

Unit Averaging for Heterogeneous Panels

Christian Brownlees

Vladislav Morozov

Problem: Estimation of Individual Parameter and Using Panel Data

- Object of interest: parameter θ in a potentially nonlinear model. θ could be anything: parameter, individual marginal effect, elasticity, etc.
For example – **quarterly GDP nowcast** for Spain.
- We have a panel of time series, but every unit has its own θ_i .
Example: cross-country heterogeneity

How to estimate θ with minimal MSE? Answer depends on time series length T :

- T large \Rightarrow just use data on unit of interest
- If T is not large, individual estimator is not very precise.
In this case hope to use panel information to reduce estimation uncertainty without incurring too much bias.
Interesting case: **moderate T** – when potential bias and variance are of the same magnitude \leftarrow **our paper**.

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Our Solution: Unit Averaging With MSE-Minimizing Weights

Our estimator for parameter of interest θ for the **fixed unit of interest**: a compromise **unit averaging** estimator:

$$\hat{\theta}(\mathbf{w}) = \sum_{i=1}^N w_i \hat{\theta}_i, \quad w_i \geq 0, \quad \sum_{i=1}^N w_i = 1.$$

where $\hat{\theta}_i$ is the individual estimator of unit i , $i = 1, \dots, N$.

How to pick weights to minimize MSE? **Target** the unit of interest

- We derive leading terms of the MSE of $\hat{\theta}(\mathbf{w})$ for θ for moderate T
- For moderate- T , MSE cannot be estimated consistently... (individual heterogeneity can be estimated only from individual time series, which are not long)
- ...But we give a “nice” estimator
- **Feasible weights** are obtained by minimizing estimated MSE. We propose **two schemes**: one uses prior information about unit similarity; the other one agnostic

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Our Results: Theory

We discuss theoretical properties in two cases:

- Moderate- T /limited information regime
- Large- T /growing information regime

Results in moderate- T /limited information regime:

- Formal derivation of leading terms of the MSE
- Results for other risk functions (Online Appendix)
- Asymptotic distribution of averaging estimator and feasible weights. Inference on the target parameter

Results in large- T case/fixed parameter asymptotics:

- Show that the estimator does not units with parameters not equal to the parameter of the target unit
- In particular, our estimator converges to the individual estimator of the target unit if heterogeneous parameters are continuously distributed

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Our Results: Applications

Application: does unit averaging work in simulations and in practice? **Yes!**

We do two applications:

- Forecasting regional unemployment rates for a panel of German labor market districts
- Nowcasting GDP for a panel of European countries (Online Appendix)

In both cases our methodology performs favorably:

- Our MSE-optimal weights improve on individual estimator (38% percent average improvement for unemployment; 9% average improvement for nowcasting)
- Gains in performance stronger for shorter panels
- Other weighting schemes including equal weights (mean group) – generally worse

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