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# The Relevance of Quasi Rationality in Competitive Markets

By THOMAS RUSSELL AND RICHARD THALER\*

Smart

My dad gave me one dollar bill  
'cause I'm his smartest son,  
And I swapped it for two shiny quarters  
'cause two is more than one!

And then I took the quarters  
And traded them to Lou  
For three dimes—I guess he don't know  
That three is more than two!

Just then, along came old blind Bates  
And just 'cause he can't see  
He gave me four nickels for my three dimes  
And four is more than three!

And I took the nickels to Hiram Coombs  
Down at the seed-feed store,  
And the fool gave me five pennies for them,  
And five is more than four!

And then I went and showed my dad,  
And he got red in the cheeks  
And closed his eyes and shook his head—  
Too proud of me to speak!

Shel Silverstein

*Where the Sidewalk Ends*

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New York: Harper & Row, 1974

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Economists generally attribute considerable rationality to the agents in their models. The recent popularity of rational expectations models is more an example of a general tendency than a radical departure. Since rationality is simply *assumed*, there is little in the literature to suggest what would happen if some agents were not rational. This is surprising in light of the accumulating evi-

dence that supports Herbert Simon's view that man should be considered at most boundedly rational. In fact, Kenneth Arrow concludes his recent review of this evidence as follows: "I hope to have made a case for the proposition that an important class of intertemporal markets shows systematic deviations from individual rational behavior and that these deviations are consistent with evidence from very different sources..." (1982, p. 8).

In this paper we start to explore the implications of irrationality for economics. We begin by defining what we mean by rational, and what departures from rationality we think are most likely. We then consider what happens if rational and less than fully rational agents (whom we call quasi rational) interact in competitive markets. We show that the knee-jerk reaction of some economists that competition will render irrationality irrelevant is apt only in very special cases, probably rarely observed in the real world. Our analysis highlights the important roles played by arbitrageurs and entrepreneurs. We find that, perhaps counter to intuition, more competition can actually make things worse by leaving no possibility of a profit to an entrepreneur who offers education or information.

## I. Rationality, Quasi Rationality, and Framing

Suppose two individuals face the same budget set, but choose different consumption bundles. What could be the reason? Three distinctly different reasons can be identified: 1) the individuals have different tastes (utility functions); 2) the individuals have different information; 3) one of the individuals has made a mistake. In this paper we are primarily concerned with behavior of the third type, so we need a method of modeling mistakes.

There is no place for mistakes in the conventional economics framework. In part, this

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is because of the difficulty of identifying nonrational (by which we mean non-utility-maximizing) behavior. Consider, for example, the observation of a single purchase. The prices that an agent faces determine a budget hyperplane, and any point on that hyperplane that the agent chooses supports some indifference surface. Thus any chosen point can be consistent with maximization.

Suppose we examine more than one expenditure. Is it possible, on the basis of a series of expenditures, to characterize these acts as rational or nonrational? Defining rational now to mean maximizing for a single,<sup>1</sup> increasing concave utility function, the answer is a qualified yes. If the actions contain within them a violation of the weak axiom of revealed preference (which is to say, that we observe both  $a$  chosen when  $b$  is affordable, and  $b$  chosen when  $a$  is affordable), then it can be concluded that no fixed increasing strictly concave function is being maximized. Typically economists have looked for violations of the weak axiom in the choices made by agents confronted with different budget sets. Unfortunately, as Hal Varian (1982) has shown, the price income data of the real world seldom oblige by providing other than nested budget sets, so much of the time violations of the weak axiom are simply not possible.

Another way in which, in principle, one could seek violations of the weak axiom is to present the agent with the same budget set, but presented in different ways. Then his choice must not change. This hypothetical test was first suggested by the inventor of the technique of revealed preference, Paul Samuelson (1983). Samuelson considered the following problem. Suppose that we confront an agent with an income-price vector  $(Y, p)$  and observe the choice  $x$ . Now confront the agent with the income-price vector  $(mY, mp)$  where  $m$  is a positive constant. Unless the consumer again chooses  $x$ , the weak axiom is being violated. The reason is simple. By multiplying both income and prices by  $m$  we do

not change the budget set. Thus any choice  $y \neq x$  at  $(mY, mp)$  violates the axiom.

The same approach has been used more recently by cognitive psychologists to demonstrate simple violations of rationality. In a remarkable series of experiments, Daniel Kahneman and Amos Tversky (1979, 1981) have shown that subjects presented with the same problem (budget set) described in different ways repeatedly change their responses. Kahneman and Tversky call such victories of form over substance "framing" effects.

