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M. HASHEM PESARAN

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**ESSAYS IN HONOR OF
M. HASHEM PESARAN:
PREDICTION AND MACRO
MODELING**

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CONTENTS

Introduction <i>Alexander Chudik, Cheng Hsiao and Allan Timmermann</i>	1
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PART A1 PREDICTION

Chapter 1 On the Evolution of US Temperature Dynamics <i>Francis X. Diebold and Glenn D. Rudebusch</i>	9
Chapter 2 Measuring Uncertainty of a Combined Forecast and Some Tests for Forecaster Heterogeneity <i>Kajal Lahiri, Huaming Peng and Xuguang Simon Sheng</i>	29
Chapter 3 Nowcasting Euro Area GDP Growth Using Bayesian Quantile Regression <i>James Mitchell, Aubrey Poon and Gian Luigi Mazzi</i>	51
Chapter 4 Multi-step Forecasting with Large Vector Autoregressions <i>Andreas Pick and Matthijs Carpay</i>	73
Chapter 5 Gains from Switching Between Forecasts <i>Allan Timmermann and Yinchu Zhu</i>	99

PART A2 MODEL INSTABILITY AND BREAKS

Chapter 6 Efficient Combined Estimation under Structural Breaks <i>Tae-Hwy Lee, Shahnaz Parsaeian and Aman Ullah</i>	119
Chapter 7 Smooth Robust Multi-Horizon Forecasts <i>Andrew B. Martinez, Jennifer L. Castle and David F. Hendry</i>	143
Chapter 8 Finite Sample Forecast Properties and Window Length under Breaks in Cointegrated Systems <i>Luca Nocciola</i>	167

PART A3
MACRO MODELING AND POLICY ANALYSIS

Chapter 9 A Meta Model Analysis of Exchange Rate Determination	199
<i>Chrystalleni Aristidou, Kevin Lee and Kalvinder Shields</i>	
Chapter 10 Dancing Alone or Together: The Dynamic Effects of Independent and Common Monetary Policies	217
<i>Povilas Lastauskas and Julius Stakėnas</i>	
Chapter 11 Measuring Productivity Growth and Technology Spillovers through Global Value Chains: Analysis of a US–Sino Decoupling	243
<i>Weilin Liu, Robin C. Sickles and Yao Zhao</i>	
Chapter 12 Checking if the Straitjacket Fits	269
<i>Adrian Pagan and Michael Wickens</i>	
Chapter 13 An Event Study of COVID-19 Central Bank Quantitative Easing in Advanced and Emerging Economies	291
<i>Alessandro Rebucci, Jonathan S. Hartley and Daniel Jiménez</i>	
Chapter 14 Government Debt, Deficits and Interest Rates 1870–2016	323
<i>Ron P. Smith</i>	
<i>Index</i>	341

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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 non-nested. 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 test 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 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 all of us.

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 A: PREDICTION AND MACRO MODELING

Part A1. Prediction

Francis X. Diebold and Glenn D. Rudebusch provide novel evidence on how range-based measures of daily temperatures have evolved over time in their chapter "On the Evolution of US Temperature Dynamics." Using more than half a century (58 years) of data on daily temperatures in a cross-section of 15 US cities, the authors inspect time-series patterns such as trend and seasonality in average temperatures and diurnal temperature ranges (maximum versus minimum temperatures on a given day). Some of their findings confirm existing knowledge – i.e., average daily temperatures have been trending upwards over time. Other findings are more surprising: while the seasonality of the average daily temperature is quite stable, the authors find strong evidence of shifts in the seasonal patterns of diurnal temperature ranges. For example, in Philadelphia the diurnal temperature range during the winter months (January through March) has clearly shifted between 1960 and 2017 with the winter lows increasing over time. Conversely, the fall (October) peak has been decreasing over time, resulting in lower diurnal temperature range highs for this month. These findings have potentially significant implications for our understanding of the economic impact of global warming.

In their chapter “Measuring Uncertainty of a Combined Forecast and Some Tests for Forecaster Heterogeneity” Kajal Lahiri, Huaming Peng, and Xuguang Simon Sheng study different approaches to estimating the uncertainty of forecast combinations. Individual forecasts – whether from surveys or generated from econometric models – are often found to be highly correlated due to their exposure to a set of common factors. What differentiates individual forecasts, then, can be modeled as an idiosyncratic error component that is specific to each forecast. Because forecast combinations are weighted averages of individual forecasts, the uncertainty of the forecast combination should reflect the amount of disagreement among forecasters – as captured through the idiosyncratic error component or arising from heterogeneity in exposures to common factors. The authors derive asymptotic results on the limits of alternative measures of uncertainty for forecast combinations as the time-series and cross-sectional dimensions both go to infinity and develop new statistics for testing the null of homogeneous idiosyncratic forecast errors.

