Mergers in which price and quality are set by bargaining*

David J. Balan† Federal Trade Commission

Jeremy A. Sandford‡ Compass Lexecon

February 18, 2022

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 whether or not the buyer's marginal rate of substitution of quality for price is decreasing, a concept related to quality being a normal good.

JEL Classification Codes: L15, L13, L40.

Keywords: Mergers, Bargaining, Quality.

*We thank 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. Sandford's work on this paper was primarily completed while he was at the FTC. The opinions expressed here are those of the authors and not necessarily those of Compass Lexecon, the Federal Trade Commission, or any FTC Commissioners.

†email: dbalan@ftc.gov

‡email: jsandford@compasslexecon.com, web: www.jasandford.com

1 Introduction

A broad literature establishes that horizontal mergers may incentivize merging firms to increase price, as each internalizes the effect of a higher price on the profits of the other.[1] The potential for such price effects motivate nearly all attempts by the U.S. antitrust agencies to block proposed mergers.[2] Mergers may also affect non-price factors, most notably product quality, and merger challenges by the U.S. antitrust agencies often allege that the merger will reduce quality,[3] while merging parties often argue that mergers will increase quality. Competing claims about merger quality effects may be particularly salient in mergers of hospitals and other healthcare providers. For example, hospitals may alter clinical quality via, for example, the ratio of health care staff to patients, the length of patient stay, or the breadth of services offered. Despite the apparent importance of merger quality effects, they remain understudied by the literature.

Our paper considers a setting in which a buyer and a seller bargain over both the price and quality of a good. The buyer will purchase at most one unit of the good from one of several sellers. When bargaining with any seller, the buyer's threat point is endogenously determined by the payoff that the buyer would realize by making a deal with its next-most favored seller. In equilibrium, the buyer reaches agreement with its most-favored seller. A merger between the buyer's two most-favored sellers reduces the buyer's threat when bargaining with its most-preferred seller to the payoff it would receive from bargaining with its third-most favored seller. This diminished threat point causes a reduction in the buyer's equilibrium payoff. The main question in this paper is under what conditions this reduced payoff takes the form of lower quality, as opposed to a higher price and equal or higher quality.

This setting aims to capture the essential features of commerce conducted via bargaining in which both quality and price determine the payoffs of both buyers and sellers. For example, healthcare

[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] 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 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."

providers and insurers may bargain over elements determining both clinical quality and price, as higher quality may be costly to providers while benefiting insurers and their customers. Similar bargaining models are widely used in academic literature,[4] and antitrust litigation (particularly involving healthcare mergers).[5]

Our main result is that a merger of a buyer's first- and second-most preferred sellers causes the buyer to receive lower equilibrium quality (as well as a higher price), if and only if the buyer's marginal rate of substitution of quality for price decreases as price increases, holding quality constant. Under this condition, the buyer's indifference curves over quality (x-axis) and price (y-axis) flatten as price increases, for any fixed quality. Since an increase in the price of the good is comparable to a decrease in wealth, the condition resembles quality being a normal good, in that a higher price (or lower income) causes the buyer to value quality less keenly relative to a lower price (and thus more of other goods). Using this language, mergers reduce equilibrium quality if and only if the quality of the good (not the good itself) is normal.

The intuition behind this result is as follows. Suppose (*arguendo*) that after price and quality are negotiated, quality (but not price) is fixed for exogenous reasons. Suppose that a merger causes a price increase, thereby (by assumption) increasing the buyer's marginal rate of substitution of quality for price. Because quality is fixed, and because the marginal cost of supplying additional quality depends only on the level of quality, and not on price, the seller's marginal cost of supplying additional quality is unchanged from when price and quality were originally negotiated. Therefore, the post-merger outcome with a higher price but unchanged quality cannot be Pareto optimal, since at the outcome the buyer has a greater willingness to tradeoff quality for price than does the seller. Hence, if the buyer and seller are able to bargain over quality (or if quality were never fixed in the first place), the axioms of Nash bargaining imply that they would agree to a lower quality following the merger. If, alternatively, the buyer's marginal rate of substitution of quality for price is decreasing (unchanged) in price, the buyer and seller would reach a post-merger bargain with greater (the same) quality.

While Gaynor (2006) established that the effect of competition on product quality is theoretically ambiguous, only a small literature exists on quality effects of mergers. Indeed, we are not aware of another paper studying merger outcomes when both price and quality are determined via bargaining. Two papers study settings in which sellers unilaterally post both price and quality.

