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Model selection and multiple research goals: The case of rational addiction

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Abstract A comparison of rational addiction and time inconsistency models of addiction highlights the complexities of model selection when researchers have goals in addition to empirical fit. Although currently the two models of addiction are underdetermined by data, each offers a different understanding of addiction; moreover, the two models offer starkly different policy implications. When the goals of understanding and policy usefulness are added to the goal of empirical fit, a more complex account of model selection is needed. First, the principle of parsimony loses some of its force when researchers also value understanding and policy usefulness. Second, when economists value understanding as well as pure prediction, a broader justification of the realism of assumptions becomes possible. Third, because radically different policy advice flows from these empirically equivalent models, this literature underscores the difficulty of separating the seemingly positive analysis of consumer behavior from normative analysis.

Keywords: rational addiction, time inconsistency, model selection, parsimony, realism of assumptions

1 MODEL SELECTION AND THE PURPOSES OF MODELS

'Those who consider only one thing have no difficulty in deciding'. – Aristotle. Sen (1991) identifies three types of economic analysis, classified by subject matter:

(1) Predictionist, whose purpose is to predict future events or to explain existing data.
(2) Descriptive, whose purpose is to describe economic phenomena.
(3) Evaluative, whose purpose is to provide a framework for normative policy prescription.

Each of these different types of analysis is defined by its purpose. Each requires a different method, according to Sen. For example, descriptive analyses often have little new predictive content, and so cannot be evaluated in the same way predictive analyses are. In the light of this diversity of purposes, the discipline's focus on empirical tests and parsimony, while

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appropriate for predictive models, may be misplaced when models serve goals other than prediction.

If economic models each served only one of Sen's three purposes, we might develop a separate set of methodological standards for each of the three types of models. This would be difficult enough. The task of model assessment is complicated further by the fact that models often attempt to promote all three goals at once – models that predict well are at the same time defended as good descriptions of economic reality and as useful guides for normative policy work.

The presence of all three purposes complicates the account of model choice. Choosing among models may involve trade-offs of legitimate goals. Moreover, principles of model evaluation that are appropriate for models with a single purpose (for example, parsimony, which promotes the goal of prediction) may lose their justification when multiple goals are at stake in the analysis. Finally, the justification for principles that promote several goals may become confused: a principle may promote a certain goal that is widely shared, and at the same time promote other goals that are of disputed importance.

A comparison of recent models of addictive behavior brings into sharp relief the conflicts between the multiple purposes of models, and the potential confusion about model evaluation. This literature serves as a case study in model selection when models have multiple purposes.

The rational addiction model of Becker and Murphy (1988) and the time inconsistency addiction model of Gruber and Köszegi (2001, 2004) have nearly identical structures, and are nearly indistinguishable by conventional econometric methods. The empirical equivalence of the two models confirms the broader conclusion of Goldfarb *et al.* (2001), that rational addiction and time inconsistency models are underdetermined by data.

Although these two models are empirically equivalent, when compared along two additional dimensions of value they are starkly different: they offer distinct understandings of human decision-making in the presence of addictive goods, and have quite different policy implications. Rational addiction models describe consumers who are forward-looking and competent to promote their welfare over time. The only reason to restrict their access to addictive goods is externalities. In time inconsistency models, consumers are forward-looking, but they have internal control problems, and cannot trust themselves to carry out their optimal consumption plans over time. Because consumers in time inconsistency models can benefit from external restrictions on consumption, these models imply a larger role for government constraints on addictive goods, through taxes and restrictions on purchase.

The differences between these two models raise important questions about the role of research purposes in model selection, and the connections between positive and normative analysis. First, because the two models have

different implications for understanding and policy advice, the principle of parsimony does not cut as sharply. One cannot rely on the principle of parsimony alone to decide between the models. Parsimony carries great weight if the only goal at stake in model choice is simple, accurate prediction; in the presence of other contested goals, it becomes less compelling.

A second important issue raised by these two models is the nature of the appeal to the realism of assumptions. Advocates for time inconsistency models assert that the assumption of time inconsistency is more realistic than the alternative of time consistency, citing survey and experimental evidence. There can be two justifications for this appeal to the realism of assumptions. One is based on confidence that, eventually, true assumptions will lead to better empirical fit; the second points to the richer understanding that more plausible assumptions make possible. This understanding is valuable in its own right. It is not always clear which of the two justifications is invoked by an appeal to the realism of assumptions.

