Econometrics of Human Capital

Philipp Eisenhauer

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grmpy Tutorial

Benedikt Kauf

Introduction

grmpy is ...

- ... an open-source Python Package for the simulation and estimation of the generalized Roy model.

- ... intended as a useful device to support and improve the understanding of the framework by providing the opportunity to experience the effect of particular specifications directly.

Setup

Setup

- Normal linear-in-parameters version of the generalized Roy model.

Potential Outcomes

$$Y_1 = \beta_1 X + U_1 \qquad Y_0 = \beta_0 X + U_0$$

Observed Outcomes

$$Y = DY_1 + (1-D)Y_0$$

Choice

$$D = \mathrm{I}[D^* > 0]$$

$$D^* = \mu_D(X, Z) - V$$

$$U_D = F_V(V)$$

The unobservables follow a normal distribution $(U_1, U_0, V) \sim N(0, \Sigma)$ with mean zero and covariance matrix Σ.

Features

Features

- *grmpy* is currently capable of the following features:
  - Simulating a dataset based on your own specifications.
  - Providing some useful information about the simulated dataset for instance:
    - Distributional outcome characteristics
    - B^{ATE}, B^{TT}, B^{TUT}
    - B^{MTE} by ventile
  - Estimating the coefficients of interest given a dataset (of a specific form).

Install the package

- OS, Linux : Use the pip install manager (*pip install grmpy*) or download the package via GitHub and install it manually.

- Windows: The same procedure as for Linux, OS but you have to verify that the *numpy* package is already installed on your machine.

Initialization file

- The initialization file provides the user with the opportunity to specify all parameters of his/her model, for instance:
  - Simulation parameters (number of observations, name of the output files)
  - Estimation parameters (optimization algorithm, start values)
  - Optimizer spezifications
  - Coefficients and covariance parameters, dummy variables ...

Initialization file

- Example
- for a detailed explanation see: *grmpy*-documentation

Simulation

- *grmpy.simulate():*
  - Input: path of the initialization file.
  - The function returns a data frame based on your specifications and different output files.
    - The data set as a pickle and a txt file.
    - An Info file that provides the distributional characteristics of the data as well as information about the different treatment effects.

Estimation

- *grmpy.fit():*
  - Input: path of the initialization file.
  - At the moment the estimation process is only capable of two different optimization algorithms:
    - Broyden Fletcher Goldfarb Shanno (BFGS) algorithm
    - Powell's conjugate direction method

- There are two different options for the start values that could be set in the initialization file:
  - *init:* The estimation process uses the coefficient values specified in the initialization file as the start values for the estimation process.
  - *auto:* The start values are determined via a simple OLS followed by a Probit regression for the choice indicator.
- The estimation results are printed to an output file.

Test battery

- We also provide a test battery that includes several tests to ensure that the processes perform as intended.
  - Property-based testing
  - Reliability testing
  - Regression testing

What’s new?

Figure: Replication Carneiro (2011)

