

Penetration or Skimming Pricing for Credence Products?

A step-by-step exercise in the spirit of Mahenc (2025)

Companion note to Mahenc, P. (2025), “Penetration or Skimming Pricing for Credence Products?,” *Journal of Economic Dynamics and Control* 180: 105196. Full reference at the end.

Overview. A firm that adds a *credence attribute* to its product—say, sustainable sourcing or a lower carbon footprint—cannot prove the claim at the point of sale. Consumers learn the truth only after a *verification phase* in which certifiers, NGOs, or regulators do their slow work. Until then, the price is the only signal. Mahenc (2025) asks: what price path credibly reveals that a new entrant is socially responsible? His answer depends on competition. Facing conventional incumbents (an *occupied* market), the responsible entrant signals with *penetration pricing*—a low introductory price that rises later. In an *untapped* market, it signals with *skimming pricing*—a high introductory price that falls later. In both cases the firm conspicuously wastes money to prove its type, an instance of Veblen’s law. This note builds the mechanism in the simplest possible setting: a two-period game with the verification lag collapsed to a single period. Seven steps follow: (a) the model, (b) the full-information benchmark, (c) the signaling problem, (d) the occupied market and penetration pricing, (e) the untapped market and skimming pricing, (f) comparative statics and the verification lag, and (g) a numerical example.

1. The Model

Consumers. A unit mass of consumers each buy at most one unit. A unit with *social performance* $e \in [0, 1]$ generates $1 - e$ units of a harmful by-product; the conventional product has $e = 0$. Consumers differ in their *aversion* x to the harm, with x distributed uniformly on $[0, 1]$. A consumer of aversion x who buys a unit of performance e at price p gets

$$u = v - (1 - e)x - p, \quad (1)$$

where v is the gross value of the product category. A higher e lowers the harm term $(1 - e)x$, so consumers pay more for a greener product.

The entrant and costs. An entrant introduces a product of performance e at a constant unit cost c_e , against a conventional alternative of unit cost c_0 . Write the *cost premium* of responsibility as

$$\varphi \equiv c_e - c_0 > 0. \quad (2)$$

A fixed setup cost $F > 0$ is sunk once the firm enters; because it is paid whether or not the firm signals, it cancels from every comparison below and we drop it.

Two scenarios. The entrant faces either

- an *untapped market*: no competitor, so the entrant is a monopolist; or
- an *occupied market*: perfectly competitive incumbents already sell the conventional product at price c_0 .

The two settings differ only in the outside option consumers have, and that difference is what flips the sign of the price signal.

Normalization. To keep the algebra light we set

$$v = 1, \quad c_0 = 0, \quad (3)$$

so the conventional unit cost (and competitive price) is 0 and the responsible unit cost is $c_e = \varphi$. Throughout we assume $\varphi < e$ (the responsible product is socially desirable) and $v - c_0 \geq 1$ (the occupied market is fully covered); both hold under (3) for the parameters we use.

Timing and the verification lag. Social responsibility is the entrant's private information. In Mahenc's full model it takes T trading periods for consumers to learn the truth; here we take the simplest case $T = 1$. The game then has two stages:

Stage 1. Verification period ($t = 1$). The entrant posts a price; consumers buy and try to infer the type from the price.

Stage 2. Full information ($t \geq 2$). The type becomes public, and the entrant charges the full-information price forever after.

Players discount the future at rate $\delta \in (0, 1)$, so the value of the full-information continuation, seen from $t = 1$, is $\frac{\delta}{1 - \delta}$ times the per-period full-information profit. Section 6 restores general T in one line.

2. Step (a): The Full-Information Benchmark

Suppose the type is known. We record the responsible entrant's optimal price and profit in each scenario; these are the post-verification payoffs the signal is trying to protect.

