Veblen Effects in a Theory of Conspicuous Consumption

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We examine conditions under which "Veblen effects" arise from the desire to achieve social status by signaling wealth through conspicuous consumption. While Veblen effects cannot ordinarily arise when preferences satisfy a "single-crossing property," they may emerge when this property fails. In that case, "budget" brands are priced at marginal cost, while "luxury" brands, though not intrinsically superior, are sold at higher prices to consumers seeking to advertise wealth. Luxury brands earn strictly positive profits under conditions that would, with standard formulations of preferences, yield marginal-cost pricing. We explore factors that induce Veblen effects, and we investigate policy implications. (*JEL* D11, D43)

In his celebrated treatise on the "leisure class," Thorstein Veblen (1899) argued that wealthy individuals often consume highly conspicuous goods and services in order to advertise their wealth, thereby achieving greater social status. Veblen's writings have spawned a significant body of research on "prestige" or "status" goods.[1] In the context of this literature, "Veblen effects" are said to exist when consumers exhibit a willingness to pay a higher price for a functionally equivalent good.[2]

Anecdotal evidence suggests that Veblen effects may be empirically significant in markets for luxury goods. According to one marketing manager, "Our customers do not want to pay less. If we halved the price of all our products, we would double our sales for six months and then we would sell nothing."[3] Indeed *The Economist* (1993) emphasizes that "[r]etailers can damage a glamorous good's image by selling it too cheaply." A recent article in the *Wall Street Journal* noted that "a BMW in every driveway might thrill investors in the short run but ultimately could dissipate the prestige that lures buyers to these luxury cars."[4] Econometric evidence also corroborates the existence of Veblen effects.[5]

Recent incarnations of Veblen's theories simply proceed from the premise that price enhances utility (see, for example, Leibenstein, 1950; Braun and Wicklund, 1989; or Creedy and Slottje, 1991). Yet Veblen himself did not

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[1] See, for example, Harvey Leibenstein (1950), and more recently Robert H. Frank (1985), Kaushik Basu (1987), Yew-Kwang Ng (1987), R. L. Basmann et al. (1988), Ottmar L. Braun and Robert A. Wicklund (1989), John Creedy and D. J. Slottje (1991), and Norman Ireland (1992). More generally, other recent studies, including George A. Akerlof (1980), Steven R. G. Jones (1984), Timothy Besley and Stephen Coate (1990), B. Douglas Bernheim (1994), Harold L. Cole et al. (1992), Chaim Fershtman and Yoram Weiss (1992), and Amihai Glazer and Kai A. Konrad (1992) explore the impact of status consciousness on economic behavior.

[2] The following passage typifies modern discussions of prestige goods: "Conspicuous consumption, or Veblen effects, are said to occur when individuals increase their demand for a good simply because it has a higher price" (Creedy and Slottje, 1991).

[3] Quoted in *The Economist* (1993 p. 96).

[4] See Timothy Aeppel (1992 p. B4).

[5] See Creedy and Slottje (1991).

endorse the view that the price of an object affects utility directly, or that individuals seek to pay high prices for the sheer pleasure of being overcharged. Rather, he proposed that individuals crave status, and that status is enhanced by material displays of wealth. According to Veblen, "In order to gain and to hold the esteem of men, wealth must be put in evidence, for esteem is awarded only on evidence" (p. 24). By social custom, the evidence consists of unduly costly goods that fall into "accredited canons of conspicuous consumption, the effect of which is to hold the consumer up to a standard of expensiveness and wastefulness in his consumption of goods and his employment of time and effort" (p. 71).

Thus, in a theory of conspicuous consumption that is faithful to Veblen's analysis, utility should be defined over consumption and status, rather than over consumption and prices. Although the prices that one pays for goods may affect status *in equilibrium*, this relation should be *derived*, not *assumed*. Moreover, since Veblen argued that individuals engage in conspicuous consumption to advertise and provide evidence of wealth, the equilibrium relation between price and status should result from signaling.

The details of Veblen's arguments naturally invite the interpretation that conspicuous consumption reflects signaling. In particular, Veblen distinguished between two motives for consuming conspicuous goods: "invidious comparison" and "pecuniary emulation." Invidious comparison refers to situations in which a member of a higher class consumes conspicuously to distinguish himself from members of a lower class. Pecuniary emulation occurs when a member of a lower class consumes conspicuously so that he will be thought of as a member of a higher class. In modern terms, these motives are the essence of the incentive compatibility conditions that form the basis for signaling. Members of higher classes voluntarily incur costs to differentiate themselves from members of lower classes (invidious comparison), knowing that these costs must be large enough to discourage imitation (pecuniary emulation).

Once the need to derive an equilibrium signaling relation between price and utility (through status) is acknowledged, it is natural to wonder whether any plausible model of conspicuous consumption would generate Veblen effects. There is no particular reason to believe that wealth is most effectively signaled by paying excessive prices for conspicuous goods. Instead, one might prefer to purchase a larger quantity of conspicuous goods at a lower price, or a higher quality of conspicuous good at a higher price.[6]

This paper investigates the conditions under which Veblen effects, defined as a willingness to pay a higher price for a functionally equivalent good, arise from the desire to signal wealth. We examine a model in which each individual's status depends upon perceptions of his wealth among social contacts. Consumers have private information about the value of their assets, and attempt to signal their wealth by consuming a conspicuous good. The sellers of this good have access to identical production technologies, and compete under conditions that would yield marginal-cost pricing under standard formulations of preferences. The model does *not* constrain consumers to signal wealth by overpaying for visibly labeled conspicuous goods: it is also possible to signal by consuming large quantities of the good at a lower price, and/or by selecting higher quality. Thus, to the extent Veblen effects are present, they must be generated endogenously.

We show that Veblen effects do *not* arise when the model satisfies the standard "single-crossing property" (which, in this context, states that the marginal cost of consuming the conspicuous good is higher for individuals with lower wealth, so that the indifference curves of consumers with different levels of wealth cross at most once).[7] However, when

[6] Certain social customs in Thailand illustrate the practice of advertising wealth through quantity, rather than price. According to Philip Shenon (1991), "It is considered acceptable, even by some Western-educated Thai women who would otherwise describe themselves as feminists, for a man to take one or more mistresses and even to be seen with them in public, so long as all of the women and their children are provided for financially ... Mistresses are to some degree a demonstration of wealth, and as a rule, the more mistresses, the wealthier the man. A handful of Bangkok's flashier millionaires are said to have 10 or more extramarital companions" (p. A4).

[7] Use of the single-crossing (or Spence-Mirrlees sorting) condition is common in models with asymmetric information. See, for example, David M. Kreps (1990).

the single-crossing property fails in a particular way, and preferences satisfy a "tangency property," Veblen effects may emerge. In particular, the resulting equilibria are characterized by the existence of "budget" brands (sold at a price equal to marginal cost), as well as "luxury" brands (sold at a price above marginal cost). Luxury brands are purchased by consumers who seek to signal high levels of wealth. It is important to emphasize that, in equilibrium, the luxury brands are not intrinsically superior to the budget brands—they are simply goods of identical quality, sold at a higher price. The manufacturers of these brands earn *strictly positive economic profits*, even under conditions that would, with standard formulations of preferences, yield marginal-cost pricing, and despite the ability of firms to vary both price and quality.

The theoretical plausibility of Veblen effects therefore depends upon the plausibility of the single-crossing property. In the simplest models of conspicuous consumption (for example, Ireland, 1992), the single-crossing property is satisfied. Since consumption of conspicuous goods reduces expenditures on other goods, declining marginal rates of substitution imply that conspicuous consumption is more costly for households with less wealth. As a result, overpayment for these goods does not arise in equilibrium. Thus, one reading of our results (one that is based on the premise that the single-crossing property holds) suggests that Veblen effects are difficult to rationalize.

However, we also exhibit several slightly more elaborate models in which the single-crossing property fails, and where this failure gives rise to Veblen effects. For example, we demonstrate that the tangency property is satisfied in the presence of bankruptcy constraints. This follows from the fact that the marginal cost of conspicuous consumption is inversely related to wealth at low expenditure levels, but positively related to wealth at high expenditure levels. Remarkably, when Veblen effects emerge, bankruptcy constraints *do not bind* in equilibrium, and so appear to be irrelevant, despite the fact that Veblen effects would not exist without them. Two other factors that can produce the requisite breakdown of single crossing are also examined. Thus, a second reading of our results (one that is sympathetic to the role of any of the factors considered here) suggests that Veblen effects are naturally rationalized within a signaling context.

The existence of Veblen effects in the context of our model has some provocative implications for public policy. Since supranormal profits result from the characteristics of demand rather than from the nature of strategic interaction among firms, evidence of high profitability does not necessarily support inferences of either collusion or oligopolistic forbearance. This observation also has implications for tax policy. Within our model, the equilibrium prices of luxury brands are demand driven, rather than supply driven—that is, luxury brands are sold at the consumer's preferred price, which is tax inclusive, and does not vary with the tax rate. Thus, as long as the tax per unit does not exceed the difference between the consumer's preferred price and marginal cost, an excise tax on luxury brands amounts to a nondistortionary tax on pure profits.

This observation is of particular interest in light of the Omnibus Budget Reconciliation Act of 1990, which, for a time, established substantial federal taxes on the sale of various conspicuous goods, including expensive automobiles, yachts, jewelry, and aircraft. One should not conclude from our analysis that these taxes were nondistortionary; whether the demand for luxury items is characterized by Veblen effects is a question that can be settled only through empirical analysis.

However, it should be noted that several predictions of our model are consistent with anecdotal evidence. First, many individuals appear to consume conspicuous goods to advertise affluence. According to Daniel Piette, vice-president of LVMH (a French conglomerate that owns Louis Vuitton, Moët et Chandon, and Christian Dior perfumes), for many individuals buying luxury goods "is all about demonstration."[8] According to *The Economist*, "the most famous (example) was Ralph Lauren, whose Polo brand was positioned to appeal to American yuppies pretending to be

[8] Quoted in *The Economist* (1993 p. 97).

Edwardian toffs'' (p. 92). Indeed, *The Economist* concludes that ''price is ... a powerful signal of exclusivity'' (p. 98). This motivates marketing strategies that appeal to status consciousness. For example, a recent Jaguar advertisement reads: ''If you could drive one car to your high school reunion, this would be it. As you swing into your alma mater in a beautiful new Jaguar XJS convertible, you can almost see the heads turn as your classmates ask, 'Isn't that ...?' ''

Second, brand-name producers apparently charge high premia on many status goods. In some cases, these premia persist even though the good is easily imitated.[9] As a result, manufacturers of status goods tend to earn supracompetitive returns.[10] This is most clearly illustrated by cases in which nearly identical versions of the same good are sold at vastly different prices. Marshall Schuon (1993) notes that less expensive cars are often ''virtually identical'' clones of pricier models. For example, ''If you don't mind a different grille and headlights, opting for the long-wheelbase Bentley Brooklands at $152,400 rather than its twin, the $178,200 Rolls-Royce Silver Spur III, can save $25,800'' (p. 20).