The violations which Kahneman and Tversky find are not only prevalent, they are systematic. That is to say, depending on how the problem is framed, it can be predicted whether the agent will choose  $x$  or  $y$ . We propose calling any such regular yet nonrational behavior *quasi rational*. Quasi-rational behavior will include some actions that can be considered mistakes in the classification scheme described above. To incorporate such mistakes in a model of a competitive market, an extra feature has to be added to the characterization of consumer behavior. The extra feature captures the consumer's process of translating raw information into a perceived budget set.

Suppose, then, that we think of agents as being given not budget sets but the ingredients from which they can construct a budget set. Call this the information set  $I$ . Assume that the individual constructs the budget set  $B$  from  $I$  using a mapping which we call  $F$  so that  $B = F(I)$ .<sup>2</sup> Once the agent has  $B$ , we know from standard duality theory that maximizing choices can be represented as the appropriate derivatives of an indirect utility function  $U$  defined on  $B$ . With the approach suggested here,  $U$  is actually defined on  $I$  so that we have  $U(F(I))$  as the integral of the maximizing choices.

What is the nature of  $F$ ? It may have subjective elements but  $F$  is not entirely

<sup>1</sup> The word single is crucial, since if tastes are allowed to change, or if a taste for "variety" is permitted, then virtually any set of actions can be rationalized.

<sup>2</sup> The language used here promises more than it delivers. The use of such terms as mapping and information set does not mean that we have a mathematically rigorous theory of this process, and is meant to be suggestive only.

subjective. It should, for example, conform to the laws of mathematics. Thus if  $I$  is a sample drawn from some population with replacement, then  $F$  should not depend on the order in which the observations are drawn or recorded. In some cases, the mapping from  $I$  to  $B$  will be so obvious that we would expect no one to get it wrong. Kahneman and Tversky call such mappings *transparent*. The cases of interest are those where the mapping is more complex or, as they say, *opaque*.

There is no shortage of evidence documenting human judgments which fail to satisfy rational objective standards. In many cases (see Kahneman, Paul Slovic, and Tversky, 1982) these lapses seem to be associated with the use of a rule of thumb (i.e., the representativeness heuristic, and the availability heuristic) in which the decision maker sometimes focuses on irrelevant aspects of the information set in constructing his budget set.

This suggests a useful distinction between correct and incorrect mappings. We label the correct (or set of correct)<sup>3</sup> mappings  $F^*$  and any incorrect mappings  $F'$ .<sup>4</sup> We now have the apparatus to characterize all three reasons referred to earlier why choices (under the same budget set) may diverge: 1) differences in  $I$ ; 2) differences in  $U$ ; or 3) differences in  $F$ . Those choices consistent with an indirect utility function  $U(F^*(I))$  are considered rational while those based on any other mapping,  $F'$ , are considered quasi rational. The term quasi rational has been chosen to capture both the rational maximizing that is suggested by the systematic regularities shown in the experimental data (subjects do not choose at random) and the inconsistencies with the axioms of rational choice.

The existence of the mapping  $F$  is not completely foreign to economics. In expected

utility theory, for example, the agent has a preference function over consequences but chooses acts. A mapping  $F$  from acts to consequences is needed to construct the budget set. In a subcase of this, portfolio theory of the Markowitz mean-variance type, investors observe the prices of assets but have preferences over the mean and variance of returns. Again a mapping  $F$  is needed to construct the relevant budget set. Indeed in financial economics the implication of heterogeneity in  $F$  is an ongoing area of investigation (Joram Mayshar, 1983; Robert Jarrow, 1983). We are here assuming not just heterogeneity in  $F$ , but the existence of a correct and incorrect  $F$ . As we shall see, however, some of the structure is identical. Finally, even in decision making under certainty, the new economic theory of the consumer of Kelvin Lancaster (1966) and Gary Becker (1965) in which consumers have preferences over characteristics but purchase market goods, requires a mapping from goods to characteristics in order to construct the budget set.

The existence of the mapping  $F$  enables us to characterize *in principle* even a single choice as nonrational. Suppose we give a consumer information concerning two choices,  $x$  and  $y$ , and that under the true mapping  $F^*$ ,  $x$  and  $y$  are identical but  $y$  is cheaper. If an individual buys  $x$ , that is nonrational. Nevertheless, it is virtually impossible to classify an act as nonrational *in practice* because of the difficulty in controlling for differences in tastes  $U(\cdot)$ , or in information  $I$ .

