THE MODAL VIEW OF ECONOMIC MODELS

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Much economic theorizing consists of elaborating and using economic models. Familiar examples are Keynesian income–expenditure models, the model or theory of the firm in perfect competition, and the model of the rational consumer. Different views of economic models have been proposed by philosophers of economics, one of which is the modal view.[1] The following passage from Daniel Hausman, a critic of the modal view, provides a rough account of the view:

> Instead they [economists] wish to interpret their models as making unrealistic claims s(4) ... about how things *would be*, were various complications absent. I shall call this view of economic models the "modal model" view, since it interprets models as making *modal* claims about how things would be. According to the modal view, sentences like "Entrepreneurs attempt to maximize profits" do not merely define predicates in models and make inexact claims in theories. Rather they state truths about certain *possible* economies. (1981, pp. 146–147)

One alternative to the modal view is an application to economic models of the structuralist view – or, as it is sometimes called, "the semantic view" – of scientific theories. A second alternative to the modal view takes economists' models to be collections of lawlike generalizations, which is an application to economic models of a popular view of scientific theories. My aim here is twofold. I want to explain in a satisfactory manner what the modal view affirms. Also, I will suggest that the modal view has some distinct advantages over the two alternatives just alluded to.

I

On the modal view, an economic model consists of a set K of definitions and non–definitional assumptions *plus* a set of objects L whose behavior is described by K and K's logical and mathematical consequences. (Some models are developed without relying on definitions; in such cases set K includes only non-definitional assumptions.) The objects in L are *hypothetical* in that they would exist if the conditions conveyed by K were met in the real world. For example, the model of the short run behavior of a business firm in perfect competition is typically developed by presenting the definition of a perfectly competitive market, as well as setting out a number of assumptions or axioms. The axioms include such statements as that firm managers select an output level which maximizes firm profits, and assumptions about the shapes of various cost curves of the firm. Using logic and mathematics, theorems are generated from the axioms and the definition of a competitive market.[2] The model describes the behavior of hypothetical objects, i.e. objects that would exist if certain conditions were met. The model includes a set of firms, firm managers, etc. – this is the model's set L – whose behavior is described by the sentences of the model. These firms, firm managers, etc. are hypothetical. They would exist if the conditions conveyed by the sentences in the set K of the model obtained in the real world.

What has been said so far about economic models holds for *theoretical* models. The modal view in the form I am prepared to defend it also recognizes *applied* models. An applied model is a model which has been applied to a *real world* situation. To apply a model M to a real world situation S is to interpret the variables and general terms in M in terms of S. To interpret a variable in M in terms of S is to replace the variable with the corresponding variable whose values are *restricted to* magnitudes in S. For example, consider a Keynesian income–expenditure model whose axioms include the following consumption function:

(1) $C = a + bDY$ $a > 0, 0 < b < 1.$

To interpret the variables "C" and "DY" in (1) and elsewhere in the model in terms of the American economy in 1989, is to replace "C" and "DY" in the model – actually or merely mentally – with "consumption spending in the U.S. economy in 1989" and "disposable income in the U.S. economy in 1989" respectively. To interpret a general term in a model M in terms of a real world situation S, is to replace the general term with another one

denoting *only* items in S. For example, to interpret the term
"firm" in the model of perfect competition in terms of the wheat
market in the United States, is to replace "firm" in the model
with a term like "American wheat farm."[3]

On the modal view *only* theoretical models are about hypo-
thetical objects. Various sentences in an applied model are true
or false statements about the real world situation to which the
model is being applied.[4] For example, suppose we apply the model
of perfect competition to the wheat market in the United States.
The axiom of the model "firm managers select an output level
which maximizes firm profits" becomes a truth or falsehood about
just the firms in the American wheat market. It will be a truth
provided that managers of wheat farms set their output level
where marginal revenue equals marginal cost (and the second
order condition for a maximum is also met). But theoretical
models do *not* contain true or false statements about real world
situations. They include *true* statements about *hypothetical*
objects. I am not saying non–definitional sentences of a theo-
retical model *would* be true if certain circumstances obtained.
The sentences of a theoretical model *are* true. The point is worth
emphasizing. A theoretical model includes in effect a domain or
universe of discourse consisting of hypothetical objects – this is
the set L mentioned at the start of this section. The sentences of
the theoretical model are interpreted in terms of the domain of
hypothetical objects. For example, a term like "firm" in the
theoretical model of perfect competition is interpreted as apply-
ing to the firms among the hypothetical objects in the model's
domain. It is stipulated or postulated that the non–definitional
sentences of a theoretical model afford a *true* description of the
hypothetical objects in the model's domain.[5] Thus the truth of
the non–definitional sentences of a theoretical model is quite
actual; it is only the objects which these sentences are about
which are hypothetical.

