The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

CESifo Working Papers
www.cesifo.org/wp

Private Enforcement, Corruption, and Antitrust Design

Peter Grajzl
Andrzej Baniak

CESIFO WORKING PAPER NO. 5602
CATEGORY 11: INDUSTRIAL ORGANISATION
NOVEMBER 2015

ISSN 2364-1428

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 5602*

Private Enforcement, Corruption, and Antitrust Design

Abstract

Recent adoption of competition laws across the globe has highlighted the importance of institutional considerations for antitrust effectiveness and the need for comparative institutional analyses of antitrust that extend beyond matters of substantive law. Contributing to the resulting nascent research agenda, we examine how the rationale for enabling versus precluding private antitrust enforcement as one salient choice in antitrust design depends on whether antitrust enforcement is corruption-free or plagued by corruption. Contingent on the nature of adjudicatory bias, bribery either discourages private antitrust lawsuits or incentivizes firms to engage in frivolous litigation. Corruption expectedly reduces the effectiveness of antitrust enforcement at deterring antitrust violations. Yet private antitrust enforcement as a complement to public enforcement can be social welfare-enhancing even in the presence of corruption. Under some circumstances, corruption actually increases the relative social desirability of private antitrust enforcement. Our analysis highlights that the appropriate design of antitrust institutions is context-specific.

JEL-Codes: K210, L400, H110, P510.

Keywords: antitrust, corruption, private enforcement, public enforcement, institutional design.

*Peter Grajzl**
Department of Economics
The Williams School of Commerce, Economics, and Politics
Washington and Lee University
USA – Lexington, VA 24450
grajzlp@wlu.edu

Andrzej Baniak
Department of Economics
Central European University
Nador u. 9
Hungary – 1051 Budapest
baniaka@ceu.hu

*corresponding author

October 22, 2015
For helpful comments and discussion, we thank Stefan Buehler, Shahar Dillbary, Vivek Ghosal, Spencer Waller, Ramsi Woodcock, and participants at the annual meeting of the European Association of Law and Economics in Vienna and seminar at Washington and Lee University.

"*Both older and newer competition systems have come to realize that a body of competition laws is only as good as the institutions entrusted with their implementation.*" (Kovacic and Eversley 2007: 1)

"*Discussions of competition policy reform, both domestically and internationally, have typically focused on issues of substance, for example, appropriate rules for merger review, abuse of dominance, and horizontal arrangements amongst competitors. However, substantive policies must be mediated through the institutions that investigate, enforce, and adjudicate competition law issues and the decision-making processes that these institutions employ. As the legal realists long ago taught us, institutional and procedural differences are likely to generate widely different substantive outcomes, even with a similar legislative mandate.*" (Trebilcock and Iacobucci 2010: 455)

"*If you were a policymaker in a country whose principal economic problem was deep systemic poverty, aggravated by corruption, cronyism, selective statism, weak institutions, and often unstable democracy, what is the foundational perspective on which you would formulate your country's antitrust law?*" (Fox 2007: 103)

1. Introduction

Antitrust law is vital to the functioning of the capitalist market system. In part due to its success at promoting competition in the developed world (see, e.g., Baker 2003), a large number of developing, emerging market, and transition countries have either recently implemented or are considering implementing antitrust legislation. Many of these jurisdictions, however, are plagued by corruption, ineffective public administration, and a resource-starved judicial system (see, e.g., Kovacic 1995, 1996, 1997, 2001; Gal 2004, Davidson 2005, Fox 2007, 2010; Sokol 2010). With a growing body of empirical evidence suggesting that the effectiveness of antitrust policies is contingent on the quality of institutions embedding them (see, e.g., Kronthaler and Stephan 2007, Voigt 2008, Feinberg et al. 2011, Ma 2013, Waked 2010), institutional deficiencies in less-developed countries raise concerns about the likely success of antitrust remedies in these economies. As a result, institutional considerations extending beyond matters of substantive law have gained prominence in global competition policy debates (see, e.g., Kovacic and Eversley 2007, Rubin 1994, Sheth 1997, Godek 1998, Kovacic 2001, Fox 2007, Gal 2010) and a new

wave of research has called for comparative institutional analysis in the antitrust context (Kovacic and Eversley 2007, Sokol 2010, Fox 2010, Trebilcock and Iacobucci 2010).

In this paper, we respond to this call and propose a novel theory about the effectiveness of one particularly salient and widely debated antitrust measure: *private antitrust enforcement*. Spurred by its prevalence in the U.S., policymakers across the world have been pondering the introduction of private antitrust enforcement as a complement to public enforcement (see, e.g., Kovacic 1995, 2001; Davidson 2005, Waller 2006, Fox and Crane 2010: Ch. 7; Gal 2010, Crane 2010). Existing theoretical and empirical research in law and economics provides important insights about the relative merits of private antitrust enforcement in institutionally sound environments such as the U.S. or the European Union (see, e.g., Breit and Elzinga 1974, 1985; Shughart 1990, Martini and Rovesti 2004, Segal and Whinston 2007, McAfee et al. 2008, Bourjade et al. 2009, Schwartz and Wickelgren 2011, Waksman 2012, Calcagno 2012, Peyer 2012, Rajabiun 2013, Hüschelrath and Peyer 2013, Cosnita-Langlais and Tropeano 2014, Feess 2015, Reuter 2015).[1] Existing research, however, provides limited guidance about the role of private antitrust enforcement in institutionally weak environments beset by ubiquitous corruption and recurrent subversion of justice; that is, the very conditions prevalent in many developing, emerging market, and transition economies (see, e.g., Rodriguez and Williams 1994, Godek 1998, Ma 2010, El Dean and Mohieldin 2001, Sheth 1997, Fox 2007, Davidson 2005, Gal 2004, 2010; Stephan 2010, Kovacic 1995, 1996, 1997, 2001; Sokol 2010).[2]

[1] For analyses of private versus public law enforcement more generally (i.e. outside of the specific context of antitrust), see Landes and Posner (1975), Polinsky (1980), and Shavell (1993). Kaplow (2014) examines optimal legal system design in a model with private suits.

[2] Avdasheva and Kryuchkova (2015) analyze antitrust enforcement in Russia but focus on public enforcement and emphasize the importance of inadequate incentives within the administrative hierarchy of competition policy over corruption as an explanation for poor antitrust outcomes.

In order to examine how the institutional environment embedding antitrust impacts the effectiveness of private antitrust enforcement, and to draw normative conclusions about antitrust design, we develop a stylized model that contrasts the system of public-private antitrust enforcement with the system of pure public enforcement in two distinct settings: one where antitrust enforcement is immune to subversion of justice and one where antitrust enforcement is beset by corruption. Our model portrays the interaction between two competing firms whose conduct is subject to public and, if permitted by law, private antitrust enforcement. We show that if private enforcement is a possibility, then under reasonable assumptions a firm in the absence of corruption resorts to private antitrust litigation only in those instances when the rival firm's actions actually violate antitrust law. The social benefits from private antitrust enforcement as a complement to pure public enforcement then depend on the gross profitability of antitrust violations. When the gross profit gain to a firm from committing an antitrust violation is ceteris paribus not particularly large, and thus the incentives to violate antitrust law are not overwhelmingly strong, the social benefits of allowing for private enforcement to complement public enforcement stem from the fact that the prospects of being sued by a rival discourages firms from violating antitrust when the threat of public enforcement alone fails to do so.

In contrast, when committing an antitrust violation results in a sizeable gross profit gain, in which case the benefits from antitrust violation exceed the expected costs from fines and compensation damages, even a system of public-private antitrust enforcement fails at deterring firms from committing antitrust violations. However, because combining public and private enforcement relative to relying on pure public enforcement increases the prospects of adjudication in the event of antitrust violations, allowing for private enforcement can be socially advantageous. Specifically, we show that enabling private enforcement as a complement to

public enforcement is in the absence of corruption socially desirable when either the social efficiency losses from antitrust-violating conduct are high or the prospect for false negative decisions in adjudication is low relative to the socially wasteful litigation costs that firms incur under private enforcement.

The presence of corruption fundamentally alters the above logic since bribery enables rival firms to directly influence adjudicatory outcomes. Both positive and normative consequences of adding private enforcement depend on the nature of adjudicatory bias under private enforcement. A strong pro-defendant bias eliminates the incentives for firms to resort to private litigation and causes the system of public-private enforcement to collapse into a de facto system of pure public enforcement. In contrast, a pro-plaintiff bias creates incentives for frivolous litigation, that is, instances when a firm files a lawsuit against the rival even when the rival took no antirust-violating action (see, e.g., Breit and Elzinga 1974, 1985; Shughart 1990, McAfee and Vakkur 2004, McAfee et al. 2007). In either case, corruption eliminates the possibility for successful deterrence of antitrust violations.

Yet allowing for private enforcement is sometimes socially beneficial even in the presence of corruption. Specifically, when adjudicators exhibit a sufficiently strong pro-plaintiff bias, allowing for private enforcement, albeit plagued by corruption, much like in the absence of corruption again increases the prospects of adjudication in the event of antitrust violation. Because bribery alters adjudicatory outcomes relative to the no-corruption scenario, however, the precise conditions that render private enforcement socially desirable in the presence corruption in general differ from those in the absence of corruption. In particular, we show that under some circumstances the presence of corruption actually *strengthens* the relative social desirability of private antitrust enforcement. We explain the implications of these findings for antitrust design.

Our paper, therefore, makes three main contributions. First, we add to the scant literature that explicitly contrasts public with private antitrust enforcement (e.g., Martini and Rovesti 2004, McAfee et al. 2008, Segal and Whinston 2007, Calcagno 2012, Reuter 2015, Hüschelrath and Peyer 2013, Cosnita-Langlais and Tropeano 2014) by elucidating how the relative desirability of private antitrust enforcement as a complement to public enforcement is shaped by corruption, a pervasive phenomenon in many jurisdictions of the less-developed world. Second, we advance the growing comparative law and economics literature that stresses the fundamental importance of a society's political, legal, and economic conditions for the functioning of antitrust laws and policies in particular (see, e.g., Gal 2004, Kovacic 2001, Sokol 2010) and for institution-building more generally (see, e.g., Murrell 1992, Rodrik 2000, Berkowitz et al. 2003, Djankov et al. 2003). Our analysis demonstrates why and how the success of private antitrust enforcement critically depends on a range of locality-specific factors such as the presence or absence of corruption, the nature of adjudicatory bias under private enforcement, the magnitude of litigation costs, and the size of consumer-incurred social inefficiency losses from antitrust violations.

Third, we contribute to the literature on the normative consequences of persistent corruption and subversion of justice for institutional design. Given that eradicating corruption has proven difficult (Svensson 2005), the literature has strived to highlight suitable institutional and organizational responses when bribery distorts decision-making and allocation of resources in a variety of contexts, including firm ownership (Shleifer and Vishny 1994), criminal law enforcement (Bowles and Garoupa 1997, Chang et al. 2000, Polinsky and Shavell 2001, Garoupa and Klerman 2004, Garoupa and Jellal 2007, Echazu and Garoupa 2010), social control of torts (Glaeser and Shleifer 2003, Baniak and Grajzl 2009), and design of adjudicatory and lawmaking systems (Glaeser and Shleifer 2002, Grajzl and Dimitrova-Grajzl 2009, Grajzl 2011). We

contribute to this literature by studying how entrenched corruption impacts the organizational design of antitrust.

The rest of the paper is organized as follows. Section 2 develops the benchmark model of antitrust enforcement in the absence of corruption and analyzes the benefits and costs of private antitrust enforcement as a complement to pure public enforcement. Section 3 augments the benchmark model by allowing for corruption in adjudication of antitrust cases. Section 4 examines how the presence of corruption alters the rationale for enabling versus precluding private antitrust enforcement. Section 5 concludes.

2. Benchmark Model: Antitrust Enforcement in the Absence of Corruption

To study the consequences of corruption for design of antitrust institutions, we first develop a benchmark model of antitrust enforcement in the absence of a possibility for bribery. The basic setting of our benchmark model resonates with that proposed by McAfee et al. (2008). Unlike McAfee et al. (2008), however, we model the government antitrust agency as a non-strategic player. This simplification allows us to, first, maintain focus on the role of private enforcement and, second, ensure tractability of the model in the corruption scenario (see Section 3).

2.1. Setup

Consider an industry comprised of two competing firms: firm 1 and firm 2. At time 1, firm 1 chooses to either take an action that violates antitrust law (A) or not to take such an action (NA). If firm 1 chooses not to commit antitrust violation, we normalize the profit of each firm to zero. If firm 1 violates antitrust law, for example via exclusionary conduct, firm 1's profit gross of any fines or damages equals $\Delta_\Pi>0$ and firm 2's profit equals $-\Delta_\Pi<0$. Δ_Π is, therefore, the increase in firm 1's gross profit and, at the same time, the decrease in firm 2's profit from firm 1's antitrust violation. In addition to transferring profits from one firm to the other, an unsanctioned antitrust

violation A is assumed to impede competition and hurt consumers, which causes social inefficiency.[3] We let $\chi>0$ be the corresponding social inefficiency cost.

Industry conduct is monitored by a governmental antitrust agency. The antitrust agency is subject to budget constraints and cannot adequately screen all industries (see, e.g., Martini and Rovesti 2004, Reuter 2015). Therefore, in period 2, conditional on firm 1 having chosen action A in the previous period, the antitrust agency investigates and prosecutes firm 1 with probability $p_A \in (0,1)$. In addition, the antitrust agency might open an investigation against a firm even if no antitrust violation took place. Let $p_{NA} \in (0,1)$ be the probability that the antitrust agency investigates and prosecutes firm 1 conditional on firm 1 having chosen action NA in the previous period. We assume that the likelihood of investigation by governmental antitrust authorities (an event we label as G in Figure 1) is greater when antitrust violation actually took place than when it did not: $p_A > p_{NA}$. All else equals, the difference between p_A and p_{NA} increases with the competence of governmental antitrust authorities at correctly identifying antitrust violations.

