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ABSTRACT

Antitrust Fines in Times of Crisis*

In a model in which firms can go bankrupt because of adverse market shocks or antitrust fines, we find that even large corporate fines may not be able to induce deterrence. Managerial penalties are thus needed. If the policy may be changed according to the state of the business cycle, then the optimal outcome can always be achieved through antitrust fines that are more severe in good times and more lenient in bad times. A time-independent policy may result in either too many bankruptcies or under-deterrence as compared to the optimal policy.

JEL Classification: K14, K42 and L13
Keywords: antitrust fines, business cycles and managing incentives

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1 Introduction

In many instances, competition authorities have reduced antitrust fines in order to avoid firm bankruptcy. This is particularly true during economic crisis, as authorities are more concerned with increased unemployment and liquidation costs. In this paper we try to identify the economic rationale for why authorities adopt this policy, as well as the circumstances under which this policy can be justified on economic grounds. We also shed light on related issues such as the effectiveness of corporate fines in inducing deterrence, as well as the role played by managerial fines, particularly so when firms face bankruptcy risk.

For the purposes of this paper, a speech by the EU Competition Commissioner in June 2010 is particularly revealing:[1] "*The Commission will continue to* [...] *set fines at a level that acts as a real deterrent. At the same time, the Commission is aware that some companies, particularly in today's economic climate, may be in financial difficulties. Those companies should not be made bankrupt because of the Commission's fine. Where their financial difficulties are real, the Commission will take that into account and lower the fine.* [...] *Competition policy is about promoting competition, not eliminating firms from the market place.*"

In his speech, the Commissioner also announced that five out of the seventeen firms that participated in the cartel of bathroom equipment manufacturers had been granted a fine reduction on the grounds of bankruptcy concerns.[2] Similarly, in the cartel of producers of TV and computer monitor tubes discovered in December 2012, one of the companies invoked its inability to pay the fine and the Commission granted a reduction of the fine; the other firms involved in the cartel paid a record fine of € 1.47 billion.[3]

These fine reductions are supported by the 2006 EU Fining Guidelines, which say that "*in exceptional cases...* [the Commission may] *take account of a company's inability to pay in a specific social and economic context provided that the fine would irretrievably jeopardise the economic viability of the undertaking concerned and cause its assets to lose all their value*" (point 35).[4] Similar provisions are contained in the US Federal Sentencing Guidelines, allowing courts to reduce fines if they "*find that the organization is not able and [...] is not likely to become able to pay the minimum fine*" (U.S.C. §8C3.3). Understanding whether lenient penalties in times of economic crisis are justified, is one of the main objectives of this paper.

The possibility of firm bankruptcy raises a related issue: whether corporate fines are sufficient to achieve deterrence when firms are protected by limited liability. We know from the literature

[1] See SPEECH/10/335 by Joaquín Almunia.

[2] More specifically, three undertakings obtained a 50% fine reduction for their difficult financial situation, while other two obtained a 25% fine discount for the same reason. Furthermore, three firms received fine reductions under the Leniency Program: one firm obtained full fine amnesty for revealing the cartel to the Commission, and two other firms got a 30% fine reduction for contributing to the Commission's investigation. Total fines amounted to 622M€. See the EU press release "Antitrust: Commission fines 17 bathroom equipment manufacturers € 622 million in price fixing cartel" (IP/10/790).

[3] Also, in 2008, the five firms involved in the cartel of providers of international removal services in Belgium claimed their inability to pay the fines, and the Commission reduced the fine to one of them by 70%. See also the 2002 Specialty Graphites and the 2003 Carbon & Graphite cartel decisions, in which the Commission granted a 33% fine discount to SGL Carbon AG because of the firm's "*serious financial constraints*" (Hviid and Stephan (2005)).

[4] See Kienapfel and Wils (2010) for a discussion of the "inability to pay" under the 1998 and 2006 Fining Guidelines.

that it is traditionally enough to set a sufficiently large fine in order to deter firms from violating the law. However, this is not true any more when bankruptcy is an issue, as the firm might be unable to pay such a high fine. Indeed, as we shall show in this paper, the possibility of bankruptcy implies that even very large corporate fines may not be able to achieve deterrence. An alternative to make up for the gap in deterrence is to impose fines on managers, as these will ultimately be paid by the firm owner through higher salaries or bonuses. For instance, top executives of a UK dairy firm earned major bonuses in 2008, just a year after the firm received a 7.3M€ fine for price-fixing.[5] Non-monetary managerial fines, such as imprisonment, are widely used in the US: from 2004 to 2010, 74% of defendants in cartel cases were sentenced to jail. In contrast, in Europe there is no criminal cartel offence at the Community level,[6] and the amount of monetary penalties that can be imposed on individuals for infringement of antitrust laws is severely capped. Furthermore, the careers of those managers involved in price-fixing do not seem to have suffered adverse effects. For instance, Robert Koehler is still CEO of SGL Carbon after admitting involvement in the graphite electrodes cartel (1999). More recently, one British Airways executive has been promoted while he was pending trial in the passenger fuel surcharges case, while another one gained a top level job at a private health insurance firm.[7] This suggests that, at least in Europe, individual managers do not internalize the social harm they cause when adopting anti-competitive conducts.

In this paper we set up a simple model to study the two antitrust issues discussed above. In particular, we analyze the effect of fines in a model where the shareholder sets contract terms and the manager chooses whether or not to take a conduct which violates antitrust laws.[8] We assume that the firm may go bankrupt – entailing a liquidation cost for managers and society[9] - both if a negative demand shock occurs and if – following an antitrust investigation and the proof of infringement – too large a corporate fine is imposed on the firm.

We find that, if the probability of detection is not too high,[10] deterrence cannot be achieved with corporate fines only, no matter how large these are. The deterrence effect of corporate fines is limited as very high fines would drive the firm into bankruptcy. Introducing sufficiently high managerial fines is thus needed to induce deterrence. The minimum managerial penalty needed to achieve deterrence is strictly positive, and it is higher the lower the corporate fine. Not surprisingly, we also find that managerial penalties are more effective when they are non-monetary, as the effectiveness of monetary penalties might be constrained by the manager's limited liability.

[5] See Robert Wiseman Dairies, 2008 Annual Report; OFT Press Release, "OFT welcomes early resolution agreements and agrees over £116m penalties" (7 December 2007) 170/70.

[6] Ireland and the UK have recently introduced criminal offences in antitrust cases.

[7] See "BA sales chief on price-fixing charge to join the board" Financial Times, November 28, 2008, and "Bupa job for BA chief in price-fix scandal" Evening Standard, December 2, 2008.

[8] Angelucci and Han (2010) also looks at antitrust issues within an agency framework. However, unlike us, they deal with compliance programmes; in particular, they explore their interaction with leniency programmes.

[9] We are only considering the social costs of bankruptcy per se, i.e., liquidation costs, without taking into account the effect on competition of having one firm less in the ex-post conviction scenario. See Branch (2002) for a review on the costs of bankruptcy.

[10] In practice, the probability of detection is low because of the AA's limited resources. Bryant and Eckard (1991) estimate the annual probability that a cartel would be detected by the US Federal authorities, conditional on being detected, to be at most between 13% and 17%. More recently, Combe et al. (2008) estimate a similar probability, between 12.9% and 13.3%, using data reported for all the cartels convicted by the European Commission from 1969 to 2008.