It is worth deflecting a misunderstanding of the modal view,
a misunderstanding which has led to a negative appraisal of the
view by some. Consider the following passage from one of
Hausman's discussions of the modal view:

> Many economists have regarded their theories as making
> claims about how things would be were various complica-
> tions absent. I do not see any way of arguing that this
> view of economic models and theories is incorrect. I have,
> however, two qualms. First I am disposed toward metaphys-
> ical modesty. If one can thoroughly and sensibly under-
> stand economic theory without making reference to merely

possible economies, so much the better. (1981, p. 147)

This passage implies that the modal view of economic models is committed to an ontology of possible or hypothetical objects. But the modal view carries no such commitment. The modal view says theoretical economic models afford true descriptions of the behavior of hypothetical objects. This does not mean the modal view is committed to the *existence* of hypothetical objects of any kind. To say a model provides a true account of hypothetical objects of some sort, is to say the model describes the behavior of objects that *would* exist if certain conditions were met. This hardly implies that objects of the sort in question *do* exist. I can give a true description of a forest fire that would occur in the Santa Cruz mountains if certain conditions were met. But this does not mean that the fire exists or is occurring.

Even though the modal view of economic models is not committed to the existence of hypothetical or possible objects, it might still be thought that the modal view relies on or presupposes the possible worlds framework which some philosophers – David Lewis, Kripke, *et al.* – have tried to develop to interpret ordinary modal discourse and provide semantics for modal logic. (Of course, many who adopt the possible worlds framework do not think that *there are* possible worlds, possible objects, etc.; only modal realists like David Lewis think this.) The modal view does say theoretical economic models afford true descriptions of hypothetical objects. And, it might be said, what else is a hypothetical object but an object that exists in, or is an inhabitant of, a possible world? The conclusion that would be drawn is that the modal view is unattractive given its involvement with the problematic possible worlds framework. However, the line of thought just set out is not persuasive. To be sure, the modal view of economists' models uses the concept of a hypothetical object. As indicated above, this notion is explainable as follows:

> (2) X is a hypothetical object iff if certain conditions were met in the real world, then X would exist.

The subjunctive conditional on the right side of "iff" in (2) obviously does not contain a term expressing the concept of a (logically) possible world or kindred notions such as an inhabitant of a possible world. Of course, there is an analysis of subjunctive conditionals, developed by David Lewis, Stalnaker, *et al.*, which uses the possible worlds framework. A rough, informal version of this analysis applied to what follows "iff" in (2) above is as follows (Lewis, 1973, p. 1):

(3) "If certain condition were met in the real world, then X would exist" means that X exists in that possible world most like the actual world in which the certain conditions are met.

If (3) reflects how we are to understand subjunctive conditionals like the right side of (2), then the notion of a hypothetical object, and so the modal view, does presuppose the possible worlds framework. But the modal view's involvement with the framework would simply be a result of the *correct* analysis of subjunctive conditionals, which happens to use the possible worlds framework. And this involvement could hardly be seen as a defect in the modal view. On the other hand, there is no general agreement among philosophers that the possible worlds approach does represent the correct analysis of subjunctive conditionals. And if it should turn out that a possible worlds analysis of subjunctive conditionals is *not* correct, then the modal view's notion of a hypothetical object defined by (2) would not presuppose the possible worlds framework. In sum, either the modal view presupposes the possible worlds framework, but this implies no defect in the modal view. Or the modal view does not involve the possible worlds framework at all in which case it cannot be seen as unattractive because of a commitment to that framework.

