Chapter 1

INTRODUCTION

The word “structural” has various different meanings in econometrics. In this book, “structural” means that explicit assumptions are made in econometric methods so that estimators or test statistics can be interpreted in terms of an economic model (or models). In some cases, some properties of the estimators and test statistics are known when they are applied to data generated from an economic model. We then use the economic model to interpret empirical results obtained by applying the econometric tools to real data. This is important because an economic model is used to analyze causal relationships between economic variables, and understanding causal relationships is essential for policy evaluations and forecasting.

As a very simple example, consider a model of demand for a good:

$$Q_t^d = a - bP_t + e_t, \tag{1.1}$$

where P_t is the price and Q_t^d is the market quantity demanded. In this model a and b are constants and e_t is the demand shock. The model assumes that the observed quantity, Q_t, is equated with Q_t^d, P_t is nonstochastic, e_t has mean zero, $E(e_t^2) = \sigma^2$, and $E(e_t e_s) = 0$ if $t \neq s$. With these assumptions the Gauss-Markov Theorem can be applied to this model. If the Ordinary Least Squares (OLS) slope coefficient estimator is applied to data of Q_t and P_t for $t = 1, \cdots, T$ in this model, then the estimator is the Best Linear Unbiased Estimator (BLUE) for the demand slope coefficient, b.

One benefit of having this structural model is that we know exactly what the limitations are when we interpret OLS results applied to real data in terms of the model. This knowledge is helpful because we can then study how to improve our econometric methods for better interpretation of data.

For example, consider the assumption made in the model that P_t is nonstochastic. This assumption is sometimes motivated by saying that the price is taken as given by the individual market participants. It is easy to see that this motivation is problematic by considering the supply side of the market. Consider a model of supply of the good:

$$Q_t^s = c + dP_t + u_t, \tag{1.2}$$

where Q_t^s the market quantity supplied and u_t is the supply shock. In equilibrium, the observed quantity, Q_t, is equal to Q_t^d and Q_t^s . Equating the right hand sides of (1.1) and (1.2), and solving for P_t , we obtain

$$P_t = \frac{1}{d+b}(a - c + e_t - u_t). \tag{1.3}$$

Hence P_t is stochastic. Moreover, (1.3) makes it clear that P_t is correlated with e_t and u_t . This means that the OLS slope coefficient estimator is not even a consistent estimator for b or d as discussed in Chapter 5. This leads us to consider an improved econometric method, an instrumental variable method, for example.

The structural demand model tells us under what assumptions we can interpret the OLS slope estimator as an unbiased estimator for b. By studying the assumptions, we can see what will happen when they are violated. This process leads to better econometric methods.

Another consideration is the trend observed in most aggregate data. The demand model with trends leads to cointegrating regressions as discussed in Chapter 15.

Instead of starting with a demand function, one can start with a utility function as in the Euler Equation Approach discussed in Chapter 10. When data contain trends, cointegrating regressions can be used to estimate preference parameters, and this Cointegration Approach can be combined with the Euler Equation Approach as described in Chapter 15.

We do not claim that structural econometrics as defined here is better than non-structural econometrics. They are tools that serve different purposes. Just as it does not make sense to argue whether a hammer is better than a screwdriver, we cannot compare structural and non-structural econometrics without specifying the purposes. For the purpose of summarizing data properties and finding stylized facts, non-structural econometrics is better. This purpose is obviously very important in economics. Using a structural econometric model that enforces a certain economic interpretation is not good for this purpose. On the other hand, after finding stylized facts with non-structural econometrics, one may wish to understand causal relationships that explain stylized facts and make policy recommendations based on causal relationships. For that purpose, structural econometrics is better than non-structural econometrics.

Similarly, we do not claim that the definition of "structural" in this book is better than other definitions. For example, Hendry (1993) and Ericsson (1995) define a structural model as an econometric model that is invariant over extensions of the information set in time, interventions or variables. Their definition is useful for their purpose of finding invariant relationships between economic variables in data, but cannot be used for our purpose of interpreting empirical results in terms of an economic model.

References

Ericsson, N. R. (1995): "Conditional and Structural Error Correction Models," *Journal of Econometrics*, 69, 159–171.

Hendry, D. F. (1993): "The Roles of Economic Theory and Econometrics in Time Series Economics," Invited paper presented at the Econometric Society European Meeting, Uppsala, Sweden.