Comments on Calibration [1]

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1 Introduction

In preparing for this panel discussion on calibration, I read some of the standard references on calibration in the econometrics literature. I also checked the biomathematics literature for the use of similar statistical methods and for discussions of such methods. I checked biomathematics rather than, for instance, physics or chemistry because I write in biomathematics occasionally and have some familiarity with the biomathematics literature. Section 5 lists my readings.

A consideration of calibration as a method of statistical analysis seems to me to involve three questions:

- Ought calibration be done?
- Can calibration be done better?
- What is the role of a refuted theory in science?

Let me address each question in turn.

2 Ought Calibration Be Done?

All of science does calibration, as far as I can tell. I offer up one exhibit from the journal *Science* that would be indistinguishable from a Kydland, Prescott, or Cooley piece were it not for the subject matter: Olsen and Schaffer (1990).

In this article, Olsen and Schaffer fit a modified SEIR model to measles data. The SEIR model is a standard model for describing the dynamics of epidemics which is expressed as system of nonlinear differential equations. Their modification consists of making the contact rate function periodic to reflect that fact that measles is primarily transmitted when children are in school. Certain parameters are the incubation period of the disease, life expectancy, etc. which Olsen and Schaffer determine from standard sources. The parameters of the contact rate function are determined by matching to the sample moments and the periodogram of measles case reports. The purpose of the study is to determine if the modified SEIR model exhibits chaotic dynamics subsequent to calibration.

As with calibration in economics, much calibration in other disciplines is poor statistics. However, it is not disastrous statistics and, as far as I can tell, most of it is good science. It moves the scientific discipline forward. Other disciplines seem to think that it would be nice if the statistics were improved, and some attention is devoted to it in their literature, but as long as the science is good, mediocre statistical practice is accepted. There seems to be little concern with whether or not a procedure satisfies the formal logic of statistical inference or fits within the paradigm of someone long since dead. Obsession with these issues seems to be unique to us members of the Econometric Society.

3 Can Calibration Be Done Better?

Yes, calibration can be done with much higher statistical efficiency than current practice achieves and without arbitrary parameter choice. Moreover, much of the complaint about the absurdity of routine rejection of approximately correct theory is due to the failure to use the newer semi-parametric methods of statistics and econometrics that are appropriate to the scientific questions being posed.

As to the latter, consider one of the most celebrated of rejections: Hansen and Singleton (1982). If the agent's utility function is given seminonparametric representation then that rejection disappears: Gallant and Tauchen (1989). The only thing wrong with the theoretical model was a functional form that was assumed for mathematical convenience in the theoretical evolution of the subject. There was no scientific substance to it.

Using the Gallant-Tauchen (1993) Efficient Method of Moments (EMM) estimator calibration can be made as efficient as maximum likelihood with little additional effort over conventional calibration (Gallant and Long, 1995). [See also Bansal, Gallant, Hussey, and Tauchen (1993) and Gourieroux, Monfort, and Renault (1993).] Under independence of data sets, there is no need for judgmental assignment of parameters when estimates and standard errors are available for them. They can be appropriately weighed into the analysis. A full panoply of inference procedures and diagnostics are available. Seminonparametric functional forms can be blended into the analysis. If desired, calibration can be made quite statistically respectable.

For examples of EMM calibration, see the Bansal, Gallant, Hussey, and Tauchen (1995) application to a two country monetary model and the Ellner, Gallant, and Theiler (1995) application to the SEIR estimation problem described in Section 2. For examples of informative diagnostics in connection with EMM see Gallant and Tauchen (1994).

4 What Is The Role of a Refuted Theory in Science?

Hall (1988) and Caswel (1988) debate the role of a refuted model in ecology and I found this discussion useful in forming my own opinions on the subject.

What was most striking about the discussion is that although each author claims to be taking an extreme position for the purpose of debate, neither thinks that refuted theory should be allowed to enter the tenants of a discipline. I have only heard the claim that refuted theory be allowed to enter tenants in economics, never in another discipline.

The most interesting aspect of Hall's (1988) discussion is the damage that can be done by use of refuted theory in policy. He recounts the damage done to northwestern salmon populations though use of the Ricker model of population dynamics. The Ricker model holds that as density increases the offspring produced per spawning adult declines. An implication is that increases in fishing pressure will not necessarily produce population declines. The consequence seems to be that substantial overfishing has been allowed to the detriment of salmon populations. Furthermore, because of this theory, rather than reduce fishing pressure artificial hatcheries have been built and the output released to the wild. The consequence of this seems to be damage to genetic stock of wild salmon. The ability to reproduce naturally has apparently been compromised.

What we in economics can learn from this discussion can be summarized in the following dictums:

- Do not teach rejected theoretical models to students as truth.
- Do not ever advise a student to use the tenants of a rejected model as a guide in policy. Real damage can thereby be done.
- Do not make nonspecific claims as to the approximate truth of a theoretical model. Either spell out the circumstances where a conclusion is empirically valid and verify that the claim holds with data or quit making the claim.

5 References

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