributional implication for daily stock returns. Journal of Applied Econometrics 25 (2), 233-261.

[3] Barndorff-Nielsen, O.E., Shephard, N., 2002. Estimating quadratic variation using realized variance. Journal of Applied Econometrics 17, 457-477.

[4] Corsi, F., 2009. A simple approximate long-memory model of realized volatility. Journal of Financial Econometrics 7, 174-196.

[5] Koenker, R., Bassett, Gilbert, J., 1978. Regression quantiles. Econometrica 46 (1), 33-50.

[6] Koenker, R., Xiao, Z., 2006. Quantile autoregression. Journal of the American Statistical Association 101 (475), 980-990.

The effects of liquidity on asset price volatility in a high-frequency world

Andreas Fuest Stefan Mittnik *

Chair of Financial Econometrics, Department of Statistics, and
Center for Quantitative Risk Analysis, Ludwig-Maximilians-Universität München

Motivated by the debate on the responsibility of high-frequency trading (HFT) for phenomena like the "flash crash", we investigate the role of electronic order-driven markets for financial stability. More specifically, we consider the question if and how liquidity affects asset price volatility in a high-frequency setup.

To this end, curve-valued liquidity l_t is measured by means of cumulative limit order volumes on the supply and demand sides of an electronic market's limit order book (LOB). A semiparametric model is introduced, GARCH-FXL (GARCH with Functional eXogeneous Liquidity), which incorporates the lagged state of the order book, l_{t-1}, into (the second moment σ_t^2 of) the conditional distribution of the de-diurnalized stock return r_t using a GARCH specification including additional functional exogeneous terms. For instance, a logarithmic GARCH-FXL(1,1,1) specification (with one FX component) is given by

$$r_t = \sigma_t \varepsilon_t, \qquad \varepsilon_t \overset{iid}{\sim} (0,1),$$
$$\log\left(\sigma_t^2\right) = \omega + \alpha \log\left(r_{t-1}^2\right) + \beta \log\left(\sigma_{t-1}^2\right) + \int \gamma(m) l_{t-1}(m) dm,$$

where γ is a functional coefficient such that $\int \gamma(m) l_{t-1}(m) dm$ maps infinite-dimensional liquidity curves to scalar conditional volatility. Assuming observed liquidity $l_t,\ t = 1, \ldots, T$, to be a realization of a square-integrable stationary functional liquidity process, functional principal components are used to expand both the l_t and the functional coefficient γ in terms of the eigenfunctions of l_t's contemporaneous covariance function $C(u,v) \equiv \mathrm{Cov}(l_t(u), l_t(v))$. Properties of the model are discussed, especially its implied liquidity impact, and a two-step estimation strategy presented. An empirical application (see figure 1) using LOB snapshots

*Address for correspondence: Chair of Financial Econometrics, Center for Quantitative Risk Analysis, Ludwig-Maximilians-Universität Munich, Akademiestrasse 1/I, 80799 Munich, Germany; Phone: +49 (0)89 2180-3522; Email: `fuest@stat.uni-muenchen.de`.

