Doubts and Dogmatism in Conflict Behavior

Alessandro Riboni
(Université de Montréal)

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Abstract. Conflicts are likely less violent if individuals entertain the possibility that the opponent may be right.

Why is it so difficult to observe this attitude? To answer this question, this paper studies information transmission from an informed principal (the parent) to a naive agent (the son). After being informed, the agent participates in a game of conflict. The parent wants to motivate his son to exert effort in the conflict, but he also cares that the son has the right incentives to acquire information and that he selects the correct policy. Finally, to study cultural transmission over time we consider a two-period OG economy where the son becomes a parent when he is old.

Under some conditions dogmatic attitudes are observed: individuals never doubt, conflicts are violent and bad decisions are made. We also argue that societies may find it difficult to abandon dogmatic attitudes over time. Under some other conditions, skeptical attitudes of systematic doubt are instead observed. However, we argue that in the long-run parents may stop inducing skeptical attitudes: societies where individuals systematically doubt are likely to switch to fact-based attitudes.

JEL Classification: D74, D64.

Keywords: Social Conflict, Cultural Transmission, Dogmatism, Doubts, Ideology, Altruism.

Address for correspondence: Alessandro Riboni, Département de Sciences Économiques, Université de Montréal, C.P. 6128, succursale Centre-ville, Montréal (Québec) H3C 3J7, Canada, alessandro.riboni@umontreal.ca

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“I believe that we can avoid violence only in so far as we practice this attitude of reasonableness in dealing with one other in social life. [This attitude] may be characterized by a remark like this: "I think I am right, but I may be wrong and you may be right." [...] One of the main difficulties is that it always takes two to make a discussion reasonable.” Karl Popper (1963, p. 357)

1. Introduction

It is hard to disagree with the view that many ideological conflicts are violent precisely because individuals, often against the evidence, negate that they “may be wrong and that [the opponent] may be right.”

The possibility of beliefs manipulation in situations of conflict has received little scrutiny by economists but has been amply documented by the psychological literature. Rokeach (1960), among others, has investigated dogmatism as a personality trait and has argued that individuals are less likely to question their system of beliefs in a conflict, even to the point of neglecting refutations. Other psychological studies, however, have pointed out that dogmatism is not the only type of beliefs manipulation that is observed in a conflict. For instance, Ferenczi (1932) and Freud (1937) argued that when facing an external threat individuals may overestimate, as opposed to underestimate, the possibility that the opponent may be right.

We believe that this subject matter should be of interest to economists for at least two reasons. First, as argued above, beliefs manipulation affects the amount of resources that are wasted in a conflict. If dogmatism induces violent conflicts, we therefore expect dogmatism to have negative consequences on economic development.¹ Second, the extent to which individual beliefs are closed to questioning likely affects the incentives to learn and conduct research.² As a result, we expect dogmatism to be associated with bad policy decisions, which are obviously detrimental to welfare.

In this paper, we consider a game of conflict where two individuals fight in order to impose their preferred policy. A key feature of our model is that one participant in the conflict has state-dependent preferences over policy alternatives. Specifically, we suppose that there are

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¹For instance, see Collier et al. (2003) who studies the consequences of civil conflicts on development.
²Among others, see Popper (1963) who forcefully argues that scientific knowledge progresses by conjectures which must then be subjected to refutations.
two states of the world: in one state, the policies that maximize the utilities of both opponents are different, while in the other state they are identical.

Crucially, we assume that the current state is not observable by the two participants in the conflict. This implies that the individual with state-dependent preferences cannot be ex-ante certain about the optimality of the policy that he is trying to impose. In our model, we suppose that this individual naively relies on the information provided by an advisor (a parent) who shares his same preferences over policy alternatives. In our paper, the parent is characterized by an altruism parameter, which measures the extent to which the parent internalizes the effort cost exerted by the son in the conflict.

The parent is assumed to be better (although not necessarily perfectly) informed about the current state. In particular, the parent receives one of two signals from Nature: one signal is perfectly informative about the current state (hence, it leaves no doubt about the policy that maximizes the son’s utility), while the other is noisy.

In this paper, we analyze how information is transmitted from parent to son and study the subsequent game of conflict between the son and his opponent.

Our results show that whether or not the parent is truthful depends on two key parameters. First, manipulation of information does not take place when the prior probability of being in a state where the preferences of the two opponents are not aligned is sufficiently low. Since we expect that prior probability to be high in a heterogeneous society, this suggests that fact-based attitudes are more likely in homogenous societies. Second, we show that the parent is truthful when Nature’s signals are more precise.

