Mergers in which price and quality are set by bargaining*

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Abstract

Mergers of horizontal competitors may affect product quality as well as price. For example, potential quality effects are often considered when analyzing healthcare mergers. There exists a small theoretical literature on the effects of mergers on quality when price and quality are chosen by a seller. In this paper, we examine mergers of sellers (e.g., healthcare providers) whose price and quality is set via bilateral bargaining with buyers (e.g., insurers). In our model, the effect of a competition-reducing merger on quality depends solely on income effects: quality being a normal good is necessary and sufficient for the merger to cause quality to decrease.

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1 Introduction

A broad literature establishes that a merger may incentivize merging firms to increase price, as each internalizes the positive effect of a higher price on the profits of the other.[1] The potential for such price effects underlie nearly all attempts by the U.S. antitrust agencies to block proposed mergers.[2] Frequently, mergers additionally implicate non-price factors. For example, the U.S. antitrust agencies often allege that a merger will diminish innovation, thereby harming consumers in the future as the rate of quality improvements slows.[3]

Apart from these dynamic effects, mergers may also have static effects on product quality. For example, vendors may compete with one another in the amount of time sales representatives allocate to each buyer, in the amount of technical support offered to buyers, or in the reliability or quality of the product sold. To take another example, hospitals may compete through clinical quality, such as the ratio of health care staff to patients, the length of patient stay, or the breadth of services offered. Unsurprisingly, concerns that a merger would diminish static quality often underlie merger challenges by the U.S. antitrust agencies.[4]

There is a burgeoning literature on the dynamic effects of mergers on innovation, and thus future quality, as summarized below. However, the literature on static quality effects of mergers is surprisingly scant. This is particularly surprising given that it has been known at least since Gaynor (2006) that the effect of a competition-reducing horizontal merger on product quality is theoretically ambiguous. Given the frequency which which U.S. agencies claim that a given merger will reduce quality, a

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

[2] See, *inter alia*, the FTC's December 2020 administrative complaint challenging the merger of Procter & Gamble and Billie, which claims "The removal of Billie as an independent competitor [...] is likely to harm consumers through higher prices, among other harms."

[3] McSweeny & O'Dea (2017) describe U.S. merger cases implicating innovation, including Steris/Synergy (in which the FTC alleged that the merger would deprive consumers of a new technology for the sterilization of medical equipment), and Bazaarvoice/PowerReviews (in which the DOJ alleged that the firms had "pushed each other to innovate in ways that help[ed] consumers and retailers."' For a recent example, see the FTC's November 2020 administrative complaint challenging the merger of CoStar and RentPath, in which the commission alleged "The Acquisition will eliminate [...] head-to-head rivalry and reduce competitive pressure [...] leading to lower quality and foregone innovation."

[4] See the FTC's November 2020 administrative complaint challenging the merger of the Methodist and Tenet hospital systems in Memphis, TN ("Methodist and [Tenet] also compete with each other to attract patients by improving quality, expanding service[] offerings, and increasing access for patients in the Memphis area. This non-price competition would also be lost post-transaction." See also the FTC's December 2020 complaint challenging the merger of the Hackensack and Englewood hospital systems in Bergen County, NJ ("[Hackensack] and Englewood compete with one another to attract patients, which incentivizes them to improve quality, technology, amenities, equipment, access to care, and service offerings."). See also footnote 3, *supra*, quoting the FTC as claiming that the merger of CoStar and RentPath would "lower quality."

deeper understanding of this relationship is important.

In this paper, we discuss one important mode of competition, which to our knowledge has not been studied before, namely bilateral bargaining between a seller and a buyer. We argue that, in this setting, mergers generically decrease both price and quality, so long as the buyer views quality as a normal good. Such bargaining models are often featured prominently in challenges by the U.S. antitrust agencies to mergers implicating business-to business commerce.[5]

Our result contrasts with a recent paper by Brekke et al. (2017), who model a game in which price and quality are posted by the seller, with buyers choosing quantities to purchase from each firm after evaluating all firms' price and quality choices. The authors identify general conditions under which mergers may increase or decrease posted quality. In a separate model, in which three sellers who compete in price and quality are spatially differentiated as in a Salop model, the authors find that a merger generically causes the two merging firms to decrease quality, while the non-merging firm responds increases its price in response. The nonmerging firm's greater margin incentivizes that firm to increase quality, and the average quality purchased increases as a result of the merger. The authors find that if demand is sufficiently responsive to quality, the merging firms may reduce quality to such an extent that it is optimal for them to set lower prices. The authors find that the effect of a merger implicating both price and quality on consumer welfare is ambiguously.

