ECONOMIC MODELS

In this chapter we give you a justification for the growing pains you may experience as we develop the model. The pain will stem from the fact that you will be forced to use models to think about the economy. This takes some "getting-use-to." Even professional economists wonder, at times, whether all the hard thinking involved in using formal models is worth it. We think it definitely is. In fact, we think building, analyzing, and criticizing models is actually fun, most of the time. It is somewhat difficult to talk about economic models until you have actually seen one in action, and as a consequence we will leave some of the justification for certain modeling principles for later. Hopefully, most of you have taken an economics course previous to this one and are familiar with simple demand-and-supply models and maybe even with some elementary theory of the firm. Whether or not you have previous exposure to economics, we advise you to read this lecture quickly for now, but refer back to it whenever you feel that you need some justification for the work ahead.

Justifying the use of abstract models

Every serious scholar uses models to understand observed phenomena. A model is just an abstract or simplified replica of the events and objects being considered. By abstract we mean the model is not a literal description of the way things actually are. The simplification highlights a particular point.

Models are also used by people outside of academia. Engineers construct scaled-down versions of buildings and subject them to various shocks in order to test their structural design. Meteorologists build computer models of the weather to forecast temperatures, precipitation, and
dangerous weather conditions. Travelers use maps highlighting important features of the road which take them from one place to another. All people use the behavior of others in particular situations to help them develop their own behavioral responses in similar, although not literally the same, situations. Football teams use scouting reports to construct replicas of the teams, made up of their own second-string players, they will face on game day. Modeling is a natural response to the complexity of life. Good models provide useful clues that help us understand and deal with real world situations.

Everyone can appreciate the usefulness of the models mentioned above. The problems they are designed to solve are not terribly complex and there is not a high degree of abstraction. In physical and social sciences, where the problems studied are often very involved, a greater degree of abstraction is needed to chip away at the complexity. This prevents some (students and professors alike!) from seeing the usefulness of economic models.

**Characteristics of a Good Model**

a. _models should be simple_

Most aspects of the economy are very complex. This is evident when one considers that economists are still arguing over basic issues such as whether changes in the supply of currency affect the unemployment rate or whether changes in wage rates substantially alter the amount of work effort supplied. To even begin to understand our economy, we must start with a highly simplified economy which abstracts away from many real world details. Since there are no rules explaining how this is done, modeling is a creative act. The basic idea is to include only the fundamental aspects of behavior, production, and trade which might explain the observable phenomenon of interest. All aspects of the economy not deemed to be fundamentally important or that would be too complex to consider are stripped away. For example, the model of the competitive firm in microeconomics does not account for the fact that the firm may be operated by many different managers, may use a particular accounting system, or may package its products with red paper, because these features are not deemed to be fundamentally important. When considering basic questions of firm supply and resource allocation, the competitive model also does not include what may be considered more fundamental features, such as the fact that
market prices may not be known with perfect certainty when production plans are made, simply
because this would complicate the model considerably, and perhaps unnecessarily, for the
particular question under study.

Many people use the fact that the competitive model is not a literal description of an
actual firm to dismiss its value. This is a naive view for two reasons. First, just because the
model cannot explain everything about a firm does not imply that the model cannot explain
anything about a firm. Second, all people who attempt to explain complex phenomena use
models, implicitly if not explicitly. It is a consequence of the limitations of the human mind that
we necessarily must simplify to explain. Those who use formal models have chosen to make
their simplifying assumptions explicit rather than leave them implicit.

b. models should be general

When developing a model, economists wish to find explanations which are common to a
whole host of settings; that is, explanations that do not depend on the particulars of any given
situation. For example, we want our results not only to be relevant for the late twentieth century
United States, but also for Canada, Great Britain, Japan, and so on; and not only for the late
twentieth century but also for earlier periods. If the model is dependent on very specific assump-
tions, it will not be widely applicable. The development of widely applicable explanations, ones
that identify common themes, is the major goal of science. This introduces another reason to
abstract from certain aspects of reality. To achieve generality, the concepts in the model must
also be general, rather than specific and detailed.

An example of a general economic concept is the "production function." This function
gives the relationship between inputs (for example, work effort, plants, and equipment) and
output (the product or service to be produced). The properties assigned to this function (for
example, the "law of diminishing marginal productivity," which says the productivity of
additional hours of work will decrease if levels of plant and equipment inputs are kept constant)
are rather abstract, but are properties that economists feel should be true for a wide variety of
actual production processes. These general concepts, however, may turn people off because they
do not provide a literal description of any particular economic process.
c. models should be logically consistent

If the analysis is not logically consistent, it cannot be trusted. How much faith would you have in a weather model that forecast a snow blizzard with a low temperature in the mid seventies? The purpose of constructing simple, general models is to analyze their behavior in search of insights. Analysis involves going from the model's basic assumptions about how the economy works to conclusions about the relationship between key variables. To have faith in the conclusions about the key relationship, we must be sure the analysis is logically consistent.