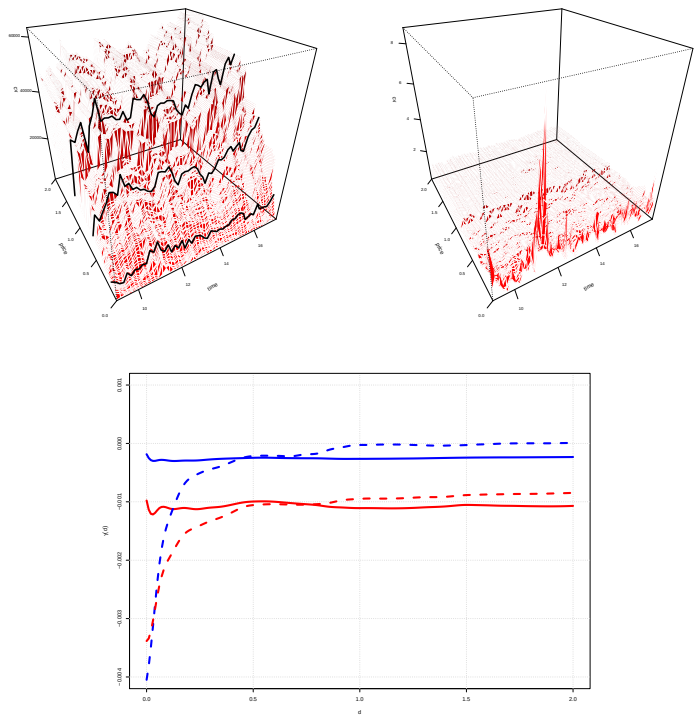


Figure 1: Upper left panel: Cumulative volume curves of sell orders for the Linde stock and one day (2010-06-03), traded via XETRA, and sampled every five minutes. Upper right panel: The de-diurnalized version of the same cumulative volumes. It can be seen that liquidity variation at the quotes is much larger than deeper in the book. Bottom panel: The estimated coefficient functions for a log-GARCH-FXL(1,1,2) model for the Linde stock, using data from 06/2010 to 09/2010 ($T = 4300$ observations: 86 trading days with 50 intra-daily observations each). Blue (red) lines indicate the demand (supply) side of the market, solid (dashed) lines a basis expansion using the first $K = 1$ ($K = 2$) eigenfunctions from the FPC decomposition for the estimation of $\gamma^{(\text{bid})}$ and $\gamma^{(\text{ask})}$.

for major stocks from the German DAX index traded via the XETRA system, taken at high frequency, illustrates that liquidity is of paramount importance for return variation. In particular, (i) low liquidity tends to produce high volatility (and vice versa), (ii) liquidity near the quotes contributes more to future volatility than liquidity deeper in the book (but the latter is still relevant), (iii) both supply and demand side liquidity curves are important, not only their sum or imbalance.

Finally, we conduct an out-of-sample forecast exercise, comparing GARCH-FXL to GARCH specifications without liquidity impact.

Lead-lag analysis with high-frequency data: an empirical study for the Japanese stock market

Takaki Hayashi *

We are concerned with very short-term, lead-lag relationships between market prices of identical stocks traded concurrently on multiple trading venues in the Japanese stock market, specifically, the Tokyo Stock Exchange and two Proprietary Trading Systems, or PTS (a term coined for an alternative trading venue in Japan). By use of high-frequency, limit-order book data for major Japanese stocks with millisecond time resolution, we empirically investigate whether there exist such lead/lags among them and measure how large or small lead/lag times are if indeed that is the case. We adopt the lead-lag estimation framework proposed by Hoffmann et al. (2010, 2013), which utilizes Hayashi and Yoshida (2005)s nonsynchronous covariance estimator. Furthermore, we conduct a longitudinal data analysis (or panel data analysis) to understand systematic patterns found in the observed lead/lag times in term of observable characteristics of the individual stocks. Empirical findings will be presented in the talk.

Keywords: Hayashi-Yoshida estimator; high-frequency data; lead-lag analysis; limit order book; nonsynchronicity; quadratic covariation; timestamp

*Graduate School of Business Administration, Keio University, Yokohama 223-8526, Japan, takaki@kbs.keio.ac.jp

Data-driven estimating, modelling and forecasting realized kernels under microstructure noise

Chen Zhou Yuanhua Feng * Manfred Kraft

Department of Economics, University of Paderborn

Realized volatility (RV) is a model-free estimator of the daily integrated volatility (IV) based on high-frequency financial data. The most simple definition of the RV for estimating the IV is the sums of squared intraday returns, called RV_0. However, it is found that, if the data exhibit microstructure noise, RV_0 is an inconsistent estimator of IV. Different approaches are introduced into the literature to correct the bias in RV_0. For instance, an unbiased estimator under i.i.d microstructure noise is indeed the cross-products between two consequent observations and is denoted by RV_Z.

Most recently, Barndorf-Nielsen et al (2008) introduced the realized kernels (RK), which are consistent estimators of the IV under given conditions. A crucial problem by applying realized kernels is the selection of the bandwidth. The main purpose of this paper is to propose a simple, fast and fully data-driven consistent bandwidth selector for realized kernels based on the iterative plug-in idee (Gasser et al., 1991). In this paper, to simplify the estimation procedure we use a biased version of the asymptotically optimal bandwidth of a realized kernel, called H_{B} and the term "consistent" is used in a relative sense that $(\hat{H}_{\mathrm{B}}-H_{\mathrm{B}})/H_{\mathrm{B}} \to 0$, as $n \to \infty$. The selected bandwidth $\hat{H}_{\mathrm{B}}$ is obtained by means of an iterative procedure. In each iteration, the resulting RK is used as an estimate of the IV, and the variance of the microstructure noise ω^2 is estimated based on the difference between RV_0 and RK. In the first iteration RV_Z is used as the initial value of RK. It is shown that $\hat{\omega}^2$ defined in this way is $\sqrt{n}$-consistent in each iteration. Both of RK and $\hat{H}_{\mathrm{B}}$ become consistent form in the third iteration, while their rate of convergence can still be improved in the fourth iteration. Thereafter, RK achieves its optimal rate of convergence of the order $O(n^{-1/5})$ and this rate of convergence is also shared by $(\hat{H}_{\mathrm{B}} - H_{\mathrm{B}})/H_{\mathrm{B}}$. The nice practical performance of the proposal is illustrated by application to data of two German and two French firms within a period of several years. Figure 1 shows the histograms of the selected optimal bandwidths of these

