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ADVANCES IN ECONOMETRICS VOLUME 43B

ESSAYS IN HONOR OF M. HASHEM PESARAN: PANEL MODELING, MICRO APPLICATIONS, AND ECONOMETRIC METHODOLOGY

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INTRODUCTION

Alexander Chudik, Cheng Hsiao and Allan Timmermann

The collection of chapters in Volume 43 of Advances in Econometrics (Part A and B) serves as a tribute to Professor M. Hashem Pesaran. Hashem is one of the most innovative, influential, and productive econometricians of his generation, with over 200 papers published in leading scientific journals to his credit along with highly influential books on both theoretical and applied topics.

Hashem has made fundamental contributions to multiple areas of theoretical and empirical econometrics, seamlessly addressing applied questions and topics of a more statistical nature. His early work dealt with the problem of model selection and hypothesis testing, focusing on situations in which the hypotheses under consideration are separate or nonnested. Subsequently, he worked on the identification, estimation, and solution of rational expectations models, and the problem of aggregation in econometric modeling. More recently, Hashem's research has focused on the econometric analysis of heterogeneous dynamic panels with unobserved common effects and spatial dependence, panel unit root tests, forecasting and decision theory, factor modeling, and variable selection with high-dimensional data. His applied interests continue to blossom and include, inter alia, the analysis of oil prices, the Iranian Economy, survey data, production networks, stock returns, house prices, business cycles, exchange rates and interest rates, and presidential election outcomes.

Hashem's work has had an impressive impact not only on his peers in the academic profession, but also on policy makers throughout the world's leading institutions. His work on global vector autoregressive modeling (GVAR), originally developed for modeling credit risk, has been used extensively by the International Monetary Fund, the European Central Bank and other leading financial institutions such as Citi, UBS, ICBC, Babamex, Banote, Caixa Economica Federal, Itau Santander and FIRA to conduct stress tests for the banking sector and model sovereign risks and macroeconomic prospects. The approach has also been used to model and predict the transmission of financial

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and macroeconomic shocks across international markets. Policy work based on GVAR modeling has not only been well received by private firms and public organizations, but has also been widely cited in media such as the *BBC*, *Bloomberg*, *CCTV*, the *Economist*, the *Financial Times*, the *Wall Street Journal* as well as national news agencies in Australia, China, Japan, New Zealand, United Kingdom and the United States.

Hashem has also influenced the economics profession by founding the *Journal of Applied Econometrics*, which has developed into one of the world's leading journals for applied economic work. From its inception, the journal has helped push forward the goal toward ensuring replicability of empirical work in the economics profession. In addition, Hashem was a co-founder of the International Association of Applied Econometrics (IAAE), which has become a very successful forum for applied researchers. Throughout his career, Hashem has mentored numerous PhD students who have gone on to successful careers in academia, government, finance, and industry.

In short, Hashem has significantly pushed forward the frontier of knowledge in econometrics and economics. Thanks to his profound and pioneering work on theoretical and empirical questions, the economics profession has gained a much better understanding of both the power and limitations of econometric analysis. Hashem's unique ability to develop sophisticated econometric methods and use them to shed light on important economic and policy questions has brought many new insights, and continues to be a source of inspiration for us all.

Consistent with Hashem's contributions, this volume includes chapters on a variety of topics. Part A of this volume contains chapters on prediction and macroeconomic modeling. Part B contains chapters on panel modeling, micro applications, and econometric methodology.

PART B: PANEL MODELING, MICRO APPLICATIONS, AND ECONOMETRIC METHODOLOGY

Part B1. Panel Data Methods

In their chapter "A Panel Data Model With Generalized Higher-Order Network effects," Badi H. Baltagi, Sophia Ding and Peter H. Egger present a high-order network-lag Durbin model with heterogeneous network processes regarding the error components. This generalized panel model accounts for two interesting features. First, network effects on the right-hand side of the model are allowed through weighted dependent variables, weighted exogenous variables as well as weighted error components. The second important feature is the presence of higher-order network effects due to (ex ante unknown) network-decay functions, or the presence of multi-layer networks among all of those. Availability of such general model is clearly a welcome addition to the literature, because the exact form of the dependence among individual cross-section units is often unknown ex ante. Monte Carlo simulation results suggest that this model performs well in terms of bias and root-mean-squared error even in modest sample sizes of only $n = 100$ cross-section units and $T = 5$ periods.

