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Emotions matter for policy-making: An example on tacit collusion and guilt

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Abstract

In the paper we show how emotions may influence the effectiveness of policies, highlighting the need for an analysis of belief-dependent motivations in policy-making. We do so by using an example of tacit collusion in an infinitely repeated duopoly. We find that which type of duopoly favors collusion the most depends on the level of guilt aversion. Specifically, it is easier to sustain collusion in a Bertrand duopoly for low levels of guilt and in a Cournot duopoly for intermediate levels of guilt. When the guilt parameter is high, collusion is sustained for any discount factor in both market structures. Moreover, we show how competition policies, such as the introduction of random audits and fines, may be less effective in the presence of guilt.

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Keywords

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Introduction

Emotions are important factors driving human behavior. This is also true when we consider economic behavior and economic decision making. Importantly, emotions may influence how individuals respond to policies, which can ultimately change their effect.

Psychological game theory (Geneakoplos et al. 1989, Battigalli and Dufwenberg 2009, Battigalli et al. 2019a) provides a tool to incorporate the effects of emotions in economic modeling. Emotions are modeled through the introduction of belief-dependent preferences, i.e., by allowing utility functions to depend not only on material payoffs, but also on beliefs about choices and about beliefs. The introduction of belief-dependent preferences makes it possible to model emotions such as guilt (Battigalli and Dufwenberg 2007) and anger (Battigalli et al. 2019b), as well as other human motivations such as reciprocity (Dufwenberg and Kirchsteiger 2004). These tools have been applied to study cooperation in the presence of incomplete information (Attanasi et al. 2016), in repeated interactions where emotions interact with reputation concerns (Attanasi et al. 2019a), and in several applications such as, for example, embezzlement (Attanasi et al. 2019b) and public good provision (Patel and Smith 2019).[1]

The influence that belief-dependent preferences have on policies has, to the best of our knowledge, never been studied in the literature. In this paper we are the first to show how the presence of emotions may affect individual behavior in a way that is relevant for policy making. We do so by discussing, as a theoretical example, how the presence of guilt affects the possibility of collusion in different duopoly environments. We first analyze the sustainability of collusion under two market structures, i.e., when the two firms compete on quantity (Cournot) or on prices (Bertrand). As guilt matters only when an individual disappoints his/her co-player, guilt becomes relevant only in the presence of a deviation from collusion. Therefore, the main effect of guilt is to reduce profits from deviation, thus favoring collusion. However, this does not happen at the same rate across market structures. We find that, for low levels of guilt, collusion is more sustainable if firms compete *à la* Bertrand, as in the standard analysis, but this relation is reversed for intermediate levels of guilt. For high levels of guilt, collusion is always sustainable under both market structures.

Then, we study how anti-collusion policies are influenced by the presence of guilt. Specifically, we evaluate how guilt influences the efficacy of a fine. We find that a fine is less effective the higher the level of guilt aversion. Also in this case we find that the effect is not homogeneous across market structures. In particular, the minimum expected fine needed to prevent collusion increases more with guilt under Bertrand competition. We see this analysis as a theoretical example of the need of including a full analysis of belief-dependent motivations in policy-making decisions, as these motivations may change the nature or the level of the optimal policy.

The relation between belief-dependent preferences and collusion has been investigated theoretically by Iris and Santos-

[1] For a general introduction to psychological game theory, its tools and its applications, see Battigalli and Dufwenberg (2020).

Pinto (2013), who focus on a different belief-dependent preference, reciprocity, and find that the presence of reciprocity favors collusion. Differently from our paper, however, the authors do not compare market structures, and they do not derive any policy implication. For what concerns guilt aversion, instead, Cooper and Kühn (2014) suggest that guilt may be one of the possible drivers of their results on the link between communication and conclusion, but no theoretical analysis has been developed so far.

The paper is organized as follows. Section 2 introduces simple guilt in the duopoly framework, discusses its effect on collusion when firms compete *à la* Cournot (Section 2.1), *à la* Bertrand (Section 2.2), and compares the two market structures (Section 2.3). Section 3 discusses how anti-collusion policies are influenced by the presence of guilt, and Section 4 concludes.