*Corresponding author: E-mail:yuanhua.feng@wiwi.upb.de

four firms. From Figure 1 we can see that most selected bandwidths located approximately between 10 and 15. In addtion, we showed that the most required iteration number for these four companies is 3. It means the data-driven bandwidth selection approach converges very fast and confirms the theoretical conclusion. Both indicate that this approach works well in practice.

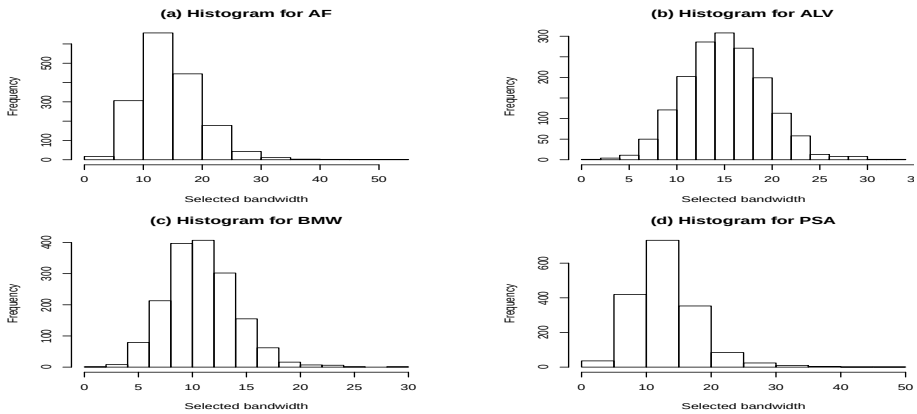


Figure 1: Histograms of selected bandwidth for all examples.

Furthermore, we use the ESEMIFAR model, which can simultaneously investigate long memory, nonparametric trends and possible structural breaks, to analyze the RK. Possible structure breaks cased by the financial crisis in 2008 may have a clear effect on the estimation results. Using piecewise ESEMIFAR model can improve the quality of estimation results.

Reference:

- Barndorff-Nielsen, O. E., Hansen, P., Lunde, A. and Shephard, N. (2008). Designing realized kernels to measure ex-post variation of equity prices in the presence of noise. *Econometrica*, 76, 1481-1536.

- Barndorff-Nielsen, O. E., Hansen, P., Lunde, A. and Shephard, N. (2009). Realised kernels in practice: trades and quotes. *Econometrics Journal*, 12, C1-C32.

- Gasser, T., Kneip, A. and Köhler, W. (1991). A flexible and fast method for automatic smoothing. *J. Amer.Statist. Assoc.* 86 643-652.

Spillovers from the US to stock markets in Asia: A quantile regression approach

Robert Maderitsch *

Abstract This paper analyzes return spillovers from the US to Asian stock markets by means of quantile regressions. Traditional studies consider spillovers as effects of the conditional means of foreign returns onto the conditional means of chronologically succeeding domestic markets' returns. We, by contrast, study the full range of quantiles of the conditional distribution of the domestic markets' returns. This enables us to document the detailed structure of spillovers across return quantiles. Generally, we find spillovers from the US to Asia to be negative. Specifically, however, we reveal an asymmetric structure of spillovers with a general decrease of spillovers from lower to upper return quantiles. Theoretically, this pattern is consistent with an asymmetric overreaction of traders in Asia to news from the US market. Extensions from the baseline model further suggest the presence of a calm-down effect over weekends as well as contagion throughout the financial crisis of 2007-08.

Key Words: Quantile regression, spillovers.
JEL Classification: C22, G14, G15

The quantile spillover model

In Ordinary Least Squares regressions, the focus is typically on the estimation of the conditional mean of a dependent variable y, given the explanatory variable(s) x. In the context of spillover studies, x typically denotes a (set of) foreign market return(s), whereas y contains the domestic market's returns. The resulting slope-coefficient(s) β is (are) considered as the spillover effect(s). Quantile regression techniques, as introduced by [4], however, allow us to model the dependence of specific conditional quantiles of the dependent variable y, given the explanatory variable(s) x. They hence provide a more detailed description of the tails of the distribution of the dependent variable y. Being robust to heteroskedasticity, skewness and leptokurtosis, they are further ideal to be employed in the context of financial return data.