Whenever beliefs manipulation occurs, it may take two forms. Under some parameter values, we argue that the parent induces dogmatic attitudes in his son. That is, he always tells his son that he has received the perfectly informative signal. Since the son is assumed to be naive, this message removes any doubt that the son may have had about the possibility that the opponent’s preferred policy is optimal for him. As a result, the dogmatic son strenuously fights. For other parameter values, we show that the parent induces skeptical attitudes in his son. That is, he always tells his son that the signal is noisy. The parent does so even when the evidence that he has received indicates that the policy that the opponent would choose is certainly not optimal for the son. As a result, the skeptical son exerts little

\footnote{Throughout the paper we use the word skepticism to indicate an attitude of systematic doubt.}
effort because he entertains the possibility that the policy that the opponent is trying to impose may be optimal.

The main considerations that impact the choice of the message by the parent are as follows. On the one hand, removing doubts induces the son to exert higher effort. Clearly, this *motivating effect* is more valuable to the parent, the lower is his altruism parameter. But on the other hand, due to a strategic interdependence in the game of conflict, instilling doubts decreases the average effort exerted by *both* opponents and reduces the conflict’s Pareto inefficiency. This effect is valuable because effort in the conflict is wasteful and because the two opponents cannot credibly commit to low effort levels. Instilling doubts is then a costly *commitment* device for the parent. In contrast to the motivating effect, we show that this *moderating effect* is more valuable to the parent, the higher is his altruism parameter.

In Section 3.5, we extend the model and suppose that the son can acquire precise information on his own if he conducts autonomous research. With some positive probability autonomous research is successful and the son is assumed to perfectly observe the current state of the world. We show that the higher is the probability of successful research, the weaker are the parent’s incentives to induce dogmatic attitudes. This result is obtained because dogmatism reduces the son’s incentive to acquire valuable information. On the other hand, we show that the possibility of autonomous research does not alter the parent’s incentives to induce skeptical attitudes.

One interesting question would be to ask how beliefs manipulation evolve over time. History and the current state of international affairs suggest that dogmatic attitudes are difficult to eradicate. In order to answer this question, in Section 3.6 we consider a two-period OG economy in which the son fights when he is young and becomes a parent in the second period of his life. Crucially, we assume that the probability that autonomous research is successful increases over time if in the previous period individuals conducted research. This assumption captures the idea that societies have well-supplied libraries, good schools and high human capital only if previous generations conducted research.

In the context of our model, we show the possibility of a dogmatic trap: societies that are initially dogmatic may find it difficult to sustain truthful reporting in later periods. The underlying reason is that dogmatism induces individuals not to conduct research; as a result, the probability of success of future research does not increase, thereby providing future gen-
erations with no incentive to abandon dogmatism. The good news is that truthful reporting is also an absorbing state: societies where information is not manipulated give incentives to conduct research, which improves the effectiveness of future research and reinforces the incentives of future generations to report truthfully. In other words, truthtelling initiates a virtuous circle in which the incentives to tell the truth become stronger over time. On the contrary, if we also assume that current research increases the precision of future signals, we obtain that skepticism cannot be observed for a long period of time. Luckily, it is not replaced by dogmatism but by truthful reporting.

The remainder of the paper is as follows. In Section 2, we analyze the related literature. Section 3 presents the basic setup with one parent, one son and one opponent. Section 3.5 considers a different setup where the son can obtain precise information on his own, while Section 3.6 analyzes the evolution of indoctrination strategies over time. Section 4 concludes. For ease of exposition, all proofs are in the Appendix.

2. Review of the Literature

This paper is related to a growing literature which studies how preferences, beliefs, and social norms are transmitted through generations.\(^4\) In Bisin and Verdier (2000, 2001) cultural transmission is the result of interactions inside the family and in the population at large. When parents are able to influence the probability with which children inherit their parents’ preferences, they show that the distribution of cultural traits in the population converges to a heterogenous distribution. More recently, various papers have looked at intergenerational transmission of norms concerning fertility and female labor supply decisions (Fernandez and Fogli, 2006), of values favoring trust and cooperation (Tabellini, 2008a,b and Algan and Cahuc, 2010) and of preferences regarding patience and work ethic (Doepke and Zilibotti, 2006).