Third, there is some evidence that the tax-inclusive prices of certain luxury goods were unaffected by the luxury tax. Specifically, Rolls Royce, Jaguar, and BMW have each run promotional campaigns in which they offered to reimburse customers for the full amount of the luxury tax. A 1991 advertisement for Rolls Royce reads: ''If the luxury tax is all that separates us, it's time to talk. From today through December 31, 1991, Rolls-Royce Motor Cars Inc. will reimburse you for the full amount of the federal luxury excise tax incurred when you purchase or lease a new Rolls-Royce or Bentley.'' This offer was still in effect through 1993.[11]

The paper is organized as follows. We describe the model in Section I. Section II examines signaling equilibria under the assumption that the single-crossing property is satisfied. Section III analyzes cases where the single-crossing property fails to hold. The plausibility of the assumptions required to generate Veblen effects is discussed in Section IV. Policy implications and other conclusions are considered in Section V.

I. The Model

This section presents the model. Sections A, B, and C describe the choices to be made by households, social contacts, and producers, respectively. The sequence of decisions in the game and the conditions for equilibrium are presented in Sections D and E, respectively. Section F defines the single-crossing property in the context of our model.

A. *Households*

Consider a household that must allocate resources over two types of consumption goods. One type is ''conspicuous,'' in the sense that its characteristics, as well as the quantity consumed, are publicly observed. The characteristics of the conspicuous good include quality, q, where $q \in [\underline{q}, \bar{q}]$. The second type of good is ''inconspicuous,'' in the sense that it is consumed privately, and not observed by others. Because of our assumptions about observability, only conspicuous consumption can potentially serve as a signal of wealth. The inconspicuous good is assumed, for simplicity, to be of fixed quality. We will use the inconspicuous good as the numeraire.

The household is endowed with resources, R, which it allocates to the consumption of the conspicuous and inconspicuous goods. Let $x(q)$ denote the quantity purchased of the conspicuous good with quality q, and let s denote

[9] Ireland (1992) describes an interesting case of this involving a very expensive brand-named basketball shoe: ''The shoes became so much a passport to social success among poor urban teenagers that a campaign to limit their commercial promotion and advertising was initiated'' (p. 2).

[10] A number of examples are cited in *The Economist* (1993).

[11] Similarly, Jaguar advertised: ''Now you can have Jaguar luxury, *free* of the luxury tax ... Just buy or lease a new 1990 or 1991 Sovereign, Vanden Plas or XJ-S from your Jaguar dealer and we'll send you a reimbursement check equal to the luxury tax based on the manufacturer's suggested retail price.'' It is interesting to note that Jaguar did *not* offer this deal on the XJ-6, which is its least expensive automobile. An advertisement for BMW read: ''We will pay the luxury tax on any new BMW ...''

total conspicuous expenditures. Since the inconspicuous good serves as the numeraire, we use z to denote both the total inconspicuous expenditure and the quantity purchased.

There are two types of households (H and L), differing according to their levels of resources (R_{H} and R_{L}, with $R_{\mathrm{L}} < R_{\mathrm{H}}$). The associated population frequencies are α and $(1 - \alpha)$, respectively. Each household knows its own type, but cannot observe the type of any other household.

Each household of type i must respect the following resource constraint:

$$(1) \qquad z \leq \gamma(s, R_i),$$

where, ordinarily, $\partial\gamma(s, R_i)/\partial s < 0$ and $\partial\gamma(s, R_i)/\partial R > 0$. This generalized form of the resource constraint subsumes several special cases considered later in this paper. Note that the standard budget constraint, $z \leq R - s$, is a special case of equation (1).

Each household cares about its total quality-weighted conspicuous consumption, defined as

$$(2) \qquad x \equiv \int_{\underline{q}}^{\bar{q}} \mu(q)x(q)\, dq,$$

where $\mu(q)$ are weighting parameters (common to all households), assumed to be increasing in q. We assume that households also care about (i) consumption of the inconspicuous good, z, and (ii) an action ρ taken by the representative social contact. Total utility for type i = H, L is given by $U_i(x, z, \rho)$. We assume that U_i is strictly increasing and continuous in each of its arguments.

Note that, with this formulation of utility, higher quality is a perfect substitute for greater quantity. Yet in terms of the workings of the model, there will be an important difference between quality and quantity, in that firms will determine the set of available qualities, while consumers will exercise any discretion that may exist with respect to quantities.

Since U_i is increasing in z, and since inconspicuous consumption is, by definition, not observable, each household will certainly consume z up to the point where equation (1) holds with equality. Therefore, we can substitute the binding resource constraint into the utility function, and write the utility of a type i household as

$$(3) \qquad W_i(x, s, \rho) = U_i(x, \gamma(s, R_i), \rho).$$

It will be analytically convenient to assume that there is an absolute bound, $\bar{s}$, on total conspicuous expenditures. This assumption can be modified or relaxed at the cost of additional analytic complexity, without altering our central findings.

B. *Social Contacts*

Veblen's theory of conspicuous consumption is based on the premise that those who put wealth "in evidence" are rewarded with preferential treatment by social contacts. Our object here is not to explore the validity of this premise, but rather to identify the conditions under which it gives rise to Veblen effects. Consequently, we adopt a treatment of social contacts which, though highly stylized, captures the essence of this premise.

We assume that the payoff of the representative social contact is $\phi(R, \rho)$, where R is the resources of the household with which the social contact interacts. We also assume that social contacts cannot observe a household's resources directly, but must instead form conjectures based upon the household's observed actions. Contacts then choose ρ to maximize the expected value of ϕ. Let $r(\pi)$ denote the value of ρ that maximizes the expected value of ϕ given R, and given a subjective assessment that the household is type H with probability π. We will assume that $r(\cdot)$ is strictly increasing so that, in particular, $r(1) > r(0)$. Since U_i is increasing in ρ, the proper interpretation of this monotonicity assumption is that social contacts would, given perfect information, treat wealthier households better. Define $\rho_{\mathrm{H}} = r(1)$ and $\rho_{\mathrm{L}} = r(0)$; ρ_i is then interpreted as the act of treating a household as if it is of type i.

C. *Producers*

The conspicuous good can be produced by a large number of firms.[12] These firms are

[12] We have assumed that households' resources consist of the inconspicuous good. Consequently, we abstract

divided into two groups. The first group consists of F incumbents, indexed $f \in [1, \dots, F]$. The rest of the firms are potential entrants. All firms can produce the same range of qualities, $q \in [\underline{q}, \bar{q}]$ and conspicuous goods are otherwise identical. The marginal cost of producing a conspicuous good of quality q is given by $c(q)$, and the production technology exhibits constant returns to scale.

We will also assume that conspicuous products of some quality level q^o are always available from an alternative (not modeled) source at a price, p^o, that is "prohibitive" in the sense that, with perfect information, households would not purchase any of the conspicuous good at this price.[13] The existence of this alternative source simplifies the analysis of equilibria, but is not essential to our analysis.

Note that, in any first-best allocation, firms will only produce quality levels that minimize the expression $c(q)/\mu(q)$. For simplicity, we will assume that there is a unique quality level that satisfies this condition; we refer to it henceforth as the first-best quality level, q^F. In addition, we will use c^F to denote the minimized value of $c(q)/\mu(q)$.

Each firm produces a single product, which is "branded" (labeled) so that social contacts can easily identify the manufacturer. Branding does not affect utility directly, and in any ordinary (inconspicuous) context, branding would be irrelevant. If instead firms were allowed to choose between labeling and not labeling, some would label in equilibrium, and the outcome would be unchanged.

All consumers and social contacts observe the prices announced by all firms. Since social contacts also observe brand labels, quantities, and qualities, they can infer any household's total expenditure on conspicuous products, as well as total quality-weighted volume.

We endow incumbents with the following minor advantage over entrants: consumers buy the product from an incumbent, unless they can *strictly* improve their utility by buying from an entrant. In the context of conspicuous goods, this assumption is natural since incumbents market recognized brands. We will also resolve consumer indifference by assuming that each household acquires the conspicuous good from a single vendor whenever it is optimal to do so, rather than spreading purchases among several vendors. This too is natural as long as there is some cost associated with consummating each transaction. Finally, when households are indifferent between the offerings of several different incumbents, customers will be allocated so that aggregate quality-weighted volume (that is, units of x, rather than units of $x(q)$) is split equally between these incumbents.[14] Note that these conditions would yield marginal-cost pricing with any standard formulation of preferences.

D. *Timing*

The game unfolds as follows. First, each incumbent f announces a quality level, q_f, and a price, p_f, for the conspicuous good. Second, potential competitors observe these quality levels and prices, and then decide whether to enter. If a firm chooses to enter, it announces a quality level and a price for the conspicuous good.[15] Third, consumers observe all announced quality levels and prices, and determine the amounts of the conspicuous good to be purchased from each firm. Each consumer carries out these transactions, spending in total the amount s and acquiring in total the quality-weighted volume x. Residual resources are used for inconspicuous consumption, z. Fourth, social contacts observe each household's branded conspicuous consumption bundles,

from the processes by which that good is produced and allocated.

[13] The existence of such a price follows, for example, if one assumes that $\partial U_i(0, z, \rho)/\partial x$ is finite. As motivation, one can think of the alternative source as "custom" work.

[14] These assumptions are not essential for the existence of Veblen effects, but affect other features of the equilibrium.

[15] Since one can take F, the number of incumbents, to be large, allowing for further entry in the second stage may seem superfluous. One might therefore be inclined to delete this stage. We do not believe that this would alter our results. However, it would render the analysis more complex, as the current structure allows us to ignore problematic subgames (for example, if all firms name a very low or very high price). The reader should bear in mind that potential entry in the second stage would only serve to strengthen competitive pressures.

form inferences about each household's wealth, and react accordingly (by choosing ρ). The payoff to each household is given by $U_i(x, z, \rho)$. Social contacts receive payoffs of $\phi(R, \rho)$, where R is the household's actual resources. Firm's payoffs are given by profits (revenues minus costs).

E. *Equilibrium Conditions*

Our game is divided into two main phases. In the first phase (stages 1 and 2), firms compete by naming prices and qualities. In the second phase (stages 3 and 4), households select consumption bundles and social contacts draw inferences about households' characteristics. The second phase is recognizable formally as a "signaling game," in the sense of Jeffrey S. Banks and Joel Sobel (1987) or In-Koo Cho and Kreps (1987). In particular, the household is the "sender," and possesses private information concerning its type, R. The ex ante probability distribution over $\{R_L, R_H\}$ is common knowledge, and is summarized by α. After the household learns its type, it sends a "message," in this case (x, s), to the social contacts, who play the role of "receivers." In response to this message, the social contacts select a "response," ρ. The payoffs to the sender (household) and receiver (social contact) depend upon the sender's type (R), the message (x, s), and the response (ρ).[16]

We reduce the set of equilibria through the use of a refinement that is similar in spirit to subgame perfection: for any outcome of the first phase, actions and inferences constitute a separating equilibrium in the second phase, and this equilibrium satisfies the Cho-Kreps (1987) "intuitive criterion," which is equivalent to equilibrium dominance.[17] Given this selection criterion for the second phase of the game, we look for Bertrand-style equilibria in the first phase.

[16] For the receiver, dependence on the message itself is degenerate, as is often the case in applied signaling models.

[17] Equilibrium with complete pooling can be ruled out with the intuitive criterion. There do exist equilibria with imperfect separation which survive the intuitive criterion and stronger refinements. Consideration of these equilibria does not materially alter the analysis, so for simplicity we focus exclusively on full separation.