II

It should be reasonably clear what the modal view of economic models amounts to. I now want to sketch the two alternatives to the modal view referred to at the outset. Let us start with what I will call "the lawlike generalization view of economic models." This is an application of a view of scientific theories which is succinctly set out in the following passage from Hausman:[6]

Few contemporary philosophers still accept the positivist view of scientific theories. Theories cannot be formalized in the way in which the logical positivists wished, and to view scientific theories as primarily formal or syntactic objects does not do justice to the way in which theories are constructed or used. Furthermore, the problems of relating theory to observation, in the form in which positivists posed them, are intractable. Many philosophers now settle for an informal construal of theories as collections of lawlike *statements* (not uninterpreted, purely syntactic sen-

tences) systematically related to one another. (1984, p. 12)

Applying the view of scientific theories presented here to economic models gives us the lawlike generalization view. According to this, an economic model is a set of lawlike general statements (true or false sentences) systematically related to one another. Presumably the sort of systematization in question is deductive. So, on the lawlike generalization view, an economic model is a set of lawlike generalities which can be organized into a deductive system. This does not mean the lawlike generalization view reflects acceptance of the logical empiricist view that a *formalized* deductive system underlies a scientific theory, including an economic model. On the lawlike generalization view, an economic model can be seen as a nonformal deductive system, and no formalized deductive system need be associated with the model. One feature of the lawlike generalization view which bears emphasizing is that statements comprising an economic model are about *real world* objects. For example, the model of the rational consumer familiar from microeconomic textbooks includes the sentence

(4) consumers have preferences that are transitive.

The term "consumers" in (4) denotes or applies to real world consumers such as you and me. A distinction between theoretical and applied models such as the modal view makes is not recognized by the lawlike generalization view. *All* economic models are applied in the sense that their terms are interpreted as denoting real world economic phenomena, and their variables are regarded as expressing real world economic magnitudes.[7]

The second alternative to the modal view I want to discuss is the structuralist position. The structuralist view I will describe is an application to economic models of a fairly simple composite of versions of the structuralist view of scientific theories presented by several different authors.[8] On the structuralist view an economic model is associated with a *definition* of a predicate. For example, a Keynesian income–expenditure model is associated with the definition: X is a Keynesian economic system iff X satisfies the following axioms. A list of the axioms would follow, which would include sentences like the consumption function (1) set out in section I. As the example indicates, a list of the axioms of a model is included in the definiens of the definition of the predicate which the model gives. A *realization* for an economic model is an item which is denoted by the predicate defined by the model.[9] For example, suppose the American economy in 1929–

1933 satisfies the axioms of a Keynesian income–expenditure model. In this case, the American economy in 1929–1933 is denoted by the predicate "is a Keynesian economic system," and so is a realization for the model. In addition, an economic model has a set of *intended applications*, which comprise the *real world* items which are intended to be (or which proponents of the model want to be) realizations for the model. For example, the American economy in 1929–1933 might be among the intended applications of a Keynesian income–expenditure model. Letting P be the predicate defined by an economic model and X a real world item, "X is a P" is an *empirical hypothesis*.[10] The sentences in the list of axioms included in the definiens of the definition of the predicate an economic model gives are without truth–value. In other words, apart from a realization for a model, the axioms – and therefore the theorems which follow from them – are lacking a truth–value (Hausman, 1981, p. 46; Hands, 1985, p. 306, p.322). Thus the axioms listed in the definiens invite comparison with the axioms of a deductive system whose non–logical terms are uninterpreted. The axioms of such a system are open sentences, and so truth–valueless. But the empirical hypotheses associated with an economic model *are* true or false. An empirical hypothesis "X is a P" is true just in case the real world item which "X" denotes is a realization for the model which gives the definition of "P."

The distinction between the modal and lawlike generalization views of economic models should be fairly clear. On the latter, all economic models are about real world objects, whereas on the modal view only applied models concern real world phenomena. Theoretical models are about hypothetical objects. But the relationship between the modal and structuralist views of economic models is less clear cut. A key difference between the two is that the structuralist view associates a definition of a predicate – which includes a list of truth–valueless axioms – with an economic model, whereas the modal view does no such thing. But there are some similarities between the structuralist and modal views. The empirical hypotheses associated with an economic model on the structuralist view are rather analogous to the applied models corresponding to a theoretical model on the modal view. Both the empirical hypotheses and the corresponding applied models say something, whether true or false, about real world economic phenomena; though an empirical hypothesis is a single statement, whereas applied models of the modal view are whole groups of statements.[11] Does the structuralist view recognize anything analogous to the theoretical models of the modal view? The set of axioms included in the definition of the predi-

cate associated with a model does not fill the bill. For, on the
modal view the axioms of a theoretical model – which are included
in the model's set K – are *truths*, albeit about hypothetical
objects. But the axioms included in the definition of a predicate
associated with a model on the structuralist view *lack* a truth-
value, unless a realization for the model is supplied. However,
the structuralist view does recognize something which is similar
to the theoretical models of the modal view. Suppose we have a
set of hypothetical objects which constitute a realization for an
economic model, and so the axioms listed in the definition of the
predicate the model gives become *truths* when interpreted in
terms of the hypothetical objects in question. Obviously this set
of truths *plus* the realization for the model in question are quite
similar to a theoretical model as conceived by the modal view.

