Mergers when price and quality are set by bargaining*

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March 15, 2026

Abstract

We study the effects of horizontal mergers on product quality in a bilateral bargaining environment. In our model, a competition-reducing merger reduces equilibrium quality as long as the buyer's marginal rate of substitution of quality for price declines with price, holding quality constant. This condition is closely related to quality being a normal good. This result holds when price and quality are jointly negotiated, and it extends to a sequential setting in which sellers first choose quality and then bargain with buyers over price. We discuss applications to procurement and healthcare markets, as well as several extensions.

JEL Classification Codes: L15, L13, L40.
Keywords: Mergers, Bargaining, Quality.

*We thank Keith Brand, Patrick DeGraba, Nathan Miller, Ted Rosenbaum, and seminar participants at the FTC, DOJ, University of Illinois, and University of Michigan for helpful comments and discussion. The opinions expressed here are those of the authors and not necessarily those of Econ One Research, Econic Partners, or any clients of either firm. While this work is original, we used AI tools to refine our writing and to check our proofs.

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1 Introduction

A broad literature establishes that horizontal mergers can increase prices, as merging firms internalize the effect of price increases on each other's profits.[1] While price effects are the most common basis for U.S. merger challenges, U.S. agencies also commonly allege that mergers will reduce quality.[2] In contrast, merging parties commonly argue that mergers will increase quality.[3] Concerns about quality often arise in mergers involving bargaining between buyers and sellers, notably including procurement negotiations, with a leading example being negotiations between health insurers and employers over the price and network quality of employer health plans. In these settings, which are the focus of our paper, buyers and sellers bargain over both price (e.g., premium, cost sharing) and quality (e.g., network quality and breadth), with a direct tradeoff between price and quality.

Despite the importance of quality effects, they remain understudied, particularly in bargaining settings, even though bargaining models are widely used in both academic research[4] and antitrust litigation.[5] Although bargaining models and classic price–quality models are well developed, little work connects merger-induced changes in bargaining leverage to endogenous quality.

One might expect that a competition-reducing merger would unambiguously lead to higher prices and lower quality, but existing work shows the effect of mergers on quality to be theoretically ambiguous. Specifically, in unilateral price-quality choice models, such as those based on the Dorfman–Steiner condition (as presented in Gaynor, Ho, and Town 2015), equilibrium price and quality depend on demand elasticities with respect to both price and quality, and mergers can either increase or decrease quality. These models assume firms choose price and quality unilaterally, but the same ambiguity exists when price and quality are jointly determined through bilateral bargaining between buyers and sellers, where mergers operate through disagreement payoffs rather than elasticities. This matters because many mergers involve bargaining settings.

[1] See Werden and Froeb (2008), for a survey of such results.

[2] See the FTC's January 2024 complaint challenging the acquisition of Community Health by Novant, alleging that the combination of two competing hospital systems would reduce quality because "the two hospitals vigorously compete to attract patients by improving their quality, service offerings, and facilities" with the result that "the proposed transaction would immediately eliminate this competition, likely reducing healthcare investment and improvements to quality of care."

[3] For instance, in responding to the FTC's (ultimately successful) challenge of the proposed Illumina/Grail merger, the parties argued that the merger would increase the effectiveness of Grail's R&D, accelerating the commercialization of Grail's product. See the summary of the parties' arguments in Section VII.E.3 of the Commission's decision.

[4] See Capps, Dranove, and Sattherthwaite (2003); and Balan and Brand (2023).

[5] See the February 21, 2017 Memorandum Opinion of the U.S. District Court for the District of Columbia blocking the merger of Anthem and Cigna, discussing at length the bargaining model put forth by the U.S. Department of Justice in its case against that merger.

Our contribution is to resolve this ambiguity for a specific but realistic bargaining setting,[6] deriving a simple condition under which a competition-reducing merger reduces equilibrium quality. Specifically, a competition-reducing merger reduces equilibrium quality as long as the buyer's marginal rate of substitution of quality for price declines with price, holding quality constant. This condition is closely related to quality being a normal good, so the result can be described as showing that mergers decrease equilibrium quality as long as the good's quality (not the good itself) is normal.

The intuition behind our main result is depicted in Figure 1. Begin with the pre-merger Nash bargaining equilibrium, represented as the tangency between the orange isoprofit line and the green indifference curve and corresponding to $x*^{pre}$ and $p*^{pre}$. The tangency indicates that the buyer and its most-preferred seller have equal willingness to trade off price for quality. Now suppose that the buyer's first-and second-choice sellers merge, but that quality (but not price) is constrained to be at the pre-merger level. Such a merger worsens the buyer's disagreement payoff, and with quality constrained it can only increase price, so the constrained post-merger equilibrium lies due north of the pre-merger equilibrium in quality-price space.

Next we lift the constraint and ask how the unconstrained post-merger equilibrium compares to the constrained one. For the seller, the marginal cost of quality depends only on the level of quality, and not on price, which means that the seller's tradeoff between quality and price at the constrained post-merger equilibrium is unchanged from the pre-merger equilibrium. For the buyer, if the MRS decreases as price increases (which roughly corresponds to quality being a normal good), then the two tradeoffs are no longer equal to each other (the orange isoprofit line and the green indifference curve are not tangent to each other), and so the constrained equilibrium cannot be a Nash bargaining equilibrium. Since the buyer has become less willing to trade price for quality, there are Pareto improving alternatives to the constrained equilibrium that lie to the southwest, meaning lower quality than at the pre-merger equilibrium.

We obtain versions of this result in two settings. First (section 3), price and quality are jointly bargained. Second (section 4), sellers first choose quality and then bargain with buyers over price. In both settings, a merger reduces the buyer's disagreement payoff by removing a bargaining alternative. And as discussed in section 4, both the result and the intuition are essentially the same in both settings.

We present a broad literature review in section 2. Here we briefly discuss one particularly important prior result, namely the well-known Dorfman–Steiner (D-S) condition as presented in Gaynor, Ho, and Town (2015). In that framework, a firm's choice of price and quality satisfies:

[6] Specifically, in our model, a buyer either purchases one unit of a good from one of several sellers, or does not purchase the good at all. When bargaining with a seller, the buyer's disagreement payoff equals the payoff from contracting with the next-best seller. A merger reduces the buyer's leverage by worsening its disagreement payoff.