First, Brekke et al. (2017) derive conditions under which mergers increase or decrease posted quality. These authors also provide a parametric example, in which they find that non-merging firm increase price in response to the merging firms decreasing quality, and the resulting higher margin

[4] See Capps, Dranove, and Sattherthwaite (2003); and Balan and Brand (2022).

[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).

incentivizes greater quality. Overall, average quality increases as a result of the merger. The authors also 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. Finally, the authors find that the welfare effect of a merger implicating both price and quality is ambiguous.

Second, Pinto & Sibley (2016) consider N firms selling differentiated products, and 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 also 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.

An empirical literature on the relationship between competition and quality in healthcare, summarized in Gaynor et al. (2015) and Gaynor (2021) finds that horizontal hospital mergers generally, but not always, reduce clinical quality. A recent paper representative of this literature is Beaulieu et al. (2020), which uses difference-in-difference techniques to measure the effect of 246 hospital mergers on mortality, readmission rate, and two composites of clinical and patient experience metrics. They find acquired hospitals experienced modest declines in the patient experience composite, but no significant changes to mortality, readmissions, or the clinical process metric.[6]

An adjacent literature studies dynamic effects on merging firms' incentives to invest in innovation and thereby affect the rate of future quality improvements. Representative papers from this literature include An and Zhao (2019) and Aghion et al. (2005). The former paper studies 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 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. Recent theoretical papers 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), Shapiro (2012), and Federico et al. (2020)), and that the effect of mergers on dynamic innovation may be ambiguous (see, *inter alia* Gilbert (2019)), depending on setting.

[6]These empirical studies measure the total change of quality, inclusive of merger efficiencies. See Romano & Balan (2011) for a conceptual framework for evaluating quality efficiencies, and Balan (2017) for a discussion of what types of efficiencies are likely to be unachievable without merger.

2 Price and quality set via bilateral bargaining

Suppose both quality and price of a good are set via Nash bargaining between a buyer and a seller. Bargaining outcomes depend on the payoffs that would be realized by both parties were bargaining to break down. Refer to these counterfactual payoffs as "threat points." In sections 2.1-2.3 we take threat points as exogenous, while section 2.4 endogenizes threat points and examines the impact of a merger on these threat points.

2.1 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, and 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 buyer has less money to spend on outside goods. $V(\cdot)$ is assumed to be concave in (p, x), so that the buyer has a diminishing marginal utility of quality. The seller's profit is given by $\pi(p, x) = p - c(x)$, where $c(x)$ is the cost of providing the good at quality x; assume that $c(\cdot)$ is differentiable with $c'(x) > 0$ and $c''(x) \geq 0$. Assume that quality is observable at the time of purchase. If the seller and buyer do not transact, each earns an exogenously-specified outside option of ω_S and ω_B, respectively.

Figure 1 depicts the (p, x) 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 1 depicts an isoprofit curve and an indifference curve representing the seller's and buyer's outside option payoffs, respectively.[7] Formally, define $ISO_a = \{(p, x) : p - c(x) = a\}$ 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_S} and IC_{ω_B}.

2.2 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 bargaining produces an interior solution, with $x > 0$ and $p > 0$.The Nash bargaining price and quality

[7] In figure 1, the isoprofit curve is depicted as linear, corresponding to $c''(x) = 0$. Were $c''(x) > 0$, the seller's isoprofit curves would instead by concave, resulting in no change to the paper's logic.