The comparison of these two models highlights a third challenge for model selection: in this literature one finds the selection of a normative framework for policy analysis entangled in the positive analysis of the details of consumer choice. The choice between these two models highlights the insight of MacIntyre (1984) that positive statements about human welfare have clear normative implications. Given the lack of a certain method for adjudicating conflicting claims about human nature and human welfare, a case exists for a pluralism of modeling; by keeping both models of addiction in view, the profession maintains the healthy empirical competition between them, and reminds itself of the normative stakes in putatively positive analysis.

Section 2 outlines each model and its rationale. Section 3 describes three dimensions of value along which one might evaluate a model: empirical fit, understanding and policy usefulness. Section 4 compares the two models along each dimension of value, and discusses the challenges raised by the addiction literature for conventional accounts of model selection.

2 TWO ECONOMIC MODELS OF ADDICTION

2.1 The Becker–Murphy model

Becker and Murphy (1988), building on the foundation laid in Stigler and Becker (1977), offer a model of addictive behavior that assumes fully rational, forward-looking behavior. The stated purpose of the model is twofold: first, to show that a behavior which appears to violate the canons of rationality is in fact a special instance of forward-looking rational choice, and second, to offer a model of addiction that does not rely on internal conflict within a divided self (see Elster 1979; Winston 1980; Thaler 1981;

Thaler and Shefrin 1981; and Schelling 1984, for models with divided selves). The rational addict follows 'a consistent maximizing plan' (Becker and Murphy 1988: 691). Given exogenous prices and the other parameters of the model, the rational addict never does something he does not intend to do, or did not intend to do in the past, or would do differently from the vantage point of the future, unless new information affects his retrospective judgment.

The model consists of a consumer who lives for T periods. The agent consumes two goods, the numeraire y and an addictive good c (e.g. cigarettes). Utility in period t is a function of y_t, c_t, and the stock of past consumption of c, S_t:

$$u = U(y_t, c_t, S_t),$$

$$U_y, U_c > 0, U_S < 0, U_{cS} > 0$$

U is concave in y, c, and S. Past consumption depreciates at rate d:

$$S_{t+1} = (1-d)S_t + c_t, \; 0 < d < 1, \; S_0 = \bar{S}_0 \tag{1}$$

The stock of past consumption S_t has a negative effect upon single-period utility, and it increases the marginal utility of c_t. Accordingly, someone who consumes c this period will add to the stock of S next period, which decreases next period's utility at the same time it makes c more desirable. The consumer has a time discount factor δ, a financial discount factor ρ, and lifetime wealth W. The price of y is 1, and the price of c at time t is π_t. In any period τ, the consumer solves the following dynamic optimization problem:

$$\underset{y,c}{\text{Max}} \sum_{t=\tau}^{T-\tau} \delta^{t-\tau} U(y_t, c_t, S_t)$$

$$\text{s.t.} \quad \sum_{t=0}^{T} \rho^t (y_t + \pi_t c_t) \leq W, \tag{2}$$

$$S_{t+1} = (1-d)S_t + c_t, \; \forall t > 0,$$

$$S_0 = \bar{S}_0$$

The only difference between this model and the standard intertemporal choice model is the addition of the stock S, which generates intertemporal complementarity in c. In rational addiction models, consumers take into account the consequences of their consumption choices on their future behavior and preferences. Consequently, at time t the forward-looking consumer discerns a total cost for c which is higher than the price at time t. By increasing c_t, the consumer increases S_{t+1}, which decreases future utility. Moreover, the consumer anticipates the effect of

today's consumption on the future desirability of c, and, through future choices of c, future stocks. The class of models that are of most interest in this literature are those in which S and c are positively related, in which a higher stock of past consumption is associated with increases in present consumption.

The rational addiction model makes predictions about consumer behavior that are confirmed in consumption data. An important implication of these models is that current consumption of an addictive good is positively related to past and expected future consumption. Many researchers have found positive correlations between past, future and present consumption of addictive goods (the most common test is conducted on cigarette consumption); this evidence appears to confirm the theory (Becker *et al.* 1994; Chaloupka and Warner 1998).

The rational addiction model offers a convenient model of consumer behavior, which explains intertemporal correlations in consumption data, and which can be used to model binges, cold turkey, cycles in the consumption of addictive goods (see Dockner and Feichtinger 1993), and even regret about addiction (Orphanides and Zervos 1995). It is also parsimonious: it utilizes no new tools beyond dynamic optimization, and does not complicate the account of rational choice by splitting the person into different selves who compete for control over the budget.

2.2 The Gruber–Köszegi model: rational addiction with time inconsistent consumers

Since Stigler and Becker (1977), economists have suggested alternative models of addiction which, unlike the rational addiction model, paint a picture of consumers who are not fully able to carry out their preferred consumption plans. One set of models (Winston 1980; Schelling 1984; Thaler and Shefrin 1981) posits a consumer divided into multiple selves whose internal conflict affects consumption choice and welfare. In all of these models the consumer may welcome external constraints on his or her consumption, in the form of higher prices for addictive goods, or outright restrictions on its purchase.