Untapped market. The indifferent consumer solves $0 = v - (1 - e)x - p$, giving demand $D_u(p) = \frac{v - p}{1 - e} = \frac{1 - p}{1 - e}$. The responsible entrant maximizes $(p - \varphi)D_u(p)$, yielding

$$\hat{p}_r^u = \frac{v + c_e}{2} = \frac{1 + \varphi}{2}, \quad \hat{\pi}_r^u = \frac{(v - c_e)^2}{4(1 - e)} = \frac{(1 - \varphi)^2}{4(1 - e)}. \quad (4)$$

A conventional monopolist would instead charge $\hat{p}_c^u = \frac{v + c_0}{2} = \frac{1}{2}$ and earn $\hat{\pi}_c^u = \frac{(v - c_0)^2}{4} = \frac{1}{4}$.

Occupied market. A consumer is indifferent between the conventional product at c_0 and the new product at p when $v - x - c_0 = v - (1 - e)x - p$, i.e. at $x = \frac{p - c_0}{e} = \frac{p}{e}$. Consumers above this cutoff buy the responsible product, giving demand $D_o(p) = 1 - \frac{p - c_0}{e} = 1 - \frac{p}{e}$. Maximizing $(p - \varphi)D_o(p)$,

$$\hat{p}_r^o = \frac{e + c_0 + c_e}{2} = \frac{e + \varphi}{2}, \quad \hat{\pi}_r^o = \frac{(e - \varphi)^2}{4e}. \quad (5)$$

A conventional entrant here is forced by competition to price at $c_0 = 0$ and earns a *zero* margin: $\hat{\pi}_c^o = 0$. This zero-profit outside option is the engine of the whole occupied-market result.

3. Step (b): The Signaling Problem

Now let the type be private in period 1. The entrant is responsible (r) or conventional (c); consumers hold a prior μ_0 that it is responsible and update to a posterior μ after seeing the price. Consumers who believe the product is responsible with probability μ treat its perceived performance as μe , so demand under belief μ is

$$D(p, \mu) = \begin{cases} 1 - \frac{p - c_0}{\mu e} & \text{occupied market,} \\ \frac{v - p}{1 - \mu e} & \text{untapped market.} \end{cases} \quad (6)$$

For any price, demand rises with μ : being *perceived* as responsible is always worth more, whatever the truth. That is exactly why a conventional entrant is tempted to mimic, and why the responsible entrant needs a signal a mimic would not copy.

Separating logic. We look for a *separating* equilibrium in which the responsible type charges a signaling price $\underline{p}$ in period 1, is believed ($\mu = 1$), and then earns the full-information profit forever; the conventional type charges its own full-information price and is believed conventional ($\mu = 0$). Two conditions must hold.

- **Incentive compatibility (IC): the conventional type must not want to mimic $\underline{p}$.** Its gain from being taken as responsible for one period must not exceed what it earns honestly. IC pins down the *direction* of the price distortion.
- **Individual rationality (IR): the responsible type must prefer to signal** rather than accept being mistaken for conventional. IR pins down *when* signaling is worthwhile.

Among all separating prices, the cheapest one—the least distorted, hence most profitable for the responsible type—is the *Riley outcome*, the unique signal that survives the intuitive criterion (Cho and Kreps, 1987). We take that price in each scenario.

4. Step (c): Occupied Market, Penetration Pricing

IC forces a low price. Suppose the responsible type is expected to charge $\underline{p}$. If the conventional type mimics it and is believed responsible, it earns the flow profit

$$\pi_c(\underline{p}, 1) = (\underline{p} - c_0) D_o(\underline{p}, 1) = \underline{p} \left(1 - \frac{\underline{p}}{e}\right),$$

which is strictly positive for any $\underline{p} \in (0, e)$ and peaks at $\underline{p} = \frac{e}{2}$. But honest behavior earns the conventional type only $\hat{\pi}_c^o = 0$. So it would gladly mimic *any* interior price: high prices cannot separate. To deter mimicry the responsible type must drive the price down to where the conventional type gains nothing,

$$\underline{p} \left(1 - \frac{\underline{p}}{e}\right) \leq 0 \iff \underline{p} \leq c_0 = 0. \quad (7)$$

(A distortion the other way, $\underline{p} \geq e$, would choke demand to zero, so no one could learn.) The cheapest such price—the highest one that still separates—is $\underline{p} = c_0$: the responsible entrant matches the competitive price.

