Disclosure Regulation and Technology Choice: A Monopoly Model of Social Quality

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Abstract

This paper studies how mandatory disclosure of social attributes to consumers affects market outcomes and the firm's choice of technology. I consider a monopolist that invests in a costly technology that determines the distribution of a product's social quality, then privately observes its realization and decides whether to disclose it. Consumers are heterogeneous in their willingness to pay for social quality. In the short run, with technology held fixed, mandatory disclosure transfers surplus from the firm to consumers but raises welfare only when low realizations of social quality are sufficiently likely. In the long run, the effect on technology adoption depends on the steepness of the technology cost. When costs rise gradually, the option to conceal substitutes for genuine adoption, and removing it forces the firm to invest more in better technology. When costs rise sharply, part of the firm's investment in social quality is aimed at lifting consumer beliefs to the point where concealment is sustainable; disclosure regulation closes this channel and lowers the equilibrium technology.

KEYWORDS: Disclosure Regulation, Social Quality, Responsible Technology Adoption, Monopoly, Asymmetric Information, ESG

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1 Introduction

Over the past decade, the environmental and social attributes of products have become an increasingly important dimension of consumer choice. Firms advertise their products as fair-trade, organic, low-carbon, cruelty-free, or ethically sourced, and consumers report a growing willingness to pay a premium for such attributes. A meta-analysis of Li and Kallas (2021) reports an average willingness to pay of nearly thirty percent for sustainable food products, with substantial heterogeneity across consumers. Yet the quality of the information that supports these claims is often poor. A 2020 study commissioned by the European Commission found that more than half of explicit environmental claims made to consumers in the EU were vague, misleading, or unsubstantiated.[1] This combination of consumer demand and unreliable communication has placed the disclosure of social and environmental product attributes at the center of recent regulatory action.

The policy response has been to move from voluntary to mandatory product-level disclosure. In the European Union, the Empowering Consumers for the Green Transition Directive entered into force in March 2024, with full application by Member States from September 2026.[2] The Directive prohibits generic environmental claims and tightens the conditions under which firms may communicate the sustainability of their products. A complementary proposal, the Green Claims Directive, would require explicit environmental claims to be substantiated by independent verification.[3] In the United Kingdom, the Competition and Markets Authority enforces a parallel framework through the Green Claims Code, backed since 2024 by direct enforcement and fines of up to ten percent of global turnover under the Digital Markets, Competition and Consumers Act.[4] These regulations share a common premise: that voluntary disclosure leaves consumers exposed to

[1]European Commission, *Inception Impact Assessment on Empowering the Consumer for the Green Transition*, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52022PC0143.

[2]Directive (EU) 2024/825 of the European Parliament and of the Council, available at http://data.europa.eu/eli/dir/2024/825/oj. The Directive amends the Unfair Commercial Practices Directive (2005/29/EC) and the Consumer Rights Directive (2011/83/EU).

[3]European Commission, *Proposal for a Directive on the Substantiation and Communication of Explicit Environmental Claims (Green Claims Directive)*, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52023PC0166. The Commission announced its intention to withdraw the proposal in June 2025; the legislative process is suspended but not formally terminated.

[4]Competition and Markets Authority, *Green Claims Code: Making Environmental Claims*, available at https://www.gov.uk/government/publications/green-claims-code-making-environmental-claims.

selective and incomplete information, and that mandatory disclosure of social and environmental attributes will improve market outcomes. This paper asks whether the premise holds, and under what conditions.

I study how mandatory disclosure shapes market outcomes when the firm chooses both the technology that determines the product's social attributes and the information it conveys to consumers. The central question is how moving from voluntary to mandatory disclosure affects prices, firm profit, consumer surplus, welfare, and the firm's incentive to invest in socially responsible technologies. The contribution of this paper is to study these effects in a product market, where social and environmental attributes enter consumer utility directly and willingness to pay is heterogeneous across buyers. This setting departs from the existing theoretical literature on disclosure of social attributes, which has focused primarily on the lender-borrower and investor-manager relationship.[5]

The model captures these features in a stylized monopoly setting. A single firm sells a product with two attributes: a consumption value common to all buyers, and a social quality that buyers value heterogeneously. The firm first chooses a costly technology that determines the distribution of social quality, then privately observes the realization, and finally sets a price and, under the voluntary regime, decides whether to disclose. Consumers observe the technology the firm has adopted and form beliefs about the social quality consistent with the distribution induced by that technology. Absent disclosure, they purchase based on these prior beliefs; under disclosure, they update on the realized social quality before deciding whether to buy at the posted price. The analysis compares this voluntary regime with a mandatory regime in which disclosure is required.

Under voluntary disclosure, the classical unraveling result of Grossman and Hart (1980) predicts full disclosure: when payoffs are monotone in the privately observed quality, the firm always finds it strictly profitable to distinguish itself from lower realizations, and concealment unravels from the top. This logic fails in the present environment. Heterogeneous willingness to pay combined with uniform pricing makes the firm's profit non-monotone in social quality: over an intermediate range, the firm cannot monetize improvements in social quality, because charging a higher price would exclude buyers

[5] See Section 1.1 for a discussion of the related literature.

with low valuation for social quality. On this range, disclosure offers no profit gain over concealment. A partial disclosure equilibrium then emerges whenever the technology induces a distribution of social quality favorable enough that buyers, upon observing non-disclosure, expect the realization to lie in this intermediate range. The firm discloses only when realizations are high enough to be monetized, conceals otherwise, and serves the entire market at the consumption value during concealment.

I first study the effects of mandatory disclosure in the short run, the horizon over which the firm cannot change its production technology. Under mandatory disclosure, for the realizations that would otherwise be concealed, the firm lowers the price when the realization is moderately negative and serves the whole market, but excludes some buyers when the realization is very negative. This results in lower firm profit and higher expected consumer surplus. The welfare effect, however, is ambiguous and trades off two inefficiencies. Under concealment, buyers purchase based on the prior, which generates positive expected surplus. However, those with high willingness to pay for social quality suffer an ex-post negative surplus when the realization is poor. Mandatory disclosure eliminates this informational loss, but at the cost of exclusion: when the realization is sufficiently negative, the firm's optimal price excludes buyers it would otherwise have served. Mandatory disclosure improves welfare when very low realizations of social quality are sufficiently likely that the inefficiency of negative ex-post surplus under voluntary disclosure outweighs the additional exclusion inefficiency under mandatory disclosure.

I then turn to the long run, when the firm chooses both its technology and its disclosure strategy. Mandatory disclosure can push the equilibrium technology toward either a higher or a lower expected social quality, depending on how the cost of better technology rises. The direction depends on where the firm's cost-minimizing technology falls relative to the threshold at which concealment becomes sustainable under voluntary disclosure.

When the cost rises sufficiently gradually, the mandatory-regime technology is high and lies above the threshold at which concealment becomes sustainable. In such cases, improvements in the technology has a lower marginal gain for the firm under voluntary disclosure compared to a mandatory regime: a higher technology reduces the probability of low realizations that the firm can hide anyway when disclosure is voluntary. Concealment therefore substitutes for investment, and the firm settles on a lower technology than it would under mandatory disclosure. Mandatory disclosure restores the marginal return to investment and raises the equilibrium technology in such cases.

Conversely, when the cost rises sharply, the mandatory-regime technology is low and lies below the threshold at which concealment becomes sustainable. In such cases, the firm can profit from investing just enough to lift consumers' beliefs above this threshold and unlock the option to hide poor realizations under voluntary disclosure. Concealment then incentivizes investment, and the firm settles on a higher technology than it would under mandatory disclosure. Mandatory disclosure, by closing the concealment channel, removes this incentive and lowers the equilibrium technology.

The long-run effects on payoffs and welfare follow from the technology comparison. Firm profit falls under mandatory disclosure regardless of the direction of the technology change. The effect on consumer surplus depends on the direction of the technology change: when mandatory disclosure raises the technology, the short-run gain reinforces a long-run gain from higher expected social quality, and consumer surplus rises unambiguously; when it lowers the technology, the long-run loss can offset the short-run gain, and the net effect is ambiguous. The welfare effect can take either sign in both cases. A third inefficiency joins the informational and exclusion inefficiencies already identified: the firm chooses technology to maximize its own profit, which differs from the social welfare objective. Mandatory disclosure can mitigate or aggravate this inefficiency depending on the direction of the technology change.

The analysis abstracts from explicit social externalities associated with the realized social quality, yet such externalities are the primary motivation for disclosure regulation in practice. The technology-choice results extend naturally to this richer welfare criterion. When the planner places weight on cleaner production, lower emissions, or improved labor practices beyond what is reflected in consumers' willingness to pay, the policy criterion shifts toward inducing a higher equilibrium technology, and the conditions identified above can provide the operative diagnostic.

The results therefore call for disclosure mandates calibrated by sector and by the dimension of social quality at issue. Where costs rise gradually, as in labor-practice monitoring or supply-chain auditing, mandatory disclosure removes concealment as a substitute for genuine investment and tends to raise both technology adoption and welfare. Where costs rise sharply, as in emissions abatement in energy-intensive manufacturing, it removes the firm's incentive to invest in sustaining favorable beliefs and tends to depress adoption and welfare. Effective disclosure policy therefore requires matching the mandate to the sector rather than applying a uniform rule.

1.1 Related Works

This paper contributes to a growing theoretical literature on the effects of mandatory disclosure of social and environmental performance. To the best of my knowledge, no prior theoretical paper studies how mandatory disclosure of social quality affects firms' technology adoption and market outcomes in a product market with heterogeneous consumers. The existing theoretical literature has approached the same regulatory question in financial settings, where the disclosing party interacts with investors or lenders rather than consumers. For instance, Aghamolla and An (2024) examine voluntary versus mandatory ESG disclosure by a manager to shareholders with heterogeneous ESG preferences. Goldstein et al. (2022) study ESG disclosure in a rational expectations model with green and traditional investors. Lashkarbolookie (2025) analyzes mandatory disclosure in a multitask principal–agent model and characterizes its effects on sustainability-linked contracts.

The present paper complements this literature by moving the analysis to a product market, where the disclosing firm interacts with consumers who value social quality heterogeneously, and where the firm's instrument is a technology that shifts the distribution of social outcomes. The closest empirical evidence is Bratten, Cheng, and Kleppe (2025), who find that mandatory greenhouse-gas disclosure raises green innovation when investor demand for sustainability is strong but lowers it when proprietary costs are high. Their conditional finding is consistent with the conditional comparative statics derived here.

This paper also connects to a theoretical literature on greenwashing and strategic environmental communication. Lyon and Maxwell (2011) develop the canonical economic model of greenwash, in which a firm selectively discloses positive environmental information under the threat of an NGO audit, and identify conditions under which audits backfire and depress disclosure. Kim and Lyon (2015) extend the analysis to coexisting greenwash and brownwash. These papers share with the present model the focus on selective disclosure of environmental attributes, but the disciplining device differs: audits and penalties in their setting, consumer beliefs and the structure of demand here. The present paper also adds a technology-choice margin absent from this literature.

The paper connects to the classical theory of voluntary disclosure of verifiable information, building on Grossman and Hart (1980), Grossman (1981), Milgrom (1981), Jovanovic (1982), and Dye (1985), in which full disclosure unravels from the top when payoffs are monotone in privately observed quality. The mechanism here is closer to a smaller literature in which heterogeneous consumer preferences sustain partial disclosure under costless verifiability. Board (2009) studies duopolists facing heterogeneous consumers and shows that disclosure intensifies price competition, so firms may withhold quality information to soften it. Hotz and Xiao (2013) examine multi-attribute products with horizontally and vertically heterogeneous consumers, and show that disclosure can raise demand elasticity and depress profit. In both papers, the force that breaks unraveling operates through competition. The present model isolates a distinct mechanism: even a monopolist with no competitive pressure may conceal, because consumer heterogeneity combined with uniform pricing creates a range of realizations over which higher quality cannot be monetized.

The long-run analysis relates to a literature on endogenous quality and disclosure. Matthews and Postlewaite (1985) show that mandatory disclosure can deter a firm from acquiring information about its product's quality, since concealment is no longer available once quality is learned. The present paper shares the spirit that mandatory disclosure can lower a firm's investment in quality-related activities, but operates through a production technology that shifts the entire distribution of social quality rather than an information-acquisition decision, and yields a conditional rather than uniform direction. Daughety and Reinganum (2008) and Levin, Peck, and Ye (2009) study quality disclosure jointly with pricing or competition, channels that are absent here.

