



*Netherlands Econometric Study Group*

## **Book of Abstracts** **2018 Annual Conference**

Friday 25 May 2018, *University of Amsterdam*, Amsterdam School of Economics

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10:00 – 11:20 Session 1: **Financial Time Series**

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**Erik Kole** *Erasmus University Rotterdam*

### Spillovers in Markov Switching

In this paper we investigate spillover effects in the presence of Markov switching using spillover indexes. In linear Gaussian VAR models these indexes depend only on the horizon, but when Markov switching is present, they also depend on the prevailing regime and the size of the shocks. As a consequence the net effect of spillovers becomes time-varying and may change its direction. Big shocks can also lead to different spillovers than small ones. We develop a framework in which spillover indexes can be defined for Markov Switching VAR models. We use it to analyze spillovers between international financial markets and between different asset classes whose returns are predictable.

**Frank Kleibergen** *University of Amsterdam*

### Robust Inference for Consumption-Based Asset Pricing

We consider different consumption measures recently proposed for asset pricing in the *Journal of Finance* and the *Journal of Political Economy*: Parker and Julliard (2005), Jagannathan and Wang (2007), Savov (2011) and Kroencke (2017). We show that their correlations with asset returns are not sufficiently large to precisely identify the risk premium and relative risk aversion. This invalidates traditional two-pass and GMM inference methods so the resulting findings cannot be trusted. We extend inference methods that remain valid irrespective of the magnitude of the correlations to allow for the large number of assets considered compared to the time-series sample size. These methods result in unbounded confidence sets for the risk premium and relative risk aversion.

Co-author: Zhaoguo Zhan Kennesaw State University

**Maria Grith** *Erasmus University Rotterdam*

### Graphical Models for Multivariate Time Series Using Wavelets

Local partial correlation and Granger causality graphs are defined for locally stationary multivariate time series processes using wavelet-based methods. In these graphs, nodes denote component processes, and edges describe pairwise conditional dependence between two processes, after removing the contemporaneous, lag and lead influences of the remaining variables. Local dependence is characterized by the wavelet partial coherence measures, defined in the time-scale domain. Based on these measures, we define undirected, directed and mixed (multi)graphs, which describe specific interactions between time processes. We illustrate our methodology for simulated data and apply it to the realized volatilities of the ten largest equity indexes in the world.

Co-authors: Matthias Eckardt Humboldt University of Berlin



Bayesian Factor Modeling with Industry Momentum Strategies

Financial and economic relations vary over time. One of these time varying relations is the increase in the correlations between equities during market downturns. During equity market crashes all stocks lose and diversification does not help much in reducing these losses. In this paper we analyze this time variation in the co-movements of equity returns with a Bayesian latent factor model. The model allows the number of latent factors to vary over time; that is, during equity market downturns fewer latent factors are assumed to be able to explain the same amount of variation in equity returns. One focus of this paper is the derivation of a Bayesian time varying latent factor model using the concept of predictive likelihoods. A second focus is to apply this modeling approach to residual industry momentum. Using US industrial portfolios over the period 1980-2015, our empirical results show that the Bayesian time varying latent factor model applied to residual industry momentum outperforms in terms of several return and risk characteristics a Bayesian factor model with standard equity risk factors in turbulent times, in particular during the crisis that started in 2008. We also find that the optimal number of latent factors varies substantially over time and that the number of optimal factors indeed decreases when the equity markets experience large losses.

