

## Book review

**Angrist, Joshua D. & Pischke, Jörn-Steffen (2015). *Mastering 'Metrics: The path from cause to effect*.** Princeton, Oxford: Princeton University Press, 304 p., 35 USD, ISBN 978-0-691-15284-4

Around five years ago, Joshua D. Angrist and Jörn-Steffen Pischke published their first joint book on econometrics tools for causal inference: *Mostly harmless econometrics* (2009). Although this book is excellent in many regards (e.g., more than 5000 quotes on Google Scholar), it was not as harmless as the title might suggest. *Mastering 'Metrics: The path from cause to effect* now fills this gap, as it is a truly non-technical introduction.

Angrist is Ford professor of economics at the Massachusetts Institute of Technology and Pischke is professor of economics at the London School of Economics and Political Science. Both teach applied econometrics and they have published a variety of their own applications of the presented methods. The book is useful in many areas of educational research, because it illustrates the logic behind causal inference when randomized trials are not feasible – this is a standard issue for many educational research questions due to financial, ethical, legal, or other reasons. International large-scale assessments are an example of this: They provide

rich information concerning diverse research questions, but are observational cross-sectional designs by nature. The book discusses the underlying logic and assumptions of causal inference and the related methods in a non-technical way, rather than focusing on the actual estimation of statistical models and mathematical properties (“It won’t surprise you to learn that there’s a formula for IV standard errors and that your econometric software knows it. Problem solved!”, p. 110).

In the chapters, the authors’ five favorite elements in the econometric toolkit are presented methodologically and illustrated in detail using actual applications. Only the most important statistical formulas are presented and thoroughly explained; appendices to each chapter provide some more technical details. Embedded comics and amusing dialog between fictitious characters make reading the book a fluent and joyful experience; the generally informal language they use is also a benefit in this regard (e.g., “randomized social experiments are expensive to field and may be slow to bear fruit, while research funds are scarce and life is short”, p. xiv). The low-threshold and explanatory nature of the book is further underlined by the fact that a supplementary website (<http://mastering-metrics.com/>) provides the datasets used in the examples, as well as further

information for instructors. Many examples are educational in nature and the basic ideas of the different methods are well illustrated, meaning that transferring them to the reader's own research questions is straightforward. Each of the first five chapters captures a different approach to causal inference, while the sixth chapter makes a connection specifically to the educational sector.

The first chapter *Randomized Trials* outlines basic experimental concepts like treatment, outcome, control and treatment group, the fundamental problem that we can always only observe one reality in one person, and the idea that randomization makes "other things equal" (p. xii). It also points out why perfect randomization is difficult to achieve in real life. Furthermore, the issue of statistical significance in the interpretation of results is discussed, as analyses are usually only based on samples drawn from populations.

As already introduced in the first chapter, treatment and control groups are not necessarily equal in all other aspects, especially under non-randomized conditions. Therefore, the idea of "Regression" is discussed in the next chapter. Regression is presented as a conditioning technique that only delivers credible results if all variables that introduce group differences apart from the treatment are observed. Such variables are then computationally made equal across the groups, so that causal inference can be made. The authors emphasize that, in most natural settings, selection bias can have multiple sources that are usually not all observable. In such cases, the power of regression is limited.

More robust inferences can be made if *Instrumental Variables* (chapter 3) are available. The approach is motivated by the example of actual experiments with non-compliance. The prerequisites for using instruments are pointed out clearly and illustrated in different examples. The power of instrumental variables that introduce a certain amount of randomization to selection processes is stressed, as well as the possibility to disentangle resulting treatment effects from selection bias.

The *Regression Discontinuity Designs* are depicted in chapter 4 and distinguished from the instrumental variables approach. The fact that variables in here have a fixed cut-off point – resulting from an external rule – which either completely determines how a treatment manifests or increases its likelihood, is illustrated. Individuals close to this cut-off can be seen as equal in other characteristics. For example, Angrist and Pischke investigate whether young adults die more often on their 21<sup>st</sup> birthday. The regression discontinuity in the mortality rate around the birthday is then interpreted as an indicator for the effect of the minimum legal drinking age, defined by law ("Some young people appear to pay the ultimate price for the privilege of downing a legal drink", p. 164). The basic idea why this method is also a robust path to causal inference is explicitly discussed.

The fact that there are not endless instrumental variables given in all areas of interest, often makes it necessary to use other approaches like *Differences-in-Differences*, which is illustrated in chapter 5. The authors explain how developments of control and treat-

ment groups can indicate treatment effects, even in the absence of randomization. The approach assumes that even if groups differ in the outcome from the very beginning, a non-parallel development of the groups can be attributed to the treatment, which is again illustrated clearly using econometric examples.

In the sixth chapter (*The Wages of Schooling*), some of the particular features of educational research topics are illustrated using examples. The chapter also integrates the main conclusions of the previous chapters and increases the readers' awareness of pitfalls in causal inference.

Because of the substantial linking between the chapters and the underlying common content, ideally, one should read the book continuously from the beginning to the end, although the chapters can also be understood independently. One big advantage of the book is its use of real life examples, which vividly illustrate the path from research question to methodological challenges and solutions, as well as interpretations. Although these examples primarily relate to the United States, the background is always explained in detail. However, this political or social background information is included in the text; explanatory boxes could further increase the readability. Apart from this, the layout and proportion of text, tables, and figures is well balanced. The only typo I noticed concerns some inconsistencies in the charter school ex-

ample (chapter 3), where the numbers in figure 3.1 and table 3.1 do not match.

The book *Mastering Metrics: The path from cause to effect* is worth reading for all educational effectiveness researchers who need tools to address their research questions in secondary analyses. No deep previous knowledge is necessary to follow the argument. Especially the language the authors use makes the book an excellent entrance point for developing an idea for a study or revising other studies. Although the authors address econometricians, the content is of interest for all researchers concerned with cause-and-effect questions. Econometric novices should read the first chapter carefully to fully understand the basic concepts and vocabulary. When it comes to the actual statistical and computational application of the methods, further literature is needed. A short section on additional literature recommended by the authors would complement the book even more. My personal recommendation would be to read *Mostly harmless econometrics* by Angrist and Pischke (2009) in a second step.

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## Reference

Angrist, J. D. & Pischke, J.-S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton, Oxford: Princeton University Press.

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