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Class Actions and Private Antitrust Litigation*

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Abstract

The paper analyzes the effect of private antitrust litigation on firms' ability to collude and charge supracompetitive market prices. When the cost of litigation is sufficiently low, firms charge high market prices, accommodate lawsuits, and accept the litigation costs as just another cost of doing business. When the cost of litigation is sufficiently high, by contrast, the firms charge lower market prices and deter litigation. We model the class action as a mechanism that allows plaintiffs to lower their litigation costs and show that class actions may or may not be socially desirable. We also show that the firms' private incentives to block class action lawsuits may be either aligned with the social incentives, socially excessive, or socially insufficient. Various extensions, such as settlement, contingent fee compensation, fee shifting (loser pays all litigation costs), and damage multipliers (e.g., treble damages), are also examined.

JEL Codes: D21, K12, K21, K41, L41

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1 Introduction

In the United States, victims of corporate misconduct and unlawful business practices can sometimes consolidate their individual lawsuits into a single class action, so as to achieve economies of scale and other benefits.[1] Examples of successful class action litigation include products liability lawsuits, pricing fixing and other antitrust lawsuits, lawsuits by employees against an employer alleging discrimination, and securities class actions by public investors. Traditionally, the U.S. legal system was quite hospitable to class actions. In 1980, for instance, the U.S. Supreme Court extolled the class-action mechanism, stating that "aggrieved persons may be without any effective redress unless they may employ the class-action device."[2] With the endorsement of the U.S. Supreme Court, class actions flourished in the United States.

Recently, however, the class-action mechanism has been under attack. Most importantly, the U.S. Supreme Court tightened the requirements for class certification through cases such as *Wal-Mart Stores, Inc. v. Dukes* and *Comcast Corp. v. Behrend*, significantly raising the barriers for new class actions.[3] Furthermore, businesses increasingly deflect class actions by requiring consumers and employees to waive their rights to bring class actions. When purchasing a cell phone plan, for example, consumers are required to sign away their right to litigate and agree to channel their complaints through individual arbitration.[4] In a series of landmark rulings, including *Concepcion*, *Italian Colors*, and *Epic Systems*, the U.S. Supreme Court upheld private contracts that block class actions.[5]

[1]See for example Dam (1975), Miller (1998), Bone (2012), and Rosenberg and Spier (2014). Notwithstanding the possible benefits, the class action has always been controversial. Many scholars and practitioners have argued that the system is inefficient and engenders a new type of agency problems, that between plaintiffs and their representative lawyers.

[2]See *Deposit Guar. Nat'l Bank v. Roper,* 445 U.S. 326, 339 (1980). Rule 23 of the Federal Rules of Civil Procedure, in its modern form, was adopted in 1966 and allows lawsuits to be brought on behalf of a class of victims who have allegedly suffered harm.

[3]See *Wal-Mart Stores, Inc. v. Dukes*, 564 U.S. 338 (2011), and *Comcast Corp. v. Behrend*, 569 U.S. 27 (2013).

[4]In recent years, these contractual arrangements have proliferated. See Gilles (2005) and Resnik (2015). Recent federal bill, such as The Fairness in Class Action Litigation Act of 2017 (FICLA), is also viewed as being hostile to class actions.

[5]See *AT&T Mobility LLC v. Concepcion*, 563 U.S. 333 (2011), *American Express Co. v. Italian Colors Rest.*, 133 S. Ct. 2304 (2013), and *Epic Systems Corp. v. Lewis*, 138 S. Ct. 1612 (2018) (holding that mandatory, individual arbitration clauses in employment contracts are consistent with both the Federal Arbitration Act and the National Labor Relations Act). In stark contrast, the Consumer Financial Protection Bureau (CFPB) sought to protect class actions in consumer financial contracts. CFPB is a federal agency formed in accordance with the Dodd-Frank Act after the recent financial crisis and is in charge of overseeing and regulating consumer financial contracts, such as credit card agreements and mortgage contracts. After a notice and comment period, CFPB issued a

This paper analyzes the private and social desirability of class action lawsuits in the context of private antitrust litigation.[6] We focus on possible price fixing by firm-defendants in a market, and the class action is modeled as a mechanism that allows consumer-plaintiffs to lower their cost of bringing lawsuits against the firm-defendants. Our analysis produces several results. Importantly, the analysis shows that class action lawsuits may or may not be socially desirable. In some circumstances, the threat of class actions may force the firms to lower their prices to avoid lawsuits. But if the class action mechanism makes lawsuits sufficiently cheap and easy to bring, firms may simply accept litigation as a necessary cost of business and engage in even more egregious anti-competitive conduct. We show that, depending on the circumstances, the firms' private incentive to block class action lawsuits may be socially excessive or socially insufficient.

We present a simple model where firm-defendants collude to fix their prices in the shadow of future litigation. A higher price-cost markup raises the level of damages that the consumers can collect, if the firms are indeed found guilty of price fixing. We parameterize the degree to which consumers are forward-looking and anticipate being plaintiffs in future antitrust litigation. Fully forward-looking consumers have rational expectations and understand that they may receive damage payments from the firms in the future. These sophisticated consumers view the expected damage payments as a rebate that partially offsets the purchase price of the product.[7] Fully myopic consumers, on the other hand, do not foresee being plaintiffs in the future, and focus only on the sticker price when deciding whether or not to purchase the product.

The most profitable strategy for the colluding firms depends on the consumers' cost of bringing private antitrust lawsuits. We analyze the firms' pricing strategies for three different regions of litigation costs: a high-cost region where the firms engage in unbridled collusion and lawsuits never arise, an intermediate-cost region where the threat of litigation disciplines the market price, and a low-cost region where firms collude and endure lawsuits in equilibrium. For each region we perform local

rule ("Arbitration Agreements Rule"), prohibiting mandatory arbitration clause in certain consumer financial contracts, on July 10, 2017. The U.S. Congress overturned the rule by a 51-50 vote (Vice President Pence casting the tie-breaking vote) on October 24, 2017. See Ackerman and Hayashi (2017). Recently, there has been debate about whether a firm that is undertaking an initial public offering (IPO) can impose a mandatory arbitration clause (which also bars class actions) or restrict the forum in its charter or bylaws. See Aggarwal, Choi, and Eldar (2019).

[6] Private antitrust litigation is both a substitute and a complement for public enforcement of antitrust violations in the United States. Between 1975 and 2012, 92% of all antitrust lawsuits filed in U.S. District courts were brought by private parties rather than by government agencies. See Sourcebook of Criminal Justice Statistics Online, *www.albany.edu/sourcebook/tost5.html*

[7] That is, the "effective price" paid by consumers is the up-front purchase price minus the future net damages award (the damages award minus their litigation cost).

comparative statics to see how lowering the consumer-plaintiffs' costs of bringing lawsuits affects prices, profits, consumer surplus and social welfare. We also examine the (potentially discontinuous) changes in welfare when costs move across regions.

First, when the consumers' cost of bringing lawsuits is above a threshold, the firms are effectively immune from litigation. Since consumers face high barriers to bringing lawsuits against the firms, the firms will collude and fix their prices at unconstrained monopoly levels. From the firms' perspective, this is the ideal outcome. From the perspective of consumers and the social planner, this is suboptimal. Consumers must pay a high price for the products, and the market suffers the conventional deadweight loss from restricted supply. Given that there is no litigation in equilibrium, though, there is no deadweight loss from litigation.

Second, when the consumers' cost of bringing suit is in an intermediate region, the firms will deter lawsuits by setting the price below the monopoly level. Had the firms charged the unconstrained monopoly price, the consumers would have filed antitrust lawsuits, and resources would be spent on litigation. In this intermediate case, the firms lower the market price to just below the point where the consumers are indifferent between bringing suit and not bringing suit.[8] Note that when the consumers' cost of bringing suit falls, the market price must fall too. The lower market price harms the firms' profits, but increases consumer surplus and benefits society more broadly (the deadweight loss shrinks).

Third, when the consumers' cost of bringing private antitrust lawsuits is in a low region, the colluding firms will choose to accommodate lawsuits. Instead of deterring lawsuits by charging a very low price, the colluding firms will instead raise their prices to (modified) monopoly levels. Here, the colluding firms make a conscious decision to accept the costs of litigation as simply another cost of doing business. In this low region, the firms and the consumers are better off when, on the margin, it is cheaper for consumers to bring private antitrust lawsuits. Lower costs correspond to lower effective prices for consumers, higher demand for the product, and higher profits for the firms.

Using this simple framework, we ask the following question: are class action lawsuits socially desirable? If one simply examines the three regions in isolation, class actions increase social welfare: in the intermediate-cost region where litigation is deterred, lowering the cost of bringing suit forces the colluding firms to lower their price-cost margins; in the low-cost region where litigation is accommodated, lowering

[8]Distorting the market price has a negative direct effect (the firms' profit margins shrink), but has a positive strategic effect (the firms avoid being sued).

the cost of bringing suit reduces the effective price that consumers pay and lowers the firm's cost of doing business. However, social welfare falls precipitously when the cost of litigation crosses from the intermediate-cost region into the low-cost region. The intermediate-cost region enjoys both lower prices and no litigation costs. The low-cost region suffers from two problems: monopoly pricing and costly equilibrium litigation. We prove that social welfare is highest when the consumer's cost of bringing suit is at the very bottom of the intermediate-cost region.

Our model shows that the private incentives to block class action lawsuits may be either aligned with the social incentives, socially excessive, or socially insufficient. Within the low-cost region, the private and social incentives to block class actions are aligned. Both producer and consumer surplus are higher when the consumers' cost of litigation falls. In the intermediate and high cost regions, the firms' private incentive to block class actions may be socially excessive. When the consumers' litigation cost falls, it can also lower the equilibrium price, thereby increasing consumer surplus and social welfare. But, of course, because the firm profits will suffer, they have no incentive to allow class actions. Finally, we show that the firms sometimes obtain higher profits moving from the intermediate-cost region to the low-cost region. Since the low-cost region suffers from monopoly pricing and equilibrium litigation, moving from the intermediate to the low-cost region is socially harmful. In that case, the firms' incentive to block class actions is socially insufficient.

We also extend the basic analysis is several directions. First, our main analysis assumes that all lawsuits go to trial. We show that in a world of frictionless settlement, whether the firms will allow credible lawsuits in equilibrium depends on the degree of consumers' myopia. If the consumers are fully forward-looking, for instance, the firms can obtain the unconstrained monopoly profit regardless of the consumers' litigation cost. If the consumers are (partially) myopic, on the other hand, the firms may choose a price below the full-monopoly level to deter lawsuits and keep settlement off the equilibrium path. Second, although our main model assumes that the litigants pay the fixed costs of legal services, the same results hold with contingent fee attorneys and a perfectly competitive market for legal services. When the market for legal services is not perfectly competitive and the contingent fee attorneys earn rents in equilibrium, on the other hand, firms are worse off and are even more likely to impose class action waivers. Fee-shifting rules and damage multipliers are also discussed.

Our model is related to the literature on the real effects of treble damages in private antitrust litigation. Breit and Elzinga (1974) and Easterbrook (1985) have argued that far-sighted consumers will take into account future damage awards when making their purchase decisions.[9] In models with costless litigation, Salant (1987) and Baker (1988) show formally how damage remedies (even treble damages) can have neutral welfare consequences and no deterrent effect. Besanko and Spulber (1990) show that this neutrality does not hold when the firms have private information about the cost of production and expected damages are under-compensatory (an assumption that we will relax). None of these papers fully characterize the equilibrium pricing and settlement strategies with costly litigation, explore the comparative statics, or derive the welfare implications with respect to class actions and class action waivers.[10]

The paper is organized as follows. Section 2 presents the basic setup of the model, characterizes the equilibrium, and evaluates the social welfare implications. Section 3 extends the basic model to include out-of-court settlement, the market for legal services, the shifting of legal fees to the loser, and damage multipliers. The proofs may be found in the Appendix.

2 The Model

Suppose there is a unit mass of consumers. Each consumer demands at most one unit of the good and has valuation $v \in [0, \overline{v}]$. The valuations are distributed according to a strictly positive and differentiable probability density function $f(\cdot)$ and corresponding cumulative density function $F(\cdot)$. Conditional on equilibrium price p, the aggregate demand is given by

$$D(p) = \int_{p}^{\overline{v}} f(v)dv.$$

There are $N > 1$ firms in the market with the identical, constant marginal cost of $c \in [0, \overline{v})$. Both the number of firms (N) and the constant marginal cost (c) are common knowledge. Firms sell homogeneous products. Consumers costlessly observe all posted prices and other non-price terms (such as a class action waiver) in the market before deciding whether (and from whom) to purchase.