In their chapter “Nowcasting Euro Area GDP Growth Using Bayesian Quantile Regression,” James Mitchell, Aubrey Poon, and Gian Luigi Mazzi develop Bayesian Quantile regression methods which can handle “ragged edge” data, that is, data arriving at irregular points in time and at different frequencies – an approach they label Bayesian MIDAS quantile regression. In an empirical application, they demonstrate how their approach can be used to include a large set of mixed-frequency predictor variables to generate density nowcasts of GDP growth in the Euro area. The authors conduct an extensive performance analysis of their approach under a wide range of shrinkage priors and separately consider performance after the outbreak of the COVID-19 pandemic. Their analysis finds that their Bayesian quantile regression approach with global-local shrinkage horseshoe priors can be used to generate accurate density nowcasts of economic activity particularly during economic recessions.

Andreas Pick and Matthijs Carpay investigate the multi-step ahead (point and density) forecasting performance of dimension reduction approaches for high-dimensional vector autoregressions (VARs). Increasing number of dimension reduction methods have been proposed in the literature to date, but their relative merits are still not well understood. Andreas and Matthijs employ factor-augmented VARs using principal components and partial least squares to extract the factors, random subset regressions, random projection, random compression, Bayesian VAR, and LASSO shrinkage approaches. Performance of these methods is evaluated using US macroeconomic and financial variables from the FRED-MD database. In this data set, random subspace and LASSO shrinkage methods are found to deliver the most precise multi-step ahead forecasts.

Allan Timmermann and Yinchu Zhu implement a switching strategy that chooses, at each point in time, the forecasting model that is expected to be most accurate conditional on a set of instruments that are used to track the relative accuracy of the underlying forecasts. They analyze the factors determining the expected gains from such a switching rule over a strategy of always using one of the underlying forecasts. They derive bounds on the expected gains from switching for both the nested and non-nested cases and also analyze the case with a highly persistent (near-unit root) predictor variable.

Part A2. Model Instability and Breaks

In their chapter “Efficient Combined Estimation Under Structural Breaks,” Tae-Hwy Lee, Shahnaz Parsaeian, and Aman Ullah consider the problem of parameter estimation in the presence of multiple breaks and heteroskedastic shocks across different regimes. The authors propose a feasible method that combines a restricted no-break estimator with an unrestricted estimator that accounts for breaks to model parameters with combination weights restricted to lie on the unit interval and sum to unity. Their analysis derives the finite-sample (approximate) bias, mean squared error and risk of the combined estimator and demonstrates that the combined estimator lowers the risk and reduces the mean squared prediction error relative to the unrestricted estimator, benefitting from shrinking toward the restricted estimator. In empirical applications to macroeconomic and financial data sets, the authors find that the combined estimator performs better than the unrestricted estimator across horizons of 1, 6, and 12 months.

The chapter “Smooth Robust Multi-Horizon Forecasts” by Andrew B. Martinez, Jennifer L. Castle, and David F. Hendry studies how a range of smooth robust forecasting methods perform when used to generate multi-step-ahead forecasts. It is often found that simple, naïve forecasting methods such as a first-order autoregressive model or a random walk produce good out-of-sample forecasts of macroeconomic data series relative to more sophisticated methods that one might have expected to be better. The authors relate this “puzzle” to the greater adaptability of the naïve forecasting methods which becomes important if the underlying data generating process is changing over time. Trend breaks can be particularly detrimental to the long-horizon forecasting performance of models that fail to adapt. The authors show that the large forecast errors often observed in the aftermath of a break can be reduced by using simple, robust methods. They show that this result can be explained by the naïve predictors effectively being local estimators of the long-run predictive relations. Because the greater adaptability of naïve estimators normally comes at the cost of introducing greater estimation error, the authors propose to smooth these estimators over post-break samples of data. Such smoothing is shown to work well in a set of Monte Carlo simulations and in empirical applications to UK productivity data and US Treasury rates.

Luca Nocciola’s chapter “Finite Sample Forecast Properties and Window Length Under Breaks in Cointegrated Systems” addresses how model instability can affect forecasting performance in the aftermath of breaks and how predictive accuracy depends on the length of the data window used to estimate model parameters. Nocciola’s analysis focuses on how the inclusion of pre-break data to estimate the parameters of a cointegration model affects forecasting performance in the presence of discrete breaks. The analysis decomposes forecast errors into bias and variance terms and shows how these components are affected by using different lengths of the estimation window. Building on this decomposition, the author proposes new simulation-based estimators for the finite sample properties of the forecasts. The chapter provides new insights into the conditions under which pre-break data can be used to help reduce mean squared prediction errors and shows how possible gains in predictive accuracy depend on the location, magnitude, and direction of the breaks.