*Corresponding author. Tel.: +49 711 459 24712. University of Hohenheim, Chair of Statistics and Econometrics II, Schloss Museumsfluegel, 70599 Stuttgart, Germany

As our baseline specification, we therefore use the following quantile spillover model:

$$Q_{r_{ASIA,t+1}}(\tau|X) = \alpha(\tau) + \beta(\tau) r_{US,t}, \tag{1}$$

where X is the regressor (matrix), containing $r_{US,t}$, the close-to-close return of the S&P 500 index on day t. $Q_{r_{ASIA,t+1}}$ is the day t+1 τth quantile of the return of an Asian stock portfolio, conditional on the US market close-to-close return on day t. The Asia stock portfolio is constructed from equally weighted open-to-close returns of stocks, contained in either the Nikkei 225 Index, the Kospi 50 Index, the Straits Times Index, the FTSE TWSE Taiwan 50 Index, the Hang Seng Index or the SSE Composite Index.* $\alpha_i(\tau)$ and $\beta(\tau)$ are the quantile-specific parameters. $\beta(\tau)$, the dependence parameter, is of central interest to us. We interpret it as the quantile-specific spillover parameter and contrast it to the spillover parameter from an Ordinary Least Squares (OLS) regression framework.

In addition to the baseline specification, we consider various model extensions. In one extension, we assess the impact of the financial crisis of 2007-08 on the quantile-specific spillovers:

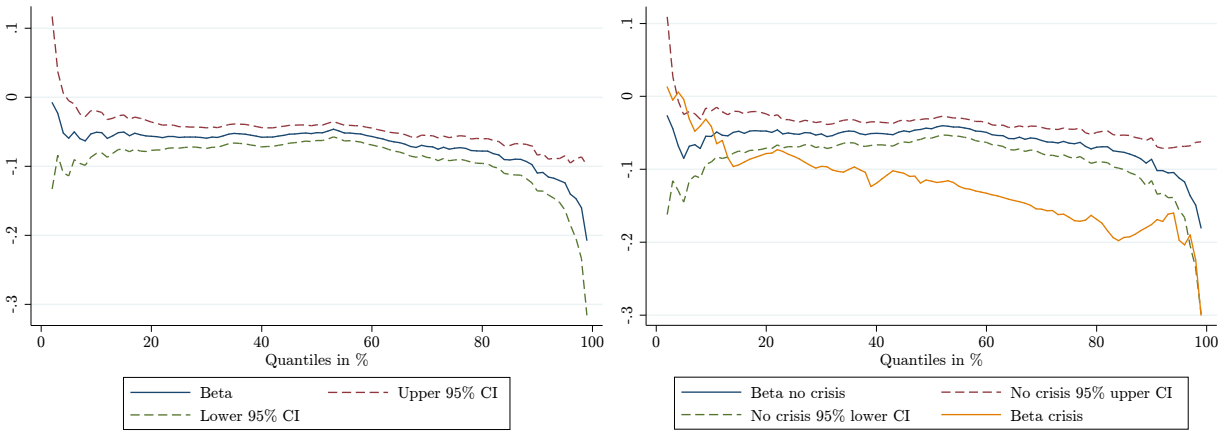
$$Q_{r_{ASIA,t+1}}(\tau|X) = \alpha(\tau) + \beta(\tau) r_{US,t} + \gamma(\tau) r_{US,t} D_{Crisis}, \tag{2}$$

where D_{Crisis} is a dummy, interacted with the S&P 500 returns $r_{US,t}$. D_{Crisis} is equal to zero in tranquil (no crisis) times and equal to one during the financial crisis of 2007-08. In accordance with popular time lines on the financial crisis, such as provided by the [1] or [3], we use August 2007 to December 2008 as the crisis period. If the financial crisis had a significant impact, then spillovers during the financial crisis ($\beta(\tau) + \gamma(\tau)$) should turn out to be significantly different from spillovers in tranquil times ($\beta(\tau)$). Theoretically, crisis-related differences in spillovers are consistent with the notion of contagion. In its broadest sense, this term is defined as a strong and sudden increase in cross-market linkages after a shock (see e.g. [2]).

*Note that in the full paper we also break down the results to the single markets.

Impact of the financial crisis of 2007-08

In the following, we present a brief extract of our results. Figure depicts estimation results for Equation (1). Figure presents estimation results for Equation (2). As apparent in Figure , spillovers from the US generally tend to be negative and statistically significantly different from zero. Further, spillovers tend to become more pronounced from lower to upper return quantiles. Theoretically, this pattern is consistent with the presence of an asymmetric overreaction phenomenon to US returns. In addition, as apparent in Figure , spillovers into the Asia portfolio are significantly affected by the financial crisis. Over the crisis period, particularly the upper return quantiles tend to exhibit stronger negative spillovers. These strengthening spillovers from the US during the financial crisis of 2007-08 are consistent with the presence of contagion.



