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Reversals in Per-Unit Pass-Through in a Screening Model of Monopolistic Nonlinear Pricing*

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Abstract

We examine per-unit cost pass-through in a two-type screening model of monopolistic nonlinear pricing. We show that per-unit pass-through for the small package is necessarily positive when the low type's participation constraint binds. Under isoelastic preferences, pass-through is higher for the small package than for the large package. This ranking, however, is not a general implication of screening. We derive a local curvature condition governing the pass-through gap and show that shifted-isoelastic preferences can reverse the ranking. A numerical illustration demonstrates that such reversals can also occur away from the local limit. Thus, screening restricts the sign of per-unit pass-through at the bottom of the menu, but not its ranking across contracts.

Keywords: Pass-through; Nonlinear pricing; Screening.

JEL classification: D42; D82; H22; L11.

1 Introduction

Under nonlinear pricing, consumers face a menu of quantity–payment contracts and select the option that best suits their preferences. Recognizing consumer heterogeneity, sellers optimally design such menus. The classical screening literature models this problem as an application of mechanism design under asymmetric information. Building on the framework of Mussa and Rosen (1978), who study endogenous product quality as a screening device, Maskin and Riley (1984) characterize optimal menus in the context of nonlinear pricing. Two types of constraints play central roles: (i) participation constraints, which ensure that consumers prefer accepting a contract to taking their outside option, and (ii) incentive compatibility constraints, which ensure that each consumer type prefers its intended contract to those designed for other types. In particular, the latter constraints prevent high-demand consumers from mimicking low-demand consumers to obtain a more favorable contract. In screening models, linkages across contracts arise through information rents and incentive compatibility constraints.¹

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¹The screening framework has subsequently been extended to competition among sellers (Stole, 1995, Rochet and Stole, 2002); see Stole (2007) for a survey. It has also provided a foundation for the structural estimation of nonlinear pricing models (Luo et al., 2018).

When production costs change, how do firms adjust both quantities and payments when incentive compatibility links the contracts offered to different consumer types? In this note, we examine cost pass-through (Weyl and Fabinger, 2013, Adachi and Fabinger, 2022) by investigating how these adjustments affect the *average per-unit price* of each package in a canonical monopolistic screening model à la Maskin and Riley (1984), with endogenous quantities and payments. A related question is examined by Adachi and Doi (2026), who consider exogenously given package sizes. In their framework, packages are treated as distinct products, and market demand is derived from consumers' discrete choices among packages and the outside option. In a simple model of a monopolist offering two package sizes (small and large), Adachi and Doi (2026) show that cost pass-through for the per-unit price of the large package, ρ_L , always exceeds that of the small package, ρ_S : $\rho_L > \rho_S$. Furthermore, ρ_S can be negative, a phenomenon they refer to as a new Edgeworth–Salinger paradox of taxation. In the original analyses of Edgeworth (1925) and Salinger (1991), the paradox concerns the possibility that a multiproduct firm's price of one product falls following an increase in the marginal cost of another product. The new version of the paradox identified by Adachi and Doi (2026) shows that the per-unit price of a small package may fall even when the common marginal cost of both package sizes increases. In their framework, linkages across fixed package sizes arise through demand substitution, buyer composition, and the outside option.

In this note, we establish three main results concerning heterogeneous cost pass-through across endogenously determined package sizes in a canonical monopolistic screening model with two consumer types à la Maskin and Riley (1984). First, in contrast to Adachi and Doi (2026), negative per-unit pass-through for the small package offered to the low consumer type cannot arise. This positivity result follows from the concavity of the utility function and the binding participation constraint of the low type. Although both frameworks involve consumer self-selection, the underlying mechanisms differ: the present model emphasizes incentive compatibility and information rents, whereas Adachi and Doi (2026) emphasize demand substitution, buyer composition, and the outside option.

Second, under isoelastic utility, per-unit pass-through is larger for the small package: $\rho_S > \rho_L > 0$. Third, we demonstrate that this ranking is not robust to changes in preference curvature. We derive a local condition that determines the direction of the pass-through gap and use shifted-isoelastic preferences to construct an analytical example in which $\rho_L > \rho_S > 0$. Thus, while the positivity of small-package pass-through follows from the basic assumptions of our screening model, the ranking of pass-through rates across contracts depends on preference curvature.