This suggests precisely the role of the laboratory experiment. By controlling for tastes and information it is possible to identify  $F$ , and in this way conclude that the behavior is indeed nonrational. It is true that for every real world example of quasi-rational behavior we can offer, rationality cannot be ruled out. This, however, in no way rules it in. At the present state of our knowledge, it seems we must allow the possibility that some behavior is quasi rational. Nevertheless, with few exceptions, economists have tended to ignore the work of the cognitive psychologists and have continued to investigate markets with only rational agents. Why

<sup>3</sup>We need not be concerned here with whether  $F^*$  is unique. It is sufficient for our analysis that we be able to identify some incorrect mapping  $F'$ .

<sup>4</sup>The mixture of subjectivity and required consistency appears also in the subjective theory of probability. It is discussed in very clear terms by Bruno de Finetti (1977).

is the experimental work given so little attention? Economists have generally been critical of these results for the following reasons:

1) "Much of the research is based on hypothetical questions. Thus respondents have little incentive to respond properly." This critique has been examined by David Grether and Charles Plott (1979) and by Grether (1980) in their replications of work by psychologists. In both studies the quasi-rational behavior was at least as strong in a condition with monetary incentives as in a condition with purely hypothetical questions. Thus while skepticism of hypothetical questions may be reasonable, the evidence about quasi-rationality cannot be attributed solely to this problem.

2) "The experiments are done in the laboratory." While this statement is true, there is other evidence of irrational behavior outside of the lab. For example, Howard Kunreuther et al. (1978) found irrational factors to be very important in determining who would buy government-subsidized flood insurance.

3) "In the real world, people will learn." There are two responses to this critique. First, the subjects have not yet learned to choose according to our normative theories, otherwise one would not obtain the reported experimental results. Second, as Hillel Einhorn and Robin Hogarth (1978) have emphasized, many situations will not provide feedback in a way that will facilitate learning. Without well-structured feedback, learning may be negligible.

4) "Economists are interested in aggregate behavior and these individual errors will wash out when we aggregate." Since the errors that have been identified are systematic (i.e., in a predictable direction), this statement is just wrong. However, there is a more subtle version of this idea.

5) "Markets will eliminate the errors." While this statement is sometimes made, it is not clear by what mechanism markets will eradicate irrational choices. While it has been argued that evolution will eventually eliminate firms that choose improperly, there is no such process at work for individuals. So far as we know, quasi-rationality is rarely fatal.

In summary, there is a large body of experimental evidence suggesting that humans make judgments and decisions in a way that can be characterized as quasi-rational. This evidence cannot be dismissed easily. It therefore seems prudent to begin to inquire about the workings of markets in which some agents are quasi-rational. Do the quasi-rationals affect prices? Does a competitive market protect or exploit the quasi-rational segment? What roles do arbitrageurs and entrepreneurs play? It is to these questions we now turn.

## II. Markets with Quasi-Rational Agents

We will investigate competitive markets with two kinds of agents, rational and quasi-rational. To capture the quasi-rational behavior, we use an extended Lancasterian model of consumption. Consumers purchase goods in the market but derive utility from the characteristics the goods possess rather than the goods per se. There is an objective mapping from goods to characteristics. The rational consumers perceive this mapping. The quasi-rationals perceive a different, incorrect mapping.<sup>5</sup>

### A. Model 1: The Basic Model

We begin by considering the simplest possible model that includes both rational and quasi-rational agents and competition. We make the following assumptions.

*Preferences.* All individuals are assumed to have the same preferences over two characteristics:

$$(1) \quad U = C_1^\alpha C_2^{1-\alpha}.$$

We concentrate our attention on characteristic 1,  $C_1$ , so that characteristic 2,  $C_2$ , should be thought of as an aggregate of all other characteristics.

Note that if the price of characteristic  $C_1$  is  $P_{C_1}$ , the individual demand for characteris-

<sup>5</sup>A similar notion is used in Douglas Auld (1972) and Claude Colantoni et al. (1976).

tic 1,  $D_{C_1}$ , is given by

$$(2) \quad D_{C_1} = \alpha Y / P_{C_1},$$

where  $y$  is the income of the individual. We assume all individuals have the same income.