It is useful to describe the second-phase equilibria in a bit more detail. Let Q denote the set of quality levels named by firms in the first phase. For each $q \in Q$, let $P(q)$ denote the set of prices announced by firms for conspicuous products of quality q. Define $\underline{p}(q) \equiv \min P(q)$, and $\bar{p}(q) \equiv \max P(q)$. For a conspicuous good of quality q and price p, we define the "quality-weighted" price, $p/\mu(q)$; this corresponds to the price of a quality-weighted unit of conspicuous consumption (that is, a unit of x, rather than of $x(q)$). In light of equation (2), households would, in the absence of informational imperfections, choose the conspicuous good with the lowest quality-weighted price. Let $\underline{p} \equiv \min_{q \in Q} \underline{p}(q)/\mu(q)$, and $\bar{p} \equiv \max_{q \in Q} \bar{p}(q)/\mu(q)$. In other words, $\underline{p}(\bar{p})$ is the lowest (highest) quality-weighted unit price quoted in the first phase.

Note that, unless $\underline{p} = \bar{p}$, an individual's quality-weighted conspicuous consumption, x, does not uniquely determine his total conspicuous expenditure, s. Depending upon which brands he selects, he may spend as little as $\underline{p}x$, or as much as $\bar{p}x$. In fact, for any s satisfying $\underline{p}x \leq s \leq \bar{p}x$, it is possible to purchase x quality-weighted units of the conspicuous good for *exactly* s.[18]

No rational consumer would ever spend more than the minimal amount needed to acquire a given quantity of the *inconspicuous* good. However, a consumer may be willing to spend more than $\underline{p}x$ to acquire x units of the conspicuous good. Since others can observe his level of consumption, $x(q)$, his selection of brands, brand prices, and brand qualities, they can infer his total expenditure, s, and quality-weighted consumption, x.

Formally, a separating equilibrium consists of total conspicuous quality-weighted quantity and expenditure choices (x_L, s_L, x_H, s_H), with $(x_L, s_L) \neq (x_H, s_H)$, satisfying incentive compatibility,

$$(4) \quad W_L(x_L, s_L, \rho_L) \geq W_L(x_H, s_H, \rho_H)$$

$$(5) \quad W_H(x_H, s_H, \rho_H) \geq W_H(x_L, s_L, \rho_L)$$

[18] Specifically, the individual could purchase ηx quality-weighted units at $\bar{p}$ and $(1 - \eta)x$ quality-weighted units at $\underline{p}$, where $\eta = [(s/x) - \underline{p}]/(\bar{p} - \underline{p})$.

and feasibility,

$$(6) \qquad \underline{p} \leq \frac{s_H}{x_H} \leq \bar{p}$$

$$(7) \qquad \underline{p} \leq \frac{s_L}{x_L} \leq \bar{p}.$$

Moreover, social contacts form beliefs, represented by a function $\hat{\pi}$ mapping the message (x, s) to a subjective probability that the household is type H. This function must satisfy the restrictions that $\hat{\pi}(x_L, s_L) = 0$ and $\hat{\pi}(x_H, s_H) = 1$. Finally, the choices (x_L, s_L) and (x_H, s_H) must be optimal (for type-L and type-H households respectively) given the relation between inferences and actions that is implied by the combination of $\hat{\pi}$ and $r(\pi)$.

Our description of a separating equilibrium is incomplete in the following sense: although we have specified total conspicuous consumption (x_L and x_H) as well as total conspicuous expenditure (s_L and s_H), we have not indicated which brands are purchased. There may well be an infinite number of conspicuous consumption bundles containing x_i quality-weighted units, and requiring an expenditure of exactly s_i (i = L, H).[19] Fortunately this is immaterial, since consumers do not care about brand selection, except insofar as it affects total cost. Indeed, consumers are completely indifferent between all conspicuous consumption bundles containing the same total number of quality-weighted units that require the same total expenditures. Though we have made several assumptions to resolve consumer indifference, our results do not depend on the specifics of these assumptions.

It should be noted that, given our assumptions so far, Veblen effects might arise simply because it is *impossible* to deter imitation by type-L households *except* by paying inflated prices for the conspicuous good. If, for example, $\bar{s}$, the absolute limit on conspicuous expenditures, is sufficiently low, then it may be impossible to deter imitation by consuming high quantity or quality. For the moment, we will assume that sufficiently high quantity or quality does suffice to deter imitation, so that the existence or nonexistence of Veblen effects depends upon a comparison of the *desirability* of signaling through price, quantity, or quality, rather than on the feasibility of deterrence. We return to this issue in Section II.B, where we discuss factors that affect the *possibility* of deterring imitation through high quantity or quality.

To state this assumption formally, we must first develop some additional notation, and state one preliminary result. Define $x_L^*(p)$ as the solution to $\max_x W_L(x, px, \rho_L)$ (where, for simplicity, we assume that this solution is unique), and let $W_L^*(p)$ denote the corresponding optimized value of the objective function. We then have the following.

LEMMA 1: *For any separating equilibrium of the subgame beginning in stage 3, all type-L households purchase $x_L^*(\underline{p})$ quality-weighted units of the conspicuous good at a total cost of $\underline{p}x_L^*(\underline{p})$.*

The argument here is a standard one. In the separating equilibrium, the L's are correctly identified. Therefore, they cannot (in a sequential equilibrium) induce social contacts to reduce ρ below ρ_L by deviating from their prescribed choice. Their optimal choice is then to select feasible levels of consumption which maximize their intrinsic utility. Consequently, if there is another $x \geq 0$ and feasible s that raises the value of $W_L(x, s, \rho_L)$, it must make them better off. This contradicts the supposition that an equilibrium prevails.

We are now prepared to provide the following sufficient condition for the *feasibility* of deterring imitation without paying inflated prices for the conspicuous good: for all $p \geq c^F$,

$$(8) \qquad W_L(\bar{s}/p, \bar{s}, \rho_H) < W_L^*(p).$$

This condition states that type-L households would choose not to imitate type-H households if type-H households purchased enough of the conspicuous good at quality-weighted

[19] Suppose, for example, that there are three brands, A, B, and C, of qualities q_j ($j = A, B, C$), sold at prices p_j, where $p_A/\mu(q_A) < p_B/\mu(q_B) < p_C/\mu(q_C)$, and suppose that $p_A/\mu(q_A) < s_i/x_i < p_C/\mu(q_C)$. Then there is an infinite number of bundles, (x_A, x_B, x_C), satisfying $p_A x_A + p_B x_B + p_C x_C = s_i$, $x_A\mu(q_A) + x_B\mu(q_B) + x_C\mu(q_C) = x_i$, and $x_j \geq 0$.

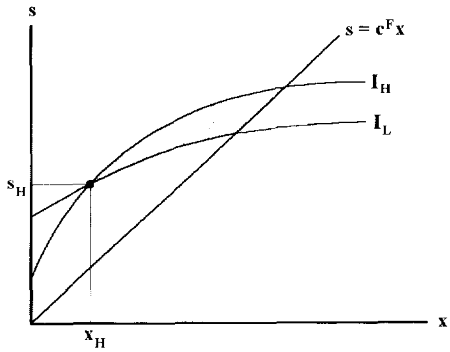

FIGURE 1. SINGLE CROSSING AND THE ABSENCE OF VEBLEN EFFECTS

price p. Consequently, type-H households could, if desired, differentiate themselves by selecting high quantity at the lowest available price, rather than by overpaying for a lower quantity.

F. *The Single-Crossing Property*

As discussed in the introduction, our objective is to determine whether Veblen effects emerge as a consequence of signaling. As we will show, the existence of Veblen effects hinges on the properties of the households' indifference curves in the (x, s) plane.

A condition known as the "single-crossing property" often plays an important role in models with asymmetric information. Figure 1 depicts indifference curves in the (x, s) plane for type-L households (I_L, corresponding to a constant value of $W_L(x, s, \rho)$) and for type-H households (I_H, corresponding to a constant value of $W_H(x, s, \rho)$) that satisfy this property. Note that the curves I_H and I_L cross only once, and that, at the crossing, the slope of I_H is steeper than the slope of I_L. To appreciate the economic content of this property, define the "benefit ratio" as the ratio of the utility gains associated with another unit of the conspicuous good, to the utility losses associated with another dollar of conspicuous expenditure. When the single-crossing property holds, the benefit ratio is always higher for households with greater resources. Formally, the single-crossing property is defined as follows.

Definition: Preferences satisfy the *single-crossing property* if, for any feasible (x, x', s, s', ρ) with $0 \leq x < x'$, $0 \leq s < s' \leq \bar{s}$, and $\rho \in [\rho_L, \rho_H]$, $W_L(x', s', \rho) \geq W_L(x, s, \rho)$ implies $W_H(x', s', \rho) > W_H(x, s, \rho)$.

Example: Suppose that household utility is additively separable in x, z, and ρ, and that the resource constraint is given by $z \leq R - s$. Then

$$(9) \quad W_i(x, s, \rho) = u(x) + v(R_i - s) + w(\rho).$$

In that case, $W_L(x', s', \rho) \geq W_L(x, s, \rho)$ implies $u(x') - u(x) \geq v(R_L - s) - v(R_L - s')$. But as long as v is strictly concave, $v(R_L - s) - v(R_L - s') > v(R_H - s) - v(R_H - s')$. Combining these statements gives us $W_H(x', s', \rho) > W_H(x, s, \rho)$. Consequently, this example satisfies the single-crossing property.

Section II demonstrates that Veblen effects cannot emerge in our model when the single-crossing property holds. Section III establishes that, in contrast, Veblen effects do emerge under alternative assumptions concerning household preferences.

II. Equilibrium with the Single-Crossing Property

In this section, we characterize the separating equilibria of this model when the single-crossing property holds. Section A demonstrates that the model cannot generate Veblen effects. Section B considers the robustness of this finding.

A. *Analysis of Veblen Effects*

The following result demonstrates that Veblen effects cannot arise when the single-crossing property is satisfied.

THEOREM 1: *Suppose that the single-crossing property holds, and that, entering stage 3, $\underline{p} \geq c^F$. Then every equilibrium for the continuation game has the property that all households purchase the conspicuous good at the quality-weighted price $\underline{p}$. Furthermore, on the equilibrium path for the entire game, $\underline{p} = c^F$, and only conspicuous goods of quality level q^F are produced.*

A formal proof of Theorem 1 appears in the Appendix. The intuition for this result is as follows. The fact that type-L households buy the conspicuous good at the quality-weighted price $\underline{p}$ follows directly from Lemma 1. It is certainly possible for type-H households to discourage imitation by choosing (x_H, s_H) with $s_H > \underline{p}x_H$. But in that case, type-H households could also consider signaling by purchasing a larger quality-weighted quantity at a lower quality-weighted price. If the single-crossing property is satisfied, then the benefit ratio is higher for type-H households, which makes it possible to choose an increase in quantity and a decrease in effective price that makes type-H households better off, while leaving type-L imitators worse off. The intuitive criterion then guarantees that, upon observing this deviation, social contacts would infer that the deviator was of type H, and respond accordingly. But in that case, the equilibrium with $s_H > \underline{p}x_H$ would be undermined. The second half of the theorem (conspicuous goods of quality q^F are available at price $\underline{p} = c^F$) then follows from standard Bertrand-style arguments.

The central idea of the theorem is illustrated graphically in Figure 1. If type-H households choose some (x_H, s_H) with $s_H/x_H > c^F$, single-crossing implies that the shaded area is nonempty. Thus, it is possible for type-H households to increase their utility, without inducing imitation, by purchasing more of the conspicuous good at a lower price. More generally, it should be evident from this figure that efficient signaling is ordinarily inconsistent with prices in excess of marginal cost unless there are no points above I_L, below I_H, and above the line $s = c^F x$, which would require the indifference curves to be tangent at (x_H, s_H). This observation anticipates the main result of the next section.