When legal framework in addition allows for private antitrust enforcement, firm 2 can file a lawsuit for antitrust damage compensation against firm 1. In the U.S., private antitrust enforcement is made possible under the provisions of Sherman and Clayton Acts. Outside of the U.S., private antitrust enforcement is less prevalent, but is slowly taking root (see, e.g., Fox and Crane 2010: 430-443). Following McAfee et al. (2008), we assume that firm 2 can file a stand-alone private lawsuit against firm 1 if government antitrust agency did not open an antitrust investigation (event NG in Figure 1). Private antitrust litigation is costly, however. Let k_1 and k_2

[3] The assumed reduction in social efficiency that results from unsanctioned action A renders action A an antitrust violation as opposed to a business tort only (see, e.g., McKann and Katz 2011).

be the fixed litigation costs for firm 1 and firm 2, respectively, if firm 2 files a lawsuit against firm 1.[4]

Regardless of whether an antitrust case against firm 1 was initiated by the antitrust agency or firm 2, there is a possibility that adjudication results in false negative and false positive decisions. For simplicity, we assume that in the absence of a possibility for subversion of justice, the frequency of false negative and false positive decisions does not vary with the adjudication venue. Thus, $q_A \in (0,1)$ is the probability that firm 1 is (correctly) found guilty of antitrust violation if the firm chose action A in period 1 and either the government antitrust agency carried out its administrative procedure or the case was heard in court as a result of firm 2's lawsuit in period 2. $q_{NA} \in (0,1)$ is the probability that firm 1 is (incorrectly) found guilty of antitrust violation if firm 1 chose action NA in period 1 and either the government antitrust agency opened the case against firm 1 or firm 2 filed a suit against firm 1 in period 2. We assume that $q_A > q_{NA}$. All else equal, the difference between q_A and q_{NA} will be large when adjudicators possess superior expertise and experience at adjudicating antitrust cases.

If firm 1 is found guilty after the antitrust agency initiated the case against firm 1, the agency imposes a monetary fine to be paid by firm 1 equal to $\mu\Delta_\Pi$. The fine multiplier $\mu \geq 1$ allows for the possibility that the fine exceeds the amount of firm 1's increase in gross profit from antitrust violation. If firm 1 is found guilty after the case against firm 1 was initiated through a private lawsuit filed by firm 2, the court orders firm 1 to pay compensatory damages to

[4] Two remarks about our approach to modeling litigation costs are in order. First, unlike McAfee et al. (2008), we assume that firm 1 does not incur litigation costs following government antitrust agency's investigation. This assumption is apposite when the procedure initiated by the government antitrust authorities is administrative rather than adversarial in nature, as is the case in many jurisdictions worldwide (see, e.g., Fox and Crane 2010). None of our substantive results on the role of private enforcement change if we instead assume that firm 1 incurs litigation costs following government antitrust agency's investigation. Second, to the extent that a major part of litigation costs are attorney fees, our model assumes that each party pays its own attorney fees (the American rule). Assuming instead that the losing party pays the winner's attorney fees (the English rule) changes the algebra of the model's solution but does not change our substantive results on the role of private enforcement.

firm 2. $\delta\Delta_\Pi$ is the amount of damages paid by firm 1 if the court finds firm 1 guilty of antitrust violation. $\delta \geq 1$ is the damage multiplier that allows for multiplying (e.g., trebling) of damages. To further allow for decoupling (see, e.g., Polinsky 1985), we let $\gamma\delta\Delta_\Pi$ be the amount received by firm 2, where $\gamma \leq 1$ is the decoupling parameter.

If firm 1 is found guilty of antitrust violation, the antitrust agency or the court in addition to levying a fine or compensation damages, respectively, also orders firm 1 to undo its action (e.g. through an injunction). When antitrust violation took place in period 1, undoing action A is assumed to eliminate the social inefficiency-inducing cost χ. In contrast, the act of undoing action NA is without loss of generality assumed to lead to no further social gains or losses. Figure 1 illustrates the sequence of moves and the terminal payoffs for the firms.

Since our interest lies in comparing alternative organizational designs for antitrust enforcement (as opposed analyzing substantive matters of law), we follow the economics literature on public and private antitrust enforcement (see, e.g., McAfee et al. 2008, Bourjade et al. 2009, Schwartz and Wickelgren 2011) and choose as our metric for efficiency total social welfare (rather than consumer welfare emphasized by competition authorities and courts).[5] In our framework, social welfare W is defined as the sum of expected payoffs to firms 1 and 2 minus the expected social inefficiency costs. All fines paid by firm 1 as well as any excess of damages paid by firm 1 over the amount received by firm 2 ($(1-\gamma)\delta\Delta_\Pi$) end in public budget and are welfare neutral. Because our interest lies in comparing social welfare attained under different antitrust enforcement regimes, we without loss of generality abstract from any fixed public costs associated with administering a given antitrust enforcement regime.

[5] Because competitors' objectives are frequently poorly aligned with social objectives, the focus on how to align competitors' incentive with total social welfare is particularly suitable in the context of the analysis of private antitrust enforcement (see Schwartz and Wickelgren 2011: 967).

Finally, we impose three assumptions. Consistent with the antitrust practice, where the law typically places an upper bound on the magnitude of the fine imposed by the antitrust agency and compensation damages awarded by the courts, we, first, assume that the fine and the damage multipliers μ and δ, respectively, are bounded from above and satisfy

$$\Omega \equiv 1-\mu(p_A q_A - p_{NA} q_{NA}) - \delta(1-p_A) q_A > 0. \tag{A1}$$

Assumption (A1) ensures that, providing that firm 1's gross profit gain Δ_Π from antitrust violation is sufficiently large, firm 1 will under certain conditions (discussed below) have an incentive to choose action A even if firm 2 chooses to sue firm 1 when the antitrust agency does not start a procedure against firm 1. If assumption (A1) fails to hold, the addition of private enforcement may be unnecessary since the system of public enforcement alone may successfully deter antitrust violations (see the Appendix, Proof of Lemmas 1 and 5).

Second, we assume that the decoupling parameter $\gamma \leq 1$ is bounded from below as follows:

$$\gamma > \frac{k_2}{\delta \Delta_\Pi}. \tag{A2}$$

Assumption (A2) ensures that there exist instances when firm 2 is willing to sue firm 1. If assumption (A2) does not hold, firm 2's expected benefit from filing a private antitrust lawsuit is too small given the litigation costs and, hence, firm 2 never sues firm 1. When (A2) fails to hold, the regime of public-private enforcement therefore collapses into a de facto regime of pure public enforcement even in the absence of corruption.

Third, we assume that in the absence of corruption the adjudicators' expertise to render a correct verdict is sufficiently high so that

$$q_{NA} < \frac{k_2}{\gamma \delta \Delta_\Pi} < q_A. \tag{A3}$$

Assumption (A3) ensures that under public-private antitrust enforcement in the absence of corruption false negative and false positive adjudicatory decisions are sufficiently rare so that firm 2, on the one hand, has no incentive to engage in frivolous litigation in an effort to exploit adjudicate errors and, at the same time, firm 2 does not a priori discard private litigation as a wasteful use of resources (see the Appendix, Proof of Lemma 2).

2.2. Pure Public Enforcement without Corruption

In order to assess the social value-added from private antitrust enforcement in the absence of corruption, we compare the system of public-private enforcement with the system of pure public enforcement. To this end, we first clarify the equilibrium and social welfare under pure public enforcement, that is, a scenario when firm 2 is unable to file a private lawsuit against firm 1 (or, equivalently, when firm 2 always plays NS; see Figure 1). We relegate proofs of all results to the Appendix.

Lemma 1: *Under pure public enforcement in the absence of corruption firm 1 chooses A and social welfare equals* $W^{PUB} = -(1 - p_A q_A)\chi$.

To illustrate Lemma 1, consider a hypothetical regime of pure public enforcement without corruption such that false negative and false positive decisions never take place ($p_A q_A$=1 and $p_{NA} q_{NA}$=0) and where the fine in the event of a guilty verdict is at least as large as the gross profit gain from antitrust violation ($\mu \geq 1$). Under such regime, firm 1 is either indifferent between choosing NA and A (when μ=1) or strictly prefers to choose NA over A (when μ>1). That is, if there existed no scope for erroneous adjudicatory decisions and no statutory limits on fines, pure public enforcement would be able to deter antitrust violations. Our model captures the more realistic scenario where unintentional and unavoidable adjudicative errors lead to false negative and false positive decisions (so that $p_A q_A$<1 and $p_{NA} q_{NA}$>0) and where the law limits the

maximum fine (assumption (A1)). In this case, firm 1 under pure public enforcement strictly prefers to choose A over NA since the net expected payoff under action A ($\Delta_\Pi - p_A q_A \mu \Delta_\Pi$) exceeds the net expected payoff under action NA ($-p_{NA} q_{NA} \mu \Delta_\Pi$). Hence, public enforcement alone is not enough to deter antitrust violations. With firm 1 choosing action A, the social inefficiency loss χ is realized whenever firm 1 is not investigated and not found guilty (that is, with probability $1-p_A q_A$).

2.3. Public-Private Enforcement without Corruption

To solve the game when private enforcement is feasible in addition to public enforcement, we use backward induction. We first examine firm 2's incentives to file a private lawsuit against firm 1 in the event when the governmental antitrust agency did not open an investigation (see Figure 1).

Lemma 2: *Suppose that government antitrust agency does not investigate firm 1. When private enforcement is possible in the absence of corruption, firm 2 chooses S if firm 1 chose A and NS if firm 1 chose NA.*

When choosing whether to file an antitrust suit or not, firm 2 compares the net expected benefits of suing over not suing (the product of the probability that firm 1 is found guilty in court and awarded compensatory damages, $q_a \gamma \delta \Delta_\Pi$, where $a \in \{\text{A,NA}\}$) with the costs of litigation (k_2). Because the likelihood that the court delivers a guilty verdict is higher when firm 1 chooses A than when firm 1 chooses NA, firm 2 sues if firm 1 chose A, but chooses not to sue if firm 1 chose NA. In the absence of corruption, Lemma 2 implies that firm 2 therefore neither engages in frivolous litigation (i.e. act of suing even if no antitrust violation takes place) nor discards private litigation as a wasteful use of resources regardless of firm 1's first-period action.

Aware of the likelihood of antitrust agency's prosecution and anticipating firm 2's actions, firm 1 weighs the pros and cons of pursuing antitrust violation. The following result summarizes firm 1's optimal action.

Lemma 3: *Under public-private enforcement in the absence of corruption firm 1 chooses A if* $\Delta_\Pi > \underline{\Delta}_\Pi$ *and NA if* $\Delta_\Pi < \underline{\Delta}_\Pi$, *where* $\underline{\Delta}_\Pi \equiv k_1(1-p_A)/\Omega > 0$ *is increasing in* k_1, q_A, μ, *and* δ, *and decreasing in* p_{NA} *and* q_{NA}. *The effect of* p_A *on* $\underline{\Delta}_\Pi$ *is in general ambiguous.*

When firm 1 anticipates that firm 2 will sue only if firm 1 chooses to violate antitrust (Lemma 2), firm 1's decision to choose A versus NA depends on the extent to which choosing A increases firm 1's expected gross payoff relative to the expected damage payments and litigation costs which equal zero when firm 1 chooses NA (since firm 2 in that case does not sue). All else equal, the required increase in gross profits that induces firm 1 to choose A increases with litigation costs (k_1); the likelihood that the court (correctly) delivers the guilty verdict if antitrust violation really took place (q_A); and the magnitude of the fine and damages (as captured by μ and δ). The required increase in gross profits which induces firm 1 to choose A decreases with the likelihood that adjudication (incorrectly) delivers a guilty verdict conditional on the antitrust agency having (wrongly) opened the case when no antitrust violation had taken place ($p_{NA}q_{NA}$).

On the other hand, the effect of an increase in the likelihood that the government antitrust agency investigates firm 1 (p_A) on firm 1's incentives to choose A is in general ambiguous and depends on the magnitude of the fine multiplier (μ; see Proof of Lemma 3). When the fine multiplier is relatively large, public antitrust enforcement has a relatively strong deterrence effect. All else equal, an increase in the likelihood that the government antitrust agency will investigate firm 1 therefore reduces the relative attractiveness for firm 1 of violating antitrust law; hence, the required increase in gross profits that induces firm 1 to choose A increases. In contrast, when the fine multiplier is relatively small, public antitrust enforcement loses some of

its bite. In this case, the reduction in expected litigation costs and damage payments that follows as a result of an increase in the likelihood that the government antitrust agency investigates firm 1 increases the relative attractiveness of antitrust violation for firm 1. Thus, the required increase in gross profits that induces firm 1 to choose A decreases.

The following result, which summarizes the equilibrium outcome and social welfare under public-private enforcement under different parameter values, is then immediately implied by Lemmas 2 and 3.

Lemma 4: *Under public-private enforcement in the absence of corruption the (subgame perfect Nash) equilibrium outcome and social welfare are respectively as follows:*

1. *If* $\Delta_\Pi > \underline{\Delta}_\Pi$, *firm 1 chooses A, firm 2 chooses S if government antitrust agency did not investigate, and* $W^{PUBPR} = -(1-p_A)\left[k_1 + k_2\right] - (1-q_A)\chi$.
2. *If* $\Delta_\Pi < \underline{\Delta}_\Pi$, *firm 1 chooses NA, firm 2 chooses NS if government antitrust agency did not investigate, and* $W^{PUBPR} = 0$,

where $\underline{\Delta}_\Pi$ *is defined in* Lemma 3.