(a) Asia Portfolio (b) Asia Portfolio extended

Figure 1: Asia portfolio.

Notes: The quantile-specific $\hat{\beta}$'s are given in blue. The corresponding dashed 95% confidence bands are given in red and green. In (a) they correspond to the total sample spillovers. In (b) they refer to the tranquil period spillovers, whereas the crisis-specific spillovers are depicted in yellow. The confidence bands are based on asymptotic standard errors, estimated using a block-bootstrap with a fixed length of 25 observations and 600 replications. Y-axes: degree of dependence. X-axes: quantiles.

References

[1] Federal Reserve Board of St. Louis, 2010. The financial crisis: A timeline of events and policy actions.

[2] Forbes, K., Rigobon, R., 2002. No contagion, only interdependence: measuring stock market comovements. Journal of Finance 57 (5), 2223C2261.

[3] Guillen, M. F., 2009. The global economic & financial crisis: a timeline, the Lauder Institute, Wharton University.

[4] Koenker, R., Bassett, Gilbert, J., 1978. Regression quantiles. Econometrica 46 (1), 33C50.

On the Behaviour of Rare Earths Prices

Wenxuan Hou * Maximilian Müler ** Denis Schweizer † **Volker Seiler** ‡

Recently, rare earths elements have gained increasing attention because of their scarcity and the quasi-monopoly of China. Rare earths elements are essential for a range of high-technology products such as mobile phones, camera lenses, computer displays and fiber optics, and green-energy technology such as hybrid and electric cars, hydrogen purification, wind energy turbines and photovoltaic cells. For many of these applications, substitutes are not available. However, China is the main producer of rare earths elements with a global market share of about 97% and controls exports of rare earths elements by setting export quotas: Twice a year, the quotas are announced by the Chinese Ministry of Commerce (MOFCOM). The setting of export quotas leads to a dual-pricing system where the export prices (FOB-prices) are much higher than the prices for the same elements within China. This policy raised concerns that China might abuse its dominant position. The volatile prices and sharp price increases in 2011 are put forward as evidence. Accordingly, the United States, Japan and the European Union jointly filed a dispute resolution case against China at the World Trade Organization (WTO) on 13 March 2012, claiming that China strategically sets the rare earths quotas to spur domestic economic development at the expense of other nations that depend on imports of rare earths from China.

In light of these recent developments, we take a closer look at the behavior of rare earths elements prices. More precisely, we analyze whether the sharp price increases in 2011 are a direct consequence of the MOFCOM's export quota announcements. We use the methodology proposed by Clemente/Montañé/Reyes (1998) to identify the structural breaks in the time series of rare earths elements prices and match these with the export quota announcement dates. The results of the double-mean break tests underline what seems to be apparent from

*University of Edinburgh Business School, Associate Professor in Finance, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, Email: Wenxuan.Hou@ed.ac.uk.

**WHU - Otto Beisheim School of Management, Assistant Professor of Financial Reporting, Burgplatz 2, 56179 Vallendar, Germany, Phone: +49 261 - 6509 233, Email: Maximilian.Mueller@whu.edu.

†WHU - Otto Beisheim School of Management, Assistant Professor of Alternative Investments, Burgplatz 2, 56179 Vallendar, Germany, Phone: +49 261 - 6509 724, Email: Denis.Schweizer@whu.edu.

‡Corresponding author; University of Paderborn, Akademischer Rat, International Economics and Macroeconomics, Warburger Straße 100, 33098 Paderborn, Germany, Phone: +49 5251 - 60 2970, Email: Volker.Seiler@wiwi.uni-paderborn.de.

visual inspection of the data: The means of the rare earths elements price series show strong level shifts. However, these structural breaks are not related to export quota announcements by the Chinese Ministry of Commerce (MOFCOM). Concerning the time series generating process, we have to reject the hypothesis of stationarity of the rare earths elements prices as - even when accounting for two structural breaks - the presence of unit-roots cannot be rejected. All in all, shocks to the time series of rare earths elements prices are permanent rather than transitory. However, these shocks are not related to export quota announcements.