Penetration. In the occupied market the responsible entrant signals by charging the competitive price $\underline{p} = c_0$, then raises the price to $\hat{p}_r^o$ once its type is public. The introductory price is *below* the full-information price: a penetration path.

The signal is a conspicuous loss. Selling at $\underline{p} = c_0 = 0$ while bearing unit cost $c_e = \varphi$, the responsible type serves the whole market ($D_o(0, 1) = 1$) at a per-period loss

$$\pi_r(c_0, 1) = (c_0 - c_e) \cdot 1 = -\varphi. \quad (8)$$

This is Veblen’s “conspicuous waste”: the responsible type burns φ per period to prove itself. A conventional firm, already earning zero, would never add a loss on top, so the loss is exactly what makes the signal credible.

IR: when is the loss worth bearing? The responsible type accepts the period-1 loss φ only if the discounted full-information profit it unlocks covers it:

$$\frac{\delta}{1 - \delta} \hat{\pi}_r^o \geq \varphi \iff \frac{\delta}{1 - \delta} \cdot \frac{(e - \varphi)^2}{4e} \geq \varphi. \quad (9)$$

Solving for δ gives a critical discount factor

$$\tilde{\delta} = \frac{4e\varphi}{(e + \varphi)^2} = \frac{4r}{(1 + r)^2}, \quad r \equiv \frac{\varphi}{e} \in (0, 1), \quad (10)$$

where the second form uses the premium-to-performance ratio $r = \varphi/e$: dividing numerator and denominator of the first form by e^2 leaves $\tilde{\delta}$ a function of r alone. The map $r \mapsto \frac{4r}{(1 + r)^2}$ rises on $(0, 1)$ and reaches 1 at $r = 1$, that is, at $\varphi = e$; there $\tilde{\delta} = 1$, so no $\delta < 1$ can separate. Desirability ($\varphi < e$, i.e. $r < 1$) keeps us strictly below that boundary.

Result 1 (occupied market). Penetration pricing separates the types if and only if $\delta \geq \tilde{\delta}$. Signaling is worthwhile only for a patient entrant, because it must survive a real, out-of-pocket loss during the verification phase before collecting the reward.

5. Step (d): Untapped Market, Skimming Pricing

IC forces a high price. Now there is no competitor. A conventional type that mimics $\underline{p}$ and is believed responsible earns

$$\pi_c(\underline{p}, 1) = (\underline{p} - c_0) D_u(\underline{p}, 1) = \underline{p} \frac{1 - \underline{p}}{1 - e},$$

while honestly it earns the conventional monopoly profit $\hat{\pi}_c^u = \frac{1}{4}$. Mimicry is deterred when

$$\underline{p} \frac{1 - \underline{p}}{1 - e} \leq \frac{1}{4} \iff \underline{p} \leq \frac{1 - \sqrt{e}}{2} \text{ or } \underline{p} \geq \frac{1 + \sqrt{e}}{2}. \quad (11)$$

The responsible type's profit is single-peaked at its full-information price $\hat{p}_r^u = \frac{1 + \varphi}{2}$, which lies inside the forbidden interval $\left(\frac{1 - \sqrt{e}}{2}, \frac{1 + \sqrt{e}}{2}\right)$ precisely when $\varphi < \sqrt{e}$. That inequality is not a separate assumption: it follows from desirability. Because $e \in (0, 1)$ we have $\sqrt{e} > e$, so

$$\varphi < e < \sqrt{e}, \quad (12)$$

and $\varphi < \sqrt{e}$ holds automatically. The optimum therefore always sits inside the interval, and the cheapest separating price is its *upper* edge,

$$\underline{p} = \frac{v + c_0}{2} + \frac{(v - c_0)\sqrt{e}}{2} = \frac{1 + \sqrt{e}}{2} > \hat{p}_r^u. \quad (13)$$

Skimming. In the untapped market the responsible entrant signals by charging the high price $\underline{p} = \frac{1 + \sqrt{e}}{2}$, then lowers it to $\hat{p}_r^u$ once its type is public. The introductory price is *above* the full-information price: a skimming path.

