MD. NAZMUL AHSAN

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Status: Permanent Resident (Canada)

FIELDS OF INTEREST

Econometrics, Financial Economics, Empirical Finance

EDUCATION

McGill University — Montreal, Canada
Ph.D. in Economics — *May 2018 (expected)*

York University — Toronto, Canada
M.A. in Economics — *June 2009*

North South University — Dhaka, Bangladesh
B.B.A. in Finance and Economics — *April 2008*
Graduated with Distinction

DISSERTATION

Title: **"Statistical Inference for Stochastic Volatility Models"**

REFERENCES

Jean-Marie Dufour
William Dow Professor of Economics
jean-marie.dufour@mcgill.ca
(+1) 514-398-6071

John W. Galbraith
Professor and Chair of Economics
john.galbraith@mcgill.ca
(+1) 514-398-2768

Victoria Zinde-Walsh
Professor of Economics
victoria.zinde-walsh@mcgill.ca
(+1) 514-398-4400 ext. 00782

FELLOWSHIPS, HONORS AND AWARDS

- Grad Excellence Award in Economics, McGill University, 2012-2013, 2015-2016.
- McGill International Doctoral Awards (MIDAs), McGill University, 2010-2013.
- McCall McBain Fellowship, McGill University, 2010-2011, 2011-2012.
- Provost's Grad Fellowship, McGill University, 2010-2011.
- Graduate Scholarship, York University, 2009-2010.
- International Tuition Fee Scholarship, York University, 2008-2010.
- Chris Sloan Book Prize Award for the Best Graduate Student of the Year, York University, 2008-2009.
- Awarded full tuition fee waiver, North South University, 2004-2007.
- Graduated with distinction *Summa-Cum-Laude* (the greatest praise), North South University, 2007-2008.

"Simple Estimators and Inference for Higher-order Stochastic Volatility Models," (with Jean-Marie Dufour). Job Market Paper

We propose several estimators for higher-order stochastic volatility models, denoted by $SV(p)$, where the latent volatility process is modeled as an $AR(p)$ process. We discuss stationarity, ergodicity and mixing properties of $SV(p)$ models. Proposed estimators include two simple estimators and GMM estimators. Several methods have been proposed in the literature to estimate $SV(1)$ model, and mostly they are costly from the computational viewpoint, inflexible across models, not easy to implement and converge very slowly. Compared to these methods, our simple estimators for $SV(p)$ models are computationally simple and very easy to apply in practice. Our simple estimators do not require choosing a sampling algorithm, initial parameters, and an auxiliary model. Using simple estimators, we develop recursive estimation procedures for $SV(p)$ models. We derive asymptotic theories for these estimators and show the usefulness of these estimators in the context of simulation-based inference technique, i.e., Monte Carlo (MC) tests. By simulation, we compare our proposed estimators to the popular Bayesian MCMC estimator. The simple $ARMA$ based estimator, suggested by this study, in most cases outperforms other estimators in terms of bias and RMSE. For larger samples, it is uniformly superior to other estimators. Finally, empirical applications related to $SV(p)$ models and simple $ARMA$ based estimator are presented. First, $SV(p)$ models fitted with S&P 500 index returns, and we found that these returns can be better modeled as an $SV(p)$ model. We also implemented MC tests to construct more reliable inference and found evidence to support the above result. Second, we conducted out-of-sample forecasting experiments to study the accuracy of volatility forecasts between $SV(p)$ models and Heterogenous Autoregressive model of Realized Volatility ($HAR - RV$) models. The results suggested that $SV(p)$ models performed better than $HAR - RV$ models for forecasting daily volatility. This result is consistent whether high volatility periods (such as Financial Crisis) are in the in-sample or in the out-of-sample. Our findings highlight the importance of higher-order SV models for forecasting volatility.

"High-Frequency Instruments and Identification-Robust Inference for Stochastic Volatility Models".