Defining booms as periods with high demand and recessions as periods with low demand, we also analyze deterrence and the optimal fine policy over the business cycle. The optimal fines are higher in good than in bad times, for the following reasons. Firstly, if the AA wants to induce deterrence, it has to impose higher fines during booms, because it is then when the incentive to behave anti-competitively is stronger. This is because the incremental profit from the anti-competitive conduct is higher during booms, which in turn implies that the risk of bankruptcy (and hence, the wage needed to induce the manager to behave anti-competitively) is lower.

Secondly, the Antitrust Authority (AA) may want to achieve deterrence in booms but not in recessions, thus enhancing the pro-cyclicality of optimal fines. Deterrence is optimal in booms since the higher demand in good times also translates into a higher deadweight loss under monopoly power. In contrast, deterrence might be sub-optimal in bad times if liquidation costs outweigh the relatively lower deadweight loss of monopoly power during recessions.

If the welfare-maximizing conduct in booms and recessions differ, the AA cannot induce the welfare-maximizing conduct under a time-independent fine policy. The second-best time-independent policy results in either too many bankruptcies or under-deterrence. If instead the policy may be changed according to the state of demand, then the optimal fine policy can always be achieved, resulting in antitrust fines being more severe in good times and more lenient in bad times. A soft fine policy (similar to the "inability to pay" provision contained in the Fining Guidelines, by which the AA can reduce fines once the state of the economy is revealed) would allow the AA to implement the same outcome.

This paper is structured as follows. In Section 2 we describe the model. In Section 3 we characterize the contract the firm owner has to offer to the manager for her to be willing to adopt either the competitive or the anti-competitive conduct; we also identify the firm owner's preferred conduct and the set of fines that achieve deterrence. In Section 4 we analyze the Antitrust Agency's optimal policy, and compare deterrence over the business cycle under time-dependent and time-independent fine policies. In Section 5 we conclude by summarizing our main findings, and by discussing our modelling choices and possible extensions.

2 The Model

We consider a model in which the owner of an incumbent firm hires a manager to run the firm. The manager chooses the firm's conduct, which the owner can perfectly observe.[11] The conduct can be either competitive (C) or anti-competitive (M); for instance, to fix ideas, suppose that under conduct M the manager tries to deter entry of potential competitors. Accordingly, the probability of entry depends on the conduct chosen by the manager. In particular, if the manager follows conduct $k \in \{C, M\}$, entry does not occur with probability p_k, with the probability of 'no entry' being higher under the anti-competitive conduct, i.e., $1 > p_M > p_C > 0$. We use $\Delta p \equiv p_M - p_C$ to define the difference between these two probabilities.

If there is entry, the incumbent firm makes losses (possibly, due to recurrent fixed costs). However, if there is no entry, the firm makes profits π_s, where s denotes the state of the business cycle,

[11] The assumption of perfect observability is made for the sake of simplicity. Assuming that the owner cannot observe the conduct chosen by the manager has no important qualitative effects on the results. See Section 5 for a discussion.

which can be a boom, $s = B$, or a recession, $s = R$. Demand $D(p)$ is subject to random shocks θ_s, which are higher in booms than in recessions, $\theta_B > \theta_R$; booms occur with probability $\alpha \in (0,1)$, while recessions occur with the remaining probability. We assume that shocks to demand are either multiplicative ($\theta_s D(p)$) or additive ($\theta_s + D(p)$), but impose no additional restrictions on the demand function other that it must be downward sloping. The assumption on demand guarantees that monopoly profits and the deadweight loss from monopoly profits are procyclical. Hence, $\pi_B > \pi_R$.[12]

The market is overseen by an antitrust authority (AA), which inspects firms with exogenous probability ρ.[13] We assume that the AA's resources are limited, thus implying that the probability of inspection is not too high:

Assumption 1: The probability of inspection is sufficiently low, $\rho < \frac{\Delta p}{p_M}$.

After an inspection, the AA can *perfectly* observe the manager's conduct. If the manager had followed conduct M, both the owner and the manager of the firm are subject to fines. We use F to denote corporate fines and f to denote managerial fines. We assume that the manager is forced to pay the full fine, e.g. because she is not protected by limited liability, or because managerial fines are non-monetary (e.g. managerial disqualification, compulsory firing, or jail).[14] Note that the AA imposes fines if it finds evidence of conduct M, regardless of realized profits (i.e., we are dealing with *per se* prohibited conducts). No fines are imposed if the manager had followed conduct C.

If entry occurs, or if the firm is fined and it does not have enough resources to pay the corporate fine, the firm is liquidated, in which case the owner makes zero profits and the manager incurs a utility loss $L > 0$. This utility loss could be interpreted as a turnover cost, as in case of liquidation the manager has to incur a search cost to find a new job. To make the problem interesting, we will assume that liquidation costs L are not too large:[15]

Assumption 2: Liquidation costs are sufficiently small, $L < \frac{p_C}{1-p_C}\pi_R$.

The game proceeds as follows:

- At **date 0**, the state of the business cycle $s \in \{B, R\}$ is realized and it is publicly observed.
- At **date 1**, the owner of the firm offers the manager a contract specifying the conduct that the manager should adopt and her wage offer. If the manager rejects the contract, the game ends.
- At **date 2**, the manager chooses the firm's conduct, $k \in \{C, M\}$, which is observed by the firm's owner.

[12] It is straightforward to see this for the case of multiplicative shocks, as the monopoly price is invariant to θ_s, so that monopoly profits and the deadweight loss from monopoly power are proportional to θ_s. Monopoly profits are also procyclical with additive shocks, as revealed-preference arguments imply $\pi_R(p_R^m) < \pi_B(p_R^m) \leq \pi_B(p_B^m)$. Furthermore, since demand is more elastic in recessions, $p_B^m > p_R^m$, and since demand moves in a parallel fashion, it follows that $DWL_R(p_R^m) = DWL_B(p_R^m) < DWL_B(p_B^m)$, where $DWL_s(p)$ denotes deadweight-loss in state s at price p.

[13] We assume that the probability of inspection is the same regardless the state of the business cycle.

[14] In the appendix we consider monetary fines.

[15] As it will become clearer in what follows, this condition implies that the owner's expected payoff under conduct C is positive regardless of the state of the business cycle. Therefore, without Assumption 2, the competitive conduct would never be chosen.

- At **date 3**, the owner observes realized profits; if profits are negative, the firm is liquidated, the manager suffers the liquidation cost L, and the game ends. Otherwise, if profits are $\pi_s > 0$, and if the manager followed the desired conduct, the manager gets her wage and the firm stays in business.[16] If the manager had not followed the owner's desired conduct, she is dismissed.

- At **date 4**, the AA inspects the firm with some exogenous probability ρ; if the firm is inspected and the manager had followed conduct C, the game ends. Otherwise, if she had followed conduct M, the owner and the manager are asked to pay their fines F and f, respectively. If the corporate fine F exceeds the firm's net profits (after paying out wages), i.e., if $F > \pi_s - w_s$, the firm is liquidated and the manager suffers the liquidation cost L. Otherwise, the firm stays in business, the owner pays the full corporate fine F, and keeps net profits $\pi_s - w_s - F$.

3 Analysis of the firm's conduct

We start by identifying the owner's preferred market conduct given the state of the business cycle. For this purpose, we first have to characterize the wage that the owner has to offer to the manager for her to be willing to accept the contract that calls her to follow either the competitive or the anti-competitive conduct.