More recently Laibson (1997) and O'Donoghue and Rabin (1999), which model the time inconsistent choices of consumers whose time preferences are quasi-hyperbolic (Strotz 1956), have made possible an intriguing modification of the rational addiction model that incorporates the insights of internal conflict models. Gruber and Köszegi (2001) offer a fully developed model of rational addiction which incorporates quasi-hyperbolic discounting, and which subsequently allows for the possibility that consumers may benefit from external constraints on their behavior.

In the conventional model of intertemporal consumption (equation (2)), at every time t consumers discount future utility exponentially:

$$u_t = \sum_{\tau=0}^{T-t} \delta^{\tau} U_{t+\tau},\ 0<\delta<1 \tag{3}$$

In this framework, any trade-offs of utility between any two periods in the future that are desirable at time t will also be desirable from the perspective of time t+1. The consumer's time path of consumption choices is time consistent.

Laibson (1997) suggests a simple form of quasi-hyperbolic discounting, in which a consumer places greater weight on the present:

$$u_t = U_t + \beta \sum_{\tau=1}^{T-t} \delta^{\tau} U_{t+\tau},\ 0<\beta<1 \tag{4}$$

In this framework, at time t the consumer assigns a relative weight to utility between time t and time t+1 that is less than the relative weight between consecutive future periods ($B\delta<\delta$). When any future period becomes the present, the consumer will similarly place greater weight on that period's utility than on the utility of the periods following it.

Incorporating quasi-hyperbolic discounting into the rational addiction model of equation (2) yields the following specification of the consumer's problem at time τ:

$$\begin{aligned} &\underset{y,c}{\text{Max}}\ U(y_\tau, c_\tau, S_\tau) + \beta \sum_{t=\tau+1}^{T-\tau} \delta^{t-\tau} U(y_t, c_t, S_t) \\ &\text{s.t.} \quad \sum_{t=0}^{T} \rho^t (y_t + \pi_t c_t) \le W \\ &S_{t+1} = (1-d)S_t + c_t,\ \forall t > 0, \\ &S_0 = \bar{S}_0. \end{aligned} \tag{5}$$

In every period the consumer solves this problem. Interestingly, the consumption path that maximizes discounted utility at time t will differ from the consumption path that maximizes utility at time t+1 – the consumer's optimal consumption path is not time consistent. When the person arrives at period four, for example, he will not weigh the trade-offs between period four and five utility in the same way that he weighs them in period zero.

If the consumer does not take into account this time inconsistency, he is 'naïve', in the terminology of O'Donoghue and Rabin (1999); if he takes into account his changing perspective over time when planning current consumption, he is said to be 'sophisticated'. The sophisticated consumer

will solve the dynamic optimization problem of equation (5) via backward induction, beginning with the solution to the problem in the last period, T.

2.3 A comparison

The only difference between the Becker–Murphy model and the Gruber–Köszegi model is the way in which consumers discount the future. Both models posit forward-looking, utility-maximizing consumers. The Becker–Murphy model is a special case of the Gruber–Köszegi model: it examines addictive behavior as the parameter β goes to one, or as consumers become less time inconsistent.

This relatively small change in specification changes the implications of the model radically. Intriguingly, the two models do not have different qualitative predictions about consumption of addictive goods: both imply that current consumption is positively correlated with past and future consumption, and that expected future increases in prices will decrease current consumption. The only clear empirical differences between the models are the differences in assumed time preference: Gruber–Köszegi assumes that rates of time preference evolve over time so that a greater weight is always placed on current utility. The practical difficulty of obtaining tight estimates of rates of time preference (Gruber and Köszegi 2001) makes it unlikely that the different assumptions can be sorted out empirically any time soon.

Although direct estimates of rates of time preference in consumption data are unavailable to help researchers distinguish the two models, there is an ongoing debate over whether the two models can be distinguished in other kinds of empirical data. Gruber and Köszegi (2004) summarize the empirical argument in favor of time inconsistency models of addiction: evidence of time inconsistency in laboratory experiments (Ainslie and Haslan 1992), evidence of time inconsistent patterns of savings and consumption (Angeletos *et al.* 2001; Della Vigna and Malmendier 2004), evidence that excise taxes on cigarettes raise reported well-being among smokers (Gruber and Mullainathan 2002), and the use of commitment devices among smokers.