III

I now turn to indicating some advantages of the modal view of
economic models over the two rival positions set out in section
II. Let us first compare the merits of the modal view and the
lawlike generalization view. There is a feature of economic theo-
rizing which the modal view accounts for much better than does
the lawlike generalization view. The feature I have in mind is
that some economic models do not purport to describe any real
world phenomena. I will call such models "nondescriptive mod-
els."[12] A clear example of a nondescriptive model is the Tiebout
model in public finance. The following are assumptions or axioms
of the Tiebout model (Tiebout, 1972, pp. 516–518):

> (A1) Consumer–voters living under local governments are
> fully mobile and move to the community whose tax and
> expenditure package best satisfies their preference for
> local public goods. (A2) Consumer–voters have full knowl-
> edge of the tax and expenditure packages of the different
> local governments. (A3) There are a large number of com-
> munities in which consumer–voters can choose to live. (A4)
> The source of consumer–voter incomes provides no obstacle
> to their full mobility – for example, they might derive all
> their income from dividends on common stock they own.
> (A5) There are no external benefits or costs from the
> provision of public goods by the communities from which
> the consumer–voters can choose. (A6) A local community
> reaches its optimum size when its expenditure package for
> existing residents is provided at lowest average cost. (A7)

Communities below optimum size try to get new residents to lower costs, and communities at optimum size try to keep population constant.

In developing his model, Charles Tiebout was not trying to describe any real world phenomena of interest to economists. And this was fortunate. Axioms of the model such as (A2) are obvious falsehoods construed as being about consumer–voters living under real world local governments in the United States or anywhere else. Thus the Tiebout model would afford a very poor description of real world phenomena were it to be regarded that way.[13]

If the Tiebout model does not purport to describe real world phenomena, what is it supposed to do? Public goods, in the economist's sense of the term, have the nonexcludability feature, i.e. it is not feasible to charge a price for them and exclude those who do not pay from consuming the goods. National defense is a frequently cited example. Many economists have believed that neither the *national* government nor a system of private markets is likely to provide the quantities of public goods people really want. Essentially this is because of the problem of preference revelation. Each person has a motive to conceal his preference for a public good hoping it will be provided anyway. Due to the nonexcludability feature, the person will then be able to consume the good without having to pay for it. Tiebout developed his model for the purpose of establishing the following claim:[14]

(TC) The provision of public goods by *local* government *can* approach the quantities people want.

Given axioms (A1)–(A4) of the Tiebout model, citizen–voters will reveal their preferences for public goods by moving to another community or staying put. Voting with one's feet provides the solution to the problem of preference revelation at the *local* level. The equilibrium state of the model obtains when no consumer–voter can better satisfy his preference for public goods provided by local government by moving to another community of less than optimum size. That is, once no consumer–voter can better satisfy his preference for public goods by moving to another community, no motive exists for further adjustment. Thus, when the Tiebout model is in equilibrium, consumer–voters have come at least fairly close to getting the quantities of public goods they want insofar as local government can provide these. Given that the Tiebout model generates this conclusion, claim

(TC) would seem to be clearly warranted.

On the lawlike generalization view of economic models, we would have to regard the Tiebout model as being about real world phenomena. A term such as "consumer-voter" in the axioms of the model would have to be interpreted as denoting or applying to inhabitants of *real world* local communities such as Santa Cruz, California and Ghent, Belgium. Now this way of looking at the Tiebout model would make sense provided that the model is to be regarded as an attempt to describe real world phenomena. For, if the model is to be seen as attempting to tell us something about what happens in real world local communities, then of course we should construe terms such as "consumer-voter" as denoting inhabitants of real world local communities. But if the Tiebout model is not to be viewed as describing how real world local communities work, what point is there in interpreting the terms in it as denoting real world objects? I think it is safe to say that the Tiebout model should *not* be regarded as an attempt to describe what happens in real world local communities. The model does not purport to give such a description. Instead, it is designed to establish a certain *possibility*, viz. the one conveyed by claim (TC) above. Moreover, viewed as an effort to describe the real world, the Tiebout model would have to be judged quite deficient. Again, axioms such as (A1) and (A2) are evident falsehoods when interpreted as being about the inhabitants of real world local communities.[15] Thus, interpreting the terms in the Tiebout model as the lawlike generalization view would have us do, would make little sense. It would distort the character of the model and the role it is designed to play.