We now define some important notation. If the equilibrium market price is p then the aggregate industry profit is given by

$$\Pi(p, c) = \int_{p}^{\overline{v}} (p - c) f(v)dv = D(p)(p - c). \tag{1}$$

[9]Easterbrook (1985, 451) notes that if consumers "have perfect information and enforcement is costless, they view the future recovery as a cents-off coupon attached to each purchase."

[10]Spulber (1989, 592) briefly discusses litigation costs and how firms may choose to either allow or prevent litigation.

Without any collusion, the unique Bertrand equilibrium is given by all firms charging $p = c$ and earning zero profits. With perfect collusion (and with no liability), on the other hand, the firms would agree to set the price at the monopoly level:

$$p^m(c) = \arg\max \Pi(p, c). \tag{2}$$

For ease of analysis, we assume that the profit function is strictly concave in price and therefore $p^m(c)$ is unique. Finally, social welfare is

$$W(p, c) = \int_p^{\overline{v}} (v - c) f(v) dv. \tag{3}$$

From the social welfare function, the first-best outcome is obtained (i.e., social welfare is maximized) when $p = c$.

Suppose that there are antitrust laws that allow consumers to bring lawsuits when the market price is above marginal cost, $p > c$. Consumers who have purchased the product can then sue the firms to collect damages $d = \theta(p-c)$ where $\theta \in (0, 1)$. There are different interpretations of the parameter θ. It could simply be the probability that the plaintiffs will successfully present evidence of collusion. Alternatively, $\theta < 1$ could reflect court error or a pro-defendant bias where the court gives a "haircut" of $1 - \theta$ to the actual overcharge. By tweaking notation, it could also reflect a biased assessment by the court of the firm-defendants' marginal costs. Note that since $\theta < 1$, the expected damage award is not fully compensatory. We will see shortly that the assumption also implies that the firms are not completely deterred from colluding on price.[11]

Litigation is expensive for both the consumers and the firms. The litigation costs per unit sold are $k_p > 0$ for the consumers (the plaintiffs) and $k_d > 0$ for the firms (the defendants). We let $k = k_p + k_d$ and assume that $c + k < \overline{v}$.[12] Given the positive litigation cost, consumers will bring suit if only if it is profitable to do so: $\theta(p - c) - k_p > 0$. When indifferent, $\theta(p - c) - k_p = 0$, we assume that consumers do not bring suit.[13] In addition to individual lawsuits, we assume that the consumers can bring a class action suit (unless this right has been waived through contract).[14] We interpret the class action as a mechanism that reduces the plaintiffs' cost of bringing

[11] Section 3.4 extends the analysis to allow $\theta \geq 1$, e.g. through supra-compensatory damages.

[12] This condition implies that the product would be sold even if all consumers bring lawsuits.

[13] Note that while each consumer places a different valuation on the product, each consumer's cost of litigation is the same. This assumption is made for simplicity.

[14] For simplicity, we assume that only the consumers who actually purchased the product can bring a lawsuit or join a class action.

lawsuits: the per-plaintiff litigation cost falls from k_p to k_p^c where $k_p^c < k_p$.[15] With class actions, therefore, consumers will bring suit when $k_p^c < \theta(p - c)$.

We let $\mu \in [0, 1]$ parameterize the degree to which consumers are forward-looking and anticipate being plaintiffs in litigation. When $\mu = 0$, the consumers are completely myopic: at the time of purchase, they are unaware that they will benefit from litigation in the future. When $\mu = 1$, the consumers are fully forward-looking: they apply higher-level reasoning and foresee being plaintiffs in ex post litigation. When $\mu = 1$, consumers will treat any future damage award, minus the litigation cost, as an expected rebate when making their purchase decisions.[16] When $\mu \in (0, 1)$, we can think of the consumers expecting to receive a rebate with probability μ. Incorporating μ, a consumer will purchase the product if their valuation for the product exceeds the perceived net price, $v \geq p - \mu \times \max\{\theta(p - c) - k_p, 0\}$. Unlike the consumers, we assume that the firms are always fully forward-looking.

The timing of the game is as follows. At $t = 1$, the N firms offer to sell homogeneous products at price, p, and with or without a class action waiver. We implicitly assume that the firms are acting in their joint interest, and have mechanisms to enforce their collusive agreement.[17] The offer terms are observed by all consumers. At $t = 2$, the consumers decide whether to purchase the product. After purchasing the product, at $t = 3$, consumers decide whether to bring suit to collect damages for any overcharges. If lawsuits are brought, the per-unit litigation costs are borne and per-unit damages $d = \theta(p - c)$ are paid at $t = 4$. For simplicity, there is no time discounting. The solution concept is subgame-perfect Nash equilibrium.

2.1 Preliminary Analysis

We begin by characterizing the firm's profit function. If $p \leq c + k_p/\theta$, the case has a (weakly) negative expected value, and the consumers do not bring lawsuits ex post. A consumer will purchase the product if $v > p$, and the firms' aggregate profits are $\Pi(p, c) = D(p)(p - c)$. If $p > c + k_p/\theta$, lawsuits have positive expected value and the consumers will bring suits ex post, obtaining a net rebate of $\theta(p - c) - k_p$ per unit. A consumer will purchase the product when their valuation (v) (weakly) exceeds the

[15] When plaintiffs' multiple lawsuits are consolidated into a single class action, the defendants may also enjoy the economies of scale. We could easily allow the defendant-firms' litigation cost to decrease to $k_d^c < k_d$, but the substantive results will not change.

[16] Alternatively, one can interpret μ as the degree to which consumers discount the future. When $\mu = 0$ the consumers consumers are extremely impatient and when $\mu = 1$ they are extremely patient. All of our results hold under this alternative interpretation.

[17] They might accomplish this through repeated interaction with low or no cost of detection.

perceived *effective price* $x(p)$, where

$$x(p) = p - \mu(\theta(p-c) - k_p). \tag{4}$$

If $p > c + k_p/\theta$, the aggregate demand is $D(x(p))$ and, taking into account the firms' litigation costs and damage payments, aggregate firm profits are

$$D(x(p))[p - c - (\theta(p-c) + k_d)]. \tag{5}$$

Rearranging this expression, and recalling that $k = k_p + k_d$, we have the following lemma.

Lemma 1. *Aggregate firm profits are a piecewise continuous function of the price p:*

$$\begin{cases} \Pi(p,c) & \text{if } p \leq c + k_p/\theta \\ \Pi(x(p), c+k) - (1-\mu)D(x(p))[\theta(p-c) - k_p] & \text{if } p > c + k_p/\theta \end{cases} \tag{6}$$

where $x(p)$ is defined in (4). Holding the price p fixed, aggregate firm profits are weakly increasing in μ.

The profit function in equation (6) is intuitive. Suppose $p \geq c + k_p/\theta$. If the consumers are completely forward-looking ($\mu = 1$), the firms' aggregate profits are $\Pi(x(p), c+k)$, the profits of a hypothetical monopolist with unit cost $c+k$. This makes sense. When $\mu = 1$, then effective price *paid by consumers* is $x(p) = p - (\theta(p-c) - k_p)$ and the effective price *received by the firms* is $p - \theta(p-c) - k_d$. Using the litigation system to transfer $\theta(p-c)$ from the firms to the consumers is inefficient, as the parties jointly bear the cost of litigation $k = k_p + k_d$. So, the first term in the firm's aggregate profit function in (6), $\Pi(x(p), c+k)$, reflects both the production cost c and the joint litigation cost k.

The second term in equation (6), $(1-\mu)D(x(p))[\theta(p-c) - k_p]$, is intuitive as well. This is the loss of firm profits stemming from the misperceptions of consumers. To understand why, recall that $\theta(p-c) - k_p$ is the consumers' net ex post rebate per unit sold. Consumers anticipate receiving fraction μ of this rebate at the time of purchase, but fraction $1-\mu$ is unanticipated. So, $(1-\mu)D(x(p))[\theta(p-c) - k_p]$ is an ex post windfall for the consumers! Thus, the second term from equation (6) quantifies the transfer of value from the firms to the myopic consumers.

Note that the firms' aggregate profits in equation (6) is a discontinuous function of the price, p. If the price is below the threshold, $p \leq c + k_p/\theta$, consumers do not bring lawsuits and the profit function reflects the production costs only, $\Pi(p,c)$. When the effective price is above the threshold, $p > c + k_p/\theta$, the consumers bring lawsuits ex post and the firms' profits drop. This happens for two distinct reasons. First, the profits fall because consumers bring lawsuits and litigation is costly. Second, when consumers are myopic and do not anticipate being plaintiffs in litigation, the consumers receive a windfall gain ex post so, as previously discussed, the firms suffer a corresponding loss.

We now define some important new notation. Inverting $x(p)$ in (4) gives:

$$p(x) = x + \left(\frac{\mu}{1-\mu\theta}\right)(\theta(x-c) - k_p). \tag{7}$$

We now define $\widehat{k}_p$ be the implicit solution to the following equation:

$$\Pi\left(c + k_p/\theta, c\right) = \max_x \left\{\Pi(x, c + k_p + k_d) - (1-\mu)D(x)[\theta(p(x)-c) - k_p]\right\}. \tag{8}$$

The left-hand side of (8) represents the firms' aggregate profits when $p = c + k_p/\theta$. No lawsuits are filed and consumers purchase the product if and only if $v \geq p = c + k_p/\theta$. The right-hand side of (8) represents the maximal profits for the firms when they charge an effective price x and all consumers bring lawsuits.[18] The following lemma states that $\widehat{k}_p$ exists and is unique.

Lemma 2. *There exists a unique $\widehat{k}_p \in (0, \theta(p^m(c) - c))$ that satisfies (8). $\widehat{k}_p$ is a strictly increasing function of μ.*

The definition of $\widehat{k}_p$ in (8) is illustrated graphically in Figure 1 for the special case where consumers are fully forward-looking ($\mu = 1$). The effective price x is on the horizontal axis. The upper parabola represents the firms' aggregate profits when there is no litigation, while the lower parabola represents the aggregate profits when there is litigation. As k_p rises, the upper parabola remains fixed and the lower parabola shifts downwards. When $k_p = \widehat{k}_p$, the aggregate profits the firm can generate while bypassing litigation (the peak of the upper parabola) are the same as the maximum profits they can earn while allowing litigation. More generally, if $\mu < 1$, then the lower parabola in Figure 1 would shift downwards, representing the loss of profits from systematic consumer misperceptions about future litigation. The upper parabola, representing firm profits without litigation, would remain fixed. Thus, as indicated in Lemma 2, the threshold $\widehat{k}_p$ is smaller when consumers are myopic ($\mu < 1$) and do not fully anticipate being plaintiffs in future litigation.

[18] Consumers would only bring suit if $p > c + k_p/\theta$ or equivalently $x > c + k_p/\theta$. The right-hand size of (8) is a theoretical construct to define the threshold $\widehat{k}_p$.

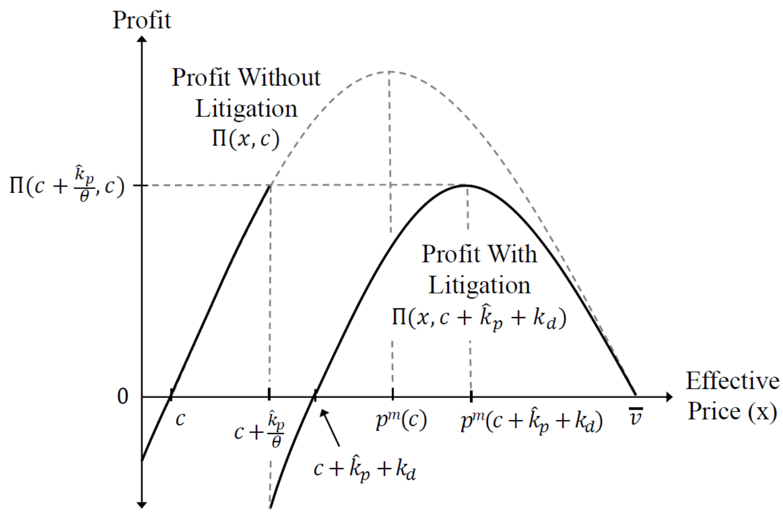

Figure 1: Definition of $\widehat{k}_p$ ($\mu = 1$)

2.2 Equilibrium Characterization

The threshold plaintiff litigation cost $\widehat{k}_p$ defined in Lemma 2 plays an important role in our analysis of the firms' pricing strategy. When $k_p < \widehat{k}_p$, because the consumers' litigation cost is sufficiently low, the firms are better off allowing lawsuits in equilibrium. In this case, the right-hand side of (8) is larger than the left-hand side. As k_p rises, $p^m(c+k)$ also rises, while $\Pi\left(p^m(c+k), c+k\right)$ falls. On the other hand, when $k_p > \widehat{k}_p$, firms will set the price just high enough to deter lawsuits in equilibrium and the left-hand side of (8) is larger than the right-hand side. As k_p rises, both $c + k_p/\theta$ and $\Pi\left(c + k_p/\theta, c\right)$ rise. When $k_p \geq \theta(p^m(c), c)$, the firms can charge the unconstrained monopoly price without having to face any lawsuits. This allows us to establish the following result.