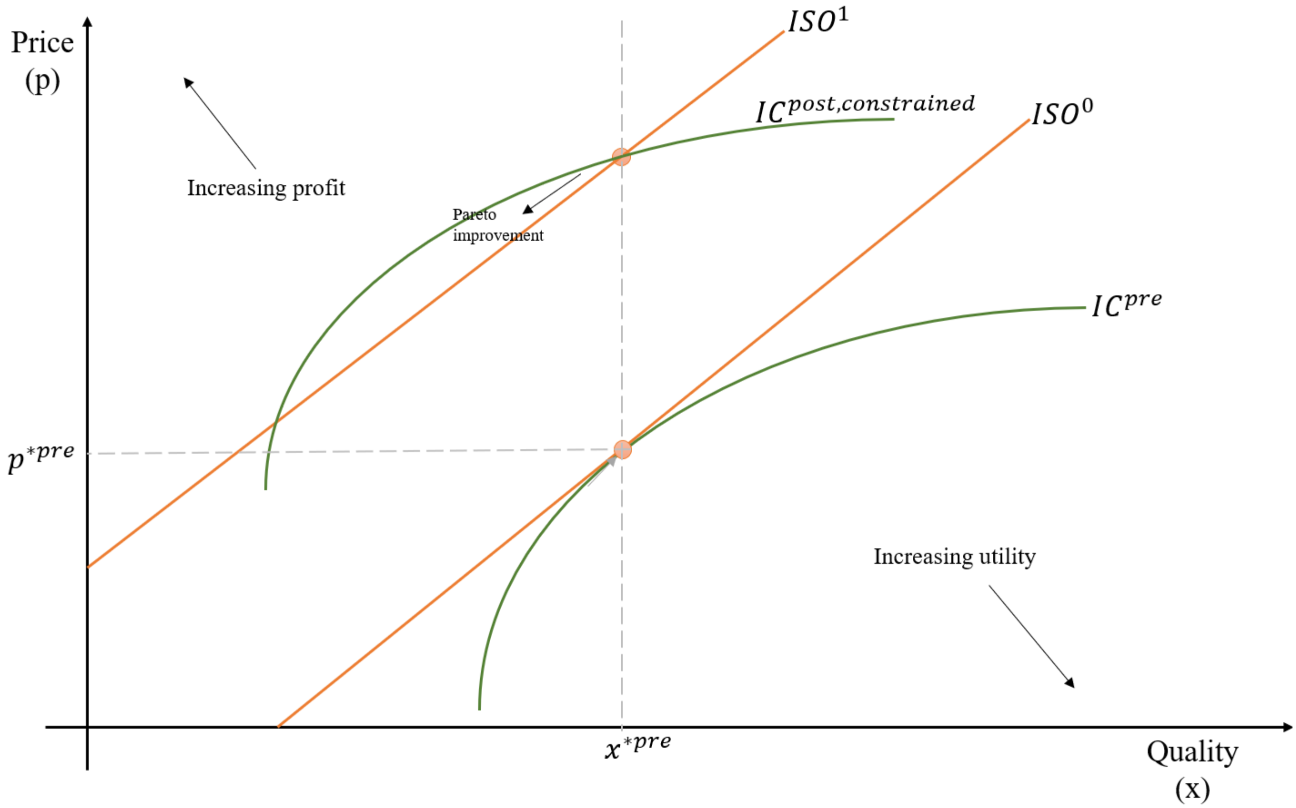

Figure 1: Intuition behind our main result

$$z = \frac{p}{d} \cdot \frac{\epsilon_z}{\epsilon_p} \tag{1}$$

where z represents quality, p represents price, ϵ_z and ϵ_p represent the demand elasticities with respect to quality and price, and d represents the marginal cost of producing quality.

The D-S condition represents the relationship between the equilibrium values of two choice variables (price and quality) and the equilibrium elasticity of demand with respect to each of them. The central insight underlying the D-S condition is that when both price and quality are endogenous, the relationship between equilibrium price and quality depends on the relative demand elasticities, which in turn depend on how both buyers and sellers trade off price against quality. For example, if (at the margin) buyers' sensitivity to quality is high relative to their sensitivity to price, then equilibrium quality will tend to be high relative to equilibrium price, and vice-versa.

The D-S condition as expressed above is not about mergers. However, it can be readily adapted to demonstrate the theoretical ambiguity of the effect of a competition-reducing merger on equilibrium quality. Consider a merging firm with pre-merger (indexed by 0) and post-merger (indexed by 1) prices and qualities that satisfy the D-S condition. Slight algebraic manipulation shows that the condition for post-merger quality to be equal to pre-merger quality (i.e., $z_1 = z_0$) is:

$$\frac{p_1}{p_0} = \frac{\epsilon_{p_1}}{\epsilon_{p_0}} \cdot \frac{\epsilon_{z_0}}{\epsilon_{z_1}} \tag{2}$$

This expression shows the merger has a zero effect on equilibrium quality when the price ratio (which must be greater than one because a competition-reducing merger with zero quality effects increases price) is equal to the product of ratios of the equilibrium values of the two demand elasticities. Breaking this equality in one direction would mean that equilibrium quality increases as a result of the merger, and vice-versa. There is no basis for ruling out either possibility, which means that the D-S condition does not generate a clear prediction for the direction of merger quality effects.

Thus, while the D-S condition demonstrates a theoretical ambiguity, it does not provide any clear basis for *resolving* it, as there is no straightforward way to determine how a merger will change those equilibrium elasticities. Our paper is about resolving that ambiguity for our specific bargaining setting, demonstrating a sharp result regarding the condition for a merger to reduce equilibrium quality.[7]

The remainder of this paper is organized as follows. Section 2 provides a review of the literature. Section 3 analyzes simultaneous bargaining over price and quality. Section 4 studies a sequential model where sellers choose quality and then bargain with buyers over price. Section 5 discusses extensions. Section 6 concludes.

2 Literature review

Our paper draws upon several literatures on the determinants of quality, and extends those literatures to a setting where price and quality are jointly determined via bargaining. To our knowledge, theoretical results on merger quality effects in bargaining settings are lacking. As discussed above, the Dorfman-Steiner condition contains the insight that equilibrium price and quality are interdependent, and are jointly determined by how buyers and sellers trade off price and quality. In the same vein as Dorfman-Steiner, other price-quality models such as Spence (1975), Mussa and Rosen (1978), and Dranove and Satterthwaite (2000) study how market power distorts quality when firms set price and quality unilaterally. Like Dorfman-Steiner, these papers do not consider settings in which price and quality are set via bargaining, as is typically the case in procurement settings. In contrast, in our model both are determined through bilateral bargaining, and mergers operate by shifting disagreement payoffs rather than elasticities. When the seller's bargaining weight approaches one, the outcome converges to unilateral seller choice, recovering the Dorfman–Steiner logic.

[7]In D-S the seller chooses price and quality. In our model price and quality are determined through bargaining. As a result, mergers in our model affect quality through changes in bargaining leverage rather than through demand elasticities, linking mergers to changes in outside options.

Several papers examine how demand characteristics affect quality outside of merger settings. The most similar papers to ours come from outside a merger setting, but share an intuition related to our main result. For instance, both Gravelle (1999) and Brekke et al. (2010) show that quality is invariant to competition when the income elasticity of quality is zero. These papers highlight how demand characteristics shape equilibrium quality, but do not analyze merger effects.

Several papers study merger quality effects in posted-price environments and find ambiguous results. Brekke et al. (2017) provide a parametric example in which non-merging firms respond to quality reductions by increasing quality, potentially raising average quality. Pinto and Sibley (2016) show through numerical simulations that mergers may either raise or lower quality depending on demand curvature. Johnson and Rhodes (2021) analyze multiproduct Cournot competition and identify product-mix effects that can generate quality increases following mergers. In contrast, we analyze merger quality effects when price is determined through bilateral bargaining, a setting commonly used in applied merger analysis. These models generate ambiguous quality effects because mergers alter firms' price incentives. In contrast, in our model mergers operate by weakening the buyer's bargaining position.

An empirical literature on healthcare competition and quality, summarized in Gaynor et al. (2015) and Gaynor (2021) finds that horizontal hospital mergers generally, but not always, reduce clinical quality.[8] Recent papers representative of this literature are Beaulieu et al. (2020) and Brand et al. (2023). The former studies 246 hospital mergers and finds no significant changes to mortality or readmissions. Brand et al. (2023) estimate average price effects of approximately 5% in a sample of 558 hospital mergers from 2009 to 2016.[9]

Finally, a large bargaining literature shows how outside options shape negotiated prices, generally treating quality as fixed, beginning with Horn and Wolinsky (1988) and extending to healthcare bargaining models such as O'Brien and Shaffer (2005), Crawford and Yurukoglu (2012), Gowrisankaran, Nevo, and Town (2015), and Ho and Lee (2017), where mergers alter bargaining leverage and prices. Our paper extends the logic of these models to allow for both quality and price to be set via bargaining.

Taken together, existing work shows that bargaining leverage affects negotiated prices, while unilateral-choice models show how market power affects quality. What has been missing is an analysis of how mergers affect quality when price and quality are jointly determined through bargaining. By endogenizing quality in a bargaining setting and identifying a simple condition under which reduced

[8]See Capps, Dranove, and Sattherthwaite (2003); and Balan and Brand (2023).

[9]Our paper studies the effect of mergers on quality exclusive of merger efficiencies and/or disefficiencies (specifically quality efficiencies, which affect the cost of producing quality, as distinct from cost efficiencies, which affect the cost of producing the good). In contrast, these empirical studies measure the *total* change of quality, inclusive of any merger efficiencies. See Romano & Balan (2011) for a conceptual framework for evaluating quality efficiencies.

buyer leverage lowers quality, our paper connects these literatures. Our contribution is to connect the bargaining literature on outside options with the price-quality literature on endogenous quality, and to show that once quality is endogenized in bargaining, mergers have a sharp quality prediction under a transparent condition on buyer preferences.

3 Bargaining over price and quality simultaneously

We first consider a model in which both the quality and the price of a good are set via a single Nash bargaining game between a buyer and a seller. Bargaining outcomes depend on the "disagreement payoffs" that would be realized by each party were bargaining to break down. Section 3.1 characterizes the Nash bargaining equilibrium over price and quality. Section 3.2 demonstrates that quality and price are inversely related along the locus of Pareto efficient points. Section 3.3 introduces multiple sellers and shows how mergers worsen buyers' disagreement payoffs, shifting outcomes toward higher prices and lower quality. Section 3.4 examines the quality effects of mergers when prices are held fixed, and Section 3.5 presents parametric examples.