A complementary literature in industrial organization studies labels and credence goods, including Dranove and Jin (2010), Bonroy and Constantatos (2015), and Baksi and Bose (2007). In these papers, quality is a deterministic choice and the analysis centers on the labeling regime at a fixed quality. The present paper instead treats social quality as a stochastic outcome of a technology choice, and compares regimes both at fixed technology and when the firm re-optimizes, which allows the regulation to act on adoption.

The rest of the paper proceeds as follows. Section 2 introduces the model. Section 3 characterizes the equilibrium of the disclosure and pricing game at a fixed technology. Section 4 analyzes the effects of mandatory disclosure regulation, and Section 5 concludes.

2 The Model

Environment There is a product with two attributes: a consumption quality and a social quality. The consumption quality is identical across buyers and generates a common willingness to pay V. The social quality captures characteristics of the product or firm that do not affect consumption directly, such as environmental standards or labor practices. Let $s \in S = [\underline{s}, \overline{s}]$ denote the social quality, where higher values reflect more favorable social outcomes. I assume $\underline{s} < 0$ and $\overline{s} > 0$, so that the social quality may be negative, capturing the possibility that poor social practices reduce buyers' willingness to pay.

Consumers A unit mass of buyers each demand one unit of the product. Buyers are heterogeneous in their valuation of the social quality. A buyer of type $\theta \in [0, 1]$ has marginal utility θ from social quality, with types distributed according to a cumulative distribution $G(\cdot)$ on $[0, 1]$. The utility of type θ from purchasing one unit of the product with social quality s at price p is:

$$u_\theta(p, s) = V - p + \theta s.$$

The outside option yields zero utility. In the baseline analysis, I assume that types are uniformly distributed, i.e. $G(\cdot) = \mathcal{U}_{[0,1]}$. In Appendix B, I characterize the necessary and sufficient conditions on $G(\cdot)$ under which the same qualitative results obtain.

The assumption of heterogeneous valuations for social quality is supported by a substantial empirical literature. Discrete choice experiments and survey-based studies consistently find that consumers exhibit positive but highly dispersed willingness to pay for social and environmental product attributes such as fair trade, organic, eco-labels, and ethical sourcing. For instance, Li and Kallas (2021) provide a meta-analysis of 80 studies on sustainable food products and report an average willingness-to-pay premium of 29.5%, with substantial cross-consumer heterogeneity attributable to demographic, cultural, and attitudinal factors[6]. The type θ in the present model captures this dispersion in a parsimonious way, and the assumption that θ is private information reflects the introspective nature of these preferences.

Given a price p and a realized social quality s, a type θ consumer purchases whenever $V - p + \theta s \geq 0$. Let $D(p, s) \subseteq [0, 1]$ denote the set of types who buy the product with social quality s at price p. I denote aggregate consumer surplus at (p, s) by

$$CS(p, s) = \int_{D(p,s)} [V - p + \theta s] \; dG(\theta).$$

The Producer A monopolist produces the product at zero marginal cost. The social quality $s \in S$ is a stochastic outcome whose distribution is determined by the monopolist's choice of technology. The monopolist selects from a continuum of technologies indexed by $t \in T = [0, 1]$, where higher t corresponds to a more socially desirable technology. Adopting technology t incurs a cost $C(t)$, which may reflect the costs of monitoring and auditing supply chains, foregoing profitable but socially undesirable production processes, or investing in cleaner equipment or alternative supply relationships. I assume the cost function $C(t)$ is continuous, strictly increasing, and convex.

Let $\{F_t\}_{t \in T}$ be a family of probability distributions on S, each admitting a strictly positive density f_t with respect to Lebesgue measure. I impose two conditions on this family. The first is a monotone likelihood ratio condition, which implies that higher t yields a first-order stochastically dominant distribution of social quality in any subset of S. The second is a regularity condition ensuring that expected payoffs are continuous in t.

[6] Theoretical work on credence-goods markets makes the same modelling choice: consumers are typically assumed to differ in their valuation of unobservable quality attributes, since such attributes reflect personal values rather than functional product features (Bonroy and Constantatos, 2015).

Assumption 1.

1. ***MLRP:*** *For all $p > q$ in T, the likelihood ratio*

$$s \mapsto \frac{f_p(s)}{f_q(s)}$$

is non-decreasing on S.

2. ***Continuity:*** *For every bounded measurable function $\phi : S \to \mathbb{R}$, the map*

$$t \mapsto \int_{\underline{s}}^{\overline{s}} \phi(x)\, f_t(s)\, ds$$

is continuous on T.

I model the social quality s as a stochastic outcome rather than a deterministic choice for two reasons. First, the social impact of a firm's production practices is inherently uncertain: even a firm that invests heavily in environmentally responsible technologies cannot fully control outcomes such as emissions levels, supply chain conduct, or regulatory assessments. Second, this formulation captures the idea that the firm chooses a technology or a process rather than directly selecting a social quality level. The realized social quality is then the outcome of that process, subject to factors outside the firm's control.

Information and Disclosure Nature draws the social quality s from the distribution F_t, where t is the monopolist's technology choice. The monopolist observes s before setting a price and supplying the product, as it learns the realization of social quality through its own internal operations (such as audits, supplier reports, or emissions measurements) to which buyers have no direct access. Buyers observe the technology choice t but not the realized s; I assume that technology choices are verifiable, for instance through third-party certification. In Section 4, I show that the monopolist would voluntarily disclose its technology choice in equilibrium, so this assumption is without loss of generality: it is equivalent to requiring that buyers' beliefs about the social quality are consistent with the true prior F_t.

Buyers' types are their private information, and the distribution of types is common knowledge. A consumer's sensitivity to social quality reflects personal values, ethical beliefs, and social identity, which are inherently introspective and unobservable to the firm. Moreover, the stochastic nature of the social quality prevents the monopolist from engaging in second-degree price discrimination. Because the monopolist cannot commit ex ante to delivering a specific realization of s, it cannot offer a menu of products with differentiated social qualities and use it as a screening device to separate buyer types.

I consider two disclosure regimes that differ in whether the monopolist can withhold the realization of the social quality from buyers. *Mandatory disclosure* requires the monopolist to reveal s at the time of sale, capturing institutional settings such as mandatory ESG reporting or carbon footprint labeling requirements. *Voluntary disclosure* allows the monopolist to decide whether to reveal s after observing it and before buyers make their purchasing decisions, capturing settings in which firms retain discretion over what social information to release. In both regimes, disclosure is truthful and costless; I follow the standard assumption in the disclosure literature that legal or reputational mechanisms preclude misreporting.

The Game I consider the following three-stage game. In Stage 1, the monopolist chooses a technology $t \in T$ and pays the cost $C(t)$. Buyers observe t and form beliefs about the social quality consistent with F_t. In Stage 2, the social quality s is realized and privately observed by the monopolist. The monopolist then sets a price p and, under voluntary disclosure, decides whether to reveal s to buyers. Under mandatory disclosure, the monopolist is required to disclose s before buyers make their purchasing decisions. In Stage 3, each buyer decides whether to purchase the product at the posted price.

The two regimes therefore differ only in Stage 2: mandatory disclosure removes the monopolist's option to withhold the realization of s, while voluntary disclosure preserves it.

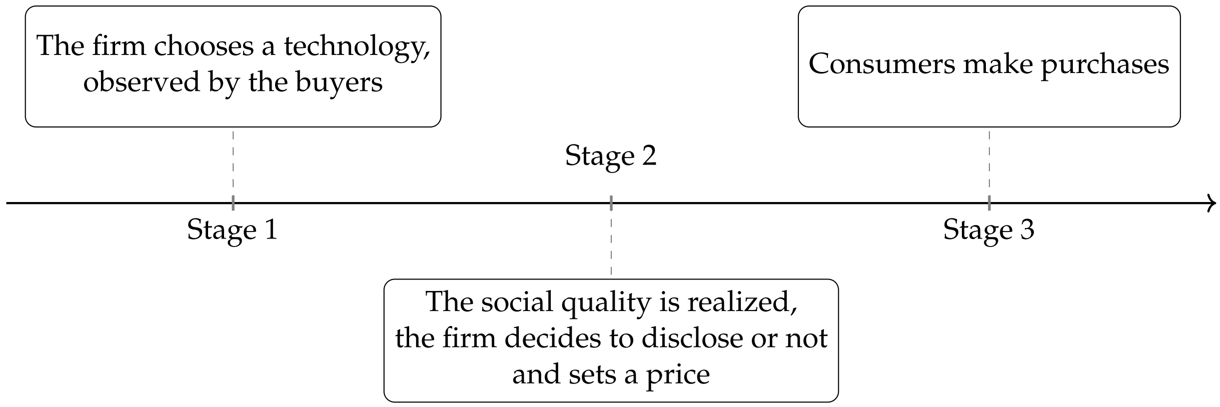


Figure 1: Timing of the Voluntary Disclosure Game

I characterize the perfect Bayesian equilibrium of the game. Under voluntary disclosure, the monopolist's strategy consists of a technology choice $t^* \in T$, a disclosure rule $d^*(s) \in \{0, 1\}$, and a pricing rule $p^*(s)$, both defined for each realization $s \in S$. Buyers' strategy consists of a purchase decision conditioned on the price and on the information available at Stage 3: the disclosed value of s if $d^* = 1$, or the event of non-disclosure if $d^* = 0$. Beliefs are required to satisfy Bayes' rule on the equilibrium path, given the monopolist's disclosure rule and technology choice. Under mandatory disclosure, the disclosure rule is fixed at $d^*(s) = 1$ for all s, and the equilibrium reduces to a technology choice and a pricing rule.

3 Equilibrium Characterization

This section characterizes the equilibrium of the game. I begin by characterizing the equilibrium in Stage 2, taking the firm's technology choice t as given. Let us first consider the firm's pricing problem under full disclosure, where buyers observe the realized social quality s before making their purchase decisions.

Lemma 1. *Under full disclosure, the monopolist's optimal price and equilibrium profit as functions of the realized social quality s are:*

$$p^*(s) = \begin{cases} \frac{V}{2} & , s \leq -\frac{V}{2} \\ V + s & , -\frac{V}{2} \leq s \leq 0 \\ V & , 0 \leq s \leq V \\ \frac{V+s}{2} & , s \geq V \end{cases} \quad , \quad \Pi(s) = \begin{cases} -\frac{V^2}{4s} & , s \leq -\frac{V}{2} \\ V + s & , -\frac{V}{2} \leq s \leq 0 \\ V & , 0 \leq s \leq V \\ \frac{(V+s)^2}{4s} & , s \geq V \end{cases}$$

When buyers observe s, the firm faces the usual monopoly pricing trade-off between margin and market coverage. This trade-off operates in two directions here, depending on the sign of s. When $s > 0$, willingness to pay is increasing in θ, so the firm may exclude low-θ buyers to extract higher surplus from socially aware consumers. When $s < 0$, the ranking reverses: high-θ buyers suffer a larger utility loss from poor social quality, and the firm may exclude them instead, retaining only buyers who are relatively less sensitive to social quality. The four regions in Lemma 1 reflect how the optimal exclusion threshold and market coverage vary as s moves relative to the consumption value V.

A notable feature of the optimal pricing in Lemma 1 is the existence of a full-coverage region, where the firm serves all buyers. Under a uniform type distribution, full coverage is optimal for $s \in [-V/2, V]$, that is, when social quality is sufficiently close to zero.[7] The logic differs across the two sub-regions. When $s \in [0, V]$, social quality is positive but insufficient for the firm to profitably exclude low-θ buyers; the firm sets $p^* = V$ and earns $\Pi(s) = V$, independent of s. When $s \in [-V/2, 0]$, social quality is negative but not sufficiently so to make excluding high-θ buyers profitable; the firm sets $p^* = V + s$ and serves the entire market. Profit is therefore not everywhere monotone in s (Figure 2): it is strictly increasing for $s < 0$, constant on $[0, V]$, and strictly increasing for $s > V$.