This paper is also related to recent literature that deals with various examples of distorted collective understanding of reality, such as anti and pro-redistribution ideologies (Bénabou, 2008, Bénabou and Tirole, 2006), over-optimism (and over-pessimism) about the value of existing cultural norms (Dessi, 2008), contagious exuberance in organizations (Bénabou, 2009), and no-trust-no-trade equilibria due to pessimistic beliefs about the trustworthiness of others.

\(^4\)See the comprehensive survey by Bisin and Verdier (2010)
(Guiso et al., 2008).

In Bénabou (2008, 2009), the individuals themselves distort their own processing of information. Here instead we consider a model of indoctrination where one opponent in the conflict receives (possibly manipulated) information from his parent. Contrary to Guiso et al. (2008), where parents can perfectly choose the beliefs of their children, indoctrination possibilities are more limited here because the parent can affect the son’s beliefs only by misreporting the private signal that he has received.

In Bénabou (2009) censorship and denial occur because individuals have anticipatory feelings. In our model the parent may decide to misreport the truth for a different set of reasons: to motivate his own son (a similar motive is also present in Bénabou and Tirole, 2002, 2006) and also, because of the existence of strategic interdependence between agents’ effort decisions, to affect the strategy of the opponent. Notice that the latter motive arises in our model also if the parent is perfectly altruistic.

Finally, we briefly review the vast literature on social conflict. Starting from the classic contributions by Grossman (1991) and Skaperdas (1992), the literature has developed theoretical models to study the determinants of social conflict. Recently, Caselli and Coleman (2006) and Esteban and Ray (2008, 2009) have focused on the role of ethnic divisions; Besley and Persson (2008a, 2008b) have investigated the economic determinants of social conflict, while Weingast (1997) and Bates (2008) have studied the importance of institutional constraints. It should be noticed that in virtually all papers on the subject, the parties in the conflict fight over a given amount of resources. In contrast, we consider here a conflict over an ideological dimension, which we expect to be more susceptible to beliefs’ manipulation.

Two recent papers have also studied how the outcomes of a conflict and of a bargaining

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5 As discussed in Bénabou and Tirole (2006), a model of indoctrination is formally identical to a model where individuals with imperfect willpower distort the information they have received to affect their effort decision in the future.

6 See the pioneering paper of Akerlof and Dickens (1982), where beliefs affect agents’ utilities through anticipation of future payoffs. More recently, among others, see Caplin and Leahy (2001).

7 In Bénabou (2009) there is no strategic interdependence between agents’ effort decisions.

8 This is different from Carillo and Mariotti (2000) and Bénabou and Tirole (2002, 2006), where a necessary condition to have strategic ignorance or beliefs manipulation is to have disagreement between the multiples selves (that is, time-inconsistent preferences). See also the classic model of strategic information transmission of Crawford and Sobel (1982), where the sender has no incentive to misreport if he has the same utility of the receiver.

9 See Blattman and Miguel (2008) for a survey.
Doubts and Dogmatism in Conflict Behavior

under the threat of war can be manipulated. In Jackson and Morelli (2007), citizens may strategically delegate the leadership of their country to a more hawkish politician in order to extract more transfers from the other country. Baliga and Sjöström (2009) consider a model of conflict where each opponent has private information about his cost of waging war. In their model, an extremist group, who is able to observe the type of one opponent, may engage in various acts (such as, a terroristic attack) so as to affect the fighting strategies of both opponents. Finally, it also bears mentioning the work by Anderlini et al. (2009). They consider a dynastic game of conflict with private communication across generations and show that destructive wars can be sustained by a sequential equilibrium for some system of beliefs. However, their model is very different from ours along various dimensions. For example, in their setting communication is about past history, which has no direct effect on current payoffs, while in our model it concerns the current state of nature, which directly affects players’ payoffs.

3. The Model

Consider a model with three players: $A$, $B$ and $\hat{A}$. Individuals $A$ and $B$ play a game of conflict. In our model, we assume that the winner of the conflict is able to impose his preferred policy to the loser.\textsuperscript{10} We let $x$ denote the policy, where $x \in X$. To streamline the analysis, $X$ includes only two alternatives: $X = \{a, b\}$.

The model is sufficiently general to admit various interpretations. For example, it could describe a conflict between two political factions in order to decide the type of economic policy (government intervention vs. laissez faire) or the type of constitution (theocracy vs. secular democracy) to adopt in the country.