Quantile Dependence between Shanghai and Hong Kong Stock Markets: A Copula-based Approach

Weiou Wu
Kemmy Business School
University of Limerick

Modelling correlations and linkages between financial asset returns are important for international investors to diversify risk, and also for monetary policy makers to control for the risk of financial contagion. There are many studies on modelling the dynamic linkages between international stock markets and most have found the existence of tail correlation and asymmetric dependence. However, traditional measure for tail dependence ignores the association between non-extreme events, that is, tail dependence only captures the probability that extreme event occurs in one market given that extreme event has already occurred in the other market, while lost the information associated with non-extreme events, which leave a large portion of useful information unexplained when modelling correlation. Furthermore, the concept of tail dependence has mostly been applied to the joint upper or joint lower case, while ignores the case that extreme events can occur in the opposite direction along the minor diagonal.

In order to provide a richer dependence structure, this paper models the quantile dependence for two Chinese stock indices through a conditional copula-GARCH approach. A copula is a function that joins one-dimensional distribution functions together to form multivariate distribution functions (Sklar, 1959). In other words, the joint distribution function can be written in terms of a copula and the marginal distribution functions. Thus, the copula contains all the information on the dependence structure of the random variables while the marginal distribution function contains all information of the margins. The use of a copula function removes the linear correlation restriction, that the joint distribution must be an elliptical distribution. Therefore, the copula provides a relatively straightforward way of modelling non-linear and non-normal joint distributions that might otherwise only be examined through simulation approaches.

The concept of quantile dependence can be embedded within the copula theory, which measures the strength of the dependence between joint upper, or joint lower tails of their support. We adapt both parametric and non-parametric estimation of copula to model the quantile dependence. In the non-parametric approach, the marginal distributions are modelled using the empirical distribution function while the same is approximated by Hansen (1994)'s skewed student' t distribution in the parametric approach. Moreover, this paper extends the modelling of quantile dependence in several other ways. That is, we define the conditional margins separately for the two stock indices and introduce the methods of selecting the optimal model. We consider extremal comovements off the main diagonal, and obtain information associated with heterogeneous as well as homogeneous behaviour. While constructing the tail dependence, we model the upper and lower tails separately, to capture the asymmetric property.

Our results can provide a richer and wider description of the dependence structure for investors and policy makers with regards to portfolio management, risk diversification, and asset allocation. While we show a clear increase in dependence as the quantile moving towards the centre of the distribution, evidence of asymmetric tails is also observed. A much stronger bivariate upper tail is observed when the quantile approaches zero. However, the lower tail dependence becomes stronger as the quantile moving towards the centre. Moreover, immediate flat spot does not observed for both bivariate tails. There are noticeable fluctuations for upper tail dependence suggesting some cut-off when calculating the tail dependent parameters.

Key Words: Quantile Dependence, Tail Dependence, Copula, Asymmetric Dependence

Acknowledgements

This work is supported by a grant from the Institute for New Economic Thinking.

The approximation of time series using fractional Brownian motion

Valeria Bondarenko

Technical University Berlin

In this paper we propose two problems related to fractional Brownian motion. First problem simultaneous estimation of two parameters-Hurst exponent and the volatility, that describe this random process.Numerical tests for the simulated fBm provided an efficient method. Second problem- approximation of the increments of the observed time series by a power function by increments from the fractional Brownian motion. Approximation and estimation shown on the example of real data- daily deposit interest rates.

Modelling financial market activities using a varying scale Log-ACD model

Sarah Forstinger* Yuanhua Feng **
University of Paderborn

Long-term dynamics in financial time series reflect the effects of a changing macroeconomic environment or other financial events. The aim of this paper is to examine the long-term dynamics as well as the conditional changes of daily average trade durations and aggregated daily trading volume data. For this analysis we propose to use a semiparametric extension of the Log ACD1 model introduced by Bauwens and Giot (2000) and Bauwens (2008). A multiplicative time varying scale function is included in the basic model which is estimated via a local linear regression with stationary errors and without any parametric specification and assumption on the conditional distribution. The use of the varying scale Log-ACD model under the log-normal conditional distribution is particularly emphasized due to the following reasons: 1. After the log-transformation the model becomes an additive nonparametric regression with stationary linear time series errors, which can hence be estimated very easily. 2. It is found that the here proposed model fits the examined data very well and 3. the model exhibits some very nice properties under the conditional log-normal distribution. The theoretical findings are applied to real financial data and compared to the estimation results yielded by the semi-ACD model in order to examine whether the use of one of the applied models is superior to the other one.