Proposition 1. *The equilibrium prices, litigation decisions, firm profits, and social welfare depend on the plaintiffs' litigation costs k_p as follows:*

1. *If $k_p < \widehat{k}_p$, the effective price is $p^m(c+\widetilde{k})$ where $\widetilde{k} = \mu k_p + \left(\frac{1-\mu\theta}{1-\theta}\right) k_d$ and lawsuits are brought in equilibrium.*[19] *Aggregate firm profits are $\left(\frac{1-\theta}{1-\mu\theta}\right)\Pi(p^m(c+\widetilde{k}), c+\widetilde{k})$ and social welfare is $W(p^m(c+\widetilde{k}), c+k)$. When $\mu \in (0,1]$, as k_p increases, both firm profits and social welfare strictly decrease. When $\mu = 0$, as k_p increases, while firm profits stay the same, social welfare strictly decreases. As μ increases,*

[19] At the time of purchase, consumer pays an actual price that is higher than $p^m(c+\widetilde{k})$ but receives a rebate ex post.

firm profits increase; social welfare increases if $\frac{k_p}{k_d} < \frac{\theta}{1-\theta}$ *and decreases if* $\frac{k_p}{k_d} > \frac{\theta}{1-\theta}$.

2. *If* $k_p \in [\widehat{k}_p, \theta(p^m(c) - c))$*, the price is* $c + \frac{k_p}{\theta}$ *and no lawsuits are brought in equilibrium. Aggregate firm profits are* $\Pi(c+\frac{k_p}{\theta}, c)$ *and social welfare is* $W(c+\frac{k_p}{\theta}, c)$*. As* k_p *increases, firm profits increase and social welfare decreases. Neither firm profits nor social welfare depend on* μ.

3. *If* $k_p \geq \theta(p^m(c)-c)$*, the price is* $p^m(c)$ *and no lawsuits are brought in equilibrium. Aggregate firm profits are* $\Pi(p^m(c), c)$ *and social welfare is* $W(p^m(c), c)$*. Neither firm profits nor social welfare depend on* k_p *or* μ.

Figure 2 shows the equilibrium effective price as a function of the plaintiff's litigation costs, k_p, for the special case where consumers are fully forward looking ($\mu = 1$). When the consumers' litigation cost is in the low range, $k_p < \widehat{k}_p$, the firms accept that current sales will generate future litigation. The colluding firms treat the litigation costs and the future damage payments as just another cost of doing business, and set price accordingly. In this case, the effective price is $p^m(c + \widetilde{k})$, the monopoly price when the unit cost is $c + \widetilde{k}$ where $\widetilde{k}$ is defined in Proposition 1. When the consumers' litigation cost is in the middle range, $k_p \in [\widehat{k}_p, \theta(p^m(c)-c))$, the firms find it worthwhile to set the price just low enough to deter lawsuits, $p = c + k_p/\theta$. When the consumer-plaintiffs' litigation cost is in the highest region, $k_p \geq \theta(p^m(c) - c)$, the firms can simply collude on the monopoly price of $p^m(c)$ and consumers will not sue since lawsuit is prohibitively expensive. The colluding firms are insulated from litigation in this case.

Figure 3 shows aggregate firm profits and social welfare as a function of the plaintiff's litigation cost, k_p, for the special case where the consumers are totally forward looking ($\mu = 1$). When $k_p < \widehat{k}_p$, in equilibrium, consumers file suit after purchasing the product. Notice that the firms' profits are falling as k_p rises in this region, just as they would if the firms' production costs were to increase. Increasing the plaintiff's litigation costs in this range also harms social welfare directly (since litigation is even more wasteful) and indirectly through an increase in the effective price and the associated reduction in demand. Note also that even as k_p goes to zero, both the social welfare and the firm profits stay below those under the unconstrained monopoly price ($p^m(c)$). The reason is that even when $k_p = 0$, firms still face a positive litigation cost ($k_d > 0$), which generates a welfare loss from litigation and also imposes a higher marginal cost on the firms ($c + k_d$), thereby reducing the aggregate demand.

When the plaintiff's litigation cost rises and crosses into the middle region, $k_p \in [\widehat{k}_p, \theta(p^m(c) - c))$, the firms lower their prices to $c + k_p/\theta$ in order to avoid costly

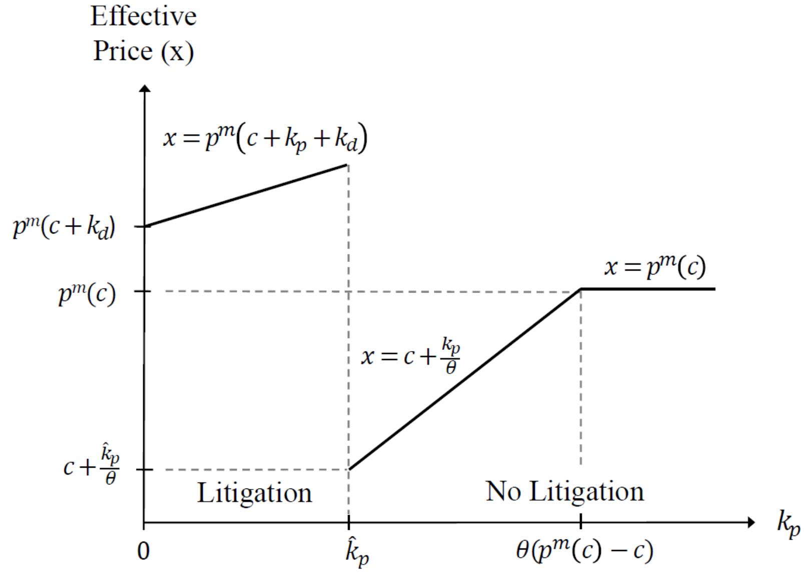

Figure 2: The Effective Price ($\mu = 1$)

litigation. This helps consumers and also increases social welfare, as shown by the discontinuity of the social welfare function when $k_p = \widehat{k}_p$. The increase in social welfare comes from two sources: (1) more consumers purchase the product because the (effective) price is lower; and (2) there is less wasteful litigation spending. When k_p rises within this middle region, firms are better off (since they can raise their prices closer to $p^m(c)$ and still avoid lawsuits) but social welfare falls (as the higher prices harm consumers and create a larger dead-weight loss).

Finally, when the consumer-plaintiff's litigation costs are in the highest region, $k_p > \theta(p^m(c) - c)$, then the firms can charge the unconstrained monopoly price $p^m(c)$ and avoid litigation. Increasing k_p has no affect on profits or social welfare in this region. The following corollary follows immediately from Proposition 1.

Corollary 1. *Firm profits are maximized when the plaintiff litigation costs are sufficiently high: $k_p \geq \theta(p^m(c) - c)$. With $k_p \geq \theta(p^m(c) - c)$, the firms charge the monopoly price, $p^m(c)$, and no lawsuits are brought in equilibrium. Social welfare is maximized when $k_p = \widehat{k}_p$. With $k_p = \widehat{k}_p$, the firms charge $\widehat{p} = c + \frac{\widehat{k}_p}{\theta} < p^m(c)$ and no lawsuits are brought in equilibrium.*

Corollary 1 tells us that the firms want the plaintiffs' litigation costs to be high, $k_p \geq \theta(p^m(c) - c)$). This makes intuitive sense. Firms would obviously like to squelch

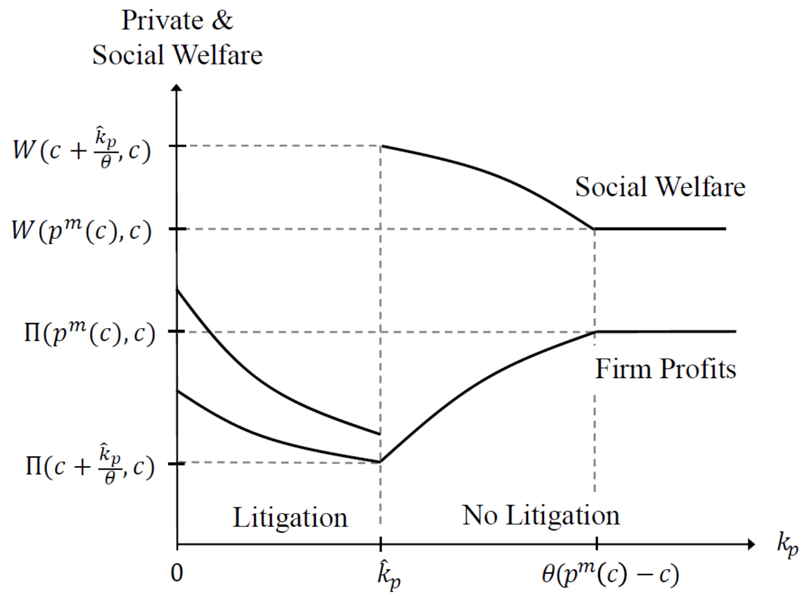

Figure 3: Private and Social Welfare ($\mu = 1$)

all future litigation and charge the unrestricted monopoly price of $p^m(c)$. This is possible only when the costs of litigation k_p are prohibitively high.

More interestingly, Corollary 1 tells us that social welfare is maximized when $k_p = \widehat{k}_p > 0$. In other words, it is not in society's interest for the plaintiff's litigation costs to be too small. If plaintiffs could costlessly bring litigation against the firms for overcharges, the firms would not simply give up and charge marginal cost. Instead, they will accept litigation as another cost of doing business and will raise their prices to reflect this. According to Proposition 1, if $k_p = 0$, the effective price charged by the firms would be $p^m(c+\widetilde{k}) > p^m(c)$ and social welfare would be $W(p^m(c+\widetilde{k}), c+\widetilde{k}) < W(p^m(c), c)$ where $\widetilde{k} = \left(\frac{1-\mu\theta}{1-\theta}\right) k_d > 0$. The society is strictly worse off (compared to the case where the plaintiffs' litigation cost is prohibitively high) when plaintiffs can costlessly bring lawsuits.[20] Since social welfare is decreasing in the plaintiff's litigation costs in the lowest region, we know that the socially optimal litigation cost is not in the lowest region. In the middle region, $k_p \in [\widehat{k}_p, \theta(p^m(c)-c))$, the firms set the price to just deter litigation, $p = c + k_p/\theta < p^m(c)$. If we were to start from $k_p = \theta(p^m(c)-c)$ and gradually decrease k_p, litigation will be kept off the equilibrium path while the price chosen by the firms will gradually decrease. As firms' profits decrease, social

[20]Even if the firms' litigation cost were zero ($k_d = 0$), firms will still charge $p^m(c)$ and earn $\Pi(p^m(c), c)$. As $k_d \to 0$, social welfare will converge to $W(p^m(c), c)$. With costless litigation, we get the invariance result.

welfare increases. Social welfare will obtain the maximum when $k_p = \widehat{k}_p$. Examining all three regions, we see that the socially optimal litigation cost is $k_p = \widehat{k}_p$.

2.3 The Private and Social Desirability of Class Actions

So far, we have assumed that each consumer will bring a lawsuit on an individual basis. Now suppose, instead, that the consumers can bring a class action against the firms for colluding on price. Recall that the class action lowers the per-plaintiff litigation cost to $k_p^c < k_p$. If, instead, firms require consumers to sign a class action waiver as a condition of purchase (through, for instance, a mandatory individual arbitration clause), we assume that the consumers' individual litigation cost remains k_p. The following proposition shows how the firms' incentive in imposing class action waivers can either be consistent with or diverge from the social welfare objective.