3.1 Model setup: Nash bargaining and pre-merger equilibrium

A buyer and a seller have an opportunity to transact, or they may decline to do so. If they do transact, the buyer pays the seller a price p in exchange for one unit of a good of quality x. Quality is valued by the buyer, but is costly for the seller to produce. The buyer's indirect utility function over quality x and price p is $V(x, p)$, assumed continuous, strictly increasing in x, strictly decreasing in p, and strictly quasiconcave. The seller's profit is $\pi(x, p) = p - c(x)$, where $c(x)$ is differentiable with $c'(x) > 0$ and $c''(x) \geq 0$. If bargaining fails, the buyer and seller receive disagreement payoffs of ω_B and ω_S, respectively. Assume an interior Nash bargaining solution with $x > 0$ and $p > 0$. We model two versions of this game. In this section, we assume that price and quality are simultaneously bargained over. In section 4, we assume that the seller first unilaterally chooses quality, and then bargains with the buyer over price alone.

Figure 2 depicts the quality-price space. The buyer's utility increases to the southeast (higher quality and lower price). The seller's profit increases to the northwest (lower quality and higher price). Figure 2 depicts an isoprofit curve and an indifference curve representing the seller's and buyer's disagreement payoffs, respectively.[10] Define $ISO_a = \{(x, p) : p - c(x) = a\}$ to be the set of points yielding a profit of a for the seller, and $IC_b = \{(x, p) : V(p, I; x) = b\}$ to be the set of points

[10]In figure 2, the isoprofit curve is depicted as linear, corresponding to $c''(x) = 0$. Were $c''(x) > 0$, the seller's isoprofit curves would instead be convex, resulting in no change to the model's logic.

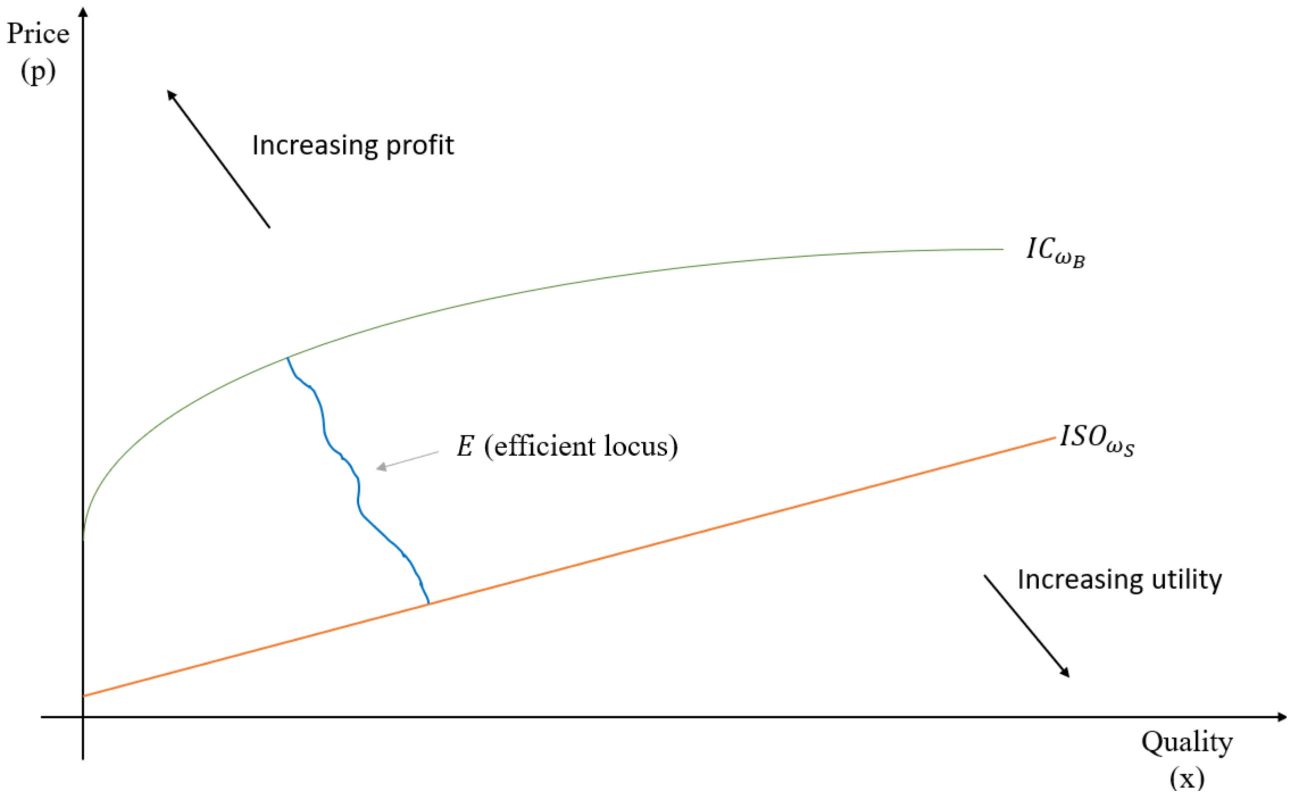

Figure 2: Representative isoprofit and indifference curves, given disagreement payoffs ω_B and ω_S, and Pareto efficient locus E.

yielding utility b for the buyer. Using this notation, the isoprofit and indifference curves depicted in figure 2 are ISO_{ω_S} and IC_{ω_B}.

Suppose the seller has bargaining weight λ and the buyer $1-\lambda$. When price and quality are jointly determined in a single bargaining game, the Nash bargaining price and quality solve the following maximization problem:

$$\max_{p,x} (p - c(x) - \omega_S)^\lambda (V(x,p) - \omega_B)^{1-\lambda} \tag{3}$$

The first-order conditions for an interior solution to equation (3) are:

$$p: \ \lambda(V(x,p) - \omega_B) = -\frac{\partial V}{\partial p}(1-\lambda)(p - c(x) - \omega_S) \tag{4}$$

$$x: \ \lambda c'(x)(V(x,p) - \omega_B) = \frac{\partial V}{\partial x}(1-\lambda)(p - c(x) - \omega_S) \tag{5}$$

Dividing equation (5) by equation (4) yields an expression equating the buyer's marginal rate of substitution between price and quality ($MRS(x,p)$, defined by $MRS(x,p) = -\frac{V_x}{V_p}$) to the seller's marginal cost of providing additional quality, $c'(x)$ (i.e., that any solution must be at a tangency between an indifference curve and an isoprofit curve).

$$c'(x) = MRS(x,p) \tag{6}$$

3.2 Model setup: Nash bargaining outcomes lie on the locus of Pareto efficient points

It follows from equation (6) (and generally from Nash bargaining axioms) that any bargaining outcome is Pareto efficient. The bargaining outcome must also be individually rational, meaning that both parties prefer it to their disagreement payoff. Define this locus of points as E:

$$E = \{(x,p) : c'(x) = MRS(x,p), \pi(x,p) \geq \omega_S, V(p,I;x) \geq \omega_B\} \tag{7}$$

A representative locus E is depicted in figure 2. The precise shape of E depends on the buyer's preferences, the sellers' costs, and the disagreement payoffs. Lemma 1 establishes that if the buyer's marginal rate of substitution $MRS(x,p)$ is decreasing in p, then the locus E is downward sloping.

Lemma 1. *When the buyer's marginal rate of substitution of quality for price $MRS(x,p)$ is decreasing in p, the locus E is downward sloping in the (x,p) space.*

Proof. Define $F(x,p) = MRS(x,p) - c'(x)$; on the set E, we have $F(x,p) = 0$. Then, by the implicit function theorem:

$$\frac{dx}{dp} = -\frac{F_p}{F_x} = -\frac{MRS_p}{MRS_x - c''(x)}$$

Since $MRS_p < 0$ by assumption, the numerator is negative. Since $MRS_x < 0$ by quasiconcavity of V and $c''(x) \geq 0$, the denominator is negative, implying $\frac{dx}{dp} < 0$. ■

The location of the Nash bargaining outcome within the set E depends on model parameters, including especially the bargaining weight λ. Values of λ closer to 1 will confer greater bargaining power upon the seller, and thus push the equilibrium closer to the buyer's disagreement payoff. Similarly, values of λ closer to 0 will confer greater bargaining power upon the buyer, and push the equilibrium closer to the seller's disagreement payoff. Along the efficient locus the buyer's and seller's tradeoffs between price and quality coincide. If the buyer's willingness to trade price for quality falls as price rises, then efficiency requires lower quality at higher prices.