Other researchers have suggested extensions to the model of consumption that preserve time consistency, and have questioned the evidence of time inconsistency. Goldfarb *et al.* (2001) assert that the differences between the rational choice and time inconsistency models of smoking are at present underdetermined by data: rational addiction models can be modified to predict a wide range of addictive behavior and survey responses. Becker and Mulligan (1997) present a model in which time preference is itself a choice variable; this modification makes the rational addiction model more flexible, so that apparent time inconsistency may be explained as rational choice of time preference. Fernandez-Villaverde and Mukherji (2002) and

Besharov and Coffey (2003) raise questions about the interpretation of laboratory behavior as time inconsistent: actions that seem time inconsistent may instead be rational responses to uncertainty.

It is fitting that proponents of these models should seek better evidence by which to select one of them; eventually, this search may bear fruit. Even Gruber and Köszegi (2004) do not think that empirical tests have yet settled the matter: 'much more is needed before the time inconsistent model will be accepted as the appropriate formulation of preferences' (p. 1963). Even if the ongoing attempts to bring data to bear on model selection are successful, the expenditure of energy on an as-yet-unproven alternative to rational addiction raises a further question in model selection: why choose models of time inconsistency as alternatives to rational addiction? Researchers have been conducting research into time inconsistency models for a decade; the decision to select them as candidate models cannot have been made on the basis of empirical fit.

Sutton (2000) expresses a general doubt about the prospects of distinguishing rival theories in data, and suggests that other factors determine model choice:

> econometric tests of rival theories are notoriously problematic, and often fail to resolve the issue. We therefore need to place a heavy reliance on our judgment as to what factors matter in a situation, as well as on a priori considerations that lead us to model a situation in one way rather than another (Sutton 2000: 101).

When two theories are underdetermined by data, the choice between the two is often made on 'pragmatic' grounds (Quine 1953).[1] The term 'pragmatic' defines a catchall category; it includes all of the goals of modeling other than empirical fit. When Quine claims that empirically equivalent models are evaluated on pragmatic grounds, he is simply claiming that researchers bring to bear goals other than empirical fit when selecting models. The most common pragmatic consideration in economics is parsimony: simple explanations are preferred. Clearly, the Becker–Murphy model is more parsimonious, so the more complicated Gruber–Köszegi model can only be justified on grounds other than empirical fit.

There are other important pragmatic considerations at stake in the choice between these two models, however. Each model offers a different understanding of human capabilities, and interprets the same patterns in consumer choice differently. Moreover, these different understandings of human behavior and welfare imply very different policy prescriptions. The choice between the two models is fraught with normative content, and provides a challenge to purportedly value-neutral empirical methods of model evaluation. To invoke parsimony is to ignore the force of these other pragmatic considerations.

What particular understanding of human nature and behavior does rational addiction incorporate by its assumptions? To our understanding it offers an account of human behavior under addiction that is consistent with the standard rational choice model. Although addicts may discount the future consequences of their actions more heavily than non-addicts, they are still forward-looking, and respond to the benefits and costs of addiction in a consistent way. Addictive goods fit neatly into an existing analytical category: they are simply complements in consumption across time. This complementarity preserves the conventional model of consumer choice. The sense that the reigning paradigm of consumer choice covers the peculiar case of addiction is a strong argument in favor of rational addiction models (Reder 1999). It preserves the unique analytical perspective of economics. Moreover, it promotes a policy perspective in which the consumer is autonomous, capable of promoting his interests through free consumption choices.

Time inconsistency models, by incorporating internal conflict into consumer choice, offer a markedly different understanding of consumer choice. Both models assume that addicts are rational, but addicts in the Gruber–Köszegi model find their addiction problematic – that is, they anticipate that they will consume more in the future than they presently would like to consume in the future. The time inconsistent consumer will welcome external constraints on his behavior, since he cannot trust himself to maximize his own utility in the future. In contrast, consumers in the rational addiction model of Becker and Murphy face no such internal contradictions. A consumer can anticipate that he will make consumption decisions in the future that fit the consumption plan made today.

The policy implications of the rational addiction model are no different from those of the conventional model of the rational consumer. The consumer is fully rational and competent to act in his best interest. In so far as he knows his own interests, the consumer considers all of the consequences of his actions on his utility when consuming today – he takes into account the full cost of his addiction when choosing it. If he did not want to smoke, he would not.

More importantly, the rational addict would never want smoking to be more expensive; any restrictions on smoking would be involuntary. The individual needs no outside help (in the forms of taxes or restrictions on consumption) to choose what is best for him. Indeed, outside restrictions on the consumption of the addictive good unambiguously make the addict worse off: 'Our model recognizes that people often become addicted precisely because they are unhappy. However, they would be even more unhappy if they were prevented from consuming the addictive goods' (Becker and Murphy 1988: 691). The validity of the preferences created by addiction are unquestioned by the policymaker.