*University of Paderborn, Warburger Str. 100, 33098 Paderborn, Germany. Email: sarahf@mail.upb.de; Tel. 0049-5251-603412

**University of Paderborn, Warburger Str. 100, 33098 Paderborn, Germany.
Email: yuanhua.feng@wiwi.upb.de; Tel. 0049-5251-603379

Control Function Approach to Weak Instruments

Nam-Hyun Kim * Winfried Pohlmeier
University of Konstanz

There are two wellknown alternative methods to address endogeneity in the literature, Instrumental Variables (IV) estimation and Control Function (CF) approach, using instrumental variables. However, it is not an easy task to find a legitimate instrument satisfying the relevance condition where a correlation between an endogenous regressor and its instrument is not weak. The excellent reviews on the weak IV issues are Bound, Jaeger and Baker (1995), and Stock, Wright and Yogo (2002). We propose to use the CF approach rather than IV estimation since the CF approach translates the weak IV problem into the multicollinearity one in a structural equation. The crucial underlying condition for CF approach is partitioning an endogenous explanatory variable into an exogenous (instrument) and an endogenous (disturbance term from a reduced equation) components. This partition allows us to control endogeneity by incorporating the disturbance term from the reduced equation in a structural equation. However, the weak correlation between the endogenous regressor and its instrument causes the multicollinearity problem since the variations of both endogenous regressor and disturbance term from the reduced equation are closely correlated. It is wellknown in the literature that the ridge type of penalised estimation method allows us to address the multicollinearity problem. Hence we aim to develop the ridge type of penalised estimation method based on the CF approach to address the weak IV issues in a linear equation case. We also reexamine the results of Angrist and Krueger (1991) who study the returns on education equation by using the quarter of birth as an instrument for educational attainment. This paper provides the estimation procedure and the asymptotic properties of the penalised estimators. In addition, we aim to establish selection procedure of a penalised parameter based on the concentration parameter which measures the strength of relevance condition for an instrument.

*Nam-Hyun Kim, Department of Economics, University of Konstanz, Germany;
email: nam-hyun.kim@uni-konstanz.de

On the iterative plug-in algorithm for estimating diurnal patterns of financial trading durations*

Sarah Forstinger **

Department of Economics, University of Paderborn

In order to adequately take into account the diurnal pattern of financial trade durations, a semiparametric extension of the ACD model was proposed recently. It is defined by introducing a smooth nonparametric scale function into the standard ACD model. In a first step this scale function is estimated nonparametrically via a local linear estimation. The estimated trend is then removed from the original data and a standard ACD model is fitted parametrically via well-known methods such as (Q)MLE. The focus here is on the discussion of the practical performance of an iterative plug-in bandwidth selection algorithm for the local linear estimation of the diurnal pattern. The main aim, in particular, is to study the impact of different factors of the proposed algorithm on the quality of the selected bandwidth. For this purpose a large simulation study is carried out based on 12 simulated data examples consisting of two different ACD models, a typical and an atypical diurnal pattern and three different sample sizes. To each of the simulated data, a semi-ACD model is fitted with different combinations of impact factors of the IPI algorithm, namely an exponential and a multiplicative inflation method, different corresponding inflation factors and different values for determining the maximal lag of the sum of residual autocovariances. Based on the simulation results, the practical behavior of the proposed bandwidth selector is assessed in different ways. By comparing the estimation results to the true values of the simulated data, the bandwidth selection, the scale function estimation and the ACD model parameter estimation are evaluated. It is shown that the proposal overall works very well in practice, but nevertheless there are some combinations of the examined impact factors which are superior to others. The algorithm with the combination of impact factors that performed the best in the simulation study was further applied to real financial data examples. It is shown here, as well, that the data-driven estimation algorithm performs well and that the quality of the estimated ACD model is clearly improved.

*This poster is based on a joint work with Yuanhua Feng and Christian Peitz, University of Paderborn.

**University of Paderborn, Germany. Email: sarahf@mail.upb.de; Tel. 0049-5251-603412

Disentangling Permanent from Transitory Spillovers

Tomáš Křehlík

Charles University in Prague

Understanding connectedness of markets together with information transmission mechanism became an important topic of interest in the current literature studying risk. Recent studies document the highly dynamic nature of volatility spillovers, potential use in macroeconomics, and interesting asymmetric structure on real data. The generalized VAR framework used to estimate spillovers on real data, however, fails to identify the source of the spillover, whether it is long- or short-run. In the paper, we first motivate the claim by covariance decomposition of real data and show that the covariance is created at various frequencies. Moreover, we secondly demonstrate that high spillovers can be induced through contemporaneous correlation in residuals as well as long-run dependence in volatilities using bi-variate two-component GARCH setting. After the empirical demonstration of the need for a methodology that would disentangle the sources of spillovers, we thirdly propose a decomposition of the spillovers to the long-term and short-term spillovers using spectral methods within the established VAR framework. The proposed methodology is tested using the simulated bi-variate two-component GARCH model and application to previously analyzed data is provided. Such decomposition brings interesting insights into the transmission mechanisms on the markets and pertains to risk management.

