Responses to the incidental parameter problem

Pua, A.A.Y.

Publication date
2016

Document Version
Final published version

Chapter 6

Summary

My thesis is a collection of essays with a common theme: what practices and methods can be considered appropriate responses to the incidental parameter problem in panel data models. In recent years, we have seen an explosion of data collected from individuals, firms, or countries across short or long periods of time. This type of data gives us an opportunity to study the dynamics of change while controlling for time-invariant unobserved heterogeneity. Unfortunately, time-invariant unobserved heterogeneity, which is usually in the form of individual-specific fixed effects, creates problems for identification, estimation, and inference, especially if we continue to use default procedures without modification.

In Chapter 1, I introduce the reader to what I consider to be the main developments in the panel data literature over the past decades that would be relevant for understanding the motivation behind the remaining chapters in my thesis. Chapters 2 to 5 document my contributions to the panel data literature.

In Chapter 2, I show the folly of the usual empirical practice in top journals of using a simple linear probability model (LPM) to approximate average marginal effects from a nonlinear binary choice model in panel data settings. Setting aside the possibility that the average marginal effect may not be point-identified, directly applying IV estimators to a dynamic LPM delivers inconsistent estimators for the true average marginal effect regardless of whether cross-sectional or time series dimension diverge.

In Chapter 3, I develop a method to use panel data so that we are able to estimate a simultaneous equations model with discrete outcomes that allow for individual-specific unobserved heterogeneity and dynamics. This type of model has been considered quite frequently (but avoided) in empirical applications and no encompassing theory has yet been developed. I use the method to revisit empirical results from a model documenting the interaction of liquidity constraints and quantity constraints on labor supply for male household heads in the Panel Study of Income Dynamics.

In Chapter 4, I use orthogonal projections to construct a bias correction method for common parameters in panel data models. The proposed method involves a corrected score which is calculated by projecting the score vector for the structural parameters onto the orthogonal complement of a space characterized by incidental parameter fluctuations. Assuming that the individual-specific effect could take on almost any finite value and that the densities for the data are correctly specified, I show that the asymptotic distribution of the structural parameters is normal and centered at zero mimicking the results of bias correction procedures considered in this literature. Furthermore, the construction of the projected score lends itself to situations where there are multiple fixed effects. Numerical experiments show that the finite sample performance of projected scores is at least as good or better than existing competitors, especially when there are three or four time periods.

In the penultimate and speculative chapter, I exploit the strong parallels between extracting usable low-dimensional information from panel data even after controlling for individual-specific unobserved heterogeneity and extracting usable low-dimenstional information from the high volume but low informational content of big data. It seemed natural to ask exactly how a machine learning method like the lasso can offer a way to obtain consistency of the structural parameters (rather than predictive power) in linear dynamic panel data models with a fixed number of time periods (typically short) if we are willing to make an assumption that the individual-specific fixed effects are sparse. Results in this chapter indicate that the asymptotic theory requires stringent conditions on the growth rate of the number and size of the individual-specific fixed effects so that consistent estimation and valid inference are possible.

I wrote the essays with a research agenda in mind. Future work that I consider a priority should explore the following ideas. Just as in Chapter 2, I need to further document situations for which the linear probability model works or does not work. Developing a nonparametric identification argument and procedures for estimation and inference for the approach considered in Chapter 3 will definitely be of value to future empirical work that seeks to avoid imposing parametric restrictions. When the second-order orthogonal projection developed in Chapter 4 is carried out to the infinite order, it would be of interest to show that either we have a score from a conditional likelihood (if it exists), a score from a marginal likelihood (if it exists), or some other object that is a function of the structural parameters alone. Finally, the stage is set for extending the ideas in Chapter 5 to nonlinear panel data models.