3.1 Competitive conduct

Let us first assume that the owner wants the manager to adopt the competitive conduct. Under the state of the business cycle $s \in \{B, R\}$, if the manager follows conduct C, the firm makes profits π_s with probability p_C, while with probability $(1 - p_C)$ the firm makes losses and it is thus liquidated. The manager receives her wage whenever the firm is not liquidated, and otherwise suffers the liquidity cost L. Hence, the owner's and the manager's expected payoffs under conduct C are respectively given by,

$$\Pi_s(C) = p_C(\pi_s - w_s),$$

and

$$U_s(C) = p_C w_s - (1 - p_C) L.$$

Let $w_s(C)$ be the minimum wage that can be offered to the manager for her to accept the contract. From $U_s(C) = 0$, it follows that

$$w_s(C) = \frac{1 - p_C}{p_C} L,$$

which is the same regardless of whether the economy is in a boom or in a recession.

Since the owner need not pay the manager more than $w_s(C)$ for her to accept the contract, the owner's expected payoff under conduct C is

$$\Pi_s(C) = p_C \pi_s - (1 - p_C) L.$$

Under Assumption 2, conduct C always has a positive expected payoff, which is higher during booms than during recessions, i.e., $\Pi_B(C) > \Pi_R(C) > 0$. Assumption 2 also guarantees that

[16] Note that we are implicitly assuming that $\pi_s \geq w_s$. Any wage offer $\pi_s < w_s$ would not be credible since the owner does not have resources other than current profits with which to pay wages.

$\pi_s - w_s(C) > 0$ in both states. This implies that under conduct C the firm only goes bankrupt if there is a negative profit realization, i.e., with probability $(1 - p_C)$.

3.2 Anti-competitive conduct

Let us now assume that the owner wants the manager to adopt the anti-competitive conduct. Under the state of the business cycle $s \in \{B, R\}$, if the manager follows conduct M, the firm makes profits π_s with probability p_M and it makes losses and it is thus liquidated with probability $(1 - p_M)$. Thus, the manager receives her wage with probability p_M, and suffers the liquidation cost L with probability $(1 - p_M)$. If the firm was not liquidated, it is inspected with probability ρ, in which case the owner and the manager are liable to pay fines F and f. However, if the owner does not have enough profits to pay the corporate fine F, the firm is liquidated and the manager suffers the liquidity cost L. Hence, the owner's and the manager's expected payoffs under conduct M are given by,

$$\Pi_s(M) = p_M\left[(1-\rho)(\pi_s - w_s) + \rho \max\{0, \pi_s - w_s - F\}\right],$$

and

$$U_s(M) = \begin{cases} p_M(w_s - \rho f) - (1 - p_M)L & \text{if} \quad F \leq \pi_s - w_s \\ p_M(w_s - \rho f) - [1 - p_M(1-\rho)]L & \text{if} \quad F > \pi_s - w_s \end{cases}.$$

Let $w_s(M)$ be the wage that makes the manager indifferent between accepting or rejecting the contract that calls her to follow conduct M in state $s \in \{B, R\}$.

Lemma 1 *Suppose the firm owner asks the manager to follow conduct M. In state* $s \in \{B, R\}$,

$$w_s(M) = \begin{cases} \widehat{w} & \text{if} \quad F \leq \pi_s - \widehat{w} \\ \widehat{w} + \rho L & \text{if} \quad F > \pi_s - \widehat{w} \end{cases},$$

where $\widehat{w} = \rho f + \frac{1-p_M}{p_M} L$.

Proof. See the Appendix. ■

If corporate fines are low, $F \leq \pi_s - \widehat{w}$, the wage that strictly covers the manager's expected costs of following conduct M is $\widehat{w}$. This wage is increasing in the expected managerial fine, ρf, and it is increasing in the expected costs of liquidation, which depend positively on L and negatively on the probability of no entry, p_M. For higher corporate fines, $F > \pi_s - \widehat{w}$, the manager knows that the firm will liquidate after an inspection, so her wage has to be increased by the additional expected liquidation costs, ρL.

Note that unlike $w_s(C)$, the minimum wage needed to induce the manager to follow M, $w_s(M)$, depends on the state of the business cycle through the critical value of F at which $w_s(M)$ jumps up. It follows directly that under conduct M, the wage that gives zero utility to the manager is higher during recessions than during booms.

Corollary 1 $w_R(M) \geq w_B(M)$, *with strict inequality for* $F \in (\pi_R - \widehat{w}, \pi_B - \widehat{w}]$.

However, note that the firm owner cannot credibly offer $w_s(M)$ if profits π_s are below that minimum wage. If that were the case, it would not be possible for the principal to induce the manager to violate the law. Building on this insight, the following proposition characterizes the wage offer that the firm owner offers the manager when he wants her to follow conduct M. It also reports the parameter values under which conduct M is not feasible.

Proposition 1 *Let $\widehat{f}_s$ be such that $\widehat{w} = \pi_s$. Suppose the firm owner asks the manager to follow conduct M. In state $s \in \{B, R\}$,*

(i)If $f < \widehat{f}_s - L$, the principal offers $w_s(M)$ and the manager accepts.

(ii) If $f \in \left(\widehat{f}_s - L, \widehat{f}_s\right)$ and $F \leq \pi_s - \widehat{w}$, the principal offers $\widehat{w}$ and the manager accepts.

(iii) Otherwise, the principal cannot make any credible wage offer that the manager accepts.

Proof. See the Appendix. ■

If managerial fines are sufficiently low, $f < \widehat{f}_s - L$, profits would be enough to cover the wage offer that makes the manager indifferent between accepting or rejecting the offer (Lemma 1). Hence, by offering $w_s(M)$, the firm owner is able to induce the manager to behave anti-competitively regardless of how large corporate fines F are. However, for higher managerial fines, the highest wage that the firm owner can credibly offer to the manager, π_s, is below the wage that would satisfy the manager's participation constraint for at least some values of F. Indeed, for $f > \widehat{f}_s$, it is not possible to induce the manager to violate the antitrust law, whereas for $f < \left(\widehat{f}_s - L, \widehat{f}_s\right)$, the manager would accept the contract only if corporate fines are low enough, $F \leq \pi_s - \widehat{w}$ (recall that the manager cares about corporate fines as these affect the probability of liquidation, which makes her lose L).

We conclude this section by deriving the owner's expected payoff under conduct M. For low managerial fines, $f < \widehat{f}_s - L$,

$$\Pi_s(M) = \begin{cases} p_M(1-\rho)(\pi_s - \widehat{w}) + \rho p_M(\pi_s - \widehat{w} - F) & \text{if} \quad F \leq \pi_s - \widehat{w} \\ p_M(1-\rho)(\pi_s - \widehat{w}) - \rho p_M(1-\rho)L & \text{if} \quad F > \pi_s - \widehat{w} \end{cases}. \tag{1}$$

The fact that the wage offer goes up at $F = \pi_s - \widehat{w}$ explains why the owner's expected payoff jumps down at $F = \pi_s - \widehat{w}$. For intermediate managerial fines, $f < \left(\widehat{f}_s - L, \widehat{f}_s\right)$, following conduct M is feasible only if $F \leq \pi_s - \widehat{w}$; hence, only the first line in (1) applies. Last, for high managerial fines, $f > \widehat{f}_s$, the manager never accepts to follow conduct M so that $\Pi_s(M) = 0$.