However, the way the modal view of economic models regards the Tiebout model results in no such distortion. On the modal view, Tiebout's model is a theoretical model whose set K contains the axioms (A1)-(A7), and whose set L is a set of hypothetical objects including consumer-voters and local communities having different tax systems and mixes of public goods. A term like "consumer-voter" in the axioms of the model does *not* denote inhabitants of real world local communities, but rather the hypothetical consumer-voters in the model's set L. Thus the Tiebout model is not seen by the modal view as attempting to describe what happens in real world local communities. Instead, the axioms of the model afford a true description of what happens in the model's domain of hypothetical objects. Obviously, the account the modal view gives of the Tiebout model is entirely faithful to the fact that the model does not purport to describe any real world phenomena.[16] Moreover, the role Tiebout's model is

designed to play can be easily understood in terms of the modal view. Again, Tiebout developed his model in order to show that it is possible for local governments to provide the quantities of public goods which approximates what consumer–voters want. On the modal view, Tiebout tried to establish such a possibility by developing a set of assumptions which afford a true description of a hypothetical domain. He reasoned from his assumptions to the theorem or conclusion that the consumer–voters of the *hypothetical* domain *do* come at least close to satisfying their preferences for public goods. Surely this is a very sensible approach to trying to establish the possibility in question.

Judging from our discussion of the Tiebout model, it seems that the lawlike generalization view of economic models does not fit at all well the fact that economics includes nondescriptive models. But the modal view is entirely consonant with this fact. And this is a significant advantage of the modal view over the lawlike generalization view.

The structuralist view is the other account of economic models whose merits I want to compare with those of the modal view. An advantage which has been claimed for the structuralist view is that it explains what D. Wade Hands has called "the empirical immunity" of economic theory. Hands describes this as follows:

> Despite the fact that most economists openly advocate the severe empirical testing of economic theories, they in fact almost never practice what they preach. Negative evidence, if acknowledged at all, is never quite sufficient to dislodge (or cause the rejection of) a professionally popular theory. (1985, p. 322)

There is no general agreement on the extent of the evidence which apparently disconfirms models or theories economists persevere in accepting.[17] But let us grant the claim that economists continue to hold onto models in the face of what seems to be adverse empirical evidence. The structuralist view is supposed to make sense of this practice in the following way (Hands, 1985, pp. 322–323). On the structuralist account of economic models, there may be empirical evidence which disconfirms a particular empirical hypothesis such as "the American economy in the 1970s is a Keynesian economic system." But an economic model itself is not disconfirmed by such empirical evidence. Indeed, an economic model is not the sort of thing that could be disconfirmed by any empirical evidence.[18] It is no wonder, then, that economists hold onto models in the face of apparently

adverse evidence; it is not really evidence against the models themselves. Now the modal view can make sense of the empirical immunity of economics as easily as the structuralist account can. On the modal view, empirical evidence can disconfirm an *applied* model corresponding to some theoretical model. But such evidence does not impugn the theoretical model at all. Empirical evidence of whatever sort is powerless to disconfirm a theoretical model.[19] For empirical evidence is formulated by statements characterizing real world economic phenomena, while a theoretical model includes *truths* about hypothetical economic phenomena. Since on the modal view apparently adverse empirical evidence does not tell against theoretical models, it is not surprising economists persevere in accepting theoretical models in the face of evidence which some have taken to disconfirm economic theories. In sum, the ability to explain the empirical immunity of economics does not distinguish the structuralist view of economic models from the modal view.

Another advantage which has been claimed for the structuralist view of economic models is expressed in the following passage from Hausman:

> This kind of endeavor is particularly prominent in economics, where theorists devote a great deal of effort to exploring the implications of perfect rationality, perfect information, and perfect competition. These explorations, which are separate from questions of application and assessment, are, I believe, what economists (but *not* econometricians) call "models." One can thus make good use of the semantic view to help understand theoretical models in economics. (Hausman, 1984, p. 13)