Recent studies have examined various aspects of nonlinear pricing. Orzach and Stano (2025) demonstrate that violations of the single-crossing condition can lead to quantity discounts with incremental prices below marginal cost. Unlike Orzach and Stano (2025), we maintain the standard single-crossing condition and examine how optimal quantity–payment contracts respond to changes in marginal cost. Our focus is on the pass-through of *average per-unit prices*, rather than the incremental price of additional units. Information rents and preference curvature play central roles in determining these contract-specific responses.²

The remainder of this paper is organized as follows. Section 2 introduces the screening model and establishes the basic properties of per-unit pass-through. Section 3 examines the ordering

²Related contributions include Bergemann et al. (2023) on robust nonlinear pricing and Krähmer and Strausz (2023) on nonlinear pricing with data-sensitive consumers.

of pass-through rates under isoelastic preferences and demonstrates how this ordering can be reversed. Section 4 provides a numerical illustration, and Section 5 concludes.

2 Per-unit pass-through in a canonical model of screening

There are two types of consumers, θ_L and θ_S , where $\theta_L > \theta_S > 0$. Throughout the paper, we refer to consumers of type θ_L as large-demand (high-type) consumers and those of type θ_S as small-demand (low-type) consumers. The population share of large-demand consumers is $\lambda \in (0, 1)$, while that of small-demand consumers is $1 - \lambda$.

A consumer of type $\theta \in \{\theta_L, \theta_S\}$ who purchases quantity q at total payment T obtains utility $\theta v(q) - T$, where $v(0) = 0$, $v'(q) > 0$, and $v''(q) < 0$ for $q > 0$. A monopolist produces a homogeneous good at a constant marginal cost $c > 0$ and offers a menu of two quantity–payment packages: a large package (q_L, T_L) and a small package (q_S, T_S) . We focus on an interior separating solution with $q_L > q_S > 0$, in which large-demand and small-demand consumers select packages L and S, respectively.

In the standard separating solution, the participation constraint of the small-demand consumers and the downward incentive compatibility constraint of the large-demand consumers bind (see, e.g., Salanié, 2005, Chapter 2):

$$T_S = \theta_S v(q_S), \quad T_L = \theta_L v(q_L) - (\theta_L - \theta_S) v(q_S). \quad (1)$$

The monopolist's profit is therefore

$$\begin{aligned} \Pi &= \lambda(T_L - cq_L) + (1 - \lambda)(T_S - cq_S) \\ &= \lambda[\theta_L v(q_L) - cq_L] + (1 - \lambda)[\tilde{\theta}_S v(q_S) - cq_S], \end{aligned}$$

where the small-demand type's virtual valuation is

$$\tilde{\theta}_S := \theta_S - \frac{\lambda}{1 - \lambda}(\theta_L - \theta_S).$$

We restrict attention to an interior separating solution, which requires $\tilde{\theta}_S > 0$ and, when $v'(0+) > 0$, is finite, $c < \tilde{\theta}_S v'(0+)$. The first-order conditions are

$$\tilde{\theta}_S v'(q_S) = c, \quad \theta_L v'(q_L) = c, \quad (2)$$

which imply $dq_j/dc < 0$ for $j \in \{L, S\}$.

Define the average per-unit price of package j as $p_j := T_j/q_j$ and its cost pass-through as $\rho_j := dp_j/dc$, for $j \in \{L, S\}$. The average per-unit price differs from the *incremental price* of moving from the small to the large package, defined by

$$m(c) := \frac{T_L(c) - T_S(c)}{q_L(c) - q_S(c)} = p_L(c) + \frac{q_S(c)}{q_L(c) - q_S(c)}[p_L(c) - p_S(c)].$$

The distinction matters because both quantities are endogenous: a low incremental price, such as the one studied by Orzach and Stano (2025), does not by itself imply any particular sign or ordering of dp_j/dc .

Our first result establishes positive per-unit pass-through for the small package under the

standard screening conditions.

Proposition 1. *If the small-demand type's participation constraint binds, $q_S > 0$, $v(0) = 0$, v is strictly concave, and $dq_S/dc < 0$, then $\rho_S > 0$.*

Proof. From (1), the small package's per-unit pass-through is

$$\rho_S = \theta_S \frac{q_S v'(q_S) - v(q_S)}{q_S^2} \frac{dq_S}{dc}. \quad (3)$$

Strict concavity and $v(0) = 0$ imply $v(q_S) > q_S v'(q_S)$. Since $dq_S/dc < 0$, both factors on the right-hand side of (3) are negative, yielding $\rho_S > 0$. $\square$

Note that this restriction need not determine ρ_L . The large-demand type's information rent is $(\theta_L - \theta_S)v(q_S)$ and falls as c increases; its payment thus responds indirectly to the small-demand type's quantity.