Although Theorem 1 does not establish the existence of an equilibrium satisfying the intuitive criterion where $s_H = c^F x_H$, this follows from standard arguments. Thus, our analysis establishes that, when the single-crossing property holds, there can be no Veblen effects: no household would choose to pay a higher price in order to enhance its status. To the extent signaling distorts the choices of type-H households, these households differentiate themselves by the quantity of the conspicuous good consumed (as in Ireland, 1992), rather than by the prices or qualities of the brands chosen.[20]

B. *Robustness*

We now establish the robustness of the result obtained in Section II.A by examining the roles of several potentially important, and possibly objectionable, assumptions. The first of these concerns the nature of competition among the producers of the conspicuous good. From the statement of Theorem 1, it should be evident that the absence of Veblen effects does not depend upon the nature of competition among firms. Note in particular that, in every continuation game, all households purchase the conspicuous good at the lowest available quality-weighted price, $\underline{p}$. A different model of competition among producers of the conspicuous good might produce an equilibrium price other than c^F, but would not alter the nature of any continuation game.[21] Thus, regardless of the process generating price and quality choices, when faced with a choice between a higher-priced brand of the conspicuous good and a lower-priced brand of the same quality, households will always choose the lower-priced brand.

In deriving Theorem 1, we have also assumed that the quantity of the conspicuous good is variable. This assumption is appropriate even if conspicuous goods are discrete objects that are used one at a time, such as watches, cars, and silk ties. Someone possessing many expensive watches can wear a Rolex on Monday, a Patek Phillipe on Tuesday, a Cartier on Wednesday, and so forth. Similarly, there are well-publicized examples of wealthy

[20] With other specifications of utility, type-H households might signal wealth through their choices of both quantity and quality. However, as long as the single-crossing property holds, they would never choose to overpay for a conspicuous good.

[21] While we have constructed a Bertrand-style game in which equilibrium prices are driven to marginal cost, other models of the competitive process might well produce higher prices (for example, when entry barriers are high and producers set capacity prior to choosing prices, as in Kreps and Jose Scheinkman [1983] and Carl Davidson and Raymond Deneckere [1986]).

celebrities who accumulate "stables" of expensive automobiles. Although these individuals wear only one watch at a time and drive only one car at a time, they manage to display quantity through ostentatious variety. Moreover, even when variety across time cannot be observed (for example, if social contact is infrequent), the ability to select an array of conspicuous goods serves the same role as variable quantity. If ownership of an Armani suit does not suffice to differentiate the wealthy from pretenders, those who wish to signal may add a Rolex watch; if that fails to do the trick, they may also brandish a Mont Blanc fountain pen, and a Hermes tie or scarf. As long as the single-crossing property is satisfied, arguments analogous to those used in the proof of Theorem 1 imply that households will prefer to signal with greater variety (quantity of differentiated conspicuous items), rather than by overpaying for less variety.

Finally, as we now demonstrate, even if quantity and variety are *both* fixed, Veblen effects still cannot arise in equilibrium, as long as firms are free to vary quality.[22] We modify the model by assuming that each household purchases either one unit of the conspicuous good from a single firm at a single price and quality, or none. A separating equilibrium for the second phase of the game consists of (q_L, p_L, q_H, p_H) with $(q_L, p_L) \neq (q_H, p_H)$ such that[23]

$$(10) \qquad W_L(\mu(q_L), p_L, \rho_L) \geq W_L(\mu(q_H), p_H, \rho_H)$$

and

$$(11) \qquad W_H(\mu(q_H), p_H, \rho_H) \geq W_H(\mu(q_L), p_L, \rho_L).$$

Moreover, p_L and p_H must be prices actually named by firms in the first phase of the game, and q_L and q_H must be qualities actually named by firms in the first phase of the game.

Define $\tilde{q}_L$ as the solution to $\max_q W_L(\mu(q), c(q), \rho_L)$, and let $\tilde{W}_L$ denote the corresponding maximized level of utility. We will assume for simplicity that $\tilde{q}_L$ is unique, and that $\tilde{W}_L > W_L(0, 0, \rho_H)$, so that type-L households will actually purchase the conspicuous good. We will also assume that[24]

$$(12) \qquad W_L(\mu(\bar{q}), c(\bar{q}), \rho_H) < \tilde{W}_L.$$

Condition (12) takes the place of condition (8) (for the case of variable quantity) as a sufficient condition for the feasibility of deterring imitation without paying inflated prices for the conspicuous good.[25] In particular, type-L households will not imitate type-H households if type-H households purchase the highest quality conspicuous good at a price equal to marginal cost. With these changes, we have the following theorem.

THEOREM 2: *Suppose that the single-crossing property holds, and that each household buys at most one indivisible unit of the conspicuous good. Then $p_L = c(q_L)$ and $p_H = c(q_H)$.*

A proof of this result is contained in the Appendix. The intuition is similar to that given for Theorem 1. The fact that there is no markup over marginal cost on units of the conspicuous good sold to type-L households

[22] It is important to realize that this conclusion does not follow directly from Theorem 1. Even though quality is, in our model, a perfect substitute for quantity from the perspective of households, control over available qualities resides with firms, rather than households. Since households must choose among the products that are actually offered, the case of fixed quantity and variable quality give households much less discretion than the case of variable quantity.

[23] It is conceivable that one might also construct a separating equilibrium in which some households purchase none of the conspicuous good. This would necessitate modification of the incentive constraints (10) and (11). However, subsequent assumptions will rule out the possibility that such an equilibrium would survive the application of the intuitive criterion.

[24] Technically, with indivisibilities, we must also assume that $c(\bar{q}) \leq \bar{s}$, so that it is feasible to purchase one unit of a conspicuous product with quality $\bar{q}$ at a price equal to the marginal cost. This is not restrictive, since, in the quantity-constrained model, we could simply define $\bar{q}$ as $c^{-1}(\bar{s})$.

[25] In some sense, condition (12) is less restrictive than condition (8), in that it only requires the inequality to be satisfied when price equals marginal cost.

follows from standard Bertrand-style arguments; competition among producers will make quality $\tilde{q}_L$ available at price $c(\tilde{q}_L)$. It is certainly possible to construct an equilibrium in which type-H households discourage imitation by choosing (q_H, p_H) with $p_H > c(q_H)$. But in that case, the single-crossing property guarantees the existence of an alternative offering with higher quality and a lower markup, such that type-H households would strictly prefer this alternative, while type-L households would strictly prefer (q_L, p_L). The intuitive criterion then implies that, if this alternative was offered, and if a household selected it, social contacts would infer that the deviating household was of type H, and respond accordingly. Consequently, if the alternative is offered, type-H households will select it. But this undermines the equilibrium, since an entrant would then have an incentive to offer this alternative.

Notice that Theorem 2 is weaker than Theorem 1, in the sense that it only describes behavior on the equilibrium path.[26] In equilibrium, households never purchase an excessively priced conspicuous good, so Veblen effects do not arise as an equilibrium phenomenon. However, off the equilibrium path, type-H households may well elect the more expensive of two equivalent brands, for the simple reason that no other alternatives are available, and acquisition of the less expensive brand would not be sufficiently costly to deter imitation by type-L households. Although Veblen effects can therefore arise out of equilibrium, it is important to reiterate that even this is a fragile result. The existence of even a single conspicuous good with flexible quantity, or the existence of a large variety of conspicuous goods (such as watches and cars) each with fixed quantity, effectively brings us back to the variable-quantity case, and eradicates Veblen effects both on the equilibrium path and out of equilibrium.

For completeness, it is worth mentioning the case where *both* quantity *and* quality are fixed. Let $q = 1$ denote the single feasible level of quality. Once again, a standard Bertrand-style argument implies that some firm will sell the conspicuous good at price $p = c(1)$, and that type-L households will purchase this brand. Define p_H as the solution to[27]

$$W_L(\mu(1), c(1), \rho_L) = W_L(\mu(1), p_H, \rho_H). \tag{13}$$

It is easy to verify that, in any equilibrium satisfying the intuitive criterion, some firm will offer the conspicuous good at price p_H, and type-H households will purchase this brand, despite the availability of an equivalent product at the lower price, $c(1)$. Thus, the fixed-quantity, fixed-quality case gives rise to Veblen effects even in equilibrium. This is the essence of the signaling equilibrium described by Wolfgang Pesendorfer (1995). It should be evident, however, that Veblen effects, when generated in this way, are highly fragile and depend on a variety of tenuous assumptions, including (i) households cannot vary quantity (either by changing the amount used at one time, or by using distinguishable units at different points in time), (ii) firms cannot vary quality, (iii) there are no other conspicuous goods with either variable quantity or variable quality, and (iv) there exist relatively few categories of conspicuous goods, so that households cannot display wealth through ostentatious variety.

III. Equilibrium Without the Single-Crossing Property

In the last section, we demonstrated that Veblen effects cannot arise when the single-crossing property holds if quantity, quality, or variety is variable. However, signaling equilibria may exist even when the single-crossing property is violated. This observation suggests that it may be possible to generate Veblen effects under less standard assumptions. In this section, we focus on cases in which the violation of the single-crossing

[26] It should be noted that this is *not* attributable to the difference between conditions (12) and (8) described in the preceding footnote, but rather follows from the fact that firms, not households, choose available qualities.

[27] A sufficient condition for the existence of p_H is that $W_L(\mu(1), c(1), \rho_L) \geq W_L(\mu(1), \bar{s}, \rho_H)$.

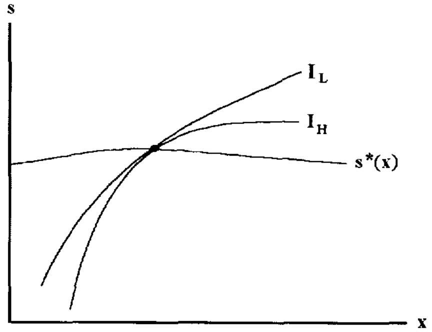

FIGURE 2. THE TANGENCY PROPERTY

property takes a particular form, which we refer to as the *tangency property*. At this point, we introduce this property as a technical condition, and explore its implications. In Section IV, we identify more primitive conditions from which this property can be derived.

Definition: Preferences satisfy the *tangency property* if there exists a continuous function $s^*(x)$ such that for any (x, x', s') (with $s' \neq s^*(x)$), $W_L(x', s', \rho_H) = W_L(x, s^*(x), \rho_H)$ implies $W_H(x', s', \rho_H) < W_H(x, s^*(x), \rho_H)$.

We illustrate this property in Figure 2. Notice that the indifference curves I_L and I_H (which presuppose $\rho = \rho_H$) are tangent to each other where they cross the function $s^*(x)$. This could occur, for example, if the benefit ratio (defined in Section I.F) is higher for households with greater resources when total conspicuous expenditures are less than $s^*(x)$, and lower when conspicuous expenditures exceed $s^*(x)$.

When the tangency property is satisfied, mutual nonimitation may be infeasible. We therefore use the following additional condition to guarantee the existence of separating equilibria.

Definition: Separation is feasible if there exists $(x_H, s_H) \neq (x_L^*(c^F), c^F x_L^*(c^F))$ with $s_H/x_H \geq c^F$ such that $(x_L^*(c^F), c^F x_L^*(c^F), x_H, s_H)$ satisfies expressions (4) and (5) (incentive compatibility).