When gross profit gain from antitrust violation is large for given expected fine, damage compensation, and litigation costs, firm 1 rationally chooses to violate antitrust law. Because the prospects of a guilty verdict against firm 1 when firm 1 chooses action A are sufficiently high, firm 2 optimally chooses to sue firm 1 if government agency does not investigate firm 1. The resulting equilibrium outcome is characterized by a lack of deterrence, which gives rise to expected social inefficiency losses, and costly private litigation (Lemma 4, part 1). In contrast, when gross profit gain from violating antitrust is relatively small for given expected fine, damage compensation, and litigation costs, firm 1 abstains from taking action A. Given that adjudication results in a guilty verdict against firm 1 with a relatively small probability when firm 1 chose NA in the first period, firm 2 chooses not to sue if government agency does not investigate firm 1. The resulting equilibrium outcome with full deterrence and no vexatious litigation is overall first-best (Lemma 4, part 2).

2.4. When is Adding Private Enforcement Socially Desirable in the Absence of Corruption?

When is therefore adding private enforcement to complement public enforcement socially desirable? The following result provides the answer.

Proposition 1: *The following holds in the absence of corruption.*

1. *If* $\Delta_\Pi < \underline{\Delta}_\Pi$, $W^{PUBPR} > W^{PUB}$.
2. *If* $\Delta_\Pi > \underline{\Delta}_\Pi$, $W^{PUBPR} \left\{ \begin{matrix} \geqq \\ \leqq \end{matrix} \right\} W^{PUB}$ *if and only if* $\chi \left\{ \begin{matrix} \geq \\ \leq \end{matrix} \right\} \underline{\chi}$,

where $\underline{\chi} \equiv \frac{k_1+k_2}{q_A} > 0$ *is increasing in* k_1+k_2 *and decreasing in* q_A, *and* $\underline{\Delta}_\Pi$ *is defined in* Lemma 3.

When the increase in gross profits from violating antitrust law is relatively small ($\Delta_\Pi < \underline{\Delta}_\Pi$), allowing for stand-alone private lawsuits to complement public enforcement unambiguously increases social welfare. The reason is that when $\Delta_\Pi < \underline{\Delta}_\Pi$, public-private enforcement, in contrast to pure public enforcement, results in deterrence of antitrust violations (see Lemmas 1 and 3). Given that the likelihood of false positive adjudicatory decisions is relatively small, firm 2 does not find it advantageous to engage in frivolous litigation. Accordingly, social welfare under public-private enforcement is maximal (Lemma 4, part 2) and strictly exceeds social welfare under pure public enforcement.

In contrast, when the increase in gross profits from antitrust violation is relatively large ($\Delta_\Pi > \underline{\Delta}_\Pi$), the possibility of a private lawsuit does not deter firm 1 from violating antitrust law even though following firm 1's antitrust violation firm 2 responds by filing a lawsuit (see Lemmas 2 and 3). The benefits of public-private enforcement over pure public enforcement in this case stem from the fact that under public-private enforcement adjudication in equilibrium happens with certainty. Allowing for private enforcement as a complement to public enforcement thus increases the ex-ante prospect of a guilty verdict against firm 1 in the event that firm 1 chooses to violate antitrust law. Therefore, the expected social inefficiency losses from antitrust violation are lower under public-private enforcement than they are under pure public

enforcement. However, public-private enforcement also involves firms incurring litigation costs. All else equal, public-private enforcement therefore dominates pure public enforcement from the social welfare standpoint when either the social inefficiency loss in the event of antitrust violation (χ) is sufficiently high; the likelihood of a guilty verdict when antitrust violation took place (q_A) is sufficiently high; or the costs of litigation (k_1+k_2) are sufficiently low.

3. Augmented Model: Antitrust Enforcement in the Presence of Corruption

We now augment the model developed in Section 2 to allow for the possibility of corruption. To this end, we endogenize the probabilities that firm 1 is found guilty of antitrust violation if adjudication takes place following firm 1's first-period action. All other aspects of the model remain as laid out in Section 2.1.

3.1. Corruption in Antitrust Enforcement

In a system of public-private antitrust enforcement, we differentiate between two distinct circumstances leading to corruption in adjudication.[6] The first is when investigation against firm 1 is initiated by the government antitrust agency. The sanction faced by firm 1 if firm 1 is found guilty of antitrust violation regardless of whether firm 1 chose action A or NA in the first period is the fine $\mu\Delta_\Pi$ imposed by the agency. The fine is not a compensation for firm 2. Thus, in this case, only firm 1 has a direct stake in the outcome of adjudication and, hence, only firm 1 may be

[6] Corruption may, at least in principle, arise even before the act of adjudication, as a consequence of government antitrust agency's deliberate preying upon specific industry members. Since government antitrust agencies have limited resources (see Section 2.1), however, this type of corruption is likely less prevalent and, thus, not subject to our analysis. Similarly, the possibility for corruption may in general lead to exchange of bribes between firms, resulting in collusive behavior. In our model the scope for such private corruption is precluded by the assumption that the loss to firm 2 when firm 1 chooses A exactly equals the gross profit gain to firm 1 (see Section 2.1). Thus, there exists no scope for renegotiation of the default scenario through exchange of bribes such that both firms would be better off.

willing to offer a positive bribe to change the expected outcome of adjudication.[7] We assume that the corrupt adjudicator cares only about the size of collected bribe and that paying a positive bribe reduces the probability that firm 1 is found guilty from $q_a>0$ to 0, where $a\in\{A,NA\}$ denotes the action chosen by firm 1 in the first period. We model bribery between firm 1 and the adjudicator as a Nash bargaining game (see, e.g., Shleifer and Vishny 1994) where $\beta\in(0,1]$ measures the bargaining strength of the corrupt adjudicator vis-à-vis firm 1. The equilibrium bribe (see Section 3.2) is then determined through maximization of the appropriate Nash bargaining product.

The second setting leading to corruption in adjudication is when firm 1 is taken to court as a result of firm 2's private lawsuit. In this case, the sanction faced by firm 1 if found guilty of antitrust violation is the payment of compensation damages $\delta\Delta_\Pi$ of which firm 2 receives the amount $\gamma\delta\Delta_\Pi$, where $\gamma\leq1$. Unlike when the case against firm 1 is initiated by the antitrust agency, and hence when the punishment is a fine transferred into the public budget, when compensation damages levied on firm 1 result in a transfer to firm 2, both firms have a direct stake in the outcome of adjudication. Therefore, both firms are willing to offer a bribe in order to influence the outcome of adjudication. Following Lien (1986, 1990), Clark and Riis (1990), and Epstein et al. (2013), we model the bribery game played by the firms as a perfectly discriminating contest (an all-pay auction) with complete information (see, e.g., Hillman and Riley 1989, Baye et al. 1993, Ellingsen 1991).[8] Specifically, if the antitrust agency did not open the case against firm 1

[7] None of our central findings about the role of private antitrust enforcement change if we instead allow for firm 2 to have a direct stake in the outcome of adjudication, either because the fine levied on firm 1 is (fully or partially) transferred to firm 2 (see McAfee et al. 2008) as is the case under restitution (see, e.g., First 2009), or if firm 2 values the outcome of adjudication for reputational reasons.

[8] None of our central results about the role of private antitrust enforcement are affected if we instead model the bribery game as an imperfectly discriminating contest of the type proposed by Tullock (1980).

but firm 2 sued firm 1, we let the probability that firm 1 is found guilty of antitrust violation given first-period action $a \in \{A,NA\}$ equal to

$$\Gamma_a \equiv \text{Prob}\left\{\text{firm 1 found guilty} \middle| \text{firm 1 chose } a\right\} = \begin{cases} 1 & \text{if } \lambda b_1 < b_2 \\ 0 & \text{if } \lambda b_1 > b_2 \\ q_a & \text{if } \lambda b_1 = b_2, \end{cases} \quad (1)$$

where b_i is the bribe paid by firm $i \in \{1,2\}$.[9] We allow the effectiveness of bribe of a given size to vary across the rival firms, a phenomenon captured by the discrimination parameter $\lambda>0$ (see, e.g., Lien 1990, Epstein et al. 2013) in (1). λb_1 is, therefore, the effective bribe of firm 1. We say that the corrupt adjudicator exhibits a pro-defendant bias (i.e. favors firm 1) when $\lambda>1$ and a pro-plaintiff bias (i.e. favors firm 2) when $\lambda<1$. We view the magnitude of λ, and thus the type of bias exhibited by corrupt adjudicators, as exogenously determined by politico-economic circumstances of the industry. For example, a pro-defendant bias might arise when firm 1 is a state-owned enterprise or a recently privatized company with strong ties to the existing entrenched political elites. In contrast, a pro-plaintiff bias may arise when operations of the incumbent's rival (firm 2) provide significant benefits to the newly-established ruling political coalition. When $\lambda=1$, the corrupt adjudicator does not discriminate between the rival firms and the bribery game is, in this sense, a 'fair' contest. Expression (1) implies that winning the bribery contest eliminates the risk for firm 1 of being found guilty following court adjudication.

3.2. Expected Payoffs

In order to solve the full antitrust game under public-private enforcement in the presence of corruption, we first compute the participants' expected terminal payoffs. We relegate the details of this derivation to the Appendix. Here, we merely highlight the most relevant patterns with the

[9] For technical completeness, specification (1) allows for the possibility of ties and sharing of the prize. However, in equilibrium, ties do not occur since one party always has an incentive to increase their bribe and win the contest (see Hillman and Riley 1989).

aid of Figure 2, which shows the sequencing of events and displays the expected terminal payoffs.

First, in instances when the antitrust agency opens a case against firm 1, firm 1 pays a strictly positive bribe equal to $\beta q_a \mu \Delta_\Pi$, where $a \in \{A,NA\}$ denotes firm 1's first-period action. Paying a positive bribe in equilibrium eliminates the risk for firm 1 of being found guilty following adjudication. For firm 1, paying the bribe $\beta q_a \mu \Delta_\Pi$ thus dominates not paying the bribe and incurring the expected fine equal to $q_a \mu \Delta_\Pi$. The size of the equilibrium bribe increases with the corrupt adjudicator's bargaining power β and the magnitude of the expected fine in the default scenario, $q_a \mu \Delta_\Pi$, $a \in \{A,NA\}$. Furthermore, the equilibrium bribe paid by firm 1 is ceteris paribus higher if firm 1 in the first period chose A instead of NA because firm 1's expected payoff in the default scenario (i.e. outcome in the absence of bribery) is higher in the former than in the latter case.

Second, when corrupt adjudication occurs as a result of firm 2 suing firm 1, the resulting all-pay bribery auction exhibits no pure strategy (Nash) equilibria: for a given (effective) bribe offered by one of the firms, the other firm can always discontinuously increase its chance of adjudicatory success by offering a marginally higher (effective) bribe than the rival firm, and therefore increase own expected payoff. Thus, equilibrium involves both firms choosing bribes according to continuous mixed strategies (see, e.g., Hillman and Riley 1989). To compute the expected terminal payoffs, we draw on the previously established results (see, e.g., Hillman and Riley 1989, Baye et al. 1996) that characterize the equilibrium of an all-pay auction with asymmetric valuations and complete information (see the Appendix).

Third, as illustrated by Figure 2, in instances when firm 2 sues firm 1, the expected terminal payoffs and equilibrium probability that firm 1 is found guilty of antitrust violation

depend on the relative magnitude of the discrimination parameter λ versus decoupling parameter γ. To explain this, note that in an all-pay auction with asymmetric valuations, first, the high-valuation party's equilibrium expected payoff equals the difference between own valuation and the opponent's valuation and, second, since the contest leads to full dissipation of the value for the low-valuation party, the low-valuation party's equilibrium expected payoff equals zero (see Hillman and Riley 1989, Baye et al. 1996). Because firm 1's effective bribe is λb_1 (see expression (1)), whether firm 1 values not having to pay compensation damages $\delta\Delta_\Pi$ more, equal, or less than firm 2 values receiving fraction $\gamma \leq 1$ of this amount, and therefore which firm earns a positive expected payoff and which firm's valuation of the 'prize' is fully dissipated in the bribery game, depends on the relative magnitude of λ versus γ (see Figure 2). The full terminal payoffs are then deduced by performing an affine transformation of the payoffs in order to inter alia take into account the litigation costs which are incurred regardless of the outcome of the bribery game (see the Appendix).

Fourth, in instances when firm 2 sues firm 1, the equilibrium probability that firm 1 is found guilty of antitrust violation (not shown in Figure 2) varies with the magnitude of λ, that is, the extent to which firm 1 or firm 2 is favored by the corrupt adjudicator. When $\lambda > \gamma$, the equilibrium probability that firm 1 is found guilty of antitrust violation ($\Gamma_A = \Gamma_{NA} = \frac{\gamma}{2\lambda}$; see the Appendix) monotonically decreases with λ; that is, an increasingly strong pro-defendant bias increases firm 1's prospects of not being found guilty of antitrust violation regardless of the action chosen in the first period. When $\lambda < \gamma$, the equilibrium probability that firm 1 is found guilty ($\Gamma_A = \Gamma_{NA} = 1 - \frac{\lambda}{2\gamma}$; see the Appendix) increases as λ decreases; that is, under an increasingly

strong pro-plaintiff bias, firm 1's prospects of being found guilty of antitrust violation increase irrespective of the first-period action.

Finally, when accounting for social welfare under a given antitrust regime in the presence of corruption, we view bribes as pure transfers that are neutral from the perspective of social welfare in that they decrease the bribe-giver's payoff and, at the same time, increase the recipient's (corrupt adjudicator's) payoff by the same amount. This view of corruption is consistent with the predominant approach to modeling corruption in the literature (see, e.g., Shleifer and Vishny 1994, Lambsdorff 2002, Svensson 2005) and allows us to focus on the welfare consequences of corruption that arise due to decision-making distortions.