*The Objective Characteristics Technology.* Characteristic 1 is contained in two goods,  $g_1$  and  $g_2$ , and only in these goods. Characteristic 2 is contained in the aggregate good  $g_3$  and only in  $g_3$ .

By Walras' Law we need only consider equilibria in the markets for  $g_1$  and  $g_2$ . We assume

$$(3) \quad g_1 = C_1; \quad g_2 = \beta C_1$$

is the true consumption technology relating quantities of characteristics to quantities of goods.

*Quasi-Rational Mapping.* Quasi-rational agents believe that the relationship in (3) is actually

$$(4) \quad g_1 = C_1; \quad g_2 = \gamma C_1 \quad \gamma \neq \beta.$$

*Number of Agents.*  $L$  individuals are rational,  $M$  quasi rational.

*Supply.* There is a fixed supply of goods 1 and 2,  $\bar{g}_1, \bar{g}_2$ .

*Demand.* Let  $P_i$  = price of good  $i$ ,  $i = 1, 2$ . If good 1 is bought, the price per unit of characteristic 1 is  $P_{C_1} = P_1$ . If good 2 is bought,  $P_{C_1} = P_2/\beta$ . Obviously buyers will buy  $C_1$  at what seems to them to be the lower price. Thus rational demands  $D^R$  are given by

$$D_1^R = ((\alpha Y / P_1), 0, (t\alpha Y / P_1))$$

as  $P_1 < P_2/\beta, P_1 > P_2/\beta, P_1 = P_2/\beta$

$$D_2^R = ((\alpha Y \beta / P_1), 0, ((1-t)\alpha Y / P_1))$$

as  $P_1 > P_2/\beta, P_1 < P_2/\beta, P_1 = P_2/\beta,$

where  $t$  is an arbitrary scalar  $0 \leq t \leq 1$ . The quasi-rational demands  $D^{QR}$  are given by the same expressions with  $\gamma$  replacing  $\beta$ .

Note that goods 1 and 2 become perfect substitutes at different prices for the rationals and the quasi rationals.

*An equilibrium* is defined as a pair  $P_1^*, P_2^*$  such that

$$D_1(P_1^*, P_2^*) = \bar{g}_1; \quad D_2(P_1^*, P_2^*) = \bar{g}_2,$$

where  $D_i$  is the aggregate demand for good  $i$ .

*A Rational Equilibrium* is defined as a pair  $\hat{P}_1, \hat{P}_2$  such that

$$D_1(\hat{P}_1, \hat{P}_2) = \bar{g}_1; \quad D_2(\hat{P}_1, \hat{P}_2) = \bar{g}_2$$

where  $D_i = (L + M)D_i^R$ ; that is, aggregate demand if all individuals in the economy are rational. We are interested in obtaining necessary conditions for an equilibrium to be a rational equilibrium.

**PROPOSITION 1:** *A necessary condition for an equilibrium to be a rational equilibrium is that  $P_1^* = P_2^*/\beta$ .*

**PROOF:**

Unless the condition is satisfied, rational individuals will not buy both goods. From this we may deduce

**PROPOSITION 2:** *Let  $\gamma > (<) \beta$ . Then a necessary condition for an equilibrium to be a rational equilibrium is that  $M/L \leq \beta \bar{g}_2 / \gamma \bar{g}_1$  ( $\leq \bar{g}_1 / \bar{g}_2$ ).*

**PROOF:**

Since the proof for  $\gamma < \beta$  parallels that for  $\gamma > \beta$  we consider only the latter. Take any price ratio  $P_1 = P_2/\beta$ . Since  $\gamma > \beta$ , all quasi rationals will buy good 2. Therefore equilibrium requires  $P_1 \leq L\alpha Y/\bar{g}_1$ . For rationality we must have  $P_1^* = P_2^*/\beta$ , so we must have  $P_2^* \leq L\alpha Y\beta/\bar{g}_1$ . This, however, would make demand for good 2,  $D_2 \geq M\alpha Y/[\alpha Y\beta/\gamma \bar{g}_1]$ . If  $\bar{g}_2$  is less than this, that is,  $\bar{g}_2 < M\gamma \bar{g}_1 / L\beta$ , equilibrium is impossible.

Proposition 2 states that a rational equilibrium will not obtain if there are "too

many" quasi-rational consumers. From this it is obvious that

**PROPOSITION 3:** *There exist equilibria which are not rational equilibria.*

This result demonstrates that the existence of markets is not sufficient to eliminate the effect of quasi-rational behavior. This market, however, has two special features which help sustain the quasi rationality: 1) the only way to trade characteristics is to trade goods; 2) there are no short sales. Both of these features are important and are analyzed in turn.