The remainder of this section is organized as follows. Section A demonstrates that Veblen effects can emerge in our model when the tangency property holds (assuming that separation is feasible).[28] In equilibrium, some firms market "budget" brands (which are sold at a price equal to marginal cost), while others sell "luxury" brands (which are sold at a price above marginal cost, despite the fact that producers are perfectly competitive). Luxury brands are not intrinsically superior to budget brands but are purchased by consumers who seek to signal high levels of wealth. Section B examines the robustness of this finding.

A. *Analysis of Veblen Effects*

To analyze the characteristics of equilibria when the tangency property holds, we require some additional notation. Specifically, let x^* denote the solution (if any) to the equation

$$(14) \quad W_L(x^*, s^*(x^*), \rho_H) = W_L^*(c^F).$$

We illustrate this solution in Figure 3, where we have superimposed the indifference curve described by the equation $W_L(x, s, \rho_H) = W_L^*(c^F)$ on $s^*(x)$. The point x^* corresponds to the intersection of this indifference curve and $s^*(x)$. It is, of course, possible that $s^*(x)$ could lie everywhere below, or everywhere above, the indifference curve of interest, in which case there would be no intersection. For our central result, we will simply assume the existence of a unique intersection.[29] In Section IV, we discuss conditions under which this assumption is satisfied.

It is easy to verify that the indifference curve of interest must lie strictly above the line $s = c^F x$ at the point $x_L^*(c^F)$.[30] Thus, depending on

[28] Veblen effects may arise when the single-crossing property fails to hold, even when the tangency property is *not* satisfied. However, the analysis of equilibria is particularly tractable when the tangency property holds.

[29] Once existence is assumed, it is easy to establish that the intersection must be unique. Specifically, if a type-L indifference curve crosses $s^*(x)$ more than once, it must be tangent to the same type-H indifference curve at each crossing (otherwise type-H indifference curves would cross). But this contradicts the strict inequality in the definition of the tangency property.

[30] Consider s solving $W_L(x_L^*(c^F), s, \rho_H) = W_L(x^*, s^*(x^*), \rho_H)$. Since $W_L(x^*, s^*(x^*), \rho_H) = W_L(x_L^*(c^F), c^F x_L^*(c^F), \rho_L) \equiv W_L^*(c^F)$, it follows from $\rho_H > \rho_L$ that $s > c^F x_L^*(c^F)$.

the location of $s^*(x)$, it is certainly *possible* that $s^*(x^*)$ would exceed $c^F x^*$,[31] as shown in Figure 3. The following result demonstrates that Veblen effects do arise in equilibrium for this case.

THEOREM 3: *Suppose that the tangency property holds, that separation is feasible, and that* $s^*(x^*)/x^* \equiv p^* > c^F$. *Then (i)* $(x_L, s_L) = (x_L^*(c^F), c^F x_L^*(c^F))$ *and* $(x_H, s_H) = (x^*, s^*(x^*))$, *(ii) only conspicuous goods of quality* q^F *are purchased, (iii) type-H households only patronize incumbents, who earn strictly positive profits, and (iv) effective quality-weighted prices,* (p_L, p_H), *and aggregate profits are independent of F (the number of incumbents).*

A formal proof of Theorem 3 appears in the Appendix. The intuition for part (i) is closely related to the intuition given for Theorem 1. The fact that type-L households buy the conspicuous good at the quality-weighted price c^F follows from Lemma 1 and Bertrand-style competition among producers. It may be possible for type-H households to discourage imitation by purchasing a sufficiently large quantity of the conspicuous good at the price c^F. But in that case, type-H households would do well to consider signaling by purchasing a smaller quality-weighted quantity at a markup over cost. Given the assumed failure of the single-crossing property, it is possible to choose a decrease in quantity and a markup that makes type-H households better off, while leaving type-L imitators worse off. The intuitive criterion then guarantees that, upon observing this deviation, social contacts would infer that the deviator was of type H, and respond with ρ_H. But in that case, the equilibrium would be undermined.

In contrast, suppose that type-H households attempt to distinguish themselves from type L's by purchasing x^* units at the inflated price $p^* > c^F$. As illustrated in Figure 3, no other point preferred by type-H households is consistent with the deterrence of imitation by type-L households. If a luxury brand producer reduces price to some p between c^F and p^*, then type-H households will be able to increase utility *holding ρ constant* by selecting a point in the shaded area of Figure 3. But type-L households prefer every point in the shaded area to $(x_L^*(c^F), c^F x_L^*(c^F))$; consequently, they would imitate this choice. Since type-H households wish to avoid imitation, no luxury brand producer can profitably attract additional business by cutting price. Under our assumptions concerning the resolution of consumer indifference, the resulting profits are shared equally by the incumbent firms. Moreover, since the equilibrium price p_H is demand driven (that is, it is the "optimal" price for type-H households) rather than supply driven, the key features of equilibrium are independent of the number of incumbents.

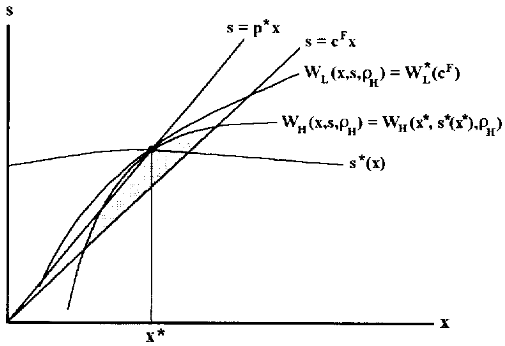

FIGURE 3. VEBLEN EFFECTS WITH THE TANGENCY PROPERTY

Several aspects of Theorem 3 deserve emphasis. With the tangency property, Veblen effects are apparent: type-H households pay $p^*\mu(q^F)$ for the conspicuous good, even though a qualitatively identical brand is available at a price of $c(q^F) < p^*\mu(q^F)$. No firm can attract type-H purchasers by lowering price, since, with a lower-priced brand, it is more costly in total to deter imitation by type-L households (recall that a higher quantity would be required). Although signaling distorts the price and quantity choices of type-H households, it does *not* distort their quality choices. Moreover, firms continue to select first-best quality. Finally, positive profits prevail despite the fact that we have assumed homogeneous goods, free entry, a constant

[31] For example, if x^* is sufficiently close to $x_L^*(c^F)$, it necessarily follows that $s^*(x^*) > c^F x^*$.

returns to scale technology, and Bertrand-style pricing—conditions that would yield marginal-cost pricing (even when indifference is resolved in favor of incumbents) with ordinary formulations of preferences.

B. *Robustness*

We now establish the robustness of Veblen effects when the tangency property holds by examining the roles of several potentially important assumptions, including those highlighted in Section II.B.

Once again, it is evident that different assumptions about the nature of competition among producers of the conspicuous good would not qualitatively alter our result. Our analysis of signaling equilibria for the second phase of the game implies that, regardless of the process generating $\underline{p}$ and $\bar{p}$, type-H households will, in a wide range of situations, select a higher-priced brand over a qualitatively equivalent lower-priced brand.

Veblen effects are also robust with respect to the alternative assumption that quantity is fixed (at one unit). For the same reasons as in Section II.B, competition among producers will make quality $\tilde{q}_{\mathrm{L}}$ available at price $c(\tilde{q}_{\mathrm{L}})$ (where the definition of $\tilde{q}_{\mathrm{L}}$ is unchanged). Define q^* as the solution to

$$(15) \quad W_{\mathrm{L}}(\mu(q^*), s^*(\mu(q^*)), \rho_{\mathrm{H}}) = \tilde{W}_{\mathrm{L}}.$$

The term q^* serves a role analogous to that of x^* from the variable-quantity case (see equation (14) in Section III.A). Using an argument completely analogous to that given in the proof of Theorem 3, it is possible to show that, as long as $s^*(\mu(q^*)) > c(q^*)$, type-H households purchase quality $q_{\mathrm{H}} = q^*$ at price $p_{\mathrm{H}} = s^*(\mu(q^*))$, and that the other features of Theorem 3 are unchanged. Naturally, Veblen effects also arise if both quantity and quality are fixed.

Another feature of equilibrium with variable quantity described in Theorem 3 is that all firms choose to produce the first-best quality, q^F. Thus, despite the imposition of assumptions that would yield marginal-cost pricing under standard formulations of preferences, *firms will not dissipate excess profits by competing in quality*. As in Section II.B, the specific choice of q^F is a somewhat special consequence of assumptions about functional forms. However, the finding that firms will not dissipate profits through quality competition is quite general, and holds even when quality is not a perfect substitute for quantity. To clarify this point, consider the equilibrium described in Theorem 3, where type-H households purchase $x^*/\mu(q^F)$ units of a quality q^F conspicuous good at a total cost of $s^*(x^*)$. Now suppose that some firm can, through some costly activity (for example, advertising or innovation), enhance the value of its product. If it undertakes this action without changing price or quality, it will not succeed in luring a single buyer away from its competitors. The reason is that the activity would also enhance the value of the product for type-L households, who would then prefer this enhanced package to $(x_{\mathrm{L}}^*(c^F),\ c^F x_{\mathrm{L}}^*(c^F))$. Thus, the enhanced package would not function as a signal of wealth, and thereby attract type-H households, unless the producer simultaneously raised price and/or lowered quality.[32]

A final robustness issue concerns our assumption that there are only two types of households. When the single-crossing property is satisfied, the extension of our model to an arbitrary number of types is completely standard. Although standard arguments do not apply when the tangency property holds, a somewhat stronger version of this condition permits the introduction of additional types with little added complexity.[33] Suppose in particular that there are $I + 1$ types of households indexed $i = 0, 1, 2, \ldots, I$, with resources R_i ($R_j < R_k$ for $j < k$). For each type $i > 0$, we will assume that there exists a continuous function $s_i^*(x)$ such that for any (x, ρ, x', s', ρ') with $s' \neq s_i^*(x)$, $W_0(x', s', \rho') = W_0(x, s_i^*(x), \rho)$ implies $W_i(x', s', \rho') < W_i(x,$

[32] In an earlier version of this paper (Bagwell and Bernheim, 1992), we considered a model with advertising in which advertising enhanced utility, but, unlike quality in the current model, did so in a way that was not a perfect substitute for quantity. We demonstrated that firms would not dissipate profits through competition in advertising.

[33] This analysis extends that of Bernheim (1991), who, in a much different context, analyzed signaling equilibria under a failure of the single-crossing property somewhat analogous to the tangency property.

$s_i^*(x), \rho)$.[34] We use x_i^* to denote the solution to $W_0(x_i^*, s_i^*(x_i^*), \rho_i) = W_0^*(c^F)$ (where $W_0^*(c^F)$ is defined analogously to $W_L^*(c^F)$). To construct the equilibrium, we assign type-0 households the bundle $(x_0^*(c^F), c^F x_0^*(c^F))$ (analogously to type-L households in the two-type case), and type-$i > 0$ households the bundle $(x_i^*, s_i^*(x_i^*))$. In other words, we select the bundle for each type-$i > 0$ household to deter imitation by the lowest type, rather than (as in the standard case) by its next lowest type. With a pair-wise analog of feasible separation between type 0 and each type i, this assures us of mutual nonimitation for each $(0, i)$ pair. Note that $W_0(x_i^*, s_i^*(x_i^*), \rho_i) = W_0^*(c^F) = W_0(x_j^*, s_j^*(x_j^*), \rho_j)$ for each (i, j) pair (with $i, j > 0$). It follows immediately from this observation and the modified tangency condition that mutual nonimitation is satisfied for (i, j) (strictly if $s_i^*(x_i^*) \neq s_j^*(x_j^*)$).

