



The Special Issue in Honor of Anirudh Lal Nagar: An Introduction

Yong Bao¹ · Aman Ullah²

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This special issue of the *Journal of Quantitative Economics* (JQE) is a tribute to the late Professor Anirudh Lal Nagar, for his eternal contributions to the econometrics profession as a leading researcher, a charismatic teacher, a mentor, and a supervisor. All of these exhibit his extraordinary dedication to the subject of Econometrics and to its growing community of students and scholars. Nagar Saheb, as he was fondly known to his friends and colleagues, along with P. C. Mahalanobis, C. R. Rao, and S. Chakravarty played a foundational role in the establishment and growth of The Indian Econometric Society (TIES). He had served as its President for five crucial years (1976–1981) and it was at about the end of this period that TIES established JQE in 1983, to promote research in the broad areas of Econometrics and Economics, and to provide a venue for economists, mathematicians, and statisticians to publish high quality quantitative papers in all areas of economics. Nagar Saheb became its founding Editor-in-Chief and from the beginning it was guided by him, C. R. Rao, Nobel Laureate Amartya Sen, T. N. Srinivasan, K. L. Krishna, D. Nachane, Kaushik Basu, among others, on its editorial board. It is currently published by the prestigious publisher Springer, and JQE is now not only the top Econometrics journal in India, it has also been significantly recognized internationally through a strong track of fundamental and high quality publications, an excellent editorial board, and the backing of a major publisher. Thus, Nagar Saheb played a key role in guiding the development and growth of JQE from 1983 till his passing away in 2014.

This special issue honors Nagar Saheb for his continued guidance of JQE as its chief editor as well as his managing editorship over the years, transferring its continuity in the hands of successive distinguished chief editors and managing editors (e.g. K. L. Krishna and D. Nachane), for his unending scholarship and learning that have contributed to our knowledge of econometrics and its limitations, and for his

✉ Yong Bao
ybao@purdue.edu

Aman Ullah
aman.ullah@ucr.edu

¹ Department of Economics, Purdue University, West Lafayette, IN 47907, USA

² Department of Economics, University of California, Riverside, CA 92521, USA

unshaken support for econometrics students, colleagues, and his professional community. We are grateful to this issue's contributors who present an impressive range of new research that covers many of the ongoing areas of econometrics, including Nagar Saheb's past work.

Nagar Saheb was born on October 4th, 1930 in Allahabad (now Prayagraj), India, and passed away on February 4th, 2014 in Pune, India. After getting his BS and MS degrees from Lucknow University, he served as a Lecturer in the same university from 1951–1957. He then got his Ph.D. in Economics from the Netherlands School of Economics (Erasmus University, Rotterdam, Holland) in 1959, under the internationally known Professor Henri Theil. After serving as Research Associate at Holland for 2 years (1959–1961), Visiting Professor at Purdue University, USA (1961–1962) and Assistant Professor at IIT Kanpur (1962–1963), he joined the Delhi School of Economics (DSE) in 1963 as a Reader and retired from there as a Professor in 1995. During this period, he also served on campus as the Head of Department of Economics (1973–1976), Dean of Social Sciences (1974–1976), Director of DSE (1973–1976, 1984–1989), Pro-Vice Chancellor of University of Delhi (1990–1995), and officiated as Vice Chancellor (1994–1995).

In a long and distinguished career of about six decades, Nagar Saheb was a visiting professor at several institutions including the Brookings Institution, Purdue University, Wharton School of Finance and Commerce at the University of Pennsylvania, University of Western Ontario, University of Windsor, Concordia University, McGill University, Australian National University, and many other internationally reputed academic institutions. He published extensively in leading international journals, including *Econometrica*, *International Economic Review*, *Journal of Econometrics*, *Sankhya*, among others. He also authored a few textbooks and many chapters in collective volumes. He was the recipient of various honors and awards, including elected Fellow of the Econometric Society (1971), UGC National Fellowship (1983–1985), Jawaharlal Nehru Award for Social Sciences (1992), the Australian Vice Chancellors' Committee Fellowship (1992), and the JP Naik National Fellowship of the Indian Council of Social Science Research (ICSSR) (1998–2000).