### B. Markets for Characteristics

One way in which characteristics could be traded directly is if they could be "stripped" from the goods and sold separately. This may or may not be feasible. For example, it is possible to disassemble an automobile and sell all of its parts, but it is not possible to disassemble and sell its relevant characteristics such as ride, handling, fuel economy, comfort, etc. An extreme case of interest is where characteristics can be decomposed costlessly.

**PROPOSITION 4:** *If characteristics can be decomposed and marketed costlessly, then a rational equilibrium will obtain.*

**PROOF:**

Suppose  $\gamma > \beta$ . Then if equilibrium were not rational,  $P_1 < P_2/\beta$ . But this would mean that  $P_{C_1}$  to the quasi rationals who buy good 2 is greater than  $P_{C_1}$  to the rationals who buy good 1. Thus the law of one price does not hold in characteristics, yielding an incentive for the rationals to buy good 1, strip it of its  $C_1$ , repackage  $C_1$  in good 2 and sell it at a profit. (There is likewise an apparent incentive for the quasi rationals to repackage in reverse, but we assume this will immediately reveal the true relationship between goods and characteristics, and so will not occur.) The action of the rationals will thus drive up the price until  $P_1 = \beta P_2$ .

In goods markets the cost of characteristics stripping is determined by production technology. In asset markets, however, characteristic stripping is not so much a matter

of technology as it is the number of markets and cost of using the markets. For example,<sup>6</sup> with a low-cost futures market in Treasury bills, a six-month Treasury bill can be stripped of its three-month component by selling a three-month futures contract in the bill. This means that the price of three-month T-bills and the combination of one six-month T-bill and one three-month future T-bill cannot get far out of line, even if financial officers of corporations have a preference for simple contracts such as three-month bills and are willing to pay a premium for such contracts.

Costless characteristic repackaging de facto sets up a market in characteristics so that the law of one price in characteristics must hold. In the absence of this market, a market in goods is not, in general, a substitute for a market in characteristics.

### C. Short Selling

In goods markets it is not generally feasible to take a short position. Markets are just not organized in a way that allows a speculator to borrow and sell Chrysler automobiles or Heinz ketchup in the expectation of a future drop in price. Short selling is permitted in some financial markets, however, and so to extend our analysis to include those markets we explore the ramifications of permitting short sales.

**PROPOSITION 5:** *Short selling will guarantee that the equilibrium is rational provided: (a) within the time space that  $g_1$  and  $g_2$  are traded, there exists a time  $T^*$  such that after  $T^*$  the true relationship between characteristics and goods is known to everyone; (b) only the rationals sell short.*

**PROOF:**

Again assume  $\gamma > \beta$ . Then if the equilibrium is not rational,  $P_2 > P_1\beta$ . But at time  $T^*$ ,  $P_2 = P_1\beta$ . Thus short selling by the rationals will be profitable and will force  $P_2$  into equality with  $P_1\beta$ .

<sup>6</sup>This example is discussed in Edwin Elton et al. (1982).

The two extra conditions are necessary to assure that an equilibrium exists and that short selling is riskless.<sup>7</sup> If the quasi rationals sell short, and if  $P_2 = \beta P_1$ , they will believe  $g_1$  is overvalued and will wish to sell it short. Thus no equilibrium will exist. The assumption that only rationals sell short is not unreasonable if rationality is associated with professional market participants. It might be called the Marshallian view based on the following from Alfred Marshall:

The private purchaser of railway shares may know nothing [about its prospects, the ability of its management and propriety of its accounts], but he buys with the confidence that all such points have been scrutinized by many keen men with special knowledge, who are able and ready to "bear" the stock if they find in it any weak spot, which... had not been allowed for in making up its value.

[cited in Mayshar, pp. 126–27, fn. 25]

The condition that the true mapping be revealed is necessary to create a pure arbitrage opportunity (some chance of gain, no chance of loss). If characteristic stripping is impossible, then knowledge of the true mapping between goods and characteristics is not sufficient to create an arbitrage opportunity. Only if the quasi rationals become informed can the correct price be assured.

Of course, in most nonfinancial markets, characteristic stripping is not costless and short selling is impossible. In these situations (within Model 1) quasi rationals do influence prices, and the rational price equilibrium need not obtain.