IV. Are Veblen Effects Plausible?

Our analysis has isolated theoretical conditions that allow us to rationalize the existence or nonexistence of Veblen effects. However, the fact that it is possible to produce Veblen effects under some appropriate set of assumptions does not necessarily imply that one is likely to observe these effects in practice. Indeed, the conditions required to generate Veblen effects may strike the reader as implausible. In this section, we examine the plausibility of the tangency property. We then discuss in greater detail the effectiveness of conspicuous expenditures as a signal of wealth.

A. *Justifications for the Failure of the Single-Crossing Property*

In this section, we demonstrate that the tangency property can be derived from more primitive assumptions. Three separate examples are considered.

Example 1: Personal Bankruptcy. Consider a modified version of the game, in which consumers must borrow to finance conspicuous expenditures, and where loans to households are potentially risky, since households may choose to default. The game unfolds in five stages rather than four, with the set of agents expanded to include a large number of potential creditors, who can borrow and lend money at the riskless rate r^* (their opportunity cost of funds). First, each incumbent f announces quality q^F and price, p_f, for the conspicuous good, and each creditor n announces an interest rate, r_n. Second, potential conspicuous good producers observe these qualities, prices and interest rates, and then decide whether to enter. If a firm chooses to enter, it announces a quality and price for the conspicuous good. Third, consumers observe all announced qualities, prices and interest rates, and determine the amounts of the conspicuous good to be purchased from each firm. Since income is not received until stage 5, these purchases must be financed through borrowing.[35] We assume for simplicity that creditors cannot monitor the total indebtedness of any client. Thus, households can obtain any desired loan at the prevailing rate market of interest, $r \geq r^*$. Fourth, social contacts observe households' branded conspicuous-consumption bundles, form inferences about households' resources, and react accordingly (choose ρ).[36] Social contacts do *not* observe households' choices of lenders. Fifth and finally, income (R) is received and loans mature. Each household has the option to default on its loan, in which case creditors receive an

[34] Note that, under this assumption, the locus of tangencies between indifference curves is independent of ρ. This property arises naturally when, for example, utility is separable in ρ and (x, s).

[35] Nothing would change if households received a portion of their incomes prior to stage 3. The extreme assumption that all income is received in stage 5 is made for simplicity only.

[36] Note that inferences are drawn in stage 3, prior to the time at which bankruptcy may be declared. We have therefore assumed implicitly that a declaration of bankruptcy would not affect status (possibly it is unobservable). However, this assumption is not essential. Even when a declaration of bankruptcy negatively affects status, the *marginal* cost of conspicuous spending will be higher for higher-income households past the point where the bankruptcy constraint binds for lower-income households. Consequently, with some technical qualifications, our results will be qualitatively unchanged.

enforceable claim against the household's income. Since bankruptcy protection allows the household to retain resources of the amount $\underline{z}$, independent of type, a declaration of bankruptcy leaves the household with resources equal to $\max\{\underline{z}, R-(1+r)s\}$. We assume that the household's conspicuous consumption is unaffected by bankruptcy (in other words, the conspicuous good cannot be repossessed).[37] All residual resources are spent on the inconspicuous good at the end of stage 5. As in the example in Section I.F, utility is additively separable, $U_i(x, s, \rho) = u(x) + v(s) + w(\rho)$.

Once creditors have selected interest rates, the game is merely a special case of the model considered in Section III. The utility of the household is described by equation (3), where

$$(16) \quad \gamma(s, R_i) = \max\{\underline{z}, R-(1+r)s\}.$$

Indifference curves in the (x, s) plane for type-L households, I_L, and for type-H households, I_H, are depicted in Figure 4. It is easy to verify directly that, given appropriate choices of c^F and $\bar{s}$, the tangency property holds for this model (including the stronger version of the condition introduced in our discussion of multiple types), as shown in Figure 2. In effect, the marginal cost of conspicuous consumption is higher (and the benefit ratio is lower) for type-L households as long as total expenditures do not exceed $s^* = (R_L - \underline{z})/(1+r)$. However, for higher levels of conspicuous spending, the marginal cost is higher (and the benefit ratio lower) for type-H households.[38] Since, in this example, s^* is independent of x, we abbreviate $s^*(x)$ as s^*.

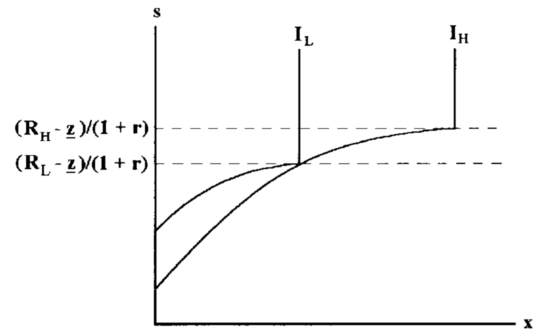

FIGURE 4. INDIFFERENCE CURVES WITH PERSONAL BANKRUPTCY

Under relatively mild conditions, incumbent producers name quality q^F and price $p^*\mu(q^F)$, creditors name the interest rate r^*, entrants name quality q^F and price $c(q^F)$, type-L households choose $(x_L^*(c^F), c^F x_L^*(c^F))$, type-H households choose (x^*, s^*), and no consumer defaults on any loan. With more than two types of households, each $i \geq 1$ would spend exactly the same amount (s^*), but those with greater resources would purchase a smaller volume at a higher price.[39]

The absence of default (in equilibrium) deserves emphasis. Type-L households spend the amount $c^F x_L^*(c^F)$ on conspicuous consumption. Since, by assumption, $s^* > c^F x_L^*(c^F)$, their bankruptcy constraint does not bind. Since type-H households spend the amount $s^* = (R_L - \underline{z})/(1+r^*)$ on conspicuous consumption, their bankruptcy constraint does not bind either. Hence, the casual observer would conclude that bankruptcy constraints are irrelevant. But this is certainly not the case—without the bankruptcy constraint, Theorem 1 applies, and no Veblen effects emerge. The key to this apparent puzzle is that type-L households are influenced by the fact that they

[37] This assumption requires some justification. Between the purchase of a conspicuous good and a declaration of bankruptcy, some or all of that good may be consumed or depreciated. Moreover, bankruptcy courts often allow individuals to retain expensive possessions (see, for example, Kirstin Downey, 1991; or Richard Hylton, 1991). One could, at the cost of introducing considerable analytic complexity, instead assume that, in the event of bankruptcy, a household consumes some fraction λ $(0 < \lambda < 1)$ of its conspicuous possessions, while the remainder, $(1-\lambda)x$, is repossessed. It does not appear that this would disturb the qualitative features of our analysis.

[38] For $s < (R_L - \underline{z})/(1+r)$, the analysis is the same as for the example in Section I.F. For $s > (R_L - \underline{z})/(1+r)$, the benefit ratio of the type-L household is infinite.

[39] Since $s_i^*(x_i^*) = s_j^*(x_j^*) = s^*$ for $i, j > 0$, it does not follow that the mutual nonimitation constraints hold strictly. Indeed, while each type $i > 0$ strictly prefers to differentiate itself from type 0, all other incentive compatibility conditions hold with equality. If income was uncertain as in Bagwell and Bernheim (1992), $s_i^*(x_i^*)$ would vary with i, and the nonimitation constraints between i, $j > 0$ would hold strictly.

would confront a binding bankruptcy constraint *if* they attempted to imitate the type-H households. Furthermore, with the introduction of income uncertainty, default does occur with positive probability, while the other features of the equilibrium remain qualitatively unchanged (see Bagwell and Bernheim, 1992). This is consistent with evidence that many wealthy individuals *are* at significant risk of bankruptcy (see, for example, Michael Allen, 1991), and that this risk is often associated with the acquisition of costly, conspicuous possessions.[40]

Example 2: Taxation. Suppose that, as in Example 1, utility is additively separable. Suppose also that some conspicuous expenditures (such as lease payments on luxury automobiles, or mortgage payments on expensive homes) are deductible expenses for the purpose of computing personal income taxes, and that marginal personal income tax rates decline with taxable income over some range (we note that the U.S. tax code has satisfied this condition since 1986 due to the "take back" of personal exemptions and itemized deductions). More specifically, suppose that taxable income is given by $Y = R - s$, that the first $\bar{Y}$ dollars of taxable income are taxed at the rate τ_1, and that additional taxable income is taxed at the rate τ_2, with $\tau_1 > \tau_2$. Assume further that $R_L > \bar{Y}$. Then

$$(17)\quad \gamma(s, R) = (1 - \tau_1)(R - s) + (\tau_1 - \tau_2)\max\{0, R - s - \bar{Y}\}.$$

In this case, $s^* = R_L - \bar{Y}$ (which is independent of x, as in Example 1). It is easily verified that, as long as either the curvature of v is not too great, or $R_H - R_L$ is relatively small, then, under appropriate choices of c^F and $\bar{s}$, the tangency property holds (including the stronger version introduced in our discussion of multiple types).

Example 3: Intrinsic Utility. Suppose that utility is given by the expression

$$(18)\quad U_i(x, z, \rho) = \theta_i u(x) + v(z) + w(\rho)$$

for i = L, H, where $\theta_L > \theta_H > 0$. In other words, assume that type-L households receive greater intrinsic utility from consuming luxury goods, perhaps because of "novelty" value, or because of personal satisfaction derived from "acting rich." Assume also that the household faces the budget constraint $z = R - s$. For simplicity, assume that $u(x) = x$. It is then possible to verify that, under appropriate choices of c^F and $\bar{s}$, the tangency property holds if $v'(R_H)/v'(R_L) < \theta_H/\theta_L$, and if $v'(R_H - s)/v'(R_L - s)$ declines with s.[41] This final property requires $v''' < 0$ over the relevant range.

B. *Why Signal with Prices?*

An implicit assumption in the analysis of Sections II and III.A concerns the resolution of indeterminacy. It is well recognized that equilibria such as those considered in this paper are characterized by "money burning," where an action imposes the same cost on all agents regardless of type (see Paul Milgrom and John Roberts [1986] or the literature on signaling in financial markets). Agents must waste a certain amount of money to sustain the equilibrium, but, as a formal matter, they are indifferent between overpaying for conspicuous goods and other dissipative activities, such as literally burning money. We recognize that individuals throw money away in a variety of forms—witness, for example, the phenomenon of heavy tipping by "high rollers." Even so, we would argue that, in practice, most methods of burning money are inferior to the conspicuous consumption of expensive, durable goods.

To signal wealth effectively, the act of burning money must be observed readily by large numbers of people (even if these people make

[40] One reporter recently summarized this relation as follows: "In the 1980s, people lived out their materialistic dreams, overspending on BMWs, huge boats, Caribbean vacations and dream condos, bankruptcy lawyers say. Then came the real estate crash and the job layoffs. Now, lawyers say, their clients are using their credit cards for basic necessities, including food and children's clothes" (Barbara Carton, 1991 p. 41).