Individual $A$ is associated to $\hat{A}$, whose role is to provide information to $A$. Individual $\hat{A}$ is assumed to be (more or less) altruistic towards $A$. Throughout this paper, we shall refer to $\hat{A}$ as the “parent” and to $A$ as the “son”.\textsuperscript{11}

\textsuperscript{10}Ideological conflicts are somewhat understudied by the literature. Usually, the games of conflict analyzed by the literature concern the division of a given amount of resources.

\textsuperscript{11}Alternatively, one could think of $\hat{A}$ and $A$ as two multiple selves that exist at different times within the same individual. On this interpretation, see also footnote 5 above.
The utility of individual $i$, where $i = A, B$, is

$$U^i(c_i, x, \theta) = -c_i + u_i(x, \theta),$$

(1)

where $c_i$ is the cost of effort exerted in the conflict and $u_i(x, \theta)$ is a term that depends on policy $x$ and on the current state, denoted $\theta \in \Omega$.\(^{12}\)

We assume that there are only two possible states of the world: $\Omega = \{\theta_A, \theta_C\}$. The state is randomly drawn by Nature. In state $\theta_A$ the preferences of $A$ and $B$ are aligned: the policy that maximizes the utility of both individuals is $b$. In state $\theta_C$ we assume instead that individuals disagree on the correct policy to implement: $A$’s preferred policy is $a$, while $B$’s preferred policy is $b$. Throughout the paper we will denote $\theta_A$ as the state of alignment and $\theta_C$ as the state of conflict.

The assumption that individuals with different views may sometimes agree seems plausible. For example, in particular circumstances (such as, an exceptional economic crisis) an individual who usually supports free-market policies may agree with a left-wing individual about the opportunity of government intervention.

The following matrix summarizes the preferred policies by each individual in each state:

<table>
<thead>
<tr>
<th></th>
<th>$A$’s optimal policy</th>
<th>$B$’s optimal policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta_A$</td>
<td>$b$</td>
<td>$b$</td>
</tr>
<tr>
<td>$\theta_C$</td>
<td>$a$</td>
<td>$b$</td>
</tr>
</tbody>
</table>

For simplicity, it is assumed that the term $u_i(x, \theta)$ is either zero or one: it is equal to one if the appropriate policy for individual $i$ in state $\theta$ is selected, and zero otherwise. More formally,

$$u_A(b, \theta_A) = u_B(b, \theta_A) = u_A(a, \theta_C) = u_B(b, \theta_C) = 1,$$

$$u_A(a, \theta_A) = u_B(a, \theta_A) = u_A(b, \theta_C) = u_B(a, \theta_A) = 0.$$  

\(^{12}\)Instead of a game of conflict, one could think that the two individuals are playing a bargaining game. In this case, $c_i$ should be interpreted as the delay cost in the negotiation.
We assume incomplete information about the current state of the world. Note that in our setting individual $B$, unlike $A$, does not need to know the current state in order to decide which policy to adopt in case of victory. In fact, he has no doubt that $b$ is the appropriate policy. On the contrary, $A$ needs to know the current state of nature in order to determine which is the appropriate policy to adopt.\textsuperscript{13}

As mentioned above, $\hat{A}$ is assumed to be (more or less) altruistic towards $A$. His utility is

$$U^\hat{A}(c_A, x, \theta) = -\beta c_A + u_A(x, \theta).$$

Let $0 \leq \beta \leq 1$. When $\beta = 1$, the utility of $\hat{A}$ coincides with the one of $A$. When $\beta < 1$, the parent is not fully altruistic vis-à-vis his son: $\hat{A}$ does not fully internalize the cost of effort exerted by $A$. However, it is important to notice that the parent does not disagree with his son on the right policy to adopt in each state $\theta$.

The prior probability that all agents assign to the state of conflict is denoted by $P(\theta_C)$. We will assume that $P(\theta_C) \in (1/2, 1)$: that is, the two individuals are (ex-ante) more likely to be in a state of conflict than in a state of alignment. To some extent, $P(\theta_C)$ can be viewed as a measure of societal heterogeneity. In fact, we expect that two randomly selected individuals from a heterogeneous society are likely to disagree on various issues; consequently, we expect them to have a high prior $P(\theta_C)$.

### 3.1. Timing and Information Structure

The period is divided in three sub-periods: $t = 0, 1, 2$. There is no discounting. At $t = 0$, information transmission from $\hat{A}$ to $A$ takes place. At $t = 1$, $A$ and $B$ play a game of conflict. At $t = 2$, the winner decides the policy. We now discuss each stage in detail.