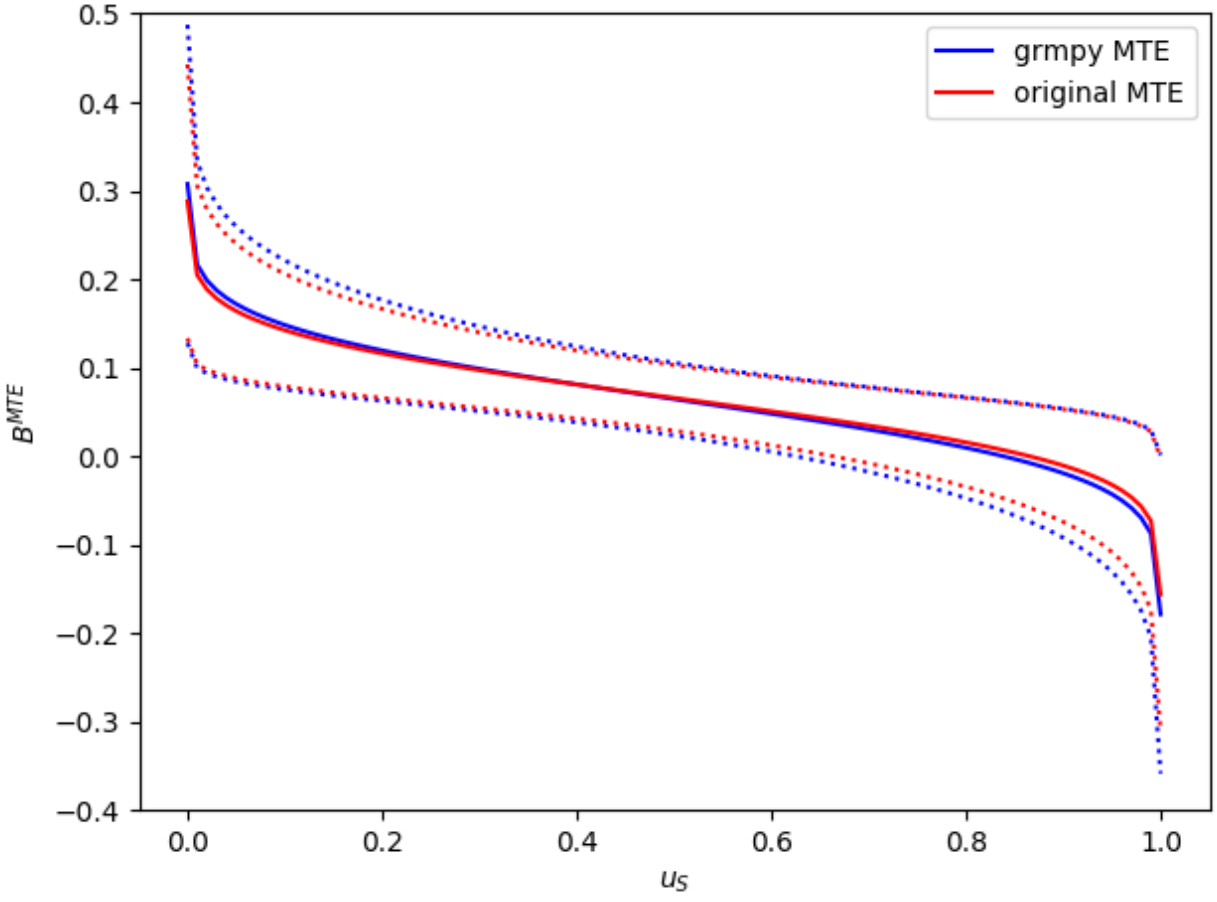
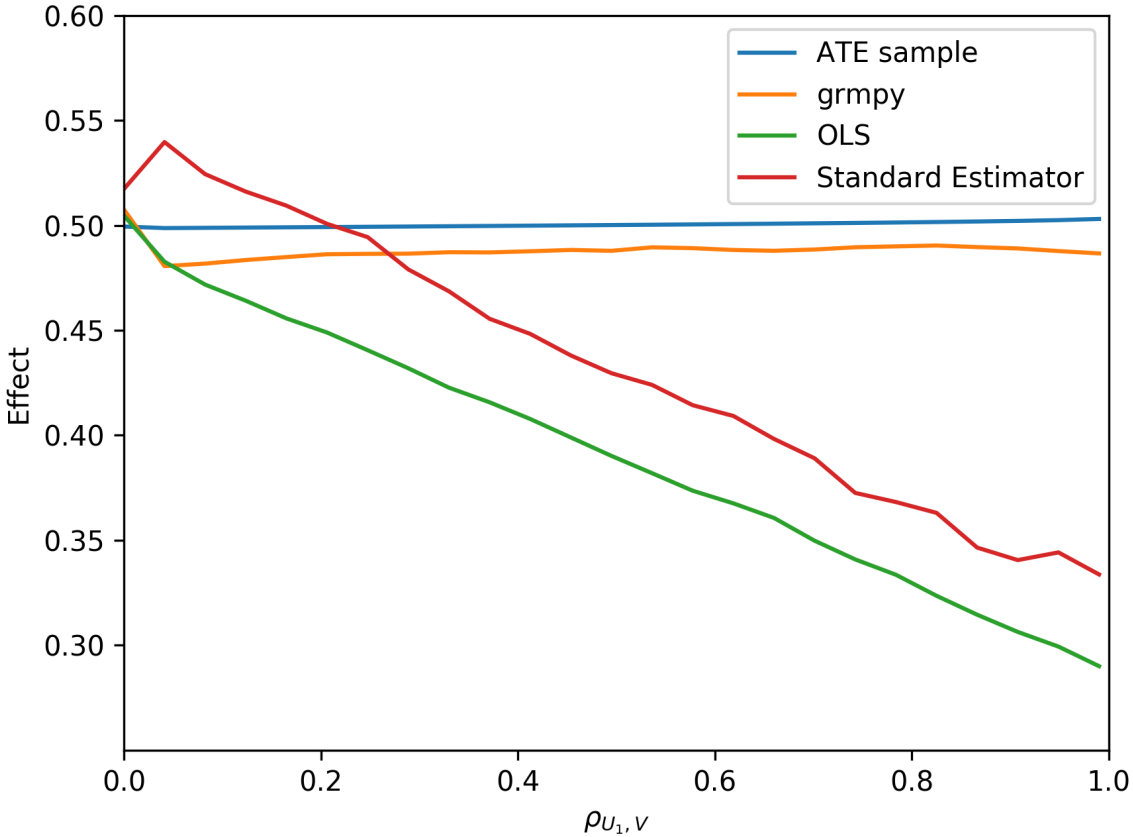