The intuition behind lemma 1 is that any point on the Pareto efficient locus is at a tangency between an indifference curve and an isoprofit curve, meaning that both parties have the same tradeoff between quality and price. It follows that at any point due north of the Pareto efficient locus, the seller's tradeoff between price and quality is the same as at the corresponding point on the Pareto efficient locus. However, by assumption, the buyer's tradeoff changes as price increases, because the higher price lowers their income available for other goods, making them less willing to trade price for quality. Since the buyer and seller have different willingnesses to trade off price for quality at points to the north of the Pareto efficient locus, it follows that any point immediately to the southwest is a Pareto improvement. Notably, an increase in price (but not quality) resembles a decrease in income, as the buyer has less income available to purchase all other goods. Thus, the condition that the marginal rate of substitution $-\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}$ is decreasing in p resembles a condition that the buyer views quality as a normal good.[11]

3.3 With multiple sellers, mergers reduce competition by lowering buyers' disagreement payoffs

To study the impact of mergers on price and quality, we now assume that the buyer can choose from among N sellers. We continue to assume that the buyer needs no more than one unit of the good, so the buyer will transact with at most a single seller. If bargaining breaks down with any one seller, the buyer may approach a different seller. A buyer who fails to reach agreement with any seller does not purchase the good at all, and receives his/her outside option, as does a seller that does not transact with a buyer. For simplicity, we normalize both outside options to 0.

Suppose further that the buyer does not value all sellers equally; the buyer's utility from transacting with seller i is $V(x,p)+\epsilon_i$, where ϵ_i represents the buyer's subjective preference over each seller.[12] Let the buyer order sellers from most preferred to least preferred based on values of ϵ_i, such that $\epsilon_1 > \epsilon_2 > ... > \epsilon_N$; refer to this ordering as ϕ. The buyer and seller 1 then bargain, with the knowledge that if bargaining breaks down the buyer will approach seller 2, then seller 3, and so on, until every possible seller has been exhausted, in which case the buyer receives its outside option of 0 (meaning that the buyer's disagreement payoff when bargaining with seller N is 0).[13] Specifically, let

[11] The discrete nature of the good (the buyer purchases either zero or one units, at fixed quality) and the fact that quality is not sold at a market price complicate this analogy. Nonetheless, a higher price means the buyer has less income available for all goods. Formally, $\frac{\partial MRS}{\partial p} < 0$ means that quality is Hicks-normal.

[12] It is convenient to think of values of ϵ_i as being draws from an i.i.d. distribution. This way, if there are many buyers, each with independent draws, the population of buyers will have a range of preferences over sellers, and all sellers find some buyers to transact with. For simplicity, the main body abstracts away from multiple buyers with different preferences by considering a single buyer. This simplifying assumption does not affect how the model is solved, but does leave open the question of why there are multiple sellers catering to a single buyer who only requires one unit of the good.

[13] In the body of the paper, we assume that buyers choose to first negotiate with their most-preferred seller, before moving on to their next-most preferred seller, etc. This assumption is unimportant, as even if a buyer chose a different ordering the logic of the paper and our results are unchanged. Nonetheless, a proof that this bargaining order is rational

V_i^ϕ refer to the utility that the buyer would receive from reaching agreement with seller i, given the ordering ϕ. It follows that $V_1^\phi > V_2^\phi > ... > V_N^\phi > 0$.

Figure 3 depicts representative indifference curves representing utility levels corresponding to the values V_i^ϕ. Similar to figure 2, the payoffs from the buyer's and the seller's outside options are represented by the curves labeled ISO_0 and IC_0, respectively. In equilibrium, the buyer will reach agreement with seller 1 and receive utility V_1^ϕ, based on a disagreement payoff of V_2^ϕ from bargaining with seller 2. The equilibrium is indicated by the point "Pre" (corresponding to the pre-merger equilibrium outcome), which lies on the locus of Pareto efficient points E, and lies between V_2^ϕ and ISO_{ω_S}. As before, the precise location of the point labeled "Pre" depends on bargaining weights and functional forms, so figure 3 is merely representative.

Now consider a merger between the buyer's two most preferred sellers, seller 1 and seller 2 under the ordering ϕ. Under joint ownership, these sellers will not wish to compete against one another, and so the merged entity will optimally remove seller 2's product from the buyer's choice set by declining to engage in bargaining over it.[14] Post-merger, reaching an agreement with seller 1 will provide the buyer with utility equal to $\widetilde{V_1^\phi} \leq V_1^\phi$: the buyer receives lower utility because the merger diminishes its disagreement payoff when bargaining with seller 1. Specifically, failure to reach agreement now results in utility of V_3^ϕ instead of V_2^ϕ.

The buyer's worsened bargaining position is depicted in figure 3, where the post-merger equilibrium, labeled "Post," reflects the lower utility obtained by the buyer. Heuristically, the same bargaining weights applied to a lesser (greater) buyer disagreement payoff yield a Nash bargaining outcome less (more) favorable to the buyer. The post-merger equilibrium point must lie on the Pareto efficient locus. Since that locus is downward-sloping, the reduced utility caused by the merger must take the form of lower equilibrium quality.

By monotonicity of Nash bargaining outcomes in disagreement payoffs (Thomson, 1987), a lower buyer disagreement point shifts the equilibrium to a lower indifference curve and higher isoprofit curve. It follows that a merger which combines a buyer's top two ranked sellers lowers quality and raises price, as reflected by the point labeled "Post" in figure 3.

Proposition 2 states this section's main result, that a merger of a buyer's two most preferred sellers both decreases equilibrium quality, so long as the buyer's marginal rate of substitution of quality for price is decreasing in price.

for the buyer is available from the authors upon request.

[14]Even if the merged firm continued bargaining over both products, internalization of diversion would similarly worsen the buyer's disagreement payoff. See Balan and Brand (2023) and Garmon (2017) as examples of models in which mergers affect the disagreement payoff of buyers when bargaining with a merging firm, to the benefit of the merging firms.

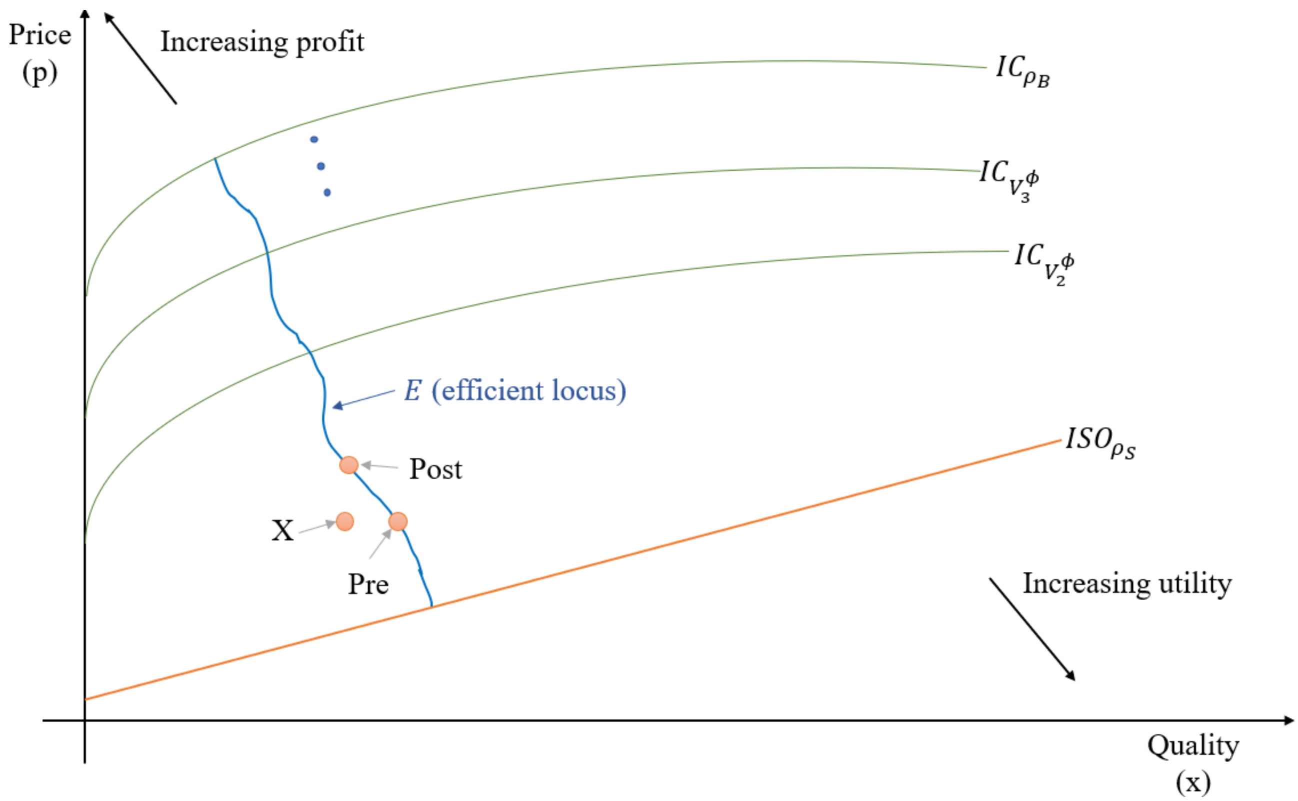

Figure 3: A merger shifts the buyer's disagreement payoff from V_2^ϕ to V_3^ϕ, worsening the buyer's equilibrium bargaining outcome.