Tacit collusion and guilt

In this paper we show how emotions matter for policy-making through the analysis of an example of tacit collusion in an infinitely repeated interaction. For the sake of simplicity we consider a market in which two duopolists with constant marginal costs $c = 0$, and intertemporal discount factor δ, offer an homogeneous good.[2] The market is characterized by a linear demand schedule, and the inverse demand is $P(q) = 1 - q$.[3]

We introduce guilt by adopting the *simple guilt* model of Battigalli and Dufwenberg (2007). Firm i's guilt depends on its guilt sensitivity, $\theta_i \geq 0$, and on firm j's expected disappointment, given j's subjective beliefs. To analyze the effect of guilt, we need to consider the players' first- and second-order beliefs about behavior. The beliefs that will be relevant for our analysis are features of i's first-order belief, in particular will be $\alpha_i^C = \mathbb{E}_i[q_j]$ in the Cournot case and $\alpha_i^B = \mathbb{E}_i[p_i]$, and of i's second-order belief $\beta_i^k = \mathbb{E}_i[\widetilde{\alpha_j^k}]$, with $k \in \{C, B\}$, depending on the market structure.

The **disappointment** of firm i is the difference, if positive, between i's expected and actual profit, that is

$$D_i(\pi_i, \alpha_i^k) = \max\{0, \mathbb{E}_{\alpha_i^k}[\widetilde{\pi}_i] - \pi_i\},$$

where π_i is the profit of firm i, and $k \in \{C, B\}$.

A firm with guilt sensitivity θ_i maximizes the psychological utility $u_i(\pi, \pi_j; \alpha_j^k) = \pi_i - \theta_i D_j(\pi_j, \alpha_j^k)$, where π_i is firm i's material profit, and $\theta_i D_j(\pi_j, \alpha_j^k)$ is firm i's **guilt** for having disappointed firm j's expectations by an amount $D_j(\pi_j, \alpha_j^k)$. For simplicity of analysis we assume throughout the paper that guilt sensitivity is the same across firms, that is $\theta_i = \theta$.

In this section, we consider whether and how the possibility of sustaining tacit collusion through *grim-trigger strategies* is affected by the introduction of belief-dependent preferences in the objective function of firm owners. A grim-trigger strategy prescribes firm i to choose the collusive action during the *cooperation phase*, and to play a Nash equilibrium (in this case the unique Nash equilibrium of the static game) during the *punishment phase*. The game starts in the cooperation phase, which lasts as long as no firm deviates. If a deviation occurs, the punishment phase starts. To analyze the effects of guilt on collusion we need therefore to consider three different aspects:

1. Collusion in the coordination phase;
2. Nash equilibrium in the punishment phase;
3. Incentives to deviate from collusion.

Note that guilt has no bite both in the coordination phase if both firms collude, and in the punishment phase, as both firms have exactly the material payoff they expect, and cannot therefore be disappointed, regardless of the type of competition. First, this implies that the collusion utility coincides with the collusion profit and it is equal to half of the monopoly profit, as in the standard case without guilt. The monopoly quantity in this setting is $q = \frac{1}{2}$, therefore, during the collusion phase, each firm will produce $\frac{1}{4}$ and have profits, and utility, equal to $\pi_i^{coll.} = \frac{1}{8} = u_i^{coll.}$. Second, Nash equilibria of the Cournot and Bertrand competition without guilt aversion are still Nash equilibria of the psychological game. Therefore, we can use the Nash equilibrium quantities and prices of the competition without guilt as a punishment.[4]

Collusion is sustainable when the discount factor δ is:

$$\delta \geq \frac{u_i^{dev.} - u_i^{coll.}}{u_i^{dev.} - u_i^{pun.}} \equiv \delta_{min},$$

where $u_i^{dev.}$ is the utility of a firm that deviates from collusion, $u_i^{coll.}$ is the utility from collusion and $u^{pun.}$ is the utility from the Nash equilibrium played in the punishment phase. Tacit collusion is more likely when deviation is less profitable ($(u_i^{dev.} - u_i^{coll.})$ small) or when the punishment is stronger ($(u_i^{coll.} - u_i^{pun.})$ large).