3.3. Pure Public Enforcement with Corruption

To assess the social benefits and costs from adding private antitrust enforcement in the presence of corruption, we compare the system of public-private enforcement to the system of pure public enforcement. We first clarify the equilibrium and social welfare under pure public enforcement when firm 2 is unable to file a private lawsuit against firm 1 (or, equivalently, when firm 2 always plays NS; see Figure 2).

Lemma 5: *Under pure public enforcement with corruption firm 1 chooses A and social welfare equals* $W^{PUB,C} = -\chi$.

Under pure public enforcement and corruption, providing that the antitrust agency investigates firm 1, firm 1 is through bribing the government antitrust authorities able to reduce the probability that it is found guilty of antitrust violation to zero. Firm 1's net expected benefit from action A then exceeds the net expected benefit from action NA, with corresponding adverse repercussions for social welfare.

3.4. Public-Private Enforcement with Corruption

To characterize the (subgame perfect Nash) equilibrium of the full game with public-private enforcement under subversion of justice, we use backwards induction. We first characterize firm 2's optimal strategy. Based on the payoffs in Figure 2 we obtain:

Lemma 6: *Suppose that government antitrust agency does not investigate firm 1. When private enforcement is possible in the presence of corruption, firm 2's optimal strategy is as follows:*

1. *If* $\lambda \leq \underline{\lambda}$*, firm 2 chooses S regardless of firm 1's first-period action.*
2. *If* $\lambda > \underline{\lambda}$*, firm 2 chooses NS regardless of firm 1's first-period action,*

where $\underline{\lambda} \equiv \gamma - \frac{k_2}{\delta \Delta_\Pi} \in (0,1)$.

Whenever the corrupt adjudicator exhibits a sufficiently strong pro-plaintiff bias ($\lambda \leq \underline{\lambda} < 1$), when firm 2 sues firm 1, firm 2 in equilibrium of the bribery contest receives a positive payoff and, therefore, prefers to sue firm 1 regardless of the action chosen by firm 1 in the first period (Lemma 6, part 1). That is, when λ is sufficiently smaller than one, the presence of corruption leads to frivolous litigation. In contrast, whenever the corrupt adjudicator does *not* exhibit a sufficiently strong pro-plaintiff bias (that is, the corrupt adjudicator exhibits a weak pro-plaintiff bias ($\underline{\lambda} < \lambda < 1$), or corruption in adjudication is a fair contest ($\lambda = 1$), or the corrupt adjudicator exhibits a pro-defendant bias ($\lambda > 1$)), as firm 2 sues firm 1 the value of the 'prize' to firm 2 in the bribery contest is in equilibrium fully dissipated. Since suing entails incurring litigation costs $k_2 > 0$, firm 2 therefore prefers not to sue regardless of firm 1's first-period action (Lemma 6, part 2). That is, when λ is sufficiently large (though possibly smaller than one), the presence of corruption completely destroys the incentives for private antitrust enforcement.

In Lemma 6 defined critical value ($\underline{\lambda}$) of the discrimination parameter λ that determines whether private enforcement in the presence of corruption gives rise to no litigation (for values of λ higher than this critical value, which corresponds to a stronger pro-defendant bias or a

weaker pro-plaintiff bias) or frivolous litigation (for values of λ lower than this critical value, which corresponds to a stronger pro-plaintiff bias or a weaker pro-defendant bias) all else equal decreases with firm 2's litigation costs (k_2) and increases with the factors determining the amount of compensation damages received by firm 2 if firm 1 is found guilty of antitrust violation (γ and $\delta\Delta_\Pi$). That is, in the presence of corruption the frivolous litigation equilibrium is more likely to occur when the prospective plaintiff's litigation costs are low and the expected award from a favorable judgment is high, and the equilibrium with no private litigation is more likely when the opposite is true. Anticipating firm 2's response in period 2, firm 1's optimal action in period 1 is as follows:

Lemma 7: *Under public-private enforcement with corruption firm 1 chooses A in the first period for any* $\lambda>0$.

When the corrupt adjudicator exhibits a sufficiently strong pro-plaintiff bias, firm 2 sues firm 1 regardless of whether firm 1 violated antitrust or not (Lemma 6, part 1). In this case, firm 1 nevertheless prefers to violate antitrust in the first period since, due to an increase in gross profit, the net gain from antitrust violation exceeds the net expected costs from not violating antitrust. In contrast, whenever the corrupt adjudicator does *not* exhibit a sufficiently strong pro-plaintiff bias, firm 2 never sues (Lemma 6, part 2). The system of public-private antitrust enforcement then effectively reduces to a system of pure public enforcement. Following Lemma 5, firm 1 again optimally chooses to violate antitrust law in the first period.

Lemmas 6 and 7 together imply the following equilibrium outcome and social welfare in the antitrust game with public-private antitrust enforcement and corruption.

Lemma 8: *Under public-private enforcement with corruption the (subgame perfect Nash) equilibrium outcome and social welfare are respectively as follows:*

1. *If* $\lambda \le \underline{\lambda}$, *firm 1 chooses A, firm 2 chooses S if antitrust agency did not investigate, and* $W^{PUBPR,C} = -p_A\chi - (1-p_A)\left[k_1 + k_2 + \frac{\lambda}{2\gamma}\chi\right]$.

2. *If* $\lambda > \underline{\lambda}$, *firm 1 chooses A, firm 2 chooses NS if antitrust agency did not investigate, and* $W^{PUBPR,C} = -\chi$,

where $\underline{\lambda}$ *is defined in* Lemma 6.

When the corrupt adjudicator exhibits a sufficiently strong pro-plaintiff bias (Lemma 8, part 1), firm 2 sues firm 1 whenever antitrust agency does not investigate firm 1 (Lemma 6, part 1). Anticipating this response, firm 1 optimally nevertheless chooses to take action that violates antitrust law in the first period (Lemma 7). If antitrust agency investigates firm 1, firm 1 through bribery reduces the equilibrium probability of being found guilty of antitrust violation to zero. If firm 2 sues firm 1, however, firms incur litigation costs and the bribing contest takes place. The equilibrium payoffs to firms 1 and 2 (see Figure 2) then reflect the relative advantage of firm 2 in the bribery contest due to the corrupt adjudicator's pro-plaintiff bias. Conditional on firm 2 suing firm 1, the equilibrium probability that the society incurs the inefficiency cost χ due to firm 1's unsanctioned antitrust violation ($1-\Gamma_A = \frac{\lambda}{2\gamma}$) increases with the extent of firm 1's clout as measured by λ.

In contrast, when the corrupt adjudicator exhibits only a weak pro-plaintiff bias, or when corruption in adjudication is a fair contest, or further when the corrupt adjudicator exhibits a pro-defendant bias (Lemma 8, part 2), firm 2 is disincentivized to file a private lawsuit against firm 1, and, as a result, the system of public-private enforcement reduces to a system of pure public enforcement (Lemma 6, part 2). Firm 1 in the first period chooses action that violates antitrust law (Lemma 7). If investigated by the antitrust authorities, firm 1 through bribery reduces the equilibrium probability of being found guilty of antitrust violation to zero. Accordingly, the society incurs the social inefficiency cost χ regardless of whether government antitrust investigation against firm 1 takes place or not.

3.5. Is Adding Private Enforcement Ever Socially Desirable in the Presence of Corruption?

We now examine whether allowing for private enforcement is ever socially warranted in the presence of corruption. We have the following result:

Proposition 2: *The following holds when corruption is possible.*

1. *If* $\lambda \leq \underline{\lambda}$, $W^{PUBPR,C} \left\{ \begin{matrix} \geq \\ = \\ < \end{matrix} \right\} W^{PUB,C}$ *if and only if* $\chi \left\{ \begin{matrix} \geq \\ = \\ < \end{matrix} \right\} \underline{\chi}^{C}$.
2. *If* $\lambda > \underline{\lambda}$, $W^{PUBPR,C} = W^{PUB,C}$,

where $\underline{\lambda}$ *is defined in* Lemma 6 *and where* $\underline{\chi}^{C} \equiv \frac{k_1+k_2}{1-\frac{\lambda}{2\gamma}} > 0$ *is increasing in* k_1+k_2 *and* λ*, and decreasing in* γ*.*

When the corrupt adjudicator exhibits a sufficiently strong pro-plaintiff bias, whether adding private enforcement is socially beneficial or not, similar to the no-corruption scenario (Proposition 1), depends on the magnitude of the social inefficiency losses caused by antitrust violation (Proposition 2, part 1). When the social inefficiency losses from antitrust violation (χ) are high, public-private enforcement welfare dominates pure public enforcement even though neither system deters firm 1 from violating antitrust (Lemma 5 and Lemma 8, part 1). To explain this, note that in instances when antitrust agency investigates firm 1 following firm 1's antitrust violation, public-private and pure public enforcement yield the same outcome: firm 1 through bribery at the adjudication stage ensures acquittal and social inefficiency loss χ is realized with certainty. Under a strong pro-plaintiff bias, the difference between public-private and pure public enforcement therefore arises in instances when, following firm 1's antitrust violation, antitrust agency fails to investigate firm 1. Under pure public enforcement, the lack of a possibility for firm 2 to file a private antitrust lawsuit implies that firm 1's antitrust violation remains unsanctioned, with corresponding adverse consequences for social welfare: conditional on no antitrust agency investigation, social inefficiency loss χ is again realized with certainty. Under public-private enforcement, however, firm 2 files a lawsuit against firm 1. While adjudication is

imperfect due to bribery, adjudication does take place and firm 1 is found guilty with a positive probability ($\Gamma_A=1-\frac{\lambda}{2\gamma}>0$; see the Appendix). The benefit of public-private enforcement over pure public enforcement in the presence of corruption thus stems from the fact that under public-private enforcement, unlike under pure public enforcement, adjudication against firm 1 following antitrust violation takes place with certainty. The costs arise because firms incur litigation expenses.

Accordingly, in the presence of corruption and a sufficiently strong pro-plaintiff bias, the threshold value of social inefficiency losses such that public-private enforcement dominates pure public enforcement from the social welfare viewpoint ($\underline{\chi}^C$) expectedly increases with litigation costs (k_1+k_2) and decreases with the extent of pro-plaintiff bias (i.e. as λ decreases). Intuitively, when following private lawsuit firm 2 enjoys a strong advantage over firm 1 in the bribery contest, which determines the outcome of adjudication, firm 1 is found guilty with near certainty. As a consequence, firm 1's antitrust violation is sanctioned with a high likelihood and the minimum social inefficiency loss that renders public-private enforcement preferred to pure public enforcement is accordingly relatively small. Furthermore, when all else equal firm 2 receives a larger share of damages paid by firm 1 if found guilty of antitrust violation (as γ increases), the value of the prize to firm 2 in the bribery contest at the adjudication stage increases. Hence, the equilibrium likelihood that firm 1 is found guilty of antitrust violation increases and, as a result, the minimum required social inefficiency loss that renders public-private enforcement preferred to pure public enforcement decreases.

In contrast, adding private enforcement in the presence of corruption is futile whenever the corrupt adjudicator does *not* exhibit a sufficiently strong pro-plaintiff bias. In this case corruption destroys the incentives for private antitrust enforcement (Lemma 6, part 1). As a

consequence, the system of public-private enforcement reduces to a system of pure public enforcement, with corresponding comparative welfare repercussions (Proposition 2, part 2).

4. How Does Corruption Matter for Antitrust Design?

The comparison of Propositions 1 and 2 suggests that, for a given magnitude of the gross profit gain from antitrust violation (Δ_{Π}), and thus for a given welfare ranking of public-private versus pure public enforcement systems in the absence of corruption, the presence of corruption in general changes the welfare ranking of these alternative enforcement systems. The presence or absence of corruption is hence a key local condition that critically determines what type of antitrust system—one of public-private enforcement or one of pure public enforcement—is socially comparatively more advantageous in a given setting.

The exact effect of corruption on the relative desirability of public-private versus pure public antitrust enforcement is in general ambiguous. When the gross profit gain from antitrust violation is relatively small, so that public-private enforcement is in the absence of corruption effective at deterring firms from committing antitrust violations (Lemma 3), in the absence of corruption the system of public-private enforcement strictly welfare dominates the system of pure public enforcement (Proposition 1, part 1). Under these conditions, the presence of corruption with either a pro-defendant bias or a weak pro-plaintiff bias discourages private lawsuits and thereby renders the system of public-private enforcement identical to the system of pure public enforcement (Proposition 2, part 2). On the other hand, under corruption with a sufficiently strong pro-plaintiff bias in private enforcement, the welfare comparison of the alternative systems in general depends on the magnitude of social welfare losses induced by antitrust violation (Proposition 2, part 1); that is, relative to the absence of corruption, with

corruption, public-private enforcement may either remain more attractive or become less attractive than pure public enforcement.

When the gross profit gain from antitrust violation is large, then in the absence of corruption neither pure public enforcement nor public-private enforcement succeed in deterring antitrust violations and the welfare comparison of public-private and pure public enforcement in the absence of corruption depends on the magnitude of social inefficiency losses induced by antitrust violation (Proposition 1, part 2). Under these same conditions but in the presence of corruption, public-private enforcement may, depending on whether corrupt private enforcement is biased toward the plaintiff or the defendant, be either more, less, or equally socially desirable as pure public enforcement (Proposition 2).

