

Structural

vs.

Reduced-Form Estimation

Microeconometrics and Its Applications

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1 Summary

1.1 The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics

In the paper *The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics*, Angrist, JD and J. Pischke, based on Leamer's point of view, oppose Leamer's complaint that "hardly anyone takes anyone else's data analysis seriously" and propose quasi-experimental findings have filtered quickly into policy discussions and become part of a constructive give-and-take between the real world and the ivory tower, at least when it comes to applied microeconomics.

In this essay, they argue that a clear-eyed focus on research design is at the heart of the credibility revolution in empirical economics. Based on the tendency of quasi-experiment, the authors have put forward their own opinions on industrial organization, macro level and merger. These points will be developed from the critical suggestions of other authors later.

1.2 But Economics Is Not an Experimental Science

However, the paper *But Economics Is Not an Experimental Science* written by Sims, very bluntly opposed part of the views of Angrist, J. D. and

J. Pischke. He believes that “Natural” experiments and “quasi” experiments are not in fact experiments, any more than are Prescott’s “computational” experiments (for example, Kydland and Prescott, 1996). They are rhetorical devices that are often invoked to avoid having to confront real econometric difficulties. Natural, quasi-, and computational experiments, as well as regression discontinuity design, can all, when well applied, be useful, but none are panaceas. Sims said that the essay by Angrist and Pischke, in its enthusiasm for some real accomplishments in certain subfields of economics, makes overbroad claims for its favored methodologies. What the essay says about macroeconomics is mainly nonsense.

The author explains that the fact that the essay is so mistaken about macroeconomics reflects a broader problem. Recent enthusiasm (when Sims wrote this article) for single-equation, linear, instrumental variables approach in applied microeconomics has led many in these fields to avoid undertaking research that would require them to think formally and carefully about the central issues of nonexperimental inference—what Griliches saw, and he sees, as the core of econometrics. Providing empirically grounded policy advice necessarily involves confronting these difficult central issues. If applied economists narrow the focus of their research and critical reading to various forms of pseudo-experimental analysis, the profession loses a good part of its ability to provide advice about the effects and uncertainties surrounding policy issues. Natural experiments, difference-in-difference, and regression discontinuity design are good ideas. They have not taken the con out of econometrics—in fact, as with any popular econometric technique, they in some cases have become the vector by which “con” is introduced into applied studies. Furthermore, over-enthusiasm about these methods, when it leads to claims that single-equation linear models with robust standard errors are all we ever really need, can lead to our training applied economists who do not understand fully how to model a dataset. This is especially regrettable because increased computing power—and the new methods of inference that are arising to take advantage of this power—make such narrow, overly simplified approaches to data analysis increasingly obsolete.

1.3 Taking the Dogma out of Econometrics: Structural Modeling and Credible Inference

Taking the Dogma out of Econometrics: Structural Modeling and Credible Inference written by Nevo and Winston is equivalent to a review about the existing results of Leamer and Angrist, providing critical opinions and supplements in related aspects. The authors point out that since the Leamer article, the empirical research has also changed in at least two other important aspects. The first point is that econometric

methods have made progress in many areas, allowing for more robust reasoning. The second point is also the main focus of the article, which is to improve and increase the use of data analysis commonly referred to as "structure methods"; that is, when using models based on economic theory. Structural modeling attempts to use data to identify the parameters of potential economic models, models based on individual choices or overall relationships derived from them. In this comment on Angrist and Pischke's article, the authors address their criticism of structural analysis and its use in industrial organization, and also offer some thoughts on why empirical analysis in industrial organization differs in such striking ways from that in fields such as labor,

In all, they firmly believe in the importance of credible inference, or "credible identification," and applaud the ingenious approaches to generating or identifying exogenous variation that often appear in the work using actual or quasi-experiments.

The authors point out the limitations of Angrist's approach in the field of industrial organization. The merger example is a good one, but it demonstrate not the "disorganization" of industrial organization, but rather the limitations of Angrist and Pischke's approach.

And on the basis of the first article, the authors point out the difference between industrial organization and labor, and draws a conclusion that their view was that the future of econometrics and applied microeconomic work is in combining careful design, credible inference, robust estimation methods, and thoughtful modeling. Therefore, any serious empirical researcher should build a toolkit consisting of different methods, to be used according to the specifics of the question being studied and the available data. That this should not be an either-or proposition seems quite obvious to us.

1.4 A Structural Perspective on the Experimentalist School

The paper *A Structural Perspective on the Experimentalist School* starts with a joke to distinguish mathematicians, economists and econometricians.

He pointed out the characteristics of econometric economists, The econometrician is well aware that by playing with assumptions—what control variables and instruments to use, what functional forms to pick—it's possible to obtain pretty much any desired coefficient on government spending in the consumption function. This is precisely the problem Leamer (p. 36) talked about: "The econometric art... involves fitting many, perhaps thousands, of statistical models. One or several that the researcher finds pleasing are selected for reporting purposes.

At the same time, the author criticized some of Angrist's views and praised some of Leamer's views.

The author did not believe that the experimentalist school provides

the answer. He believed that "experimentalist" school conveys a false sense of certainty. They came up with "convincing" estimates of "causal effects" that are not "too sensitive to assumptions." They argued this kind of thinking presents a false panacea, and that all statistical inference relies on some untestable assumptions.