Within the context of this model, the only justification for government restrictions on access to the addictive good is externalities. In the case of cigarettes, only external costs such as secondhand smoke or costs imposed on the common pool healthcare system can justify a cigarette tax. The excise taxes justified by the externalities of cigarettes are small relative to actual excise tax rates (Manning *et al.* 1991; Chaloupka and Warner 1998; Kenkel *et al.* 2002 incorporate peer externalities to justify a higher optimal tax). This theory cannot be used to justify paternalistic government regulation of addictive goods (Pollak 1978, 2002). It offers no policy framework for those who begin with the assumption that smokers can benefit from outside help.

Because it offers a strikingly different vision of human choice, the Gruber–Köszegi framework implies a more paternalistic policy toward addictive goods. Consumers in the Gruber–Köszegi framework are vulnerable, not only to externalities imposed by others, but to their own lack of self-control ('internalities'). In this model, taxes are an external device by which a person can manage an internal coordination problem. Since the internal costs of addiction are much larger than the external costs, time inconsistency models can be used to justify much higher taxes than are justified by external costs alone (Gruber and Köszegi 2004).

How should economists choose between these two models? Is the analytical complication of time inconsistency a welcome improvement to the model of addiction, even if it does not improve empirical fit? The answer depends upon the relative values of empirical fit, understanding and policy usefulness. The next section defines these dimensions of value more carefully, and discusses model selection in the light of them.

3 EMPIRICAL FIT, UNDERSTANDING AND POLICY USEFULNESS

In economics, rival theories are tested by comparing their implications in observed data. Gruber and Köszegi (2001) admit that empirical tests of cigarette consumption 'cannot distinguish the rational addiction model from alternatives such as ours'. Because of the empirical equivalence of the two models, the principle of parsimony counts against the more complicated time inconsistency model. In spite of this, Gruber and Köszegi argue for the value of their model along other dimensions. Indeed, they cite the empirical equivalence of their model and the Becker–Murphy model as a point in their favor: one need not sacrifice empirical fit to adopt their model and its unique insights. They are clearly arguing for more complex criteria for model selection.

The deference that economists give to the value of empirical fit testifies to its primacy among the purposes of economic models. If the empirical performance of the Gruber–Köszegi model was poorer than that of the Becker–Murphy model, few economists would be willing to consider its

other charms; the weight they attach to the empirical equivalence of the two models is testimony to the importance of empirical fit. Before defining the other purposes of modeling, we must first define empirical fit more carefully.

I choose the term 'empirical fit' over the more common terms, 'prediction' and 'explanation'. Friedman (1953) famously asserted that the only purpose of models was successful prediction; in practice, models are judged both by their predictions for the future and by the account they give for patterns in historical data. A model demonstrates empirical fit to the extent that its logical implications are observed in data; the data may be historical or not yet observed.

Model A has a better empirical fit than model B if A has empirical implications that B does not have, and if those implications can be observed in data. For example, unlike early habit-formation models of addiction, which predicted a positive correlation between current and previous consumption of addictive goods, the Becker–Murphy model correctly predicts that current consumption should be correlated with both past and future consumption. The Gruber–Köszegi model implies the same intertemporal correlations in consumption; its different implications for discount rates cannot be distinguished in data, however.

When two models are empirically equivalent, appeals are often made to one of two principles to select one model. One might invoke parsimony to select the rational addiction model, which is analytically simpler, and consonant with the standard rational choice paradigm. One might instead invoke the realism of the assumption of time inconsistency, confirmed in survey research on addictive behavior, to select the Gruber–Köszegi model. Both of these arguments are premature. Parsimony is the decisive factor in model choice only when empirical fit is the sole purpose of modeling; when there are multiple purposes, parsimony is only one of several relevant factors. Appeals to the realism of assumptions can be valid for one of two reasons: if realistic assumptions can be expected to result in better empirical fit eventually, or if realistic assumptions promote worthy goals other than empirical fit. To evaluate these two arguments, we must first take a position on the existence of and relative merits of the other purposes of models – to increase our understanding, and to inform policy.[2]

What Sen (1991) terms the 'descriptive' purpose of models I term 'understanding'. Understanding satisfies a universal desire for knowledge. Human beings desire models that are in an important sense true. For a model to add to our understanding, it must not only fit the data well, but it must also be based on plausible assumptions. One understands something when one can invoke a true explanation of it. In his critique of the instrumentalist approach (whose only concern is empirical fit), Caldwell (1992) notes that the desire for knowledge plays a prominent role: instrumentalist accounts do not satisfy the human desire for true explanations. Moreover, economists act as if their models are true, even if

they are methodologically neutral on the truth of their assumptions. In their desire to understand, and not simply to describe patterns in data, economists conform to Aristotle's claim that all people desire to know (Aristotle 1941b).