Co-authors: Stefano Grassi   Lennart Hoogerheide   Herman K. van Dijk   Arco van Oord

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11:20 - 11:40   Coffee - Tea Break

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11:40 - 12:40      ***Invited Lecture***

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**Peter C.B. Phillips**

*Yale University*

Dynamic Panel Modeling of Climate Change

We discuss some conceptual and practical issues that arise from the presence of global energy balance effects on station level adjustment mechanisms in dynamic panel regressions with climate data. The paper provides asymptotic analyses, observational data computations, and Monte Carlo simulations to assess the use of various estimation methodologies, including standard dynamic panel regression and cointegration techniques that have been used in earlier research. Intriguingly from an econometric perspective and importantly for global policy analysis, it is shown that despite the substantial differences between the estimates of the regression model parameters, estimates of global transient climate sensitivity (of temperature to a doubling of atmospheric CO<sub>2</sub>) are robust to the estimation method employed and to the specific nature of the trending mechanism in global temperature, radiation, and CO<sub>2</sub>

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12:40 - 13:40   Lunch and posters

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**Mario P. Rothfelder** *Tilburg University*

Estimating Sparse Long-Run Precision Matrices for Linear Multivariate Time Series

This paper proposes a novel estimator for the sparse inverse of the long-run covariance matrix (also known as long-run precision matrix) of a multivariate linear time series. The proposed estimator minimizes the  $\ell_1$ -penalized log-likelihood function of an i.i.d. mean-zero normal random vector. This is possible by reinterpreting the likelihood as a special case of the Bregman-divergence which measures the distance between any positive definite and symmetric matrix and the true long-run covariance matrix of the time series. I show that the resulting LASSO-type estimator is  $T^{b/2}$ -consistent with 0

**Anne Opschoor** *Vrije Universiteit, Amsterdam*

Time-varying tail behavior for realized covariance matrices

Abstract: The distribution of realized variances is typically fat-tailed. This paper proposes a new score-driven model to capture the time-varying tail behavior. We do so by assuming a  $FS$  distribution for the realized variance with a time varying mean for the unobserved true volatility process and a time varying shape parameter for the tail. The score-driven dynamics imply that the influence of large values of the realized variance on future values of the volatility and tail are downweighed. We apply our model to realized variances of 30 financial stocks of the S\&P 500 during the period 2001-2014 and show that the tail varies over time, on top of the time varying volatility. Results on one-step ahead density forecasts and Volatility-at-Risk predictions show that our model outperforms recently developed benchmarks.

**Nicolas Tavenier** *KU Leuven*

Flexible shrinkage of large-dimensional covariance matrices

An optimal rule is derived for shrinking large-dimensional sample covariance matrices under Frobenius loss. The rule generalizes the optimal linear shrinkage rule of Ledoit and Wolf (2004) to broader parametric families of rules. The families include, for instance, polynomial and spline rules. The oracle version of the optimal rule is very simple and attains the lower bound on the Frobenius loss in finite samples. A feasible version is proposed and approximates the lower bound under large-dimensional asymptotics where  $p/n \rightarrow c > 0$ . In a variety of settings, nonlinear shrinkage is found to substantially improve upon linear shrinkage and to perform on par with the current state-of-the-art, but highly complex, nonlinear shrinkage estimator.

Co-authors: Geert Dhaene KU Leuven

**Eleni Aristodemou** *University of Amsterdam*

A Discrete Choice Model for Horizontally and Vertically Differentiated Alternatives

In this paper we develop a novel discrete choice demand model for horizontally and vertically differentiated products, with consumer preferences for products modeled over both an unordered, horizontal "brand" dimension, and an ordered, vertical "quality" dimension. This allows the model to capture important features of consumer substitution patterns when both kinds of differentiation are present. The unordered-ordered discrete nature of the two dimensions of the individual decision problem typically results in set identification of model parameters. We use the structure of the choice problem to characterize the identified set. Our characterizations can potentially be used to lead to a significant dimension-reduction in searching over the parameter space in constructing set estimates or confidence sets, and are compatible with recently developed techniques for inference via maximum likelihood when point identification fails such as those of Liu and Shao (2003) and Chen, Tamer, and Torgovitsky (2012).

Co-author: Adam Rosen Duke University

**Laura Spierdijk** *University of Groningen*

Moment conditions for the quadratic regression model with measurement error.