Proposition 2. *A merger of the buyer's two most-favored sellers will lower the quality resulting from Nash bargaining between the buyer and the most-favored seller if the buyer's marginal rate of substitution of quality for price is decreasing in price.*

Proof. Let $d_0 = V_2^\phi$ be the buyer's disagreement payoff before a merger of sellers 1 and 2 and $d_1 = V_3^\phi < d_0$ denote the disagreement payoff after the merger, and $(x^*(d), p^*(d)) \in E$ denote the Nash bargaining outcome for disagreement payoff d. By monotonicity of bargaining outcomes in disagreement payoffs (Thomson (1987)), $d_1 < d_0$ implies $V(x^*(d_1), p^*(d_1)) < V(x^*(d_0), p^*(d_0))$. Since outcomes lie on the downward-sloping efficient locus E (see lemma 1), this implies $x^*(d_1) < x^*(d_0)$ and $p^*(d_1) > p^*(d_0)$. ■

It follows from proposition 2 that a merger of *any* two sellers makes the buyer worse off. This happens directly if the two sellers are the buyer's two most-preferred options (by proposition 2). It happens indirectly if they are not, because the removal of *any* seller i as an option for the buyer worsens the buyer's disagreement payoff when bargaining with seller $i - 1$, which in turn reduces the buyer's disagreement payoff when bargaining with sellers $i - 2$, $i - 3$, and so on, all the way back to seller 1, with whom the buyer will contract in equilibrium.

3.4 Quality effects of mergers when prices are fixed

Suppose that a merger was determined to be harmful, and a proposed remedy was to fix the price at the pre-merger level. This remedy obviously does not prevent harm from reduced quality, as the reduction of the buyer's disagreement payoff allows the seller to offer lower utility which, because prices are fixed, can only take the form of lower quality. A more interesting question is whether this quality reduction is larger or smaller than the one that would be caused by the merger absent this remedy. That is, does the remedy mitigate the quality harm or exacerbate it? A similar question arises when the price is fixed by regulation rather than by a proposed remedy. For this comparison we impose mild additional curvature conditions: convex costs of quality (i.e., $c''(x) \geq 0$) and diminishing marginal utility of quality (i.e., $V_{xx} \leq 0$).

Let (x_0^*, p_0^*) denote the pre-merger Nash bargaining equilibrium, let (x_1^*, p_1^*) be the post-merger equilibrium, and let $(x_1^*(p_0^*), p_0^*)$ be the post-merger equilibrium when price is exogenously fixed at p_0^*, possibly as a proposed merger remedy. Note that $(x_1^*(p_0^*), p_0^*)$ must lie on a point that is due west (in x-p space) of (x_0^*, p_0^*), meaning lower quality and the same price; the reduction in competition must put the buyer on a lower indifference curve, and since price is fixed this must take the form of lower quality. Such a point is depicted by "X" in figure 3. We show that fixing price at pre-merger levels exacerbates the quality reduction caused by a merger, in proposition 3.

Holding price fixed while worsening the buyer's disagreement payoff reduces the buyer's effective income. When the buyer's marginal rate of substitution of quality for price declines with price, this income effect lowers the marginal value of quality relative to the seller's marginal cost, shifting the efficient bargaining outcome along the Pareto frontier toward lower quality.

Proposition 3 extends this reasoning into a formal proof.

Proposition 3. $x_1^*(p_0^*) < x_1^* < x_0^*$.

Proof. Let $S_S = p - c(x) - \omega_S$ and $S_B = V(x,p) - d$ denote the seller's and buyer's surplus, respectively, and recall that d denotes a vector of disagreement points. Using this notation, the Nash bargaining first-order condition in quality is

$$F(x, p; d) = c'(x)S_b - V_x(x,p)S_S = 0 \tag{8}$$

Because c is increasing and $p_1 > p_0$, we have that

$$S_S(x_1^*, p_0^*) = p_0^* - c(x_1^*) - \omega_S < p_1^* - c(x_1^*) - \omega_S = S_S(x_1^*, p_1^*) \tag{9}$$

Because V is decreasing in p, we have that

$$S_B(x_1^*, p_0^*) > S_B(x_1^*, p_1^*) \tag{10}$$

Because $F(x_1^*, p_1^*; d_1) = 0$, it follows that $F(x_1^*, p_0^*; d_1) > 0$, i.e., that the first-order condition is not satisfied at quality x_1^* if price is fixed at its pre-merger level p_0^*.

Taking the derivative of F w.r.t. x yields $F_x = c'' S_B - V_{xx} S_S + 2c' V_x > 0$, because each term is nonnegative, and at least the last term is strictly positive. By the implicit function theorem, exactly one value of x solves $F(x, p_0; d_1)$. Because $c''(x) \geq 0$ and $V_{xx} \leq 0$ by assumption, and because $S_B > 0$ and $S_S > 0$, it follows that $\frac{\partial F}{\partial x} = c''(x) S_B - V_{xx}(x, p_0) S_S + 2c'(x) V_x > 0$, i.e. that lowering quality decreases F, for any price. Consequently, any quality level at which $F(x_1^*(p_0^*), p_0^*; d_1) = 0$ must satisfy $x_1^*(p_0^*) < x_1^*$, and proposition 2 has already established that $x_1^* < x_0^*$ and that $p_1^* > p_0^*$. ■

The intuition for this result is as follows, which mirrors the intuition behind our results in section 3. Consider point $(x_1^*(p_0^*), p_0^*)$. At this point, the price is the pre-merger price p_0^*, so the buyer's available budget for all other goods (other than the one being negotiated over) is the same as at (x_0^*, p_0^*), but the good being negotiated over is of lower quality. This affects the buyer's tradeoff between quality and price, increasing the willingness to accept a higher price in exchange for higher quality compared to (x_0^*, p_0^*) (i.e., increasing the MRS). If $c(x)$ is linear or convex in quality, then the seller will have a (weakly) increased willingness to offer higher quality in exchange for a higher price. This means that eliminating the requirement to fix price at p_0^* (i.e., allowing (x_1^*, p_1^*) to be the post-merger equilibrium) will cause equilibrium quality to increase, which in turn means that fixing the price at the pre-merger level exacerbates the quality harm from the merger.[15]

3.5 Parametric examples

Two parametric examples illustrate the results of lemma 1 and proposition 2.

3.5.1 Cobb-Douglas

First, consider a Cobb-Douglas buyer utility function, $V(x, p) = (B - p)^{\frac{1}{2}} x^{\frac{1}{2}}$, where B is the buyer's total budget, which is assumed to be high enough that the buyer chooses to purchase one unit of the good at quality x and price p. It is direct that V is strictly quasiconcave.[16] Assume the seller has a constant marginal cost of quality, c. It is straightforward to show that the buyer's pre-merger equilibrium indifference curve is ω_0 is $p = B - \frac{\omega_0^2}{q}$, and the seller's pre-merger isoprofit curve is π_0 is $p = a_0(\pi_0) + dq$. (The assumption that the marginal cost of quality is constant means that the slope of the isoprofit function is always c, so only the intercept $a_0(\pi_0)$ is relevant). Setting the derivatives

[15] Informally, this result can be interpreted as meaning that the constraint increases the quality harm as long as all goods other than the quality of the good in question are collectively normal.

[16] Taking logs of V, the Hessian has diagonal elements $-\frac{1}{2x^2}$ and $-\frac{1}{2(B-p)^2}$, and off-diagonal elements of zero, and thus is negative definite.

equal to each other shows that $q_0^* = \frac{\omega_0}{\sqrt{c}}$. From this expression it is easy to see that equilibrium quality is increasing in the buyer's utility, which means that competition-reducing mergers, which reduce the buyer's utility, cause quality to decrease. This result is expected, as all goods are normal goods under Cobb-Douglas utility, and our result is closely related to quality being a normal good.

To tie this result to the intuition described in section 1, note that any Nash bargaining solution solves the following Pareto efficiency condition, under which the seller's marginal cost of quality equals the buyer's marginal rate of substitution of quality for price:

$$c = \frac{B - p}{x} \tag{11}$$

The buyer's MRS is decreasing in p, holding quality constant. Since the seller's tradeoff between price and quality is unaffected by price, this means that no point directly north of an equilibrium point can satisfy the efficiency condition that the buyer's marginal rate of substitution equals the seller's marginal cost of providing additional quality. And since the price increase causes the buyer to be less willing to trade price for quality, that equality can only be restored at a lower quality level.