To further illustrate how the presence of corruption matters for optimal antitrust design and to clarify that the presence of corruption may either decrease or increase the social desirability of private antitrust enforcement relative to the no-corruption setting, consider the scenario when in the absence of corruption gross profit gain from antitrust violation is relatively large ($\Delta_{\Pi}>\underline{\Delta}_{\Pi}$; Proposition 1, part 2) and, at the same time, in the presence of corruption there is a sufficiently strong pro-plaintiff bias in private antitrust enforcement ($\lambda<\underline{\lambda}$; Proposition 2, part 1). In this setting, summarized by Figure 3, suppose, first, that adjudication in the absence of corruption results in relatively few (though still some) adjudicative errors so that the probability that the defendant (firm 1) is correctly found guilty of antitrust violation (q_A) is relatively high. Then, the relative desirability of public-private enforcement versus pure public enforcement depends on the extent to which corrupt adjudicators in the event of private antitrust lawsuit discriminate in favor of the plaintiff (firm 2). When all else equal the extent of pro-plaintiff bias in corrupt adjudication is relatively small (λ is only marginally smaller than $\underline{\lambda}$; point B in Figure

3), the likelihood that the defendant is correctly found guilty of antitrust violation under public-private enforcement in the presence of corruption is smaller than the corresponding probability in the absence of corruption ($\Gamma_A<q_A$). Hence, the minimum level of social inefficiency losses from antitrust violation that render public-private enforcement welfare superior to pure public enforcement is greater in the presence of corruption than in the absence of corruption ($\underline{\chi}^C > \underline{\chi}$); that is, public-private enforcement is on average more desirable vis-à-vis pure public enforcement in the absence of corruption than it is in the presence of corruption. (In Figure 3, the solid downward-sloping line depicts the set of points where $\underline{\chi}^C = \underline{\chi}$ or, equivalently, $\Gamma_A=q_A$.) In this case, the presence of corruption all else equal decreases the relative social desirability of private antitrust enforcement.

The opposite conclusion holds, however, when all else equal the extent of pro-plaintiff bias under corrupt adjudication is relatively large (λ is close to zero; point C in Figure 3) or, alternatively, when adjudication in the absence of corruption is relatively more prone to errors so that the probability that the defendant is correctly found guilty of antitrust violation (q_A) is relatively small (points D and E in Figure 3). Under these circumstances, the defendant, upon committing an antitrust violation followed by a private lawsuit, is more likely to be correctly found guilty in the presence of corruption than in the absence of corruption ($\Gamma_A>q_A$). All else equal, bribery in this case thereby effectively facilitates a reduction in the scope for false negative adjudicatory decisions in the event of private litigation. Hence, at points C, D, and E in Figure 3 the minimum level of social inefficiency losses from antitrust violation that renders public-private enforcement welfare superior to pure public enforcement is greater in the absence of corruption than in the presence of corruption ($\underline{\chi} > \underline{\chi}^C$). In other words, the presence of corruption all else equal *increases* the relative social desirability of private antitrust enforcement.

5. Conclusion

Varied success with the adoption of competition laws in developing, emerging market, and transition economies has underscored the importance of institutional considerations for antitrust design that extend beyond matters of substantive law (see, e.g., Kovacic and Eversley 2001, Trebilcock and Iacobucci 2010, Sokol 2010). Yet to date, little research has attempted to explicitly elucidate the role of a society's wider institutional environment for appropriate antitrust design. Consequently, the existing literature provides limited guidance about appropriate antitrust measures in the context of institutionally weak environments characteristic of developing, emerging market, and transition economies (see, e.g., Fox 2007).

As a step toward filling this gap in the literature, this paper develops a simple model that illustrates how the social benefits and costs associated with one important and widely debated choice in antitrust design—allowing for private antitrust litigation—vary depending on whether antitrust enforcement is corruption-free or, as in many developing, emerging market, and transition economies, beset by corruption. Our analysis shows, first, that the impact of bribery on the willingness of firms to rely on private antitrust enforcement is in general ambiguous. Depending on the nature of adjudicatory bias under private antitrust litigation, corruption either destroys firms' incentives to file private lawsuits, and therefore eliminates any role for private antitrust enforcement, or, alternatively, breeds vexatious litigation.

Second, although the presence of bribery expectedly erodes the capacity of public-private antitrust enforcement to deter antitrust violations, allowing for private enforcement to complement public enforcement in the presence of corruption is under some circumstances nevertheless socially advantageous. Such conditions arise when private antitrust litigation in the presence of corruption exhibits a sufficiently strong pro-plaintiff bias and, at the same time,

either the litigation costs incurred under private enforcement are sufficiently low or the social inefficiency costs from unsanctioned antitrust violations are large. In essence, when private litigation is made possible in the presence of corruption, a pro-plaintiff bias in adjudication decreases the prospects that antitrust violations would remain unsanctioned, which in turn reduces the expected social costs from antitrust-violating conduct relative to the scenario when private antitrust litigation is precluded.

Finally, our analysis shows that the precise circumstances under which private enforcement as a complement to public enforcement welfare dominates pure public enforcement differ depending on whether antitrust enforcement is corruption-free or plagued by corruption. Under some circumstances, the presence of corruption in fact increases the relative social desirability of private antitrust enforcement. In this sense, our analysis, albeit focused on one specific facet of antitrust design, demonstrates that the appropriate antitrust measures are highly context-dependent and that one-size-fits-all transfer of antitrust practices from developed to less-developed countries may have detrimental unintended consequences.

References

Avdasheva, Svetlana and Polina Kryuchkova. 2015. "The 'Reactive' Model of Antitrust Enforcement: When Private Interests Dictate Enforcement Actions – The Russian case." *International Review of Law and Economics*, forthcoming.

Baker, Jonathan B. 2003. "The Case for Antitrust Enforcement." *Journal of Economic Perspectives*, 17:4, 27-50.

Baniak, Andrzej and Peter Grajzl. 2009. "Industry Self-regulation, Subversion of Public Institutions, and Social Control of Torts." *International Review of Law and Economics*, 29, 360-374.

Berkowitz, Daniel, Katharina Pistor and Jean-Francois Richard. 2003a. "The Transplant Effect." *American Journal of Comparative Law*, 51:1, 163-204.

Bourjade, Sylvain, Patrick Rey, and Paul Seabright. 2009. "Private Antitrust Enforcement in the Presence of Pre-Trial Bargaining." *The Journal of Industrial Economics*, 57:3, 372-409.

Bowles, Roger and Nuno Garoupa. 1997. "Casual Police Corruption and the Economics of Crime." *International Review of Law and Economics*, 17:1, 75-87.

Breit, William and Kenneth G. Elzinga. 1974. "Antitrust Enforcement and Economic Efficiency: The Uneasy Case for Treble Damages." *Journal of Law and Economics*, 17:2, 329-356.

Breit, William and Kenneth G. Elzinga. 1985. "Private Antitrust Enforcement: The New Learning." *Journal of Law and Economics*, 28:2, 405-443.

Calcagno, Claudio. 2012. "Stand-Alone Private Antitrust Damages: (How) Should Competition Authorities React?" *European Journal of Law and Economics*, 34, 365-389.

Chang, Juin-Jen, Lai, Ching-Chong, and C. C. Yang. 2000. "Casual Police Corruption and the Economics of Crime: Further Results." *International Review of Law and Economics*, 20:1, 35-51.

Cosnita-Langlais, Andreea and Jean-Philippe Tropeano. 2014. "Institutional Design and Antitrust Evidentiary Standards." Unpublished manuscript.

Crane, Daniel A. 2010. "Optimizing Private Antitrust Enforcement." *Vanderbilt Law Review*, 63, 675-723.

Davidson, Kenneth M. 2005. "Creating Effective Competition Institutions: Ideas For Transitional Economies." *Asian-Pacific Law and Policy Journal*, 6:1, 71-129.

Djankov, Simeon, Edward L. Glaeser, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer. 2003. "The New Comparative Economics." *Journal of Comparative Economics*, 31:4, 595-619.

Echazu, Luciana and Nuno Garoupa. 2010. "Corruption and the Distortion of Law Enforcement Effort." *American Law and Economics Review*, 12:1, 162-180.

El Dean, Bahaa Ali and Mahmoud Mohieldin. 2001. "On the Formulation and Enforcement of Competition Law in Emerging Economies: The Case of Egypt." *Business Law International*, 3, 289-315.

Feinberg, Robert M., Mieke Meurs, and Kara M. Reynolds. 2012. "Maintaining New Markets: Explaining Antitrust Enforcement in Central and Eastern Europe." *Journal of Industry, Competition and Trade*, 12, 203-219.

Feess, Eberhard. 2015. "On the Interplay of Public and Private Law Enforcement with Multiple Victims." *European Journal of Law and Economics*, 39, 79-95.

First, Harry. 2009. "The Case for Antitrust Civil Penalties." *Antitrust Law Journal*, 76:1, 127-166.

Fox, Eleanor M. 2007. "Economic Development, Poverty, and Antitrust: The Other Path." *Southwestern Journal of Law and Trade in the Americas*, 13, 101-125.

Fox, Eleanor M. 2010. "Antitrust and Institutions: Design and Change." *Loyola University Chicago Law Journal*, 41, 473-488.

Fox, Eleanor M. and Daniel A. Crane. 2010. *Global Issues in Antitrust and Competition Law*. Thomson Reuters.

Gal, Michal S. 2004. "The Ecology of Antitrust Preconditions for Competition Law Enforcement in Developing Countries." In: *Competition, Competitiveness and Development: Lessons from Developing Countries*, UNCTAD, 21-52.

Gal, Michal S. 2010. "When the Going Gets Tight: Institutional Solutions when Antitrust Enforcement Resources are Scarce." *Loyola University Chicago Law Journal*, 41, 417-441.

Garoupa, Nuno, Mohamed Jellal. 2007. "Further Notes on Information, Corruption, and Optimal Law Enforcement." *European Journal of Law and Economics*, 23:1, 59-69.

Garoupa, Nuno and Daniel Klerman. 2004. "Corruption and the Optimal Use of Nonmonetary Sanctions." *International Review of Law and Economics*, 24:2, 219-225.

Glaeser, Edward L. and Andrei Shleifer. 2003. "The Rise of the Regulatory State." *Journal of Economic Literature*, 41:2, 401-425.

Glaeser, Edward L. and Andrei Shleifer. 2002. "Legal Origins." *Quarterly Journal of Economics*, 117:4, 1193-1229.

Godek, Paul E. 1998. "A Chicago-School Approach to Antitrust for Developing Economies." *The Antitrust Bulletin*, 43, 261-274.

Grajzl, Peter. 2011. "A Property Rights Approach to Legislative Delegation." *Economics of Governance*, 12:2, 177-200.

Grajzl, Peter and Valentina Dimitrova-Grajzl. 2009. "The Choice in the Lawmaking Process: Legal Transplants vs. Indigenous Law." *Review of Law and Economics*, 5:1, 615-660.

Hüschelrath, Kai and Sebastian Peyer. 2013. "Public and Private Enforcement of Competition Law–A Differentiated Approach." ZEW Discussion Paper No. 13-029.

Kaplow, Louis. 2014. "Optimal Design of Private Litigation." Unpublished manuscript. Available at: http://isites.harvard.edu/fs/docs/icb.topic1275090.files/Paper02_Kaplow_02-10.pdf.

Kovacic, William E. 1995. "Designing and Implementing Competition and Consumer Protection Reforms in Transitional Economies: Perspectives from Mongolia, Nepal, Ukraine, and Zimbabwe." *DePaul Law Review*, 44:4, 1197-1224.

Kovacic, William E. 1996. "The Competition Policy Entrepreneur and Law Reform in Formerly Communist and Socialist Countries." *American University International Law Review*, 11:3, 437-474.

Kovacic, William E. 1998. "Getting Started: Creating New Competition Policy Institutions in Transition Economies." *Brookings Journal of International Law*, 23:2, 403-453.

Kovacic, William E. 2001. "Institutional Foundations for Economic Legal Reform Transition Economies: The Case of Competition Policy and Antitrust Enforcement." *Chicago-Kent Law Review*, 77, 265-315.

Kovacic, William E. and DeCourcey Eversley. 2007. " An Assessment of Institutional Machinery: Methods Used in Competition Agencies and What Worked for Them." International Competition Network, Competition Policy Implementation Working Group.

Kronthaler, Franz and Johannes Stephan. 2007. "Factors Accounting for the Enactment of a Competition Law–An Empirical Analysis." *The Antitrust Bulletin*, 52:2, 137-168.

Lambsdorff, Johann Graf. 2002. "Corruption and Rent-Seeking." *Public Choice*, 113, 97-125.

Landes, William M. and Richard A. Posner. 1975. "The Private Enforcement of Law." *Journal of Legal Studies*, 4, 1-46.

Ma, Tay-Cheng. 2013. "Legal Transplant, Legal Origin, and Antitrust Effectiveness." *Journal of Competition Law and Economics*, 9:1, 65-88.

Ma, Tay-Cheng. 2010. "Competition Authority Independence, Antitrust Effectiveness, and Institutions." *International Review of Law and Economics*, 30, 226-235.

Martini, Gianmaria and Cinzia Rovesti. 2004. "Antitrust Policy and Price Collusion: Public Agencies vs Delegation." *Louvain Economic Review*, 70:2, 127-151.

McAfee, R. Preston, Hugo M. Mialon, and Sue H. Mialon. 2008. "Private v. Public Antitrust Enforcement: A Strategic Analysis." *Journal of Public Economics*, 92, 1863-1875.

McAfee, R. Preston, Hugo M. Mialon, and Sue H. Mialon. 2007. "Private Antitrust Litigation: Procompetitive or Anticompetitive?" In: Ghosal, Vivek and Johan Stennek (Eds.), *The Political Economy of Antitrust*, Elsevier, 453-462.

McAfee, R. Preston and Nicholas V. Vakkur. 2004. "The Strategic Abuse of the Antitrust Laws." *Journal of Strategic Management Education*, 1:3, 1-18.