Proposition 2. *Suppose the firms can require class action waivers from consumers as a condition of sale, thus blocking class actions and raising the consumers' cost of bringing private antitrust lawsuits from k_p^c to k_p. Define $\overline{k}_p$, such that $\Pi\left(c + \frac{\overline{k}_p}{\theta}, c\right) = \left(\frac{1-\theta}{1-\mu\theta}\right)\Pi(p^m(z), z)$ where $z = c + \left(\frac{1-\mu\theta}{1-\theta}\right)k_d$. The threshold $\overline{k}_p$ exists and satisfies $\overline{k}_p \in (\widehat{k}_p, \theta(p^m(c) - c))$ when $\mu \in (0, 1]$ and $\overline{k}_p = \widehat{k}_p$ when $\mu = 0$.*

1. *When $k_p \leq \widehat{k}_p$, firms have at least weak incentive to allow class actions and, when they do allow class actions, this is socially efficient. Firms' incentive to allow class actions is strict when $\mu \in (0, 1]$, and when $\mu = 0$, the firms are indifferent.*

2. *When $k_p \in (\widehat{k}_p, \overline{k}_p)$, there exists a threshold $\underline{k}_p \in (0, \widehat{k}_p)$ where firms block (allow) class actions if $k_p^c > \underline{k}_p$ ($k_p^c \leq \underline{k}_p$). When $k_p^c \leq \widehat{k}_p$, firms' allowing (blocking) class actions is socially inefficient (efficient). When $k_p^c > \widehat{k}_p$, firms' blocking class actions is socially inefficient.*

3. *When $k_p \geq \overline{k}_p$, firms will block class actions. Firms' blocking class actions is weakly socially efficient (inefficient) when $k_p^c > \widehat{k}_p$ ($k_p^c \leq \widehat{k}_p$).*

Although the proof is somewhat involved, the reasoning behind the statements Proposition 2 is fairly straightforward. Whether or not the firms will require the consumers to sign a class action waiver–thereby blocking class action lawsuits–depends on the consumers' individual litigation cost. The easiest case is when $k_p \leq \widehat{k}_p$. In this case, because litigation takes place in equilibrium and the firms treat that as another cost of doing business, it is in their interest to lower the litigation cost, for instance, by allowing consumers to bring a class action. Interestingly, as the individual litigation cost decreases from k_p to k_p^c, not only will the firms' aggregate profits increase, but the social welfare also increases. The increase in social welfare comes from the fact that the deadweight loss from litigation has gotten smaller and also that the lower marginal cost leads to a lower equilibrium price, thereby serving a larger consumer base.

At the opposite end, when $k_p \geq \overline{k}_p$, because the consumers' litigation cost (without class action) is sufficiently high and firms' profits will only decrease when the consumers' litigation cost decreases, firms have no incentive to allow class actions. Whether the firms' imposing class action waivers is socially efficient depends on the magnitude of k_p^c. If $k_p^c < \widehat{k}_p$, allowing class actions will decrease social welfare (from Corollary 1), and the firms' imposing class action waivers is socially efficient. On the other hand, if $k_p^c \geq \widehat{k}_p$, by allowing class actions, while still keeping litigation off the equilibrium path, the equilibrium price will (at least weakly) decrease, thereby increasing social welfare. The firms' imposing class action waivers in that setting is socially inefficient.

Finally, when the consumers' litigation cost (without class action) falls in the middle region, $\widehat{k}_p < k_p < \overline{k}_p$, whether or not the firms will require a class action waiver depends on both k_p and the magnitude of k_p^c. If, for instance, $k_p > \widehat{k}_p$ and k_p^c is sufficiently close one, allowing class actions will only decrease the firms' profits. On the other hand, if k_p^c is sufficiently close to zero, firms will want to allow class actions in equilibrium. When class actions are allowed, however, social welfare is strictly lower (per Corollary 1). This is because, without the class action, firms are already charging a sufficiently low price to keep litigation off the equilibrium path and, therefore, social welfare is relatively high. When class actions are allowed, social welfare decreases due to all the litigation cost in equilibrium.

3 Extensions

Having presented the main analysis, we now consider several extensions. They include: (1) settlement of credible lawsuits, (2) plaintiff-attorneys who receive compensation based on the litigation outcome (contingent fee compensation), where the market for legal services may or may not be perfectly competitive; (3) fee shifting (English rule) between the plaintiff-consumers and the defendant-firms, where the loser pays the fees of the winner; and (4) damages multipliers, such as treble damages.

3.1 Settlement

In the main model, cases go to trial whenever the firms charge $p > c + k_p/\theta$. Since trials impose a deadweight loss of $k = k_p + k_d$, the firms and the consumers have a joint incentive to settle out of court to avoid the costs of litigation. Under symmetric information, all credible cases will settle and the parties are able to avoid the deadweight loss. We will show, however, unless the consumers are fully forward-looking ($\mu = 1$), firms cannot realize unconstrained monopoly profit and the firms may (depending on k_p) have an incentive to impose class action waivers.

Suppose that information is symmetric at the time of settlement bargaining: all the relevant parameters (including whether the consumers made a purchase) are common knowledge. We model settlement negotiations using simple Nash bargaining where $\alpha \in [0, 1]$ represents the defendants' (firms') bargaining power.[21] If $p \leq c + k_p/\theta$ then the plaintiffs do not have a credible threat to go to trial, so no lawsuits are brought. If $p > c + k_p/\theta$ then the plaintiffs have a credible threat to go to trial. The least the plaintiffs would be willing to accept to settle the case is $\underline{s}(p) = \theta(p - c) - k_p$, and the most the defendants would be willing to pay is $\overline{s}(p) = \theta(p - c) + k_d$. The case therefore settles for $s(p) = \alpha\underline{s}(p) + (1 - \alpha)\overline{s}(p)$, or

$$s(p) = \theta(p - c) + k_d - \alpha(k_p + k_d). \tag{9}$$

Note that the firms capture fraction α of the bargaining surplus, $k_p + k_d$. Since the case will settle for $s(p)$, the effective price perceived by the consumers is

$$x(p) = p - \mu s(p). \tag{10}$$

If $\mu = 1$, the consumers are fully forward-looking and anticipate the "settlement rebate" $s(p)$ at the time of purchase. If $\mu < 1$, the settlement rebate is less-than-fully anticipated.

Lemma 3. *Aggregate firm profits may be written as a piecewise continuous function of the price, p:*

$$\begin{cases} \Pi(p, c) & \text{if } p \leq c + k_p/\theta \\ \Pi(x(p), c) - (1 - \mu)D(x(p))s(p) & \text{if } p > c + k_p/\theta \end{cases} \tag{11}$$

where $s(p)$ and $x(p)$ are defined in (9) and (10), respectively.

[21] This is equivalent to a random-offeror model where α is the probability that the defendant makes the offer. One could also use an alternating offer bargaining protocol; different discount factors for the consumers and firms would yield an uneven division of surplus.

It is interesting to compare the firms' aggregate profit function with settlement in (11) to the profit function in (6) when settlement is impossible. When $p \leq c + k_p/\theta$, the consumers do not have a credible threat to sue. No lawsuits are brought and the profit functions in (6) and (11) are the same. When $p > c + k_p/\theta$ the profit functions in (6) and (11) are different. In (11), the first term $\Pi(x(p), c)$ are the profits of a monopolist with effective price $x(p)$ and production cost c. By contrast, in (6), the first term $\Pi(x(p), c + k)$ includes the cost of litigation k. This difference makes sense, since the parties avoid the litigation costs by setting out of court. The second term in (11) is the unanticipated settlement value captured by the myopic consumers, $(1 - \mu)D(x(p))s(p)$, where $s(p)$ is defined in (9). Similarly, in (6), the second term is the unanticipated litigation value captured by consumers.

Note that the firm's profit function in (11) is discontinuous when $p = c + k_p/\theta$. When p rises and crosses this threshold, there is a discrete transfer of value $(1 - \mu)D(x(p))s(p)$ from the firms to the myopic consumers. This transfer of value is unanticipated by consumers at the time of purchase, and therefore has a negative effect on the firms' aggregate profits. Now, we establish the following result, which, among others, shows that, unless $\mu = 1$, the firms are unable to realize unconstrained monopoly profit even when all cases settle.

Proposition 3. *Suppose the consumers and the firms engage in Nash settlement bargaining under symmetric information with $\alpha \in [0, 1]$ representing the firms' bargaining power. There exists a threshold $\widehat{k}_p^s \in (0, \theta(p^m(c) - c)]$ with the following properties.*

1. *When $k_p < \widehat{k}_p^s$ and $\mu \in [0, 1]$, the effective price is $p^m(c + \widetilde{k}^s)$ where $\widetilde{k}^s = \left(\frac{1-\mu}{1-\theta}\right)[(1-\alpha)k_d - \alpha k_p]$ and all cases settle in equilibrium. Aggregate firm profits are $\left(\frac{1-\theta}{1-\mu\theta}\right)\Pi\left(p^m(c + \widetilde{k}^s), c + \widetilde{k}^s\right)$ and social welfare is $W(p^m(c+\widetilde{k}^s), c)$. As k_p increases, both firm profits and social welfare increase.*

2. *When $k_p \in [\widehat{k}_p^s, \theta(p^m(c) - c))$ and $\mu \in [0, 1)$, the price is $c + k_p/\theta$ and no lawsuits are brought in equilibrium. Aggregate firm profits are $\Pi(c + k_p/\theta, c)$ and social welfare is $W(c+k_p/\theta, c)$. As k_p increases, firm profits increase and social welfare decreases.*

3. *When $k_p \geq \theta(p^m(c) - c)$ and $\mu \in [0, 1]$, the firms charge $p^m(c)$ and no lawsuits are brought in equilibrium. Aggregate firm profits are $\Pi(p^m(c), c)$ and social welfare is $W(p^m(c), c)$. Neither firm profits nor social welfare depend on k_p.*

When $\mu = 0$, $\widehat{k}_p^s \in (0, \theta(p^m(c) - c))$. As μ increases, $\widehat{k}_p^s$ increases; and when $\mu = 1$, $\widehat{k}_p^s = \theta(p^m(c) - c)$.

When $\mu = 1$, so consumers are fully forward looking, Proposition 3 implies that the firms will realize the unconstrained monopoly profit of $\Pi(p^m(c), c)$ regardless of k_p. In Case 1, when $k_p < \widehat{k}_p^s$, one can verify that $\widetilde{k}^s = 0$. It follows that the effective price is $p^m(c)$, and the firm profits are $\Pi(p^m(c), c)$. In other words, with fully forward looking consumers, the firms can raise the price to take into account the "settlement rebate," $s(p)$, the consumers fully expect to receive. One can show that $\widehat{k}_p^s = \theta(p^m(c) - c)$, so the range for k_p in Case 2 disappears. In Case 3, firm profits are $\Pi(p^m(c), c)$. Taken together, when $\mu = 1$, the firms are able to realize the unconstrained monopoly profit for all values of k_p. Since the firms can get the monopoly profit $\Pi(p^m(c), c)$ for all values of k_p, class action waivers are unnecessary.

When the consumers are (at least) partially myopic, i.e., $\mu < 1$, the consumers do not take full account of the settlement rebate when making their purchase decisions. The firms' incentives to impose class action waivers and their effect on social welfare also change consumers are myopic ($\mu < 1$). First, in Case 1 where $k_p \leq \widehat{k}_p^s$, then an increase in k_p increases firm profits. Since the effective price falls as k_p increases, social welfare rises too. So, in Case 1, the private and social incentives to adopt class action waivers are aligned. Second, in Case 2 when $k_p > \widehat{k}_p^s$, the firms push litigation off the equilibrium path and set $p = c + k_p/\theta$. Given that all cases settle under symmetric information in equilibrium, although there is no welfare loss from litigation, because the firms get to collude on a higher price with a higher k_p, social welfare will decrease with class action waivers.

3.2 The Market for Legal Services

In the main analysis, we assumed that the consumer-plaintiffs paid *directly* for the litigation cost, k_p. In many private antitrust lawsuits, lawyers pay the costs k_p out of pocket and are paid on a contingency basis. In other words, the lawyer receives a percentage share of the damage award if the case is won, and nothing if the case is lost. We now extend the model to consider the market for legal services and alternative fee arrangements. We will show that the results of the benchmark model are robust with additional nuance.

To begin, suppose that attorneys come from a market for legal services that enjoys market power parameterized by $\gamma \in [0, 1]$. If $\gamma = 0$, then the market for legal services is perfectly competitive; lawyers bid against each other for the right to represent clients. The lawyer's total compensation when $\gamma = 0$ is sufficient to cover the cost k_p and nothing more.[22] In this case, the lawyer receives a net return from litigation of zero, and each plaintiff enjoy a net return of $\theta(p-c)-k_p$. If $\gamma = 1$, then the market for

[22] We will assume away the problems of moral hazard.

legal services is monopolistic. The lawyer's total compensation extracts the full net value of litigation. So the lawyer's net return (measured per plaintiff) is $\theta(p-c)-k_p$, and the consumer-plaintiffs get nothing. More generally, the lawyer and the plaintiffs will share the net return from litigation in proportion to the competitiveness of the market, $\gamma \in [0,1]$. The lawyer's net return (per plaintiff) is $\gamma[\theta(p-c)-k_p]$, and the plaintiff's net return is $(1-\gamma)[\theta(p-c)-k_p]$.