Pinto & Sibley (2016) also consider posted prices and quality levels, with N firms selling differentiated products. The authors show via a series of numerical simulations that a merger of two firms may increase or decrease quality. In their model, mergers are particularly likely to generate increases in quality when demand is inelastic. The authors argue that approximations of a merger's effect on quality based on apparent incentives of the merging firms may misfire, if quality is considered separately from price. Outside of a merger setting, both Gravelle (1999) and Brekke et al. (2010) show that quality is invariant to competition when the income elasticity of quality is zero.

Our paper has implications for three broader – and related – strands of literature. The first empirically examines dynamic effects on quality of horizontal mergers, e.g. through changed incentives to innovate. Representative papers from this literature include An and Zhao (2019) and Aghion et al. (2005). The former paper finds that the 1997 merger of Boeing and McDonnell Douglas and finds evidence consistent with the merger having resulted in dynamic efficiencies stemming from accelerated learning-by-doing, and with these efficiencies outweighing any anticompetitive effects of the

[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 (and discussing the bargaining model put forth by the DOJ at length). See also the June 12, 2018 Memorandum Opinion of the same court finding for the defendants in the DOJ's challenge of the merger of AT&T and Time Warner, which again discusses at length the bargaining model used by the DOJ to analyze alleged anticompetitive merger price effects.

merger. The latter paper describes an inverted U-shaped relationship between competition and innovation, with more competition resulting in greater innovation (and thus greater future quality) from a baseline of low competition, but the result reversing for greater baseline levels of competition.

Second, a theoretical literature examines whether mergers are likely to increase or decrease the incentive to produce quality-enhancing innovations. Recent entries to this literature have suggested both that mergers should be viewed as generically diminishing the incentive for firms to engage in innovative research and development (see, *inter alia*, Federico et al. (2017)), and that the effect of mergers on dynamic innovation may be ambiguous (see, *inter alia* Gilbert (2019)), depending on setting.

Third, a large empirical literature, as summarized in Gaynor et al. (2015) and Beaulieu et al. (2020) finds that horizontal mergers generally, but not always, reduce clinical quality in hospital mergers. These empirical studies measure the *combined* effects of lost competition and any quality efficiencies (whether positive or negative) that the merger might cause.[6]

Section 2 provides the main intuition for our result in a straightforward setting. Section 3 outlines our model, and contains our main result. Section 4 concludes.

2 Illustration of model

The basic intuition for behind our result is depicted in Figure 1. As is standard in Nash bargaining, both the buyer and the seller have an outside option, which represents the payoff that they will receive if no agreement is reached. Before the merger, a buyer negotiating with their first-choice seller has as their outside option the utility from reaching an agreement with their second-choice seller.[7] If the first-choice and second-choice sellers merge, then the buyer's outside option falls to the utility associated with the third-choice seller, thereby reducing the buyer's bargaining leverage with the first-choice seller. The figure depicts a buyer with concave indifference curves u_1 and u_0 (with concavity implying that that higher quality reduces the buyer's willingness to pay for additional quality),[8] and utility increasing to the southeast. The figure further depicts iso-profit curves for the seller reflecting

[6]In standard antitrust analysis, an "efficiency" is something that reduces the variable cost of producing an additional unit of *output*. A positive quality efficiency (negative efficiencies are also possible) is something that reduces the variable cost of producing an additional unity of *quality*. See Romano & Balan (2011) for a conceptual framework for evaluating quality efficiencies, and Balan (2017) for a discussion of what kinds of efficiencies are likely to be merger specific.

[7]The utility associated with the second-choice seller is in turn a function of the utility from the third-choice seller, and so on recursively until some fixed outside option is reached.

[8]If the buyer is a business, rather than a consumer, refer to the corresponding locus of points as an isoprofit curve. To the extent the business buyer's own customers have diminishing willingness to pay for quality, the buyer's isoprift curve would be concave, as pictured.