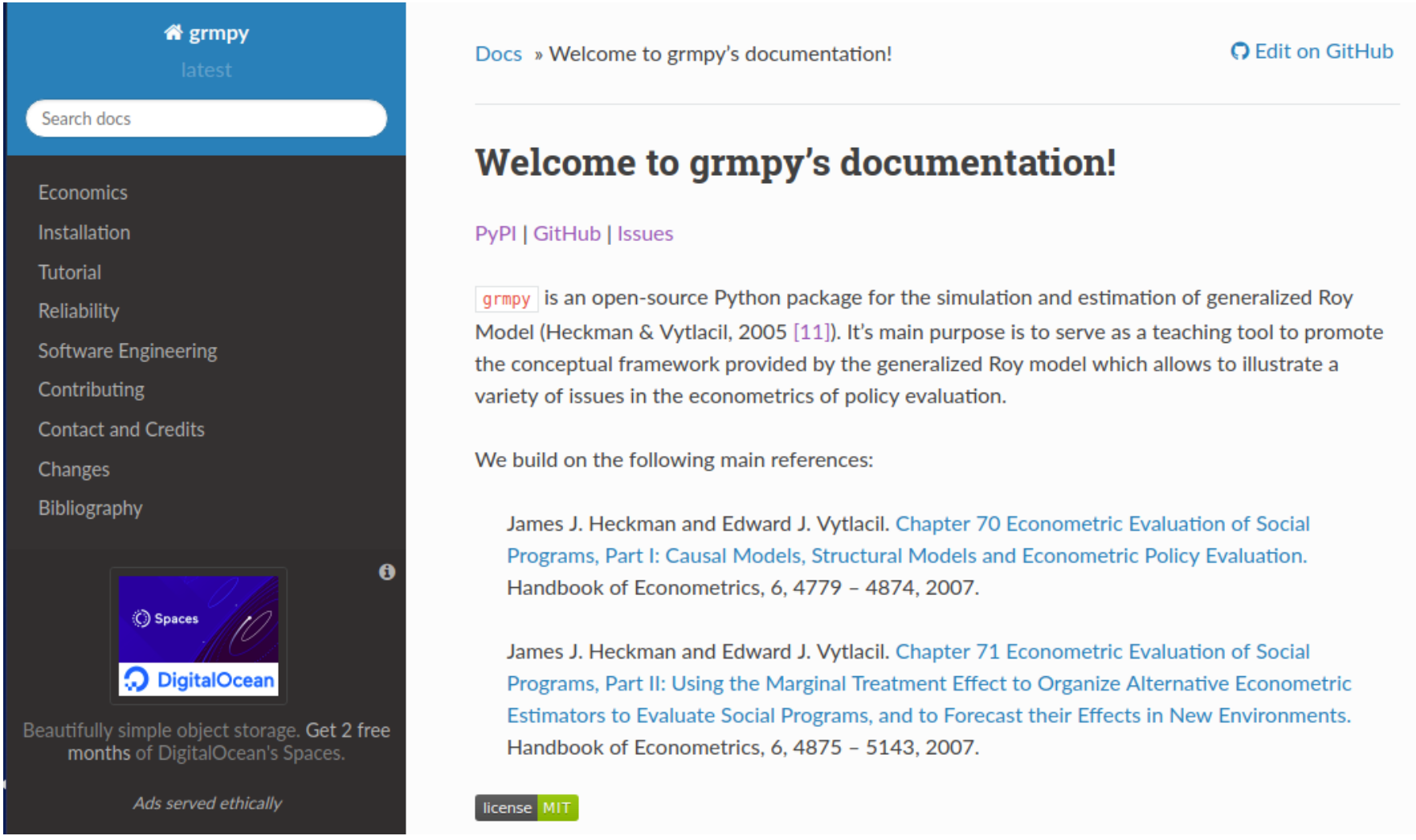
Figure: Performance comparison



Implementation of standard errors and adjustments on the output files

See: Example

Online documentation



Appendix

References

Abbring, J. H., & Heckman, J. J. (2007). Econometric evaluation of social programs, part III: Distributional treatment effects, dynamic treatment effects, dynamic discrete choice, and general equilibrium policy evaluation. In J. J. Heckman & E. E. Leamer (Eds.), *Handbook of econometrics* (Vol. 6, pp. 5145–5303). Amsterdam, Netherlands: Elsevier Science.

Heckman, J. J., & Vytlacil, E. J. (2007a). Econometric evaluation of social programs, part I: Causal effects, structural models and econometric policy evaluation. In J. J. Heckman & E. E. Leamer (Eds.), *Handbook of econometrics* (Vol. 6B, pp. 4779–4874). Amsterdam, Netherlands: Elsevier Science.

Heckman, J. J., & Vytlacil, E. J. (2007b). Econometric evaluation of social programs, part II: Using the marginal treatment effect to organize alternative economic estimators to evaluate social programs and to forecast their effects in new environments. In J. J. Heckman & E. E. Leamer (Eds.), *Handbook*

of econometrics (Vol. 6B, pp. 4875–5144). Amsterdam, Netherlands: Elsevier Science.