3 Pass-through ordering and its reversal

In this section, we first show a sharper result on the pass-through ordering by assuming the isoelastic utility function, $v(q) = q^\alpha/\alpha$, where $0 < \alpha < 1$. Notably, its curvature, $-qv''(q)/v'(q)$, is a constant, $1 - \alpha$. Under this simplification, we obtain the following ranking.

Proposition 2. *Under isoelastic utility and an interior separating solution, $\rho_S > \rho_L > 0$.*

Proof. From (2), $q_j = (\theta_j^*/c)^{1/(1-\alpha)}$, with $\theta_S^* = \tilde{\theta}_S$ and $\theta_L^* = \theta_L$. Setting $r = q_S/q_L \in (0, 1)$, differentiation of the average payments yields

$$\rho_S = \frac{\theta_S}{\alpha \tilde{\theta}_S} > \frac{1}{\alpha}, \quad \rho_L = \frac{1}{\alpha} \left[1 - \frac{\theta_L - \theta_S}{\theta_L} r^\alpha \right] < \frac{1}{\alpha}. \quad (4)$$

Moreover, since $0 < \theta_S < \theta_L$ and $0 < r < 1$,

$$1 - \frac{\theta_L - \theta_S}{\theta_L} r^\alpha > \frac{\theta_S}{\theta_L} > 0,$$

which establishes $\rho_L > 0$. $\square$

The isoelastic benchmark also has a useful scale property. Both optimal quantities adjust proportionally to a cost change, so their ratio $r = q_S/q_L$ is independent of c . Accordingly, ρ_S and ρ_L in (4) are constant along the interior cost range, with $p_j(c) = \rho_j c$. Hence the inequality $\rho_S > \rho_L$ cannot be reversed merely by changing the level of marginal cost when preferences are isoelastic. The reversal below requires a departure from this constant-curvature structure.

For a general strictly concave v , we define the following two indices:

$$K(q) := \frac{v(q) - qv'(q)}{-q^2 v''(q)}, \quad H(q) := \frac{v'(q)}{-v''(q)}.$$

Here, $K(q)$ measures the cost response of an average price along a given type's optimal quantity adjustment, whereas $H(q)$ measures the corresponding quantity sensitivity.

The first-order conditions and (1) imply

$$\rho_S = \frac{\theta_S}{\tilde{\theta}_S} K(q_S), \quad (5)$$

$$\rho_L = K(q_L) + (\theta_L - \theta_S) \left[\frac{v'(q_S)}{q_L \tilde{\theta}_S [-v''(q_S)]} - \frac{v(q_S)}{q_L^2 \theta_L [-v''(q_L)]} \right]. \quad (6)$$

The bracketed term reflects the effect of the information rent on the large-demand type's average per-unit price. To distinguish its components, let $d := \theta_L - \theta_S > 0$ and $R(c) := d \cdot v(q_S(c))$. Since $p_L = \theta_L v(q_L)/q_L - R(c)/q_L$, we can equivalently write:

$$\rho_L = \underbrace{K(q_L)}_{\text{own-contract response}} - \underbrace{\frac{R'(c)}{q_L}}_{\text{rent relief}} + \underbrace{\frac{R(c)}{q_L^2} \frac{dq_L}{dc}}_{\text{rent per unit}}.$$

The rent-relief term is positive: as marginal cost rises, the lower optimal quantity reduces the information rent owed to the large-demand type. The last term is negative: the large-demand type's own quantity also falls, so the remaining rent deduction becomes larger per unit. Hence the information-rent channel itself has opposing effects, whose net sign is generally ambiguous. The small-demand type faces no analogous rent deduction because its participation constraint binds. This asymmetry helps explain why the sign restriction in Proposition 1 is more robust than a ranking across contracts.

To characterize the ordering locally, fix $\theta_S = \theta > 0$ and $\lambda \in (0, 1)$, set $\theta_L = \theta + d$, and consider $d \downarrow 0$. Let $q_0 > 0$ solve $\theta v'(q_0) = c$. Assume that v is C^3 near q_0 and that the interior branch exists locally. By defining the pass-through gap by $G(d) := \rho_S - \rho_L$, we obtain the following local result.