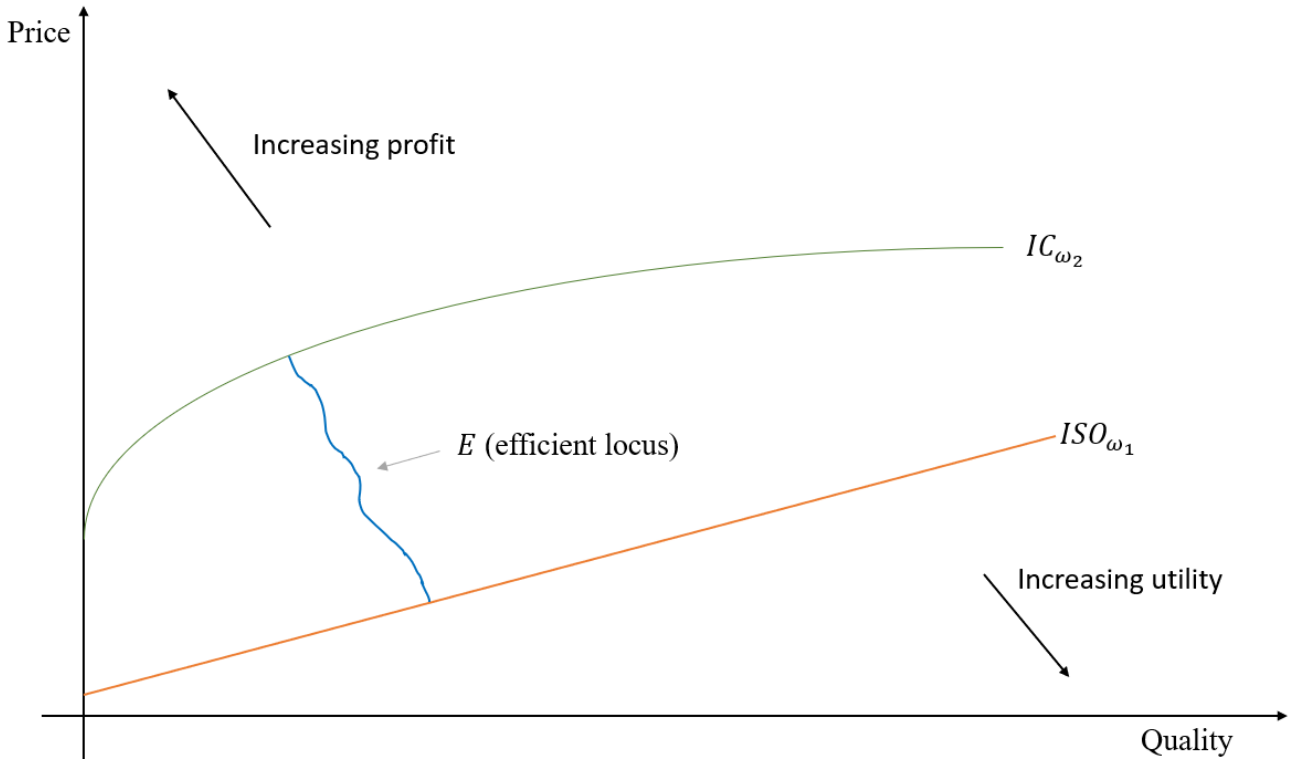

Figure 1: An isoprofit line and indifference curve giving all (x, p) pairs yielding, respectively, the same profits and utility as each party's outside option. Locus E describes the set of Pareto efficient (x, p) combinations, defined by points of tangency between isoprofit lines and indifference curves.

solve the following maximization problem:

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

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

$$p : \lambda(V(p, I; x) - \omega_B) = -\frac{\partial V}{\partial p}(1 - \lambda)(p - c(x) - \omega_S) \tag{2}$$

$$x : \lambda c'(x)(V(p, I; x) - \omega_B) = \frac{\partial V}{\partial x}(1 - \lambda)(p - c(x) - \omega_S) \tag{3}$$

Dividing equation (3) by equation (2) yields the expression below in equation (4), which says that in any NB solution the buyer's marginal rate of substitution between price and quality equals $c'(x)$, the provider's marginal cost of an additional unit of quality.

$$c'(x) = -\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}} \tag{4}$$

It follows from equation (4) (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 outside option. Formally define the locus of points that both lie on the Pareto efficient locus and are individually rational as:

$$E = \{(p, x) : c'(x) = -\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}, \pi(p, x) \geq \omega_S, V(p, I; x) \geq \omega_B\} \tag{5}$$

The location of the Nash bargaining outcome within 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 outside option. Similarly, values of λ closer to 0 will confer greater bargaining power upon the buyer, and push the equilibrium closer to the seller's outside option.

A representative locus E is depicted in figure 1. The precise shape of E depends on the buyer's preferences over quality and the outside option, and specifically how those relative preferences vary across different indifference curves parameters; as well as the seller's costs and the model parameters.

Lemma 1 establishes that if the buyer's marginal rate of substitution $-\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}$ is decreasing in p, then the locus E is downwards sloping.