I now turn to pricing and disclosure under the voluntary regime. The non-monotonicity of profit in s has important implications for the firm's disclosure incentives. A classical result due to Grossman and Hart (1980) establishes that when the firm's payoff is strictly increasing in a privately observed quality, unraveling arguments imply that full disclosure is the unique equilibrium: the firm always finds it strictly profitable to distinguish itself from lower-quality types, so concealment unravels from the top. This logic may fail

[7]In Appendix B, I characterize the conditions on a generic distribution $G(\cdot)$ under which a full-coverage region emerges. The necessary and sufficient condition for full-coverage pricing is $g(0) > 0$: there must exist a positive mass of buyers who place no value on social quality.

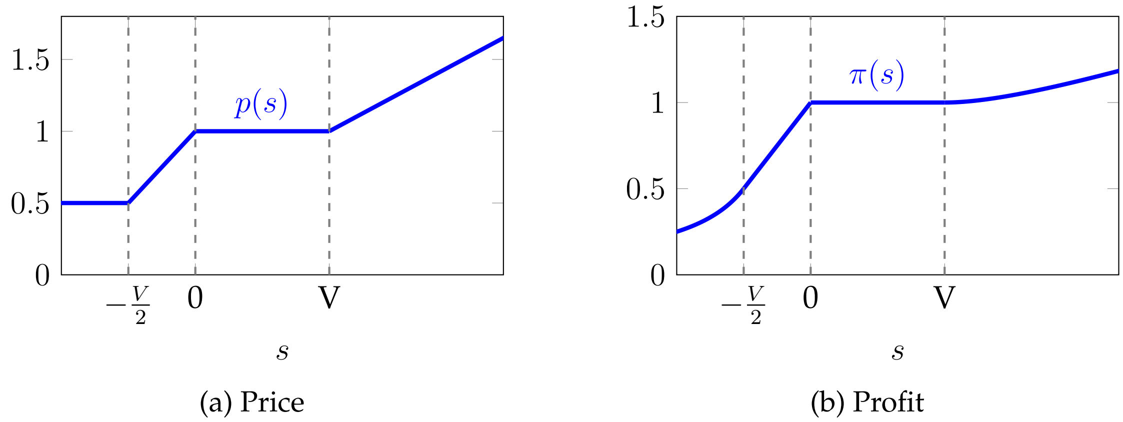


Figure 2: Price and Profit as functions of s, uniform case with $V = 1$, $s \in [-1, 2]$.

here, since on the interval $[0, V]$, profit is constant in s, and the firm may find it optimal to withhold the realized social quality when it is not sufficiently high. The emergence of a non-disclosure equilibrium then depends crucially on buyers' expectations about the social quality conditional on the event of non-disclosure, that is, on what buyers infer when the firm chooses not to disclose s. The following proposition characterizes the necessary and sufficient conditions for a non-disclosure equilibrium to exist in this setting.

Proposition 1.

1. *If $\mathbb{E}_t[s \mid s \leq V] < 0$, full disclosure is the unique equilibrium. The firm discloses the social quality for all $s \in S$, and sets a price according to Lemma 1.*

2. *If $\mathbb{E}_t[s \mid s \leq V] \geq 0$, a partial disclosure equilibrium exists. The firm discloses the social quality if and only if $s > V$, charging $p^*(s) = \frac{V+s}{2}$. For $s \leq V$, the firm conceals the social quality setting $p^*(s) = V$, and all buyers purchase the product.*

The two cases reflect how buyers' beliefs upon non-disclosure, formed by the distribution $F_t(s)$, interact with the firm's pricing incentives. When $\mathbb{E}_t[s \mid s \leq V] < 0$, the standard unravelling argument applies. For any realization s, the firm strictly prefers to disclose, because the belief buyers would form upon non-disclosure, $\mathbb{E}_t[s \mid d = 0]$, lies strictly below the actual realization s in each of the four pricing regions of Lemma 1. Concealment therefore yields a lower profit than disclosure, and the standard top-down unravelling restores full disclosure as the unique equilibrium.

When $\mathbb{E}_t[s \mid s \leq V] \geq 0$, the unravelling argument breaks down on the full-coverage interval $[0, V]$. For any $s > V$, the firm strictly prefers to disclose, since revealing the realization of s allows it to charge $p^*(s) = (V + s)/2 > V$. For $s \leq V$, however, disclosure cannot raise the price above V: in the full-coverage region, the firm would set $p = V$ even with full information. Concealment is therefore weakly preferable, and consistent beliefs sustain non-disclosure as an equilibrium. Buyers' expectation conditional on non-disclosure, $\mathbb{E}_t[s \mid d = 0]$, can be consistently positive, so they are willing to purchase at price V, allowing the firm to capture the entire market without revealing s.

The partial disclosure equilibrium is sustained by buyers' belief that, conditional on non-disclosure, the social quality is drawn from its prior distribution restricted to $[\underline{s}, V]$, yielding the expectation $\mathbb{E}_t[s \mid s \leq V]$. Under costless disclosure, this equilibrium is not unique: a full disclosure equilibrium can also be supported by pessimistic off-path beliefs that assign, for example, the worst realization $\underline{s}$ to non-disclosure, which deters any type from withholding s. The two equilibria can be distinguished by an arbitrarily small disclosure cost. With a disclosure cost $\epsilon > 0$, when s is in the full-coverage region $[0, V]$, the firm strictly prefer to withhold s, since disclosure does not raise their price above V, while types with $s > V$ still strictly prefer to disclose. The full-disclosure equilibrium can therefore be eliminated by an arbitrarily small disclosure cost whenever a partial disclosure equilibrium can emerge. Since the paper's focus is the effects of mandatory disclosure regulation, I adopt this selection and study the partial disclosure equilibrium whenever it exists.

To summarize, the existence of a partial disclosure equilibrium in this environment rests on two factors: heterogeneity in consumers' valuation of social quality, and consumers' sufficiently optimistic expectations about its realization. Heterogeneity, combined with the firm's uniform pricing, limits the monopolist's ability to extract profit from positive social quality when it is not sufficiently high. As a result, buyers who observe non-disclosure infer that the concealed social quality is either positive but not high enough to be monetized, or negative. Consequently, when consumers are sufficiently optimistic such that their expectation of s conditional on non-disclosure is positive, the firm can profitably withhold the realization of s and capture the entire market at a price equal to the consumption value V.

With the continuation equilibrium of Stages 2 and 3 in hand, I now turn to the firm's technology choice in Stage 1. Let $j \in \{\mathcal{V}, \mathcal{M}\}$ index the disclosure regime, with $\mathcal{V}$ denoting voluntary disclosure and $\mathcal{M}$ denoting mandatory disclosure, and let $\Pi^j(s)$ denote the firm's Stage 2 equilibrium profit at realization s under regime j. Anticipating the continuation equilibrium, the firm selects a technology $t \in T$ to maximize expected profit net of the technology cost:

$$\max_{t \in T} \ \mathbb{E}\big[\Pi^j(s) \mid s \sim F_t\big] - C(t).$$

The disclosure regime enters the problem through $\Pi^j(s)$. Voluntary and mandatory disclosure induce different profit functions, and hence different incentives for technology adoption. The next section examines how disclosure regulation shapes the equilibrium technology choice t^*, and traces its implications for firm profit, consumer surplus, and welfare.

4 The Effects of Mandatory Disclosure

I analyse the effects of mandatory disclosure regulation in two steps, distinguished by whether the firm's technology is held fixed or can be adapted to the new regulation. In the *short-run analysis*, I take the technology t as fixed and examine how moving from voluntary to mandatory disclosure affects firm profit and consumer surplus. This isolates the direct effect of disclosure regulation on Stage 2 outcomes. In the *long-run analysis*, I allow the firm to re-optimize its technology choice in Stage 1, and study how the regime change reshapes the equilibrium technology t^* and the resulting payoffs.

The Short Run:

Suppose the firm's technology choice t is such that a partial disclosure equilibrium emerges, that is, $\mathbb{E}_t[s \mid s \leq V] \geq 0$. In this equilibrium, the firm conceals s on the region $[\underline{s}, V]$, sets a price equal to V, and serves the entire market. Under mandatory disclosure, consumers instead observe the realization of s, and by Lemma 1, the firm lowers its price whenever s is negative. Profit therefore falls on $[\underline{s}, 0]$, and the firm's expected profit in Stage 2 is strictly lower under mandatory disclosure.

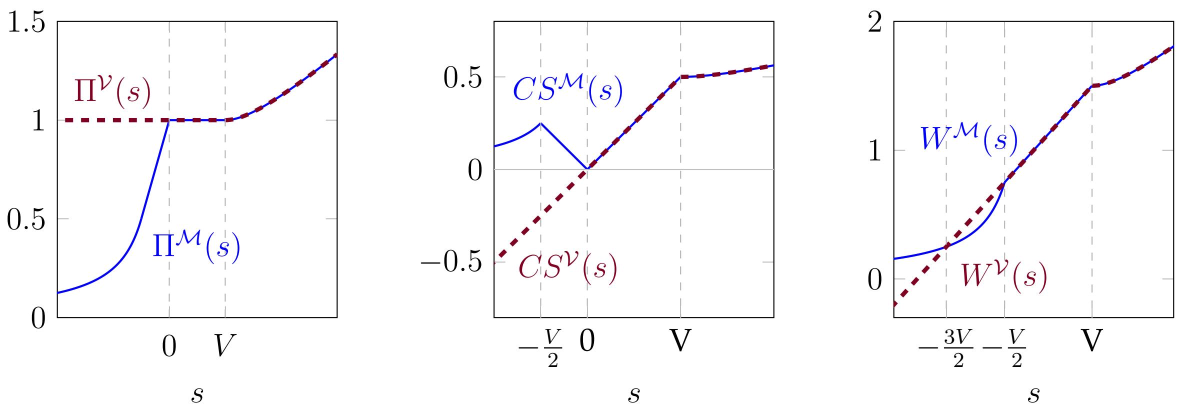
Consider next the effect on consumer surplus. Under voluntary disclosure, when the firm conceals s on $[\underline{s}, V]$ and sets $p = V$, a consumer of type θ obtains realized utility θs, which is positive for $s \in [0, V]$ and negative for $s \in [\underline{s}, 0]$. Buyers nonetheless purchase, because the conditional expectation $\mathbb{E}_t[s \mid s \leq V]$ is non-negative, ensuring a positive expected utility. Under mandatory disclosure, the firm's pricing rule on this region is given by Lemma 1: $p^*(s) = V$ for $s \in [0, V]$, so consumer surplus is unchanged; $p^*(s) = V + s$ for $s \in [-V/2, 0]$, so each buyer of type θ obtains $\theta s - s \geq 0$, strictly higher than under concealment; and $p^*(s) = V/2$ for $s \in [\underline{s}, -V/2]$, where some high-$\theta$ buyers are excluded and obtain zero rather than the negative payoff θs they would receive at price V. Aggregate consumer surplus is therefore weakly higher under mandatory disclosure for every realization of s, and strictly higher on $[\underline{s}, 0]$. Taking expectations over $F_t(\cdot)$, mandatory disclosure raises expected consumer surplus.

Let us now consider the welfare implications of mandatory disclosure in the short run. I define welfare at any realization of social quality s as the unweighed sum of consumer surplus and firm profit:

$$W^j(s) = CS^j(p, s) + \Pi^j(p, s), \qquad j \in \{V, M\}.$$

While mandatory disclosure raises consumer surplus and lowers firm profit, these two effects do not generally cancel. Two distinct inefficiencies arise in this setting, and the regime change affects both of them. The first is allocative: when $s < -V/2$, the firm's posted price exceeds the willingness to pay of high-θ types, who are excluded from the market under full disclosure but would purchase under concealment. The second is informational: on the concealment region $[\underline{s}, 0]$, the firm sets $p = V$ regardless of s, so consumers obtain negative ex post utility from a transaction they would have refused had s been disclosed. Mandatory disclosure eliminates the informational inefficiency but may aggravate the allocative inefficiency, since revealing s results in the firm excluding buyers it would otherwise have served.