For the analysis to be logically consistent certain rules must be followed. The invention of mathematics was purposely designed to provide a language which forces those using it to follow logical rules. Therefore, models are typically written down mathematically or using diagrams and graphs which represent the mathematics in a more concrete form. While the use of mathematics has this valuable advantage, it makes "doing" economics more difficult. First you must learn the mathematics and then you must accept the discipline it imposes on your thought process. This can all be very frustrating at times, and sometimes it even turns professional economists against the use of formal models. In addition, putting your ideas down in mathematical form makes your model look that much less like an "actual" economy. This reinforces some people's belief that models are nothing more than an intellectual game with no tie to reality. Fortunately, good economic reasoning is also intuitive. Having derived a result using formal reasoning, an economist should then be able to tell a "story," using common language instead of mathematics that captures the essence of the insight.

In summary, we cannot pretend to understand our economy if we cannot first understand how simplified versions of our economy work. Models should be viewed as rigorous testing grounds for our initial beliefs about the economy. They force us to be logical and they provide insights that would not occur to us otherwise. While it is easy to poke fun at models because of their unrealistic assumptions, this trivial and empty practice should be avoided. The more challenging and fruitful exercise is to think deeply about what abstract models tell us about the real world. To drop the use of formal models would open the door to sloppy, inconsistent reasoning, which is not reasoning at all.

d. models should yield useful insights and mimic certain aspects of reality
Models take time and energy to build and to justify the expenditure of these resources models should be useful. By useful we mean that they should help us understand or predict. For example, to be useful a model of the weather should give fairly accurate predictions about temperatures. The predictions do not have to be perfect, this would be too much to ask. But on average they should be close, and the model should predict that temperatures in the summer exceed those in the winter. A topographical map helps us understand the lay of the land, and this may help us plan our hike or invasion. It does not have to show each pebble or even each boulder, but it certainly should distinguish between cliffs and plains.

You have probably heard the saying "good in theory, but bad in practice." This last property of a good model is inconsistent with this old saying. If the model yields useful insights and mimics that part of reality in which we have an interest, then it is good in practice. We can translate the saying into one with which we can agree - "a logically consistent theory does not necessarily yield useful insights or mimic reality." There are many models that are consistent, but not very useful. But these are not our best models or perhaps even good ones.

What is Reality?

A good model or theory should mimic reality, but what is reality? Reality for the macroeconomist consists primarily of the relationship of variables to real output. Since we are interested in understanding the business cycle, we first want to detrend the variables before examining their relationship to real output, and, just as in chapter 1, we do this by calculating growth rates. Once we have the growth rates, the next step is to find out how the growth rate of the variable is correlated with output growth. For example, Okun's law tells us that the unemployment rate tends to fall during an expansion and rise during a recession. When on average a variable moves in the opposite direction as output over the business cycle, we say that the variable is countercyclical, and so the unemployment rate is countercyclical. On the other hand, if the growth rate of a variable typically increases when output growth increases, we say the variable is procyclical. We will see in the next chapter that consumption is procyclical. If a variable does not have a systematic relationship with real output, we say that it is acyclical. As
we study macroeconomic variables in the coming chapters, we will first want to know about their cyclical behavior. This information guides both the development of the model and its evaluation, and for this reason we call this information the **guiding facts**.

**Constructive Criticism**

By defending the use of models we do not mean to suggest that models should go completely without criticism. The question is what are constructive ways to criticize models. In constructive professional assessment of models there are three questions which are usually asked.

1. **Is the model consistent?**
   
   Clearly you should not trust anyone's reasoning if you are not sure it is logically consistent. It must be clear that the argument proceeds from the assumptions to the conclusions in a logical fashion.

2. **Is the model insightful?**
   
   If you are going to go to all the trouble of constructing models, they should expose nonobvious relationships between variables or non-obvious explanations of why variables are empirically related.

3. **Does the model mimic certain aspects of reality?**
   
   We know certain facts about our economy, for example, imposing rent control reduces the number of rental units traded. If the competitive model was unable to replicate this event, it would be a less convincing model of market exchanges. To take a macro example, a good model should predict that consumption is procyclical.

**Summary**
Generally, economists like to argue and will welcome criticism in the form of the questions posed above. Throughout the book we will use these criteria to assess the models we discuss. It's only when people question the realism of their assumptions, without appreciating why the assumptions are made, that economists get testy.

Review and Discussion Questions

1. Give the most convincing argument you can for use of models.

2. What do we mean when we say a model is abstract? We once heard a famous physicist say, "Models are concrete, it is the real world which is abstract." What do you think he meant by this?

3. A frustrated student will often say, "I just can't handle all the graphs. When are we going to talk about real world economics." How would you respond to these comments?

4. What criteria are used in the constructive assessment of models?