To sum up, high managerial fines simply make antitrust laws violation impossible as there is no credible wage offer that would induce the manager to behave anti-competitively. Furthermore, even when managerial fines are not that high, an increase in managerial fines translates into higher wages, which reduce the firm owner's profits under the anti-competitive conduct. In contrast, if managerial penalties are low, it is always possible for the firm owner to induce the anti-competitive conduct even if corporate fines are very large. We have also shown that the firm owner's profits are lower during recessions than during booms, both because the incremental profit for the anti-competitive conduct is lower and because the wage that needs to be paid to the manager is higher.

3.3 The Owner's Preferred Conduct

Before proceeding, it may be useful to stress that the anti-competitive conduct allows the owner to reduce the probability of liquidation as well as to earn higher gross profits (before netting out

wage payments). This derives from two facts: (i) the probability of getting positive profits is higher under M than under C, and (ii) since the probability of inspection is low enough (Assumption 1), this difference is only partially offset by the fact that under conduct M corporate fines might drive the firm to bankruptcy. This is stated in the following Lemma.

Lemma 2 *Under Assumption 1* $\left(\rho < \frac{\Delta p}{p_M}\right)$*, conduct M (i) reduces the probability of liquidation and (ii) increases the owner's gross profits (before netting out wage payments).*

Proof. See the Appendix. ■

The above thus suggests that, absent wages, the owner would prefer the manager to adopt the anti-competitive conduct. However, the effect of fines on wages might make the owner prefer the competitive conduct as higher corporate and managerial fines translate into higher wages, which reduce the firm's profits and increase the probability of bankruptcy. More specifically, deterrence is achieved if and only if $\Delta\Pi_s \equiv \Pi_s(M) - \Pi_s(C) \leq 0$. The next Proposition sheds light on this issue by providing a necessary and sufficient condition for deterrence.

Proposition 2 *There is deterrence in state* $s \in \{B, R\}$ *if and only if the managerial fine* f *is sufficiently high, i.e., if* $f \geq f_s(F)$*, with* $f_s(F)$ *(weakly) decreasing in* F *and* $\lim_{F\to\infty} f_s(F) = \underline{f}_s > 0$*. In particular, this implies that deterrence cannot be achieved without managerial fines* f *no matter how large the corporate fine* F *is.*

Proof. See the Appendix. ■

Proposition above provides two key insights. First, managerial fines are important: deterrence cannot be achieved with corporate fines only, no matter how large these are. Indeed, raising F above $\pi_s - \widehat{w}$ is totally ineffective as the firm would go bankrupt. And if $f = 0$, following conduct M is profitable even if $F > \pi_s - \widehat{w}$: whenever the firm is not inspected, earning higher profits under M than under C makes M worthwhile.[17] Furthermore, setting positive managerial fines is not enough, as for them to be effective they have to be at least equal to $\underline{f}_s$, and they have to be higher the lower the corporate fine F.

As long as managerial fines are high enough so that deterrence can be achieved, corporate and managerial fines become substitutes, i.e., $f_s(F)$ is (weakly) decreasing in F. This goes in line with the literature on Law and Economics, which shows that if a non-monetary penalty can be imposed on the agent, this would reduce the penalty that would need to be imposed on the principal (Polinsky and Shavell, 1993).

3.4 The Owner's Preferred Conduct over the Business Cycle

In this model, the anti-competitive conduct is relatively more attractive during booms than during recessions. This is because the profit increase from violating the law is higher during booms than during recessions, and because the lower risk of bankruptcy translates into lower managerial wages in good than in bad times (Corollary 1).

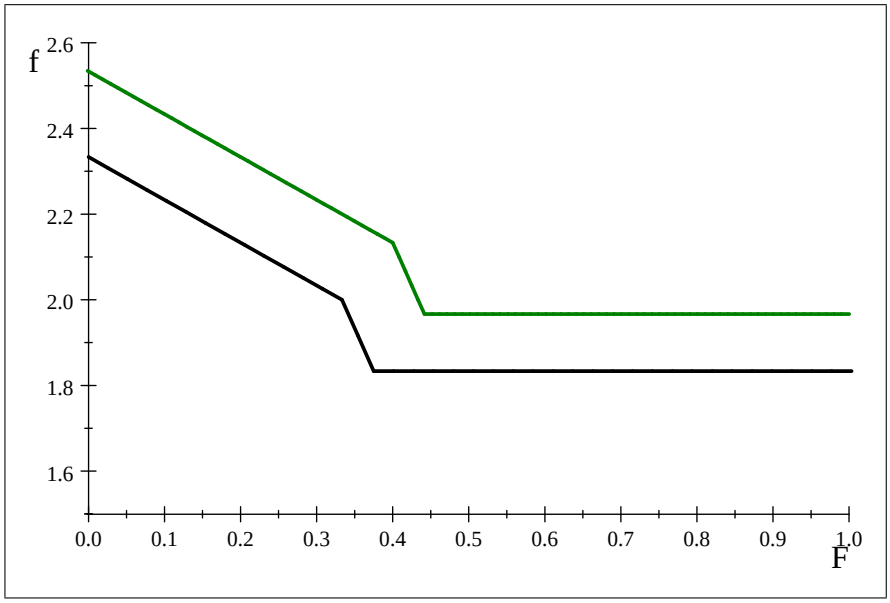
[17] This holds true as long as the probability of inspection ρ is sufficiently low (Assumption 1).

As a consequence, a given fine policy (f, F) that achieves deterrence during recessions need not achieve deterrence during booms. Accordingly, the next Lemma demonstrates that the minimum managerial fine needed to achieve deterrence is higher during booms than during recessions.

Lemma 3 *The critical managerial fine $f_s(F)$ is increasing in π_s. Therefore, $f_R(F) < f_B(F)$ for all F.*

Proof. See the Appendix. ■

To illustrate this result, the following figure depicts f_B (upper line) and f_R (lower line) as a function of F.



Critical managerial fines above which conduct C is chosen. Parameter values $p_M = 0.5,\ p_C = 0.25,\ \rho = 0.25,\ L = \frac{1}{6}$ and $\pi_R = 1$ (lower line) and $\pi_B = 1.1$ (upper line)

We have so far assumed that the state of demand affects only profits in case of no entry, but not other parameters of the model. One could instead argue, for instance, that booms also imply a lower liquidation cost L. As already argued, an increase in π_s facilitates the anti-competitive conduct. In contrast, a reduction in L (in general) favours conduct C: given that the probability of liquidation is higher under C than under M, a reduction in the liquidation cost is relatively more beneficial under C than under M. However, under the assumption that the increase in profits during booms is sufficiently larger than the reduction in L, the comparative statics would remain as in Lemma 3.[18]

4 Antitrust Agency's Policy

We now move to characterizing the Antitrust Agency's optimal fine policy. Suppose that the AA chooses the fine policy so as to maximize expected welfare $E[W]$; since public funds are costly,

[18] More in detail, suppose that π and L depend on a parameter x that increases (decreases) during booms (recessions), and it is such that $\frac{\partial \pi}{\partial x} > 0$ and $\frac{\partial L}{\partial x} < 0$. Then, a sufficient condition for booms to facilitate the anticompetitive conduct (for all F), is the following

$$\frac{\partial \pi}{\partial x} > \left(1 + \frac{\rho\left(1 - (1-\rho)\, p_M\right)}{\Delta p - \rho p_M}\right)\left(-\frac{\partial L}{\partial x}\right) > -\frac{\partial L}{\partial x}.$$

It is not possible to find a simple sufficient condition for the opposite conclusion, namely, that recessions facilitate the anticompetitive conduct.

if two fine policies lead to the same level of expected welfare, we assume that the AA chooses the fine policy that yields higher fine revenues. Expected welfare is the weighted sum of welfare during booms (which occur with probability α) and recessions,

$$E[W] = \alpha W_B + (1-\alpha) W_R.$$

In a given state $s \in \{B, R\}$ of the business cycle, welfare is equal to the expected sum of producers and consumers surplus plus expected liquidation costs.[19] Let us use W_s^* and W_s^m to denote the sum of producers and consumers surplus when there is either entry or no entry in the market, respectively. Under the assumption that entry drives prices down to marginal costs of the incumbent firm,[20] the deadweight loss from monopoly power in state s is $DLW_s = W_s^* - W_s^m$.