Figure 3 plots payoffs and welfare under both regimes. Panel (c) shows that the two regimes deliver identical welfare for $s > -V/2$. On the interval $[-V/2, 0]$, prices differ



(a) Profit (b) Consumer surplus (c) Welfare

Figure 3: Profit, consumer surplus, and welfare under voluntary and mandatory disclosure, with uniform distribution of types and $V = 1$.

across regimes, but the entire market is served under both, so the regime change merely transfers surplus from the firm to consumers and leaves total welfare unchanged. On the interval $[\underline{s}, -\frac{V}{2}]$, the comparison is non-trivial. Mandatory disclosure excludes high-θ buyers who would have purchased under concealment, raising the allocative inefficiency. At the same time, it prevents the negative ex-post utility that these buyers would have had at price V, reducing the informational inefficiency. The balance between the two effects depends on the realization of s. When s is sufficiently low, the negative ex-post utility under voluntary disclosure is large, and mandatory disclosure yields higher welfare. When s is close to $-\frac{V}{2}$, the loss from exclusion dominates, and voluntary disclosure yields higher welfare. The net welfare effect is therefore ambiguous a priori and depends on the distribution $F_t(\cdot)$.

As Figure 3c shows, with a uniform distribution of consumer types, the welfare functions under the two disclosure regimes intersect at $s = -\frac{3V}{2}$. At this realization, the additional allocative inefficiency induced by mandating disclosure exactly offsets the informational efficiency gain from preventing negative ex-post consumer utility. The welfare ranking of the two regimes therefore depends on the relative likelihood of social quality falling in $[\underline{s}, -\frac{3V}{2}]$ versus $[-\frac{3V}{2}, -\frac{V}{2}]$. Intuitively, mandatory disclosure is welfare-improving when low realizations of social quality are sufficiently likely, since these are the realizations at which concealment imposes the largest informational losses on consumers, outweighing the allocative cost of exclusion.

The following proposition summarizes the effects of mandatory disclosure regulation on firm profit and consumer surplus, and provides a sufficient condition for the regulation to be welfare-improving.

Proposition 2.

Suppose the voluntary regime results in a partial disclosure equilibrium. Then:

1. *Mandatory disclosure unambiguously raises expected consumer surplus and lowers expected firm profit.*

2. *The welfare effect of mandatory disclosure is ambiguous. A sufficient condition for mandatory disclosure to be welfare-enhancing is*

$$\mathbb{E}_t\left[s \mid s < -\frac{V}{2}\right] \leq -\frac{3V}{2}.$$

Proposition 2 highlights that mandatory disclosure regulation systematically transfers surplus from the firm to consumers, but its effect on aggregate welfare depends on the distribution of social quality induced by the firm's technology. When extreme negative realizations of social quality are sufficiently likely, mandatory disclosure improves welfare by curbing the firm's ability to monetize concealment at the expense of consumers. When the distribution is concentrated around moderate realizations, however, the additional exclusion induced by full information dominates, and mandatory disclosure reduces welfare. This analysis takes the technology t as given. Yet the firm's choice of t in Stage 1 determines the distribution $F_t(\cdot)$, and this choice itself responds to the disclosure regime. The next section turns to this long-run perspective.

The Long Run

The short-run analysis has two implications for the firm's technology choice. First, the firm's profit $\Pi^j(s)$ is non-decreasing in s, so by MLRP a higher technology t induces a first-order stochastically dominant distribution of social quality and raises expected profit in Stage 2[8]. Second, Proposition 2 establishes that, whenever a partial disclosure equilibrium exists, expected profit in Stage 2 is strictly higher under voluntary disclosure than under the mandatory regime. The disclosure regime therefore affects the firm's technology choice only through technologies that sustain a partial disclosure equilibrium. To rule out the trivial case in which the disclosure regime has no effect on the firm's technology choice, I assume that the set T contains both technologies that sustain a partial disclosure equilibrium and technologies that do not.

Assumption 2.

$$\mathbb{E}_{t=0}\left[s \mid s \leq V\right] < 0 < \mathbb{E}_{t=1}\left[s \mid s \leq V\right].$$

The lowest technology in T induces a conditional expectation $\mathbb{E}_t[s \mid s \leq V]$ that is negative, ruling out a partial disclosure equilibrium by Proposition 1, while the highest technology induces a positive conditional expectation, sustaining one. Under MLRP, the conditional expectation $\mathbb{E}_t[s \mid s \leq V]$ is increasing in t, and the continuity condition in Assumption 1 ensures it varies continuously. Therefore, there exists a threshold technology $\hat{t} \in T$ such that a partial disclosure equilibrium emerges if and only if $t \geq \hat{t}$. The disclosure regime is payoff-relevant only for technologies above this threshold; below $\hat{t}$, the firm fully discloses s regardless of the regime, and the two regimes coincide.

To assess how mandatory disclosure regulation affects the firm's technology choice, I compare expected Stage 2 profit as a function of t under the two regimes, $\mathbb{E}_t[\Pi^{\mathcal{M}}(s)]$ and $\mathbb{E}_t[\Pi^{\mathcal{V}}(s)]$. Let $\bar{\Pi}^j(t) \equiv \mathbb{E}_t[\Pi^j(s)]$ denote expected Stage 2 profit under regime $j \in \{\mathcal{M}, \mathcal{V}\}$ when the firm adopts technology t. The firm's Stage 1 problem under regime j then reduces to choosing technology t to maximize $\bar{\Pi}^j(t) - C(t)$.

Two features of $\bar{\Pi}^{\mathcal{V}}(t)$ and $\bar{\Pi}^{\mathcal{M}}(t)$ drive the comparison, both concerning the threshold $\hat{t}$ at which the voluntary regime switches from full to partial disclosure. At this threshold, $\Pi^{\mathcal{V}}(s)$ jumps upward pointwise on $[\underline{s}, V]$: for $t < \hat{t}$ the firm fully discloses and earns $\Pi^{\mathcal{M}}(s)$, whereas for $t \geq \hat{t}$ the firm conceals s on $[\underline{s}, V]$ and earns $V \geq \Pi^{\mathcal{M}}(s)$. As a result, $\bar{\Pi}^{\mathcal{V}}(t)$ jumps upward at $\hat{t}$, while $\bar{\Pi}^{\mathcal{M}}(t)$ varies continuously in t.

[8]Since the firm's expected stage 2 profit is strictly increasing in t, the standard unraveling argument of Grossman and Hart (1980) implies that the firm voluntarily discloses its technology choice whenever such disclosure is verifiable, for instance through third-party certification of the production process.

Above the threshold, the slopes of $\bar{\Pi}^{\mathcal{V}}(t)$ and $\bar{\Pi}^{\mathcal{M}}(t)$ also differ. Under mandatory disclosure, raising t shifts probability mass toward higher realizations of s across the regions where $\Pi^{\mathcal{M}}(s)$ is strictly increasing, namely $[\underline{s}, 0]$ and $[V, \overline{s}]$. Under voluntary disclosure, $\Pi^{\mathcal{V}}(s)$ is flat at V on the concealment region $[\underline{s}, V]$, so reallocating mass within this region leaves $\bar{\Pi}^{\mathcal{V}}(t)$ unchanged; only mass shifted into $[V, \overline{s}]$ raises it. The marginal return to a better technology is therefore strictly smaller under voluntary disclosure than under mandatory disclosure for $t \geq \hat{t}$. The following Lemma summarized the properties of the firm expected profit as a function of its technology under the two disclosure regimes.

Lemma 2.

Under Assumptions 1 and 2, the expected Stage 2 profits $\bar{\Pi}^{\mathcal{M}}(t)$ and $\bar{\Pi}^{\mathcal{V}}(t)$ satisfy the following properties.

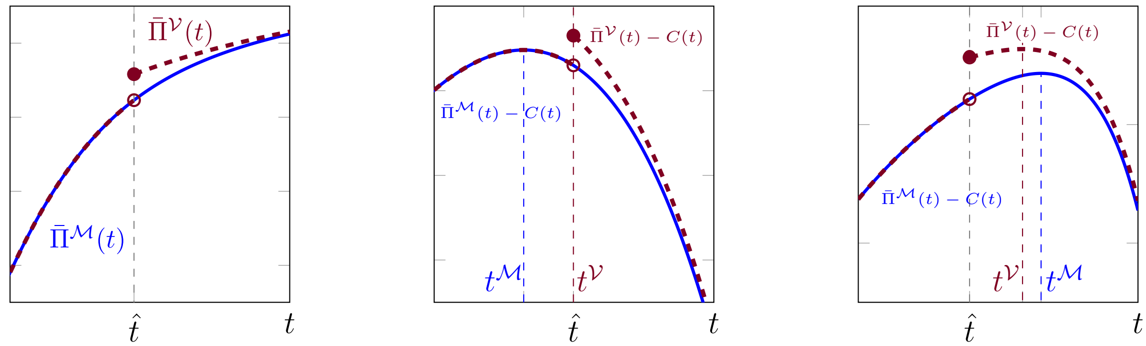
1. *Both $\bar{\Pi}^{\mathcal{M}}(t)$ and $\bar{\Pi}^{\mathcal{V}}(t)$ are non-decreasing in t, and $\bar{\Pi}^{\mathcal{M}}(t)$ is continuous.*

2. *$\bar{\Pi}^{\mathcal{V}}(t)$ coincides with $\bar{\Pi}^{\mathcal{M}}(t)$ on $[0, \hat{t})$ and exhibits an upward jump at $\hat{t}$: $\lim_{t \to \hat{t}^+} \bar{\Pi}^{\mathcal{V}}(t) > \bar{\Pi}^{\mathcal{M}}(\hat{t})$.*

3. *The difference $\bar{\Pi}^{\mathcal{V}}(t) - \bar{\Pi}^{\mathcal{M}}(t)$ is non-increasing in t on $[\hat{t}, 1]$.*

Figure 4a depicts the expected Stage 2 profits $\bar{\Pi}^{j}(t)$ under the two regimes for a numerical example with a one-parameter exponential family of distributions. Appendix C reports the detailed calculations. The distribution parameter is calibrated so that the threshold $\hat{t}$ lies in the interior of the technology set ($\hat{t} \approx 0.5$), ensuring that the disclosure regime is payoff-relevant. Figures 4b and 4c depict the net Stage 1 profit under two cost functions, each yielding a different equilibrium technology across regimes. The two panels illustrate that mandatory disclosure can induce either a higher or a lower equilibrium technology, $t^{\mathcal{M}}$, than the the equilibrium technology that the firm chooses under a voluntary regime $t^{\mathcal{V}}$.

Consider first the case depicted in Figure 4b, in which the technology chosen under mandatory disclosure, $t^{\mathcal{M}}$, lies below the threshold $\hat{t}$. Under voluntary disclosure, the firm's choice is driven by the upward discontinuity in net Stage 1 profit at $\hat{t}$. Although net profit is decreasing on $[t^{\mathcal{M}}, \hat{t})$, the firm can attain a higher payoff than at the local optimum



(a) Expected Stage 2 Profits (b) Stage 1 Profit, $C(t) = 1.5t^4$ (c) Stage 1 Profit, $C(t) = 1.5t^{10}$

Figure 4: Expected Stage 2 profits and net Stage 1 profits for the numerical example with one-parameter exponential family of distributions and two different cost functions. Panel (a) depicts $\bar{\Pi}^j(t)$. Panel (b) depicts the case $t^{\mathcal{M}} < t^{\mathcal{V}}$. Panel (c) depicts the case $t^{\mathcal{M}} > t^{\mathcal{V}}$.

$t^{\mathcal{M}}$ by adopting $\hat{t}$, since this technology induces expectations sufficient to sustain a partial disclosure equilibrium and allows it to conceal low realizations of social quality in Stage 2. The option to conceal therefore raises the firm's incentive to invest in a higher technology, and voluntary disclosure results in a higher equilibrium technology than the mandatory regime.

Consider next the case depicted in Figure 4c, in which the technology chosen under mandatory disclosure, $t^{\mathcal{M}}$, lies above the threshold $\hat{t}$. The firm's choice under voluntary disclosure, $t^{\mathcal{V}}$, then lies strictly below $t^{\mathcal{M}}$. The reason follows from the slope comparison established above: on the concealment region $[\underline{s}, V]$, voluntary-regime profit $\Pi^{\mathcal{V}}(s)$ is flat on $[\underline{s}, V]$, so the shifts of probability mass within this region leave $\bar{\Pi}^{\mathcal{V}}(t)$ unchanged. The marginal return to a higher technology is therefore strictly smaller under voluntary disclosure than under mandatory disclosure, and the firm invests less. Mandatory disclosure regulation thus induces a higher equilibrium technology than the voluntary regime whenever the firm's mandatory-regime choice already lies above $\hat{t}$.