#### D. Production

Up to now we have been assuming that both goods are in fixed supply. To allow for production we will consider three cases: increasing costs, constant costs, and decreasing

costs. Formal proofs follow the same lines as above so we just present the results.

*Increasing Costs.* If both goods are produced with technologies involving increasing marginal costs, then the results of the previous section are qualitatively the same. A rational equilibrium can obtain as long as the number of quasi rationals in the economy is small enough.

*Constant Marginal Costs.* The constant marginal cost case is a knife-edge situation. Competition assures that price equals marginal cost so both goods can only coexist if the ratio of marginal costs is exactly equal to  $\beta$ . The size of the two groups of consumers is irrelevant.

*Decreasing Marginal Cost.* When both goods are produced with economies of scale, then a rational equilibrium can occur with both goods existing. Also, if the quasi rationals are large enough in number and the goods are close enough in efficiency cost, then the quasi rationals can lead to the wrong good being produced. The rationals in this case recognize that it will be cheaper for them to join the quasi rationals than to buy their preferred (*ex ante*) good.<sup>8</sup>

#### E. Comparison with Results in Finance

The models of fixed supply presented so far are very close in structure to a class of models in financial economics first introduced by John Lintner (1969).

In these models, individuals have different beliefs concerning the mean and variance of assets. The reasons for these different beliefs are not investigated so there is no counterpart to our notion of rationality and quasi rationality, but still the market is composed of individuals with different beliefs, and this assumption might be expected to produce similar results.

In an important sense, however, our results are quite different. In the financial mod-

<sup>7</sup>In the finance literature on arbitrage pricing, these two conditions appear as: 1) all investors agree on the state representation; 2) all investors agree on probability zero events.

<sup>8</sup>A similar problem is analyzed by John Haltiwanger and Michael Waldman (1985). They call increasing costs congestion and decreasing costs synergy.



els à la Lintner, market prices reflect *all* beliefs. For that reason Lintner himself found the extension of the model to heterogeneous beliefs basically uninteresting, since everything that was true for homogeneous individuals now became true for "the market." In the models we discuss, market prices may give zero weight to the beliefs of one class of agents. Why the difference? The reason hinges on special assumptions made in the financial literature which prevent the financial system from breaking up into subsystems. Because assets are assumed to be joint normally distributed and agents are assumed to have exponential utility functions, all individuals hold all assets. For that reason, asset prices reflect all beliefs. In our model, because there are more goods than characteristics and because the technology is linear, it is possible for rational agents completely to escape the influence of quasi-rational agents by specializing in consumption of the good(s) which the quasi-rationals cause to be underpriced. It is precisely this force that can restore rationality to the market. Obviously a necessary condition for this to occur is that there are more goods than characteristics. As the finance examples make clear, this is not sufficient. If, for any reason, all goods are bought by all agents, quasi-rationals must influence prices. Thus the examples we discussed earlier are actually biased towards the result that market prices will be fully rational, since they permit rational agents to form their own subeconomies.

### III. An Example

As we emphasized in the introduction, it is generally not possible to prove that any act or set of actions is generated by quasi-rational behavior. Differences in tastes and/or information can rarely be ruled out completely. Nevertheless, we present here some data from a market where the law of one price (for characteristics) is violated. While a plausible quasi-rational explanation can be given, as usual rational-based explanations can also be made. Our purposes, therefore, are just to give an example of how a market might turn out when a quasi-rational rule of thumb is widely used, and

to use the example to address some other theoretical issues.

#### A. Dishwashing Liquid

In 1981 Consumers Union (CU) conducted a study of the price and efficiency of dishwashing liquids. The study was replicated in 1984 with very similar results. We will present the more recent data. Thirty-five brands of dishwashing liquid were tested for their ability to wash dishes. Few differences among brands were discovered on most dimensions, but wide variation was found on the number of dishes a given quantity of the brand could wash. This "dishes washed per squirt" measure was called an efficiency factor. Brands were placed into four groups according to their efficiency factor. Brands in the top group were arbitrarily given an efficiency factor of 1.0. By multiplying the nominal price of the brand by the efficiency factor, a "real cost" was calculated. If the law of one price holds for the characteristic dishes washed, then the real cost of each brand should be about the same.