This study is about estimating the quadratic regression model with classical measurement error. Griliches and Ringstad (1970) were the first to underline the importance of correcting for measurement error in the quadratic regression model. They showed that the effect of measurement error is exacerbated by the quadratic term in a regression model where the unobserved regressor and the measurement errors are normally distributed. The present study proposes a consistent estimator for the quadratic regression model with normal measurement error and possibly heteroskedastic regression error. This estimator exploits moments up to order four and does not impose any further distributional assumptions. For the linear regression model with measurement error, this approach was originally introduced by Geary (1942), who used moments up to order three, and applied by many others (e.g., Erickson and Whited, 2000, 2002, 2011, 2014; Meijer et al., 2017). We use simulation to analyze the finite-sample properties of the proposed estimator and to make the comparison with the semi-parametric, sieve-based approach of Schennach and Hu (2013). We also provide an empirical application related to the impact of Tobin's  $q$  on investments.

Co-authors: Erik Meijer University of Southern California Tom Wansbeek University of Groningen

**Paolo Gorgi** *Vrije Universiteit, Amsterdam*

Missing observations in observation-driven time series models

We argue that existing methods for the treatment of missing observations in observation-driven models lead to inconsistent inference. We provide a formal proof of this inconsistency for a Gaussian model with time-varying mean. A Monte Carlo simulation study supports this theoretical result and illustrates how the inconsistency problem extends to score-driven and, more generally, to observation-driven models, which include well-known models for conditional volatility. To overcome the problem of inconsistent inference, we propose a novel estimation procedure based on indirect inference. This easy-to-implement method delivers consistent inference. The asymptotic properties are formally derived. Our proposed method shows a promising performance in both a Monte Carlo study and an empirical study concerning the measurement of conditional volatility from financial returns data.

17:00 – 18:00 Session 6: **Methods & Applications**

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**Olivier De Groot** *KU Leuven*

The effects of high school curriculum. A model of program and effort choice.

This paper addresses the impact of study programs in secondary education on long run educational and labor market outcomes. I estimate a dynamic model of educational decisions that allows for observed and unobserved differences in initial ability. It is novel in that it adds unobserved effort as a choice variable, along with the choice of study program. This replaces traditional approaches, which assume end-of-year performance follows an exogenous law of motion. I use the model to calculate how each study program contributes to different outcomes and I investigate policies that aim to match students to the right program. I find that academically rigorous programs are important to improve higher education outcomes, while vocational programs prevent drop out, grade retention and unemployment. At the same time, policies that encourage underperforming students to switch to less academic programs do not have a negative impact on higher education outcomes and they substantially reduce grade retention and drop out. I also find that ignoring the fact that students choose their effort level generates biases in counterfactual predictions.

**Tom Boot** *University of Groningen*

Confidence sets for averaging estimators

We construct confidence sets for estimators that average an unbiased estimator with estimators from restricted and potentially misspecified models. The confidence sets are centered at the averaging estimator, yield asymptotically correct coverage, and reduced expected volume. If the restricted estimator increases the distance to the parameter vector under the null, a substantial power increase compared to the standard Wald test can be achieved.

**Julio A. Crego** *Tilburg University*

Endogenous Health Groups and Heterogeneous Dynamics of the Elderly Health dynamics and its associated medical and care costs are a major concern of the elderly. Due to its multidimensionality, however, researchers struggle to summarize health into a single discrete variable that can be incorporated into a structural model. We propose a methodology to classify individuals into groups of health and characterize their transition across these groups as they age. Specifically, we use Markov chain Monte Carlo techniques to estimate a panel Markov switching model that exploits information from both the cross-sectional and time series dimensions. For individuals in the Health and Retirement Survey for the US, we identify four clearly differentiated health groups depending on individual's physical and mental disabilities. Furthermore, we show that these groups outperform other measures of health commonly used in the literature at explaining the use of nursing homes, home health care, out of pocket medical expenses, and at predicting mortality.