At $t = 0$, Nature sends to $\hat{A}$ a signal $s \in \{s_{ND}, s_D\}$ which is (not necessarily fully) informative about the current state $\theta$. It is crucial to assume that this signal is privately observed by $\hat{A}$. Signal $s_{ND}$ is perfectly informative and leaves no doubt that the state is $\theta_C$. Conversely, signal $s_D$ is noisy and indicates that the state may not be $\theta_C$. In other terms, $s_D$ makes the parent doubt.\textsuperscript{14}

\textsuperscript{13}In a previous draft of this paper, we also considered an extension where both opponents have state-dependent preferences and they are informed by their respective parents.

\textsuperscript{14}The thrust of most of our results would not change with a more general information structure. The
The conditional probabilities of receiving signals $s_{ND}$ and $s_D$ in state $\theta_A$ are

$$P(s_{ND} \mid \theta_A) = 0 \text{ and } P(s_D \mid \theta_A) = 1.$$  \hfill (3)

In state $\theta_C$, they are

$$P(s_{ND} \mid \theta_C) = \gamma \text{ and } P(s_D \mid \theta_C) = 1 - \gamma,$$  \hfill (4)

where $\gamma \in (0, 1)$.

Let $\mu^{\hat{A}}(s)$ denote $\hat{A}$’s posterior probability that the state is $\theta_C$ after signal $s$. Parent $\hat{A}$ updates his prior according to Bayes’ Rule:

$$\mu^{\hat{A}}(s_D) = \frac{P(\theta_C)(1 - \gamma)}{1 - P(\theta_C) + P(\theta_C)(1 - \gamma)} \leq P(\theta_C),$$  \hfill (5)

$$\mu^{\hat{A}}(s_{ND}) = 1.$$  \hfill (6)

The parameter $\gamma$ can be viewed as a measure of the precision of Nature’s signals. In fact, as $\gamma$ goes to one signals become more informative. Instead, when $\gamma = 0$ the parent’s posterior after $s_D$ coincides with his initial prior $P(\theta_C)$.

Upon receiving a signal from Nature, $\hat{A}$ decides which messages $m^{\hat{A}}$ to send, where $m^{\hat{A}} \in \{s_{ND}, s_D\}$. The message is public.

Throughout this paper we assume that $A$ is naive: $A$ believes the signal that $\hat{A}$ sends.\(^{15}\) In other words, $A$ does not realize that the parent may not always tell the truth. (Also notice that the naivete of $A$ is known to $B$ and to $\hat{A}$.) Consequently, upon receiving message $m_{\hat{A}}$, $A$’s posterior, which is denoted by $\mu^A(m_{\hat{A}})$, is equal to (5) when $m_{\hat{A}} = s_D$ and is equal to (6) when $m_{\hat{A}} = s_{ND}$. The naivete assumption is somewhat justified because of the particular relationship between parent and son and on the assumption that $\hat{A}$ is altruistic vis-à-vis $A$.\(^{16}\)

At $t = 1$, we posit the following game of conflict. Individuals $A$ and $B$ simultaneously

\(^{15}\)We briefly discuss what happens when $A$ is not naive at the end of Section 3.4.

\(^{16}\)Notice that the parent cannot fabricate new evidence so as to perfectly choose the posterior of his son. Instead, we assume here that $\hat{A}$ can affect $A$’s beliefs only by misreporting the signal received from Nature. A similar assumption is also made in Bénabou and Tirole (2006), Bénabou (2008, 2009), and Dessi (2008).
choose effort levels $c_A$ and $c_B$, where $c_A, c_B \geq 0$. The probability of $i$ winning the contest given his own effort decision and the one of the opponent is

\[
p_i(c_i, c_{-i}) = \begin{cases} 0 & \text{if } c_i < c_{-i}, \\ 1 & \text{if } c_i > c_{-i}, \\ \frac{1}{2} & \text{if } c_i = c_{-i}. \end{cases}
\]

(7)

In words, the individual that exerts the highest effort wins with probability one. This technology of conflict, which is extremely sensitive to effort differences, turns out to be analytically tractable for our purposes.\textsuperscript{17}

At $t = 2$, the winner of the conflict is able to pick the policy.