Although the plaintiffs receive a net return $(1-\gamma)[\theta(p-c)-k_p]$ ex post, they may not fully anticipate this net return ex ante. When viewed ex ante, the consumer expects to receive proportion $\mu \in [0,1]$ of this amount, where as before μ is the degree to which the consumers are forward looking. We can therefore write the effective price paid by a consumer as a function of μ and γ:

$$x(p) = p - \mu(1-\gamma)\max\{\theta(p-c)-k_p, 0\}. \tag{12}$$

When $\gamma = 0$, so the market for lawyers is perfectly competitive, then the effective price is exactly as it was in equation (4). This makes sense: when the market is competitive, lawyers bid the contingent fee down to just cover the lawyers' cost, k_p and so the consumer receives all of the net surplus created, $\theta(p-c)-k_p$. When lawyers have monopoly power, so $\gamma = 1$ then consumers receive none of the net surplus from litigation so the effective price is $x(p) = p$.

As in our benchmark model, the aggregate firm profits are $D(x(p))[p-c-(\theta(p-c)+k_d)]$ and, as before, we can express the firms' aggregate profits as a function of the effective price x. When $\theta(p-c)-k_p \leq 0$ then lawsuits are not brought and firm profits $\Pi(p,c)$ or equivalently $\Pi(x,c)$. When $\theta(p-c)-k_p > 0$ then lawsuits are brought and firm profits are:

$$\Pi(x, c+k) - (1-\mu(1-\gamma))D(x)[\theta(p(x)-c)-k_p]. \tag{13}$$

All of our results from the benchmark model hold, with the parameter μ replaced by its modified value $\mu(1-\gamma)$.

Proposition 4. *Suppose the lawyers bear the litigation cost of k_p and receive a fraction $\gamma \in [0,1]$ of the plaintiffs' net recovery. All of our previous results hold, with μ replaced by $\mu' = \mu(1-\gamma)$.*

Note that introducing a market for legal services does not change the qualitative results from Part 2. As shown earlier, the firm's private incentive to block class actions through class action waivers may be socially excessive or socially insufficient. Note also that these results are robust to the particular *method* of compensation. In particular, a contingent percentage β that satisfies $\theta\beta(p-c) = \gamma[\theta(p-c)-k_p]$

gives the lawyer a share γ of the net surplus. Rearranging terms, the equilibrium contingent fee β may be written as:

$$\beta = \gamma - \frac{\gamma k_p}{\theta(p-c)}. \tag{14}$$

Thus, the lawyer could reap the net returns characterized above through an alternative fee arrangement, including a contingent fee, and our results would not be affected.

3.3 Fee Shifting

In the main analysis, the plaintiff and the defendant were responsible for paying their own litigation costs regardless of the outcome at trial. This is the rule typically used in the United States (the American Rule). Suppose instead that the loser in litigation must reimburse the winner for the litigation costs (the English Rule). If we let $\theta \in (0,1)$ represent the plaintiff's probability of winning at trial then, with fee-shifting, the plaintiff's and defendant's expected litigation costs become $k_p^{ER} = (1-\theta)(k_p + k_d)$ and $k_d^{ER} = \theta(k_p + k_d)$, respectively.

A change from the American Rule to the English Rule may increase or decrease prices, profits, and social welfare depending on whether θ is smaller than or greater than $\frac{k_d}{k_p+k_d}$. If $\theta > \frac{k_d}{k_p+k_d}$, the plaintiff is likely to win at trial and the plaintiff's expected litigation costs are lower under the English Rule than the American Rule. If $\theta < \frac{k_d}{k_p+k_d}$, the plaintiff is likely to lose at trial and the plaintiff's expected litigation costs are higher under the English Rule. All of the results of the benchmark model will continue to hold, with the threshold $\widehat{k}_p^{ER}$, determined by equation (8), but using k_p^{ER} and k_d^{ER}, instead of k_p and k_d, respectively.

Proposition 5. *Suppose the loser in litigation must reimburse the winner's litigation costs. With $\mu = 1$, when $\theta > \frac{k_d}{k_p+k_d}$, we get $\widehat{k}_p^{ER} > \widehat{k}_p$, and when $\theta \leq \frac{k_d}{k_p+k_d}$, we get $\widehat{k}_p^{ER} \leq \widehat{k}_p$. With $\mu < 1$, however, $\widehat{k}_p^{ER} \gtreqless \widehat{k}_p$.*

Before we proceed, one unique aspect about private antitrust lawsuits in the U.S. is that it utilizes one-way fee-shifting for the benefit of the plaintiffs. Under Clayton Act §4(a), when the plaintiffs prevail, they are entitled to recover "the cost of suit, including a reasonable attorneys fee" from the defendants. The defendants, on the other hand, do not recover their expenses from the plaintiffs when they prevail and are subject to the American rule. With plaintiff-friendly, one-way fee-shifting, the plaintiff's and defendant's expected litigation costs become $k_p^{CA} = (1-\theta)k_p$ and $k_d^{CA} = k_d + \theta k_p$, respectively. The threshold $\widehat{k}_p^{CA}$ is determined by equation (8), and will of course be the same as the value $\widehat{k}_p$ in Proposition 1. Since $k_p^{CA} = (1-\theta)k_p < k_p$, the treshhold vaue for the plaintiff's litigation cost will be higher. With lower plaintiff litigation cost, keeping litigation off the equilibrium path becomes less attractive for the firms and they become more likely to allow litigation in equilibrium.

3.4 Damage Multipliers

In private antitrust suits, plaintiffs are sometimes entitled to recover multiple times the actual harm suffered (e.g., treble damages under Clayton Act §4(a)). While multiple damages provide a stronger ex post incentive to the consumers to bring suit, previous literature has cast doubt on whether it works as deterrence (Easterbrook (1985), Salant (1987), and Baker (1988)). The basic story, similar to ours with fully forward-looking consumers ($\mu = 1$), is that, with higher damages, consumers would become willing to pay more for the product and the firms can charge a higher price ex ante, so that, in the end, firms realize the same expected monopoly profit and the consumers obtain the same expected surplus. What is important in the analysis, however, are the assumptions that (1) the ex post private litigation is costless and (2) there is less than full deterrence ($\theta < 1$).[23]

In the main model, θ was the expected fraction of the overcharge $(p - c)$ awarded to the plaintiffs in litigation. We can reflect a damages multiplier by adjusting θ. For example, if there is a 25% chance of winning the cases, and only compensatory damages are awarded (100% of the overcharge), then $\theta = .25 \times 1 = .25$. If, on the other hand, treble damages are awarded (300% of the overcharge), then $\theta = .25 \times 3 = .75$. The bigger the damages multiplier, the higher the θ. With a sufficiently generous damages multiplier, we may even have $\theta \geq 1$. As the following proposition shows, with costly litigation ($k_p > 0$), the neutrality result no longer holds but the firms can realize a strictly positive profit even when $\theta > 1$. Finally, whether the firms will impose a class action waiver will depend crucially on θ.

Proposition 6. *When $\theta < 1$, as θ increases, $\widehat{k}_p$ increases when $\mu = 1$ but may or may not increase when $\mu < 1$. When $\theta \geq 1$, firms will set $p = \min\{p^m(c), c + k_p/\theta\}$, avoid litigation in equilibrium, and realize a strictly positive profit $\forall k_p > 0$ and $\forall \mu \in [0, 1]$.*

Recall that Proposition 1 characterizes the equilibrium price, litigation decisions, firm profits, and social welfare when $\theta < 1$. If consumers are forward-looking ($\mu = 1$) and $k_p < \widehat{k}_p$ then the effective price is $p^m(c + k)$ where $k = k_p + k_d$, lawsuits are brought in equilibrium, and firm profits are $\Pi(p^m(c + k), c + k)$. So, when $\mu = 1$

[23] This is similar to our extension in Section 3.1 where all cases settle and the parties do not incur any litigation cost in equilibrium. There, when consumers are fully forward-looking ($\mu = 1$), the firms achieve monopoly profits $\Pi(p^m(c), c)$ for all $\theta < 1$.

and $k_p < \widehat{k}_p$, the neutrality result holds: as θ rises, firms increase the price to offset the more generous rebate and earn the same aggregate profit. However, according to Proposition 6, when θ rises, the threshold $\widehat{k}_p$ rises. Intuitively, as θ rises, pushing litigation off the equilibrium path becomes less attractive because the profit margin (k_p/θ) decreases. So, there is more litigation in equilibrium. This also implies that, with respect to class action waivers, in a broader parameter space (or k_p space), firms will have an incentive to reduce the consumers' litigation cost (k_p) which will also increase welfare.

With myopic consumers ($\mu < 1$), however, the neutrality result no longer holds. The equilibrium prices, litigation decisions, profits and welfare will depend on the parameter θ. In case 1 of Proposition 1, as θ rises, because the myopic consumers' purchase decision is unaffected by the change in θ but the firms' expected litigation payment ($\theta(p - c) + k_d$) rises, firms' aggregate profit falls. At the same time, pushing litigation off the equilibrium path also becomes unattractive, for the same reason as with the fully forward-looking consumers. This makes the effect of change in θ on $\widehat{k}_p$ ambiguous. For instance, when θ is relatively small, a small increase can have a big effect on the profits the firms can earn by pushing litigation off the equilibrium path but a relatively small effect on the profits in case they allow litigation. The effects can be reversed when θ is relatively large. Changes to the firms' incentive on imposing class action waivers (and blocking class actions) are similarly ambiguous.

When $\theta \geq 1$, it is no longer in the firms' interest to allow litigation in equilibrium regardless of μ. If the firms set a price $p > c + k_p/\theta$ then lawsuits are brought and the firms realize a negative profit. However, with $k_p > 0$, firms can still set $p = c + k_p/\theta$, push litigation off the equilibrium path and earn positive profits (with the profit margin of k_p/θ). Given that the size of consumers' litigation cost directly translates to the size of profit margins, firms will have a strong incentive to increase k_p as much as they can. With $\theta \geq 1$, therefore, firms will surely impose class action waivers on consumers and block class actions. This is socially inefficient since it allows the firms to charge a higher price and generate a larger deadweight loss.

4 Concluding Remarks

The paper has examined the effect of class actions and class action waivers in the context of private antitrust lawsuits, in particular, lawsuits against collusion among competitors. Class action waivers, often through mandatory individual arbitration clauses, have received much attention especially since the U.S. Supreme Court has endorsed such private ordering mechanism. The paper has shown that whether the firms will require the consumers to waive their right to bring a class action depends on the consumers' individual litigation cost. Furthermore, depending on the circumstances, firms' incentive in seeking class action waivers can be aligned with the social objective. This is the case, for instance, when the consumers' litigation costs are relatively low so that the firms treat litigation in equilibrium as just another cost of doing business. The paper has also shown that the core results remain robust to possible settlements, contingent fee attorneys, fee shifting, and damages multiplier.

While the current focus of the paper was on price fixing and private antitrust lawsuits, the analysis is applicable to other settings where the firms' pre-sale behavior can affect the terms of trade. Examples include product design (product liability and consumer financial contracts), false advertising (*Concepcion*), employment (*Epic Systems*), and unlawful monopolization (*Italian Colors*). In the products liability setting, for instance, firms may fundamentally lack sufficient ex ante incentives to design safer products.[24] The class action can be an effective mechanism for aligning the firm's private incentives with those of society. If firms can block consumers from using the class action mechanism, forcing them to pursue individual actions, then product safety is clearly compromised. Firms also have a strong incentive to minimize or eliminate product liability lawsuits ex post.[25] We plan to broaden our analysis to other settings where pre- and post-sale behavior of the firm could play an important role in choosing the litigation regime (e.g., asking for a class action waiver).

[24] In Choi and Spier (2014), competitive firms reduce safety levels in order to cream-skim the low risk consumers. In Hua and Spier (2018), firms tailor the product to suit the needs of the marginal consumer instead of the average consumer. Safety is suboptimal if the marginal consumer has a lower willingness to pay for safety than the average consumer. In Hamada (1975), consumers systematically underestimate product risks. In these and other settings, products liability induces firms to design safer products.

[25] The ex post incentive to minimize or eliminate product liability lawsuits for the firm that has produced a (likely) defective product is clear. Even for the firm that has produced a (likely) non-defective product, to the extent that there could be frivolous litigation, the firm would want to minimize or eliminate product liability lawsuit ex post.