Accordingly, welfare under conduct C in state $s \in \{B, R\}$ is given by,

$$W_s(C) = p_C W_s^m + (1-p_C) W_s^* - (1-p_C) L,$$

which can be rewritten as

$$W_s(C) = W_s^* - p_C DWL_s - (1-p_C) L. \tag{2}$$

Similarly, welfare under conduct M in state s is given by,

$$W_s(M) = \begin{cases} p_M W_s^m + (1-p_M) W_s^* - (1-p_M) L & \text{if} \quad F \leq \pi_s - \widehat{w} \\ p_M W_s^m + (1-p_M) W_s^* - [1 - p_M(1-\rho)] L & \text{if} \quad F > \pi_s - \widehat{w} \end{cases},$$

which can be rewritten as

$$W_s(M) = \begin{cases} W_s^* - p_M DWL_s - (1-p_M) L & \text{if} \quad F \leq \pi_s - \widehat{w} \\ W_s^* - p_M DWL_s - [1 - p_M(1-\rho)] L & \text{if} \quad F > \pi_s - \widehat{w} \end{cases}. \tag{3}$$

Note that under conduct M welfare is always strictly lower when the corporate fine would drive the firm bankrupt. This implies that, whenever the AA does not want to induce deterrence in state s, it would rather avoid bankruptcy by setting $F \leq \pi_s - \widehat{w}$. Therefore, when comparing welfare across conducts, we can restrict attention to the case $F \leq \pi_s - \widehat{w}$.

Let us use $\Delta W_s \equiv W_s(M) - W_s(C)$ to denote the difference between the two welfare levels, depending on whether conduct M or C is chosen. Extracting (2) from (3) in case $F \leq \pi_s - \widehat{w}$ yields,

$$\Delta W_s = [L - DWL_s] \Delta p. \tag{4}$$

The comparison between welfare levels under the anti-competitive and the competitive conducts reflects the trade-off between the social costs of bankruptcy (which, by Lemma 2, is less likely under conduct M) versus the social costs of monopoly power (which is less likely under conduct C). In state $s \in \{B, R\}$, deterrence is thus optimal if and only if $\Delta W_s < 0$, i.e., if the deadweight loss due to monopoly power exceeds the social costs of bankruptcy, $DWL_s > L$.

[19] Note that wages or fines do not affect welfare directly, as they are considered to be transfers within the economy. However, as we will see, they might affect welfare through their effect on liquidation.

[20] This is just assumed for simplicity. It would just be enough to assume that prices are lower under entry, so that DLW_s would give the increased deadweight loss from no entry.

As we noted in Section 2, the fact that demand is higher during booms implies that deadweight loss from monopoly power is procyclical, $DWL_B > DWL_R$. Therefore, the difference in welfare levels between conducts M and C is lower in booms than in recessions,[21]

$$\Delta W_B = [L - DWL_B]\,\Delta p < \Delta W_R = [L - DWL_R]\,\Delta p.$$

To determine whether deterrence is optimal in booms and/or recessions, we can thus distinguish two cases:[22]

Case (a). $\Delta W_B < \Delta W_R < 0$: it is optimal to achieve deterrence both in booms and in recessions.

Case (b). $\Delta W_B < 0 < \Delta W_R$: deterrence is optimal only during booms.

We will also consider three types of policies, depending on the timing on the AA decisions, or equivalently, depending on its commitment power:

- **Time-dependent policy**: Having observed the state of the business cycle, the AA chooses its fine policy (F, f) once and for all.
- **Time-independent policy**: Without knowing the state of the business cycle, the AA chooses its fine policy (F, f) once and for all.
- **Soft fine policy**: Without knowing the state of the business cycle, the AA chooses its fine policy (F, f). Once the state is realized, the AA has the option to reduce the fines.

Time-dependent fine policy In order to characterize the optimal fine policy over the business cycle, let us first assume that the AA can condition its fine policy on the state of the business cycle (or equivalently, the AA sets the fine policy once the state is realized). Without managerial fines, optimality can never be achieved given that it is not possible to induce deterrence (Proposition 2). Hence, the only effect of fines is on the probability of bankruptcy, which the AA wants to minimize. With this purpose, the highest fines it can set in order to maximize fine revenues are procyclical, with $F_B = \pi_B - \widehat{w}$ in booms and $F_R = \pi_R - \widehat{w}$ in recessions.

In contrast, if there are no constraints on the level of managerial fines, a time-dependent policy can induce the optimal conduct in every state $s \in \{B, R\}$. Consider first case (a), in which deterrence is always optimal. Deterrence can be achieved by simply setting (f_s, F_s) sufficiently high so that $\Delta\Pi_s < 0$. These high fines will not force firms to liquidate given that they will follow conduct C and will thus never be asked to pay fines. Thus, welfare is as in equation (2): there is a deadweight loss due to monopoly power with probability p_C, and liquidation with probability $(1 - p_C)$. Note that even though the AA has discretion to implement different fines in different states, a constant or time independent fine policy would also achieve the same outcome.

In case (b), deterrence is optimal only in booms. Hence, (f_R, F_R) have to be set low enough so as not to discourage firms from following conduct M in recessions. Given that in case of indifference

[21] Note that the same inequality would hold if L differed in booms and recessions, with turnover costs for the manager being higher during recessions. We could also allow Δp to change in booms and in recessions. However, for the discussion below, this is irrelevant as all that matters is the sign of ΔW_s.

[22] The case $\Delta W_R > \Delta W_B > 0$ is not interesting as deterrence is never optimal. For this reason we do not consider it here.

the AA wants to maximize fine revenues, the optimal fine policy will be $f_R = 0$ and $F_R = \pi_R - \widehat{w}$ so as to induce violation while still avoiding bankruptcy in recessions.[23] Thus, welfare is as in the first line of equation (3): there is a deadweight loss with a higher probability p_M, but liquidation with a lower probability $(1 - p_M)$. Since deterrence is still optimal during booms, then the optimal fine policy during booms is (f_B, F_B) so that $\Delta\Pi_B < 0$. Again, the optimal (time-dependent) fine policy is procyclical, with higher fines in booms than in recessions.

Time-independent fine policy Let us now consider the case in which the AA cannot condition its fine policy to the state of the business cycle, i.e., it has to commit to its fine policy, once and for all, before observing the state of the business cycle.

As with time-dependent policies, deterrence cannot be achieved without managerial fines. Hence, the only effect of fines is on the probability of bankruptcy, which the AA wants to minimize. With this purpose, the highest fine it can set in order to maximize fine revenues is $F = \pi_R - \widehat{w}$. Note that this policy implies a revenue loss for the AA as compared to the time-dependent policy, which allowed the AA to set a higher fine $F = \pi_B - \widehat{w}$ during booms.