Cournot duopoly in the presence of guilt

We begin our analysis by considering the case of two firms competing *à la* Cournot, i.e., by choosing quantities simultaneously. As discussed above, the collusion profits are the same as in the traditional analysis without guilt, i.e., $\pi^{coll.} = \frac{1}{8}$. In the punishment phase firms play the standard Cournot-Nash equilibrium. Each firm's quantity is $q_i^{pun.} = \frac{1}{3}$, the equilibrium price is $p = \frac{1}{3}$ and each firm's profit is $\pi^{pun.} = \frac{1}{9}$. Moreover, recall that both in the collusion phase and in the punishment

[2] For an analysis of the standard case of tacit collusion with Bertrand and Cournot duopolies see for example Belleflamme and Peitz (2015).

[3] We assume $c = 0$ and $P(q) = 1 - q$ to keep the analytical results simple, as the analysis should be taken as an example. However, the analysis does not substantially change if we assume a generic linear demand. Results with marginal costs c and linear demand $P(q) = a - q$ are available upon requests from the author. Please note that, also in the more general version, the thresholds δ_{min}^k, $k \in \{C, B\}$ do not depend on a and c.

[4] This implies that no firm has an incentive to deviate from the punishment phase.

phase each firm has the expected profit, no firm is disappointed, and therefore utilities coincide with material profits. Hence, $u_i^{coll.} = \frac{1}{8}$ and $u_i^{pun.} = \frac{1}{9}$.

The psychological component, instead, has a relevant effect in the presence of a deviation. Consider the case in which firm j plays the collusion quantity, whereas firm i deviates from collusion. Note that, in this case, firm j expects collusion, and firm i knows it, therefore $\alpha_j = q_i^{coll.} = \beta_i$, and $\mathbb{E}_{\alpha_j}[\widetilde{\pi}_j] = \pi_j^{coll.}$. Firm i's utility from deviation–given by both material profit and guilt component– is therefore

$$u_i(q_i, q_j^{coll.}; q_i^{coll.}) = (1 - q_i - q_j^{coll.})q_i - \theta[\pi_j^{coll.} - \pi_j(q_i, q_j^{coll.})],$$

where $q_j^{coll.} = \frac{1}{4}$ is the collusion quantity chosen by j, $\pi_j^{coll.} = \frac{1}{8}$ is the cooperation profit that firm j expects to make, and $\pi_j(q_i, q_j^{coll.})$ is firm j's profit, if firm j colludes, and firm i deviates to q_i.[5] Such profit is:

$$\pi_j(q_i, q_j^{coll.}) = \left(1 - q_i - \frac{1}{4}\right)\frac{1}{4} = \frac{3}{16} - \frac{q_i}{4}.$$

Firm j's disappointment is therefore:

$$D_j = \left[\frac{1}{8} - \frac{3}{16} + \frac{q_i}{4}\right] = \left[\frac{q_i}{4} - \frac{1}{16}\right],$$

which is strictly positive when $q_i > \frac{1}{4}$.

We can now compute $u_i^{dev.}$, that is, the utility obtained by choosing the optimal deviation quantity when the opponent chooses the cooperation quantity, by maximizing the utility from deviation $u_i(q_i, q_j^{coll.}; q_i^{coll.})$ w.r.t. q_i

$$\max_{q_i} \left(1 - q_i - \frac{1}{4}\right) q_i - \theta\left[\frac{q_i}{4} - \frac{1}{16}\right].$$

The first order condition gives $q_i^{dev.} = \frac{3-\theta}{8}$. Note that if $\theta \geq 1$, $q_i^{dev.} \leq q_i^{coll.}$, so that no deviation is optimal for guilt levels above 1, and no firm will ever defect from cooperation, regardless of the discount factor δ, because guilt is so high that it makes the one-period utility from deviation lower than the collusion profit. If $\theta < 1$, instead, the optimal deviation quantity is decreasing in θ: higher guilt aversion implies that even when the firm deviates, its deviation is closer to the collusion outcome than when the firm only maximizes the monetary profit. Moreover, when $\theta = 0$, $q_i = \frac{3}{8}$, which is the optimal deviation quantity of the standard case with no guilt aversion.