[41] This follows from the fact that the slope of a type-i indifference curve is given by $\theta_i/v'(R_i - s)$.

little or no attempt to observe it), and it must be interpreted as evidence of substantial resource dissipation. Thus, one can certainly destroy substantial resources by burning dollar bills on one's front lawn, but relatively few people will observe this activity since it is both brief and localized. It is also possible to waste substantial resources in numerous small increments during the normal course of social interaction, for example by tipping excessively at every opportunity. However, since other individuals observe this behavior only at isolated moments, tipping serves as an effective signal only if others believe that current behavior is representative. In contrast, expensive durable goods, including one's automobiles, jewelry, and clothing are all observed regularly by numerous other individuals during the normal course of social interaction, and provide durable emblems of substantial resource dissipation.[42]

The predisposition for signaling wealth through the purchase of expensive, conspicuous, durable goods does not completely resolve the issue of indeterminacy. While we have focused on the case of a single conspicuous good (with many brands), the extension of our analysis to an arbitrary number of conspicuous goods is straightforward and yields essentially identical conclusions, except that the distribution of demand across conspicuous goods is indeterminant. Thus, our theory does not explain which durable, conspicuous goods households will choose as signals. Given the diversity of actual behavior, we regard this as a virtue, rather than a difficulty.

One might also wonder why households do not simply publish tax returns or audited asset statements. If one takes our theory literally, it is also difficult to understand why consumers remove price tags from their conspicuous possessions. Obviously there are other important considerations that influence the choice of a signal; completely transparent exhibitions of wealth seem socially unacceptable. An example of these kinds of concerns has been described by *The Economist* (1993 p. 98): "Men flocked to the likes of Patek Philippe and Ebel, apparently because watches are the one sort of luxury good that has what the marketers at Cartier smilingly describe as a 'functional alibi'."

C. *The Observability of Price Concessions*

Another assumption implicit in the analysis of Sections II and III.A is that firms cannot make a secret price concession to any given buyer. If secret concessions are possible, then the equilibrium described in Section III.A will break down: type-H agents prefer to buy the conspicuous luxury good at a lower price, as long as they still get credit for purchasing it at the higher price.[43]

There are many possible solutions to this problem. Each luxury brand producer clearly has an incentive to commit himself to a policy of making no secret concessions. Indeed, the argument in the preceding paragraph implies that the signaling value of conspicuous consumption is present only if the producer has made a credible commitment of this sort. One approach is to rely on intermediaries. By selling products to intermediaries (for example, car dealerships) at publicly observable prices that exceed marginal cost, the manufacturer places a lower bound on secret price concessions (equilibrium prices cannot be less than "dealer invoice"). Another possibility is that manufacturers will rely on reputations. Once a luxury brand acquires a reputation for being sold at heavy discounts, the "snob value" associated with its purchase may be eroded.

In practice, manufacturers of luxury goods do indeed adopt these kinds of mechanisms in order to maintain high prices. According to *The Economist* (1993 p. 98):

[42] The observation that agents can burn money in a variety of different ways is troublesome in other contexts, such as financial market signaling. Since investors have strong incentives to learn all relevant information about stocks, the firm need not undertake dissipative activities that investors will observe with little or no effort, nor need they seek durable emblems of dissipation (since potential investors can always review financial records). Thus, one can entertain general doubts about models with money burning without being skeptical about the specific model examined in this paper.

[43] This motivates manufacturers to thwart the distribution of imitations of their products, such as fake Rolex watches and Polo shirts.

> Recently a fight broke out between big perfume houses and a clutch of British retailers who, having bought such brands as Chanel No. 5 on the "grey market," were then reselling them for 60% below the recommended price. For some companies, like Vuitton, the solution is to restrict sales outside their own boutiques. Those that use specialist distributors must monitor them closely. Cartier has one person in Paris whose sole responsibility is to keep tabs on its watches once they leave the workshop.

V. Policy Implications and Conclusions

The existence of Veblen effects in the context of our model has some provocative implications for public policy. Since supranormal profits result from the characteristics of demand rather than from the nature of strategic interaction among firms, evidence of high profitability does not necessarily support inferences of either collusion or oligopolistic forbearance.

The implications for tax policy are equally controversial. Within our model, the equilibrium prices of luxury brands are demand driven, rather than supply driven—that is, luxury brands are sold at the consumer's preferred price, which is tax inclusive, and does not vary with the tax rate. Thus, as long as the tax per unit does not exceed the difference between the consumer's preferred price and marginal cost, and as long as the tax does not fall on budget brands, an excise tax on conspicuous goods amounts to a nondistortionary tax on pure profits.

Consider, for example, tax-price relations of the form $\tau(p) = \max\{0, t(p-k)\}$, where the parameters t and k satisfy $0 < t < 1$ and $k \geq c(q^F)$ (so that, in equilibrium, the tax falls only on luxury brands).[44] It is easy to verify that equilibrium quantities and prices are invariant with respect to t, and that the tax is therefore equivalent to a nondistortionary levy on pure profits. This family of tax schedules is of particular interest, since it includes the federal luxury taxes created by the Omnibus Budget Reconciliation Act of 1990 (OBRA). In particular, this Act imposed a 10 percent excise tax ($t = 0.1$) on the portion of the retail price of certain items that exceeds a product-specific threshold (k). The thresholds were: \$30,000 for automobiles, \$100,000 for boats and yachts, \$250,000 for aircraft, and \$10,000 for jewelry and furs.[45]

It is worth emphasizing that traditional modes of analysis would produce highly misleading conclusions within the current context. Suppose that the inconspicuous good, z, is nontaxable. Assuming that the planner's objective is efficiency, rather than distribution, the preceding analysis implies that only luxury brands should be taxed (as long as revenue requirements are not too high). In contrast, since the demand for luxury brands in our model is highly price elastic, the application of traditional Ramsey-style optimal tax formulas would suggest that the government should raise a significant fraction of its revenue by taxing budget brands.[46]

We mentioned in Section IV.B that, in a model with many conspicuous goods, the distribution of demand across conspicuous goods is indeterminant. This implies that the response to an increase in the luxury tax rate on some specific conspicuous good is also indeterminant. It is possible, for example, that prices could simply adjust so that profits shift to a more lightly taxed industry (with side-payments among firms, one might even expect this to occur). Thus, there may be advantages to adopting a reasonably broad-based luxury tax, such as the one originally envisioned in OBRA.

Our results on luxury taxation stand in sharp contrast to those of Ireland (1992) and Ng (1987). Ireland considers a signaling model of conspicuous consumption that satisfies the single-crossing property (and which, therefore, does not give rise to Veblen effects). In his model, a tax on luxury goods *does* dis-

[44] The analysis proceeds similarly as long as $\tau(c(q^F)) = 0$, $p > c(q^F) + \tau(p)$ for p slightly greater than c^F as well as for some $p \geq p^*\mu(q^F)$, and $\tau(p) \geq 0$ for all p.

[45] The 1994 threshold for automobiles was \$32,000, while the luxury tax on all other goods has been repealed effective January 1993.

[46] See Bagwell and Bernheim (1992) for a detailed derivation.

tort behavior. However, since equilibrium involves excessive consumption of the conspicuous good, the tax may actually be welfare improving. Ng studies optimal taxation of a special class of commodities, which he labels "diamond goods," for which consumers' preferences are defined over the amount of money spent on acquisition, rather than over amounts consumed. Since a change in the price of a diamond good does not alter the utility received by consumers, the optimal rate of taxation for a diamond good is infinite. The contrast between our results and those of Ireland and Ng therefore reveals the sensitivity of policy implications to the particular formulation of the demand for luxury goods.

APPENDIX

PROOF OF THEOREM 1:

To prove the first part of this theorem, we begin by applying Lemma 1, which tells us that all type-L households purchase $x_L^*(\underline{p})$ quality-weighted units at $\underline{p}$. Next, we claim that type-H households will also purchase all conspicuous units at the quality-weighted price $\underline{p}$. We establish this claim by supposing that, on the contrary, $s_H/x_H > \underline{p}$, and inducing a contradiction. The argument leading to the contradiction consists of four steps.

Step 1: The incentive compatibility constraint binds, that is,

$$\text{(A1)} \qquad W_L(x_H, s_H, \rho_H) = W_L^*(\underline{p}).$$

Suppose on the contrary that this is not the case. Then the right-hand side of (A1) must exceed the left-hand side (otherwise incentive compatibility would be violated). Consider (x_H', s_H'), with s_H' slightly less than s_H, and $x_H' = x_H$, such that $s_H'/x_H' \geq \underline{p}$, and such that incentive compatibility still holds with strict inequality. Then type-L households prefer their equilibrium payoff, $W_L^*(\underline{p})$, to (x_H', s_H', ρ) for all $\rho \in [\rho_L, \rho_H]$. In contrast, there are some values of $\rho \in [\rho_L, \rho_H]$ (specifically, ρ_H) for which type-H households prefer (x_H', s_H', ρ) to their equilibrium outcome, (x_H, s_H, ρ_H). Thus, by the logic of the intuitive criterion, social contacts must infer $R = R_H$ upon observing (x_H', s_H'), and respond by selecting $\rho = \rho_H$. But type-H households prefer (x_H', s_H', ρ_H) in particular to their equilibrium outcome, (x_H, s_H, ρ_H). Thus, the candidate equilibrium fails the intuitive criterion. This establishes that (A1) must hold.

Now we define $\hat{x}$ as the maximum value of $x \in [x_H, \bar{s}/\underline{p}]$ satisfying

$$\text{(A2)} \qquad W_L(x, \underline{p}x, \rho_H) = W_L^*(\underline{p}).$$

Step 2: $\hat{x}$ is well defined, $\hat{x} > x_H$, and $\underline{p}\hat{x} < \bar{s}$. First, note that $\bar{s} \geq s_H > \underline{p}x_H$, so $x_H < \bar{s}/\underline{p}$, implying that the feasible set is nonempty. Next, note that

$$\text{(A3)} \qquad W_L(x_H, \underline{p}x_H, \rho_H) > W_L(x_H, s_H, \rho_H) = W_L^*(\underline{p})$$

and

$$\text{(A4)} \qquad W_L(\bar{s}/\underline{p}, \bar{s}, \rho_H) < W_L^*(\underline{p})$$

(where the last inequality follows from (8)). (A3), (A4), continuity, and the intermediate value theorem give us existence of $\hat{x}$. $\hat{x} \neq x_H$ (and therefore $\hat{x} > x_H$) follows from (A3). Finally, since $\hat{x} < \bar{s}/\underline{p}$ ($\hat{x} \neq \bar{s}/\underline{p}$ follows from (A4)), $\underline{p}\hat{x} < \bar{s}$.

Step 3: $W_H(\hat{x}, \underline{p}\hat{x}, \rho_H) > W_H(x_H, s_H, \rho_H)$. This follows from the single-crossing property, since $\hat{x} > x_H$ and $W_L(\hat{x}, \underline{p}\hat{x}, \rho_H) = W_L^*(\underline{p}) = W_L(x_H, s_H, \rho_H)$ (which in turn implies $\underline{p}\hat{x} > s_H$, since $\hat{x} > x_H$).

Step 4: There exists x_H', s_H' with $s_H' = \underline{p}x_H'$ such that $W_L(x_H', s_H', \rho_H) < W_L^*(\underline{p})$ and $W_H(x_H', s_H', \rho_H) > W_H(x_H, s_H, \rho_H)$. To see this, let $x_H' = \hat{x} + \varepsilon$ and $s_H' = \underline{p}x_H'$. For $\varepsilon > 0$ sufficiently small, (x_H', s_H') necessarily satisfies the required properties (recall that $\hat{x}$ is defined as the *largest* value of x satisfying (A2)).

Now we assert that the candidate equilibrium fails the intuitive criterion. This follows from step 4 through an argument completely analogous to that given in step 1 above. Thus, we have the desired contradiction, and we conclude that type-H households must purchase all conspicuous units at the quality-weighted price $\underline{p}$.