In contrast, suppose that managerial fines can be set as high as desired. We already argued before that in case (a) optimality could be achieved with a constant fine policy over time. Let's then focus on case (b).

In case (b), the optimal policy depends on the state of the business cycle, with deterrence being optimal only during booms. If the AA is forced to set a fixed fine, the optimal outcome can never be achieved. Recall that, by Lemma 3, the minimum managerial fine to induce deterrence in recessions is lower than in booms, $\underline{f}_R < \underline{f}_B$. Accordingly, a fine policy with $f < \underline{f}_R$ always induces the anti-competitive conduct and it is thus inefficient during booms; a fine policy with $f \in \left(\underline{f}_R, \underline{f}_B\right)$ induces an inefficient conduct in both booms and recessions, and a fine policy with $f > \underline{f}_B$ always achieves deterrence and it is thus inefficient during recessions. In detail, expected welfare for these three fine ranges is

$$E[W] = \begin{cases} \alpha W_B(M) + (1-\alpha) W_R(M) & \text{if} \quad f < \underline{f}_R \\ \alpha W_B(M) + (1-\alpha) W_R(C) & \text{if} \quad f \in \left(\underline{f}_R, \underline{f}_B\right) \\ \alpha W_B(C) + (1-\alpha) W_R(C) & \text{if} \quad f > \underline{f}_B \end{cases}.$$

Since the second option is clearly dominated by any of the other two, lets compare expected welfare under $f < \underline{f}_R$ and $f > \underline{f}_B$. Taking the difference between the two welfare levels yields,

$$\alpha \Delta W_B + (1-\alpha) \Delta W_R = \Delta W_R - \alpha \Delta p \left[DWL_B - DWL_R\right],$$

where the first term is positive as we are in case (b), and the second term is negative by Assumption 3. Hence, there exists a critical value $\widehat{\alpha}$ so that if booms are sufficiently likely, $\alpha > \widehat{\alpha}$, the second best (time-independent) policy is to set $f > \underline{f}_B$, whereas if recessions are sufficiently likely, $\alpha < \widehat{\alpha}$, the second best policy is to set $f < \underline{f}_R$. In the first case, there is a welfare loss since there is more bankruptcy during recessions than under the first-best policy, while in the second case the welfare loss is associated to the exercise of market power during booms.

[23] Note that it is preferable to set $f = 0$ rather than any other positive f. This is so since a lower f translates into lower wages, implying that the owner of the firms makes higher net profits, which can then be extracted through the corporate fine.

To sum up, as compared to the time-dependent policy, the time independent policy leads to lower fine revenues when managerial fines cannot be used; and it cannot induce the optimal conduct in case (b) even when managerial fines can be raised with no bound. Thus, time-dependent policies are preferable.

However, implementing time-dependent policies in practice might prove difficult, as it would require writing down all the economic contingencies under which the AA can change its fine policy. In contrast, a soft fine policy might do the trick, as argued next.

Soft fine policy Suppose that the AA sets the fine policy before observing the state, but has no commitment power not to reduce the fine once the state is observed. In the case with no managerial fines, the AA would set $F = \pi_B - \widehat{w}$, which it would reduce to $F = \pi_R - \widehat{w}$ after a low demand realization so as to avoid bankruptcy. In case (b) with managerial fines, the AA can fix (F, f) so as to achieve deterrence during booms. If a low demand realization occurs, the AA has incentives to exempt firms from paying such high fines, in order to induce them to exercise market power while at the same time avoiding bankruptcy.

This soft-fine policy is probably reflective of what we observe in practice.[24] And, contrary to what might be suspected, the AA does not lose reputation when reducing the fines, but rather gains credibility: it is important that firms predict that the AA will eventually reduce the fines, as otherwise they would be deterred from following conduct M during recessions.

This discussion is summarized in our last statement.

Proposition 3 (*i*) *If* $f = 0$, *time-dependent and time-independent fine policies yield the same outcome, but the former allow to raise more fine revenues during booms.* (*ii*) *If* f *can be freely chosen, with time-dependent policies, the optimal fines are (weakly) procyclical.* (*iii*) *The optimal time-dependent policy induces the optimal conduct, whereas time-independent fine policy induces an inefficient conduct whenever the optimal conduct in booms and recessions differ.*

5 Conclusions and Discussion

In this paper we have studied two antitrust issues which have recently been at the centre of policy discussions; namely, the necessity (or not) of imposing fines not only to companies but also to individual managers, and the desirability (or not) of imposing less severe fines in times of economic crisis.

For this purpose, we have constructed an admittedly simple model in which the firm owner (principal) offers a contract to the manager (agent), who chooses whether or not to violate the antitrust law. The anti-competitive conduct increases profits, and thus reduces the probability of firm bankruptcy, but it faces the firm and the manager with the risk that the antitrust authority detects the antitrust violation and condemns them to pay fines. Furthermore, if the corporate fine drives the firm bankrupt, the manager has to bear liquidation costs associated with unemployment and the need to search for a new job. The contract the firm owner offers to the manager has to take

[24] For instance, in the bathroom cartel, the Competition Commissioner stated that fines were "reduced to a level they [firms] should be able to pay", which coincides with the prediction that in recessions fines are reduced to $F = \pi_R - \widehat{w}$.

into account the manager's expected costs of violating the law (managerial fines plus liquidation costs), and thus compensate the manager ex ante through increased wages. Therefore, the antitrust policy affects the firm owner directly through the corporate fine, but also indirectly through its effect on the higher wage he has to offer to the manager to induce her to violate the law. These two effects improve deterrence, to the extent that they reduce the firm owner's profits under the anti-competitive conduct.

As long as the probability of discovering anti-competitive conducts is not too large, even high corporate penalties are unlikely to fully deter violations of antitrust laws. The deterrence effect of corporate fines is limited to the extent that firms never end up paying such high fines, as they drive them into bankruptcy. This is not to say that corporate fines should not be raised above their current levels (an issue on which this paper is silent),[25] but it rather shows that increasing corporate fines might prove ineffective, particularly so during economic downturns. Instead, we have argued that the focus should be put on managerial fines: setting sufficiently high managerial fines is a necessary condition to achieve deterrence. Current managerial fines are modest or non-existent, so that there is scope to increase them significantly.[26]

We have also used this model to identify the optimal fine policy over the business cycle, taking into account both the social costs of bankruptcy as well as those associated with market power. Whereas the level of the fines needed to achieve deterrence during booms is higher than during recessions, achieving deterrence during booms is more valuable given that the welfare loss due to monopoly power is higher. Hence, whereas it might be optimal to be lenient with market power during recessions, achieving deterrence during booms is always beneficial. The fact that the optimal conduct might differ in booms and recessions implies that time-independent fine policies lead either to inefficiencies or to a loss of fine revenues. Indeed, allowing the AA to condition its fine policy on the state of the business cycle seems preferable in both dimensions. Still, time-dependent policies cannot achieve optimality unless managerial fines are set sufficiently high. A soft fine policy that gives the AA some discretion to lower fines during economic downturns might replicate the same outcome as time-dependent policies.

Needless to say, a soft fine policy may be problematic for reasons outside this model. Notably, we have considered a simple static model, which can thus not capture firms' dynamic incentives to behave anti-competitively in good times, and to dissipate profits rather than setting aside reserves, knowing that in bad times the risk of bankruptcy may prevent them from paying the fine.