The contrast between the two cases is driven by the cost function $C(t)$, which is uniformly lower on T in the case depicted in Figure 4c than the one in Figure 4b. When the cost of higher technologies is low enough that the firm's mandatory regime choice $t^{\mathcal{M}}$ exceeds the threshold $\hat{t}$, voluntary disclosure yields a strictly lower technology, since the flatness of $\Pi^{\mathcal{V}}(s)$ on the concealment region dampens the marginal return to investment. When the cost rises sharply enough that $t^{\mathcal{M}}$ falls below $\hat{t}$, voluntary disclosure can instead yield a higher technology: the upward jump in $\bar{\Pi}^{\mathcal{V}}(t)$ at $\hat{t}$ induces the firm to adopt the threshold technology, where the conditional expectation $\mathbb{E}_t[s \mid s \leq V]$ becomes non-negative and concealment is sustainable. The following proposition formalizes this comparison.

Proposition 3.

Assume that the firm's optimal technology choice is unique under both regimes. Then mandatory disclosure induces a strictly higher technology than the voluntary regime, $t^{\mathcal{M}} > t^{\mathcal{V}}$, if and only if $t^{\mathcal{M}} > \hat{t}$.

Proposition 3 reveals a trade-off for the regulator. The option to conceal negative social qualities raises the firm's payoff just above the threshold $\hat{t}$, with two opposing effects. When the marginal cost rises sharply, the firm would settle below $\hat{t}$ if s was observable for consumers. In this case, the option to conceal s can pull the choice of technology up to the threshold; mandatory disclosure removes this pull and can lower the equilibrium technology. When the marginal cost rises slowly and the firm already invests above $\hat{t}$, concealment dampens the return to further investment; mandatory disclosure removes this dampening and raises the equilibrium technology. Mandatory disclosure therefore improves technology adoption when feasible technologies are sufficiently favourable and their cost rises gradually, but backfires when higher technologies are expensive and the firm relies on the option to conceal as the marginal incentive to invest in a higher technology.

The remainder of this section examines the long-run effects of mandatory disclosure on firm profit, consumer surplus, and welfare. The effect on profit is immediate. Whenever a partial disclosure equilibrium emerges under voluntary disclosure, Proposition 2 establishes that $\bar{\Pi}^{\mathcal{M}}(t) \leq \bar{\Pi}^{\mathcal{V}}(t)$ for every technology t. The firm's net Stage 1 profit, $\max_{t \in T}[\bar{\Pi}^j(t) - C(t)]$, therefore falls under mandatory disclosure regardless of how $t^{\mathcal{M}}$ compares to $t^{\mathcal{V}}$. The effects on consumer surplus and welfare are less direct, since the regime change shifts both the distribution of social quality and the firm's pricing rule.

Let $\overline{CS}^j(t) \equiv \mathbb{E}[CS^j(s) \mid s \sim F_t]$ denote expected Stage 1 consumer surplus under regime j. The change in expected consumer surplus admits a natural decomposition through $t^{\mathcal{V}}$:

$$\overline{CS}^{\mathcal{M}}(t^{\mathcal{M}}) - \overline{CS}^{\mathcal{V}}(t^{\mathcal{V}}) = \underbrace{\left[\overline{CS}^{\mathcal{M}}(t^{\mathcal{V}}) - \overline{CS}^{\mathcal{V}}(t^{\mathcal{V}})\right]}_{\text{regime effect}} + \underbrace{\left[\overline{CS}^{\mathcal{M}}(t^{\mathcal{M}}) - \overline{CS}^{\mathcal{M}}(t^{\mathcal{V}})\right]}_{\text{technology effect}}. \tag{1}$$

The regime effect captures the short-run change at fixed technology, holding the distribution of social quality at $F_{t^{\mathcal{V}}}$. By Proposition 2, this term is strictly positive: mandatory disclosure raises expected consumer surplus at any fixed technology that sustains a partial disclosure equilibrium. The technology effect captures the additional change induced by the shift in the firm's technology choice, and its sign is not pinned down by monotonicity arguments. Under voluntary disclosure, $CS^{\mathcal{V}}(s)$ is monotone in s, so $\overline{CS}^{\mathcal{V}}(t)$ is non-decreasing in t by MLRP. The technology effect in (1), however, is evaluated under the mandatory profit function, and $CS^{\mathcal{M}}(s)$ is non-monotone in s: it is decreasing on $[-V/2, 0]$. The following proposition characterizes the long-run effect of mandatory disclosure on firm profit and consumer surplus.

Proposition 4.

Maintain the uniqueness assumption of Proposition 3, and suppose that a partial disclosure equilibrium emerges under voluntary disclosure. Then:

1. *Mandatory disclosure strictly reduces the firm's expected profit.*
2. *Mandatory disclosure strictly increases expected consumer surplus when $t^{\mathcal{M}} > t^{\mathcal{V}}$. When $t^{\mathcal{M}} < t^{\mathcal{V}}$, the effect on expected consumer surplus is ambiguous.*

Part (1) follows directly from Proposition 2, which establishes that $\bar{\Pi}^{\mathcal{M}}(t) \leq \bar{\Pi}^{\mathcal{V}}(t)$ for every technology t. Part (2) cannot be obtained from (1) alone, since the technology effect in this decomposition does not have a determinate sign. The proof of Proposition 4 establishes the result through an alternative decomposition that exploits the monotonicity of $CS^{\mathcal{V}}(s)$, and shows that the sum of the two effects is strictly positive whenever $t^{\mathcal{M}} > t^{\mathcal{V}}$.

The decomposition in (1) clarifies why the comparison is ambiguous in the opposite case. When $t^{\mathcal{M}} < t^{\mathcal{V}}$, the technology effect can operate in the opposite direction to the regime effect: a lower technology shifts probability mass toward lower realizations of social quality, which can reduce expected consumer surplus. The sign of the net change then depends on which effect prevails. When the technology gap $t^{\mathcal{V}} - t^{\mathcal{M}}$ is small, the technology effect is modest and the positive regime effect dominates, so expected consumer surplus rises under mandatory disclosure even though the firm chooses a lower technology. When the technology gap is large, the distribution of social quality shifts substantially toward lower realizations, and the resulting loss can outweigh the regime effect, such that expected consumer surplus falls. The numerical examples in Appendix C illustrate both cases.

I now turn to the long-run welfare effect of mandatory disclosure. The same decomposition applies:

$$\overline{W}^{\mathcal{M}}(t^{\mathcal{M}}) - \overline{W}^{\mathcal{V}}(t^{\mathcal{V}}) = \underbrace{\left[\overline{W}^{\mathcal{M}}(t^{\mathcal{V}}) - \overline{W}^{\mathcal{V}}(t^{\mathcal{V}})\right]}_{\text{regime effect}} + \underbrace{\left[\overline{W}^{\mathcal{M}}(t^{\mathcal{M}}) - \overline{W}^{\mathcal{M}}(t^{\mathcal{V}})\right]}_{\text{technology effect}}. \tag{2}$$

Neither component has a determinate sign. The regime effect can take either sign: by Proposition 2, mandatory disclosure raises welfare at a fixed technology only when very low realizations of social quality are sufficiently likely, and this condition may or may not hold at $t^{\mathcal{V}}$. The technology effect can also take either sign, since the firm chooses technology to maximize profit rather than welfare. Moreover, each sign of the technology effect is compatible with either sign of the technology change, whether $t^{\mathcal{M}} > t^{\mathcal{V}}$ or $t^{\mathcal{M}} < t^{\mathcal{V}}$. The long-run welfare effect of mandatory disclosure is therefore ambiguous, and the direction of the technology change alone is not sufficient to sign it. The following observation summarizes this property.

Observation 1. *Mandatory disclosure can raise or lower expected net welfare under each sign of $t^{\mathcal{M}} - t^{\mathcal{V}}$. All four sign combinations of $(t^{\mathcal{M}} - t^{\mathcal{V}}, \overline{W}^{\mathcal{M}} - \overline{W}^{\mathcal{V}})$ arise within the family of numerical examples reported in Appendix C.*

The numerical examples in Appendix C construct the four sign combinations by varying the cost function so as to control both the direction and the magnitude of the technology gap $t^{\mathcal{M}} - t^{\mathcal{V}}$. When the gap is small, the technology effect is negligible and the regime effect at $t^{\mathcal{V}}$ determines the sign of the welfare change. By Proposition 2, this regime effect can be positive or negative depending on whether very low realizations of social quality are sufficiently likely at $t^{\mathcal{V}}$. A small technology gap can therefore deliver either sign of $\overline{W}^{\mathcal{M}} - \overline{W}^{\mathcal{V}}$, under either direction of the change in technology choice. When the technology gap is large, the technology effect becomes the dominant force, and either reinforces or undermines the regime effect. A large positive gap, $t^{\mathcal{M}} > t^{\mathcal{V}}$, can raise expected social quality and push welfare up; a large negative gap, $t^{\mathcal{M}} < t^{\mathcal{V}}$, can lower expected social quality and push welfare down. The four sign combinations of $(t^{\mathcal{M}} - t^{\mathcal{V}}, \overline{W}^{\mathcal{M}} - \overline{W}^{\mathcal{V}})$ then arise from the four combinations of (small or large) gap with (positive or negative) direction.

The welfare effect of mandatory disclosure reflects the interaction of three inefficiencies in this environment. The first is the standard monopoly exclusion inefficiency in pricing. The second is the ex-post negative surplus borne by consumers when the firm conceals low realizations of social quality under the voluntary regime. The third is the wedge between the monopolist's private return to investing in technologies that yield higher expected social quality and the social return to such investment. The voluntary regime mitigates the first inefficiency through concealment but introduces the second, while the third is present under both regimes. Mandatory disclosure eliminates the second inefficiency, sharpens the first, and reshapes the third by altering the marginal return to technology. The analysis above establishes that mandatory disclosure can raise expected consumer surplus and induce a higher equilibrium technology when the cost of better technology rises sufficiently slowly, and that it can raise net welfare when the firm's initial technology is sufficiently likely to generate very low realizations of social quality.

A broader assessment can go beyond the welfare measure adopted here. I do not model the externalities associated with social quality, yet such externalities are the primary motivation for ESG and disclosure regulation in practice. These externalities can be incorporated by augmenting the planner's objective with an additional term $B(t)$, increasing in t, that captures the social value of cleaner production, lower emissions, or improved labor practices beyond what is reflected in consumers' willingness to pay. The planner then maximizes $\mathbb{E}_t[W^j(s)] + B(t)$ rather than expected net welfare alone. When the marginal social gain $B'(t)$ is sufficiently large, the planner's preferred policy is the one that induces the higher equilibrium technology, even if the corresponding change in expected net welfare is negative. From this perspective, Proposition 3 provides the operative criterion for policy: its necessary and sufficient condition for mandatory disclosure to raise the equilibrium technology, $t^{\mathcal{M}} > t^{\mathcal{V}}$, identifies the environments in which the regulation aligns with the planner's objective.

5 Conclusion

Firms routinely make costly investments whose social consequences they cannot fully predict, from auditing supply chains to abating emissions or monitoring labor practices. Consumers value the underlying product in much the same way, but differ sharply in how much they care about its social footprint: for some buyers a poor footprint is a deal-breaker, while others are indifferent or even averse to paying for it. Once a firm learns how its operations have actually performed, it must decide what to charge and, where regulation permits, what to tell the public. This paper studies these choices in a model where a monopolist invests in a costly technology that shapes the distribution of social quality, privately observes its realization, and then sets a price and a disclosure decision. We compare market outcomes under voluntary and mandatory disclosure, asking how the regime shapes pricing, technology adoption, and welfare.

This paper analyzes the effects of disclosure regulation along two horizons. In the short run, with the firm's technology fixed, mandatory disclosure transfers surplus from the firm to consumers but leaves aggregate welfare ambiguous. The transfer accrues mainly to consumers with low willingness to pay for social quality, who continue to be served at a lower price, while consumers with high willingness to pay bear both the negative ex-post surplus from concealment and the exclusion that disclosure induces at low realizations. Mandatory disclosure improves welfare only when low realizations of social quality are sufficiently likely to make the informational gain outweigh the cost of additional exclusion. In the long run, a third channel enters through the firm's technology choice, and the steepness of the technology cost is decisive. When costs rise gradually, the option to conceal substitutes for further investment, and mandatory disclosure raises the equilibrium technology. When costs rise sharply, investment serves to lift consumers' beliefs to the point where concealment becomes sustainable. This raises the marginal return on social investment, and removing this option pulls the equilibrium technology down.