Co-authors: Dante Amengual Cemfi Jesus Bueren Cemfi

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19:00 Dinner

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**Yicong Lin** *Maastricht University*

#### GLS Estimation and Confidence Sets for the Date of a Single Break in Models with Trends

In this paper, we derive the asymptotics of a generalized least squares (GLS) estimator of the structural break date in the time series models with a single break in level and/or trend and stationary errors. The asymptotic distribution theory can be readily applied for testing and inference. It is found that the GLS, ordinary least squares (OLS) and GLS quasi-differencing (GLS-QD) break date estimators are asymptotically equivalent. The common asymptotic distribution of these three estimators captures the asymmetry and bimodality often observed in finite samples, and delivers good approximations in general settings. As the GLS estimator relies on the unknown inverse autocovariance matrix, we construct feasible GLS (FGLS) estimators using a consistent estimator of the inverse matrices. Monte Carlo studies show finite sample gains of the FGLS estimators when there is a strong serial correlation. Furthermore, we propose three novel constructions of confidence sets by using the FGLS break date estimators. The confidence sets are based on either a pivotal quantity or the inversion of multiple likelihood-ratio tests. The asymptotic critical value does not depend on nuisance parameters. We find that our proposed methods have fairly accurate coverages and short lengths in various simulations. When there are persistent errors and small break sizes, one of our suggested confidence sets yields good coverage and relatively short length consistently.

Co-authors: Eric Beutner, Stephan Smeekes, Maastricht University

**Sun Li** *Maastricht University*

#### Detecting Time Irreversibility Using Quantile Autoregressive Models

The aim of this paper is twofold. First, we propose to detect time irreversibility in stationary time series using quantile autoregressive models (QAR). We show that this approach provides an alternative way to identify causal from noncausal models. Although we obviously assume non-Gaussian disturbances, we do not need any parametric likelihood function to be maximized (e.g. the Student or the Cauchy). This is very interesting for skewed distributions for instance. Secondly, we propose to extend QAR models to quantile regressions in reverse time. This new modelling is appealing for investigating the presence of bubbles in economic and financial time series. We illustrate our analysis using hyperinflation episodes in Latin American countries.

Co-author: Alain Hecq Maastricht University

**Michael Gong** *Erasmus University Rotterdam*

#### Forecasting Implied Volatility Surface Using Put-Call Parity Deviations

The (implied) volatility surface is the collection of option-implied volatilities for different strike prices and maturities. Existing literature documents that the volatility surface can be modelled by a limited number of factors using simple regression techniques, and that these factors are persistent. The put-call parity for options prescribes a strong relation for put and call options with the same moneyness and maturity. We propose a new equilibrium-correction based model for the volatility surface that extends the existing factor approach while explicitly benefitting from the predictive power of put-call parity deviations. We apply the model to S&P500 index options and options of 95 stocks, and show that the new model improves the existing model with a 40% decrease of in-sample RMSE and 30% for out-of-sample RMSFE. The economic significance evaluation shows that the new model can generate higher Sharpe ratio than existing model.

Co-authors: Dick van Dijk, Michel van der Wel Erasmus School of Economics

**Marc Nientker** *Vrije Universiteit, Amsterdam*

#### A Time-Varying Parameter Model for Local Explosions

This paper introduces a new time-varying parameter model for local explosions. Explosions are observed in economic and financial time-series when bubbles are formed. The proposed model can be used to describe and predict the emergence, existence and burst of bubbles. We use a flexible observation driven formulation that allows for different bubble shapes and behavior. We establish stationarity, ergodicity, fading memory and bounded moments of the data generated by our model and obtain the consistency of a maximum likelihood estimator. We also demonstrate that sample paths converge, so that we can filter data to separate and identify the unobserved bubble. We study the finite-sample properties of our indirect estimator through a comprehensive Monte Carlo simulation. Finally, we apply the model in a financial application.