The signal is forgone sales, not a loss. At the skimming price the responsible type still earns a *positive* margin; it simply serves fewer consumers than at $\hat{p}_r^u$, skimming the cream of the market most willing to pay for responsibility. The high price is one a conventional type cannot afford to match: its product is worth less to consumers, so the same high price would cost it too many sales relative to its comfortable monopoly profit. Again the signal works by wasting something the mimic values more—here, sales volume.

IR holds for all δ . Because signaling here means a *reduced* profit rather than an outright loss, the responsible type is willing to signal regardless of how patient it is.

Result 2 (untapped market). *Skimming pricing separates the types for every δ .* Unlike penetration, it needs no patience threshold: both types have a profitable future, so the only question is the direction of the period-1 distortion, and IC sends it upward.

6. Step (e): Comparative Statics and the Verification Lag

The occupied-market threshold (10) carries the paper's comparative statics. Differentiating,

$$\frac{\partial \tilde{\delta}}{\partial e} = \frac{4\varphi(\varphi - e)}{(e + \varphi)^3} < 0, \quad \frac{\partial \tilde{\delta}}{\partial \varphi} = \frac{4e(e - \varphi)}{(e + \varphi)^3} > 0 \quad (\text{since } \varphi < e). \quad (14)$$

Result 3 (comparative statics). *Signaling is easier (a lower $\tilde{\delta}$) when the product is more differentiated (higher e) and when the cost premium of responsibility is smaller (lower φ).* A greener product commands a larger future profit worth protecting, and a cheaper premium makes the period-1 loss smaller; both slacken the patience requirement. The ratio form (10) says the same thing at a glance: $\tilde{\delta}$ rises in $r = \varphi/e$, and higher e or lower φ both lower r .

The verification lag. With a general verification length T , the responsible type repeats the penetration price for T periods, so the separation condition (9) becomes $\frac{\delta^T}{1 - \delta} \hat{\pi}_r^o \geq \varphi \frac{1 - \delta^T}{1 - \delta}$, which reduces to

$$\delta \geq \tilde{\delta}^{1/T}. \quad (15)$$

The threshold $\tilde{\delta}^{1/T}$ rises toward 1 as $T \rightarrow \infty$: a longer verification lag makes penetration harder to sustain and demands a more patient entrant.

Result 4 (greenwashing). *When $\delta < \tilde{\delta}^{1/T}$ the occupied-market entrant cannot separate, and pooling prices—greenwashing—take over the early periods.* Anything that speeds verification (faster certification, active NGOs) lowers the bar for honest signaling; anything that slows it (fake certification, information lobbying) protects greenwashing. The untapped market, by contrast, separates for any T and any δ .

The two scenarios are summarized in Table 1, and the two price paths in Figure 1.

	Occupied market (competition)	Untapped market (monopoly)
Signaling strategy	Penetration (low price)	Skimming (high price)
Signaling price $\underline{p}$	c_0	$\frac{v + c_0}{2} + \frac{(v - c_0)\sqrt{e}}{2}$
Bias vs. full information	Downward	Upward
Period-1 sacrifice	A loss, $-\varphi$	Forgone sales (profit still > 0)
Separation requires	$\delta \geq \tilde{\delta} = \frac{4e\varphi}{(e + \varphi)^2}$	every δ
Real-world echoes	Costco/Kroger organic; BYD EVs; free samples	Tesla Model S; luxury eco-brands

Table 1: The two scenarios of Mahenc (2025). Competition flips the sign of the price signal: a responsible entrant penetrates a market held by conventional incumbents but skims an untapped one.