Estimation of the volatility surface under a spatial model for high frequency financial data

Christian Peitz *

The analysis of the volatility of high frequency returns on financial markets is of great interest. We propose the use of a spatial model for this analysis which is estimated non-parametrically, where the activities on financial markets of a single day and over a longer observation period can be investigated simultaneously. The proposed method estimates the mean surface and the volatility surface at the same time. The idea is to smooth the data over the time of day on a given day in a first step. The results obtained in the first step are then smoothed over all observed days. It is found that the volatility surface before, during and after the financial crisis of 2008 forms a volatility saddle. The application to real financial data examples shows that the volatility saddle describes the volatility of high frequency returns for those companies very well. We will introduce an alternative method to the standard bivariate kernel regression. A very powerful alternative is the double-conditional smoothing approach, which:

1. runs much faster than the traditional bivariate kernel regression,
2. allows to analyze ultra-high frequency data over a large timespan,
3. delivers valuable intermediate results.

The detailed results obtained, indicate some special features of the data under consideration. In particular, they show that high-frequency returns may exhibit multiplicative random effects.

*Econometric and quantitative Methods, Faculty of Economics, University of Paderborn, D-33100 Paderborn, Germany

A general semiparametric GARCH framework estimated under weak moment conditions

Yuanhua Feng * **Xuehai Zhang** Chen Zhou
Faculty of Business Administration and Economics
University of Paderborn, Germany

This paper proposes a wide class of semiparametric GARCH models by introducing a scale function into a GARCH-type model for featuring long run volatility dynamics caused by changing macroeconomic environment, which can be though of as an MEM (multiplicative error model) with a varying scale function. Our focus is to estimate the scale function under suitable weak moment condition by means of the Box-Cox-transformation of the absolute returns. To ensure the wide applicability of this model, we propose to estimate the scale function first independent of any GARCH specification. To overcome the drawbacks of the kernel and the local linear approaches, a non-negatively constrained local linear estimator of the scale function is used. It is then proposed to fit a suitable parametric GARCH model to the standardized residuals. In particular, the use of the APARCH (asymmetric power ARCH) is suggested. Asymptotic properties of the proposed nonparametric and parametric estimators are studied in detail. An iterative plug-in algorithm is developed for selecting the bandwidth, which is also carried out independent of the parametric specification of the stationary part. Application to real data sets shows that the proposals works very well in practice.

*Corresponding author: E-mail:yuanhua.feng@wiwi.upb.de

An exponential SEMIFAR model applied to forecasting financial market activity *

Chen Zhou **

Department of Economics, University of Paderborn

This paper considers modeling and forecasting of long memory and a smooth scale function in different nonnegative financial time series aggregated from high-frequency data based on an exponential FARIMA (EFARIMA) and its semiparametric extension (ESEMIFAR). Necessary and sufficient conditions for the existence of a stationary solution of the EFARIMA and its properties under the log-normal assumption are studied in detail. An approximately best linear predictor based on the truncated AR(∞) form of the logarithmic process is proposed. Approximate variances of the prediction errors for an individual observation and for the conditional mean are obtained. Forecasting intervals for these quantities in the log-transformed data and in the original process are calculated under the log-normal assumption. Application to realized volatility , trading volumes and other datasets shows that the proposal works very well in practice.

Key Words: Approximately best linear predictor, Realized volatility, Financial forecasting, Long memory, Nonparametric scale function, ESEMIFAR

*This poster is based on a joint work with Yuanhua Feng, University of Paderborn.

**University of Paderborn, Germany. Email:chenzhou@mail.uni-paderborn.de.

Programme Committee

Luc Bauwens, Université catholique de Louvain
Jan Beran, University of Konstanz
Wolfgang Härdle, Humboldt University of Berlin
Oliver Linton, Cambridge University
Timo Teräsvirta, Aarhus University
Yuanhua Feng, University of Paderborn

A special invited lecture: Peter M. Robinson, LSE

Local Organizing Committee

Yuanhua Feng,
Thomas Gries,
Sonja Lück,
Christian Peitz,
Sarah Forstinger

Assistants of Organization

Chen Zhou (Assistant for documentation and the Book of Abstracts),
Tobias Benninger (technical support)

Center for International Economics,
NSVCM
Faculty of Business Administration and Economics
University of Paderborn
Warburger Str. 100
33098 Paderborn
Tel: +49 (0) 52 51 60 5002 (german)
Tel: +49 (0) 52 51 60 3412 (english)
E-Mail: info.nsvcm@uni-paderborn.de