The utility from (the optimal) deviation is:

$$\begin{aligned} u_i^{dev.} &= \left(1 - \frac{(3-\theta)}{8} - \frac{1}{4}\right)\frac{(3-\theta)}{8} - \theta\left[\frac{3-\theta}{32} - \frac{1}{16}\right] \\ &= \frac{9 - 2\theta + \theta^2}{64}. \end{aligned}$$

[5]Note that, when we first introduced disappointment, guilt and psychological utilities, we wrote $u_i(\cdot)$ and $D_j(\cdot)$ as function of the material profits (and of beliefs) for simplicity of notation, as firms choose quantities under Cournot competition, and prices under Bertrand competition. Here, we explicit how utilities depend on the chosen quantities, which in turn determine profits.

Note that the utility from deviation is decreasing in θ in the region in which deviation may be profitable ($\theta < 1$). As a matter of fact,

$$\frac{\partial u_i^{dev.}}{\partial \theta} = -\frac{1}{32} + \theta\frac{1}{32},$$

which is negative for $\theta < 1$.

In the infinitely repeated Cournot duopoly with simple guilt, if $\theta < 1$ collusion is sustainable when

$$\delta \geq \frac{9 - 18\theta + 9\theta^2}{17 - 18\theta + 9\theta^2};$$

if $\theta \geq 1$ collusion is sustainable for every value of δ.

We argued above that when $\theta \geq 1$ collusion is sustainable for every δ. When $\theta < 1$, instead, collusion is sustainable when $\delta \geq \frac{u_i^{dev.} - u_i^{coll.}}{u_i^{dev.} - u_i^{pun.}} \equiv \delta_{min}$. The threshold, with a Cournout duopoly and in the presence of guilt aversion, depends on θ as follows:

$$\delta_{min}^C(\theta) = \frac{\frac{(9-2\theta+\theta^2)}{64} - \frac{1}{8}}{\frac{(9-2\theta+\theta^2)}{64} - \frac{1}{9}} = \frac{9 - 18\theta + 9\theta^2}{17 - 18\theta + 9\theta^2}.$$

Note that $\delta(0) = \frac{9}{17}$. This is the same result obtained in the case of collusion on quantity without the belief-dependent component. Moreover, the threshold $\delta_{min}^C(\theta)$ is decreasing in θ for $\theta < 1$. For $\theta > 1$ collusion is sustainable for every value of δ. This implies that, as we might have expected, collusion is more sustainable when firms have psychological concerns in disappointing the colluding partner.

Bertrand duopoly in the presence of guilt

Let us now consider the possibility of collusion when firms compete *à la* Bertrand, in the presence of simple guilt. As in the Cournot competition, the collusion utility coincides with the collusion material profit, $\frac{1}{8}$, and the collusion price is $\frac{1}{2}$. During the punishment phase there is no possibility for disappointment, therefore the punishment can be characterized by the typical Bertrand-Nash equilibrium where each firm sets a price equal to its marginal cost, and firms make zero profits, so that the punishment utility coincides with the material profit $u_i^{pun.} = \pi_i^{pun.} = 0$. Guilt aversion is instead relevant when we consider possible deviations from collusion. Consider the case in which firm j chooses the collusion price, whereas firm i deviates from collusion. Recall that the demand function in Bertrand is discontinuous. For this reason, to analyze firm i's deviation, we have to consider three possible types of deviation:

1. the monopoly price $p = \frac{1}{2}$, in which case we have the collusion outcome, and both firms have utilities equal to the collusion profits $u_i^{coll.} = u_j^{coll.} = \frac{1}{8}$;

2. a price higher than the monopoly price, in which case firm i has zero demand and zero profits. This however is never profitable for firm i;

3. a price lower than the monopoly price, in which case, regardless of the chosen price, firm i serves the whole market. This implies that j's disappointment does not depend on i's chosen price, and it is equal to $\pi_j^{coll.} = \frac{1}{8}$. Therefore, the best deviation for firm i in this region is to set a price $\frac{1}{2} - \varepsilon$.