Thinking of the result described in section 3.4, we have that:

$$x_1^*(p_0^*) = \frac{B - p_0^*}{c}, \text{ and } x_1^* = \frac{B - p_1^*}{c} \tag{12}$$

Because $p_1^* > p_0^*$, we have that $x_1^*(p_0^*) < x_1^*$, which is consistent with the result of proposition 3

3.5.2 Additively-separable buyer utility

Now, suppose the buyer's utility is $V = x^\alpha + B - p^\beta$, with $\alpha \leq 1$ and $\beta > 1$. Suppose further that the seller's cost of quality x is given by $c(x) = \frac{1}{2}x^2$.[17] We begin by showing that the MRS is decreasing in price holding quality fixed. The first-order condition for the solution to the Nash bargaining problem between buyer and seller can be written as:

$$x = \left[\frac{\alpha}{\beta}\frac{1}{p^{\beta-1}}\right]^{\frac{1}{2-\alpha}} \tag{13}$$

$$x^\alpha - p^\beta - \omega_B = \beta p^{\beta-1}(p - \frac{1}{2}x^2 - \omega_S) \tag{14}$$

Set $\omega_S = 0$ for tractability. A tedious though straightforward manipulation of equations (13) and (14), contained in the appendix, confirms that $p'(\omega_B) < 0$ so long as $\beta > 1$, and that $x'(\omega_B) > 0$, meaning that a merger which reduces a buyer's disagreement payoff lowers quality.

[17]Unlike Cobb-Douglas, this utility function lacks a closed-form solution for equilibrium quality. However, we can characterize the equilibrium outcome as described above.

For $\alpha \leq 1$ and $\beta > 1$, this MRS condition holds. Using the same intuition as above, note that the MRS is $\frac{\alpha x^{\alpha-1}}{\beta p^{\beta-1}}$, which is decreasing in p (i.e., is lower at points that are due north of any point on the Pareto efficient locus) so long as $\beta > 1$, and decreasing in x so long as $\alpha \leq 1$.

Together, these examples illustrate that the quality-reducing effect of mergers arises across standard utility specifications whenever the buyer's MRS of quality for price declines with price, holding quality constant.

4 Bargaining over price when sellers commit to quality in advance

We now turn to how mergers affect quality when sellers first commit to a quality level and then bargain with buyers over price with both parties knowing the quality level that the seller has committed to. This sequential-move version of the game more closely matches scenarios in which sellers set a quality level that applies across buyers, or in which buyers and sellers are unable to specify material dimensions of quality via contract. Examples of such scenarios include healthcare providers like hospitals who largely determine quality (e.g., number and skill level of doctors, sophistication of facilities) prior to bargaining with insurers, and professional services firms like law firms that largely determine the number and quality of staff available to work on a matter prior to engaging with a client. We find that the prediction that emerges from a sequential version of the model is the same: subject to an additional assumption that the buyer's utility is additively separable in price and quality, a merger of two sellers lowers equilibrium quality if the buyer's MRS of quality for price is decreasing in price, holding quality constant.

The intuition, which is similar to the one described in the introduction, is as follows. The seller knows, for any small increment of quality, how much the buyer values that increment, and what fraction of that value it will capture if it supplies that increment. Its equilibrium condition is to choose quality such that this increment is equal to the marginal cost of quality. Now suppose that a competition-reducing merger occurs, and that quality is constrained to be at the pre-merger equilibrium level, resulting in an increase in price. Under that constraint, since quality is unchanged, the marginal cost of quality is unchanged as well. But the price will be higher, which means the buyer will be poorer. If quality is a normal good, then the buyer will value the increment in quality less than at the pre-merger level, violating the seller's equilibrium condition such that a small decrease in quality will increase profits.

As in the simultaneous bargaining game, a merger of two sellers leaves buyers worse off because it lowers a buyer's disagreement payoff when bargaining with seller 1 (e.g., if sellers 1 and 2 merge, the buyer would no longer be able to leverage a potential bargain with seller 2 when bargaining with seller 1). We work backwards to describe the two-stage bargaining game. In stage 2, with quality x already set, the buyer and seller bargain over price. The Nash bargaining solution solves:

$$\max_p (p - c(x) - \omega_S)^\lambda (V(x,p) - \omega_B)^{(1-\lambda)}$$

The first order condition is:

$$\lambda(V(x,p) - \omega_B) + (1-\lambda)V_p(x,p)(p - c(x) - \omega_S) = 0 \tag{15}$$

Equation (15) implicitly defines price as a function of quality and the buyer's outside option, i.e., $p = p(x, \omega_B)$.

In stage 1, sellers choose quality anticipating the effect of the quality level on the stage 2 bargaining outcome $p(x, \omega_B)$. Let $\Pi_S(x;\omega_B) = p(x;\omega_B) - c(x) - \omega_S$ denote the seller's payoff at the end of stage 2, reflecting both the outcome of the stage 2 bargaining game and the seller's choice of quality in stage 1.

Then, in stage 1, sellers choose quality x to solve:

$$\max_x \Pi(x;\omega_B)$$

The first-order condition is:

$$\frac{\partial \Pi_S}{\partial x} = p_x(x^*;\omega_B) - c'(x^*) = 0 \tag{16}$$

As in the simultaneous bargaining game described in section 3, the mechanism through which a merger affects equilibrium outcomes is reducing the disagreement payoff available to buyers. For instance, a merger of a buyer's top two sellers shifts that buyer's disagreement payoff when bargaining with his top choice to the buyer's third-most preferred seller. Further, as shown in section 3, a merger of *any* two sellers worsens a buyer's disagreement payoff with any seller, by worsening the buyer's set of alternatives to a seller he is bargaining with. Thus, we solve for the effect of mergers on equilibrium quality in the two-stage game described above by solving for the derivative of equilibrium quality (x^*) with respect to a buyer's disagreement payoff (ω_B).

To determine the sign of the derivative of quality (x^*) with respect to a buyer's disagreement payoff (ω_B), we first determine how ω_B affects the responsiveness of the stage 2 price, p^* to changes in quality. From equation (16), the effect of a change in ω_B on the seller's choice of quality depends on how ω_B shifts the derivative of the Stage 2 price, p_x. Therefore, we first develop conditions under which $p_{x\omega_B} < 0$. We then show that, by equation (16), that $p_{x\omega_B} < 0$ implies that equilibrium quality x^* decreases if the buyer's outside option ω_B decreases.

Our proof depends on the following assumptions. First, and most importantly, we assume that the buyer's value function is additively separable in quality x and price p and that price has an increasingly negative incremental effect on buyer utility, i.e., that:

$$V(x,p) = u(x) - g(p)$$

where $u(x)$ describes the rate at which higher quality makes the buyer better off, and $g(p)$ describes the rate at which a higher price makes the buyer worse off, with $u' > 0$, $u'' \leq 0$, $g' > 0$, and $g'' > 0$. Reasons that g may be convex (i.e., $g'' > 0$) include, for instance, quantity responses from the buyer (e.g., the buyer really cares about quantity of a good consumed, if quantity is affected by price then after optimizing over quantity the buyer's value will generally be concave in price, which corresponds to $g'' > 0$. Further, in a healthcare context, the buyer may face distortions as price increases resulting in a marginally higher price near some threshold resulting in greater costs to the buyer than a marginally higher price below the threshold (e.g., a higher price may cause more patients to exceed deductibles, resulting in an insurer bearing a higher share of total health costs).[18] Importantly, it is direct to show that $u' > 0$ and $g'' > 0$ together imply that a buyer's MRS of quality for price is decreasing in price,[19] meaning that under the assumed slope and curvature conditions a buyer becomes less willing to trade off price for quality as price rises. Just as in the simultaneous bargaining game presented in section 3, we show that under this condition, a merger of sellers decreases quality.

We further assume that the third derivative of g is positive, i.e., that $g'''(p) > 0$. This assumption is sufficient, but not necessary for our result.[20] As our proof below will make clear, our result holds if the third derivative of g is negative, provided that it is sufficiently small in magnitude so as to produce a positive sum when added to a positive term depending on the second derivative of g. Finally, we assume that $c''(x) - p_{xx}(x;\omega_B) > 0$, a regularity condition that makes the seller's stage 1 problem locally concave, as needed to guarantee a unique interior solution.

[18] If a buyer were to have quaslinear utility over quality x and price p, i.e., $V(x,p) = u(x) - p$, then quality would be invariant to the buyer's outside option. In this case, the seller's stage 1 choice of quality determines the size of the "pie" to be split in stage 2, and Nash bargaining allocates a constant share of incremental surplus to each party, meaning the seller's marginal incentive to invest in quality is independent of the buyer's outside option.