The second part of the theorem is an immediate corollary of the first part. The free entry assumption, combined with the usual Bertrand-style argument, implies that some firms must, in equilibrium, choose quality q^F

and sell their products at price $c(q^F) = \mu(q^F)c^F$. Clearly, only conspicuous goods of quality q^F will be available at quality-weighted price c^F, so only these will be produced.

PROOF OF THEOREM 2:

We begin by establishing that, in equilibrium, some firms offer, and type-L households purchase, a conspicuous product of quality $\tilde{q}_L$ at price $c(\tilde{q}_L)$. Suppose on the contrary that $(q_L, p_L) \neq (\tilde{q}_L, c(\tilde{q}_L))$. Since firms cannot lose money in equilibrium, either $q_L \neq \tilde{q}_L$ and $p_L \geq c(q_L)$, or $q_L = \tilde{q}_L$ and $p_L > c(q_L)$. In either case,

$$\text{(A5)}\quad W_L(\mu(q_L), p_L, \rho_L) < W_L(\mu(\tilde{q}_L), c(\tilde{q}_L) + \varepsilon, \rho_L)$$

for some small ε. Suppose then that an entrant offered $\tilde{q}_L$ at price $c(\tilde{q}_L) + \varepsilon$. For any household electing the entrant's offering, social contacts must respond with $\rho \geq \rho_L$. Therefore, by (A5), all type-L households will purchase the conspicuous good from the entrant. This implies that the entrant would earn a profit, which contradicts the supposition that an equilibrium prevails.

Now we establish that $p_H = c(q_H)$. Suppose on the contrary that $p_H > c(q_H)$ (this is the only other possibility, since, in equilibrium, price cannot be less than marginal cost). We induce a contradiction through four steps (the argument here is analogous, but not identical, to that used in the Proof of Theorem 1).

Step 1: The incentive compatibility constraint binds, that is

$$\text{(A6)}\quad W_L(\mu(q_H), p_H, \rho_H) = \tilde{W}_L.$$

Suppose on the contrary that this is not the case. Then the right-hand side of (A6) must exceed the left-hand side. Consider (q'_H, p'_H), with $q'_H = q_H$ and $p'_H = p_H - \varepsilon$ for some small ε, such that the incentive constraint still holds with strict inequality. The intuitive criterion implies that, if this alternative was offered by some new entrant, and if a household selected it, social contacts would infer that the deviating household was of type H, and respond with ρ_H (type-L households would not choose this alternative regardless of social contacts' inferences, while type-H households would choose this alternative for some inferences, for example, ρ_H). Consequently, if this alternative is offered, type-H households will select it. Knowing this, it is in the interest of an entrant to offer (q'_H, p'_H), which undermines the equilibrium.

Now define $\hat{q}$ as the maximum value of $q \in [q_H, \bar{q}]$ satisfying

$$\text{(A7)}\quad W_L(\mu(q), c(q), \rho_H) = \tilde{W}_L.$$

Step 2: $\hat{q}$ is well-defined, and $\bar{q} > \hat{q} > q_H$. Since, by supposition, $p_H > c(q_H)$,

$$\text{(A8)}\quad W_L(\mu(q_H), c(q_H), \rho_H) > W_L(\mu(q_H), p_H, \rho_H) = \tilde{W}_L.$$

Existence of $\hat{q}$ follows from (A8), (12), continuity, and the intermediate value theorem. $\hat{q} \neq q_H$ (and therefore $\hat{q} > q_H$) follows from (A8). $\hat{q} \neq \bar{q}$ (and therefore $\hat{q} < \bar{q}$) follows from (8).

Step 3: $W_H(\mu(\hat{q}), c(\hat{q}), \rho_H) > W_H(\mu(q_H), p_H, \rho_H)$. This follows from the single-crossing property, since $\mu(\hat{q}) > \mu(q_H)$ and $W_L(\mu(\hat{q}), c(\hat{q}), \rho_H) = \tilde{W}_L = W_L(\mu(q_H), p_H, \rho_H)$.

Step 4: There exists q'_H, p'_H with $p'_H > c(q'_H)$ such that $W_L(\mu(q'_H), p'_H, \rho_H) < \tilde{W}_L$ and $W_H(\mu(q'_H), p'_H, \rho_H) > W_H(\mu(q_H), p_H, \rho_H)$. To see this, simply take q'_H slightly larger than $\hat{q}$, and p'_H slightly greater than $c(q'_H)$.

The intuitive criterion implies that, if (q'_H, p'_H) was offered by some new entrant, and if a household selected it, social contacts would infer that the deviating household was of type H, and respond with ρ_H (type-L households would not choose this alternative regardless of social contacts' inferences, while type-H households would choose this alternative for some inferences, for example, ρ_H). Consequently, if this alternative was offered, type-H households would select it. Knowing this, it is in the interest of an entrant to offer (q'_H, p'_H), which undermines the equilibrium. Thus, we have the desired contradiction.

PROOF OF THEOREM 3:

Using the same arguments given in the proof of Theorem 1, it is easy to show that, in a separating equilibrium, (i) type-L households purchase $x_L^*(\underline{p})$ quality-weighted units of the conspicuous good at price $\underline{p}$ (the lowest quality-weighted price announced in the first phase), and (ii) $\underline{p} = c^F$. We prove the rest of the theorem through the following five steps.

Step 1: If $\underline{p} = c^F$, then the intuitive criterion requires that, in a separating equilibrium, the type-H choice (x_H, s_H) must solve

$$\text{(A9)} \qquad \max_{x,s} W_H(x, s, \rho_H)$$

subject to

$$\text{(A10)} \qquad c^F \leq \frac{s}{x} \leq \bar{p}$$

and

$$\text{(A11)} \qquad W_L(x, s, \rho_H) \leq W_L^*(c^F).$$

That is, type-H households maximize their utility, buying from a combination of different firms offering prices between c^F and $\bar{p}$, subject to the constraint that the type-L households must choose not to mimic them.

Suppose on the contrary that the type-H choice, (x_H, s_H), does not solve this problem. Then there is some feasible (x, s) such that $W_H(x, s, \rho_H) > W_H(x_H, s_H, \rho_H)$ and $W_L(x, s, \rho_H) < W_L^*(c^F)$. This in turn implies that there is some feasible (x'_H, s'_H) such that

$$\text{(A12)} \qquad W_H(x'_H, s'_H, \rho_H) > W_H(x_H, s_H, \rho_H)$$

and

$$\text{(A13)} \qquad W_L(x'_H, s'_H, \rho_H) < W_L^*(c^F).$$

To see this, suppose first that $s/x < \bar{p}$. Then we can simply take $x'_H = x$ and $s'_H = s + \varepsilon$ for some small $\varepsilon > 0$. If, on the other hand, $s/x = \bar{p}$, let $x'_H = x + \varepsilon$ and $s'_H = \bar{p}x'_H$ for some small $\varepsilon > 0$; since $\bar{p} \geq p^o/\mu(q^o)$ (where p^o was defined as the prohibitive price at which a conspicuous good of quality q^o is available from some alternative source), the desired conclusion follows. Now we argue that (x_H, s_H) cannot satisfy the intuitive criterion. By (A13), type-L households prefer their equilibrium payoff, $W_L^*(c^F)$, to (x'_H, s'_H, ρ) for all $\rho \in [\rho_L, \rho_H]$. In contrast, by (A12), there are some values of $\rho \in [\rho_L, \rho_H]$ (for example ρ_H) for which type-H households prefer (x'_H, s'_H, ρ) to their equilibrium outcome, (x_H, s_H, ρ_H). Thus, by the logic of the intuitive criterion, social contacts must infer $R = R_H$ upon observing (x'_H, s'_H), and respond by selecting $\rho = \rho_H$. But type-H households prefer (x'_H, s'_H, ρ_H) in particular to their equilibrium outcome, (x_H, s_H, ρ_H). Thus, the candidate equilibrium fails the intuitive criterion.

Step 2: If $\bar{p} \geq p^*$, then $(x^*, s^*(x^*))$ is the unique solution to maximizing (A9) subject to (A10) and (A11). By the tangency property, it is immediate that $(x^*, s^*(x^*))$ is the unique solution to maximizing (A9) subject to (A11). Since it is assumed that $\bar{p} \geq p^* > c^F$, $(x^*, s^*(x^*))$ satisfies (A10), and therefore continues to be the unique solution to maximizing (A9) subject to both (A10) and (A11).

Step 3: $(x_L^*(c^F), c^F x_L^*(c^F), x^*, s^*(x^*))$ satisfies incentive compatibility (expressions (4) and (5)). Note that, with $(x_L, s_L) = (x_L^*(c^F),\ c^F x_L^*(c^F))$, expression (4) is equivalent to (A11), and expression (5) is equivalent to

$$\text{(A14)} \qquad W_H(x_H, s_H, \rho_H) \geq W_H(x_L^*(c^F), c^F x_L^*(c^F), \rho_L).$$

$(x^*, s^*(x^*))$ satisfies (A11) by the definition of x^*. Assume (contrary to the claim) that $(x^*, s^*(x^*))$ violates expression (A14). Since $(x^*, s^*(x^*))$ maximizes (A9) subject to (A11), it is necessarily the case that (A14) is violated for all (x_H, s_H) satisfying (A11). But this contradicts the assumption that separation is feasible.

Step 4: In equilibrium, $\bar{p} \geq p^*$. Suppose that, on the contrary, $\bar{p} < p^*$. Then an entrant could name q^F and price $p^*\mu(q^F)$, implying a quantity-weighted price of p^*. Our previous analysis (steps 1, 2, and 3) implies that all type-H households would purchase exactly $x^*/\mu(q^F)$ units from this entrant, who would earn profits of $x^*(p^* - c^F) > 0$. This contradicts the assumption that an equilibrium prevails.

Step 5: In equilibrium, the purchases of the type-H households are divided equally between the F incumbents, each of which names quality q^F and price $p^*\mu(q^F)$. To demonstrate this result, we exploit our assumptions concerning the resolution of household indifference. First, we argue that at least one firm must quote the quality-weighted price p^*. Suppose on the contrary that no firm quotes this price. Since each household resolves indifference in favor of making all purchases from a single firm, an entrant could profitably undertake a deviation to quality q^F and price $p^*\mu(q^F)$. Second, we argue that at least one incumbent must name p^*. Suppose on the contrary that no incumbent names p^*. Then, by the preceding argument, at least one entrant must quote p^*. Since indifference is resolved in favor of making all purchases from a single firm, incumbents make no sales and earn zero profits. Since indifference is also resolved in favor of incumbents, any incumbent could earn $x^*(p^* - c^F) > 0$ by deviating to quality q^F and price $p^*\mu(q^F)$, which establishes a contradiction. It follows that type-H households only purchase the conspicuous good from incumbents. Third, we argue that all incumbents must quote p^*. Suppose on the contrary that $N < F$ incumbents quote p^*. Since type-H households only purchase conspicuous output at the quality-weighted price p^*, no incumbent earns a profit unless it quotes p^*. Suppose that the $(N + 1)$th incumbent deviates to quality q^F and price $p^*\mu(q^F)$. Type-H households will be indifferent between purchasing their x^* quality-weighted units from this incumbent and from the other N incumbents quoting the quality-weighted price p^*. Demand would then be split evenly between these incumbents, and the deviator would earn $x^*(p^* - c^F)/(N+1) > 0$. Fourth and finally, we argue that each incumbent chooses quality q^F. This follows from the fact that incumbent f earns $x^*(p^* - c(q_f)/\mu(q_f))/F$, which is maximized at $q_f = q^F$.

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