Arnab Bhattacharjee, Jan Ditzen and Sean Holly extend the well-known temporal error-correction representation results of Engle-Granger to characterize dependence across both time and cross-section dimensions. Developing error-correction models for a spatial or network framework as well as spatio-temporal framework allow the authors to study short- and long-run dynamics of spatial or network panel data over time and space. They apply their model to quarterly house prices and personal incomes across 324 local authorities in England over the period 1997q1 to 2016q4, and provide new evidence and interpretation of nonstationary spatio-temporal dynamics.

In their chapter entitled "Heterogeneity and Dynamic Dependence in Panel Analysis of Individual Behavior," Kannika Damrongplasit and Cheng Hsiao illustrate that the expected outcomes of a variable y conditional on some observed variables in x can be expected to be homogenous only if x captures the essential heterogeneity in y across individuals and time, and the parameters that characterize the conditional expectation relation stay constant. If there is unobserved heterogeneity or parameter variations (due to change in external conditions, such as a policy change), then inference on $E(y|x)$ can be misleading. Considering reduced form state-dependent labor participation decision model to a health shock, estimated using Australian HILDA panel data from 2002 to 2009, authors demonstrate that it is not only important to capture the observed heterogeneity in a sample, but it is also important to capture the unobserved heterogeneity in economic agents in order to obtain valid statistical inference. In addition, it is important to examine if parameters stay constant if external conditions changed.

Cheng Hsiao, Yan Shen and Qiankun Zhou contribute to the volume with their chapter "Multiple Treatment Effects in Panel-Heterogeneity and Aggregation." Their analysis uses panel data to estimate individual treatment effects for multiple individuals while allowing for heterogeneity in the impact of the treatment. The authors develop an F-test of homogeneous versus heterogeneous treatment effects. They also consider a range of aggregation methods for estimating the average treatment effect, including aggregating multiple units into a single unit and estimating the treatment effect on the combined unit versus estimating treatment effects at the level of individual units before aggregating to get an average treatment effect. Monte Carlo simulation results presented by the authors suggest that the order of estimation and aggregation has little effect on estimates of the average treatment effect. Finally, the authors demonstrate their methods empirically using data on China's peer-to-peer lending market.

Artūras Juodis contributes to the literature on estimation of linear panel data models with predetermined regressors by analyzing the properties of a least-squares based estimator that relies on backward means of regressors to approximate individual fixed effects – also labeled as the Orthogonal to Backwards Means (OBM) estimator. Artūras presents several novel theoretical results. They include the asymptotic distribution of the OBM estimator for the linear panel data model with general predetermined regressors, a discussion of sufficient conditions for the OBM estimator to be asymptotically efficient, and a discussion of the bias-variance tradeoff inherent to this approach. Theoretical results are accompanied with extensive Monte Carlo results where the OBM

estimator is compared with other competing estimators. Small sample evidence shows that OBM can be a viable alternative to the standard bias-corrected fixed effects estimators, but the superiority of the OBM estimator is mostly limited to autoregressive models.

CY (Chor-yiu) Sin derives asymptotic distribution for the error-component test of Breusch and Pagan (1980) under various assumptions about the cross-section dimension (N) and the time dimension (T) of the panel: (i) when both dimensions (N,T) go to infinity jointly, (ii) when N is fixed and $T\to\infty$, and (iii) when T is fixed and $N\to\infty$. While the asymptotic distribution is normal under (i) and (ii), it is not under (iii). Monte Carlo experiments illustrate the importance of the choice of critical values obtained under the three different scenarios regarding the panel dimensions.