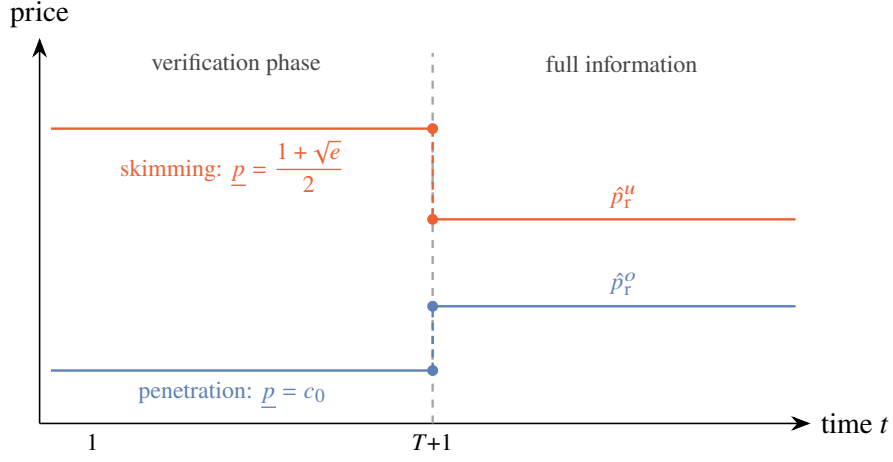


Figure 1: The two signaling price paths. In the occupied market the responsible entrant *penetrates*: it holds the low competitive price c_0 through the verification phase, then raises the price to $\hat{p}_r^o$. In the untapped market it *skims*: it holds a high price $\underline{p} = \frac{1+\sqrt{e}}{2}$, then lowers it to $\hat{p}_r^u$. Both distortions shrink to zero once the type is public.

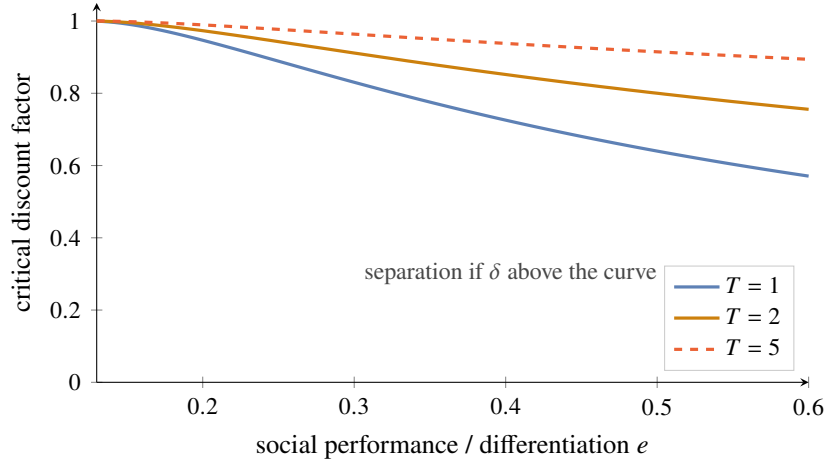


Figure 2: The occupied-market threshold $\tilde{\delta}^{1/T} = [4e\varphi/(e + \varphi)^2]^{1/T}$ against differentiation e , at $\varphi = \frac{1}{8}$, for three verification lengths. It falls with e (more differentiation makes signaling easier) and rises with T (a longer verification lag makes it harder), approaching 1 as $T \rightarrow \infty$. Penetration separates only for discount factors above the relevant curve; the untapped market needs no such condition.