Table 1 presents CU's results. As can be seen, the law of one price fails to hold. There is a clear negative relationship between the nominal selling price and the real cost. The most expensive brands are usually the best buys. There may, of course, be other characteristics, such as kindness to hands. However, CU found little difference on these dimensions. Furthermore, the most expensive brands are likely to have more of *all* the (positive) characteristics so adding more characteristics would probably strengthen the results.

We think the most plausible explanation for this finding is that some consumers confuse the mapping from price per bottle to price per dish washed. It is well known in marketing that many consumers have a general tendency to buy either the cheapest brand or the most expensive brand. This tendency represents a shopping strategy that greatly reduces decision-making costs at the supermarket. It may well be *rational* to use such a strategy. It would take so long to fully analyze every decision for a single week's family shopping expedition that some sim-

TABLE 1—REAL COSTS OF DISHWASHING LIQUID

Group	Number of Brands in the Group	Average Price	Efficiency Factor	Real Cost
A	8	1.97	1.0	1.97
B	6	1.60	1.4	2.24
C	19	.97	2.7	2.61
D	2	.72	4.7	3.36

Source: *Consumer Reports*, July 1984, p. 413.

plifying strategies must be used. In cases where quality or taste is easy to judge, a family may learn to make specific alterations to their general strategy (“Don’t buy generic cola”). In other cases, such as the dishwashing liquid, a family would have to do some fairly sophisticated testing to determine that its usual “buy cheap” strategy was (in this case) inappropriate.

Since this market has remained stable over the last few years (and probably for much longer), it becomes interesting to ask why the inefficient brands survive. We will consider four forces that could push the (characteristics) market back into equilibrium: arbitrage, entry, education, and tied sales.

*Arbitrage and Entry.* Arbitrage would be possible if one could profitably buy the expensive brands, dilute them, and sell the diluted product as a cheap brand. However, there is no reason to think this is possible. Entry into the “no frill,” generic dishwashing liquid market is relatively free. There are unlikely to be profits to be made by entering this market. The high real cost of these brands probably represents the high fixed cost of packaging and distribution. Literally buying the high-priced brands off the shelf and diluting them for resale is surely an unprofitable venture, and since the data do not necessarily imply extraordinary profits in any segment, entry alone cannot be expected to solve the problem.

*Education.* One of the high-price/low-cost brands of dishwashing liquid has, from time to time, run an advertising campaign that stresses the true economy of their brand relative to the low-cost “so-called bargain

brands.” This is an example of a firm trying to educate the quasi-rational segment. Whenever a consumer can be educated at a cost that is less than his potential gain from switching to the efficient product, a profit opportunity exists. However, ironically, this education will not take place if the market is truly competitive. With perfect competition, no one seller can charge a premium above marginal cost and so there is no incentive to pay the costs of education. Only if there is some monopolistic element, such as brand names, will there be a potential return to education. Even then, the educator runs the risk that the education will not be brand specific, so other high-cost brands may be able to free ride at the educator’s expense.

*Tied Sales.* Jerry Hausman (1979) has done a careful study of consumer purchases of air conditioners. He finds, much as in the dishwashing liquid example, that more expensive air conditioners are better buys because they are generally more energy efficient. He reports that the average purchase implies a discount rate of 25 percent after considering utilization rates and energy costs. Furthermore, the implicit discount rates vary systematically with income. Purchases by low-income households imply discount rates of 27, 39, and 89 percent in the three lowest income classes in Hausman’s sample. These rates are all much higher than the prevailing borrowing rates (around 18 percent on most credit purchases) at that time.<sup>9</sup>

Hausman discusses several possible solutions to the apparently inefficient purchases being made. One is of particular interest here:

Another possible type of market solution would be to have utility companies purchase appliances and lease them to their customers. Presumably utilities would be willing to engage in such activity, since they could borrow money to finance the more energy-efficient

<sup>9</sup>Air conditioners are rarely purchased by the very poor so most buyers probably have access to at least installment-buying-type credit.

appliances and then charge a rental rate which would leave the consumer better off. Utilities could develop expertise in choosing the optimal efficiency model in terms of climate and intended utilization and help their customers make a better choice. [p. 51]

While Hausman's idea is along the right lines, it may not go far enough. What the utility would have to do to be sure of getting optimal choices is to rent the air conditioners with the utility costs included in the rental. Only by tying the sale of the air conditioner services with the purchase of the electricity could the possibility of quasi-rational choices be ruled out. Of course, other problems such as monitoring utilization might prevent such an arrangement from succeeding. Nevertheless, the theoretical point of interest here is that only by creating a market in the ultimate consumption commodity (the characteristics in the model) can the seller guarantee rational choices.