Because Friedman (1953) asserts that the only legitimate goal of economics is empirical fit ('prediction'), he appears to dismiss the need for realistic explanations in economics: the truth or falsity of assumptions is irrelevant to economic research. Accurate prediction is all that matters. By rejecting any concern about realism of assumptions, Friedman renounces any ambition to understand economic phenomena. Consequently, he denies the value of direct evidence on the realism of assumptions, since realistic assumptions need not improve empirical fit.

Commentators on Friedman's work have refined the notion of realism of assumptions, and have disputed the irrelevancy of true assumptions for prediction. Musgrave (1981) notes that Friedman fails to distinguish three kinds of assumptions: negligibility assumptions, which are claims that certain real factors need not be taken into account for accurate prediction; domain assumptions, which are claims that a given theory is true only under certain conditions; and heuristic assumptions, which are simplifying assumptions that aid in the explication of complicated theories. Each of these types of assumption is realistic or unrealistic in a different way. For example, the negligibility assumption that 'transactions costs are small' is not a claim that there are no real transaction costs; instead, it is a claim that we may safely ignore them when making predictions. In contrast, the domain assumption that 'the model only applies when transaction costs are zero' does not deny the existence of transaction costs; instead, it asserts that the model only applies to those environments in which transaction costs are small. Musgrave details the confusions that arise from the ambiguity about realism in Friedman's work.[3]

Mäki (1992) objects to the all-or-nothing separation between true and false statements in Friedman's work. Mäki draws a subtler distinction, between what he terms 'hopeless falsehoods' ('the surface of the earth is covered with vodka') and idealizations, simplifications and approximations ('transaction costs are zero'). The latter kinds of statements are, strictly speaking, false, but they are not *entirely* false: they make the analysis tractable, and help to isolate the effect of the causal factors analyzed. In other words, one need not discard the goal of understanding in order to pursue the goal of empirical fit. On the contrary, a certain degree of abstraction is necessary to understanding.[4]

Most economists treat rationality assumptions not as hopeless falsehoods, but as idealizations or approximations to actual behavior. As noted above, the rational addiction model can be construed as an idealization of the Gruber–Köszegi model, in which the time inconsistency parameter β (in equation (4)) is equal to 1. In the light of Mäki's distinctions, Friedman's

claims appear too strong: of course researchers must abstract from reality in their models, but it does not follow that all strictly untrue assumptions are equal. Assumptions that are 'closer' to the truth may improve empirical fit.

Hausman (1992, 2001) affirms the value of empirical fit, but argues that true assumptions promote empirical fit; it is *because* economists value empirical fit that true assumptions are important. The behavior of economists in the face of poor empirical fit attests to the importance of true assumptions. When economists attempt to figure out why a theory fits the data poorly, they often examine the realism of their assumptions first. Leplin (1984) notes that the most plausible explanation for the reliable predictions of a model is the truth of its assumptions.

If Hausman is right that the truth or falsity of assumptions matters for empirical fit, then those who seek to improve empirical fit need not discount understanding. Understanding and empirical fit may be complementary. Realism in assumptions is more than instrumentally valuable, however. Understanding is valued for its own sake. Although few economists would accept models whose empirical fit is relatively poor simply because those models were more plausible, they may accept a more complicated model which fits the data as well as alternatives, and which seems more plausible (Hirschman 1984). Because understanding depends importantly on the degree to which the constituents of an explanation are true (Hausman 1992: 139), to the extent that economists seek understanding for its own sake, they value true descriptions about human behavior and motivation even when those descriptions do not improve empirical fit.

If economists seek to understand economic phenomena, they must evaluate the truth or falsity of their models. This can be done in several ways. Empirical fit is important, of course; models that fail to explain patterns in the data are unlikely to add to our understanding. Empirical fit is not the only criterion of truth, however, since it is possible to fit a model to data without understanding the causal mechanisms generating the data. If economists want their models to increase their understanding, they must concern themselves with the plausibility of assumptions.

A third pragmatic consideration in model selection brings into play both empirical fit and understanding, particularly when the object of understanding is human nature. Economics is supposed to inform policy. It is supposed to help policymakers understand what is at stake in law and regulation, by predicting the effects of legislation, and understanding the effects and role of a social order's institutions. The role of empirical fit, even when it is not based on a thorough understanding, is obvious. Policymakers want to know how taxes and regulation will affect economic growth and government finances, even if forecasters are not certain of the theories underlying their forecasts.