Yoonseok Lee and Donggyu Sul propose a robust trimmed mean group panel estimation, by trimming the outlying cross-section units of which the sample variances of regressors are either extremely small or large. This allows for a more robust estimation without much sacrifice of efficiency compared with pooled estimators. Specifically, two trimming methods are considered: one based on the order statistics of the sample variance of each regressor, and one based on the Mahalanobis depth of the sample variances. Limiting distribution of each estimator is provided, and the usefulness of this approach is nicely documented by Monte Carlo illustrations as well as an empirical illustration to effects of police on crime using annual data on US states.

Part B2. Micro Modeling

Gareth Anderson and Mehdi Raissi shed light on potential reasons for anemic productivity growth in Italy over the period 1999–2015. Using firm-level panel data and relying on recent dynamic heterogeneous panel data methods developed by Hashem Pesaran and coauthors, they find a significant negative long-term effects of persistent corporate debt accumulation on the productivity growth of Italian firms, suggesting that the persistent debt build ups within Italian firms have reduced the firm productivity growth. Among the set of interesting results provided by Gareth Anderson and Mehdi Raissi is also evidence of a threshold level of corporate debt (estimated at about three times corporate value added) beyond which productivity drops off significantly. These empirical findings provide support for policy initiatives that promote healthier corporate balance sheets as well as other structural reforms to enhance productivity of Italian firms.

Maasoumi and Wang examine the history of wage earnings for women and their potential wage distributions in the United States. Using the Current Population Survey data from 1976 to 2013, they analyze the entire counterfactual distributions to separate the "structure" and human capital "composition" effect. The reference outcome in these decompositions is women's observed earnings distribution, and inverse probability methods are employed, rather than the conditional quantile approaches. They also provide decision theoretic measures of the distance between two distributions, to complement assessments based on mean, median, or particular quantiles and assess uniform rankings of alternate

distributions by tests of stochastic dominance in order to identify evaluations robust to subjective measures.

Part B3. Econometric Methodologies

Abadir and Atanasova provide evidence that the expectation hypothesis as a long-run theory of the term structure of interest rates is strongly affected by a handful of outliers. They also suggest a feasible strategy to the account of the outliers and to determine the number of outliers that cause a theory to fail.

Amengual, Sentana and Tian study the statistical properties of Pearson correlation coefficients of Gaussian ranks, and Gaussian rank regressions – OLS applied to those ranks. They show that these procedures are fully efficient when the true copula is Gaussian and the margins are nonparametrically estimated, and remain consistent for the population analogues otherwise. They compare them to Spearman and Pearson correlations and their regression counterparts theoretically and in extensive Monte Carlo simulations. Empirical applications to migration and growth across US states, the augmented Solow growth model, and momentum and reversal effects in individual stock returns confirm that Gaussian rank procedures are insensitive to outliers.

Baltagi, Bresson, Chaturvedi and Lacroix investigate the robustness of Bayesian panel data models to possible misspecification of the prior distribution. The proposed robust Bayesian approach departs from the standard Bayesian framework in two ways. First, they consider the ε-contamination class of prior distributions for the model parameters as well as for the individual effects. Second, both the base elicited priors and the ε- contamination priors use Zellner (1986)'s *g*-priors for the variance-covariance matrices. They propose a general "toolbox" for a wide range of specifications, which includes the dynamic panel model with random effects, with cross-correlated effects *á la* Chamberlain, for the Hausman-Taylor world and for dynamic panel data models with homogeneous/heterogeneous slopes and cross-sectional dependence. They also use a Monte Carlo simulation study to compare the finite sample properties of our proposed estimator to those of standard classical estimators.

Dufour and Nguyen propose inference methods for endogeneity parameters in linear simultaneous equations models allowing for weak identification and missing instruments. Their new proposed inference methods retain identification robustness as well as allow the reduced form to be incomplete, e.g. due to missing instruments. They propose easily applicable inference methods for endogeneity parameters – in particular, two-stage procedures. An application to a model of returns to schooling is also presented.

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PART B1

PANEL DATA METHODS