Given the reference to perfect competition and the like, Hausman seems to claim here that the structuralist view of models (he calls it "the semantic view") has the advantage of enabling us to understand nondescriptive models in economics such as the Tiebout model and the model of perfect competition. This claim implies that nondescriptive models can be viewed along structuralist lines without distorting their nature or role in economic theorizing. This implication seems plausible enough. We might reconstruct the Tiebout model along structuralist lines by recasting the model as defining a predicate like "is a Tiebout system of local governments." The definition would be this: X is a Tiebout system of local governments iff X satisfies the following axioms. The definiens would be completed by listing axioms (A1)–(A7) of the Tiebout model set out above. A set or system of

hypothetical consumer–voters and local governments could be specified as a realization for the model. This set of hypothetical objects would be denoted by "is a Tiebout system of local governments." Theorems of the model can be interpreted in terms of the set of hypothetical objects in question, including the theorem that when the Tiebout model is in equilibrium, consumer–voters at least come fairly close to getting the quantities of public goods they want. The fact that this theorem so interpreted can be deduced establishes the possibility that local governments can provide at least close to the quantities of public goods people want. This structuralist presentation of the Tiebout model seems compatible with the fact that it is a nondescriptive model, as well as the fact that its role is to establish the *possibility* just mentioned.[20] Yet the apparent fact that viewing nondescriptive models along structuralist lines does not distort their nature or role, gives us *no* reason for preferring the structuralist view of economic models over the modal view. As indicated above, the modal view is entirely consonant with the presence in economics, and the functioning, of nondescriptive models.

The last two paragraphs may give the impression that the structuralist and modal views of economic models are pretty much tied as far as their worth or merits go. But this is not so. The modal view enjoys a significant advantage over the structuralist view. The modal view is a much better description than the structuralist view of the way economists *in fact* present and apply their models. As a matter of fact, in presenting or developing a model, economists do *not* give a definition of a predicate of the sort described by the structuralist position. For example, in developing his model, Tiebout simply did not state a structuralist style definition of a predicate such as "is a Tiebout system of local governments." Economists do set out assumptions or axioms when they develop a model. And *sometimes* presenting a model includes giving one or more definitions. But the definitions are *not* at all like a structuralist definition of a predicate. For example, the usual development of the model of the behavior of a firm in perfect competition includes a definition of a perfectly competitive market. The definition specifies conditions individually necessary and jointly sufficient for a market being perfectly competitive, conditions such as the firms on the sellers' side of the market produce a homogeneous good. But the definition does not say a market is perfectly competitive iff it satisfies the axioms of the model such as "firm managers select an output level which maximizes firm profits." So the structuralist view just does not fit the way economists actually present their

models apart from applications to the real world. The modal view affords a better fit here. On the modal view a theoretical model may include one or more definitions like the definition of a perfectly competitive market, and it definitely includes a separate list of axioms or assumptions. And, as just indicated, this in fact is how economists present their models. Nor in applying their models to the real world, do economists affirm empirical hypotheses of the sort the structuralist view talks of. Instead, economists apply models to real world situations in the manner described by the modal view in the second paragraph of section I.[21] This could be readily confirmed by looking at applications of models to real world situations given in textbooks on microeconomic and macroeconomic theory.

It might be admitted that the structuralist view does not afford as faithful a description of the way economic models are actually presented as does the modal view. But, it might be said, the structuralist view should not be seen as a description of how economists actually present and apply their models. Instead it should be seen as characterizing a way in which economic models can be reconstructed which is illuminating.[22] And we should compare the structuralist and modal views as illuminating reconstructions of economic models, rather than descriptions of the actual manner in which models are handled in economics. In response to this, the modal view itself involves a certain amount of reconstruction of economists' models. On the modal view, a theoretical model includes a set of hypothetical objects whose behavior is described by the axioms of the model. But in presenting their models, economists usually do not specify a set of objects explicitly identified as hypothetical whose behavior is described by assumptions of the models. Furthermore, I am willing to grant that economic models can be reconstructed or restated along structuralist lines. For a given economic model, philosophers of economics can invent a predicate and recast the model so that it gives a structuralist style definition of the predicate – this was done above for the Tiebout model. But what gain in illumination would flow from restating economic models along structuralist lines which we do not get from the modal view? As we have seen, viewing economic models from the structuralist perspective can make sense of the empirical immunity of economic theory. But recall that the modal view can do this just as well. It has been claimed the structuralist view enables us to understand nondescriptive models in economics such as the Tiebout Model. But, as indicated above, the modal view also affords us this understanding. In short, I do not see that anything illuminating results from structuralist reconstructions

of economic models which the modal view does not also give us. But since the modal view is a much better description of how economists actually present and apply models, the modal view is the better of the two accounts of economic models.[23]

The modal view has been compared to the structuralist and lawlike generalization views of economic models. On the basis of the discussion here, the modal view is preferable to either of its two rivals.