From a practical point of view, discretion embodied in a soft fine policy could be misused to the extent that fines might be lowered for reasons other than the maximization of total welfare; the lack of transparency about the methodology used to grant fine discounts might also contribute to this end (Stephan (2006)).

Another important issue is how to assess firms' claims of insolvency. In this stylized model, we have assumed that the AA is perfectly informed about demand levels and profits, so that it can

[25] Using a sample of 283 international cartels discovered since January 1990, Connor (2007) argues that there is under-deterrence. Similarly, using a sample of 386 firms convicted of price fixing between 1955 and 1993, Craycraft et al. (1997) found that most firms could easily pay the actual fines imposed, thus casting doubts on their deterrence effects. Combe and Mennier (2009) arrive at a similar conclusion. In contrast, Allain et al. (2011) question the "myth of under-deterrence".

[26] See Harrington (2010) for a similar argument.

perfectly assess whether a given fine would drive the firm bankrupt. However, in reality the AA faces serious difficulties in assessing whether firms' claims of insolvency are real. In the European Union, the methodology to assess firms' ability to pay contained in the 2006 EU Fining Guidelines requires the Commission to look at the companies' annual financial statements, the financial ratios that measure the company's solidity, profitability, solvency and liquidity, as well as its relations with banks and shareholders. This analysis has often led the EC to conclude that firms' claims of their inability to pay are unjustified.[27]

5.1 Robustness

We conjecture that our first conclusion, namely, that managerial fines are needed to achieve deterrence, would be valid in any model of firm bankruptcy. Instead, our second conclusion, namely, that a (time-dependent) antitrust policy should be more severe in good times and more lenient in bad times, is more likely to be sensitive to the assumptions made. Let us then recall the main assumptions behind this result: (i) bankruptcy is costly from a social point of view, (ii) the deadweight loss of monopoly power is higher during booms, (iii) liquidation costs L stay constant over the business cycle, and (iv) the probability of inspection by the AA is sufficiently low.

The result that deterrence may not always be optimal derives from the fact that liquidation entails social costs, which enter into the welfare function. The fact that it is more important to achieve deterrence during booms than during recessions derives from the assumption that the deadweight loss from monopoly power is pro-cyclical, which in turn relies on the assumption that demand is higher during booms. This conclusion would be enhanced if we also allowed liquidation costs L to move counter-cyclically (reflecting the fact that turn-over times are shorter during booms). Last, we have shown that the minimum fines needed to achieve deterrence are higher in good than in bad times, which again results from the fact that demand is higher during booms. If we had also allowed L to move over the cycle, the result would remain unchanged as long as the effect of the economic cycle on the incremental profits from the anti-competitive conduct is more pronounced than the effect on liquidation costs.

Last, if the probability of inspection was high enough, there would always exist a pair of corporate and managerial fines that would induce full deterrence. In particular, deterrence would be possible even without managerial fines. However, we believe that assuming a low probability of inspection is natural, as this assumption is consistent with the AA facing limited budgets.

5.2 Extensions

In light of the concern otlined before, it would be interesting to develop a model in which the AA faces asymmetric information regarding firms' financial ability to pay the fines. Asymmetric information creates informational rents that would force the AA to reduce the fines to firms that would otherwise over-state their inability to pay. Economic intuition indicates that if the degree of asymmetric information is severe enough, time-independent policies might be preferable to the extent that they would allow the AA not to pay informational rents to firms.

[27] For instance, ten out of the seventeen firms involved in the bathroom cartel claimed that they would be unable to pay the fine, but the EC only granted the fine reduction to half of them. In the cartel of removal services case, all five firms involved claimed inability to pay, but the 70% fine reduction was granted to only one of them.

Another relevant extension would be to consider the possibility that the AA makes mistakes and with some small probability fines competitive firms. In our model, we found that under some cases, fines could be raised high enough so as to achieve deterrence. This created no bankruptcy concerns given that firms would always behave competitively and would thus not be fined. However, if the AA makes Type I errors, raising fines to achieve deterrence might come at the cost of increasing bankruptcy rates.

So far, the model has assumed that the firm owner can perfectly monitor the manager's conduct. A relevant extension would be to introduce asymmetric information between the firm owner and the manager. Intuitively, asymmetric information on the manager's conduct enhances the deterrence effect of managerial fines: these fines force the firm owner to pay informational rents to the manager so as to make it incentive compatible for her to follow the anti-competitive conduct. Informational rents reduce the firm owner's willingness to induce the manager to break the law, and thus facilitate deterrence. To the extent that the degree of asymmetric information might depend on firms' sizes or on firms' internal structures, this analysis could shed some light on the deterrence effect of fines in small versus large firms or under centralized versus decentralized organizational structures.

In line with this idea, it would be relevant to explore the role of managerial fines in a model in which the manager can substitute effort in cost reducing activities with anti-competitive behavior. Hence, if the firm owner cannot observe the manager's conduct, he cannot distinguish whether a high profit realization is the outcome of high effort and a competitive conduct, or of low effort and an anti-competitive conduct. While similar types of models have been analyzed before (Garoupa (1996) and Aubert (2009)), adding the possibility of firm bankruptcy would allow for a complete assessment of the deterrence effect of corporate and managerial fines.

We leave all these issues for future research.

Appendix A. Proofs of Lemmas and Propositions

Proof of Lemma 1. Suppose $F \leq \pi_s - w_s$. From the expression $U_s(M) \geq 0$, the minimum wage w_s that can be offered to the manager is $\widehat{w} = \rho f + \frac{1-p_M}{p_M} L$. The condition $F \leq \pi_s - w_s$ is thus satisfied if $F \leq \pi_s - \widehat{w}$. Suppose now that $F > \pi_s - w_s$. The minimum wage that can be offered to the manager is $\widehat{w} + \rho L$. The condition $F > \pi_s - w_s$ is thus satisfied if $F > \pi_s - \widehat{w} - \rho L$. If $\pi_s - \widehat{w} - \rho L < F \leq \pi_s - \widehat{w}$, the two solutions are feasible. However, the owner's expected payoff is higher under the former as the wage he pays to the manager is lower. To sum up, the manager's wage offer that gives her zero utility is $\widehat{w}$ if $F \leq \pi_s - \widehat{w}$, and it is $\widehat{w} + \rho L$ otherwise. ■

Proof of Proposition 1. Let $\widehat{f}_s$ be such that $\widehat{w} = \pi_s$, i.e., $\widehat{f}_s = \frac{1}{\rho}\left(\pi_s - \frac{1-p_M}{p_M} L\right)$. (i) For $f < \widehat{f}_s - L$, $\pi_s > \widehat{w} + \rho L > \widehat{w}$, so that the firm owner can credibly offer the wage that gives zero utility to the manager, $w_s(M)$. (ii) For $f \in \left(\widehat{f}_s - L, \widehat{f}_s\right)$, $\widehat{w} + \rho L > \pi_s > \widehat{w}$, so that for $F > \pi_s - \widehat{w}$, the highest wage that the firm owner could offer, π_s, would not satisfy the manager's participation constraint. (iii) The same is true for $f > \widehat{f}_s$ as for any value of F, $\widehat{w} + \rho L > \widehat{w} > \pi_s$. ■

Proof of Lemma 2. (i) Under conduct M, if $F \leq \pi_s - \widehat{w}$, the firm is liquidated only if profits are negative, so that the probability of liquidation is $(1 - p_M)$. Alternatively, if $F > \pi_s - \widehat{w}$, the firm is liquidated if profits are negative or if they are positive and the firm is inspected, so that the probability of liquidation is $1 - p_M(1 - \rho)$. Under conduct C, the firm is liquidated only when profits are negative; hence, with probability $1 - p_C$. Combining these results, the difference between the probability of liquidation under both conducts is given by $-\Delta p < 0$ if $F \leq \pi_s - \widehat{w}$ and by $\rho p_M - \Delta p < 0$ if $F > \pi_s - \widehat{w}$. Note that this latter expression is also negative by Assumption 1.