We study stochastic volatility (SV) models in a linear instrumental variable (IV) framework since the latent feature of the volatility process induces an endogeneity problem. We consider both low-frequency and high-frequency volatility proxies as instruments for latent volatilities. However, in a linear IV-type framework, it is a well-known problem that when the identification conditions are not satisfied, standard asymptotic theory for estimators and test statistics typically collapses and when instruments are weak, the limiting distributions of standard test statistics have non-standard distributions and often depend heavily on nuisance parameters, see Dufour (2003). In our framework, there is a possibility that some of the potential instruments for the latent volatility may be weak or not valid. This can be due to the fact that the high-frequency instruments are weakly correlated with the daily latent volatility in the presence of the market microstructure noise or some of the low-frequency instruments, past values of daily volatility estimates, may not sufficiently be correlated with the daily latent volatility. We propose inferential procedures that are not only robust to weak instruments but also robust to market microstructure noise. Proposed identification-robust methods include variant of Anderson-Rubin (AR) type test, split-sample (SS) type procedure, union-intersection and sample-split (UI-SS) methods, and simultaneous inference (SI) procedure. For the distributional theory of our procedures, three different kinds of assumptions about the errors are employed. First, on assuming Gaussian errors, we propose exact inferential procedures. Second, we show that our proposed procedures can be extended for non-standard error distributions using the Monte Carlo (MC) test method. Third, we show that under quite general distributional assumptions, our proposed procedures are asymptotically valid. By simulation, we examined the size and power properties of these proposed tests. Finally, some empirical applications relating to financial time series of returns are presented.

"A simple quasi-efficient estimator for stochastic volatility models," (with Jean-Marie Dufour).

The estimation procedures of stochastic volatility (SV) models are complex and mostly based on simulation techniques and numerical optimization procedures. In this study, we propose a simple estimator for SV that is analytically tractable, computationally simple and easy to implement in practice. Further, it does not require the use of any numerical optimization procedures or the choice of initial parameter values, and does not require the choice of auxiliary model. We derive the asymptotic distributional theory of our simple estimator and show the usefulness of our simple estimator in the context of simulation-based inference procedure, i.e., Monte Carlo (MC) test technique. By simulation, our simple estimator yields good statistical properties compare to other estimators in terms of bias, root mean square error and time. Finally, several empirical applications are presented. First, SV models fitted with several stock returns, and we found that these returns can be modeled as an SV model. We also implemented MC tests to construct more reliable

inference since the estimated volatility persistence parameter is nearly unit root. Second, we conducted out-of-sample forecasting experiment to compare the forecasting performance of the SV model with GARCH-type and Heterogenous Autoregressive model of Realized Volatility ($HAR-RV$) type models. Forecasts are evaluated using different forecast evaluation measures and the results suggested that SV model performed better than other competing models for forecasting daily volatility. This finding is consistent across different forecast horizons.

"Measuring Uncertainty with a Class of Stochastic Volatility Models," (Work in progress)

In this paper, I extend the uncertainty measure of Jurado, Ludvigson and Ng (AER, 2015) allowing for a wide range of stochastic volatility models. I propose several uncertainty measures allowing for more flexible stochastic volatility models. These include jumps, higher order stochastic volatility, stochastic volatility in mean, leverage effects, t-distributed and moving average innovations. Furthermore, I provide Bayesian model comparison and outline of an adaptive importance sampling approach to compute the marginal likelihood for comparing models.

"Optimal Invariant Inference for a Time Series that is Measured with Error," (with Jean-Marie Dufour).

We consider making inference in time series models in the presence of imprecise measures that may distort the dynamic properties of the true latent time series. In practice, we often encounter this problem. For example in the context of time series of volatility, the integrated variance and a corresponding realized measure of volatility can be viewed as a latent process and an observed process, respectively. We propose point optimal invariant (POI) tests in this context. POI tests are exact small sample tests with excellent power properties. The empirical evidence in the literature indicates that in general POI tests often outperform tests constructed using other testing methods. For the distributional theory of our procedures, two different kinds of assumptions about the errors are employed. First, on assuming Gaussian errors, we propose exact inferential procedures. Second, we show that our proposed exact inferential procedures can be extended for non-standard error distributions using the Monte Carlo test method.

Conference Presentations and Accepted Papers

- "Simple Estimators and Inference for Higher-order Stochastic Volatility Models" (with Jean-Marie Dufour)
  — Invited Seminar, York University, Toronto, February 2018.
  — CIRANO Seminar, Montreal, December 2017.
  — CIREQ-McGill Lunch Seminar, McGill University, Montreal, October 2016.
  — 50th Annual Conference of the CEA, University of Ottawa, Ottawa, June 2016.
  — 11th World Congress of the Econometric Society, Montreal, August 2015.
  — 11th CIREQ Ph.D. Students' Conference, Montreal, May 2015.