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NOTES

1. On Neil DeMarchi's recent interpretation of J. S. Mill's philosophy of economics, Mill adopts a somewhat crude version of the modal view. (DeMarchi himself seriously underestimates the relevance of the modal view to understanding post-classical economic theory.) See DeMarchi, 1986. I have tried to show (Rappaport, 1986) that the modal view can be used to defend neoclassical microeconomics from the charge of incorporating falsehoods.

2. A look at any standard presentation of neoclassical microeconomics will verify this description of the elaboration of the model. For example, see Nicholson, 1978, p. 286, pp.

3. A useful distinction can be made between casual applications of economic models and applications employing the techniques of econometrics (Gibbard and Varian, 1978, p. 672). I am describing here only casual applications of economic models.

4. Economic models seldom, if ever, fit the real world exactly. So it would be better to say that sentences in an applied model are *approximately* true concerning the real world situation to which the model is being applied. And to say this is to affirm that the real world situation in question closely resembles the way the world would be if the sentences in the applied model were true.

5. Gibbard and Varian claim (1978, p. 667) that the sentences of a model that is not applied to a real world situation are without truth-value. This contradicts the account of theoretical models supplied by the modal view. But I do not find acceptable this claim Gibbard and Varian make about the sentences of non-applied models. See Rappaport, 1986, p. 292, pp. 295-296 note 6. The way the non-definitional sentences of a theoretical model acquire their truth is a case of what

Quine calls "legislative postulation," which he regards as a way in which sentences in set theory have their truth fixed. See Quine, 1966, pp. 110–113.

6. But Hausman himself does not adopt the lawlike generalization view. He seems to accept a structuralist construal of economic models. See Hausman, 1981, pp. 44–48; 1984, pp.

7. Sometimes the lawlike generalization view is put forward as holding for theories in social science generally, and therefore for economic theories or models in particular. See Brodbeck, 1968, pp. 457–458. Alexander Rosenberg has held that the general sentences of neoclassical microeconomics are lawlike general statements whose subject matter is real world economic phenomena (Rosenberg, 1976, chs. 3, 6, and 8). This reflects acceptance of the lawlike generalization view. The Rosenberg of 1976 thinks that the lawlike generalizations of microeconomics are qualified by explicit or implicit *ceteris paribus* clauses (*Ibid.*, p. 130, pp. 133–138). And this is perfectly compatible with the lawlike generalization view of economic models.

8. Versions of the structuralist (or semantic) view of theories are found in Suppes (1957), Stegmüller (1976), Van Fraassen (1980), and Giere (1984). Hands (1985) and Hausman (1981) present structuralist accounts with an emphasis on application to economics (though Hands' final assessment of the structuralist position is negative).

9. Structuralists usually speak of models for a theory (Suppes, 1957, p. 253). I have used the term "realization" instead of "model" here to avoid confusion between economic models and models as items which satisfy the axioms of a deductively organized theory.

10. Some versions of structuralism would *identify* an economic model with an ordered n–tuple which contains the set of realizations for the model and the set of intended applications (Stegmüller, 1976, p. 118; Hands, 1985, p. 311). Other versions would identify an economic model or theory with the conjunction of the empirical hypotheses associated with the model (Giere, 1984, p. 83).

11. In Hausman's version of the structuralist view, an empirical hypothesis associated with an economic model logically implies what he calls "closures of" the axioms of the model (1981, pp. 47–48). These are the axioms of the model interpreted in terms of the real world item or system which the empirical hypothesis is about. In Hausman's version of structuralism, a set of closures of the axioms of a model is the closest thing to an applied model of the modal view.

12. Gibbard and Varian distinguish (1978, p. 665) between ideal models and descriptive models, though they say little in explanation of the distinction. What Gibbard and Varian call "ideal models" would seem to be the same as my nondescriptive models. It should be noted that from the fact that a model is nondescriptive, it does *not* follow that it can play no role in understanding real world economic phenomena. The model of perfect competition is nondescriptive. Yet economists standardly use it as a framework for understanding real world agricultural markets.