Economic knowledge has more profound influences upon public policy than its forecasts, however. The evaluation of public policy, and of the

constitutional order itself, relies crucially on an understanding of the nature of human welfare and the role of institutions in promoting that welfare. The explanations that economists give for human behavior and social exchange embody assumptions about human nature and community; policymakers who make use of the explanations are also making use of the assumptions about human nature when they use the models to inform policy (Hodgson 2001).

Consequently, economists' attempts at positive prediction embroil them in moral debates about the political order. These debates go back to Plato (1999) and Aristotle (1941a) in the Western tradition; both built accounts of public order on claims about human nature and human happiness in community. One cannot discuss the welfare consequences of public policies without taking a stand on what makes humans happy (or better off, or freer).

4 IMPLICATIONS FOR MODEL SELECTION

The challenges of model selection in the addiction literature can be fully appreciated only in the light of differences along three dimensions of value: empirical fit, understanding and policy usefulness. First, the implications of parsimony for understanding and policy are stark in this model, since the application of the principle favors not only the rational choice model, but all of its normative implications. Second, the realism of the time consistency assumption of the Becker–Murphy model is irrelevant to the choice of models on the grounds of empirical fit, since time inconsistency has not improved empirical fit as of this writing. At this point in the literature's development, the realism of assumptions bears only on the understanding offered by the models. Third, the blurring of positive and normative leads directly to Aristotle's insight that the design of the political order depends crucially on factual judgments about the nature of the human person. Disagreements in the realm of positive economics (how best to model human decision-making) spill over directly into disagreements in the normative realm.

If empirical fit is the only goal of economic modeling, then the principle of parsimony makes perfect sense, and one should prefer the Becker–Murphy model over the Gruber–Köszegi model of addiction. The choice between these two models makes it clear just how little weight is given to understanding and policy usefulness when parsimony rules. The radically different understandings of human choice over addictive goods, and the sharply differing implications for tax policy, are dismissed as irrelevant when the simpler model is chosen only because it is simpler. The importance of these other purposes lessens the force of appeals to parsimony.

It should be noted that a researcher may favor parsimony *because* it promotes a particular understanding of human nature: that of competent

consumers capable of promoting their own interests without outside interference (Hausman 1992: 210; Hodgson 2001: ch. 6). Goldfarb *et al.* (2001) suggest that ideological considerations may influence researchers to favor one addiction model over another. An economist who is skeptical of government competence to make social improvements over the free choices of autonomous consumers is likely to look more favorably on the principle of parsimony, and on the rational choice models it favors. On the contrary, economists who have less confidence in individuals to promote their welfare independently of government action will reject parsimony when it threatens their understanding of the shortcomings of consumer choice and forces them to rely on models whose rationality assumptions they find implausible.

To make the point that ideology may influence the judgment of economists is not to impugn the character of economists of any ideological stripe. As Coase (1994) notes, it would be surprising if different schools of economics did not produce different models of economic behavior. The competing models embody very different understandings of human nature. It is not surprising that economists who understand human nature differently should disagree over which model is best. When these disagreements are veiled behind appeals to parsimony or criticisms of the realism of assumptions, the issues at stake in model selection become muddled. Parsimony should not be invoked when it forestalls important debates about the understanding offered by models, and their policy usefulness. In the same way, the realism of assumptions, when it does not improve empirical fit, can only be invoked when differences in understanding or policy usefulness are at stake in model selection.

Critics of the Becker–Murphy model criticize the unrealism of the assumption that consumers exercise a forward-looking rational agency in consumption, and always choose consistently, citing survey evidence on self-reported inner conflict among consumers.[5] In contrast, the assumptions of the Gruber–Köszegi model are consistent with the self-reported experience of addicts. Is such an appeal to direct evidence on the assumptions of the model enough to determine a choice between the two models, without reference to the different understandings in the two models?

If the two models fit consumption data equally well, direct confirmation or disconfirmation of the assumptions of the models does not disqualify the Becker–Murphy model *unless understanding matters to model selection independently of its promise to improve empirical fit in the future*. A defender of rational addiction models may take note of the evidence that consumers are not as forward-looking or time consistent as he assumes, and still not accept that the discrepancy between his assumptions and reality are significant enough to warrant a change in models.[6] After all, the more complicated assumptions of the Gruber–Köszegi models do not result in a better fit in consumption choice data.

Modeling assumptions are approximations to reality. For example, economists would not include transaction costs in their models unless the inclusion resulted in better empirical fit; this does not mean that they believe transaction costs are zero, only that the costs are not significant enough to be included in the empirical analysis. Why should economists treat time inconsistency any differently, and include it in models even when it does not improve empirical fit?