Lemma 1. *When the buyer's marginal rate of substitution of quality for price $-\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}$ is decreasing in p, the locus E is downward sloping in the (x, p) space.*

Proof. Consider an (arbitrary) point $A \in E = (x_0, p_0)$. Now consider an (arbitrary) point $B = (x_0, p_1)$, such that $p_1 > p_0$. Graphically, point B lies due north of point A. Since points A and B have the same quality x_0, and since marginal cost $c'(x)$ depends only on x, it follows that the slope of the isoprofit curve through point A is the same as the slope of the isoprofit curve through point B.

Since (by assumption), the buyer's marginal rate of subsitution is decreasing in p, we have that $MRS_B < MRS_A$. That $MRS_B \neq c'(x_0)$ implies that point B is not on the locus E. That $V(p, I; x)$ is assumed to be concave in (p, x) then implies that marginal rate of substitution $-\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}}$ is decreasing in x along any indifference curve. Thus, the element of E that also lies on the indifference curve through point B must have a quality level $x < x_0$. ■

Notably, an increase in price (but not quality) resembles a decrease in income, as the buyer has less wealth available to purchase 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 view quality as a normal good.[8]

[8]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 wealth available for all goods.

2.3 Competition among sellers

Now suppose the 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. A buyer who fails to reach agreement with any seller receives the exogenously-specified outside option ω_B. Suppose for simplicity that each seller has the same outside option, ω_S.

Suppose further that the buyer's utility from a bargain with seller i is given by $V(p, I; x) + \epsilon_i$, where ϵ_i represents an i.i.d. draw from a distribution representing the buyer's subjective preference over each seller. Let the buyer order sellers from most preferred to least preferred based on values of ϵ_i, such that $\epsilon_1 > \epsilon_2 > ... > \epsilon_N$; 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, then seller 3, and so on, until every possible seller has been exhausted, in which case the buyer receives its exogenously-specified outside option, ω_B. Specifically, let V_i^ϕ refer to the utility that the buyer would receive when bargaining with seller i, given the ordering ϕ. It follows that V_i^ϕ is decreasing in i. Further, given that the buyer is always free to eschew bargaining in favor of its outside offer, it follows that $V_i^\phi \geq \omega_B$.

Figure 2 depicts representative indifference curves representing utility levels corresponding to the values V_i^ϕ. As in figure 1, the payoffs from the buyer's and the seller's exogenously-determined outside options are represented by the curves labeled ISO_{ω_S} and IC_{ω_B}, respectively. In equilibrium, the buyer will reach agreement with seller 1, receiving utility V_1^ϕ; the point "pre" (corresponding to a pre-merger equilibrium outcome) both lies on the locus of Parteo 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 2 is merely representative.

2.4 Mergers may affect outside options, thereby lowering quality

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.[9] 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 threat point when bargaining with seller 1. Specifically, failure to reach agreement now results

[9] See Balan and Brand (2022), Garmon (2017), and Miller (2014) as examples of models in which mergers affect the outside option of buyers when bargaining with a merging firm, to the benefit of the merging firms.

in utility of V_3^ϕ instead of V_2^ϕ. The buyer's worsened bargaining position is depicted in figure 2, 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 threat point yield a NB outcome less (more) favorable to the buyer.

As a general matter, Nash bargaining outcomes vary monotonically in each side's threat point; see Thomson (1987). This monotonicity implies that a less preferred threat point for the buyer results in a Nash bargaining outcome on a lower indifference curve, and consequently on a higher isoprofit curve. Since both pre- and post-merger bargaining outcomes lies on locus E, it follows that if E is downward sloping (as described by Lemma 1 and as depicted in figure 2), a merger which combines a buyer's top two ranked firms lowers quality and raises price, as reflected by the point labeled "Post" in figure 2.

Proposition 1 summarizes our main result, that a merger of a buyer's two most preferred sellers both decreases equilibrium quality and increases equilibrium price, so long as the buyer's marginal rate of substitution of quality for price increases as price increases, meaning that the buyer's indifference curves over price and quality, as depicted in figure 2, flatten as price increases.