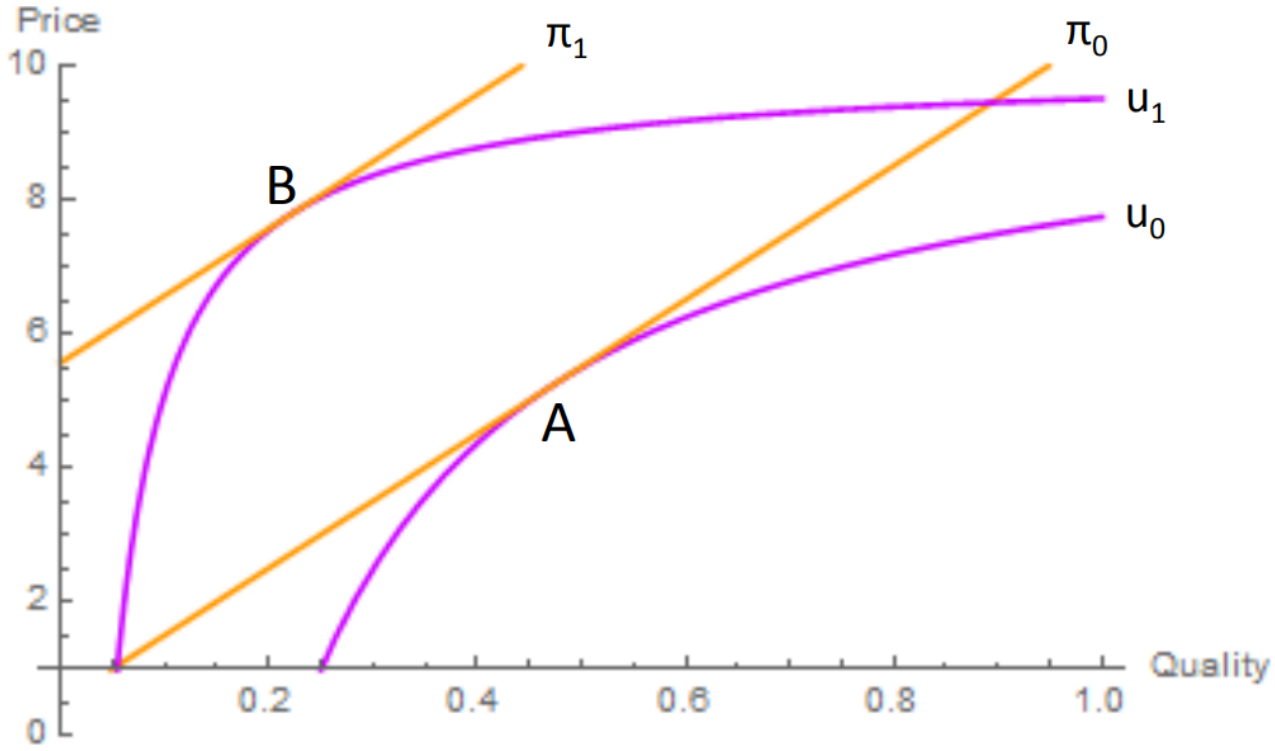

Figure 1: Suppose that point A represents a pre-merger bargain. Necessarily, a merger that lowers the buyer's outside option results in a bargain that places the buyer on a lower indifference curve. So long as this second indifference curve is flatter than the first at the quality level represented by point A, the linearity of the seller's isoprofit lines and convexity of the buyer's indifference curves imply that any Pareto efficient point on this second indifference curve lie to the left of point A, implying lower quality in the post-merger bargain.

a linear cost of quality, and profits increasing to the northwest. Suppose that Point A represents a pre-merger Nash bargaining outcome. The post-merger bargain, reflecting the buyer's worse outside option, will lie on some indifference curve u_1 to the northwest, generating lower utility for the buyer.[9]

Now consider the point on u_1 that has the same slope as at Point A, depicted by Point B. If the post-merger bargaining outcome were at that point, then the buyer's tradeoff between price and quality would be the same pre- and post-merger. This is the outcome that would realize were a buyer to faces a budget constraint that shifted parallel in response to a reduction in income. The consumer is poorer, but relative prices are unchanged, so the change in the buyer's choice is due solely to income effects. Nash bargaining's Pareto optimality and the linearity of the seller's iso-profit lines together imply that Point B will in fact be the post-merger bargaining outcome, and from this it follows that the merger