After his retirement from DSE in 1995, Nagar Saheb became a Visiting Professor at the Jawaharlal Nehru University and an Honorary Fellow at the National Institute of Public Finance and Policy. Over his career, Nagar Saheb mentored and supervised a large number of econometricians (theory and applied), many of whom are today internationally prominent scholars. In addition, he collaborated and coauthored with an unusually large number of researchers across the discipline. He was a born teacher (Guru) who created generations of students and followers; also see a comment by Goswami (2014).

Research Contributions

Nagar Saheb was a world-renowned econometrician and an international authority on finite sample econometrics with many path-breaking papers in it. His interests were wide ranging from various areas of econometric theory, applied econometrics, forecasting, to economic policy. He published widely in all these areas in

many leading journals. The intent of this special issue is to honor him with a collection of state-of-the-art articles on various topics such as foundations, econometric methods, and applications.

Nagar Saheb's earliest path-breaking work grew from his thesis and was published in *Econometrica* (1959). This was the paper "The bias and moment matrix of the general k -class estimators of the parameters in simultaneous equations," which gave the small sample bias and mean squared error (MSE) for the k -class estimators of structural parameters in a single equation of the simultaneous equations model. The results for LIML, 2SLS and OLS estimators, as special cases followed and were also discussed in this paper. Another fundamental and pioneering paper then followed in *International Economics Review* (1962) on the finite sample properties of double k -class estimators, which contained results on a larger class of estimators of structural parameters. Both these papers were developed through an innovative and challenging introduction of a new Taylor-type stochastic expansion of econometric estimators. This laid the foundation of a new stochastic expansion method for future generations of econometricians, including many of his students, for developing the finite sample moments of a class of estimators in various econometric models. In fact this is now known in the profession as "Nagar's Expansion" coined by Sargan (1974), who looked into the conditions of its validity, related to a question raised in Srinivasan (1970) on the convergence and meaning of an infinite series stochastic expansion and its truncation to the first few terms. Since then there were extensive research developments and publications on studying the analytical finite (small) sample properties of econometric estimators and test statistics, details on which can be seen in the book by Ullah (2004), Bao and Ullah (2021), and contributed papers in Carter et al. (1990) by R. L. Basmann, J. Dreze, H. Theil, and Nobel Laureate L. Klein, among others. Also, see a book by the Nobel Laureate J. D. Angrist (Angrist and Pischke 2009) for the impact of Nagar (1959)'s work on empirical economics with respect to weak and many instruments.

Nagar Saheb's research contributions were beyond theoretical econometrics. His work on simulations of the Brookings econometric model has been highly recognized among scholars interested in studying macro-economics and policy simulations. These were in the mid-1960s. From 1990 he began a new wave of research activities in the measurement of human development and quality of life (Nagar and Basu 2002), which has been well received including when he presented this work at the Economics Department, University of California, Riverside. He helped the Ministry of Finance, Government of India, to develop an econometric model to forecast tax revenues (Nagar et al. 2008) and contributed to the UNCTAD Report on Trade and Development Index. His thoughts for new ideas and research were unending which he continued to have till the last moments of his constructive and productive life. Towards the tail end he published Nagar et al. (2012), in which a structural simultaneous equations model for the Indian economy was estimated for studying the interdependent relationships between per capita income, health and air pollution. The paper also proposes a new method of constructing indices of a large number of variables by the principal components method. This can potentially enable one to estimate the effect of any particular variable from the index, if deemed necessary.

Research Papers in this Special Issue

This special issue includes 18 papers contributed by Nagar Saheb's many friends, mentors, colleagues, coauthors, and scholars, influenced by his contributions to econometrics science. All papers have been reviewed in the usual manner by at least two independent referees and hold the usual JQE international standard of high quality articles. In our discussion that follows, the papers that were accepted and are now included in this special issue are broadly classified into three groups: (i) finite sample econometrics, (ii) econometrics (theory and applied), and (iii) forecasting.

