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Editorial Introduction to the 40th Anniversary Special Issue

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ABSTRACT

We introduce this special issue, based on the proceedings of a conference held in the Department of Economics in the University of Oxford from 7 to 9 April 2025, organised to commemorate the 40th anniversary of cointegration. Following a setting of the scene and discussion of the motivation for the conference, the papers are summarised in order of their appearance, setting out their relevance for the issue. Some brief remarks conclude the discussion.

JEL Classification: C32, C12, C13, C22

The August 1986 issue of the *Oxford Bulletin of Economics and Statistics* was a special issue containing papers dealing with the then newly developing field of cointegration. Hendry [1] wrote the editorial introduction, presenting the argument that the consequences of assuming non-stationarity of time series in modelling, for the statistical properties of estimators and tests, were profound.

Granger [2], the second paper in the August 1986 issue, presented one of the earliest accounts of cointegration. Section 2 of this paper contained a discussion of cointegration in bivariate systems, Section 3 discussed testing for cointegration using residual series, and Section 4 set out some of the formal analysis of cointegrated systems that was published as Engle and Granger [3] the following year. Section 5 contained preliminary ideas to deal with time-varying cointegration.

This 1986 issue of the *Bulletin* was the first collection of papers devoted to cointegration to appear in the literature, and marked presciently the way ahead, particularly for the analysis of macroeconomic time series and macro-modelling. In the years to follow, the literature grew in every conceivable direction to consider the maximum likelihood estimation of cointegrated systems [4], and the formal analyses of the many different aspects of estimation and testing in a nonstationary world that the framework provided.

It is important to emphasise that no precise cutoff date can be prescribed when the literature can be deemed to have taken off and that 1986 only provides a convenient landmark. Papers by Dickey and Fuller [5, 6], Evans and Savin [7, 8], Granger [9], Granger and Newbold [10] and Nelson and Plosser [11] had already appeared, working paper versions of Engle and Granger [3], Phillips [12, 13], Phillips and Durlauf [14], and Stock [15] *inter alia* were also available, and work on error correction mechanisms such as Sargan [16] and Davidson et al. [17] had already indicated the potential of working with long-run relations in macroeconomic modelling.

The asymptotic theory underlying estimation and inference largely needed to be worked out, and this has been the task for the 40 years that have followed. But like the seabirds that told Columbus that land was near, plus or minus 1986 was the year that showed the way ahead for cointegration.

The current special issue commemorates both the 1986 special issue as well as the centenary of the publication of Yule's [18] remarkable paper on how 'nonsense correlations' can emerge

between time series, a warning that the empirical literature still routinely ignores, often in supposedly mostly harmless ways, a warning that Granger and Newbold [10] brought back to the forefront of econometric thinking. We owe to Yule our primary econometric sensibility of how econometric analysis can falter if inadequate account is taken of the time series properties of the variables being modelled. This carries through to the most recent literature on pooled time series and cross-sections, an area that is not represented in this special issue but nevertheless is an active field of research.

This special issue has been 2 years or more in the making, from the request for papers, to the organizing of the conference upon which this special issue is based (Oxford 7–9 April 2025), to the review and preparation of the papers for publication.

It is not within the scope of this brief introduction to provide an overview of the literature. This would be the task of a lengthy survey, or better still a book. We do however provide, within the framework of a transcribed panel discussion [19], a discussion of the role played by some of the key participants in this literature as explained by them in the panel. The role of the *Bulletin* in the literature is also presented to set the current issue into context.

Following Ericsson and Martinez [19], 17 original papers make up this special issue, divided broadly into two sections.

The first section begins with Schumacher [20] and continues with a set of papers extending the original framework of the cointegration literature.

Schumacher places the development of the Granger Johansen Representation Theorem (GJRT) in an historical context, primarily within the mathematical research on matrix-valued functions, but in some other contexts going back to the nineteenth century. He argues that connections can be found not only with pure mathematics but also with engineering (in the study of dynamics), and that these connections have been obscured by differences in the respective languages of discourse. The wider context of the GJRT is thus explored in this paper which serves to give the theory a deeper meaning within a broad mathematical framework.

Beare and Howlett [21] invoke a novel (but, in the end, potentially simpler) method of characterizing in general terms the set of all solutions to the original system explaining the core component of the GJRT. They do this by disaggregating or separating the system into its natural components such that these smaller linear systems on subspaces have dimensions summing to the dimension of the original linear system.