[9]Thomson (1987) establishes as a general matter that in two-player bargaining games, Nash bargaining outcomes are monotonic in outside options.

will reduce quality if and only if quality is a normal good.[10]

In many settings quality is likely to be a normal good: assuming that richer people and poorer people are consuming the same product, richer people are likely to have a higher willingness to pay for quality. There exist circumstances in which a product has zero income effects (e.g., quasi-linear utility), and this is particularly likely when the product represents a small fraction of total spending. This may also be true of quality in some circumstances, in which case our model would predict no effect of a merger on quality. It is difficult to imagine a circumstance in which quality would be an inferior good.

3 Price and quality set via bilateral bargaining

We now introduce a model in which both quality and price of a single good are set via Nash bargaining. In this model, the bargaining outcome depends on the outcomes both parties would experience should bargaining break down. In section 3.1 we take these outside options as exogenous, while section 3.4 examines the impact of a merger on these outside options.

3.1 Model Setup

A buyer and a seller may 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 costly for the seller to produce, but is valued by the buyer. The buyer's indirect utility function over price p and income I, parameterized by quality x, is given by $V(p, I; x)$, where V is continuous, strictly decreasing in p, and strictly increasing in I and x; a higher p lowers utility because the consumer has less money to

[10] An alternative, equivalent intuition for our main result is as follows. Consider the point on Figure 1 that is on u_1 and that is due north of Point A. Call this point the "candidate" equilibrium. At this point, the seller's tradeoff between price and quality is the same as at it was before: profits have changed, but quality has not, which means that the cost of producing quality has not, which in turn means that the tradeoff also has not. As for the buyer, moving to a lower indifference curve with quality fixed means that the buyer has become poorer and has taken *all* of the effect in the form of a higher price. The now-poorer buyer will not want to buy the same quality as before, but will prefer to take part of the effect in the form of lower quality (and a lower price, freeing up income to purchase other goods). This means that they buyer's tradeoff is not the same at the candidate equilibrium as in the pre-merger equilibrium; specifically, at the candidate equilibrium the buyer is less willing to accept a higher price in exchange for higher quality. So at the candidate equilibrium, the seller's tradeoff is the same, but the buyer's tradeoff is different, which means the tradeoffs can no longer be equal to each other. So the candidate equilibrium is not in fact an equilibrium. The equilibrium must be at some other point where the tradeoffs are equal again. This can only be a point with strictly lower price and lower quality, at which the buyer's willingness-to-pay for quality will be higher.

spend on outside goods.[11] $V(\cdot)$ is assumed to be quasiconcave in (p, x).

The seller's profit is given by $\pi(p, x) = p - dx - c$, where d is the constant marginal cost of providing an additional unit of quality, and c is the portion of the cost of providing the good that is independent of quality. We consider a full information game; in particular, quality is fully observable at the time of purchase. If the seller and buyer do not transact, each earns an outside option of ω_1 and ω_2, respectively. For the time being we assume these outside options are set exogenously.

Figure 2 depicts the (p, x) space. In this space, the buyer's utility increases to the Southeast (higher quality and lower price). Individual indifference curves are concave to the origin, because the buyer has diminishing marginal utility of quality. The seller's profit increases to the Northwest (lower quality and higher price). Figure 1 depicts an isoprofit curve and an indifference curve representing the seller's and buyer's outside option payoffs, respectively. The iso-profit curve is depicted as linear, but as discussed below, it can also be convex to the origin and our main result would be unchanged. Formally, define $ISO_a = \{(p, x) : p - dx - c = a\}$ to be the set of points yielding a profit of a for the seller, and $IC_b = \{(p, x) : V(p, I; x) = b\}$ to be the set of points yielding utility b for the buyer. Using this notation, the isoprofit and indifference curves depicted in Figure 1 are ISO_{ω_1} and IC_{ω_2}.