It is interesting to compare this conclusion with that made by Richard Posner in a similar case:

The leverage theory (of tie-in sales) held that if a seller had a monopoly of one product, he could and would monopolize its indispensable complements as well, so as to get additional monopoly profits. Thus, if he had a patented mimeograph machine, he would lease the machine at a monopoly price and also require his lessees to buy the ink used in the machine from him and charge them a monopoly price for the ink. This procedure, however, makes no sense as a matter of economic theory. The purchaser is buying a service, mimeographing. *The pricing of its components is a mere detail*; it is, rather, the total price of the service that he cares about. If the seller raises the price of one component, the ink, the purchaser will treat this as an increase in the price of the service. If the machine is already being priced at the optimal monopoly level, an increase in the price of the ink above the competitive level will raise the total price of the service to the

consumer above the optimal monopoly level and will thereby reduce the monopolist's profits.

[1979, p. 929, emphasis added]

Posner, of course, explicitly assumes rational consumers. He says that to do otherwise would be "inconsistent with the premises of price theory." But if even some consumers are quasi rational, then the way the prices of the various components of a good are framed is no longer a "mere detail." Indeed, framing effects in particular, and quasi rationality generally, open the possibility that repackaging goods via tie-in sales and other similar devices can increase both consumer welfare and monopoly profits. Thus the "Chicago" position on tie-in sales (to permit them) may be right, though for the wrong reasons.

## V. Conclusion

When we assume that consumers, acting with mathematical consistency, maximize utility, therefore, it is not proper to complain that men are much more complicated and diverse than that. So they are, but if this assumption yields a theory of behavior which agrees tolerably well with the facts, it must be used until a better theory comes along.

[George Stigler, 1966, p. 6]

There are two possible justifications for the use of maximizing models in applied microeconomics. As Stigler suggests above, one justification is that the models are good predictors. This is the usual "as if" position. The alternative justification is that markets guarantee that only rational behavior can survive. Our reading of the psychology literature referred to earlier suggests that the first justification is frequently violated. Deviations from maximizing behavior are both common and systematic. The implication of the current paper is that the second justification will rarely apply, except (perhaps) in some highly efficient financial markets. Where does that leave us?

First of all, our analysis suggests that research on individual decision making is

highly relevant to economics whenever predicting (rather than prescribing) behavior is the goal. The notion that individual irrationalities will disappear in the aggregate must be rejected. However, as Stigler implies, the neoclassical theory will not be abandoned until an acceptable (superior) alternative is available. Such theories will have to be explicitly descriptive rather than normative. The usual approach in economics is to solve for the optimal solution to a problem, and then to *assume* the agents in the model chose accordingly. Thus the model is supposed to be simultaneously normative and descriptive. A model such as Kahneman and Tversky's (1979) prospect theory abandons any claim to normative value. It simply tries to describe human behavior. Thaler and H. M. Shefrin's 1981 self-control theory of saving is in a similar spirit. Both theories seem to fit the data well. It is worth mentioning that both of these models are still basically maximizing. Quasi rationality does not imply random choice.

In the absence of such behaviorally motivated alternative theories, one intermediate step can be taken. A standard practice in applied work is to use the theory to impose restrictions to the empirical estimates. The estimates are then forced to satisfy the restrictions. In the absence of evidence to support the *assumption* that the theory describes behavior, a simple precaution is to do the estimates in an unconstrained fashion whenever that is possible. For example, Grether gave subjects in an experiment a Bayesian revision task in which they *should* equally weight the (given) prior odds and likelihood ratio. He then estimated how they *did* combine the data and found that the subjects on average overweighted the likelihood ratio. The model he estimated would outperform an alternative model that assumed proper Bayesian revision. Until better theories are developed, such atheoretical estimation procedures seem appropriate.

Our analysis also has implications for the use of evolutionary arguments in economics. In a review of Richard Nelson and Sidney Winter's 1982 book on this subject, Michael Spence says that "markets discipline agents

and modify their behavior." This statement is clearly true for agents within firms, but has limited applicability to individuals acting as consumers or investors. In fact, the more efficient the market, the *less* discipline the market provides. In a fully arbitrated market, all goods (assets) yield the same characteristics per dollar (returns), thus individuals can choose in any manner without penalty. Only in less than fully efficient markets is there any penalty to quasi rationality.

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