A communication strategy for $\hat{A}$ specifies a message for every signal $s$. For $i = A, B$, the effort and the decision strategies specify the effort in the game of conflict and the policy decision in case of victory for every message of $\hat{A}$, respectively.\textsuperscript{18} The equilibrium of the game we have just described is standard. At each stage, players maximize their expected utility given their beliefs at that stage and given the strategies of the other players.

3.2. Policy Decisions

We solve the model by backward induction. At $t = 2$, the decision rule of individual $B$ in case of victory in the conflict is trivial. For all $m_{\hat{A}}$,

\[
D_B(m_{\hat{A}}) = b.
\]

(8)

The decision by $A$ is also straightforward: $A$ picks $a$ only if his posterior probability of being in a state of conflict is greater than $1/2$, which constitutes the threshold of indifference between the two policy decisions. That is,

\[
D_A(m_{\hat{A}}) = \begin{cases} a & \text{if } \mu^A(m_{\hat{A}}) > 1/2, \\ b & \text{if } \mu^A(m_{\hat{A}}) \leq 1/2. \end{cases}
\]

(9)

\textsuperscript{17}In the social conflict literature, this technology of war is considered, for instance, by Jackson and Morelli (2007, ex. 3). This type of contest, known in the literature as all-pay auction, has also been considered by the lobbying and rent-seeking literature: e.g., Ellingsen (1991), Baye et al. (1993), and Che and Gale (1998). For a survey of other technologies of conflict, see Garfinkel and Skaperdas (2007).

\textsuperscript{18}Notice that $m_{\hat{A}}$ affects the effort decision of $B$ indirectly, through its effect on $A$’s beliefs.
3.3. The Game of Conflict

We now determine the effort decisions at $t = 1$. At the beginning of $t = 1$, both $A$ and $B$ observe the message $m_{\hat{A}}$ sent by $\hat{A}$. Individual $B$ knows that $A$ is naive and, consequently, is able to figure out $\mu^A(m_{\hat{A}})$, the posterior belief of player $A$ that the state is $\theta_C$.

To find out the equilibrium in the game of conflict, two cases must be considered. First, suppose $\mu^A(m_{\hat{A}}) \leq 1/2$. In this case, it is immediate from (9) that $A$ and $B$ agree that $b$ is the correct policy to adopt. Then, $c_A, c_B = 0$.

Second, suppose $\mu^A(m_{\hat{A}}) > 1/2$. In this case, from (9) we obtain that $A$ and $B$ want to pursue different policies. A conflict is then inevitable. From the all-pay auction literature, it is well known that our game of conflict does not have a Nash equilibrium in pure strategies, but does have an equilibrium in continuous mixed strategies. Let $G_i(.)$ denote the equilibrium cumulative distribution of individual $i$’s effort. The expected payoff to $A$ from exerting effort $c_A$ is

$$EU^A = [1 - G_B(c_A)] (1 - \mu^A(m_{\hat{A}})) + G_B(c_A)\mu^A(m_{\hat{A}}) - c_A.$$  

To obtain (10) note that with probability $G_B(c_A)$ individual $A$ wins and implements policy $a$, which gives $A$ an expected payoff equal to $\mu^A(m_{\hat{A}})$. With complementary probability, $B$ wins and implements $b$, which gives $A$ an expected payoff equal to $1 - \mu^A(m_{\hat{A}})$. We can rewrite (10) as

$$EU^A = (1 - \mu^A(m_{\hat{A}})) + G_B(c_A) (2\mu^A(m_{\hat{A}}) - 1) - c_A.$$  

From expression (11) it is immediate to verify that $A$ never exerts an effort level strictly greater than his value, which is given by $2\mu^A(m_{\hat{A}}) - 1$.$^{19}$ Further, note that $A$’s maximum effort level goes to zero when $\mu^A(m_{\hat{A}})$ goes to $1/2$. Intuitively, when the two states become equally likely, $A$ has no incentive to enter into a conflict.

The expected payoff to $B$ is instead

$$EU^B = G_A(c_B) - c.$$  

Note that $B$’s valuation is 1, which is weakly greater than $A$’s valuation. This is because $B$ has no doubt that $b$ is the right policy.

$^{19}$This is the value to $A$ of winning the conflict relative to the option of remaining inactive. It is obtained by subtracting $1 - \mu^A(m_{\hat{A}})$ from $\mu^A(m_{\hat{A}})$. 
The equilibrium of the game of conflict is characterized by the following proposition.