Co-authors: Francisco Blasques, Siem Jan Koopman VU University

**Luca Margaritella** *Maastricht University*

#### Granger Causality test in High-dimensional VARs: a Post-Double-Selection Procedure

We develop an asymptotic F-test procedure to test for Granger causality in high-dimensional (HD) VARs. The Montecarlo simulations reported show positive performances of the proposed procedure in highly-parametrized scenarios. We apply the routine to investigate the Money-Income causality relation using the FRED-QD dataset.

Co-authors: Stephan Smeekes, Alain Hecq, Maastricht University

**Kasia Lasak** *University of Amsterdam*

#### A FCVAR Model Analysis of Long-run Relationship and Price Discovery in the Foreign Exchange Market.

We apply the recently developed fractional cointegration VAR (FCVAR) model to analyse the long-memory relationship between the spot and the forward exchange rates, as well as detecting the principal contributor of the price discovery process in the foreign exchange market for major reserve currencies (e.g., USD, Euro, GBP, CAD, JPY, and CHF). Based on Figuerola-Ferretti and Gonzalo (2010) and Dolatabadi et al.(2014), we apply a theoretical framework to covered interest rate parity. Subsequently, we build a linkage to the CVAR model and generalize this to the

FCVAR model. Price discovery can be analysed in the FCVAR (or CVAR) model by a straightforward hypothesis test on the adjustment coefficients. By imposing the FCVAR model, we find that the fractional parameter is significantly different from one, which indicates that the CVAR model may be less appropriate than the FCVAR model. Moreover, neither the spot nor the forward exchange rate is identified as the key contributor in the price discovery process for the Euro, CAD, or CHF; however, the spot market of the foreign exchange market dominates price discovery in the case of the GBP, whereas the forward exchange rate dominates price discovery for the JPY. Keywords: FCVAR model, price discovery, foreign exchange market.

Co-author: Yingzi Liu

**Jochem Oorschot** Erasmus University Rotterdam

Tail dependence of OLS

This paper shows that if the errors in a multiple regression model are heavy-tailed, the ordinary least squares (OLS) estimators of the regression coefficients are tail dependent. In addition, the fitted sum of squares (FSS) and the residual sum of squares (RSS) are strongly tail dependent. This is in contrast to a regression model with errors that follow a normal distribution: in that case, the FSS and RSS are independent.

Co-authors: Chen Zhou De Nederlandsche Bank, Erasmus University Rotterdam

**Hanan E.G. Ahmed** *Tilburg University*

Improved estimation of the extreme value index using related variables

Heavy tailed phenomena are naturally analyzed by extreme value statistics. A crucial step in such an analysis is the estimation of the extreme value index, which describes the tail heaviness of the underlying probability distribution. We consider the situation where we have next to the  $n$  observations of interest another  $n+m$  observations of one or more related variables, like, e.g., financial losses due to earthquakes and the related amounts of energy released for a longer period than that of the losses. Based on such a data set, we present an adapted version of the Hill estimator that shows greatly improved behavior and we establish the asymptotic normality of this estimator. For this adaptation the tail dependence between the variable of interest and the related variable(s) plays an important role. A comprehensive simulation study confirms the substantially improved performance of our adapted estimator relative to the Hill estimator. We also present an application to the aforementioned earthquake losses.

Co-author: John Einmhal, Tilburg University

**Etiënne Wijler** *Maastricht University*

SPECS: An Automated Approach Towards Sparse Single Equation Cointegration Modelling

In this paper we propose the Single-equation Penalized Error Correction Selector (SPECS), a customized form of l1-penalized regression, as an automated estimation procedure for single-equation error correction models. SPECS is shown to possess oracle properties and is capable of correctly identifying and estimating appropriate linear combinations of the cointegrating vectors that may occur in the underlying DGP. A simulation study shows strong selective capabilities, as well as superior predictive performance in the context of nowcasting compared to high-dimensional models that ignore cointegration. Finally, we nowcast Dutch unemployment rates with the use of google trends in which we confirm the strong performance of our procedure.