Finite Sample Econometrics

Within the first group, Bao and Ullah (2021) review the literature, along with some new results, which expanded since Nagar (1959)'s seminal paper on the approximate bias and MSE of the k -class estimators (LIML, OLS and 2SLS(IV estimator or control function estimator) as special cases) of the parameters of a linear single structural equation out of a simultaneous equations model. While Nagar's results were confined to the k -class, double k -estimators, and related estimators in other linear econometric models under normality, Bao and Ullah describe generalizations to finite sample approximate moments for a large class of estimators under i.i.d. and dependent data in nonlinear models with non-normal errors. They also explore the path of studying the exact and approximate distributions of a variety of estimators in different econometric models. In addition, the authors cover the impact of Nagar (1959)'s results on empirical applications involving instrumental variables, which can be weak and/or of large number or high dimension. However, this set of results were for the 2SLS estimator (control function estimator) in a linear model.

Hahn and Hausman (2021) consider a non-linear pseudo-panel model with endogeneity, and examine whether the well-known control variable estimation with many instruments is subject to the bias as pointed out in the literature for linear models. In the spirit of Nagar (1959)'s pioneering analytical bias adjusted 2SLS estimator, for such a nonlinear model they cleverly show how the analytical bias can be characterized, and indicate that the split sample cross fitting does not remove the bias.

The search of bias adjusted estimators continues in Giles (2021)' contribution which considers estimating the parameters of the Weibull distribution when the data arise from "length-biased" sampling. The analytic Cox-Snell "corrective" approach is used to reduce biases of the estimators and he shows that this can be done effectively and without consequences for the mean squared errors. Simulation results show the severe consequences of failing to allow for "length-biased" sampling, even in large samples.

The issue of bias and its adjustments continue to be the subject of further concern in the paper by Bao (2021) in which a new asymptotic bias adjusted estimator is proposed for a first order dynamic fixed effects panel model. The within-group (WG) estimator is inconsistent (asymptotically biased) when N is large and T is finite. He obtains a binding function based on its asymptotic bias term, inverts it in the spirit of indirect inference, and thus corrects the asymptotic bias of the WG estimator.

The proposed estimator is shown to be simulation-free, robust to distributional assumption on the error terms, and is asymptotically normally distributed with good finite sample properties compared with other asymptotically unbiased (consistent) estimators.

The thrust of Rilstone (2021)'s work is to generalize the results of Nagar (1959) to develop higher-order stochastic expansions for non-linear estimators, which are smooth functions in sample averages of the estimator's influence function and its derivatives. These can be used to obtain the first four moments of the estimators or test statistics, unlike only the first two moments in many previous studies. Such results are useful for deriving their skewness and kurtosis and also for developing their approximate Edgeworth distribution functions. The results are valid for independent sampling.

Nagar (1959)'s expansions were specific to the parametric econometric estimators, and the conditions of its validity were explored in Sargan (1974). Its challenging generalization for nonparametric and semiparametric estimators has been attempted by Kotlyarova et al. (2021), who provide stochastic expansion and its conditions of validity for such estimators and review approaches to improved estimation, bias reduction, and model averaging.

Hillier and Kan (2021) look at another level of generalization which will be instrumental in the future growth of finite sample econometrics in the multivariate case and for a wider class of econometric models. Most of the results Nagar (1959) developed involved estimators which were a function of central or non-central Wishart matrix (e.g. 2SLS, OLS, k -class). Hillier and Kan have developed new results on the analytical moments of Wishart matrix (central and non-central) and a computational algorithm to calculate them.

