

# Introduction to Symposium on Time Series Error Correction Methods in Political Science

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In recent years, political science has seen a boom in the use of sophisticated methodological tools for time series analysis. One such tool is the general error correction model (GECM), originally introduced to political scientists in the pages of this journal over 20 years ago (Durr 1992; Ostrom and Smith 1992) and re-introduced by De Boef and Keele (2008), who advocate its use for a wider set of time series data than previously considered appropriate. Their article has proven quite influential, with numerous papers justifying their methodological choices with reference to De Boef and Keele's contribution.

Grant and Lebo (2016) take issue with the increasing use of the GECM in political science and argue that the methodology is widely misused and abused by practitioners. Given the recent surge of research conducted using error correction methods, there is every reason to take their suggestions seriously and provide a fuller discussion of the points they raise in their paper. The present symposium serves such a role. It consists of Grant and Lebo's critique, a detailed response by Keele, Linn, and Webb (2016b), and shorter comments by Esarey (2016), Freeman (2016), and Helgason (2016). Finally, Lebo and Grant (2016) and Keele, Linn, and Webb (2016a) reflect on the contributions made in the symposium, as well as discuss outstanding issues.

## 1 The Symposium

The symposium begins with Grant and Lebo's critique of the GECM. While they raise a number of important points, their concerns center on three aspects of its application: The model is indiscriminately used without due consideration for whether it is applicable to the data at hand; the results of the model are prone to misinterpretation; and the properties of much of the data which is of interest to political scientists are such that the GECM is not suitable for its analysis. Grant and Lebo go on to recommend wider use of fractional integration methods (FIMs) and the three-step fractional error correction model, as an alternative to the GECM.

Keele, Linn, and Webb (2016b) challenge many of the points raised by Grant and Lebo. Two areas are especially contentious: First, Keele et al. contend that Grant and Lebo's interpretation of the results of the GECM is mistaken and provide an account of how one should interpret the model, emphasizing the importance of the long-run multiplier. Second, they highlight the risks posed by overfitting models to data and the low power of statistical tests when analyzing relatively short time series. The latter point indicates that the three-step fractional error correction model suggested by Grant and Lebo might not be suitable for much of the data which is of interest to political scientists.

Comments by Esarey (2016), Freeman (2016), and Helgason (2016) consider different aspects of the exchange. Esarey and Helgason each weigh in on the debate over whether FIMs are preferable to the GECM, when time series are potentially fractionally integrated. Esarey finds that the latter provides a servicable approximation to the former, while Helgason's findings are more mixed: For large sample sizes, FIMs produce superior predictions of long-run effects, but for smaller sample sizes, the GECM outperforms the alternative. Finally, Freeman (2016) brings a more "big picture" approach to the debate, discussing a number of methodological weaknesses in the use of error correction methods in political science research. Importantly, the replies by Lebo and Grant (2016) and Keele, Linn, and Webb (2016a) offer critical points going forward.

While disagreement over important aspects of time series modeling in political science remains, the papers in the symposium are in agreement on a number of issues where practitioners have veered too far off the path. Two points are particularly timely. First, before analyzing the temporal relationship between two (or more) variables, it is necessary to pretest the univariate properties of the series under study and only after such tests choose a modeling strategy. Second, when studying the relationship between two (or more) series, the analyst must ensure that they are of the same level of integration; that is, they have to be balanced. As Keele et al. note, the GECM can provide insight into both of these issues, in addition to the usual battery of univariate tests for integration, structural breaks, and conditional heteroskedasticity. The papers thus agree that the GECM is only appropriate for data with certain statistical properties, and by going through such a pretesting process, many of the issues highlighted by Grant and Lebo could be avoided by practitioners. Aside from these areas of agreement, however, much remains unresolved.

We believe this to be a symposium of great relevance to time series analysts in political science. Similarly, readers may find Box-Steffensmeier et al. (2014) helpful. Both this recent book and the exchange highlight important aspects of error correction methods that have mostly been neglected by practitioners and, furthermore, suggests numerous avenues for further research on error correction methods in political science research. The symposium is sure to be of value to both applied political scientists working with time series data in their research, as well as political methodologists.

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