When is deviation to $\frac{1}{2} - \varepsilon$ optimal? In this case, the utility from this (optimal) deviation when the opponent chooses the cooperation price is:

$$u_i^{dev.} = \frac{1}{4} - \frac{\varepsilon}{2} - \theta\frac{1}{8} = \frac{1}{4}\left[1 - \frac{\theta}{2}\right] - \frac{\varepsilon}{2}.$$

As the firm can choose ε as close to zero as it likes, the utility from the optimal deviation is approximately $\frac{1}{4}\left[1 - \frac{\theta}{2}\right]$. Note that the utility from deviation is decreasing in θ, as it was before. However, the optimal deviation is not. In Bertrand competition, as long as the firm deviates, it does so as in a model without guilt aversion. The only consequence of guilt is to lower the utility from deviation, without affecting the pricing behavior of the deviating firm, or the loss for the other duopolist.

In the infinitely repeated Bertrand duopoly with simple guilt, if $\theta < 1$ collusion is sustainable when $\delta \geq \frac{1-\theta}{2-\theta}$; if $\theta \geq 1$ collusion is sustainable for every value of δ.

As in the Cournot duopoly, for high levels of guilt aversion firms have no incentive to deviate regardless of the value of δ, as the utility from collusion is always higher than the utility from deviation. This happens when

$$u_i^{dev.} = \frac{1}{4}\left[1 - \frac{\theta}{2}\right] \leq \frac{1}{8} = u_i^{coll.},$$

i.e., when $\theta \geq 1$.

If $\theta < 1$, instead, the minimum discount factor that sustains collusion is:

$$\delta_{min}^B(\theta) = \frac{u_i^{dev.} - u_i^{coll.}}{u_i^{dev.} - u_i^{pun.}} = \frac{\frac{1}{4}\left[1 - \frac{\theta}{2}\right] - \frac{1}{8}}{\frac{1}{4}\left[1 - \frac{\theta}{2}\right] - 0} = \frac{1-\theta}{2-\theta}.$$

Note that $\delta_{min}^B(0) = \frac{1}{2}$, which is the standard result when there is no psychological component in the utility function. Moreover, as in the Cournot case, it is easier to sustain collusion the higher the level of guilt, given that $\frac{\partial \delta}{\partial \theta} = -\frac{1}{(2-\theta)^2} < 0$.

Which market structure helps collusion the most?

In the traditional analysis, we know that Bertrand competition helps collusion the most, as $\delta_{min}^B < \delta_{min}^C$ when we are considering a duopoly. When we introduce the possibility that firm owners experience guilt if they disappoint their counterpart, the relation between Bertrand and Cournot duopoly is no longer monotone. Both market structures sustain collusion more easily when the guilt sensitivity θ increases, but they do so at a different speed. As a matter of fact, both the strength of punishment, measured by $u_i^{coll.} - u_i^{pun.}$, and the incentive to deviate, measured by $u_i^{dev.} - u_i^{coll.}$, are smaller in the Cournot duopoly than in the Bertrand one. As a consequence, the Cournot duopoly is more affected by changes in θ than the Bertrand one, as $\delta_{min.}^C$ decreases faster than $\delta_{min.}^B$. The following result summarizes the relation between Cournot and Bertrand duopoly for every level of θ.

$\delta_{min}^B < \delta_{min}^C$ when $\theta < \frac{1}{9}$; $\delta_{min}^B = \delta_{min}^C$ when $\theta = \frac{1}{9}$; $\delta_{min}^B > \delta_{min}^C$ when $\frac{1}{9} < \theta < 1$; collusion is sustained for every δ under both market structures otherwise.