Appendix: Proofs

Proof of Lemma 1. The case where $p \leq c + k_p/\theta$ was proven in the text. Suppose $p > c + k_p/\theta$. We now show that (5) and (6) are equivalent. Rewrite the second part of the profit function from (6) as:

$$D(x(p))(x(p) - c - k_p - k_d) - (1-\mu)D(x(p))[\theta(p-c) - k_p].$$

Substituting for $x(p)$ from (4), this becomes

$$D(x(p))[p - \mu(\theta(p-c) - k_p) - c - k_p - k_d] - (1-\mu)D(x(p))[\theta(p-c) - k_p]$$

$$= D(x(p))[p - c - k_p - k_d] - \mu D(x(p))[\theta(p-c) - k_p] - (1-\mu)D(x(p))[\theta(p-c) - k_p]$$

$$= D(x(p))[p - c - k_p - k_d] - D(x(p))[\theta(p-c) - k_p]$$

$$= D(x(p))[p - c - (\theta(p-c) + k_d)].$$

These are the firm's aggregate profits in (5). Piecewise continuity is immediate. Now consider the comparative statics for μ. From (4) we see that $x(p)$ is weakly decreasing in μ. Therefore $D(x(p))$ is weakly increasing in μ, so the firm profits in (5) are weakly increasing in μ. □

Proof of Lemma 2. Consider first the left-hand side of (8). When $k_p = 0$, the left-hand side of (8) is $\Pi(c,c) = 0$. When $k_p = \theta(p^m(c) - c)$ the left-hand side is $\Pi(p^m(c), c)$, the monopoly profit without the threat of litigation. The left-hand side of (8) is strictly increasing in k_p in the range $(0, \theta(p^m(c) - c))$.[26]

We will now show that the right-hand side of (8) is positive, decreasing in k_p, and smaller than $\Pi(p^m(c), c)$. To facilitate this, we will rewrite the profit function. Using (5), we can rewrite the right-hand side of (8) as

$$\max_x \{D(x)\left[p(x) - c - (\theta(p(x) - c) + k_d)\right]\}. \tag{15}$$

or equivalently

$$\max_x \{D(x)(1-\theta)\left(p(x) - c\right) - k_d\}. \tag{16}$$

Substituting the expression for $p(x)$ from (7) and rearranging terms, the right-hand side of (8) is equivalent to:

$$\max_x \left\{ \tfrac{1-\theta}{1-\mu\theta} D(x)\left[x - c - \mu k_p - \left(\tfrac{1-\mu\theta}{1-\theta}\right) k_d\right] \right\}. \tag{17}$$

[26]When $k_p > \theta(p^m(c) - c)$ then the left-hand side is decreasing in k_p.

This is strictly positive (since x is chosen to maximize profits); strictly decreasing in k_p (by the envelope theorem); and smaller than $\Pi(p^m(c), c)$. Therefore an implicit solution $\widehat{k}_p \in (0, \theta(p^m(c) - c))$ exists and is unique.

Now, let's turn to the comparative statics and show that $\widehat{k}_p$ is an increasing function of μ. Let $x^*(k_p, \mu)$, which we write as x^* for brevity, be the value of x that maximizes (17). Then equation (8) defining $\widehat{k}_p$ may be written as:

$$\Pi(c + \widehat{k}_p/\theta, c) = \tfrac{1-\theta}{1-\mu\theta} D(x^*) \left[x^* - c - \mu\widehat{k}_p - \left(\tfrac{1-\mu\theta}{1-\theta}\right) k_d \right], \tag{18}$$

or, equivalently,

$$\Pi(c + \widehat{k}_p/\theta, c) = \tfrac{1-\theta}{1-\mu\theta} D(x^*) \left[x^* - c - \mu\widehat{k}_p \right] - D(x^*) k_d. \tag{19}$$

Totally differentiating with respect to $\widehat{k}_p$ and μ and rearranging terms gives:[27]

$$\tfrac{d\Pi(c+\widehat{k}_p/\theta,c)}{dx} d\widehat{k}_p/\theta = -\tfrac{(1-\theta)\mu}{1-\theta} D(x^*) d\widehat{k}_p + \tfrac{1-\theta}{(1-\mu\theta)^2} D(x^*)[\theta(x^* - c) - \widehat{k}_p] d\mu.$$

Moving the terms involving $d\widehat{k}_p$ to the left-hand side, this becomes

$$\left[\tfrac{d\Pi\left(c+\widehat{k}_p/\theta,c\right)}{dx} (1/\theta) + \tfrac{(1-\theta)\mu}{1-\theta} D(x^*) \right] d\widehat{k}_p = \left[\tfrac{1-\theta}{(1-\mu\theta)^2} D(x^*) \left(\theta(x^* - c) - \widehat{k}_p \right) \right] d\mu.$$

Since $c + \widehat{k}_p/\theta < p^m(c)$, we know $d\Pi\left(c + \widehat{k}_p/\theta, c\right)/dx > 0$ so the expression in brackets on the left-hand side is strictly positive. Now consider the right-hand side. Since x^* maximizes (17), we have $x^* > p^m(c) > c + \widehat{k}_p/\theta$, and so $\theta(x^* - c) - \widehat{k}_p > \theta(p^m(c) - c) - \widehat{k}_p > 0$. So, the expression in brackets on the right-hand side is strictly positive, too. This concludes the proof that $d\widehat{k}_p/d\mu > 0$. $\square$

Proof of Proposition 1. Let's start with case 3. If the firms charge price $p^m(c)$ then consumers do not bring suit because $k_p \geq \theta(p^m(c) - c)$ and the aggregate profits are $\Pi(p^m(c), c)$. From (6) we know that other prices lead to lower profits.

Now, consider Case 2. Since $k_p \in [\widehat{k}_p, \theta(p^m(c) - c)))$, we have that $c + k_p/\theta \in [c + \widehat{k}_p/\theta, p^m(c))$. Since consumers do not sue the firms when $p \leq c + k_p/\theta$ and profits are increasing in p in this range, $p = c + k_p/\theta$ is the most profitable price that deters

[27] Using the envelope theorem, we may disregard the effects of changes of $\widehat{k}_p$ and μ through x^*.

litigation. If the firm charge $p > c + k_p/\theta$ then consumers bring lawsuits. (8) implies that this would lead to lower aggregate profits.

Finally, consider Case 1. If $k_p < \widehat{k}_p$ defined in Lemma 2 then the firms will raise the price to $p > c + k_p/\theta$ and accommodate lawsuits in equilibrium. Using (17) above, firm profits may be written as

$$\left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x)\Big(x - c - \widetilde{k}\Big),$$

where $\widetilde{k} = \mu k_p + \left(\tfrac{1-\mu\theta}{1-\theta}\right) k_d$, so $p^m(c + \widetilde{k})$ is the effective price that maximizes firm profits. This verifies firm profits in Case 1 of the proposition.

The comparative statics for Case 2 and Case 3 are immediate. Consider Case 1. Social welfare may be written $W(p^m(c + \widetilde{k}), c + k)$.[28] An increase in k_p will impact social welfare through both k and $\widetilde{k}$. First, when k_p rises, the litigation costs $k = k_p + k_d$ rise and social welfare falls. Second, when k_p rises, $\widetilde{k}$ rises so $p^m(c+\widetilde{k})$ rises and social welfare falls. Now consider a change in μ. An increase in μ may either increase or decrease social welfare: if $\frac{k_p}{k_d} < \frac{\theta}{1-\theta}$ then $\widetilde{k}$ falls and social welfare rises; if $\frac{k_p}{k_d} > \frac{\theta}{1-\theta}$ then $\widetilde{k}$ rises and social welfare falls. Now consider aggregate firm profits. Using (19) the aggregate profits may be written as

$$\tfrac{1-\theta}{1-\mu\theta} D(p^m(\cdot))\left[p^m(\cdot) - c - \mu k_p\right] - D(p^m(\cdot))k_d, \tag{20}$$

where $p^m(\cdot) = p^m(c + \widetilde{k})$. We first consider a change in k_p. Holding $\mu \in (0, 1]$ fixed, firm profits are a decreasing function of k_p. When $\mu = 0$, firm profits do not depend on k_p. Now consider a change in μ. Differentiating firm profits with respect to μ, and applying the envelope theorem, the slope is

$$\tfrac{1-\theta}{(1-\mu\theta)^2} D(p^m(\cdot))\left[\theta(p^m(\cdot) - c) - k_p\right]. \tag{21}$$

This is positive because $p^m(\cdot) > p^m(c)$ and $\theta(p^m(c) - c) - k_p > 0$. $\square$

Proof of Proposition 2. We first show that there exists a unique $\overline{k}_p$ such that

$$\Pi\left(c + \overline{k}_p/\theta, c\right) = \left(\tfrac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z), \tag{22}$$

[28] Note that social welfare depends on $\widetilde{k}$ only through its effect on the price, $p^m(c + \widetilde{k})$.

where $z = c + \left(\frac{1-\mu\theta}{1-\theta}\right) k_d$ and $\overline{k}_p \in (\widehat{k}_p, \theta(p^m(c) - c))$ when $\mu \in (0, 1]$ and $\overline{k}_p = \widehat{k}_p$ when $\mu = 0$.

Recall that the expression $\Pi\left(c + k_p/\theta, c\right)$ represents the firms' profits if they charge $p = c + k_p/\theta$ and litigation is deterred. This is a strictly increasing function of k_p for all $k_p \in [0, \theta(p^m(c) - c)]$, equals zero if $k_p = 0$, and equals $\Pi(p^m(c), c)$ when $k_p = \theta(p^m(c) - c)$. The right-hand side of the equality, $\left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z)$, represents the firms' profits when $k_p = 0$ (but $k_d \geq 0$) and all lawsuits are brought (see Case 1 of Proposition 1). This is independent of k_p, is strictly positive (since we've assumed $k_p = 0$ in defining z), and is strictly smaller than $\Pi(p^m(c), c)$ for all $k_d > 0$. Therefore, there exists a unique $\overline{k}_p$, such that $\Pi\left(c + \frac{\overline{k}_p}{\theta}, c\right) = \left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z)$ where $z = c + \left(\frac{1-\mu\theta}{1-\theta}\right) k_d$.

In terms of how $\overline{k}_p$ depends on μ, first, note that when $\mu \in (0, 1]$, $\left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z)$ is strictly decreasing with respect to k_p (per Lemma 2). Hence, $\left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z) > \left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z + \mu\widehat{k}_p), z + \mu\widehat{k}_p)$. Given that $\widehat{k}_p > 0$ and that $\Pi\left(c + k_p/\theta, c\right)$ is strictly increasing with respect to k_p, we must have $\overline{k}_p \in (\widehat{k}_p, \theta(p^m(c) - c))$. Second, when $\mu = 0$, $\left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z)$ is independent with respect to k_p and $\left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z), z) = \left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(z + \mu\widehat{k}_p), z + \mu\widehat{k}_p)$. Hence, $\overline{k}_p = \widehat{k}_p$.

We will now define the threshold $\underline{k}_p$ in case 2. Note that for $(\widehat{k}_p, \overline{k}_p)$ to be a non-empty set, we need $\mu \in (0, 1]$. Given a value $k_p \in (\widehat{k}_p, \overline{k}_p)$, define $\underline{k}_p \in (0, \widehat{k}_p)$, such that

$$\Pi\left(c + k_p/\theta, c\right) = \left(\frac{1-\theta}{1-\mu\theta}\right) \Pi(p^m(y), y), \tag{23}$$

where $y = c + \mu\underline{k}_p + \left(\frac{1-\mu\theta}{1-\theta}\right) k_d$. The left-hand side are the firm' profits if they charge $p = c + k_p/\theta$ and litigation is deterred. The left-hand side is positive, greater than $\Pi(c + \widehat{k}_p/\theta, c)$, and does not depend on $\underline{k}_p$. The right-hand side represents the firms' profits if litigation is allowed (see Case 1 of Proposition 1). Since y is an increasing function of $\underline{k}_p$, the right-hand side is a decreasing function of $\underline{k}_p$. When $\underline{k}_p = 0$ then $y = z$ and the left-hand side is smaller than the right-hand side (since $k_p \in (\widehat{k}_p, \overline{k}_p)$). When $\underline{k}_p = \widehat{k}_p$ then the left-hand side is larger than the right-hand side. Therefore the threshold $\underline{k}_p \in (0, \widehat{k}_p)$ exists and is unique. With $\overline{k}_p$ and $\underline{k}_p$ properly defined, let's turn to the three cases in the proposition.

First, consider Case 1, where $k_p \le \widehat{k}_p$. By definition, we get $k_p^c < k_p \le \widehat{k}_p$. From Case 1 of Proposition 1, we know that profits are (at least weakly) higher with k_p^c, while social welfare is strictly higher with k_p^c. Hence, when $\mu \in (0,1]$ firms have a strictly positive incentive to allow class actions and the social welfare is higher. When $\mu = 0$, the firms are indifferent with respect to class action.