**PROPOSITION 1:** If $0 \leq \mu^A(m_{\bar{A}}) \leq 1/2$, we have $c_A = c_B = 0$ and policy $b$ is selected.

If instead $1/2 < \mu^A(m_{\bar{A}}) \leq 1$, in the unique Nash equilibrium, $B$ randomizes his effort uniformly on $[0, 2\mu^A(m_{\bar{A}}) - 1]$. Player $A$ exerts zero effort with probability equal to $2(1 - \mu^A(m_{\bar{A}}))$. Conditional upon exerting positive effort, $A$ also randomizes uniformly on $[0, 2\mu^A(m_{\bar{A}}) - 1]$.

The proof, which is contained in the Appendix, follows Hillman and Riley (1988). Note that when $\mu^A(m_{\bar{A}}) > 1/2$, Proposition 1 establishes that the maximum effort level of both individuals is given by $2\mu^A(m_{\bar{A}}) - 1$, the valuation of the lower-valuing individual. Moreover, $A$ remains inactive with positive probability, which is increasing in his degree of doubt. In contrast, individual $B$ always enters the conflict.

When $\mu^A(m_{\bar{A}}) = 1$, we obtain from Proposition 1 that the conflict is particularly violent: both players enter with probability one and effort is distributed uniformly on the interval $[0, 1]$. In what follows, a conflict in which the values of winning are equal to one for both players will be referred to as a total conflict.

Appealing to Proposition 1, for every message $m_{\bar{A}}$ we can compute the expected sum of effort levels of the two opponents as of time 1:

$$E_1(c_A + c_B) = (2\mu^A(m_{\bar{A}}) - 1)\mu^A(m_{\bar{A}}).$$

(13)

Note that (13) is increasing in $\mu^A(m_{\bar{A}})$ or, in other terms, decreasing in $A$’s level of doubt.

### 3.4. Message Strategies

The information transmission game is immediate to solve given the simple structure with a binary state of the world and binary signals.

Intentionally, we kept the setting as tractable as possible. In fact, our interest here is not to contribute to the information transmission literature but to establish conditions of economic nature under which beliefs are manipulated and proceed to the extensions analyzed in Subsections 3.5 and 3.6.
Depending on the underlying parameters (namely, $\beta$, $\gamma$ and the initial prior of being in state $\theta_C$) we will show (see Propositions 2 and 3) that the parent uses one of three message strategies. First, there exists a region of parameter values where the parent reports the Nature’s signal in a \textit{truthful} manner. Second, for other parameters values we obtain that $\hat{A}$ always sends message $s_{ND}$ regardless of the actual signal received from Nature. In this case, we say that $\hat{A}$ induces a \textit{dogmatic attitude} in his son. Finally, there exists a third region of parameter values where $\hat{A}$ always sends message $s_D$ regardless of the actual signal. In this other case, we say that $\hat{A}$ induces a \textit{skeptical attitude} of systematic doubt in his son.

In order to understand the incentives of the parent to manipulate information, Lemmas 1 and 2 compute the payoffs to $\hat{A}$ for every message and for every signal.

**LEMMA 1:** Suppose that Nature sends signal $s_{ND}$. If $\hat{A}$ is truthful, $\hat{A}$’s expected payoff is

$$-\frac{\beta}{2} + \frac{1}{2}.$$  \hfill (14)

If $\hat{A}$ sends the false message $s_D$, his expected payoff is

$$\left(2\mu^A(s_D) - 1\right) \frac{1 - \beta (2\mu^A(s_D) - 1)}{2}.$$  \hfill (15)

**LEMMA 2:** Suppose instead that Nature sends signal $s_D$. If $\hat{A}$ is truthful, $\hat{A}$’s expected payoff is

$$\left(2\mu^A(s_D) - 1\right) \frac{1 - \beta (2\mu^A(s_D) - 1)}{2} + 2 \left(1 - \mu^A(s_D)\right) \left(1 - \mu^\hat{A}(s_D)\right).$$  \hfill (16)

If $\hat{A}$ sends the false message $s_{ND}$, his expected payoff is

$$-\frac{\beta}{2} + \frac{1}{2}.$$  \hfill (17)

To understand (15) and (16), notice that from Proposition 1 we know that with probability $2\mu^A(s_D) - 1$ individual $A$ enters the conflict upon receiving message $s_D$. Conditional on $A$ exerting a positive effort, both individuals have the same probabilities of winning. Notice
that expression (16) contains an extra term compared to (15). This occurs because, whenever $A$ exits the conflict, $\hat{A}$ expects to obtain a positive payoff when $s = s_D$ but not when $s = s_{ND}$. Finally, expressions (14) and (17) are the parent’s utilities of inducing $A$ to play a total conflict. Note that the lower is $\beta$, the higher is the parent’s utility from a total conflict.