13. Economists have made some effort to determine to what extent the circumstances envisaged by the Tiebout model resemble what goes on in real world local communities. The approach which economists have adopted is to try to infer from the Tiebout model some statement which can be tested against empirical data. An example of such a statement is: a community's level of expenditure on public goods is positively correlated with local property values, and the level of local taxes is negatively related to property values (Oates, 1969, pp. 959–962). The inferred statement is then tested with the aid of multiple regression analysis. Depending on the outcome, some conclusion is reached about the resemblance between the world of the Tiebout model and the real world. The fact that economists have tried to determine what resemblance, if any, holds between the world of the Tiebout model and the real world, is perfectly consistent with the model not purporting to describe anything in the real world.

14. See Tiebout, 1972, pp. 513–514. Also, Tiebout says (*Ibid.*, p. 522) "It is the contention of this article that, for a substantial portion of collective or public goods, this problem *does have* a conceptual solution." (The problem Tiebout is alluding to is specifying a mechanism for getting consumer–voters to reveal their preferences for public goods, and so for the quantities of such goods people want to be provided.) Note Tiebout describes his model as affording a *conceptual* solution of the problem.

15. Perhaps an advocate of the lawlike generalization view would say (A1) and (A2) are *not* falsehoods once they are qualified with the appropriate *ceteris paribus* clauses. But in fact, in presenting his model Tiebout did not view its axioms as qualified by *ceteris paribus* clauses. Moreover, the *ceteris paribus* clauses which do qualify *some* statements in economics exclude each of a number of specified circumstances which could explain a breakdown of the statement qualified. For example, the law of demand says: *ceteris paribus*, the

quantity of a good buyers purchase and the good's own price are negatively related. The *ceteris paribus* clause in front of the law of demand excludes the presence of each of a number of circumstances – a change in buyers' income, a change in the price of a substitute good, etc. – which, if present, could cause a failure of quantity purchased to vary negatively with the good's own price. But what circumstances would be excluded by a *ceteris paribus* clause in front of, say, axiom (A2) of the Tiebout model? That consumer–voters lack complete knowledge of the tax and expenditure packages of the different local communities? But if *this* is what is excluded, axiom (A2) becomes a mere tautology, which would seem inconsistent with at least the spirit of the lawlike generalization view of economic models.

16. On the modal view there is an indefinite number of *applied* models corresponding to the theoretical Tiebout model. The Tiebout model might be applied – in the sense described in section I – to the set of local communities in the United States, the set of local communities in France, etc. (But given what we know about people who inhabit real world local communities, all these applied models would include statements which are false.) The discussion of the Tiebout model here does not concern any of these applied models. It is only concerned with the model Charles Tiebout presented in his original paper which was designed to establish the possibility conveyed by claim (TC).

17. Alexander Rosenberg claims the empirical failures of neoclassical microeconomics are considerable (1986, p. 129). He affirmed this in response to D. Wade Hands assertion to the contrary (1984, p. 497).

18. This claim looks plausible on versions of structuralism which identify an economic model with an ordered n-tuple which includes the set of realizations of the model, etc. (see note 10 above). But the claim would obviously be incorrect on a version of structuralism identifying a model with the conjunction of empirical hypotheses associated with it.

19. Elsewhere I have developed this point at somewhat greater length for neoclassical microeconomic models (Rappaport, 1986, pp. 293–294).

20. Philosophers of economics have applied the structuralist view in some detail to Walrasian general equilibrium theory (Händler, 1980; Hands, 1985). Hands says (1985, p. 329) the set of intended applications of general equilibrium theory is pretty much *empty*. The same is true of the set of intended applications of the structuralist reconstruction of the

Tiebout model. No set of real world local communities or governments is going to satisfy axioms of the Tiebout model like (A2).

21. Recall from note 3 above that the account of applied models supplied by the modal view is restricted to non–econometric applications of models.

22. Logical empiricists made a rather similar claim about their view that a scientific theory is associated with a formalized deductive system. For example, Richard Rudner says (1966, p. 18) "It would be a serious mistake to construe the foregoing account [of theories as formalized deductive systems] as a description of the *actual* process by which theories are, or should be, formulated. It is *not* a description of any *process* of theory construction, actual or proposed; it is, rather, an account of the logical or structural characteristics of theories."

23. Hands makes the sensible suggestion (1985, p. 304) that a *good* philosophical account of economic models either helps us better understand such models, or accurately describes how economists actually handle their models, or both. My case here for the modal view relies on Hands' criterion. The structuralist view does not enable us to explain anything about economic models which the modal view cannot also explain; and the modal view is a more accurate description of how economists present and apply models. So, on Hands' criterion for a good philosophical account of models, the modal view has the advantage over the structuralist view.

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