[19] Note that:

$$MRS = \frac{u'(x)}{g'(p)}$$
$$\Rightarrow \frac{\partial}{\partial p} MRS = -\frac{u'(x)g''(p)}{g'(p)^2} < 0$$

where the final inequality follows because $u'(x)$ and $g''(p)$ are both assumed to be greater than zero.

[20] As the proof will make clear, the weakest condition that would yield our result is that $(1-\lambda)(g'''(p)(p-c-\omega_S) + g''(p)) + g''(p) > 0$. This condition is implied by Assumptions A.1 and A.2, but can be satisfied even if Assumption A.2 does not hold.

Our assumptions are stated explicitly below.

Assumption A.1: $g''(p) > 0$ (Convexity of price)

Assumption A.2: $g'''(p) > 0$ (Regularity of marginal distortion)

Assumption A.3: $c''(x) - p_{xx}(x; \omega_B) > 0$ (Stage 1 concavity)

Together, these assumptions ensure that higher prices increasingly distort the buyer's valuation of quality, so that a deterioration in the buyer's outside option weakens the seller's incentive to invest in quality.

Proposition 4 demonstrates that under assumptions A.1-A.3, the derivative of equilibrium quality (x^*) with respect to a buyer's disagreement payoff (ω_B) is negative, meaning that mergers of sellers—which necessarily lower buyers' disagreement payoffs by removing options for the buyers—result in lower quality.

This implies that the Nash bargaining solution to the Stage 2 game is given by equation (17) below.

$$\lambda(u(x) - g(p) - \omega_B) = (1 - \lambda)g'(p)(p - c(x) - \omega_S) \tag{17}$$

Proposition 4. *Under assumptions A.1-A.3, equilibrium quality x^* is decreasing in the buyer's outside option ω_B.*

Proof. Under the implicit function theorem, differentiating (16) w.r.t. x yields:

$$\frac{\partial x^*}{\partial \omega_B} = \frac{p_{x\omega_B}(x^*, \omega_B)}{c''(x^*) - p_{xx}(x^*, \omega_B)} \tag{18}$$

Under Assumption A.3, the sign of $\frac{\partial x^*}{\partial \omega_B}$ is the same as the sign of $p_{x\omega_B}(x, \omega_B)$. The rest of the proof demonstrates that $p_{x\omega_B}(x, \omega_B) > 0$.

Under the assumption of additive separability, the Nash bargaining solution to the stage 2 bargain is given by equation (19) below.

$$F(p; u, \omega_B) = \lambda(u(x) - g(p) - \omega_B) - (1 - \lambda)g'(p)(p - c(x) - \omega_S) = 0 \tag{19}$$

By the implicit function theorem, there exists a function $p(\omega_B)$ satisfying $F(p(\omega_B); u, \omega_B) = 0$, of which the following is true:

$$\frac{\partial p}{\partial \omega_B} = -\frac{F_{\omega_B}}{F_p} \tag{20}$$

It is direct to verify that both the numerator and denominator of the right-hand side of (20) are negative, and thus $\frac{\partial p}{\partial \omega_B} < 0$. Specifically:

$$\begin{aligned} F_{\omega_B} &= -\lambda < 0 \\ F_p &= -\lambda g'(p) - (1-\lambda)[g''(p)(p-c-\omega_S) + g'(p)] < 0 \\ \Rightarrow \frac{\partial p}{\partial \omega_B} &= -\frac{F_{\omega_B}}{F_p} < 0 \end{aligned} \tag{21}$$

Next, we show that $\frac{\partial p}{\partial u}$ is decreasing in p, meaning that as price increases, incremental quality x translates into less additional price. Differentiating (19) w.r.t. u yields:

$$\frac{\partial p}{\partial u} = \frac{\lambda}{(1-\lambda)g''(p)(p-c-\omega_S) + g'(p)} \tag{22}$$

From equation (22), $\frac{\partial p}{\partial u}$ is decreasing in p under Assumptions A.1 and A.2 because the numerator is positive and invariant in p, while the denominator is increasing in p .

Since $\frac{\partial p}{\partial \omega_B} < 0$ and $\frac{\partial p}{\partial u}$ is decreasing in p, a reduction in ω_B lowers $\frac{\partial p}{\partial u}$. Specifically, combining equations (21) and (22) implies:

$$\frac{\partial}{\partial \omega_B}\frac{\partial p}{\partial u} > 0$$

Finally, note that the sign of $p_{x\omega_B}$ is the same as the sign of $\frac{\partial}{\partial \omega_B}\frac{\partial p}{\partial u}$ (i.e., positive), because:

$$\frac{\partial p}{\partial x} = \frac{\partial p}{\partial u}u'(x)$$
$$sign\left(\frac{\partial}{\partial \omega_B}\frac{\partial p}{\partial x}\right) = sign\left(\frac{\partial}{\partial \omega_B}\frac{\partial p}{\partial u}\right) > 0$$

The result follows. ■

In short, the proposition demonstrates that a merger worsens the buyer's outside option, raising the bargained price. Because higher prices are increasingly distortionary, quality improvements translate into smaller price increases. This weakens the seller's incentive to invest in quality.

5 Discussion and extensions

In our model, equilibrium bargains are between a single seller and a final buyer with preferences over price and quality (i.e., not a business-to-business transaction). In that scenario, proposition 2 states that the effect of mergers on quality depends solely on whether the buyer's relative value of quality and price increases or decreases as price increases (roughly, whether quality is a normal good). In this section, we describe potential extensions to the baseline model.

5.1 Quality effects of mergers for business-to-business transactions

In some situations the buyer that negotiates with the seller is a business rather than a final consumer. In such situations the buyer's indifference curves would be replaced with isoprofit curves. Those isoprofit curves would be a function of the final demand for the buyer's product, as well as the cost of other inputs besides the one being bargained over. Insofar as the final buyers have diminishing marginal utility of quality, the buyer's isoprofit curves may be concave, as are the indifference curves in figures 2 and 3. Concavity of the buyer's isoprofit curves implies a declining marginal willingness to trade price for quality, reproducing the income-effect channel in Proposition 2.

5.2 Quality effects of healthcare provider mergers with insurer intermediaries

Among the mergers for which quality effects are the most important and receive the most attention are mergers of healthcare providers, most notably hospitals but also physician practices, surgery centers, imaging centers, dialysis centers, and more. Providers and insurers bargain over price, but mostly do not bargaining over quality, so the model in section 4 is likely more applicable than the one in section 3, but as discussed the two models have the same result and essentially the same intuition.

We believe that healthcare provider mergers are close enough to our setting for our model to be informative regarding the likely effect of such mergers on equilibrium quality, as the effect that underlies our main result is likely present. However, there are two important differences, which we identify informally here and leave resolution for future research.

First, the immediate buyer of health care provider services, the managed care insurer, does not contract with only one seller in equilibrium. Insurers, even those relying on restrictive networks, contract with multiple health care providers. This does not fit our setting, where one buyer transacts with one seller.

Second, the standard way to model healthcare provider competition is known as "Nash-in-Nash," which refers to a Nash equilibrium among Nash bargains (see for example Balan and Brand (2023)). While Nash-in-Nash involves many negotiations (one for each provider-insurer pair) rather than just one negotiation as in our model, it has the attractive property that each negotiation can be thought of as a standard Nash bargain: a single buyer negotiates with a single seller, each with a disagreement payoff.[21] Indeed, evaluating the effect of a merger on a single bargain, without re-equilibrating all counterfactual scenarios, is a key tool in the analysis of healthcare mergers; see e.g. Garmon (2017),

[21] What makes this possible is the assumption that the participants in each negotiation have beliefs, which turn out to be correct in equilibrium, about the outcomes of all other negotiations. These beliefs are inputs into the disagreement payoffs of the buyer and the seller in each individual negotiation. See Balan and Brand (2023) for further explanation. Note that in this case those beliefs would also include beliefs about the quality of the other providers.

Balan and Brand (2023), and Brand and Lau (2025), describing the use and accuracy of willingness to pay (WTP) and upward pricing pressure (UPP) metrics for predicting the price effects of hospital mergers.

Although the Nash-in-Nash model, like our model in section 3, features individual negotiations between buyer-seller pairs, it is not identical to our model. To see why, we return to the thought experiment discussed in the introduction of a post-merger outcome with quality constrained to be at the pre-merger level. In our model, the *only* factor that causes the tradeoff between price and quality to be different at the constrained post-merger equilibrium compared to the pre-merger equilibrium is that the buyer is poorer. But in Nash-in-Nash, there is an additional difference, namely that prices for all the *other* providers (as well as the premiums) are different as well, which affects the disagreement payoffs of both parties. The effect of this additional factor on the tradeoff between price and quality is not obvious. So in this environment, the income effect from our model is present, which unambiguously decreases quality as long as the buyer's marginal rate of substitution of quality for price declines with price (holding quality con- stant), but an additional effect of unknown sign and magnitude is present as well.