Co-author: Stephan Smeekes, Maastricht University

**Caterina Schiavoni** *Maastricht University*

Realtime estimation of unemployment with dynamic factor and state space models

Estimation of unobserved components is considered in high-dimensional state space models using a dynamic factor approach. Our method allows for variables to be observed at different frequencies and updates the estimation when new information becomes available. We apply the methodology to unemployment estimation as done by Statistics Netherlands, who uses a multivariate state space model to produce monthly figures for the unemployed labour force using series observed with the Labour Force Survey (LFS). We extend the model by including auxiliary series about job search behaviour from Google Trends and claimant counts, partially observed at higher frequencies. Our factor model allows for nowcasting the variable of interest, providing unemployment estimates in real time before LFS data become available.

Co-authors: Jan van den Brakel Statistics Netherlands, Franz Palm & Stephan Smeekes Maastricht University

**Bernd Schwaab** *European Central Bank*

Nonlinear dynamic factor models with interacting level and volatility

Volatility is an important ingredient in economic and financial decision making and yet the interaction between the levels and volatilities of macroeconomic and financial variables is not well understood. We propose a class of nonlinear dynamic factor models that has factor structures for both levels and volatilities. Both sets of latent factors are modeled jointly in an unrestricted vector autoregressive model. We develop a computationally convenient approximate filtering method for the estimation of all factors. The algorithm relies on numerical integration and can be implemented by augmenting the Kalman filter with weighted least squares regressions. The deterministic model parameters can be estimated by maximum likelihood. Some theoretical bounds and a simulation study show that the methodology is highly accurate when compared to feasible alternative methods. The model is applied in two empirical studies. First, we consider euro area government bond yields between 2008 and 2012 and show that the volatility factor became an economically significant predictor of the yield levels in several countries. Bond purchases by the European Central Bank reduced yields but not the dispersion of pricing errors. Second, the model is applied for forecasting the levels of U.S. macroeconomic variables. We show that the inclusion of interacting volatility factors improves out-of-sample forecasts.

**Alexander Heinemann** *Maastricht University*

#### A Justification of Conditional Confidence Intervals

To quantify uncertainty around point estimates of conditional objects such as conditional means or variances, parameter uncertainty has to be taken into account. Attempts to incorporate parameter uncertainty are typically based on the unrealistic assumption of observing two independent processes, where one is used for parameter estimation, and the other for conditioning upon. Such unrealistic foundation raises the question whether these intervals are theoretically justified in a realistic setting. This paper presents an asymptotic justification for this type of intervals that does not require such an unrealistic assumption, but relies on a sample-split approach instead. By showing that our sample-split intervals coincide asymptotically with the standard intervals, we provide a novel, and realistic, justification for confidence intervals of conditional objects. The analysis is carried out for a general class of Markov chains nesting various time series models.

Co-authors: Eric Beutner, Stephan Smeekes, Maastricht University

**Alaa Abi Morshed** *Tilburg University*

#### Test for structural breaks in the variance of OLS estimators

Researchers usually want to know whether the variance of their estimators is changing over the sample, as this is informative about the estimator's efficiency and, in turn, has important consequences for inference. To that end, we propose a sup Wald structural break test for the variance of OLS estimators in a linear regression. The asymptotic distribution of our test is data dependent and we provide bootstrap distributions. Additionally, our test enjoys satisfactory size and power properties.