Phillips [22] considers a semiparametric approach to rank selection in a function space reduced rank regression to allow an extension of the linear cointegrating model to cross-section data under general forms of dependence. Consistent rank selection is made via information criteria, extended to the curve time series environment, and the standard limit processes involved in cointegrating regressions with multiple time series are thereby generalised.

Franchi and Paruolo [23] discuss semiparametric inference on cointegration and attractor spaces for I(1) linear processes of medium to large cross-section dimension, using an approach based on empirical canonical correlations and functional approximations of Brownian motions. Testing involves looking at the number of common trends in specified sub-systems and uses selection criteria or sequences of tests.

Duffy and Jiao [24], Abreu and Rodrigues [25], Berenguer-Rico and Nielsen [26], Boswijk and Franses [27], Gonzalo and Pitarakis [28] and Nielsen, Rahbek and Paruolo [29] propose various detailed extensions of the CVAR framework.

Duffy and Jiao explore the implications of working with a CVAR for making inference on the number of common trends in the presence of nonlinearity and regime shifts. The empirical relevance of such data generation processes is evident when considering behaviour of variables of interest, for example, at the zero lower bound. The contribution of this paper is to use a novel distribution theory to derive the asymptotic behaviour of their test statistic and to show that the inferences have the correct sizes and good power properties.

Abreu and Rodrigues continue the theme of nonlinearity studied by Duffy and Jiao and analyse nonlinear cointegration and factors within a threshold factor vector error correction model. This paper also has bearing with Phillips [22] described earlier, with its focus on dependence structures across cross-sections of data, for example when looking at a panel of government bond yields from multiple countries.

Berenguer-Rico and Nielsen study ADL and CVAR models in the presence of indicator variables to account for outliers. They show that Least Trimmed Squares estimation provides robustness to outliers of many types and has the same asymptotic properties as an infeasible OLS estimator.

Boswijk and Franses investigate cointegration analysis in a mixed data sampling regression (MIDAS)—that is, where the variables in the data set are observed at different frequencies. A theoretical structure is provided whereby the underlying data are generated at high frequencies but the data for the dependent variable are observable only at a low frequency. A test for cointegration is proposed within this rather challenging scenario, its asymptotic distribution is derived, and the efficacy of this method is established via publicly available data to construct a model for quarterly total inflation as a function of energy costs.

Gonzalo and Pitarakis deal with so-called sparse relationships in high-dimensional datasets where cointegration may be difficult to detect. Their method essentially involves using large-data techniques to narrow down the subset of covariates within which equilibrium relationships with a target variable are considered to ensure model consistency. Information theoretic model choice techniques are used to avoid reliance on distributional assumptions.

The Nielsen, Paruolo and Rahbek paper derives asymptotic and bootstrap confidence bands for permanent and transitory decompositions of CVAR systems with the investigation of the best

estimators of the permanent components. The empirical focus of this paper is on price discovery in markets.

This first section is rounded off, by way of a focused survey, by Tjostheim [30] who considers the question of cointegration within the context of panels of time series, spatial series and spatio-temporal series. The adequate modelling of cross-section dependence in such models is challenging and requires the development of new techniques. This work also ties in nicely with the material in Phillips [22] in this issue.

The second section begins with the paper by Castle et al. [31]. A cointegrated vector equilibrium correction model with key climate variables is used to model anthropogenic climate change and to provide forecasts long period ahead. The remarkable stability of this model over 150 years underlines the robustness of the methods adopted, yet at the same time highlights the many uncertainties evident for the next century.

The next two papers — in many ways companion pieces — by Johansen and Juselius [32] and Chevillon and Kurita [33]. Both papers explore cointegrated vector autoregressions (CVAR) through the lens of a control problem.

Johansen and Juselius show how, within a CVAR, a nonstationary target variable may be made stationary through the control of an instrument variable. Within the context of monetary economics, the paper considers the period of the chairmanship of the Federal Reserve Board by Burns and Miller, discussing via a detailed empirical analysis the relationship between the federal funds rate and inflation and the use of the three-month T-bill rate as an intermediate instrument to control inflation.