(ii) Under conduct M, the owner's gross profits (before netting out wage payments) are *at least* equal to $p_M(1 - \rho)\pi_s$,[28] as if profits are high and if there is no inspection the firm is not liquidated. Under conduct C, the owner's gross profits are $p_C \pi_s$. Hence, the difference between the two profits is at least equal to $(\Delta p - \rho p_M)\pi_s > 0$, which is positive under Assumption 1. ■

Proof of Proposition 2. Let's first suppose that f and F are such that the firm owner offers the manager $w_s(M)$ and she accepts (Lemma 1). The owner's expected profit difference, $\Delta\Pi_s \equiv \Pi_s(M) - \Pi_s(C)$, is equal to

$$\Delta\Pi_s = \begin{cases} X_s + \rho p_M(\pi_s - \widehat{w} - F) & \text{if} \quad F \leq \pi_s - \widehat{w} \\ X_s - \rho p_M(1 - \rho) L & \text{if} \quad F > \pi_s - \widehat{w} \end{cases}, \tag{5}$$

where

$$\widehat{w} = \rho f + \frac{1 - p_M}{p_M} L \text{ and}$$
$$X_s = (\Delta p - \rho p_M)\pi_s - (p_M(1 - \rho)\widehat{w} - (1 - p_C) L)$$

Note that $\Delta\Pi_s$ is strictly decreasing in F up to $F = \pi_s - \widehat{w}$, where it jumps down and it becomes flat thereafter. The source of this discontinuity is the increase in the liquidation costs under M when F drives the firm to bankruptcy.

[28] If $F \leq \pi_s - \widehat{w}$, the owner would additionally earn $p_M \rho(\pi_s - F) > 0$.

Solving $\Delta\Pi_s = 0$ for the critical managerial fine f_s shows that

$$f_s(F) = \begin{cases} \frac{\Delta p}{\rho p_M}(\pi_s + L) - F & \text{if} \quad F < \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} \\ \frac{1}{\rho}\left((\pi_s + L) - \frac{1}{p_M}L - F\right) & \text{if} \quad \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} \leq F \leq \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} + L\rho \\ \frac{\Delta p - \rho p_M}{(1-\rho)\rho p_M}(\pi_s + L) + \frac{1-(1-\rho)p_M}{(1-\rho)p_M}L & \text{if} \quad \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} + L\rho < F \end{cases} . \tag{6}$$

Expression above is everywhere continuous in F and (weakly) decreasing in F (the first and second lines of the expression are strictly decreasing while the third line is flat). This, together with the fact that the third line is positive, implies that $f_s(F) > 0$ for all F. Hence, deterrence cannot be achieved with corporate fines only.

Now, by Assumption 2, it is easy to check that $\widehat{f}_s > f_s(0)$ and $\widehat{f}_s - L > \lim_{F\to\infty} f_s(F)$. By Lemma 1, for $f < \widehat{f}_s - L$, the firm owner offers the manager $w_s(M)$ and she accepts, so that our initial assumption is satisfied. For $f \in \left(\widehat{f}_s - L, \widehat{f}_s\right)$ and $F > \pi_s - \widehat{w}$, there does not exist a credible wage offer that would induce the manager to follow M. However, the fact that $\widehat{f}_s - L > \lim_{F\to\infty} f_s(F)$ implies that the owner would not prefer conduct M even if he could credibly offer $w_s(M)$. Similarly, the fact that $\widehat{f}_s > f_s(0)$ implies that for $f > \widehat{f}_s$, even if it was possible to induce the manager to follow M, the firm owner would never want to do so. It follows that expression (6) properly defines the critical value of f above which deterrence is achieved. ■

Proof of Lemma 3. Taking derivatives in (6),

$$\frac{\partial f_s}{\partial \pi_s} = \begin{cases} \frac{1}{\rho}\frac{\Delta p}{p_M} > 0 & \text{if} \quad F < \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} \\ \frac{1}{\rho} > 0 & \text{if} \quad \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} \leq F \leq \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} + L\rho \\ \frac{1}{\rho}\frac{\Delta p - \rho p_M}{(1-\rho)p_M} > 0 & \text{if} \quad \frac{(\pi_s+L)p_C - L}{p_M(1-\rho)} + L\rho < F \end{cases} .$$

Furthermore, since the points of discontinuity are also increasing in π_s, it follows that f_s is overall increasing in π_s. Last, $\pi_B > \pi_R$ implies $f_R < f_B$. ■

Appendix B: Extensions

Monetary Fines

In this section we consider the case of monetary fines, which differ from the ones considered in the main text in that the manager is now protected by limited liability. To simplify the analysis, suppose demand is constant and thus omit the s subscript.

If the manager follows conduct M, her expected utility becomes

$$U_M = \begin{cases} p_M(w - \rho\min\{w, f\}) - (1 - p_M)L & \text{if} \quad F \leq \pi - w \\ p_M(w - \rho\min\{w, f\}) - [1 - p_M(1-\rho)]L & \text{if} \quad F > \pi - w \end{cases} .$$

To make the argument simple, suppose that managerial fines are large enough so that the wage offers in Lemma 1 would not allow the manager to fully pay the fine. It follows that the manager would make strictly positive utility as she would not pay the full fine but would receive a wage which was computed to give her zero utility under unlimited liability. Hence, under limited liability, the manager's expected wage could be reduced without violating his participation constraint. Thus, the expected wage needed to induce conduct M is now reduced. Since expected wages under conduct

C are unaffected by fines, this implies that it is more difficult to achieve deterrence with monetary than with non-monetary fines.

Proposition 4 *Non-monetary fines are more effective than monetary fines in achieving deterrence.*

Proof of Proposition 4. If $f < \frac{(1-p_M)}{p_M(1-\rho)}L$, wages with monetary and non-monetary fines are the same, given that the wage offers computed above exceed the monetary fine, $\widehat{w}+\rho L > \widehat{w} > f$, where recall that $\widehat{w} = \rho f + \frac{1-p_M}{p_M}L$. The opposite is true if $f > \frac{1-p_M(1-\rho)}{p_M(1-\rho)}L$, as in this case $f > \widehat{w}+\rho L > \widehat{w}$. Since the manager, if fined, would only pay up to her salary, the wage offers can be reduced below $\widehat{w}+\rho L$ and $\widehat{w}$ without violating the participation constraint. Following the same logic as in the proof of Lemma 1, we can readily compute expected wages in this case,

$$w_M = \begin{cases} w' & \text{if} \quad F \leq \pi - w' \\ w' + \frac{\rho}{(1-\rho)}L & \text{if} \quad F > \pi - w' \end{cases}.$$

Similarly, for the remaining values, $f \in \left(\frac{(1-p_M)}{p_M(1-\rho)}L, \frac{1-p_M(1-\rho)}{p_M(1-\rho)}L\right)$, wage offers are

$$w_M = \begin{cases} w' & \text{if} \quad F \leq \pi - w' \\ \widehat{w} + \rho L & \text{if} \quad F > \pi - w' \end{cases}.$$

■

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