Proposition 3. *For any sufficiently small $d > 0$, $\rho_S \gtrless \rho_L$ if and only if $K(q_0) \gtrless H(q_0)K'(q_0)$.*

Proof. At $d = 0$, $q_S = q_L = q_0$, and differentiation of (2) gives

$$q'_S(0) = -\frac{\lambda H(q_0)}{(1-\lambda)\theta}, \quad q'_L(0) = \frac{H(q_0)}{\theta}.$$

Hence, differentiation of (5) and (6) at $d = 0$, using $v(q_0)/[-q_0^2 v''(q_0)] = K(q_0) + H(q_0)/q_0$, gives

$$G(0) = 0, \quad G'(0+) = \frac{K(q_0) - H(q_0)K'(q_0)}{(1-\lambda)\theta}.$$

Continuity verifies the desired result. $\square$

To interpret Proposition 3, imagine a small increase in the type gap d around a common-type benchmark. The term $K(q_0)$ favors a higher pass-through for the small package, while $H(q_0)K'(q_0)$ captures how the curvature index changes as the two quantities move in opposite directions. For isoelastic preferences, $K(q) = 1/\alpha$ for every q , so that $K'(q) = 0$ and the first force prevails. With non-isoelastic preferences, $K'(q)$ need not vanish; a sufficiently steep increase in K can overturn the isoelastic ranking even though $v'(q) > 0$ continues to imply standard single crossing.

To explore the possibility of a reversal in the pass-through ordering, we consider shifted-

isoelastic preferences:

$$v(q) = \frac{(q+a)^\alpha - a^\alpha}{\alpha}, \quad a \geq 0, \quad 0 < \alpha < 1.$$

The isoelastic benchmark above corresponds to $a = 0$, whereas $a > 0$ allows the curvature of preferences to vary with quantity. Here $v'(0) = a^{\alpha-1} < \infty$. The interior condition for the small-demand type condition is therefore

$$c < \tilde{\theta}_S a^{\alpha-1}. \quad (7)$$

In particular, $\tilde{\theta}_S > 0$ alone does not suffice. The two optimal quantities are $q_S = (\tilde{\theta}_S/c)^{1/(1-\alpha)} - a$ and $q_L = (\theta_L/c)^{1/(1-\alpha)} - a$. As $q \downarrow 0$, direct Taylor expansion gives

$$K(q) = \frac{1}{2} + \frac{2-\alpha}{6a}q + O(q^2), \quad H(q) = \frac{q+a}{1-\alpha},$$

and consequently

$$\lim_{q \downarrow 0} [K(q) - H(q)K'(q)] = \frac{1-2\alpha}{6(1-\alpha)}. \quad (8)$$

Proposition 4. *Fix $a > 0$, $\lambda \in (0, 1)$, $\theta > 0$, and $\alpha \in (1/2, 1)$. For some $c > 0$ and sufficiently small $d > 0$, an interior separating solution exists with $\rho_L > \rho_S > 0$.*

Proof. Choose $q_0 > 0$ sufficiently small that the quantity in brackets in (8) is negative, and set $c = \theta v'(q_0)$. Because $c < \theta a^{\alpha-1}$, the baseline solution is interior. For sufficiently small $d > 0$, the interiority for the small-demand type (7) holds. Proposition 3 then gives $\rho_L > \rho_S$ and Proposition 1 gives $\rho_S > 0$. $\square$

Note that the condition $\alpha > 1/2$ is sufficient but necessary for the reversal result. In the next section, we provide a numerical comparison.

4 A numerical illustration

Figure 1 illustrates the preference dependence of the gap $\rho_S - \rho_L$. With $(a, \lambda, \theta_S, c) = (0.1, 0.2, 1, 1)$, we vary $\theta_L = 1 + \Delta_\theta$ and $\alpha \in \{0.3, 0.5, 0.7\}$. Optimal quantities are computed analytically from (2); per-unit pass-through is evaluated with a centered cost difference of 10^{-5} . The gap is positive near the left of the plotted range but turns negative as type heterogeneity increases for some curvatures. The figure illustrates reversals beyond the small- d limit used in Proposition 4.