It may be alarming to some economists to suggest that model selection may sometimes involve more than carefully crafted hypotheses and sharply defined empirical tests. When empirical work does not (or cannot) distinguish competing theories, however, the other purposes of economic modeling (understanding and policy usefulness) come into play, and may determine model selection. Individual economists may favor one empirically equivalent model over another because it seems more 'plausible' – it helps them to understand economic behavior in terms that are believable to them. Thus, the Gruber–Kőszegi model appeals to those who find the assertion that consumers act in a time consistent way implausible, and who believe that government can help people to control themselves. The Becker–Murphy model appeals to those who value the general rationality assumptions of economics, and the freedom of individuals to determine their own choices free of government interference.

These very different understandings of human nature – human beings in need of paternalistic interventions, or as capable of the autonomous promotion of their own welfare – lead to very different policy prescriptions. It is neither surprising nor shocking that economists would take these policy prescriptions into account when selecting models when the data do not speak clearly. Neither is it surprising that economists would draw on their understanding of human nature when seeking new models to test against received theories.

The rational addiction literature is notable because it forces economists to confront the multiple purposes of their analysis. Although there are ongoing efforts to test rational addiction models against time inconsistency models (see, for example, Gruber and Mullainathan 2002), the two models are at present empirically equivalent. Because economists have been unable to test the differing empirical implications of the models, the other goals of research – increased understanding and policy usefulness – come sharply into focus in model selection.

The goals of understanding and policy usefulness are evident in this literature, because of the failure of empirical work to distinguish between the two models. These goals are implicit in other economic fields, also, although competing models may not differ as sharply along the dimensions of understanding or policy usefulness. Economists should acknowledge the existence of multiple goals, and allow them to play a role in the way they think and argue about model selection. It is better to have them out in the

open; a recognition of their existence will result in a richer account of model selection.[7]

One may see the connection between conceptions of human nature, policy and model selection, without abandoning the attempt to develop effective empirical tests of rival theories. The case for continued efforts to bring data to bear on model selection is not weakened by the recognition that models serve other purposes. It matters very much for policy which model of addiction is the true one. Although many kinds of evidence inform our judgments about our own natures as humans – personal experience, the shared experience of others, the norms of culture, psychological research on human cognition and personality – we expect plausible theories of human nature to fit the data better than implausible theories. Empirical fit deserves its high rank among the goals economists seek. The principle of parsimony, however, should not be applied blindly to promote empirical fit, since it may retard the pursuit of other goals important to economists: understanding and policy usefulness.

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NOTES

1 Because Quine (1953) asserts that theories are always underdetermined by data, he asserts that model selection is always made on 'pragmatic' grounds. Hausman (1992) lists 'aesthetic appeal', 'heuristic power' and 'normative force' as pragmatic considerations relevant to model selection.

2 Although the 'official' aim of economics is predictionist, Hausman (1992) and McCloskey (1994) both assert that economists are not really predictionists, interested only in 'empirical fit', in practice. Hausman traces the heritage of Millian deductive method in economics. Economics reasons from a set of accepted lawlike assertions which are inexact, to construct a compact if imperfect understanding of the economy. McCloskey (1994) criticizes predictionist method as unworkable and unpracticed, and alleges that economists use a much more eclectic method to ascertain truth about the economy. Coase (1994) notes that one of the virtues of models is that they help economists to understand the social world, and Robbins (1963) acknowledges that most economists want to produce work that informs policy.

3 Musgrave also speculates that empirical testing affects modeling assumptions. The encounter with data can force an economist to transform a negligibility assumption ('transaction costs are zero') into a domain assumption ('the model only applies where transaction costs are zero') into a heuristic assumption ('for now, assume that transaction costs are zero; we will complicate the model with transaction costs later').

4 Mäki's discussion of the role of abstraction highlights the fact that parsimony can promote understanding as well as empirical fit, although the evaluation of

its contributions to understanding requires more judgment about the trade-off between abstraction and true description.

5 Gruber and Köszegi (2004) summarize the arguments in favor of time inconsistency; Goldfarb *et al.* (2001) argue that survey evidence, empirical tests and evidence from health studies do not clearly favor any one model.

6 Understood in this way, the assumption of time consistency is an example of negligibility assumption, as defined by Musgrave (1981).

7 A full account of model selection with multiple research goals is difficult to formulate methodologically: there is no pre-existing set of disciplinary preferences on which to evaluate trade-offs among goals, and disagreements will not always be resolvable by appeals to data. The intellectual faculty brought into play by this complex context goes by the name of 'prudence', or 'practical reason'. Yuengert (2004) uses prudence as an organizing principle for his account of economic research.

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