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 increases as price increases, holding quality constant.*

Proof. Follows from above discussion. ■

Finally, it may be instructive to consider a parametric example, so here we briefly consider a Cobb-Douglas utility function assuming a constant marginal cost of quality equal to d. Let the buyer's utility be $U = (B-p)^{\frac{1}{2}} q^{\frac{1}{2}}$, 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 price p and quality q. It is straightforward to show that the buyer's pre-merger indifference curve u_0 is $p = B - \frac{u_0^2}{q}$, and the expression for the seller's pre-merger iso-profit curve 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 iso-profit function is always d, so only the intercept $a_0(\pi_0)$ is relevant). Setting the derivatives equal to each other shows that $q_0^* = \frac{u_0}{\sqrt{d}}$. 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.

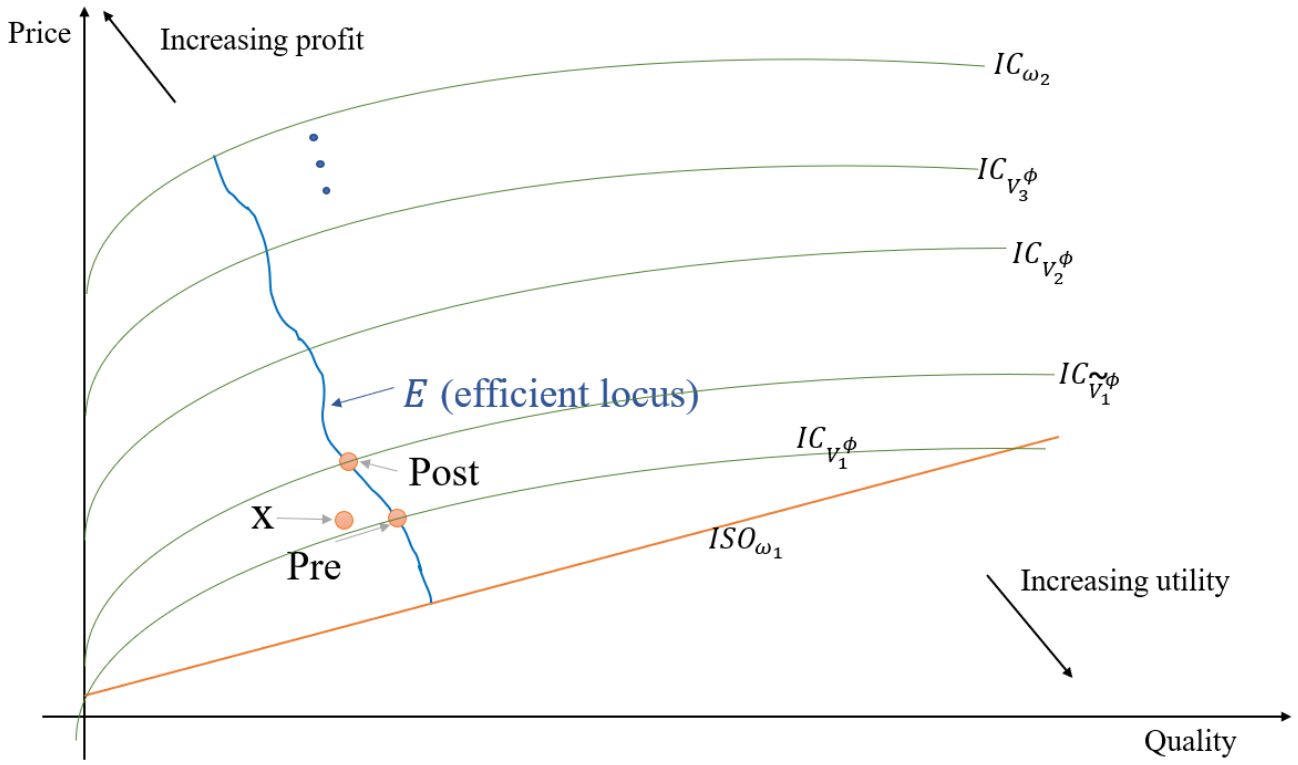

Figure 2: Pre-merger, the Nash bargaining outcome is determined based on the buyer having an outside option of V_2^ϕ. Post-merger, the bargaining outcome is determined based on a buyer's outside option of V_3^ϕ. Since the Nash bargaining outcome varies monotonically in the outside options, it follows that post-merger quality decreases and price increases (i.e., the post-merger equilibrium lies to the northwest of the pre-merger equilibrium), so long as the buyer's indifference curves decrease in slope as price increases (but not quantity) increases.