For a direct comparison holding the type gap fixed, Table 1 sets $\Delta_\theta = 0.3$ and reports pass-through rates calculated from the analytical expressions (5)–(6). At $\alpha = 0.3$ the small contract has the larger response, while at $\alpha = 0.7$ the ranking is reversed. Both pass-through rates remain positive in every row. Thus the reversal does not depend on negative pass-through at the bottom of the menu; it arises from the relative response of the two optimal contracts.

Table 1: Per-unit pass-through at a common type gap

α	ρ_S	ρ_L	$\rho_S - \rho_L$
0.3	1.4050	1.2759	0.1291
0.5	1.2008	1.1546	0.0462
0.7	1.0292	1.0975	-0.0682

Notes: $a = 0.1$, $\lambda = 0.2$, $\theta_S = c = 1$, and $\theta_L - \theta_S = 0.3$. Values are computed analytically and rounded to four decimals.

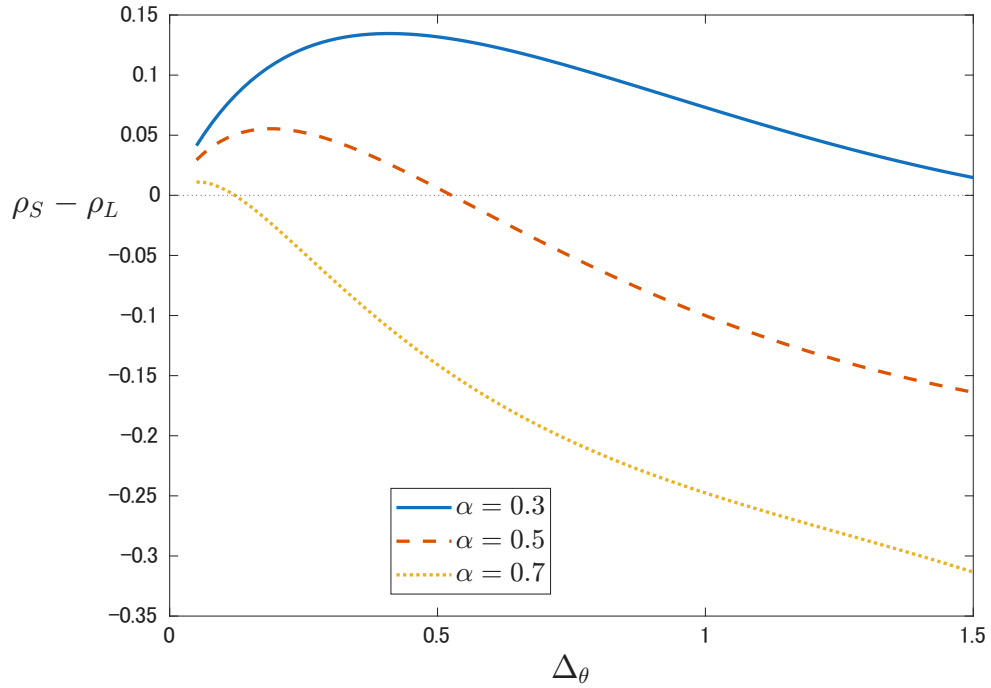


Figure 1: Per-unit pass-through gap and preference curvature. The curves plot $\rho_S - \rho_L$ against Δ_θ for $a = 0.1$, $\lambda = 0.2$, and $\theta_S = c = 1$.

5 Concluding remarks

This paper has examined how two approaches to nonlinear pricing—a discrete-choice model with fixed package sizes, as in Adachi and Doi (2026), and a traditional screening model with endogenous quantities and payments—yield different mechanisms of per-unit cost pass-through. In the screening model, concavity and binding low-type participation imply positive per-unit pass-through for the small package. Under isoelastic preferences, pass-through is higher for the small package than for the large package. However, a local curvature condition and a shifted-isoelastic example establish that this ranking can reverse. Thus, incentive compatibility affects the responses of nonlinear tariffs to cost shocks without imposing a universal ranking of per-unit pass-through across packages.

The distinction between a sign restriction and a ranking restriction matters for interpreting observed price schedules. In screening, quantities and payments are determined jointly, and information rents link the prices of different contracts. By contrast, with fixed package sizes, substitution across packages, changes in the composition of buyers, and participation decisions can shape the effects of cost shocks, as in Adachi and Doi (2026). Since both approaches can generate heterogeneous pass-through, the ordering of per-unit price changes alone does not identify the underlying pricing mechanism. Empirical work distinguishing these channels would require additional information on contract quantities, consumer choices, and participation responses.

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