7. Step (f): A Numerical Example

Take

$$v = 1, \quad c_0 = 0, \quad e = \frac{1}{4}, \quad \varphi = \frac{1}{8},$$

so the responsible unit cost is $c_e = \varphi = \frac{1}{8}$. Both scenarios are socially desirable, $\varphi < e$, since $\frac{1}{8} < \frac{1}{4}$; and by (12) this already delivers the upward skimming distortion, as $\varphi < e < \sqrt{e}$ reads $\frac{1}{8} < \frac{1}{4} < \frac{1}{2}$. The premium-to-performance ratio is $r = \frac{\varphi}{e} = \frac{1}{2}$.

Occupied market (penetration). From (5),

$$\hat{p}_r^o = \frac{e + \varphi}{2} = \frac{3}{16}, \quad \hat{\pi}_r^o = \frac{(e - \varphi)^2}{4e} = \frac{1}{64}.$$

The entrant signals by charging the competitive price $\underline{p} = c_0 = 0$ during verification, taking a loss of $\varphi = \frac{1}{8}$ per period, then raises the price to $\frac{3}{16}$. The critical discount factor, in ratio form with $r = \frac{1}{2}$, is

$$\tilde{\delta} = \frac{4r}{(1+r)^2} = \frac{4 \cdot \frac{1}{2}}{\left(\frac{3}{2}\right)^2} = \frac{2}{\frac{9}{4}} = \frac{8}{9}.$$

So penetration separates the types only if $\delta \geq \frac{8}{9}$: the entrant must be quite patient.

Untapped market (skimming). From (4) and (13),

$$\hat{p}_r^u = \frac{1 + \varphi}{2} = \frac{9}{16}, \quad \underline{p} = \frac{1 + \sqrt{e}}{2} = \frac{1 + \frac{1}{2}}{2} = \frac{3}{4}.$$

The entrant signals by charging the high price $\frac{3}{4}$ during verification, then lowers it to $\frac{9}{16}$. Since $\frac{3}{4} > \frac{9}{16}$, the introductory price is biased *upward*. A conventional mimic would earn $\underline{p} \frac{1 - \underline{p}}{1 - e} = \frac{3}{4} \cdot \frac{1/4}{3/4} = \frac{1}{4}$, exactly its honest monopoly profit $\hat{\pi}_c^u = \frac{1}{4}$: it is just deterred. Skimming separates for every δ .

The same performance level $e = \frac{1}{4}$ and premium $\varphi = \frac{1}{8}$ thus produce *opposite* price signals—a rock-bottom 0 under competition, a premium $\frac{3}{4}$ under monopoly—purely because of the competitive environment.

8. What the Toy Model Keeps and Drops

Mahenc's central messages all survive the simplification:

1. **Competition flips the signal.** Penetration (a low, rising price) in the occupied market; skimming (a high, falling price) in the untapped market (Results 1 and 2).
2. **Signaling is conspicuous waste.** The responsible type sacrifices profit during verification—an out-of-pocket loss under competition, forgone sales under monopoly—and the mimic cannot afford to copy it.

3. **Patience matters only under competition.** Penetration needs $\delta \geq \tilde{\delta}$; skimming works for all δ .
4. **Comparative statics.** Signaling is easier with more differentiation and a smaller cost premium, and harder the longer verification takes—with greenwashing filling the gap when the entrant is too impatient (Results 3 and 4).

What the toy model drops, relative to Mahenc (2025): (i) the general verification length T is collapsed to $T = 1$, so the trigger-strategy and never-dissuaded-once-convinced machinery that sustains repeated separation is replaced by a single period (Section 6 restores the $\tilde{\delta}^{1/T}$ scaling in one line); (ii) the multi-period pooling/greenwashing phase and its timing are only sketched, not derived; and (iii) the equilibrium-selection argument (intuitive criterion, Riley outcome) is stated rather than proved. Each can be reinstated at the cost of the dynamic bookkeeping that makes the full paper dense. For teaching, the two-period version already delivers the penetration -versus-skimming dichotomy and the Veblen logic behind it.

References

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