These results have direct implications for the design of disclosure regulation. Mandatory disclosure is most likely to improve technology adoption, and is more likely to raise expected welfare, in sectors where higher social quality can be achieved through moderate investments in monitoring, organizational standards, or compliance procedures, as in modern manufacturing and retail supply chains. In sectors where improving social quality requires intensive capital investment, such as energy-intensive manufacturing, mandatory disclosure is likely to depress technology adoption and welfare by removing incentives for optics. Once the externalities associated with social quality are taken into account, the case for mandatory disclosure becomes stronger in the first class of sectors and weaker in the second. Disclosure mandates should therefore be calibrated to the cost structure of the targeted sector, since a uniform policy can raise technology adoption in some industries while possibly harming it in others.

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Appendix

A Omitted Proofs

Proof. of Lemma 1:

At any price p, a consumer of type θ purchases the product if and only if $u_\theta(p, s) = V - p + \theta s \geq 0$.

Case $s > 0$. The marginal type is $\hat{\theta}(p, s) = (p - V)/s$, and demand equals $1 - (p - V)/s$, restricting attention to prices $p \geq V$ (any $p < V$ is dominated by $p = V$, which already serves the entire market), the firm solves

$$\max_{p \geq V} \; p\left(1 - \frac{p - V}{s}\right).$$

The unconstrained maximizer is $p^\circ = (V + s)/2$. The constraint $p \geq V$ binds whenever $p^\circ < V$, i.e., $s < V$. Hence the optimal price is $p^*(s) = V$ for $s \in [0, V]$ and $p^*(s) = (V + s)/2$ for $s \geq V$.

Case $s < 0$. The marginal type is $\hat{\theta}(p, s) = (p - V)/s$, and demand equals $(p - V)/s$. The firm solves

$$\max_{p \in [V+s,\, V]} \; p \cdot \frac{p - V}{s}.$$

The unconstrained maximizer is $p^\circ = V/2$. The corresponding marginal type $\hat{\theta}(p^\circ, s) = -V/(2s)$ lies in $[0, 1]$ if and only if $s \leq -V/2$. For $s \in [-V/2, 0)$, $\hat{\theta}(p^\circ, s) > 1$, so the relevant corner is $p = V + s$, which sets $\hat{\theta} = 1$ and serves the entire market. Hence the optimal price is $p^*(s) = V + s$ for $s \in [-V/2, 0)$ and $p^*(s) = V/2$ for $s \leq -V/2$.

Substituting $p^*(s)$ into the profit function yields the expression for $\Pi(s)$ stated in the lemma. □

Proof. of Proposition 1:

Fix a technology $t \in T$ and write $\mu \equiv \mathbb{E}_t[s \mid s \leq V]$.

1. Suppose $\mu < 0$. I show that full disclosure is the unique equilibrium. Existence is immediate: full disclosure yields the full-information profit $\Pi(s)$ from Lemma 1, which no pooling continuation can exceed.

For uniqueness, suppose by contradiction that there exists an equilibrium in which the firm conceals s on some measurable set $N \subseteq S$ of positive measure. Let $\mu_N \equiv \mathbb{E}_t[s \mid s \in N]$ denote the buyers' posterior expectation upon non-disclosure, and let p_N denote the firm's price under non-disclosure. By Lemma 1, the firm's payoff from disclosing s is $\Pi(s)$, and its payoff from concealing is at most $\Pi(\mu_N)$, since the optimal price against a market that believes the social quality equals μ_N cannot exceed the full-information optimum at μ_N.

By Lemma 1, $\Pi(s) > V$ for $s > V$, so disclosure is strictly optimal on $(V, \overline{s}]$ in any equilibrium, and hence $N \subseteq [\underline{s}, V]$. The buyers' posterior then satisfies $\mu_N \leq \mu < 0$. The same unraveling argument as in the standard case applies: at any $s \in N$, the firm strictly prefers to disclose, since $\Pi(s) > \Pi(\mu_N)$ on every region of Lemma 1 relevant to $N \subseteq [\underline{s}, V]$. This contradicts the assumption that N is the concealment set. Full disclosure is therefore the unique equilibrium.

2. Suppose $\mu \geq 0$. I construct a partial disclosure equilibrium with disclosure rule $d^*(s) = \mathbf{1}\{s > V\}$, pricing rule $p^*(s) = (V + s)/2$ when s is disclosed and $p^*(s) = V$ when it is concealed, and buyer belief $\mathbb{E}_t[s \mid d = 0] = \mu \geq 0$.

Buyer optimality. Under disclosure with $s > V$ at price $(V + s)/2$, buyer behavior coincides with the full-information optimum of Lemma 1. Under non-disclosure at price V, a type θ has expected utility $\theta\mu \geq 0$, so all types weakly prefer to purchase.

Belief consistency. On the equilibrium path, non-disclosure occurs when $s \leq V$, so Bayes' rule yields $\mathbb{E}_t[s \mid d = 0] = \mathbb{E}_t[s \mid s \leq V] = \mu > 0$.

Firm optimality. By Lemma 1, $\Pi(s) \leq V$ for $s \leq V$ and $\Pi(s) > V$ for $s > V$. Concealing at price V is therefore weakly optimal on $[\underline{s}, V]$ and disclosing is strictly optimal on $(V, \overline{s}]$.

The proposed strategies and beliefs form a perfect Bayesian equilibrium. □

Proof. of Proposition 2:

Suppose the voluntary regime sustains a partial disclosure equilibrium, so that $\mu \equiv \mathbb{E}_t[s \mid s \leq V] \geq 0$. By Proposition 1, under voluntary disclosure the firm conceals s on $[\underline{s}, V]$ at price V and discloses s on $(V, \overline{s}]$ at price $(V + s)/2$.

1. The firm's profit under mandatory disclosure is $\Pi^{\mathcal{M}}(s)$ is given by Lemma 1. Under voluntary disclosure, $\Pi_V(s) = V$ on $[\underline{s}, V]$ and $\Pi_V(s) = \Pi_M(s)$ on $(V, \overline{s}]$. Hence, $\Pi_V(s) \geq$

$\Pi_M(s)$ for every s, with strict inequality on $[\underline{s}, 0)$. Taking expectations under F_t yields $\mathbb{E}_t[\Pi_V(s)] > \mathbb{E}_t[\Pi_M(s)]$.

For consumer surplus, integrating $V - p^*(s) + \theta s$ over the buyers who purchase at price $p^*(s)$ from Lemma 1 gives, under mandatory disclosure,

$$CS^{\mathcal{M}}(s) = \begin{cases} -V^2/(8s) & s \le -V/2, \\ -s/2 & -V/2 \le s \le 0, \\ s/2 & 0 \le s \le V, \\ (V+s)^2/(8s) & s \ge V. \end{cases}$$

Under voluntary disclosure, the firm sets $p = V$ on $[\underline{s}, V]$ and all types purchase, while $CS_V(s) = CS_M(s)$ on $(V, \overline{s}]$, so

$$CS^{\mathcal{V}}(s) = \begin{cases} s/2 & s \le V, \\ (V+s)^2/(8s) & s \ge V. \end{cases}$$

Comparing pointwise: On $[0, \overline{s}]$, $CS^{\mathcal{M}}(s) = CS^{\mathcal{V}}(s)$. On $[-V/2, 0)$, $CS^{\mathcal{M}}(s) = -s/2 > 0 > s/2 = CS^{\mathcal{V}}(s)$. On $[\underline{s}, -V/2)$, $CS^{\mathcal{M}}(s) = -V^2/(8s) > 0 > s/2 = CS^{\mathcal{V}}(s)$. Hence $CS^{\mathcal{M}}(s) \ge CS_V(s)$ for every $s \in S$, with strict inequality on $[\underline{s}, 0)$. Taking expectations yields $\mathbb{E}_t[CS^{\mathcal{M}}(s)] > \mathbb{E}_t[CS^{\mathcal{V}}(s)]$.

2. On $[0, \overline{s}]$, both regimes induce the same allocation and price. On $[-V/2, 0]$, the allocation is the same under both regimes but the price differs; the regime shift transfers surplus from the firm to consumers and leaves welfare unchanged. The two welfare functions therefore differ only on $[\underline{s}, -V/2]$, where

$$W^{\mathcal{M}}(s) = \Pi^{\mathcal{M}}(s) + CS^{\mathcal{M}}(s) = -\frac{V^2}{4s} - \frac{V^2}{8s} = -\frac{3V^2}{8s},$$

and, with all buyers purchasing at $p = V$ under voluntary disclosure,

$$W^{\mathcal{V}}(s) = V + \int_0^1 \theta s \, d\theta = V + \frac{s}{2}.$$

Hence

$$\mathbb{E}_t[W^{\mathcal{M}}(s)] - \mathbb{E}_t[W^{\mathcal{V}}(s)] = F_t(-V/2) \cdot \mathbb{E}_t\left[W^{\mathcal{M}}(s) - W^{\mathcal{V}}(s) \mid s < -V/2\right],$$

I show that the conditional expectation on the right-hand side is non-negative under the sufficient condition provided in the proposition. Set $u \equiv |s|$ and $m \equiv \mathbb{E}_t[|s| | \, s < -V/2] = -\mathbb{E}_t[s \mid s < -V/2]$. The condition $\mathbb{E}_t[s \mid s < -V/2] \le -3V/2$ is equivalent to $m \ge 3V/2$.

The function $f(u) = 1/u$ is convex on $(0, \infty)$. Jensen's inequality yields

$$\mathbb{E}_t\left[\frac{3V^2}{8|s|}\,\middle|\, s < -V/2\right] \geq \frac{3V^2}{8m}.$$

A sufficient condition for $\mathbb{E}_t[W^{\mathcal{M}}(s) - W^{\mathcal{V}}(s) \mid s < -V/2] \geq 0$ is therefore

$$\frac{3V^2}{8m} \geq V - \frac{m}{2}.$$

Rearranging gives $4m^2 - 8mV + 3V^2 = 4(m - V/2)(m - 3V/2) \geq 0$, which holds true for $m \geq 3V/2$. Hence $\mathbb{E}_t[W^{\mathcal{M}}(s)] \geq \mathbb{E}_t[W^{\mathcal{V}}(s)]$ if $m \geq 3V/2$, and the stated condition is sufficient for mandatory disclosure to be welfare-enhancing. □

Proof. of Lemma 2:

Property 1. By Lemma 1, $\Pi^{\mathcal{M}}(s)$ is non-decreasing in s; under voluntary disclosure with a partial disclosure equilibrium, $\Pi^{\mathcal{V}}(s) = \max\{V, \Pi^{\mathcal{M}}(s)\}$, which is also non-decreasing in s. By MLRP, a higher t induces a first-order stochastically dominant distribution of s, and the expectation of any non-decreasing function is non-decreasing in t. Continuity of $\bar{\Pi}^{\mathcal{M}}(t)$ follows from Assumption 1.

Property 2. For $t \leq \hat{t}$, the voluntary regime yields full disclosure by Proposition 1, so $\bar{\Pi}^{\mathcal{V}}(t) = \bar{\Pi}^{\mathcal{M}}(t)$. For $t > \hat{t}$, the firm conceals on $[\underline{s}, V]$ at price V, so $\Pi^{\mathcal{V}}(s) = V$ on this region while $\Pi^{\mathcal{M}}(s) \leq V$ with strict inequality on $[\underline{s}, 0)$. Hence

$$\bar{\Pi}^{\mathcal{V}}(t) - \bar{\Pi}^{\mathcal{M}}(t) = \int_{\underline{s}}^{V} \left[V - \Pi^{\mathcal{M}}(s)\right] f_t(s)\, ds > 0$$

for all $t > \hat{t}$, since $V - \Pi^{\mathcal{M}}(s) > 0$ on $[\underline{s}, 0)$ and f_t has full support. Continuity of the integrand in t then gives $\lim_{t \to \hat{t}^+} \bar{\Pi}^{\mathcal{V}}(t) > \bar{\Pi}^{\mathcal{M}}(\hat{t})$.