Now, consider Case 2, where $k_p \in (\widehat{k}_p, \overline{k}_p)$. Note that, we are assuming that $\mu \in (0,1]$. If $k_p^c > \underline{k}_p$, from above, firm profits are lower with class actions. So the firm will block class actions. From Proposition 1, if $k_p^c \ge \widehat{k}_p$, the firms' blocking class actions is socially inefficient. On the other hand, if $k_p^c < \widehat{k}_p$, firms' blocking class actions is socially efficient. When $k_p^c \le \underline{k}_p$ then firm profits are (at least weakly) higher with class actions and the firm will therefore allow class actions. From Proposition 1 and Corollary 1, we know that social welfare would be higher if class actions were blocked.

Finally, consider Case 3, where $k_p \ge \overline{k}_p$. For any $k_p^c < k_p$, firm profits are lower with class actions (even if $k_p^c = 0$). So the firms will block class actions. This is socially inefficient if $k_p^c > \widehat{k}_p$. This is because social welfare is decreasing in k_p^c when $k_p^c \in [\widehat{k}_p, \theta(p^m(c) - c)$ (see Proposition 1 Case 2). Blocking class actions is socially efficient if $k_p^c \le \widehat{k}_p$. □

Proof of Lemma 3. When $p \le c + k_p/\theta$ lawsuits are not brought and so aggregate profits are $D(p)(p-c) = \Pi(p,c)$. When $p > c + k_p/\theta$ cases are brought and are settled for $s(p)$. Firm profits are:

$$D(x(p))(p - c - s(p))$$

$$= D(x(p))(p - \mu s(p) - c - (1-\mu)s(p))$$
$$= D(x(p))(p - \mu s(p) - c) - (1-\mu)D(x(p))s(p).$$

Substituting $x(p) = p - \mu s(p)$ from (10), profits are

$$D(x(p))(x(p) - c) - (1-\mu)D(x(p))s(p)$$

$$= \Pi(x(p), c) - (1-\mu)D(x(p))s(p).$$

□

Proof of Proposition 3. If $k_p \geq \theta(p^m(c) - c)$, then the firms can charge $p^m(c)$ without any threat of litigation. If $k_p < \theta(p^m(c) - c)$, then consumers would bring suit if the firms charge $p^m(c)$. Suppose the price is sufficiently high (i.e., $p > c + k_p/\theta$), so that the consumers have a credible threat to go to trial. The firms' aggregate profits are $D(x(p))(p - c - s(p))$ where $x(p)$ is defined in (10) above. Substituting for $s(p)$ from (9) above gives the firms' aggregate profits:

$$D(x(p))\left[(1-\theta)(p-c) - k_d + \alpha(k_p + k_d)\right].$$

We will now replace $p - c$ in this profit function with a function that doesn't depend on p directly and is linear in $x(p) - c$. Substituting (9) into (10) allows us to write:

$$x(p) = p - \mu\theta(p-c) + \mu k_p - \mu(1-\alpha)(k_p + k_d),$$

which becomes:

$$x(p) = (p-c) + c - \mu\theta(p-c) + \mu k_p - \mu(1-\alpha)(k_p + k_d),$$

$$x(p) = (1-\mu\theta)(p-c) + c - \mu[k_d - \alpha(k_p + k_d)],$$
$$(1-\mu\theta)(p-c) = x(p) - c + \mu[k_d - \alpha(k_p + k_d)].$$

Dividing by $1 - \mu\theta$ allows us to write $p - c$ as a linear function of $x(p) - c$:

$$p - c = \left(\tfrac{1}{1-\mu\theta}\right)(x(p) - c) + \left(\tfrac{\mu}{1-\mu\theta}\right)[k_d - \alpha(k_p + k_d)]. \tag{24}$$

We now replace $p - c$ in the firm's profit function above with this expression and get:

$$D(x(p))\left[\left(\tfrac{1-\theta}{1-\mu\theta}\right)(x(p)-c) + \left(\tfrac{(1-\theta)\mu}{1-\mu\theta}\right)[k_d - \alpha(k_p+k_d)] - \left(\tfrac{1-\mu\theta}{1-\mu\theta}\right)[k_d - \alpha(k_p+k_d)]\right]$$

$$= D(x(p))\left[\left(\tfrac{1-\theta}{1-\mu\theta}\right)(x(p)-c) - \left(\tfrac{1-\mu}{1-\mu\theta}\right)[k_d - \alpha(k_p+k_d)]\right]$$
$$= \left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x(p))\left[x(p) - c - \left(\tfrac{1-\mu}{1-\theta}\right)(k_d - \alpha(k_p+k_d))\right]$$
$$= \left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x(p))\left(x(p) - c - \widetilde{k}^s(k_p,\mu)\right).$$

where

$$\widetilde{k}^s(k_p,\mu) = \left(\tfrac{1-\mu}{1-\theta}\right)(k_d - \alpha(k_p + k_d)). \tag{25}$$

To summarize, when $p > c + k_p/\theta$, then lawsuits are settled and the aggregate firm profits are $\left(\frac{1-\theta}{1-\mu\theta}\right)\Pi\left(x(p), c + \widetilde{k}^s(k_p,\mu)\right)$. If $p = c + k_p/\theta$, the firms deter lawsuits and earn profits of $\Pi(c + k_p/\theta, c)$.

Define $\widehat{k}_p^s$ to be the implicit solution to

$$\Pi(c + k_p/\theta, c) = \max_x \left\{ \left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x) \left(x - c - \widetilde{k}^s(k_p, \mu)\right) \right\}. \tag{26}$$

where $\widetilde{k}^s(k_p, \mu)$ is defined in (25) above.

Claim 1. An implicit solution to equation (26), $\widehat{k}_p^s \in (0, \theta(p^m(c) - c)]$, exists and is unique.

Proof of Claim 1. Consider first the left-hand side of (26). When $k_p = 0$, the left-hand side is equal to $\Pi(c, c) = 0$, and when $k_p = \theta(p^m(c) - c)$ it is equal to $\Pi(p^m(c), c)$. Moreover, $\Pi(c + k_p/\theta, c)$ is a strictly increasing function of k_p for all $k_p \in [c, \theta(p^m(c) - c)$. Finally, regularity condition on the demand function, i.e., $D''(p)(p - c) + 2D'(p) < 0\ \forall p$, implies that $\Pi(c + k_p/\theta, c)$ is a concave function of k_p.

Now consider the right-hand side of (26). First, note that since $\widetilde{k}^s(k_p, \mu)$ defined in (25) is a weakly decreasing function of k_p. Therefore, using the envelope theorem, the right-hand side of (26) is a continuous and weakly increasing function of k_p. Second, when $k_p = 0$, the right-hand side is strictly positive (as it is for all k_p). Hence, when $k_p = 0$, the right-hand side of (26) is strictly larger than the left-hand side.

We will now show that when $k_p = \theta(p^m(c) - c)$, the right-hand side is, at least weakly, smaller than the left-hand side. Note first that the left-hand side of (26) is independent of μ $\forall k_p \in [0, \theta(p^m(c) - c)]$. Second, when $\mu = 1$, (25) implies that $\widetilde{k}^s(k_p, 1) = 0$, so the right-hand side of (26) equals $\max_x \{D(x)(x - c)\} = \Pi(p^m(c), c)$ $\forall k_p$. That is, when $\mu = 1$, the right-hand side of (26) is equal to the left-hand side. Third, we now show that when $\mu < 1$, the right-hand side of (26) is smaller than $\Pi(p^m(c), c)$. Differentiating the right-hand side of (26) with respect to μ, and after some simplification, we get:

$$\left(\frac{D(x^*)}{1-\mu\theta}\right) \left[\left(\frac{\theta(1-\theta)}{1-\mu\theta}\right) (x^* - c - \widetilde{k}^s(k_p, \mu)) + (k_d - \alpha(k_p + k_d)) \right],$$

and substituting for $\widetilde{k}^s(k_p, \mu)$ from (25) and combining terms gives

$$= \left(\frac{1-\theta}{1-\mu\theta}\right) D(x^*) \left[\left(\tfrac{\theta}{1-\mu\theta}\right) (x^* - c) + \left(\tfrac{1}{1-\mu\theta}\right) (k_d - \alpha(k_p + k_d)) \right].$$

Substituting $x^* - c = (1-\mu\theta)(p^* - c) - \mu(k_d - \alpha(k_p + k_d))$ from equation (24),

$$= \left(\frac{1-\theta}{1-\mu\theta}\right) D(x^*) \left[\theta(p^* - c) - \left(\tfrac{\mu\theta}{1-\mu\theta}\right)(k_d - \alpha(k_p + k_d)) + \left(\tfrac{1}{1-\mu\theta}\right)(k_d - \alpha(k_p + k_d))\right]$$

$$= \left(\frac{1-\theta}{1-\mu\theta}\right) D(x^*) \left[\theta(p^* - c) + k_d - \alpha(k_p + k_d)\right],$$

and using the formula for $s(p)$ from (9),

$$= \left(\frac{1-\theta}{1-\mu\theta}\right) D(x^*) s(p^*).$$

Given that $s(p) > 0$ whenever $\theta(p - c) > k_p$, which is the case for the right-hand side, this expression is strictly positive. Therefore, the right-hand side of (26) is a strictly increasing function of μ. In sum, we have established existence of an implicit solution $\widehat{k}_p^s$ and that when $\mu = 1$ that $\widehat{k}_p^s = \theta(p^m(c) - c)$ and when $\mu \in [0, 1)$ that $\widehat{k}_p^s \in (0, \theta(p^m(c) - c))$.

We have already shown that the left-hand side is an increasing and a concave function of k_p. We now show the right-hand side is an increasing and a convex function of k_p. Letting $x^*(k_p, \mu)$ be the effective price that maximizes the right-hand side of (26). We may rewrite the right-hand side of (26) as

$$\left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x^*(k_p, \mu))(x^*(k_p, \mu) - c - \widetilde{k}^s(k_p, \mu)).$$

Using the envelope theorem, the derivative of the right-hand side of (26) with respect to k_p is

$$-\left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x^*(k_p, \mu)) \frac{d\widetilde{k}^s(k_p, \mu)}{dk_p}.$$

Using the expression for $\widetilde{k}^s(k_p, \mu)$ in (25), this becomes

$$-\left(\tfrac{1-\theta}{1-\mu\theta}\right) D(x^*(k_p, \mu)) \left(\tfrac{-\alpha(1-\mu)}{1-\theta}\right) = \left(\tfrac{\alpha(1-\mu)}{1-\mu\theta}\right) D(x^*(k_p, \mu)) > 0$$

and the second derivative is

$$\left(\tfrac{\alpha(1-\mu)}{1-\mu\theta}\right) \frac{dD(x^*(k_p, \mu))}{dx} \frac{dx^*(k_p, \mu)}{dk_p}.$$

Note that $dD(\cdot)/dx < 0$ because demand curves slope downwards and, from (25), we have $dx^*(k_p, \mu)/dk_p < 0$. So the second derivative is positive. Therefore the right-hand side of (26) is an increasing and convex function of k_p. Combining with the results that the right-hand side (1) is strictly positive when $k_p = 0$; (2) is strictly smaller than $\Pi(p^m(c), c)$ when $k_p = \theta(p^m(c) - c)$ and $\mu < 1$; and (3) is increasing with respect to k_p, we have established uniqueness. Finally, given that the right-hand side is increasing with respect to μ while the left-hand side is independent of μ, as μ increases, $\widehat{k}_p^s$ increases, and as shown before, when $\mu = 1$, $\widehat{k}_p^s = \theta(p^m(c) - c)$: the comparative statics is also established. $\square$

Before we proceed, we need to prove one more point: in case $k_p < \widehat{k}_p^s$, consumers will, in fact, have a credible litigation threat in equilibrium. Unlike the case without the possibility of settlement, this issue is not as straightforward since, when α is sufficiently close to 1, for instance, we can have $\widetilde{k}^s < 0$ and the firms can have an effective marginal cost that is lower than c, which, in turn, lowers x^*.

Claim 2. If $k_p < \widehat{k}_p^s$ defined in (26), and if the effective price is $p^m(c + \widetilde{k}^s)$ where $\widetilde{k}^s = \left(\frac{1-\mu}{1-\theta}\right)[(1-\alpha)k_d - \alpha k_p]$, then consumers have a credible threat to sue and all cases settle in equilibrium.