Chevillon and Kurita seek to extend some of the analysis in Johansen and Juselius by exploring the difficulties caused by failures to identify intermediate and final targets (although well-defined in theory) in practice. From this follows their attempt to propose intermediate and final targets in an empirical setting and to propose methods for policy implementation as well as ex post policy evaluation.

Bruns and Luetkepohl [34] show how to test the assumption of time invariance of the impact effects of shocks, a necessary condition for identifying structural shocks. Their method rests on exploiting long-run restrictions based on the cointegration structure of the variables.

Tribone, Martinez and Ericsson [35] formalise the testing of economic and statistical hypotheses for labour markets in a cointegrated framework and show how labour markets can be better understood by the study of multiple cointegrating relationships and the effects that can be observed when the data are disaggregated by both age and gender.

The final paper of the special issue, by Escribano, Rodriguez and Arranz [36], grapples with a well-studied, yet possibly not satisfactorily resolved problem of modelling money demand functions. The analysis sets itself the ambitious task of constructing a long durée money demand equation (based on studying real broad money balances) over the period 1877–2023. Modelling over such a long period requires the use of nonlinear error correction — underpinned by a derivation of a nonlinear Granger representation theorem and a two-step estimation procedure. The key instabilities identified in the modelling include the two world wars, some regulatory changes as well as the COVID pandemic, generating, according to the authors, a common and dramatic 6.5% excess inflation effect over the historical 2.2% average inflation rate since 1877.

Taken together, the papers demonstrate the unique richness of thought and techniques that have gone into the development of the theory of nonstationary processes and cointegration and their applicability to modelling a vast range of economic phenomena. The presumption of this literature is that time series methods are important and that econometrics cannot be reduced to the investigation of so-called 'causal' relationships. Few claims for 'causality' are made in our literature, perhaps because few are needed for the purposes of our investigation. This notwithstanding, policy can be studied within our frameworks and forecasting undertaken in models that take proper account of instabilities and incorporate the many interactions — as captured, for example, by cointegrating relationships — within the datasets used to build the models.

The papers in this special issue include contributions to cross-section dependence, nonlinearity, structural change, mixed frequencies, factor models, climate change, and identification. The core of the ideas presented in the 1986 special issue holds firm; the many substantial developments show the continuing rich potential of this way of thinking.

In closing, the editors feel it fitting to dedicate this special issue to the memory of Sir Clive Granger, without whom the cointegration literature as we know it would not exist, and to our teachers, past and present, some of whom have contributed to this issue. To Clive and to them, we owe our greatest debts. We would also like to take this opportunity to remember Christopher Sims, whose sad passing was announced while the papers were in preparation and whose work on vector autoregressive models remains seminal to the literature that followed on modelling long-run relationships.

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Ethics Statement

The authors have nothing to report.

References

1. D. F. Hendry, "Econometric Modelling with Cointegrated Variables: An Overview," *Oxford Bulletin of Economics and Statistics* 48 (1986): 201–212.

2. C. W. J. Granger, "Developments in the Study of Cointegrated Variables," *Oxford Bulletin of Economics and Statistics* 48 (1986): 213–228.

3. R. F. Engle and C. W. J. Granger, "Co-Integration and Error Correction: Representation, Estimation, and Testing," *Econometrica* 55 (1987): 251–276.

4. S. Johansen, "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control* 12 (1988): 231–254.

5. D. A. Dickey and W. A. Fuller, "Distribution of the Estimators for Auto-Regressive Time Series With a Unit Root," *Journal of the American Statistical Association* 74 (1979): 427–431.

6. D. A. Dickey and W. A. Fuller, "Likelihood Ratio Statistics for Auto-Regressive Time Series With a Unit Root," *Econometrica* 49 (1981): 1057–1072.

7. G. B. A. Evans and N. E. Savin, "Testing for Unit Roots: 1," *Econometrica* 49 (1981): 753–777.

8. G. B. A. Evans and N. E. Savin, "Testing for Unit Roots: 2," *Econometrica* 52 (1984): 1241–1270.

9. C. W. J. Granger, "Some Properties of Time Series Data and Their Use in Econometric Model Specification," *Journal of Econometrics* 16 (1981): 121–130.

10. C. W. J. Granger and P. Newbold, "Spurious Regressions in Econometrics," *Journal of Econometrics* 2 (1974): 111–120.