5.3 Quality effects when sellers unilaterally set price and quality

As discussed in section 2, two previous theory papers on the effects of mergers on quality (Brekke et al. (2017) and Pinto and Sibley (2016)) consider environments where the seller chooses price and quality, and in both papers merger quality effects are of ambiguous sign. This is as expected based on the discussion of the Dorfman-Steiner condition in the introduction. While the environment in our paper is different (bargaining between a single buyer and a single seller), applying the intuition from our main result can be usefully applied to the this environment as well.

Assume that all buyers buy at most one unit of the good. For now also assume that all consumers have identical preferences, and differ only in their budget endowment B that is distributed according to some non-degenerate distribution with support $[\underline{B}, \overline{B}]$. At the pre-merger equilibrium, for seller 1 (WLOG) there is an equilibrium price p_0^*, an equilibrium quality x_0^*, and a marginal buyer characterized by $B = B_0^*$.

Now let seller 1 merge with a competing seller 2. Using the same logic described in section 1, imagine that quality is constrained to be at the pre-merger equilibrium level, and let p_1^{*con} denote the constrained post-merger equilibrium. At this constrained post-merger equilibrium, relative to the pre-merger equilibrium, all buyers are poorer by $p_1^{*con} - p_0^*$. But in this environment (and in contrast to our model), moving from the pre-merger equilibrium to the constrained equilibrium changes the *identity* of the marginal buyer to one characterized by a different, higher value of B; let B^{*con} denote the value of B in the post-merger constrained equilibrium. It must be that the quantity B^{*con} is greater than the value B_0^* associated with the pre-merger marginal buyer because the pre-merger marginal buyer dropped out of the market in response to even a small price increase. So the merger-induced price increase both makes the new marginal buyer poorer by the amount of the price increase and substitutes the original marginal buyer for a different one with a higher B. The effect of the merger on the *net* budget of the marginal consumer is $(B^{*con} - B_0^*) - (p_1^{*con} - p_0^*)$. Since everything else is unchanged by assumption, the *only* effect of the merger in this highly stylized environment is to change the net budget of the marginal buyer; if the net budget of the marginal buyer at the constrained equilibrium is higher than that at the pre-merger equilibrium (and if quality is a normal good), then the merger increases quality, and vice-versa.

Relaxing symmetry and the assumption that consumers differ only in B introduces the additional complication that the comparison of the constrained equilibrium versus the pre-merger equilibrium will also depend in complicated ways on the shape of demand for both price and quality (though the effect of the merger on the net budget will still matter). To fully analyze how this will affect mergers is beyond the scope of this paper. A potentially worthwhile avenue for future research would be to identify a utility function/demand function that reflects diminishing marginal return to quality, and then use that to fully examine the effect of mergers and quality in a posted quality/price environment.

6 Conclusion

The effect of a horizontal merger on product quality is of direct relevance to antitrust enforcement. If the elimination of competition between merging firms reduces quality, then the merger can only increase quality on net if there are quality efficiencies (i.e., reductions in the cost of producing quality) sufficient to outweigh that reduction.[22] This paper analyzes the effect of mergers on quality when price is negotiated by bargaining, finding that mergers reduce quality if the buyer's marginal rate of substitution of quality for price is decreasing in price. This condition resembles the buyer seeing quality as a normal good, so our result can be expressed by saying that the effect of mergers on equilibrium quality in our setting depends solely on income effects: mergers reduce quality as long as quality (not the good itself) is a normal good. Our result holds both when price and quality are simultaneously bargained over—as may be the case in a procurement, such as an employer negotiating both the terms of a health insurance plan and its price—and when sellers first commit to quality level

[22]However, as our paper predicts that merger-induced reductions in quality are driven by income effects, if these income effects are small in magnitude, the net quality efficiencies net of any disefficiencies required so that a merger increases quality are likely to be small as well. Note, however, that various frictions (e.g., credit constraints, behavioral effects) can mimic income effects even when the good has a small budget share.

by making a sunk investment in quality and then bargain with buyers over price.

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7 Calculation referenced in section 3.5.2

This section provides the calculations behind the results presented in section 3.5.2, which discusses a numerical example illustrating our main result.

Substituting equation (14) into equation (13) gives:

$$\left[\frac{\alpha}{\beta}\frac{1}{p^{\beta-1}}\right]^{\frac{\alpha}{2-\alpha}} - p^{\beta} - \omega_B = \beta p^{\beta-1}(p - \frac{1}{2}\left[\frac{\alpha}{\beta}\frac{1}{p^{\beta-1}}\right]^{\frac{2}{2-\alpha}} - \omega_S)$$

$$\Rightarrow \left[\frac{\alpha}{\beta}\right]^{\frac{\alpha}{2-\alpha}} - p^{(\beta-1)(\frac{\alpha}{2-\alpha})+\beta} - p^{(\beta-1)(\frac{\alpha}{2-\alpha})}\omega_B = \beta p^{(\beta-1)(\frac{\alpha}{2-\alpha})+(\beta-1)}(p - \frac{1}{2}\left[\frac{\alpha}{\beta}\frac{1}{p^{\beta-1}}\right]^{\frac{2}{2-\alpha}} - \omega_S)$$

$$\Rightarrow K_1 + K_2 = p^{(\beta-1)(\frac{\alpha}{2-\alpha})}\left(p^{\beta}(1+\beta-\beta\frac{\omega_S}{p}) + \omega_B\right) \tag{23}$$

$$\text{where: } K_1 = \left[\frac{\alpha}{\beta}\right]^{\frac{\alpha}{2-\alpha}} \text{ and } K_2 = \beta\frac{1}{2}\left[\frac{\alpha}{\beta}\right]^{\frac{2}{2-\alpha}} \tag{24}$$

If $\omega_S = 0$, then it is direct to show that if $\beta > 1$, $\frac{\partial g(p,\omega_B)}{\partial p} > 0$ and $\frac{\partial g(p,\omega_B))}{\partial \omega_B} < 0$, where $g(p,\omega_B) = p^{(\beta-1)(\frac{\alpha}{2-\alpha})}\left(p^{\beta}(1+\beta-\beta\frac{\omega_S}{p}) + \omega_B\right)$, the right-hand side of equation (23). From these results it follows that p is decreasing in ω_B, meaning that as the buyer's outside option increases, the Nash bargaining price decreases. From equation (13), it is direct that quality and price are inversely related if $\beta > 1$, so it follows that quality is increasing in the buyer's disagreement payoff.

More formally, equation (23) implicitly defines p as a function of ω_B, i.e., $p(\omega_B)$. Applying the implicit function theorem to differentiate $p(\omega_B)$ yields:

$$K_1 + K_2 = p^{(\beta-1)(\frac{\alpha}{2-\alpha})}\left(p^{\beta}(1+\beta-\beta\frac{\omega_S}{p}) + \omega_B\right)$$

$$\Rightarrow 0 = (\beta-1)(\frac{\alpha}{2-\alpha})p^{(\beta-1)(\frac{\alpha}{2-\alpha})-1}p'(\omega_B)\left(p^{\beta}(1+\beta-\beta\frac{\omega_S}{p}) + \omega_B\right)$$
$$+ p^{(\beta-1)(\frac{\alpha}{2-\alpha})}\left(\beta p^{\beta-1}p'(\omega_B)(1+\beta) + 1\right)$$

$$\Rightarrow p'(\omega_B) = -\frac{p^{(\beta-1)(\frac{\alpha}{2-\alpha})}}{(\beta-1)(\frac{\alpha}{2-\alpha})p^{(\beta-1)(\frac{\alpha}{2-\alpha})-1}\left(p^{\beta}(1+\beta-\beta\frac{\omega_S}{p}) + \omega_B\right) + p^{(\beta-1)(\frac{\alpha}{2-\alpha})}\left(\beta p^{\beta-1}p'(\omega_B)(1+\beta)\right)}$$

This is less than zero so long as $\beta > 1$. Thus, so long as $\beta > 1$, it follows that $p'(\omega_B) < 0$. From equation (13), it follows that $x'(\omega_B) > 0$. Since the effect of a merger on a negotiation is to decrease a buyer's disagreement payoff, it follows that mergers decrease quality so long as $\beta > 1$ (or at least mergers involving at least one buyer's second-best option).