McCann Kevin and Alyse L. Katz. 2011. "When Business Torts Give Rise to Antitrust Liability." American Bar Association, Section of Litigation. Available at: http://apps.americanbar.org/litigation/committees/businesstorts/articles.html.

Murrell, Peter.1992. "Evolution in Economics and in the Economic Reform of the Centrally Planned Economies." In: Clague, Christopher C. and Gordon Rausser (Eds.), *The Emergence of Market Economies in Eastern Europe*, Blackwell, 35-53.

Peyer, Sebastian. 2012. "Private Antitrust Litigation in Germany from 2005 to 2007: Empirical Evidence." *Journal of Competition Law and Economics*, 8:2, 331-359.

Rajabiun, Reza. 2013. "Private Enforcement and Judicial Discretion in the Evolution of Antitrust in the United States." *Journal of Competition Law and Economics*, 8:1, 187-230.

Polinsky, A. Mitchell. 1980. "Private Versus Public Enforcement of Fines." *Journal of Legal Studies*, 9, 105-127.

Polinsky, A. Mitchell. 1985. "Detrebling versus Decoupling Antitrust Damages: Lessons from the Theory of Enforcement." *The Georgetown Law Journal*, 74, 1231-1236.

Polinsky, A. Mitchell and Steven Shavell. 2001. "Corruption and Optimal Law Enforcement." *Journal of Public Economics*, 81:1, 1-24.

Reuter, Tim. 2015. "Private Antitrust Enforcement and the Role of Harmed Parties in Public Enforcement." *European Journal of Law and Economics*, forthcoming.

Rodriguez, A.E. and Mark D. Williams. 1994. "The Effectiveness of Proposed Antitrust Programs for Developing Countries." *North Carolina Journal of International Law and Commercial Regulation*, 19, 209-232.

Rodrik, Dani. 2000. "Institutions for High-Quality Growth: What They are and How to Acquire Them." *Studies in Comparative International Development*, 35:3, 3-31.

Rubin, Paul H. 1994. "Growing a Legal System in the Post-Communist Economies." *Cornell International Law Journal*, 27, 1-47.

Shavell, Steven M. 1993. "The Optimal Structure of Law Enforcement." *Journal of Law and Economics*, 36, 255-287.

Schwartz, Warren F. and Abraham L. Wickelgren. 2011. "Optimal Antitrust Enforcement: Competitor Suits, Entry, and Post-Entry Competition." *Journal of Public Economics*, 95, 967-972.

Segal, Ilya R. and Michael Whinston. 2007. "Public vs. Private Enforcement of Antitrust Law: A Survey." *European Competition Law Review*, 28, 323-332.

Sheth, Manisha M. 1997. "Formulating Antitrust Policy in Emerging Economies." *The Georgetown Law Journal*, 86, 451-477.

Shleifer, Andrei and Robert W. Vishny. 1994. "Politicians and Firms." *Quarterly Journal of Economics*, 109:4, 995-1025.

Shughart, William F. II. 1990. "Private Antitrust Enforcement: Compensation, Deterrence, or Extortion?" *Regulation*, 13, 53-61.

Sokol, D. Daniel. 2010. "Antitrust, Institutions, and Merger Control." *George Mason Law Review*, 17, 1055-1148.

Stephan, Andreas. 2010. "Cartel Laws Undermined: Corruption, Social Norms, and Collectivist Business Cultures." *Journal of Law and Society*, 37:2, 345-367.

Svensson, Jakob. 2005. "Eight Questions about Corruption." *Journal of Economic Perspectives*, 19:3, 19-42.

Trebilcock, Michael J. and Edward M. Iacobucci. 2010. "Designing Competition Law Institutions: Values, Structure, and Mandate." *Loyola University Chicago Law Journal*, 41, 455-471.

Tullock, Gordon. 1980. "Efficient Rent Seeking." In: Buchanan, James M., Robert Tollison, and Gordon Tullock (Eds.), *Toward a Theory of the Rent Seeking Society*, College Station: Texas A&M University Press, 97-112.

Voigt, Stefan. 2009. "The Effects of Competition Policy on Development–Cross-Country Evidence Using Four New Indicators." *Journal of Development Studies*, 45:8, 1225-1248.

Waked, Dina I. 2010. "Antitrust Enforcement in Developing Countries: Reasons for Enforcement and Non-Enforcement Using Resource-Based Evidence." SSRN Working Paper No. 1638874.

Waksman, Alexander. 2012. "Clientless Actions: A Semi-Private Approach to the Enforcement of EU Competition Law." *Erasmus Law and Economics Review*, 2:1, 22-38.

Waller, Spencer Weber. 2006. "Towards a Constructive Public-Private Partnership to Enforce Competition Law." *World Competition*, 29:3, 367-381.

Figure 1: Public-private antitrust enforcement, expected firm payoffs in the absence of corruption

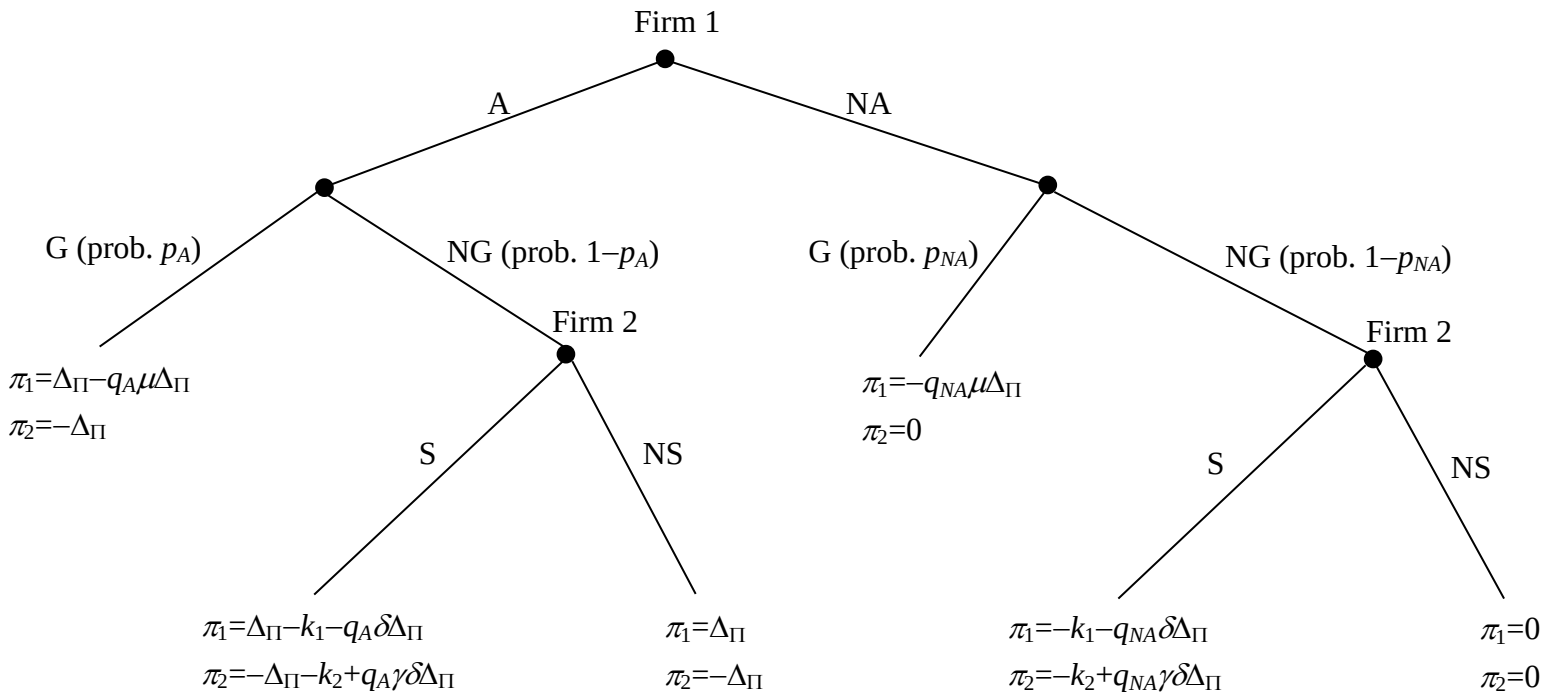


Figure 2: Public-private antitrust enforcement, expected firm payoffs in the presence of corruption

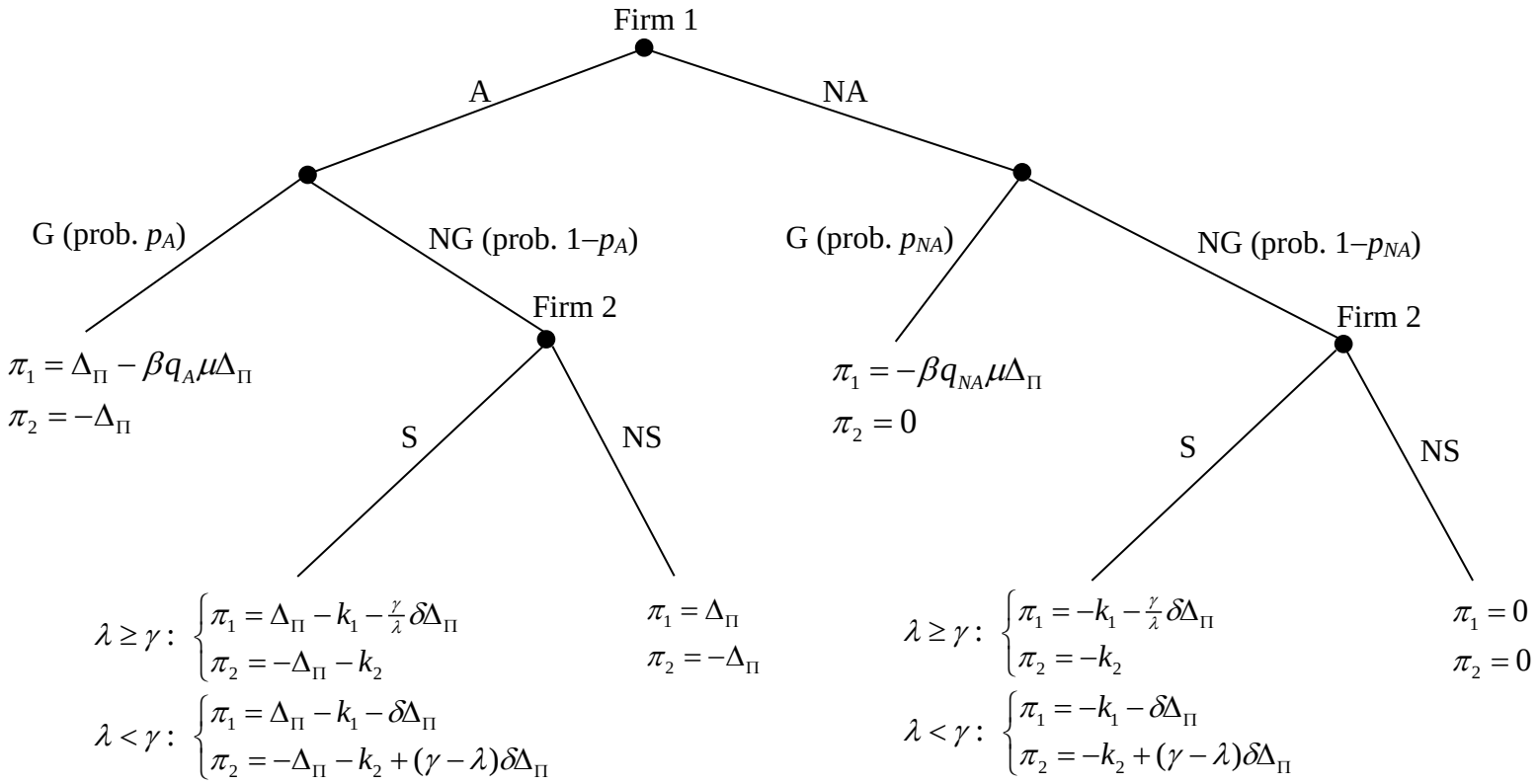
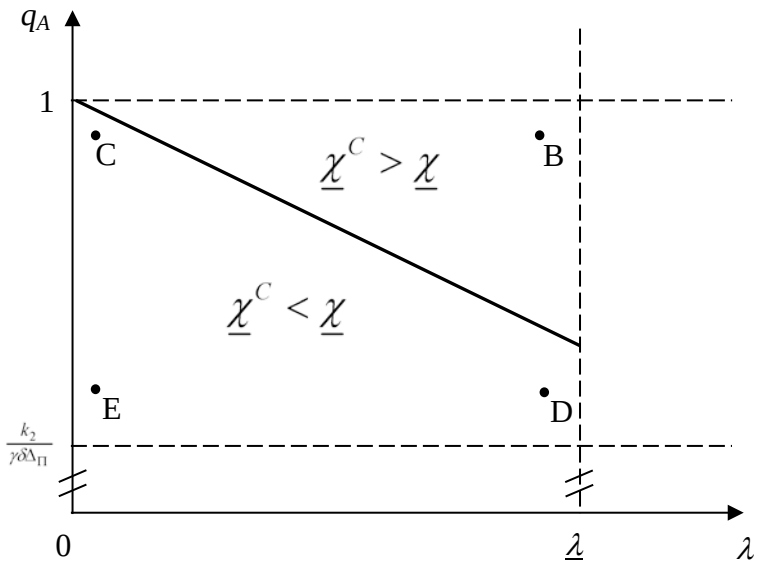


Figure 3: The relative desirability of public-private vs. pure public enforcement in the absence of corruption and in the presence of corruption when Proposition 1, part 2, and Proposition 2, part 1, apply



Appendix

Proof of Lemma 1:

Under pure public enforcement firm 1 chooses A if and only if

$$p_A[\Delta_\Pi - q_A\mu\Delta_\Pi] + (1-p_A)\Delta_\Pi > p_{NA}[-q_{NA}\mu\Delta_\Pi], \quad \text{(A.1)}$$

or, equivalently, if and only if

$$\Delta_\Pi[1-\mu(p_A q_A - p_{NA}q_{NA})] > 0. \quad \text{(A.2)}$$

When assumption (A1) holds, the left-hand side of (A.2) is always positive; thus, firm 1 always chooses A. Social welfare under pure public enforcement then equals

$$W^{PUB} = p_A(1-q_A)[-\chi] + (1-p_A)[-\chi], \quad \text{(A.3)}$$

which simplifies to $W^{PUB} = -(1-p_A q_A)\chi$.