Proof of Claim 2. In this proof, we will do comparative statics on the parameters k_p and α and will hold all of the other parameters constant. Let $\widehat{k}_p^s(\alpha)$ be the implicit solution to (26), expressed as a function of the parameter α (while holding all other parameters fixed). Let $x^*(k_p, \alpha)$ denote the effective price that maximizes the right-hand side of (26) and let $p^*(k_p, \alpha)$ be the corresponding actual price paid by consumers at the time of sale. Using the definitions of $s(p)$ and $x(p)$ in (9) and (10) we have:

$$p = \frac{x(p) - \mu\theta c + \mu(k_d - \alpha(k_p + k_d))}{1 - \mu\theta}, \tag{27}$$

and so we have

$$p^*(k_p, \alpha) = \frac{x^*(k_p, \alpha) - \mu\theta c + \mu(k_d - \alpha(k_p + k_d))}{1 - \mu\theta}. \tag{28}$$

We will now proceed to prove that $p^*(k_p, \alpha) > c + k_p/\theta$ for all $k_p < \widehat{k}_p^s(\alpha)$.

We will now prove that when $k_p = \widehat{k}_p^s(\alpha)$ and the effective price is $x^*(\widehat{k}_p^s(\alpha), \alpha)$ and the actual price is $p^*(\widehat{k}_p^s(\alpha), \alpha)$, then the consumers have a credible threat to sue: $p^*(\widehat{k}_p^s(\alpha), \alpha) \geq c + \widehat{k}_p^s(\alpha)/\theta$. We first prove this for $\alpha = 1$, and then prove the result for all α. Later, we will establish that the lawsuits are credible for all $k_p < \widehat{k}_p^s(\alpha)$ as well.

Consider first the special case where $\alpha = 1$. It is not difficult to show that the firms' profit function in (11) is a continuous function of p in this special case. Note that when $\alpha = 1$ and $p = c + k_p/\theta$, then equation (9) gives $s(p) = 0$ and equation (27) gives us $p = x(p)$. So, the firms' profits in (11) when p approaches $c + k_p/\theta$ from below or above is equal to $\Pi(p, c)$. Recall that $x^*(\widehat{k}_p^s(1), 1)$ is the effective price that maximizes on the right-hand side of (26). The maximized profits on the right-hand side of (26) equal the profits on the left-hand side, $\Pi(c + \widehat{k}_p^s(1)/\theta, c)$. So $p^*(\widehat{k}_p^s(1), 1) = x^*(\widehat{k}_p^s(1), 1) = c + \widehat{k}_p^s(1)/\theta$. Therefore the plaintiff has a (weakly) credible threat to sue.

Now suppose $\alpha < 1$. We will prove that when $k_p = \widehat{k}_p^s(\alpha)$, that the actual price $p^*(\widehat{k}_p^s(\alpha), \alpha) > c + \widehat{k}_p^s(\alpha)/\theta$ so the plaintiff has a credible threat to sue. First, we will prove that $p^*(k_p, \alpha)$ is a decreasing function of α. Recall that $x^*(k_p, \alpha) = p^m(c + \widetilde{k}^s)$ where $\widetilde{k}^s = \left(\frac{1-\mu}{1-\theta}\right)[(k_d - \alpha(k_p + k_d)]$. So holding k_p fixed, an increase in the parameter α will lower the value of $\widetilde{k}^s$ and will decrease the firm's effective price. Therefore the effective price $x^*(k_p, \alpha)$ is an decreasing function of α. Examination of equation (28) verifies that $p^*(k_p, \alpha)$ is a decreasing function of α, too.[29]

Second, we will prove that $\widehat{k}_p^s(\alpha) < \widehat{k}_p^s(1)$ for all $\alpha < 1$. To streamline the proof, define the function $\Psi(k_p, \alpha)$ be the maximized profits on the right-hand side of (26). Given the definition of $\widehat{k}_p^s(1)$, we have:

$$\Pi(c + \widehat{k}_p^s(1)/\theta, c) = \Psi(\widehat{k}_p^s(1), 1). \tag{29}$$

Since $\widetilde{k}^s = \left(\frac{1-\mu}{1-\theta}\right)[k_d - \alpha(k_p + k_d)]$ is a decreasing function of α, we know that the right-hand side of (26) is an increasing function of α. So, holding k_p fixed at $\widehat{k}_p^s(1)$, we have $\Psi(\widehat{k}_p^s(1), 1) > \Psi(\widehat{k}_p^s(1), \alpha)$. Next, since $\widetilde{k}^s = \left(\frac{1-\mu}{1-\theta}\right)[k_d - \alpha(k_p + k_d)]$ is a decreasing function of k_p, we have $\Psi(\widehat{k}_p^s(1), \alpha) > \Psi(0, \alpha)$. Finally, we know that $\Psi(0, \alpha) > 0 = \Pi(c + 0/\theta, c)$. Putting these expressions together, for all $\alpha < 1$, we have:

$$\Pi(c + \widehat{k}_p^s(1)/\theta, c) > \Psi(\widehat{k}_p^s(1), \alpha) > \Psi(0, \alpha) > \Pi(c + 0/\theta, c). \tag{30}$$

It follows that there is a fixed point, $\widehat{k}_p^s(\alpha) \in (0, \widehat{k}_p^s(1))$, that satisfies $\Pi(c + \widehat{k}_p^s(\alpha)/\theta, c) = \Psi(\widehat{k}_p^s(\alpha), \alpha)$.

To recap, we have established above that when $k_p = \widehat{k}_p^s(\alpha)$ and the effective price

[29] Consider the right-hand side of equation (28). When α rises, $x^*(k_p, \alpha)$ falls and there is also a negative direct effect since α appears with a negative sign in the numerator. Therefore $p^*(k_p, \alpha)$ is a decreasing function of α.

is $x^*(\widehat{k}_p^s(\alpha),\alpha)$ that the actual price $p^*(\widehat{k}_p^s(\alpha),\alpha) \geq c + \widehat{k}_p^s(\alpha)/\theta)$ so consumers have a credible threat to sue. We will show that the threat to sue is also credible when $k_p < \widehat{k}_p^s(\alpha)$.

Recall that the effective price that maximizes the profit function on the right-hand side of (26) is $x^*(k_p,\alpha) = p^m(c+\widetilde{k}^s)$ where $\widetilde{k}^s = \left(\frac{1-\mu}{1-\theta}\right)[k_d - \alpha(k_p+k_d)]$. Since $\widetilde{k}^s$ is a decreasing function of k_p for all $\mu < 1$ and $\alpha > 0$, we know that the effective price $x^*(k_p,\alpha)$ is a decreasing function of k_p. To verify that the actual price $p^*(k_p,\alpha)$ is a decreasing function of k_p, consider the right-hand side of equation (28) above. When k_p rises, the right-hand side falls for because $x^*(k_p,\alpha)$ falls and because k_p appears with a negative sign. So, when $k_p < \widehat{k}_p^s(\alpha)$, the actual price is higher: $p^*(k_p,\alpha) > p^*(\widehat{k}_p^s(\alpha),\alpha)$. Since $c + k_p/\theta < c + \widehat{k}_p^s(\alpha)/\theta$, the plaintiff has a credible threat to sue for all $k_p < \widehat{k}_p^s(\alpha)$. □

In sum, we have shown that there exists a unique $\widehat{k}_p^s \in (0, \theta(p^m(c)-c)]$, such that (1) when $k_p < \widehat{k}_p^s$, firms allow litigation in equilibrium and charge the effective price of $p^m(c+\widetilde{k}^s)$; (2) when $k_p \in [\widehat{k}_p^s, \theta(p^m(c),c))$, firms set the price equal to $c + k_p/\theta$ and disallow litigation in equilibrium; and (3) when $k_p \geq \theta(p^m(c)-c)$, firms charge $p^m(c)$, realize full monopoly profits, while no lawsuits are brought in equilibrium. □

Proof of Proposition 5. From the expressions of $k_p^{ER} = (1-\theta)(k_p+k_d)$ and $k_d^{ER} = \theta(k_p+k_d)$, it is clear that (1) when $\theta > \frac{k_d}{k_p+k_d}$, $k_p^{ER} < k_p$; (2) when $\theta < \frac{k_d}{k_p+k_d}$, $k_p^{ER} > k_p$; and (3) when $\theta = \frac{k_d}{k_p+k_d}$, $k_p^{ER} = k_p$.

Now, consider the equation (8). With the English Rule, in order to maximize the profit while keeping the litigation off the equilibrium, the firms will now have to set $\theta(p-c) = k_p^{ER}$. Hence, when $\theta > \frac{k_d}{k_p+k_d}$ and $k_p^{ER} < k_p$, the left-hand side of the equation (8) is larger. Conversely, when $\theta < \frac{k_d}{k_p+k_d}$ and $k_p^{ER} > k_p$, the left-hand side of the equation (8) is smaller.

Similarly, with the English Rule, it is easy to show that the maximized right-hand side of the equation (8) becomes:

$$\Pi(x^*, c+k_p+k_d) - (1-\mu)D(x^*)[\theta(p(x^*)-c) - k_p^{ER}],$$

where we used the expression x^* to denote the argument that maximizes the right-hand side of (8). From the expression, it is clear that, when $\mu = 1$, because the second term disappears, the right-hand side is independent of the cost reimbursement rules.

Hence, with $\mu = 1$, when $\theta > \frac{k_d}{k_p+k_d}$, we get $\widehat{k}_p^{ER} > \widehat{k}_p$; and when $\theta \leq \frac{k_d}{k_p+k_d}$ we get $\widehat{k}_p^{ER} \leq \widehat{k}_p$.

On the other hand, when $\mu < 1$, when $\theta > \frac{k_d}{k_p+k_d}$, the right hand size is smaller compared to the case without fee-shifting. Since both sides of equation (8) decrease, we get $\widehat{k}_p^{ER} \gtreqless \widehat{k}_p$. When $\theta \leq \frac{k_d}{k_p+k_d}$, both sides of equation (8) increase, thereby making it uncertain whether $\widehat{k}_p^{ER}$ is greater or smaller than $\widehat{k}_p$. $\square$

Proof of Proposition 6. Suppose $\theta < 1$ and consider the equation (8). When we differentiate the right-hand side with respect to θ, with the envelope theorem, we get:

$$-(1-\mu)D(x^*)\left[p(x^*,\theta) - c + \theta\frac{\partial p(x^*,\theta)}{\partial\theta}\right],$$

and using the expression for $p(x)$ in (7) this becomes

$$-(1-\mu)D(x^*)\left[p(x^*,\theta) - c + \theta\left(\left(\frac{\mu}{1-\mu\theta}\right)^2(\theta(x^*-c)-k_p) + \left(\frac{\mu}{1-\mu\theta}\right)(x^*-c)\right)\right].$$

Note that when $\mu = 1$, the expression is equal to zero. That is, with $\mu = 1$, the right-hand side does not change as θ changes. When $\mu < 1$, on the other hand, since $x^* - c > 0$ in equilibrium, the expression is strictly negative. For instance, when $\mu = 0$, the expression becomes $-D(x^*)(p(x^*,\theta) - c) < 0$. Hence, when $\mu < 1$, the right-hand side decreases as θ increases: allowing litigation in equilibrium becomes less attractive as θ increases.

Now consider the left-hand side of (8). Since we know that when the firms are blocking litigation in equilibrium, the price $c + k_p/\theta$ is less than the full monopoly price, $p^m(c)$. Recall that the profit function $\Pi(p, c)$ is concave in price p. So raising θ lowers the price $c + k_p/\theta$, making it even further away from $p^m(c)$ and reducing firm profits. Therefore, the left-hand side of (8) decreases as θ increases.

Combining these two results, when $\mu = 1$, while the right-hand side of the equation (8) stays constant, the left-hand side decreases, thereby increasing $\widehat{k}_p$. In other words, when $\mu = 1$, the firms become more willing to allow litigation in equilibrium. On the other hand, when $\mu < 1$, both the right-hand side and the left-hand side of equation (8) decrease, thereby making it ambiguous whether $\widehat{k}_p$ will increase or decrease.

Now suppose $\theta \geq 1$. If $p^m(c) \leq c + k_p/\theta$, the firms can charge $p^m(c)$ without the threat of litigation. So the case of interest is $p^m(c) > c + k_p/\theta$. Using equation (5), if the firms charge a price $p > c + k_p/\theta$, the firms' aggregate profits are

$$D(x(p))((1-\theta)(p-c)-k_d) < 0,$$

since $\theta \geq 1$ and $k_d > 0$. When $\theta \geq 1$, the firms will not allow litigation in equilibrium. Hence, the optimal strategy for the firms is to set $p = c + k_p/\theta$, avoid litigation in equilibrium, and realize a positive profit $\forall k_p > 0$ and $\forall \mu \in [0, 1]$. $\square$

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