Recall that if $\theta \geq 1$ collusion is sustainable for every value of δ under both types of competition. When $\theta < 1$, instead, $\delta_{min}^C = \frac{9-18\theta+9\theta^2}{17-18\theta+9\theta^2} > \frac{1-\theta}{2-\theta} = \delta_{min}^B$ when $1 - 10\theta + 9\theta^2 > 0$. Solving $1 - 10\theta + 9\theta^2 = 0$ for θ we obtain $\theta = \frac{1}{9}$ and $\theta = 1$. Hence, Result 3 follows.

The result shows that knowledge of the belief-dependent motivations of the agent is essential to anticipate which market structure favors collusion the most. This may be relevant for example for a competition authority which aims at preventing collusion and which has to either monitor or set up the rules of the competition. The next section investigates the problem of the competition authority further.

The effect of guilt on competition policies

In this section we focus on our main theoretical contribution, i.e., the analysis of the interaction between belief-dependent preferences and policies in determining economic outcomes. We therefore consider the problem of a competition authority which aims at preventing collusion. The presence of guilt aversion may impact on the effectiveness of the policy measures that the competition authority adopts. In the paper, we only focus on the simplest possible policy: the introduction of a fine. We model collusion and the introduction of the fine as in Aubert et al. (2006).[6] We introduce the assumption that, in order for collusion to happen, firms need to coordinate somehow, and that the proof of this coordination activity can be obtained if the authority audits the firm. Specifically, the evidence of collusion in one period is available only for that period.

We assume that the tax authority can impose a maximal fine F with probability ρ. If firms collude, expected utility from collusion is therefore $u_i^{coll.} - \rho F$. When one firm deviates, its expected utility is $u_i^{dev.}(\theta) - \rho F$.[7] In the punishment phase, instead, there is no possibility of being fined, as evidence on past collusions is no longer available, and given that in a punishment phase firms play a Nash equilibrium and do not collude. Following Aubert et al. (2006), we assume that the fine is in expectation too small to deter collusion,

[6] Aubert et al. (2006) focus mostly on leniency and whistleblowing policies. Our analysis can be extended also to these two policies, and the comparative statics on guilt that we obtain in the present analysis of the fine are preserved.

[7] The assumption that the firm may incur a fine also after a deviation comes from the fact that the proof of coordination activity for one period exists even if ex-post one firm chooses to deviate. However, note that our comparative statics are unchanged even if we assume that firms who deviate never pay a fine.

i.e., the expected utility from collusion is greater than the expected utility from the Nash equilibrium that is used as punishment, which is the outcome of the duopoly when the two firms compete instead of colluding, $u_i^{coll.} - \rho F > u_i^{pun.}$.

The fine is therefore sufficient to induce firms to deviate from collusion if

$$(u_i^{dev.}(\theta) - \rho F) + \frac{\delta}{1-\delta} u_i^{pun.} \geq \frac{1}{1-\delta}(u_i^{coll.} - \rho F),$$

that is when $\rho F \geq \frac{1}{\delta}\left(u_i^{coll.} - (1-\delta)u_i^{dev.}(\theta) - \delta u_i^{pun.}\right) = \overline{\rho F}$. The minimum level of expected fine needed to prevent collusion is increasing in the collusion profit, and decreasing both in the deviation profit and in the punishment profit. Note that only the utility from deviation depends on θ, and that, both under Cournot and under Bertrand competition, $\frac{\partial u_i^{dev.}}{\partial \theta} < 0$. As a consequence, the presence of guilt increases the threshold above which the fine prevents collusion, thus making the fine less effective. A competition authority that wants to implement a fine to prevent collusion should therefore take into account these psychological mechanisms that affect the utility from deviation in a way that decreases the effect of the policy itself.

If we want to understand how guilt differentially affects the effectiveness of the fine depending on the market structure, we first need to understand how the fine changes the possibility of collusion in the absence of guilt. Recall that in both market structures the collusion utility is the same. Cournot and Bertrand competition differ instead in their utilities in the punishment phase, which are higher under Cournot competition than under Bertrand, and in their utilites from deviation (higher under Bertrand than under Cournot competition). Both a high punishment utility and a high deviation utility reduce the minimum level of expected fine needed to prevent collusion, but, in the equation which defines $\overline{\rho F}$, the former is weighted by δ, and the latter is weighted by $1-\delta$. As a consequence, when $\theta = 0$, the minimum level of expected fine needed to prevent collusion, $\overline{\rho F}$, is higher for Cournot competition when the discount factor is low, $\delta < \frac{63}{127}$, and higher for Bertrand competition when the discount factor is high, $\delta > \frac{63}{127}$.