3.2 Pareto Efficient Locus

Concave indifference curves and weakly convex iso-profit curves are sufficient to guarantee that, for every possible indifference curve, there exists single point that is tangent to an iso-profit curve. At these points (and only at these points), the seller's tradeoff between price and quality the same as the buyer's; these points (and only these points) are Pareto efficient. This locus of PE points that are also individually rational – meaning that they generate profit of at least ω_1 for the seller and utility of at least ω_2 for the buyer – is depicted in Figure 2 as E. The shape of E varies with the underlying utility function, so what is graphed is merely a representative locus.

The locus E also resembles an income expansion path, which traces out how the consumption of two or more goods changes as a budget constraint is relaxed or tightened.[12] Consequently, as a general matter the shape of E depends on the consumer's preferences over quality and outside goods, and specifically how those relative preferences vary across different indifference curves. The buyer's marginal rate of substitution is $-\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}$. At any point on the PE locus, this must be equal to d, the cost

[11] For convenience, the dependence of $V(\cdot)$ on other variables, such as the prices of other goods, is suppressed.

[12] What distinguishes E from an income expansion path is that, in the present example, quality is not a good that is purchased for a fixed price. Instead, it is an aspect of a good that is bargained over, along with price. Consequently, quality does not have a "price" such that it would make sense to speak of a budget line for the consumer, much less how the consumer's purchase of quality would vary as such a budget line shifted.

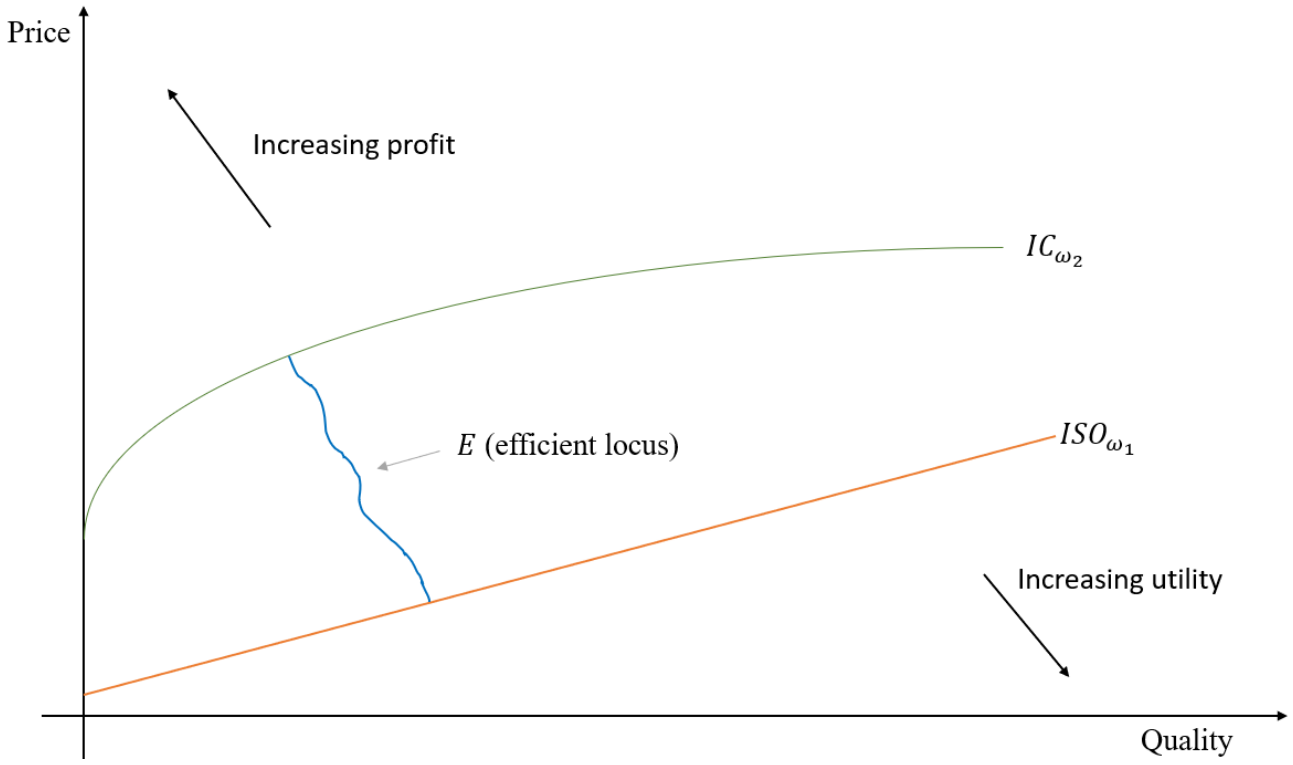

Figure 2: An isoprofit line and indifference curve giving all (x, p) pairs yielding, respectively, the same profits and utility as each party's outside option. Locus E describes the set of Pareto efficient (x, p) combinations, defined by points of tangency between isoprofit lines and indifference curves.

to the seller of an additional unit of quality.