The paper by Phillips (2021) makes an important and practical contribution in which methods are developed for analyzing the asymptotic behavior of bootstrap techniques with nonstationary time series. The results in this paper reinforce long-held warnings about using the bootstrap with dependent data. Phillips shows that the bootstrap is inconsistent in spurious regressions and that the failure of the bootstrap effectively turns a spurious regression into a co-integrating regression. In particular, the serial correlation of the residuals in the bootstrap regression is not even first order consistent. The block bootstrap serial correlation is first order consistent, but with a slower rate of convergence and limiting distribution different from that of the sample serial correlation coefficient.

Namba (2021) also gives an alert on the bootstrap in the context of estimating the mean of a multivariate normal distribution by using the Stein-rule and its positive part procedures. He shows that the conventional bootstrap is not always consistent, and proposes a modified bootstrap method that is consistent.

Econometrics (Theory and Applied)

The paper by De Luca and Magnus (2021) considers the estimation of the mean of a multivariate normal distribution using James-Stein and the Thompson class of estimators. Most existing papers analyze the trace of the MSE matrix (risk) of these

estimators and then compare with that of the ML estimator. In contrast in this paper the authors consider the entire MSE matrix of these estimators for comparison, in particular its eigenvalues. They show that there are only two different eigenvalues and that the popular Stein paradox is no longer a paradox.

Chaturvedi et al. (2021) develop a generalized Bayes estimator of the parameters in the spatial Durbin regression model, establish its minimaxity, and show that its risk is uniformly lower compared to that of the OLS estimator.

Nachane and Dubey (2021) introduce the spectral envelope technique for analyzing the decoupling problem among economies. They provide some interesting findings: all the countries considered have a common cycle of approximately 42 months and a common global cycle of a periodicity between 3 and 4 years.

The paper by Dua and Tuteja (2021) considers a Markov-switching model to analyze the regime changing behavior and dynamic linkages among currency and equity markets of India, Japan, Eurozone, and the US. While univariate results identify bull and bear states by high/low returns and low/high volatility for the stock indices and returns, a multivariate VAR analysis provides interesting results that incorporate some of the turbulent periods like 9/11, housing bubble burst, US–China trade war, COVID-19 pandemic, among others.

Kakwani and Luo (2021) study how the pattern of growth impacts the reduction of poverty in rural China. The empirical results show, among others, that economic growth has been unfavorable to the poor. The authors identify the income sources that lead to pro-poor outcomes and suggest how policy makers can formulate pro-poor policies.

Forecasting

The paper by Habibnia and Maasoumi (2021) is on improved forecasting in big data environments incorporating possible nonlinear dynamic settings, high dimensional predictors, and model complexity. The shrinkage estimation of a back-propagation algorithm of a neural net with skip-layer connections has been implemented. The proposed new approach, in an application to forecasting equity premiums, captures nonlinear dynamics between equities and provides improved performance compared to alternative existing procedures.

Mariano and Ozmuur (2021), on the other hand, under the mixed-frequency dynamic latent factor models and mixed data sampling regression model, are interested in comparing predictive accuracy of alternative forecasting methods for Philippine's inflation, real GDP growth, and other related macroeconomic variables. Their results indicate that no forecasting method is a clear winner, so they suggest combining forecasts from alternative methods for improvement of forecasts in practice.

Franses (2021), for improving macroeconomic forecasts, proposes a formal method to include judgment to a forecast which makes the combined forecast reproducible. As an illustration, a forecast from a benchmark simple time series model is only modified when the value of a factor, estimated from a multitude of variables, exceeds a user-specified threshold. He provides forecasting results based on annual real GDP growth in 52 African countries as an illustration.

Sharma and Bera (2021) consider one-way and two-way error component regression models (panel data random effects models) and propose estimates of random components as well as the predictions from the model. In an empirical application, by using the panel data on gasoline demand, they report that the proposed predictions from the one-way error component model consistently perform better than the alternative available predictions in the literature in terms of mean absolute prediction error for the in-sample part and as good as for the out-of-sample part. The two-way error component model produces better in-sample and out-of-sample predictions.

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