11. C. R. Nelson and C. I. Plosser, "Trends and Random Walks in Macroeconomic Time Series," *Journal of Monetary Economics* 10 (1982): 139–162.

12. P. C. B. Phillips, "Understanding Spurious Regressions in Econometrics," *Journal of Econometrics* 33 (1986): 311–340.

13. P. C. B. Phillips, "Time Series Regression With a Unit Root," *Econometrica* 55 (1987): 277–301.

14. P. C. B. Phillips and S. N. Durlauf, "Multiple Time Series Regression With Integrated Processes," *Review of Economic Studies* 53 (1986): 473–495.

15. J. H. Stock, "Asymptotic Properties of Least Squares Estimators of Cointegrating Vectors," *Econometrica* 55 (1987): 1035–1056.

16. J. D. Sargan, "Wages and Prices in the United Kingdom: A Study in Econometric Methodology," in *Econometric Analysis for National Economic Planning*, ed. P. E. Hart, G. Mills, and J. N. Whittaker (Butterworths, 1964), 25–54.

17. J. E. H. Davidson, D. F. Hendry, F. Srba, and S. Yeo, "Econometric Modelling of the Aggregate Time-Series Relationship Between Consumer's Expenditure and Income in the United Kingdom," *Economic Journal* 88 (1978): 661–692.

18. G. U. Yule, "Why Do We Sometimes Get Nonsense-Correlations Between Time-Series? A Study in Sampling and the Nature of Time-Series," *Journal of the Royal Statistical Society* 89 (1926): 1–64.

19. N. R. Ericsson and A. B. Martinez, "Unit Roots and Cointegration: A Panel Discussion With David Hendry, Peter Phillips, Katarina Juselius and Søren Johansen," 2026, this issue.

20. J. M. Schumacher, "The Mathematical History Behind the Granger-Johansen Representation Theorem," 2026, this issue.

21. B. K. Beare and P. Howlett, "The Natural Components of a Regular Linear System," 2026, this issue.

22. P. C. B. Phillips, "Semiparametric Cointegrating Rank Selection for Curved Cross Section Time Series," 2026, this issue.

23. M. Franchi and P. Paruolo, "Inference on the Attractor Space via Functional Approximation," 2026, this issue.

24. J. A. Duffy and X. Jiao, "Inference on Common Trends in in a Cointegrated Nonlinear SVAR," 2026, this issue.

25. D. Abreu and P. M. M. Rodrigues, "Large-Dimensional Cointegrated Threshold Factor Models: The Global Term Structure of Interest Rates," 2026, this issue.

26. V. Berenguer-Rico and B. Nielsen, "Least Trimmed Squares: Cointegration and Outliers," 2026, this issue.

27. H. P. Boswijk and P. H. Franses, "Cointegration in a Midas Regression," 2026, this issue.

28. J. Gonzalo and J.-Y. Pitarakis, "Detecting Sparse Cointegration," 2026, this issue.

29. H. B. Nielsen, A. Rahbek, and P. Paruolo, "Confidence Bands for Price Discovery," 2026, this issue.

30. D. Tjostheim, "Cointegration in Panel, Spatial and Spatio-Temporal Models: Some Recent Advances and Applications," 2026, this issue.

31. J. L. Castle, J. A. Doornik, D. F. Hendry, and L. Jackson, "Forecasting Climate Change Using a Multivariate Cointegrated System," 2026, this issue.

32. S. Johansen and K. Juselius, "Inflation Control in a CVAR Model With an Application to the Burns/Miller Period in the USA," 2026, this issue.

33. G. Chevillon and T. Kurita, "Towards Empirical Assessments of Controlled Cointegrated Models," 2026, this issue.

34. M. Bruns and H. Luetkepohl, "Heteroscedastic Structural VAR Identified Using a Multivariate Cointegrated System," 2026, this issue.

35. V. Tribone, A. B. Martinez, and N. R. Ericsson, "Insights From Cointegration: Gender and Age Disparities in the U.S Labor Market," 2026, this issue.

36. A. Escribano, J.-A. Rodrigues, and M. A. Arranz, "40 Years of Empirical Evidence of Cointegration and Nonlinear Equilibrium Correction in UK Money Demand Since the Nineteenth Century," 2026, this issue.