Lemma 1 establishes a link between the buyer viewing quality as a normal good – meaning that were she able to purchase as many units of quality as she wished at price d, equal to the marginal cost of producing quality – and the locus E being downward sloping.

Lemma 1. *When quality is a normal good, the locus of Pareto Efficient points is downward sloping.*

Proof. Consider an (arbitrary) PE point $A = (x_0, p_0)$. Let point $B = (x_0, p_1)$, $p_1 > p_0$ describe an (also arbitrary) point at which the buyer has lower utility, but at which quality is identical to that at A. Graphically, B is due north of A. Because the buyer views quality as a normal good, it follows that the her marginal rate of substitution at B is less than at A, and therefore less than the slope of the seller's isoprofit line at the same point. Therefore, the point on the buyer's indifference curve through B that has the same slope as the seller's isoprofit line must have quality $x \leq x_0$. The claim follows. ■

3.3 Nash Bargaining and Pre-Merger Equilibrium

We now consider the Nash bargaining game, in which price p and quality x are determined. Suppose the seller has bargaining weight λ and the buyer $1-\lambda$. We assume that the function $V(\cdot)$ is such that Nash bargaining produces an interior solution, with $x > 0$ and $p > 0$.[13] The resulting price and quality solve the following maximization problem:

$$\max_{p,x} \left(p - dx - c - \omega_1\right)^{\lambda} \left(V(p, I; x) - \omega_2\right)^{1-\lambda} \tag{1}$$

The first-order conditions for an interior solution to equation (1) are:

$$p: \lambda(p - dx - c - \omega_1)^{\lambda-1}(V(p, I; x) - \omega_2)^{1-\lambda} + (p - dx - c - \omega_1)^{\lambda}(1-\lambda)(V(p, x; I) - \omega_2)^{-\lambda}\frac{\partial V}{\partial p} = 0$$

$$\Rightarrow \lambda(V(p, I; x) - \omega_2) = -\frac{\partial V}{\partial p}(1-\lambda)(p - dx - c - \omega_1) \tag{2}$$

$$x: \lambda(p - dx - c - \omega_1)^{\lambda-1}(-d)(V(p, I; x) - \omega_2)^{1-\lambda} + (p - dx - c - \omega_1)^{\lambda}(1-\lambda)(V(p, I; x) - \omega_2)^{-\lambda}\frac{\partial V}{\partial x} = 0$$

$$\Rightarrow \lambda d(V(p, I; x) - \omega_2) = \frac{\partial V}{\partial x}(1-\lambda)(p - dx - c - \omega_1) \tag{3}$$

Dividing equation (3) by equation (2) yields the expression below in equation (4), which says that in any Nash bargaining solution the consumer's marginal rate of substitution between price and quality equals d, the cost to the provider of an additional unit of quality.

$$d = -\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}} \tag{4}$$

It follows from equation (4), and from the fact that Nash bargaining outcomes are axiomatically Pareto efficient, that any Nash bargaining outcome lies on E, the locus of efficient points. Formally define the locus of points that are both feasible and Pareto efficient as:

$$E = \{(p, x) : d = -\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}, \pi(p, x) \geq \omega_1, V(p, I; x) \geq \omega_2\} \tag{5}$$

The Nash bargaining axioms of efficiency and individual rationality then determine that any bargaining outcome lie on E. The particulars of where on E a given bargain lies 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 buyer closer to his outside option. Similarly, values of λ closer to 0 will confer greater bargaining power upon the buyer, and push the seller closer to her outside option.