Similarly, this paper also distinguished the difference between labor economics and industrial organization and questioned Angrist's views on industrial disorganization. A main theme of the Angrist and Pischke paper is the "proof is in the pudding" argument. They claim that labor economics, utilizing experimental methods, has left other fields in the dust. Specifically, in Keana's point of view, labor has developed wide consensus on a broad range of questions, while fields like macro and industrial organization remain in disarray.

In fact, labor economists have not reached consensus on anything.

Actually, the Angrist and Pischke case for broad consensus/progress in labor is essentially rhetorical. They list many experimental papers that have obtained "convincing" and "influential" results but rarely state what the results are—presumably because we'd see they are controversial.

The author emphasizes the importance of data in econometrics and agree that all econometric work, whether structural or not, should ideally be based on such plausibly exogenous variation in the data. The fundamental problem facing econometrics is how adequately to control the whimsical character of inference, how sensibly to base inferences on opinions.

1.5 The Limits of Inference with Theory: A Review of Wolpin (2013)

The last article, *The Limits of Inference with Theory: A Review of Wolpin (2013)* written by Rust is more like a collation and summary of the author's views in the first four articles. However, unlike the previous four articles, the author did not spend a lot of space on demonstrating the limitations of certain viewpoints, but instead emphasized some of the viewpoints that are of progressive significance for econometrics.

First of all, in the article, the author defines many terms, for example, At the risk of oversimplifying, empirical work that takes theory "seriously" is referred to as structural econometrics whereas empirical work that avoids a tight integration of theory and empirical work is referred to as reduced form econometrics.

It is important to have some degree of agreement on what a model is, since different people have very different definitions—some more encompassing than others.

The term structure or structural model has an additional meaning that many economists ascribe to that requires the analyst to be able to

specify and identify deep parameters that are policy invariant and it's detailed definition of Marschak (1953) is that a structure consists of "(1) a set of relations describing human behavior and institutions as well as technological laws and involving in general, nonobservable random disturbances and nonobservable random errors in measurement; (2) the joint probability distribution of these random quantities."

The author finally concluded that econometric policy evaluation and forecasting is either impossible or highly unreliable using nonstructural or quasi-structural models, which emphasizes the importance of structure learning.

2 Critical Thinkings

Coincidentally, I studied both *microeconometrics and its applications* and *experimental economics* at the same time this semester. The empirical analysis, inference, experiment, structure, etc. repeatedly mentioned in the above five articles are all terms that I have heard repeatedly during the course of learning.

In general, these five articles can be called a battle of American economists in empirical research methods: **Reduced Form Approach** and **Structural Approach**. The difference between these two schools lies in their role in empirical research on economic theory.

Reduced Form Approach believes that empirical research should let "Let data speak for itself" (Let data speak for itself). They believe that the economic theory model is determined by the will of the researcher, and the conclusion obtained by imposing the will of the researcher on the data will be correct only if the model is correct. Because it is impossible for researchers to know what model is correct, their main research tool is simple: use various regression analyses.

Structure Approach believes that data cannot fully reveal how it was generated (Data only can never reveals its own data generating process). The Structure Approach was originally created by the Cowles Foundation (now at Yale University), and Jacob Marschak was an early elaborator. **Structure Approach** believes that if the goal of economic research is the data generating process, then the data generating structure can only be understood with the assistance of the researcher's model, even if the researcher's model may be wrong. **Structural Approach** is very close to physicists in scientific research methods. To understand how matter works, physicists often propose models and then test them with experiments. The physicist's model may be wrong, even if the model is consistent with all current data. But without a model, a physicist's theory is useless, because a large amount of data without a model can not be used for prediction (Prediction). Economists at **Structural Approach** pay attention to the model and to estimate the primitive

parameters in the model. The so-called original parameters refer to those parameters in the preferences and technical equations. These parameters will not change due to policy interventions (Invariant to Policy Interventions). Therefore, the policy predictions obtained by Structural Approach can pass Lucas Critique. On the contrary, most of the parameters estimated by the **Reduced Form Approach** study are not original parameters, so they cannot be used to make predictions, especially the impact of policies that have never been implemented.

Just as George Box said, “*all models are wrong, but some are useful.*”. Useful at a minimum because without a model of some kind there is typically only hand waving. Attempts to go beyond data description without a model are “not even wrong”. That’s because one cannot even define what “right” means for different people hold different kind of view.

And let’s repeat what Pablo Picasso said, “*Art is not truth. Art is a lie that makes us realize truth...*”. The art of empirical work includes selecting a model that captures essential features for the purpose at hand and allows one to justify an interpretation of a measurement. This will involve assumptions that one could question, debate, reject, or improve upon. But only by specifying a model can one speak coherently about whether the maintained assumptions are problematic, whether certain data allow measurement, what alternative assumptions might imply, and how science might progress.

Therefore, in our own survey, we should be careful about the language of empirical economics and don’t be fooled by common abuses. Try not to become part of the problem ourselves. Better yet, look for opportunities to overcome the false barriers by bringing insights from artificially disconnected literatures together.

Last but not least, don’t underestimate the extent to which an economic model can be useful—even essential—to good empirical work.