Property 3. For $t > \hat{t}$,

$$\bar{\Pi}^{\mathcal{V}}(t) - \bar{\Pi}^{\mathcal{M}}(t) = \int_{\underline{s}}^{V} \left[V - \Pi^{\mathcal{M}}(s)\right] f_t(s)\, ds.$$

The integrand $V - \Pi^{\mathcal{M}}(s)$ is non-negative and non-increasing in s, strictly decreasing on $[\underline{s}, 0)$. By MLRP, a higher t shifts probability mass toward higher values of s, lowering the expectation of any non-increasing function. Hence $\bar{\Pi}^{\mathcal{V}}(t) - \bar{\Pi}^{\mathcal{M}}(t)$ is non-increasing in t on $(\hat{t}, 1]$, with strict decrease whenever the MLRP shift moves positive mass toward higher values of s in $[\underline{s}, 0]$ and toward $[0, \overline{s}]$. □

Proof. of Proposition 3:

The firm's Stage 1 problem under regime $j \in \{\mathcal{V}, \mathcal{M}\}$ is $\max_{t \in T} \bar{\Pi}^j(t) - C(t)$. I assume the unique optimum is t^j.

($\Leftarrow$) If $t^{\mathcal{M}} > \hat{t}$, then $t^{\mathcal{V}} < t^{\mathcal{M}}$. Define $\Delta(t) \equiv \bar{\Pi}^{\mathcal{V}}(t) - \bar{\Pi}^{\mathcal{M}}(t)$. By Property 3 of Lemma 2, $\Delta(t)$ is non-increasing on $(\hat{t}, 1]$, with strict decrease over any sub-interval on which MLRP redistributes positive mass within $[\underline{s}, 0]$ and toward $[0, \bar{s}]$. The voluntary-regime objective decomposes as

$$\bar{\Pi}^{\mathcal{V}}(t) - C(t) = [\bar{\Pi}^{\mathcal{M}}(t) - C(t)] + \Delta(t).$$

The first bracket is maximized at $t^{\mathcal{M}}$. The second is strictly decreasing on a neighborhood to the left of $t^{\mathcal{M}}$ in $(\hat{t}, t^{\mathcal{M}}]$ by Property 3 and the strict monotonicity of $\Pi^{\mathcal{M}}$ on $[\underline{s}, 0)$. By the standard single-crossing argument, the sum is maximized at a strictly lower t than $t^{\mathcal{M}}$. Hence $t^{\mathcal{V}} < t^{\mathcal{M}}$.

($\Rightarrow$) If $t^{\mathcal{M}} \leq \hat{t}$, then $t^{\mathcal{V}} \geq t^{\mathcal{M}}$. On $[0, \hat{t}]$, Property 2 gives $\bar{\Pi}^{\mathcal{V}}(t) = \bar{\Pi}^{\mathcal{M}}(t)$, so the two objectives coincide and any optimum of the mandatory problem on $[0, \hat{t}]$ is also a candidate optimum of the voluntary problem. Two cases arise. If the voluntary optimum lies in $[0, \hat{t}]$, uniqueness gives $t^{\mathcal{V}} = t^{\mathcal{M}}$. If the voluntary optimum lies in $(\hat{t}, 1]$, then the upward jump in $\bar{\Pi}^{\mathcal{V}}$ at $\hat{t}$ has made some $t > \hat{t}$ strictly preferable to $t^{\mathcal{M}}$, so $t^{\mathcal{V}} > \hat{t} \geq t^{\mathcal{M}}$. In both cases, $t^{\mathcal{V}} \geq t^{\mathcal{M}}$.

Combining the two directions: $t^{\mathcal{M}} > t^{\mathcal{V}}$ if and only if $t^{\mathcal{M}} > \hat{t}$. □

Proof. of Proposition 4:

Part 1. By Lemma 2, $\bar{\Pi}^{\mathcal{V}}(t) \geq \bar{\Pi}^{\mathcal{M}}(t)$ for every $t \in T$, with strict inequality for $t > \hat{t}$. When a partial disclosure equilibrium emerges under voluntary disclosure, we have $t^{\mathcal{V}} > \hat{t}$, so $\bar{\Pi}^{\mathcal{V}}(t^{\mathcal{V}}) > \bar{\Pi}^{\mathcal{M}}(t^{\mathcal{V}})$. Combining this with the optimality of $t^{\mathcal{M}}$ under the mandatory regime,

$$\bar{\Pi}^{\mathcal{M}}(t^{\mathcal{M}}) - C(t^{\mathcal{M}}) \;\leq\; \bar{\Pi}^{\mathcal{M}}(t^{\mathcal{V}}) - C(t^{\mathcal{V}}) \;<\; \bar{\Pi}^{\mathcal{V}}(t^{\mathcal{V}}) - C(t^{\mathcal{V}}).$$

Mandatory disclosure therefore strictly reduces the firm's net expected profit in Stage 1.

Part 2, case $t^{\mathcal{M}} > t^{\mathcal{V}}$. Decompose the long-run change in consumer surplus as follows:

$$\overline{CS}^{\mathcal{M}}(t^{\mathcal{M}}) - \overline{CS}^{\mathcal{V}}(t^{\mathcal{V}}) \;=\; \underbrace{[\overline{CS}^{\mathcal{M}}(t^{\mathcal{M}}) - \overline{CS}^{\mathcal{V}}(t^{\mathcal{M}})]}_{\text{Term 1}} \;+\; \underbrace{[\overline{CS}^{\mathcal{V}}(t^{\mathcal{M}}) - \overline{CS}^{\mathcal{V}}(t^{\mathcal{V}})]}_{\text{Term 2}}.$$

Term 1 is strictly positive. By Proposition 2, $CS^{\mathcal{M}}(s) \geq CS^{\mathcal{V}}(s)$ for every s, with strict inequality on $[\underline{s}, 0)$. Since $f_{t^{\mathcal{M}}}$ has full support, $\overline{CS}^{\mathcal{M}}(t^{\mathcal{M}}) > \overline{CS}^{\mathcal{V}}(t^{\mathcal{M}})$.

Term 2 is also non-negative in this case. Under voluntary disclosure, the consumer surplus as a function of s is

$$CS^{\mathcal{V}}(s) = \begin{cases} s/2 & s \leq V, \\ (V+s)^2/(8s) & s \geq V. \end{cases}$$

which is increasing on the entire support S. By Assumption 1, MLRP implies first-order stochastic dominance: a higher technology induces a stochastically larger distribution of s. Therefore $\overline{CS}^{\mathcal{V}}(t)$ is non-decreasing in t, and since $t^{\mathcal{M}} > t^{\mathcal{V}}$, $\overline{CS}^{\mathcal{V}}(t^{\mathcal{M}}) \geq \overline{CS}^{\mathcal{V}}(t^{\mathcal{V}})$.

Combining the two terms, if $t^{\mathcal{M}} > t^{\mathcal{V}}$,

$$\overline{CS}^{\mathcal{M}}(t^{\mathcal{M}}) > \overline{CS}^{\mathcal{V}}(t^{\mathcal{V}}).$$

Part 2, case $t^{\mathcal{M}} < t^{\mathcal{V}}$. The effect of mandatory disclosure on expected consumer surplus is ambiguous in this case. In appendix C, section **??** reports two numerical examples that establish this ambiguity, both built on the same family of distributions but with different cost functions. In both, the voluntary regime delivers $t^{\mathcal{V}} = \hat{t}$: the firm's choice of technology under voluntary disclosure is pulled up to the threshold $\hat{t}$ by the upward jump in $\overline{\Pi}^{\mathcal{V}}$, which enables concealment. The two examples differ in how far $t^{\mathcal{M}}$ falls below $\hat{t}$. In the first example, the cost is such that $t^{\mathcal{M}}$ lies just below $\hat{t}$. The technology change is small, and the positive short-run effect of mandatory disclosure on consumer surplus dominates. In this case, expected consumer surplus is higher under mandatory disclosure. In the second example, the cost is such that $t^{\mathcal{M}}$ lies well below $\hat{t}$. The technology change is large, and the loss from a lower expected social quality dominates the short-run gain. In this case, expected consumer surplus is lower under mandatory disclosure.

□

B Generalization

The main results of the paper rest on the existence of a partial disclosure equilibrium, which in turn rests on a single property of optimal monopoly pricing: the presence of a full-coverage region in social quality over which the firm serves the entire market at a price equal to the consumption value V. On this region, the firm cannot extract additional surplus from higher realizations of social quality, so concealment becomes weakly preferable to disclosure whenever buyers' beliefs upon non-disclosure are sufficiently favorable. The uniform distribution of buyer types adopted in the baseline analysis is a tractability device that delivers this property in closed form. It is not the source of the result. The remainder of this section shows that the same qualitative conclusions obtain under a generic distribution $G(\cdot)$ of buyer types, provided G satisfies the regularity conditions stated below.

Claim 1. *Let G be a distribution on $[0, 1]$ with $G(0) = 0$. Assume the density $g(\cdot)$ is continuously differentiable , and let $V > 0$. If $V \cdot g(0) > 0$, then there exists $s^* > 0$ such that for every $s \in (0, s^*]$ the optimal monopoly price is*

$$p^*(s) = V.$$

Equivalently, the corner solution $p^*(s) = V$ for $s > 0$ exists for a non-degenerate interval $(0, s^*]$.

Proof. For $s > 0$, every price p that induces a non-trivial demand satisfies $p \in [V, V + s]$. Reparametrize by the marginal type

$$\hat{\theta} = \frac{p - V}{s} \in [0, 1],$$

so that demand equals $1 - G(\hat{\theta})$ and profit becomes

$$\pi(\hat{\theta}; s) = (V + s\hat{\theta})[1 - G(\hat{\theta})], \qquad \hat{\theta} \in [0, 1].$$

The candidate price $p = V$ corresponds to $\hat{\theta} = 0$ and yields $\pi(0; s) = V$. To prove the claim, it suffices to show there exists a threshold $s^* > 0$ such that

$$(V + s\hat{\theta})[1 - G(\hat{\theta})] \leq V \qquad \text{for all } \hat{\theta} \in [0, 1] \text{ and all } s \in (0, s^*]. \tag{$*$}$$

Expanding the left-hand side, inequality $(*)$ is equivalent to

$$s\,\hat{\theta}\,[1-G(\hat{\theta})] \leq V\,G(\hat{\theta}) \qquad \text{for all } \hat{\theta}\in(0,1]. \tag{$**$}$$

The key step is to show that $G(\cdot)$ admits a linear lower bound on $[0,1]$: there exists a constant $c>0$ such that

$$G(\hat{\theta}) \geq c\,\hat{\theta} \qquad \text{for all } \hat{\theta}\in[0,1]. \tag{†}$$

Define the function:

$$h(\hat{\theta}) \equiv \begin{cases} \frac{G(\hat{\theta})}{\hat{\theta}} & ,\hat{\theta}\in(0,1] \\ g(0) & ,\hat{\theta}=0 \end{cases}$$

Note that $h(\hat{\theta})$ is positive, continuous, and bounded in $[0,1]$ since $G(0)=0$, and:

$$\lim_{\hat{\theta}\to 0^+} \frac{G(\hat{\theta})}{\hat{\theta}} = g(0) > 0$$

Hence, by the extreme value theorem, $h(\cdot)$ attains a strictly positive minimum

$$c \;\equiv\; \min_{\hat{\theta}\in[0,1]} h(\hat{\theta}) > 0,$$

and (†) follows from the definition of $h(\cdot)$. Now set $s^* \equiv V\,c > 0$. For any $s\in[0,s^*]$ and any $\hat{\theta}\in[0,1]$, using $1-G(\hat{\theta})\leq 1$ and (†),

$$s\,\hat{\theta}\,[1-G(\hat{\theta})] \;\leq\; s\,\hat{\theta} \;\leq\; V\,c\,\hat{\theta} \;\leq\; V\,G(\hat{\theta}),$$

which implies $(**)$. Therefore $\pi(\hat{\theta};s)\leq V = \pi(0;s)$ for every $\hat{\theta}\in[0,1]$, so $\hat{\theta}=0$ (equivalently $p=V$) is a global maximizer of $\pi(\hat{\theta};s)$ and $p^*(s)=V$ for all $s\in[0,s^*]$. □

C Numerical Examples

All numerical examples use the same support, parameter values, and family of distributions, which I report here once. Each example differs only in the cost function $C(t)$.