[13] Additional conditions on utility may be required to produce an interior solution. For example, $\frac{\partial V}{\partial x} \to \infty$ as $x \to_+ 0$ and $\frac{\partial V}{\partial x} \to 0$ as $x \to \infty$ may suffice. Interiority may also require a condition on $\frac{\partial V}{\partial p}$.

3.4 Mergers may affect outside options, thereby lowering quality

Now suppose one buyer chooses among N sellers. The buyer may choose to bargain with any seller, but needs no more than one unit of the good. If bargaining breaks down with any one seller, the buyer may approach a different seller. If the buyer is unable to reach agreement with *any* seller, she receives her outside option utility of ω_2.

The buyer orders sellers from most attractive to least attractive, with seller 1 being the most attractive and N the least attractive; for convenience, 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 (again, with seller numbers referring to the ordering ϕ). Specifically, let V_i^ϕ refer to the utility that the buyer would receive when bargaining with seller i, given an outside option determined by her ordering ϕ, i.e. $\omega_2 = V_{i+1}^\phi$. For consistency in notation, set $V_{N+1}^* = \omega_2$. In equilibrium, the buyer will reach agreement with seller 1, receiving utility V_1^ϕ.

Now consider a merger between the consumer's top two sellers, 1 and 2 under 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 from the buyer's choice set by declining to engage in bargaining over the services of seller 2.[14] This will lower the consumer's outside option when bargaining with firm 1 from V_2^ϕ to V_3^ϕ.

Figure 2 plots the effect of this shift on the bargaining outcome. The indifference curve $IC_{V_2^\phi}$ represents the buyer's outside option when bargaining with firm 1 prior to the merger of firms 1 and 2. The indifference curve $IC_{V_3^\phi}$ represents the consumer's outside option following the merger of 1 and 2, once the merged entity declines to offer firm 2's product to the consumer.[15] The point labeled "Pre" represents the Nash bargaining outcome prior to the merger, for some indirect utility function $V(\cdot)$, bargaining weight λ, and parameters d and c. Nash bargaining outcomes vary monotonically in each side's outside option; see Thomson (1987). This monotonicity implies that a less preferred outside option for the buyer results in a Nash bargaining outcome on a lower indifference curve, and consequently on a higher isoprofit curve.

Since Nash bargaining outcomes are (axiomatically) Pareto efficient, and therefore satisfy equation (4), any post-merger bargaining outcome necessarily lies on locus E. It follows that if E is downward sloping (as described by Lemma 1 and as depicted in Figure 3), a merger which combines a buyer's top two ranked firms lowers quality and raises price, as reflected by the point labeled

[14] See Garmon (2017) and Miller (2014) as examples of models in which mergers affect the outside option of consumers when bargaining with a merging firm, to the benefit of the merging firms.

[15] The merged entity would generically pull firm 2's product, and not firm 1's, since the latter generates a greater surplus when sold to the buyer, and because the seller's profit is monotonically increasing in the total surplus generated by the transaction.