Proof of Lemma 2:

If firm 1 chose A in period 1 and no antitrust agency investigation took place, then firm 2 chooses S if and only if $-\Delta_\Pi + q_A\gamma\delta\Delta_\Pi - k_2 > -\Delta_\Pi$ or, equivalently, when $q_A > k_2/(\gamma\delta\Delta_\Pi)$, where $k_2/(\gamma\delta\Delta_\Pi) < 1$ by assumption (A2). If firm 1 chose NA in period 1 and no antitrust agency investigation took place, then firm 2 chooses S if and only if $q_{NA}\gamma\delta\Delta_\Pi - k_2 > 0$ or, equivalently, when $q_{NA} > k_2/(\gamma\delta\Delta_\Pi)$. With $q_A > q_{NA}$, when assumption (A3) holds, therefore, firm 2 chooses S if firm 1 chooses A and NS if firm 1 chooses NA.

When assumption (A3) does not hold, firm 2 either has an incentive to engage in frivolous litigation (i.e. firm 2 chooses S regardless of firm 1's first-period action) or discards private litigation as a wasteful use of resources (i.e. firm 2 chooses NS regardless of firm 1's first-period action). The former obtains when the likelihood of false positive decisions is large ($q_A > q_{NA} > k_2/(\gamma\delta\Delta_\Pi)$). The latter obtains when the likelihood of false negative decisions is large (when $k_2/(\gamma\delta\Delta_\Pi) > q_A > q_{NA}$).

Proof of Lemma 3:

If firm 2 chooses S when firm 1 chooses A and NS if firm 1 chooses NA (see Lemma 2), then firm 1 chooses A if and only if

$$p_A[\Delta_\Pi - q_A\mu\Delta_\Pi] + (1-p_A)[\Delta_\Pi - q_A\delta\Delta_\Pi - k_1] > p_{NA}[-q_{NA}\mu\Delta_\Pi]. \quad \text{(A.4)}$$

Upon collecting terms, when assumption (A1) holds, (A.4) can be expressed as $\Delta_\Pi > \underline{\Delta}_\Pi \equiv k_1(1-p_A)/\Omega$, where $\Omega>0$ and $\underline{\Delta}_\Pi>0$. Thus, firm 1 chooses A if $\Delta_\Pi>\underline{\Delta}_\Pi$ and NA if $\Delta_\Pi<\underline{\Delta}_\Pi$. The following sign the impact of the parameters on $\underline{\Delta}_\Pi$:

$$\frac{\partial \underline{\Delta}_\Pi}{\partial k_1} = \frac{1-p_A}{\Omega} > 0 \tag{A.5}$$

$$\frac{\partial \underline{\Delta}_\Pi}{\partial q_A} = k_1(1-p_A)\frac{(-1)}{\Omega^2}\left[-\mu p_A - \delta(1-p_A)\right] > 0 \tag{A.6}$$

$$\frac{\partial \underline{\Delta}_\Pi}{\partial \mu} = k_1(1-p_A)\frac{(-1)}{\Omega^2}\left[-(p_A q_A - p_{NA} q_{NA})\right] > 0 \tag{A.7}$$

$$\frac{\partial \underline{\Delta}_\Pi}{\partial \delta} = k_1(1-p_A)\frac{(-1)}{\Omega^2}\left[-(1-p_A) q_A\right] > 0 \tag{A.8}$$

$$\frac{\partial \underline{\Delta}_\Pi}{\partial p_{NA}} = k_1(1-p_A)\frac{(-1)}{\Omega^2}\mu q_{NA} < 0 \tag{A.9}$$

$$\frac{\partial \underline{\Delta}_\Pi}{\partial q_{NA}} = k_1(1-p_A)\frac{(-1)}{\Omega^2}\mu p_{NA} < 0. \tag{A.10}$$

Finally, the effect of p_A on $\underline{\Delta}_\Pi$ equals

$$\frac{\partial \underline{\Delta}_\Pi}{\partial p_A} = \frac{(-k_1)}{\Omega^2}\left[1-\mu(q_A - p_{NA} q_{NA})\right]. \tag{A.11}$$

The sign of the right-hand side of (A.11) is in general ambiguous: it is positive for $\mu>\underline{\mu}$ and negative for $\mu<\underline{\mu}$, where $\underline{\mu} \equiv \frac{1}{q_A - p_{NA} q_{NA}} > 1$.

Proof of Lemma 4:

If $\Delta_\Pi>\underline{\Delta}_\Pi$, Lemmas 2 and 3 imply that firm 1 chooses A and firm 2 chooses S if government antitrust agency did not investigate. Recall that if firm 1 is found guilty, the excess of firm 1's damage payments over the amount received by firm 2 ($(1-\gamma)\delta\Delta_\Pi$) goes to public budget and is welfare neutral. Social welfare therefore equals

$$W^{PUBPR} = p_A(1-q_A)[-\chi] + (1-p_A)[-k_1 - k_2 - (1-q_A)\chi], \tag{A.12}$$

which simplifies to $W^{PUBPR} = -(1-p_A)[k_1+k_2] - (1-q_A)\chi$.

If $\Delta_\Pi<\underline{\Delta}_\Pi$, Lemmas 2 and 3 imply that firm 1 chooses NA and firm 2 chooses NS if government antitrust agency did not investigate. Social welfare then equals $W^{\mathrm{PUBPR}}=0$.

Proof of Proposition 1:

Follows directly from the comparison of welfare expressions stated in Lemmas 1 and 4.

Lemma A1 (Hillman and Riley 1989, Baye et al. 1993): Consider an all-pay auction with complete information and two bidders, indexed 1 and 2. The bidders' gross valuations for the prize are v_1 and v_2, respectively, where $v_1 \geq v_2$, and bidders' bids are b_1 and b_2. Bidder 1's expected payoff is $P_1(b_1,b_2)v_1 - b_1$ and bidder 2's expected payoff is $(1-P_1(b_1,b_2))v_2 - b_2$, where the probability that bidder 1 wins, $P_1(b_1,b_2)$, satisfies

$$P_1(b_1,b_2) = \begin{cases} 1 & \text{if } b_1 > b_2 \\ 0 & \text{if } b_1 < b_2 \\ \sigma & \text{if } b_1 = b_2, \end{cases}$$

with $\sigma \in (0,1)$. Then, the following characterizes the equilibrium:

1. Bidder 1 always submits a positive bid whereas bidder 2 submits a positive bid with probability v_2/v_1. Conditional upon submitting a positive bid, each bidder bids according to a continuous uniform mixed strategy over the interval $[0,v_2]$.
2. The expected payoff to bidder 1 equals $v_1 - v_2 \geq 0$ and the expected payoff to bidder 2 equals 0.
3. The expected total spending (i.e. expected revenue for the seller) equals $(v_2/v_1)(v_2/2)+(v_2/2)$.
4. The prize is allocated to bidder 1 with probability $1-v_2/(2v_1)$ and to bidder 2 with probability $v_2/(2v_1)$.

Proof of Lemma A1: See Hillman and Riley (1989) and Baye et al. (1993).

Derivation of expected payoffs in Figure 2 and the equilibrium probabilities that firm 1 is (not) found guilty of antitrust violation:

If firm 1 chooses A, government antitrust agency does not investigate firm 1, and firm 2 chooses NS, then firm 1's payoff equals $\pi_1 = \Delta_\Pi$ and firm 2's payoff equals $\pi_1 = -\Delta_\Pi$. If firm 1 chooses NA, government antitrust agency does not investigate firm 1, and firm 2 chooses NS, firms 1 and 2 earn payoff of $\pi_1 = \pi_2 = 0$.

If firm 1 chooses A and government antitrust agency investigates firm 1, then payoff to firm 1 equals $\Delta_\Pi - q_A \mu \Delta_\Pi$ in the absence of bribery and $\Delta_\Pi - b_1$ with bribery. The corrupt adjudicator's payoff equals 0 in the absence of bribery and b_1 with bribery. With corrupt adjudicator's bargaining strength vis-à-vis firm 1 equal to $\beta \in (0,1]$, the equilibrium bribe maximizes the Nash product $[b_1 - 0]^{\beta} \cdot [\Delta_\Pi - b_1 - (\Delta_\Pi - q_A \mu \Delta_\Pi)]^{1-\beta}$. Obtaining the first-order condition

and solving for b_1 gives the equilibrium bribe $b_1=\beta q_A \mu \Delta_\Pi$. Thus, firm 1's expected payoff equals $\pi_1=\Delta_\Pi-\beta q_A \mu \Delta_\Pi$. Firm 2's payoff equals $\pi_2=-\Delta_\Pi$. The equilibrium probability that firm 1 is found guilty of antitrust violation is 0.

If firm 1 chooses NA and government antitrust agency investigates firm 1, then payoff to firm 1 equals $-q_{NA}\mu\Delta_\Pi$ in the absence of bribery and $-b_1$ with bribery. The corrupt adjudicator's payoff equals 0 in the absence of bribery and b_1 with bribery. The equilibrium bribe now maximizes the Nash product $[b_1-0]^{\beta}\cdot[-b_1-(-q_{NA}\mu\Delta_\Pi)]^{1-\beta}$ and equals $b_1=\beta q_{NA}\mu\Delta_\Pi$. Thus, firm 1's expected payoff equals $\pi_1=-\beta q_{NA}\mu\Delta_\Pi$. Firm 2's payoff equals $\pi_2=0$. The equilibrium probability that firm 1 is found guilty of antitrust violation is 0.

If firm 1 chooses A, government antitrust agency does not investigate firm 1, and firm 2 chooses S, then firm 1's expected payoff equals

$$\pi_1 = \Delta_\Pi - k_1 - \Gamma_A \delta \Delta_\Pi - b_1 \tag{A.13}$$

and firm 2's expected payoff equals

$$\pi_2 = -\Delta_\Pi - k_2 + \Gamma_A \gamma \delta \Delta_\Pi - b_2, \tag{A.14}$$

where the probability that firm 1 is found guilty of antitrust violation, Γ_A, is defined in (1). Upon adding and subtracting $\delta\Delta_\Pi$ on the right-hand side of (A.13) and defining $b_1'=\lambda b_1$, (A.13) can be rewritten as

$$\pi_1 = \tfrac{1}{\lambda}\left[\lambda\Delta_\Pi - \lambda k_1 - \lambda\delta\Delta_\Pi + \pi_{1n}\right], \tag{A.15}$$

where

$$\pi_{1n} = (1-\Gamma_A)\lambda\delta\Delta_\Pi - b_1'. \tag{A.16}$$

Similarly, (A.14) can be expressed as

$$\pi_2 = -\Delta_\Pi - k_2 + \pi_{2n}, \tag{A.17}$$

where

$$\pi_{2n} = \Gamma_A \gamma \delta \Delta_\Pi - b_2. \tag{A.18}$$

To find the equilibrium expected payoffs in the all-pay bribery auction based on payoffs (A.13) and (A.14), we first find the equilibrium expected payoffs in the all-pay bribery auction with payoffs (A.16) and (A.18), where parties' valuations of the prize equal $\lambda\delta\Delta_\Pi$ and $\gamma\delta\Delta_\Pi$, respectively.

Note that $\lambda\delta\Delta_\Pi \geq \gamma\delta\Delta_\Pi$ if and only if $\lambda \geq \gamma$. Accordingly, if $\lambda \geq \gamma$, in the all-pay auction defined by payoffs (A.16) and (A.18), firm 1's equilibrium expected payoff equals $\pi_{1n}=(\lambda-\gamma)\delta\Delta_\Pi>0$ and firm 2's equilibrium expected payoff equals $\pi_{2n}=0$ (see Lemma A1, part 2). Hence, the equilibrium expected payoffs in the all-pay bribery auction based on payoffs (A.13) and (A.14) then equal

$$\pi_1 = \Delta_\Pi - k_1 - \tfrac{\gamma}{\lambda}\delta\Delta_\Pi \tag{A.19}$$

and

$$\pi_2 = \Delta_\Pi - k_2. \tag{A.20}$$

The equilibrium probability that firm 1 is not found guilty of antitrust violation equals

$$1-\Gamma_A = \text{Prob}\left\{b_1' > b_2 \middle| b_2 > 0\right\}\text{Prob}\left\{b_2 > 0\right\} + \text{Prob}\left\{b_1' > b_2 \middle| b_2 = 0\right\}\text{Prob}\left\{b_2 = 0\right\}. \tag{A.21}$$

Drawing on Lemma A1, part 1, the right-hand side of (A.21) simplifies to $\frac{1}{2}\frac{\gamma\delta\Delta_\Pi}{\lambda\delta\Delta_\Pi} + (1-\frac{\gamma\delta\Delta_\Pi}{\lambda\delta\Delta_\Pi})$, and thus, consistent with Lemma A1, part 4, $1-\Gamma_A = 1-\frac{\gamma}{2\lambda} \in [\frac{1}{2},1)$.