When we introduce guilt aversion, however, the picture changes. As a matter of fact, $u_i^{dev.}$ decreases more with θ under Bertrand competition than under Cournot competition. Therefore, the minimum expected fine needed to prevent collusion is higher in Bertrand duopoly than in Cournot duopoly not only for high values of δ, as before, but also for low values of δ when the level of guilt is sufficiently high. This is summarized in the following result.

When $\delta > \frac{63}{127}$, $\overline{\rho F}_B > \overline{\rho F}_C$. When $\delta < \frac{63}{127}$, $\overline{\rho F}_B > \overline{\rho F}_C$ if $\theta > k$, where k is the positive root of $9\theta^2 + 36\theta - 63(1-\delta) + 64\delta = 0$; $\overline{\rho F}_B < \overline{\rho F}_C$ otherwise.

To prove this we note that $\overline{\rho F}_C - \overline{\rho F}_B > 0$ when $9\theta^2 + 36\theta - 63(1-\delta) + 64\delta < 0$. When $\delta > \frac{63}{127}$ both roots of the equation $9\theta^2 + 36\theta - 63(1-\delta) + 64\delta = 0$ are negative, therefore $\overline{\rho F}_C < \overline{\rho F}_B$ as in the standard case with no guilt aversion; when $\delta < \frac{63}{127}$, instead, one of the root is positive and the other negative. Hence, Result 4 follows.

Our analysis can be extended, with similar results, to dicuss the other policies in Aubert et al. (2006): leniency and whistleblowing policies. Both types of policies become less effective, in that the minimum reward that the authority has to grant to the firm that reports collusion, or to the employee who acts as an informant is increasing in θ, and the effect is stronger for Bertrand competition, as it is driven by the impact of θ on the profit from deviation.

Conclusions

This paper shows, through the analysis of a theoretical example of tacit collusion, the importance of the analysis of belief-dependent motivations in policy making.

In the paper, we analyze the problem of tacit collusion in infinitely repeated interactions in the presence of guilt aversion both under Cournot and Bertrand competition. We consider a duopoly in which tacit collusion is implemented by using grim-trigger strategies. We highlight how guilt aversion only affects profits from deviation, as both in the punishment phase (when the standard Nash equilibrium is played) and in the cooperation phase without deviation (when the collusion outcome is played) each firm receives exactly its expected profit, and no one is disappointed. We find that the profit from deviation is decreasing in the level of guilt, and that the minimum value of the discount factor δ that allows collusion is decreasing in the guilt sensitivity θ as well, for both market structures. Therefore, as expected, guilt aversion fosters cooperation between firms.

Moreover, we show that the presence of guilt affects which market structure favors competition the most. Specifically, we find that when the guilt parameter is low, collusion is more sustainable when firms are in a Bertrand duopoly, as in the standard analysis without belief-dependent preferences. For intermediate levels of guilt, instead, Cournot duopoly is the best environment for collusion, while for high levels of guilt aversion ($\theta > 1$ in our model) collusion is sustainable in both market structures for every discount factor δ.

Finally, we show that the effectiveness of a fine is lowered by the presence of guilt. Therefore, our paper suggests, through a theoretical example, that an analysis of possible belief-dependent motivations is important in policy-making, as they may affect the optimal policy choice.

We believe that the contribution of our paper goes beyond the specific example that we consider. We show that belief-dependent preferences may affect policy outcomes. In our model, they do so favoring collusion, and therefore reducing the effectiveness of a policy such as a fine. There may be other economic situations, however, or other policies, in which belief-dependent preferences and policies complement each other and induce more favorable economic outcomes with lower effort. Therefore, the link between emotions and policies should be explored further in future research.

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