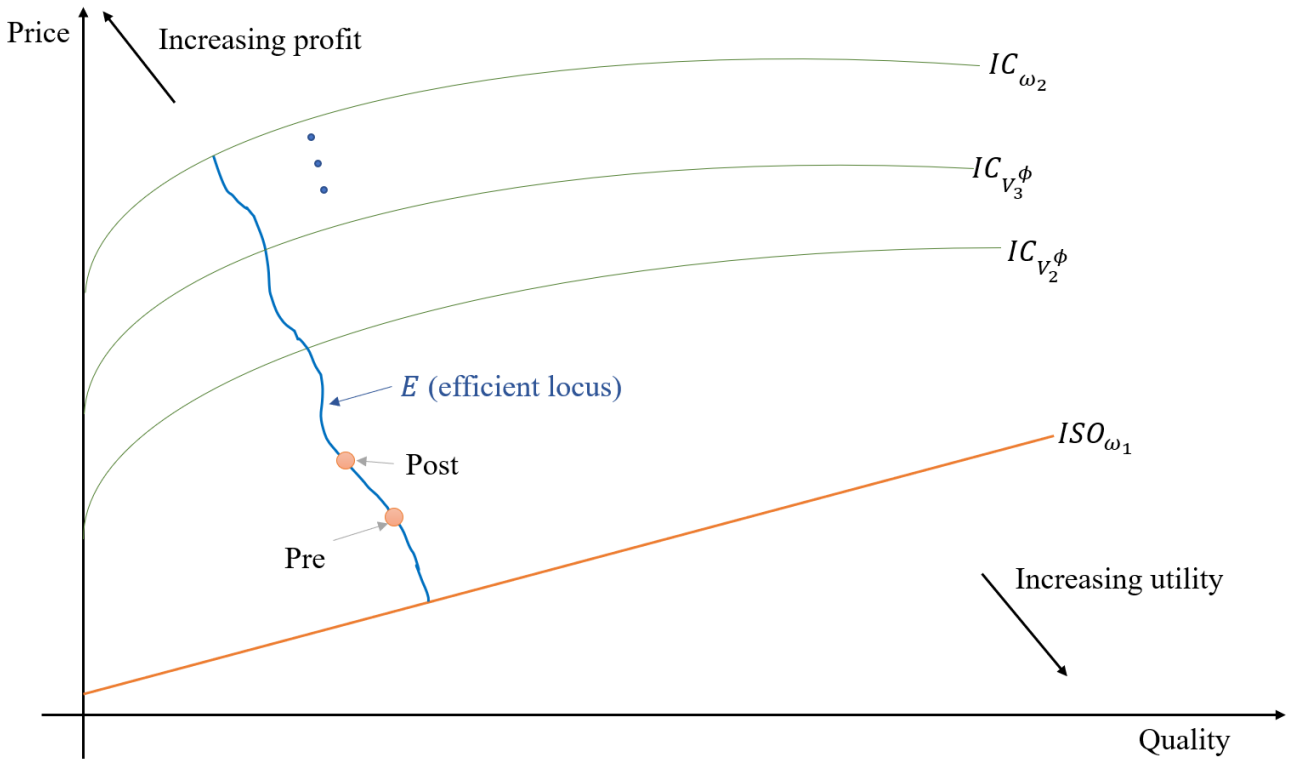

Figure 3: Pre-merger, the Nash bargaining outcome is determined based on the consumer having an outside option of V_2^ϕ. Post-merger, the bargaining outcome is determined based on a consumer outside option of V_3^ϕ. Since the Nash bargaining outcome varies monotonically in the outside options, it follows that post-merger quality decreases and price increases, so long as the consumer views quality as a normal good when priced efficiently.

"Post" in Figure 3. Since we established earlier that the locus E moves to the Northwest as firm profit increases if the consumer views quality as a normal good when priced efficiently, it follows that a merger of a consumer's top two ranked firms lowers quality and raises price so long as the consumer views quality as a normal good when quality is priced efficiently.

Proposition 1 summarizes this section's main result.

Proposition 2. *A merger of the buyer's two most-favored sellers will lower the quality resulting from Nash bargaining between the buyer and her most-favored seller if the buyer views quality as a normal good when its price equals the marginal cost of producing quality.*

Proof. Follows from above discussion. ■

4 Conclusion

The static effect of a merger on product quality is frequently at issue in the analysis of mergers. If a given class of mergers lower quality, all else equal, then a merger can only increase quality if there are quality efficiencies. In this paper, we develop a bargaining model in which both price and quality are determined via bilateral bargaining. In the model, we show that mergers reduce quality if and only if quality is a normal good, meaning that a richer buyer would purchase more quality were it priced at the marginal cost of quality than would a poorer buyer. This intuitive condition likely applies to a variety of industries. If quality is neither normal nor inferior, than our model predicts that a merger would have no effect on quality. This result appears contrasts with recent results from the literature suggesting that when price and quality are set unilaterally by sellers, mergers of sellers can increase quality, or have ambiguous effects.

Several extensions suggest themselves, which for the time being we leave to future research. First, our model contains some stylized assumptions – such as linearity of isoprofit curves. Future work can test the dependence of our result on these assumptions. Second, in some contexts sellers may unilaterally choose quality, and then bargain only over price with either a single buyer or a collection of buyers. Extending our analysis to mergers in this setting would inform antitrust policy towards such mergers. Finally, in some health care contexts, price is largely fixed, such as by reimbursement rates fixed by law. Future work can usefully evaluate how the negative quality effects of a merger depend on prices being fixed; mergers may be particularly likely to result in large quality decreases in this context.

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