3 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 outside option allows the seller to offer it lower utility which, by assumption 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?[10] To answer this question using the framework developed in Section 2, consider the point marked "X" in figure 2. At this point, price is at the pre-merger level, and quality is at the unconstrained post-merger level. Note that this point cannot lie on E, and therefore cannot be an equilibrium bargaining outcome.

[10] A similar question arises when the price is fixed by regulation rather than by a proposed remedy.

While we do not offer a formal proof, a sketch of a result is as follows. At point "X," the buyer's available budget for all goods other than the one being negotiated over is the same as at the pre-merger outcome, but the good is of lower quality. This makes the buyer more willing to accept a higher price in exchange for higher quality than at the pre-merger equilibrium. 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 the equilibrium must be a point on E that is to the northwest of point "X", which in turn means that fixing the price exacerbates the quality harm.

4 Discussion

In our model, the bargaining is between a single seller and a single 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). While this scenario does occur in the real world, there are other scenarios in which additional effects are also present. In this section, we informally sketch some of these additional effects, while leaving formal treatment for future research.

4.1 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 iso-profit curves. Those iso-profit 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 iso-profit curves may be concave, as are the indifference curves in figures 1 and 2. If the resulting isprofit lines are concave, an analogue of proposition 2 would hold.

4.2 Quality effects of healthcare provider mergers with insurer intermediaries

In healthcare provider merger cases (most notably hospitals but also physician practices, surgery centers, imaging centers, dialysis centers, and more), the clinical quality effect of the merger plays a central role in the analysis.[11] A key feature of healthcare markets is the role of insurance intermediaries: most healthcare services are not sold directly to patients, but rather are paid for by insurers that negotiate with providers over the terms under which the providers will be included in the insurer's

[11] See footnote 3, *supra*.

provider network. There is still bilateral bargaining between a buyer and a seller, but now the buyer is the insurer rather than the consumer of healthcare services.

The standard way to model this environment is known as "Nash-in-Nash," which refers to a Nash equilibrium among Nash bargains (see for example Balan and Brand (2022)). 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 an outside option.[12] Indeed, evaluating the effect of a merger on a single bargain, without re-equilibriating all counterfactual scenarios is a key tool in the analysis of healthcare mergers; see e.g. Garmon (2017) describing the use and accuracy of willingness to pay (WTP) and upward pricing pressure (UPP) metrics.

Although the Nash-in-Nash model, like our model in section 2, has a single buyer negotiating with a single seller, the two models are not identical. To see why, we return to the thought experiment discussed in the introduction of a post-merger outcome with quality exogenously fixed at the pre-merger level. Call such a post-merger outcome a "candidate equilibrium." In our model, the *only* factor that causes the tradeoff between price and quality to be different at the candidate 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 outside options 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 formal model is present, which unambiguously tends to decrease quality, but an additional effect of unknown sign and magnitude is present as well.

4.3 Quality effects when sellers unilaterally set price and quality

As discussed in section 1, 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 unilaterally sets price and quality, and in both papers merger quality effects are of ambiguous sign. While the environment in our paper is different (bargaining between a single buyer and a single seller), our approach of identifying a "candidate" post-merger equilibrium (where quality is fixed at the pre-merger level and price is the equilibrium price given that quality) can be usefully applied to the posted price/quality environment as well.

[12] 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 outside options of the buyer and the seller in each individual negotiation. See Balan and Brand (2022) for further explanation. Note that in this case those beliefs will also include beliefs about the quality of the other providers.

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_1^{pre}, an equilibrium quality x_1^{pre}, and a marginal buyer characterized by $B = B^{pre}$.

Now let Seller 1 merge with a competing Seller 2. At the candidate equilibrium, every buyer is poorer by $p_1^{can} - p_1^{pre}$. But in this environment (and in contrast to our formal model), moving from the pre-merger equilibrium to the candidate equilibrium changes the *identity* of the marginal buyer to one characterized by a different, higher $B = B^{can}$ (higher 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 $(B^{can} - p_1^{can}) - (B^{pre} - p_1^{pre})$. 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 candidate 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 candidate 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.

5 Conclusion

The perceived 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. This paper analyzes the effect of mergers on quality when price and quality are both determined via Nash bargaining. We find that in this environment mergers reduce quality if and only 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 mergers reduce quality as long as quality (not the good itself) is a normal good. We also informally discuss how the results would change in environments that differ from that of our main model. In those cases the income effect that we identify is present, but other effects are present as well, with the overall effects left for future research.

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