In contrast, if $\lambda<\gamma$, in the all-pay auction defined by payoffs (A.16) and (A.18), firm 1's equilibrium expected payoff equals $\pi_{1n}=0$ and firm 2's equilibrium expected payoff equals $\pi_{2n}=(\gamma-\lambda)\delta\Delta_\Pi>0$ (see Lemma A1, part 2). Then, the equilibrium expected payoffs in the all-pay bribery auction based on payoffs (A.13) and (A.14) equal

$$\pi_1 = \Delta_\Pi - k_1 - \delta\Delta_\Pi \tag{A.22}$$

and

$$\pi_2 = -\Delta_\Pi - k_2 + (\gamma-\lambda)\delta\Delta_\Pi. \tag{A.23}$$

The equilibrium probability that firm 1 is not found guilty of antitrust violation then equals

$$1-\Gamma_A = \text{Prob}\left\{b_1' > b_2 \middle| b_1' > 0\right\}\text{Prob}\left\{b_1' > 0\right\} + \text{Prob}\left\{b_1' > b_2 \middle| b_1' = 0\right\}\text{Prob}\left\{b_1' = 0\right\}. \tag{A.24}$$

Drawing on Lemma A1, part 1, the second term on the right-hand side of (A.24) is zero and, thus, the right-hand side of (A.24) simplifies to $\frac{1}{2}\frac{\lambda\delta\Delta_\Pi}{\gamma\delta\Delta_\Pi}$. Thus, consistent with Lemma A1, part 4, $1-\Gamma_A = \frac{\lambda}{2\gamma} \in (0,\frac{1}{2})$.

If firm 1 chooses NA, government antitrust agency does not investigate firm 1, and firm 2 chooses S, then firm 1's expected payoff equals

$$\pi_1 = -k_1 - \Gamma_A\delta\Delta_\Pi - b_1 \tag{A.25}$$

and firm 2's expected payoff equals

$$\pi_2 = -k_2 + \Gamma_A \gamma \delta \Delta_\Pi - b_2. \tag{A.26}$$

Upon adding and subtracting $\delta\Delta_\Pi$ on the right-hand side of (A.25), and making use of the fact that $b_1'=\lambda b_1$, (A.25) can be rewritten as

$$\pi_1 = \tfrac{1}{\lambda}\left[-\lambda k_1 - \lambda\delta\Delta_\Pi + \pi_{1n}\right], \tag{A.27}$$

where π_{1n} is defined in (A.16). Similarly, (A.26) can be expressed as

$$\pi_2 = -k_2 + \pi_{2n}, \tag{A.28}$$

where π_{2n} is defined in (A.18). To find the equilibrium expected payoffs, we again first make use of the equilibrium expected payoffs in the all-pay bribery auction with payoffs (A.16) and (A.18), noted above, and then deduce the equilibrium expected payoffs in the all-pay bribery auction based on payoffs (A.25) and (A.26).

If $\lambda \geq \gamma$, we have $\lambda\delta\Delta_\Pi \geq \gamma\delta\Delta_\Pi$, and thus $\pi_{1n}=(\lambda-\gamma)\delta\Delta_\Pi>0$ and $\pi_{2n}=0$ (see Lemma A1, part 2). Hence, the equilibrium expected payoffs in the all-pay bribery auction based on payoffs (A.25) and (A.26) then equal

$$\pi_1 = -k_1 - \tfrac{\gamma}{\lambda}\delta\Delta_\Pi \tag{A.29}$$

and

$$\pi_2 = -k_2. \tag{A.30}$$

Using analogous steps as when firm 1 chose A (see expression (A.21) and the surrounding discussion), the equilibrium probability that firm 1 is not found guilty of antitrust violation equals $1-\Gamma_{NA} = 1-\Gamma_A = 1-\tfrac{\gamma}{2\lambda} \in [\tfrac{1}{2}, 1)$.

In contrast, if $\lambda<\gamma$, we have $\lambda\delta\Delta_\Pi<\gamma\delta\Delta_\Pi$, and hence $\pi_{1n}=0$ and $\pi_{2n}=(\gamma-\lambda)\delta\Delta_\Pi>0$ (see Lemma A1, part 2). The equilibrium expected payoffs in the all-pay bribery auction based on payoffs (A.25) and (A.26) then equal

$$\pi_1 = -k_1 - \delta\Delta_\Pi \tag{A.31}$$

and

$$\pi_2 = -k_2 + (\gamma - \lambda)\delta\Delta_\Pi. \tag{A.32}$$

Using analogous steps as when firm 1 chose A (see expression (A.24) and the surrounding discussion), the equilibrium probability that firm 1 is not found guilty of antitrust violation equals $1-\Gamma_{NA} = 1-\Gamma_A = \tfrac{\lambda}{2\gamma} \in (0, \tfrac{1}{2})$.

Proof of Lemma 5:

Under pure public enforcement with corruption, firm 1 chooses A if and only if

$$p_A[\Delta_\Pi-\beta q_A\mu\Delta_\Pi]+(1-p_A)\Delta_\Pi > p_{NA}[-\beta q_{NA}\mu\Delta_\Pi], \tag{A.33}$$

or, equivalently, if and only if

$$\Delta_\Pi[1-\beta\mu(p_A q_A-p_{NA}q_{NA})]>0. \tag{A.34}$$

When assumption (A1) holds, the left-hand side of (A.34) is always positive; hence, firm 1 always chooses A. If government antitrust agency investigates firm 1, the corrupt adjudicator's bribe revenue equals $\beta q_A\mu\Delta_\Pi$. Following bribery, the probability that firm 1 is found guilty of antitrust violation equals 0. Social welfare under pure public enforcement with corruption then equals $W^{PUB,C}=p_A[(\Delta_\Pi-\beta q_A\mu\Delta_\Pi)-\Delta_\Pi+\beta q_A\mu\Delta_\Pi-\chi]+(1-p_A)[\Delta_\Pi-\Delta_\Pi-\chi]=-\chi$.

Proof of Lemma 6:

Consider first the case when $\lambda\geq\gamma$ and see Figure 2, If firm 1 chose A in the first period and the government antitrust agency did not investigate firm 1, then firm 2 chooses NS over S since $-\Delta_\Pi>-\Delta_\Pi-k_2$. If firm 1 chose NA in the first period and the government antitrust agency did not investigate firm 1, then firm 2 chooses NS over S since $0>-k_2$.

Consider next the case when $\lambda<\gamma$ and see Figure 2. If firm 1 chose A in the first period and the government antitrust agency did not investigate firm 1, then firm 2 chooses S over NS if and only if $-\Delta_\Pi-k_2+(\gamma-\lambda)\delta\Delta_\Pi>-\Delta_\Pi$ or, equivalently, $\lambda<\underline{\lambda}\equiv\gamma-k_2/(\delta\Delta_\Pi)$, where $1>\underline{\lambda}>0$ because of assumption (A2) and the fact that $\gamma\leq 1$. If firm 1 chose NA in the first period and the government antitrust agency did not investigate firm 1, then firm 2 chooses S over NS if and only if $-k_2+(\gamma-\lambda)\delta\Delta_\Pi>0$ or, equivalently, $\lambda<\underline{\lambda}$.

Thus, when $\lambda<\underline{\lambda}$, firm 2 chooses S regardless of whether firm 1 chose A or NA in the first period (Lemma 6, part 1). When $\lambda>\underline{\lambda}$, in contrast, firm 2 chooses NS regardless of whether firm 1 chose A or NA in the first period (Lemma 6, part 2).

Proof of Lemma 7:

Suppose, first, that $\lambda<\underline{\lambda}\equiv\gamma-k_2/(\delta\Delta_\Pi)$, in which case firm 2 always chooses S if antitrust agency does not investigate firm 1 (see Lemma 6, part 1). Then, firm 1 chooses A in the first period if and only if

$$p_A[\Delta_\Pi-\beta q_A\mu\Delta_\Pi]+(1-p_A)[\Delta_\Pi-k_1-\delta\Delta_\Pi]>p_{NA}[-\beta q_{NA}\mu\Delta_\Pi]+(1-p_{NA})[-k_1-\delta\Delta_\Pi], \quad \text{(A.35)}$$

or, equivalently, if and only if

$$\Delta_\Pi[1-\beta\mu(p_Aq_A-p_{NA}q_{NA})+\delta(p_A-p_{NA})]>-k_1(p_A-p_{NA}). \quad \text{(A.36)}$$

The term in the brackets on the left-hand side of (A.36) is positive because of assumption (A1). Since the right-hand side of (A.36) is negative, (A.36) always holds. Hence, firm 1 always chooses A.

Suppose, next, that $\lambda>\underline{\lambda}\equiv\gamma-k_2/(\delta\Delta_\Pi)$, in which case firm 2 always chooses NS if antitrust agency does not investigate firm 1 (see Lemma 6, part 2). Then, firm 1 chooses A if and only if (A.33) or, equivalently, (A.34) holds. (A.34) holds because of assumption (A1). In sum, firm 1 chooses A for any value of $\lambda>0$.

Proof of Lemma 8:

Suppose first that $\lambda<\underline{\lambda}\equiv\gamma-k_2/(\delta\Delta_\Pi)$. By Lemma 6, part 1, and Lemma 7, firm 1 chooses A and firm 2 chooses S if antitrust agency did not investigate. To compute social welfare, we, first, calculate the corrupt adjudicator's expected bribe revenue in instances when government agency does not investigate firm 1 and firm 2 sues firm 1. $\lambda<\underline{\lambda}\equiv\gamma-k_2/(\delta\Delta_\Pi)$ implies $\lambda<\gamma$, in which case firm 1's valuation of the prize in the all-pay bribery auction based on payoffs (A.16) and (A.18) is lower than firm 2's valuation (see Derivation of expected payoffs in Figure 2 above). Drawing on Lemma A1, part 1, and noting that $b_1'=\lambda b_1$, we therefore have

$$E[b_1+b_2]=\tfrac{1}{\lambda}E[b_1']+E[b_2]=\tfrac{1}{\lambda}\tfrac{\lambda\delta\Delta_\Pi}{\gamma\delta\Delta_\Pi}\tfrac{\lambda\delta\Delta_\Pi}{2}+\tfrac{\lambda\delta\Delta_\Pi}{2}=\lambda\delta\Delta_\Pi\tfrac{1+\gamma}{2\gamma}. \quad \text{(A.37)}$$

Second, we evaluate expected social losses from firm 1's antitrust action. To this end, recall that the probability that, following adjudication initiated by firm 2, firm 1 is not found guilty of antitrust violation equals $1-\Gamma_A=\frac{\lambda}{2\gamma}$ (see Derivation of expected payoffs in Figure 2 and the equilibrium probabilities that firm 1 is (not) found guilty of antitrust violation above). The expected social losses from antitrust violation conditional on government antitrust agency not investigating firm 1 thus equal $\frac{\lambda}{2\gamma}\chi$. Third, conditional on government antitrust agency not investigating firm 1, the expected amount of damages paid by firm 1 that are not a transfer to firm 2 equals $\left(1-\frac{\lambda}{2\gamma}\right)(1-\gamma)\delta\Delta_\Pi$. Social welfare therefore equals

$$W^{PUBPR,C} = p_A\left[(\Delta_\Pi - \beta q_A \mu \Delta_\Pi) - \Delta_\Pi + \beta q_A \mu \Delta_\Pi - \chi\right] + (1-p_A)\left[(\Delta_\Pi - k_1 - \delta\Delta_\Pi) + (-\Delta_\Pi - k_2 + (\gamma-\lambda)\delta\Delta_\Pi) + (1-\tfrac{\lambda}{2\gamma})(1-\gamma)\delta\Delta_\Pi + \lambda\delta\Delta_\Pi \tfrac{1+\gamma}{2\gamma} - \tfrac{\lambda}{2\gamma}\chi\right], \quad \text{(A.38)}$$

which upon collecting terms simplifies to

$$W^{PUBPR,C} = -p_A\chi - (1-p_A)\left[k_1 + k_2 + \tfrac{\lambda}{2\gamma}\chi\right]. \quad \text{(A.39)}$$

To verify the validity of the second term on the right-hand side of (A.39), note that in the instance when government antitrust agency does not investigate firm 1, the ex-ante expected payoffs to firm 1, firm 2, and the corrupt adjudicator, respectively, can be expressed as

$$E[\pi_1]=\Delta_\Pi - k_1 - \Gamma_A\delta\Delta_\Pi - E[b_1] \quad \text{(A.40)}$$

$$E[\pi_2]=-\Delta_\Pi - k_2 + \Gamma_A\gamma\delta\Delta_\Pi - E[b_2] \quad \text{(A.41)}$$

$$E[b_1+b_2]=E[b_1]+E[b_2] \quad \text{(A.42)}$$

The expected amount of damages paid by firm 1 that are not a transfer to firm 2 equals

$$\Gamma_A(1-\gamma)\delta\Delta_\Pi, \quad \text{(A.43)}$$

and the expected loss for the society from antitrust violation equals

$$(1-\Gamma_A)\chi. \quad \text{(A.44)}$$

Adding (A.40), (A.41), (A.42), and (A.43), subtracting (A.44), and noting that in equilibrium $\Gamma_A = 1-\frac{\lambda}{2\gamma}$ yields $-k_1 - k_2 - \frac{\lambda}{2\gamma}\chi$. Taking into account that these payoffs are conditional on government antitrust agency not investigating firm 1, an event which takes place with probability $1-p_A$, then yields the second term on the right-hand side of (A.39).

Suppose, next, that $\lambda > \underline{\lambda} \equiv \gamma - k_2/(\delta\Delta_\Pi)$. By Lemma 6, part 2, and Lemma 7, firm 1 chooses A and firm 2 chooses NS if antitrust agency did not investigate. Therefore, social welfare under public-private enforcement with corruption in this case equals $W^{PUBPR,C} = W^{PUB,C} = -\chi$ (see Proof of Lemma 5).

Proof of Proposition 2:

Follows directly from the comparison of welfare expressions stated in Lemmas 5 and 8.