Part A3. Macro Modeling and Policy Analysis

Aristidou, Lee and Shields propose a novel approach to modeling exchange rates based on a set of models distinguished by the drivers of the rate and regime duration. The models are combined into a “meta model” using model averaging and non-nested hypothesis-testing techniques. The meta model accommodates periods of stability and slowly evolving or abruptly changing regimes involving multiple drivers. Estimated meta models for five exchange rates provide a compelling characterization of their determination over the last 40 years or so, identifying “phases” during which the influences from policy and financial market responses to news succumb to equilibrating macroeconomic pressures and vice versa. Their meta models also appear to deliver good forecasting performance.

Lastauskas and Stakėnas propose a methodology that combines synthetic control ideas with the impulse response functions to uncover dynamic response paths for treated and untreated units, controlling for common unobserved factors. Focusing on the largest euro area countries, Germany, France, and Italy, they find that an unexpected rise in interest rates depresses inflation and significantly appreciates exchange rate, whereas GDP fluctuations are less successfully controlled when a country belongs to the monetary union than would have been the case under the independent monetary policy. Importantly, Italy turns out to be the overall beneficiary, since all three channels – price, GDP, and exchange rate – deliver the desired results. They also find that stabilizing an economy within a union requires somewhat smaller policy changes than attempting to stabilize it individually, and therefore provides more policy space.

Weilin Liu, Robin C. Sickles, and Yao Zhao propose and estimate a novel production model with heterogeneous productivity growth and spatial interdependence for 44 industries in the US and China from 1981 to 2010. Significant spillover effects of the industries in the global value chain are estimated. The model is then used to evaluate different scenarios of decoupling of bilateral trade between the United States and China – a highly topical issue given the trade frictions and disputes between the United States and China in recent years. Results suggest average output declines of 5.5% in the United States and 7.0% in China when the international intermediate trade drops by 10%. Moreover, were trade totally cut off, the United States would suffer a 37.0% drop in output and China would suffer a 46.7% decline. These findings strongly illustrate a lose-lose consequences of “decoupling” policies between the United States and China.

Pagan and Wickens look at how one might assess the fit of DSGE models using a variety of measures, rather than what seems to be an increasingly common device – the Marginal Data Density. They find that models by Christiano et al. (2014) and Ireland (2004) fail to make a match by a large margin. Both of these models feature more shocks than observed variables, resulting in the shocks having a singular density, and so making them correlated. When correlated one can neither interpret impulse responses nor perform variance decompositions. They illustrate against a strong argument for having straitjacket, as it enforces some desirable behavior on models and makes researchers think about how to account for any non-stationarity in the data with examples drawn from the SVAR literature and also more eclectic models such as Holston et al. (2017) for extracting an estimate of the real natural rate.

Rebucci, Hartley and Jiménez, explore the impact of quantitative easing (QE) policies during the Covid pandemic in their chapter “An Event Study of COVID-19 Central Bank Quantitative Easing in Advanced and Emerging Economies.” To capture the heterogeneity of the circumstances surrounding each of these policy events, the authors use event study methodology to analyze how 30 QE announcements carried out by 21 central banks affected daily bond yields and exchange rates during the early period after the pandemic outbreak (March and April of 2020). Using a GVAR model fitted to pre-COVID data, Rebucci et al. explore how the QE announcements were transmitted to yields on long-term bonds. They find sizeable effects of QE actions on bond yields in advanced economies and even larger effects in emerging markets. Moreover, the US Federal Reserve Bank appears to have played a pivotal role in the global transmission of shocks to long-horizon interest rates, although local QE interventions also had a significant effect on country-specific financial markets. Finally, the effect of the QE shocks appears not to have been limited to the financial markets but spilled over to the real economy – an important consideration, of course, when assessing the impact of the unprecedented central bank interventions launched during the Covid pandemic.

Smith examines the effect of changes in the public debt-GDP ratio on long, 10 year, interest rates in a panel of 17 countries over the period 1870–2016 controlling for other variables, in particular the world interest rate. His estimates suggest that it is the change in debt, rather than the level of debt or the deficit, that matters for long interest rates. World interest rates have long and short run effects on interest rates which are very well determined and close to one. Current inflation has a small but significant effect.

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PART A1

PREDICTION