**Oliver Wichert** *Tilburg University*

#### Liquidity premiums in various asset classes

##### An asymptotically UMP test for unit roots in cross-sectionally dependent panels

This paper derives optimal tests for the unit-root hypothesis in large  $n$  and large  $T$  heterogeneous panels with cross-sectional dependence generated by a factor structure. We consider the two prevalent setups in the literature, that of Moon and Perron (2004) and the PANIC setup of Bai and Ng (2004). While these have usually been considered as completely different setups, we show that in fact they are asymptotically equivalent in the sense that both experiments are locally asymptotically normal with the same central sequence. Using Le Cam's theory of statistical experiments we can thus derive the local asymptotic power envelopes and optimal tests jointly in both setups. More specifically, it turns out that all tests have the same sizes and local asymptotic powers in both setups. We also suggest a test that is asymptotically uniformly most powerful in both setups. Thus, from a local, asymptotic point of view, applied researchers do not need to decide on one of the two frameworks anymore to conduct optimal unit-root tests. In particular, the restriction that both the factors and the idiosyncratic parts are integrated of the same order imposed in Moon and Perron (2004) does not yield any increase in potential asymptotic power. We use Monte-Carlo simulations to investigate possible gains and differences in finite samples.

Co-authors: I. Gaia Becheri, Feike C. Drost, Ramon van den Akker, Tilburg University.

**Lingwei Kong** *University of Amsterdam*

### Finite Sample Distributions of Identification Robust Factor Pricing Statistics

We conduct identification robust inference in settings where asymptotic approximations of identification tests and identification robust tests fail because of small sample and/or many moment conditions. We focus on statistical inference over the risk premia in linear factor models where conventional asymptotic distributions can lead to size distortions. Several test statistics are explored for their finite sample properties.

**Agnieszka Borowska** *Vrije Universiteit, Amsterdam*

### Partially Censored Posterior for Robust and Efficient Risk Evaluation

A novel approach to inference for a specific region of the predictive distribution is introduced. An important domain of application is accurate prediction of financial risk measures, where the area of interest is the left tail of the predictive density of logreturns. Our proposed approach originates from the Bayesian approach to parameter estimation and time series forecasting, however it is robust in the sense that it provides a more accurate estimation of the predictive density in the region of interest in case of misspecification. The first main contribution of the paper is the novel concept of the Partially Censored Posterior (PCP), where the set of model parameters is partitioned into two subsets: for the first subset of parameters we consider the standard marginal posterior, for the second subset of parameters (that are particularly related to the region of interest) we consider the conditional censored posterior. The censoring means that observations outside the region of interest are censored: for those observations only the probability of being outside the region of interest matters. This approach yields more precise parameter estimation than a fully censored posterior for all parameters, and has more focus on the region of interest than a standard Bayesian approach. The second main contribution is that we introduce two novel methods for computationally efficient simulation: Conditional MitISEM, a Markov chain Monte Carlo method to simulate model parameters from the Partially Censored Posterior, and PCP-QERMit, an Importance Sampling method that is introduced to further decrease the numerical standard errors of the Value-at-Risk and Expected Shortfall estimators. The third main contribution is that we consider the effect of using a time-varying boundary of the region of interest, which may provide more information about the left tail of the distribution of the standardized innovations. Extensive simulation and empirical studies show the ability of the introduced method to outperform standard approaches.

**Sanna Stephan** *University of Amsterdam*

### Maximum Likelihood Estimation of Information Diffusion in Dense Networks

The advantage of Maximum Likelihood (ML) estimation arise from its ability to make full usage of all the information contained in a dataset. Moment-based estimation on the other hand only recovers information as far as it is relevant for the moment conditions. Nonetheless, ML estimation is rarely applied to network models. Whenever only individuals' choices on the market, but not their interactions in the network are observed, computing the log-likelihood function becomes highly challenging if not impossible. Since all neighboring individuals potentially impact one another, the total number of possible results of this interaction explodes when the network is dense. We propose an algorithm that derives restrictions on the network interaction from the observable data, employs innovative data-management techniques and neglects highly unlikely scenarios, thereby establishing an approximative log-likelihood function. We employ our algorithm to the data from Banerjee et al "The diffusion of Microfinance" and demonstrate that the approximation error is negligible in the parameter space around the maximum.

Co-authors, Marco van der Leij &, Frank Kleibergen, University of Amsterdam