Common environment. The social quality takes values in $\mathcal{S} = [-3, 3]$, the consumption value is $V = 1$, and the family of distributions $\{f_t\}_{t\in[0,1]}$ is a one-parameter exponential family:

$$f_t(s) = \frac{e^{\theta(t)\,s}}{Z(\theta(t))}, \qquad s \in [-3, 3],$$

where

$$\theta(t) = \kappa\,(t - t_0), \qquad Z(\theta) = \int_{-3}^{3} e^{\theta s}\,ds = \frac{e^{3\theta} - e^{-3\theta}}{\theta} \quad (\theta \neq 0),$$

with calibrated parameters $\kappa = 1.5$ and $t_0 = -0.1$. This family satisfies strict MLRP: for $t' > t$, the likelihood ratio $f_{t'}(s)/f_t(s)$ is strictly increasing in s. Under these parameters, $\mathbb{E}_{t=0}[s \mid s \leq V] = -0.801 < 0$ and $\mathbb{E}_{t=1}[s \mid s \leq V] = 0.399 > 0$, so Assumption **??** is satisfied. The threshold technology, defined by $\mathbb{E}_{\hat{t}}[s \mid s \leq V] = 0$, is $\hat{t} \approx 0.4989$. The expected payoff functions $\bar{\Pi}^{\mathcal{M}}(t) = \mathbb{E}_t[\Pi^{\mathcal{M}}(s)]$ and $\bar{\Pi}^{\mathcal{V}}(t) = \mathbb{E}_t[\Pi^{\mathcal{V}}(s)]$ are defined as in the main text, and $\bar{\Pi}^{\mathcal{V}}(t)$ exhibits an upward jump of approximately 0.035 at $\hat{t}$.

For each case, I solve

$$t^{\mathcal{M}} = \arg\max_{t\in[0,1]} \left\{\bar{\Pi}^{\mathcal{M}}(t) - C(t)\right\}, \qquad t^{\mathcal{V}} = \arg\max_{t\in[0,1]} \left\{\bar{\Pi}^{\mathcal{V}}(t) - C(t)\right\},$$

and report the equilibrium technology, net firm profit, expected consumer surplus, and expected net welfare under each regime.

Numerical Case 1. Cost function $C(t) = 1.5\,t^4$. The interior optimum under mandatory disclosure lies above the threshold, $t^{\mathcal{M}} \approx 0.410 < \hat{t}$, while under voluntary disclosure the upward jump at $\hat{t}$ pulls the firm up to $t^{\mathcal{V}} \approx \hat{t}$. Here $t^{\mathcal{M}} < t^{\mathcal{V}}$.

Numerical Case 2. Cost function $C(t) = 1.5\,t^{10}$. Both optima lie above the threshold, and $t^{\mathcal{M}} \approx 0.627 > t^{\mathcal{V}} \approx 0.594$.

Numerical Case 3. Cost function $C(t) = 0.27\,t + 0.05\,t^2$. The mandatory optimum lies just below the threshold, $t^{\mathcal{M}} \approx 0.499$, while $t^{\mathcal{V}} \approx \hat{t}$. The gap is small.

Numerical Case 4. Cost function $C(t) = 0.53\,t + 0.05\,t^2$. The mandatory optimum is well below the threshold, $t^{\mathcal{M}} \approx 0.304$, while $t^{\mathcal{V}} \approx \hat{t}$. The gap is large.

Numerical Case 5. Piecewise cost function with very low marginal cost on $[0, t_\star]$ and sharply rising marginal cost on $[t_\star, 1]$:

$$C(t) = \begin{cases} 0.05\,t & \text{if } t \in [0, t_\star], \\ 0.15\,t + 50\,(t - 0.80)^2 - K & \text{if } t \in [t_\star, 1], \end{cases} \qquad t_\star = 0.799, \quad K = 0.07995.$$

The kink point $t_\star$ is chosen so that the quadratic piece has slope 0.05 at $t_\star$, matching the slope of the linear piece; K is chosen so that C is continuous at $t_\star$. The function is continuous, strictly increasing, and convex on $[0, 1]$. Both optima lie just below 0.8, and $t^{\mathcal{M}} > t^{\mathcal{V}}$ by a small margin.

		Mandatory ($\mathcal{M}$)		Voluntary ($\mathcal{V}$)		
Case	$C(t)$	$t^{\mathcal{M}}$	Profit	$t^{\mathcal{V}}$	Profit	
1	$1.5\,t^4$	0.410	1.048	0.499	1.065	
2	$1.5\,t^{10}$	0.627	1.143	0.594	1.164	
3	$0.27\,t + 0.05\,t^2$	0.499	0.976	0.499	1.011	
4	$0.53\,t + 0.05\,t^2$	0.304	0.873	0.499	0.881	
5	piecewise (see above)	0.800	1.149	0.800	1.157	
		$CS^{\mathcal{M}}$	$W^{\mathcal{M}}$	$CS^{\mathcal{V}}$	$W^{\mathcal{V}}$	$W^{\mathcal{M}} - W^{\mathcal{V}}$
1	$1.5\,t^4$	0.511	1.559	0.498	1.563	-0.004
2	$1.5\,t^{10}$	0.559	1.702	0.531	1.694	$+0.008$
3	$0.27\,t + 0.05\,t^2$	0.534	1.510	0.498	1.509	$+0.001$
4	$0.53\,t + 0.05\,t^2$	0.477	1.350	0.498	1.379	-0.029
5	piecewise (see above)	0.582	1.731	0.574	1.731	-0.0002

Table 1: **Equilibrium outcomes across the five numerical cases.** All values are computed for the exponential family on $\mathcal{S} = [-3, 3]$ with $V = 1$, $\kappa = 1.5$, $t_0 = -0.10$, and threshold $\hat{t} \approx 0.499$. Profit and welfare are reported net of the technology cost $C(t^j)$.

C.1 Direction of the Technology Effect: Cases 1 and 2

Cases 1 and 2 illustrate the two directions in which mandatory disclosure can shift the equilibrium technology. They share the family of distributions and differ only in how sharply the cost function rises.

In Case 1, the cost rises slowly enough that the mandatory optimum $t^{\mathcal{M}} \approx 0.410$ falls below the threshold $\hat{t} \approx 0.499$. Under voluntary disclosure, the firm could remain at this interior optimum, but doing so leaves the upward jump in $\bar{\Pi}^{\mathcal{V}}$ at $\hat{t}$ unexploited. Adopting the threshold technology induces a posterior belief that sustains a partial disclosure equilibrium and allows the firm to conceal low realizations of social quality in Stage 2. The firm therefore moves up to $t^{\mathcal{V}} \approx \hat{t}$. Concealment substitutes for genuine investment, and the voluntary regime delivers a higher equilibrium technology than the mandatory regime.

In Case 2, the cost rises sharply and the mandatory optimum $t^{\mathcal{M}} \approx 0.627$ already lies above the threshold. The voluntary-regime firm then operates in the region where the slope of $\bar{\Pi}^{\mathcal{V}}$ falls strictly below the slope of $\bar{\Pi}^{\mathcal{M}}$: on the concealment region, voluntary-regime profit is flat at V, so MLRP-induced redistribution of probability mass within this region leaves $\bar{\Pi}^{\mathcal{V}}$ unchanged. The marginal return to a better technology is therefore smaller under voluntary disclosure, and the firm optimally invests less, $t^{\mathcal{V}} \approx 0.594 < t^{\mathcal{M}}$. Mandatory disclosure raises the equilibrium technology by removing the slope-dampening effect of concealment.

The contrast between the two cases is consistent with Proposition **??**: mandatory disclosure induces a strictly higher technology than voluntary disclosure if and only if $t^{\mathcal{M}} > \hat{t}$.

C.2 Ambiguity of the Consumer-Surplus Effect when $t^{\mathcal{M}} < t^{\mathcal{V}}$: Cases 3 and 4

When mandatory disclosure raises the equilibrium technology, expected consumer surplus rises unambiguously. When mandatory disclosure lowers the equilibrium technology, the short-run gain from disclosure can be offset by the long-run loss from a lower expected social quality, and the net effect on consumer surplus is ambiguous. Cases 3 and 4 establish this ambiguity. Both deliver $t^{\mathcal{V}} \approx \hat{t}$, pulled up by the upward jump in $\bar{\Pi}^{\mathcal{V}}$, and differ only in the linear coefficient of the cost function, which controls how far $t^{\mathcal{M}}$ falls below $\hat{t}$.

In Case 3, $t^{\mathcal{M}} \approx 0.499$ lies just below $\hat{t}$. The technology gap $t^{\mathcal{V}} - t^{\mathcal{M}}$ is small, so the technology effect on consumer surplus is negligible. The short-run regime effect dominates, and mandatory disclosure raises expected consumer surplus, $CS^{\mathcal{M}} \approx 0.534 > 0.498 \approx CS^{\mathcal{V}}$.

In Case 4, $t^{\mathcal{M}} \approx 0.304$ lies well below $\hat{t}$. The technology gap is large, and the resulting loss in expected social quality dominates the short-run gain from disclosure. Expected consumer surplus falls under mandatory disclosure, $CS^{\mathcal{M}} \approx 0.477 < 0.498 \approx CS^{\mathcal{V}}$.

C.3 Ambiguity of the Welfare Effect

The long-run welfare effect of mandatory disclosure admits all four sign combinations of $(t^{\mathcal{M}} - t^{\mathcal{V}}, W^{\mathcal{M}} - W^{\mathcal{V}})$. The five cases reported in Table 1 cover all of them. The decomposition

$$W^{\mathcal{M}} - W^{\mathcal{V}} = \underbrace{\left[\bar{W}^{\mathcal{M}}(t^{\mathcal{V}}) - \bar{W}^{\mathcal{V}}(t^{\mathcal{V}})\right]}_{\text{regime effect}} + \underbrace{\left[\bar{W}^{\mathcal{M}}(t^{\mathcal{M}}) - \bar{W}^{\mathcal{M}}(t^{\mathcal{V}})\right]}_{\text{technology effect}}$$

isolates the two channels through which the regime change affects welfare: the regime effect captures the short-run change at fixed technology, and the technology effect captures the change induced by the shift from $t^{\mathcal{V}}$ to $t^{\mathcal{M}}$.

Case 2 delivers $t^{\mathcal{M}} > t^{\mathcal{V}}$ with $W^{\mathcal{M}} > W^{\mathcal{V}}$. The technology effect is positive and dominates a near-zero regime effect: mandatory disclosure raises welfare by inducing a higher equilibrium technology. Case 3 delivers $t^{\mathcal{M}} < t^{\mathcal{V}}$ with $W^{\mathcal{M}} > W^{\mathcal{V}}$. The two technologies nearly coincide, so the technology effect is negligible, and the positive short-run regime effect determines the sign of the welfare change. Cases 1 and 4 deliver $t^{\mathcal{M}} < t^{\mathcal{V}}$ with $W^{\mathcal{M}} < W^{\mathcal{V}}$. The technology gap is large enough that the negative technology effect dominates the positive regime effect, and mandatory disclosure reduces welfare.

Case 5 completes the classification. The piecewise cost function pins both $t^{\mathcal{M}}$ and $t^{\mathcal{V}}$ to a small neighborhood of 0.80, so the technology gap $t^{\mathcal{M}} - t^{\mathcal{V}}$ is small. At $t^{\mathcal{V}} \approx 0.80$, the distribution $f_{t^{\mathcal{V}}}$ places little mass on the very negative realizations that would make the informational gain of disclosure outweigh its allocative cost. The sufficient condition of Proposition **??** fails, and the regime effect at $t^{\mathcal{V}}$ is negative. With the curvature of $C(t)$ chosen high enough that the small positive technology effect cannot offset the negative regime effect, mandatory disclosure raises the equilibrium technology but reduces welfare: $t^{\mathcal{M}} > t^{\mathcal{V}}$ with $W^{\mathcal{M}} < W^{\mathcal{V}}$.

The five cases therefore establish that the direction of the technology change alone is not sufficient to sign the welfare effect of mandatory disclosure: each sign of $t^{\mathcal{M}} - t^{\mathcal{V}}$ is compatible with either sign of $W^{\mathcal{M}} - W^{\mathcal{V}}$, and the welfare comparison depends on the joint magnitudes of the regime and technology effects.