- "High-Frequency Instruments and Identification-Robust Inference for Stochastic Volatility Models"
  — CIREQ Econometrics Conference in Honor of Prof. Jean-Marie Dufour, Montreal, May 2016.
  — 12th CIREQ Ph.D. Students' Conference, May 2016, Montreal, Canada.
  — CIREQ-McGill Lunch Seminar, McGill University, Montreal, April 2016.

- "A simple quasi-efficient estimator for stochastic volatility models" (with Jean-Marie Dufour)
  — CIREQ-McGill Lunch Seminar, McGill University, July 2015.

Academic Experience

- **Course Lecturer, McGill University**
  - Economic Statistics Honours (ECON 257D2), Winter 2017, Jointly taught with Prof. Russell Davidson
    Textbook: Newbold P, Carlson W, Thorne B., ***Statistics for business and economics***, Pearson, 2012.
  - Econometrics - II Honours (ECON 469), Winter 2015
    Textbook: Davidson, R., and J. G. MacKinnon, ***Econometric Theory and Methods***, Oxford University Press, New York, 2004.

- **Course Lecturer, North South University**
  - Investment Theory and Portfolio Analysis (FIN 435), Summer 2012
    Textbook: Bodie, ZVI, Alex Kane and Alan Marcus, ***Investments***, 9th Edition, McGraw-Hill Irwin, 2010.
- **Teaching Assistant, McGill University**
  - Financial Econometrics (ECON 763), Winter 2016
  - Economic Statistics - Honours (ECON 257D1), Fall 2012, Fall 2013, Fall 2014, Fall 2015
  - Economic Statistics - Honours (ECON 257D2), Winter 2013, Winter 2014, Winter 2014
  - Economic Statistics (ECON 227D2), Winter 2015
  - Honurs Macroeconomics (ECON 352D1), Fall 2010
  - Economic Development I (ECON 313), Summer 2013, Fall 2016
  - Economic Development II (ECON 314), Winter 2012
  - Microeconomic Analysis and Applications (ECON 208), Fall 2011
  - Macroeconomic Analysis and Applications (ECON 209), Winter 2011
- **Teaching Assistant, York University**
  - Econometric Theory (ECON 4220/5220), Winter 2010
  - Topics in International Monetary Economics (ECON 4200), Fall 2008
  - Economics of Gender (ECON 4369), Winter 2009
  - Economics of Gender - Writing (ECON 3709), Fall 2008, Winter 2010
  - Intermediate Mathematics for Economists (ECON 3530), Fall 2009
  - Labour Economics: Theory - Writing (ECON 3249), Fall 2009
  - Use of Economic Data (ECON 3210), Summer 2009
  - Intermediate Microeconomic Theory I (ECON 2300), Summer 2009
- **Undergraduate Teaching Assistant, North South University**
  - Applied Mathematics II (ECO 244), Summer 2008
  - Introduction to Microeconomics (ECO 101), Summer 2006, Fall 2006, Winter 2007
  - Introduction to Macroeconomics (ECO 104), Summer 2007
  - Intermediate Microeconomic Theory I (ECO 203), Summer 2007
  - Intermediate Macroeconomic Theory I (ECO 204), Summer 2007
  - Intermediate Microeconomic Theory II (ECO 303), Summer 2007

Affiliations and Professional Services

The Econometric Society
The American Finance Association (AFA)
Canadian Economic Association (CEA)
Centre Interuniversitaire de Recherche en Economie Quantitative (CIREQ)
Center for Interuniversity Research and Analysis of Organizations (CIRANO)
General Secretary, Bangladeshi Graduate Students' Society of McGill University (BGSS-McGill), 2014
VP (Finance), McGill Economics Graduate Association (MEGA), 2012-2013
VP (Student Services), Economics Graduate Students' Association (EGSA), York University, 2009-2010

Other Information

Languages: English (Fluent), Bengali (Native), French (Basic)

Computer: MATLAB, R, Python, SAS, GAUSS, Eviews, MySQL, LaTex