The considerations that matter in the parent’s decision whether or not to send a truthful message are as follows. On the one hand, $\hat{A}$ has an incentive to remove $A$’s doubts about the possibility that $B$ may be right in order to increase $A$’s effort in the conflict. This motivating effect is present in our model because the parent does not fully internalize the cost of effort of $A$. On the other hand, $\hat{A}$ may want to instill doubts in $A$ to reduce the inefficiency of the game of conflict. To understand this moderating effect, recall from Proposition 1 and (13) that if $A$ has more doubts, conflicts are less violent because the equilibrium effort levels of both players decrease. In other terms, instilling doubts is a defence mechanism which moderates the escalation of violence in the conflict. This effect is valuable because effort in the conflict is wasteful and because the two opponents cannot credibly commit to low effort levels. Instilling doubts is then a commitment device for the parent. This device, however, is costly. In fact, when the state is $\theta_C$, instilling doubts induces $A$ to exit the conflict with high probability. As a result, policy $b$, which is suboptimal for $A$ in state $\theta_C$, is more often implemented.

The parent then chooses the message strategy that optimally solves the trade-off between, on the one hand, inducing $A$ to enter the conflict more often but obtaining a smaller return whenever $A$ enters and, on the other hand, making $A$ enter less often but obtaining a larger return, conditional on $A$ entering the conflict.

The terms of this trade-off depend, among other things, on $\beta$. Consider, for instance, a parent with high $\beta$. The motivating effect is not very valuable to him because from equations (14) and (14) we know that his expected payoff from a total conflict is close to zero. Therefore, a sufficiently altruistic parent would rather increase the expected payoff of a conflict than maximize the probability that $A$ exerts positive effort. The converse holds true for a parent with low $\beta$: his expected payoff from a total conflict is so large that he always prefers to maximize the probability that $A$ enters the conflict, even at the cost of inducing a total conflict. This is why we may observe skeptical (resp. dogmatic) attitudes when $\beta$ is high (resp. low).
Proposition 2 considers the case where $\hat{A}$ is sufficiently altruistic ($1/2 \leq \beta \leq 1$). Notice that the case of perfect altruism is also included.

**PROPOSITION 2: (Skepticism)** Fix any $\gamma \in (0, 1)$ and suppose that $1/2 \leq \beta \leq 1$. For all $P(\theta_C) \leq \bar{P}$, where

$$\bar{P} = \frac{1}{2 \beta(1-\gamma) + \gamma},$$

information transmission is truthful. When instead $P(\theta_C) > \bar{P}$, parent $\hat{A}$ reports $s_D$ regardless of Nature’s signal.

As we discussed above, Proposition 2 establishes that when $\beta$ is sufficiently high, $\hat{A}$ may have an incentive to pool and always send message $s_D$. Proposition 2 also says that skeptical attitudes are observed only when $P(\theta_C)$ is sufficiently large (i.e., above the cutoff $\bar{P}$). To understand why the prior must be sufficiently high, suppose that $P(\theta_C)$ is just above $1/2$. Note that after receiving the false message $s_D$ when the actual state is $\theta_C$, $A$ would (incorrectly) believe that $b$ is the right decision and would give up the fight. If he lies, the parent would then earn a payoff of zero.

Proposition 3 discusses the case when $0 \leq \beta < 1/2$.

**PROPOSITION 3: (Dogmatism)** Fix $\gamma$ and suppose that $0 \leq \beta < 1/2$. For all $P(\theta_C) \leq \hat{P}$, where

$$\hat{P} = \frac{1}{2(1-\beta)(1-\gamma) + \gamma},$$

information transmission is truthful. When instead $P(\theta_C) > \hat{P}$, parent $\hat{A}$ always reports $s_{ND}$ regardless of Nature’s signal.

The previous proposition establishes that when $\beta$ is sufficiently low, $\hat{A}$ may have an incentive to send message $s_{ND}$ after all signals $s$. As a result, $A$ and $B$ always engage in a total conflict. As in Proposition 2, manipulation of information occurs when $P(\theta_C)$ is sufficiently large (i.e., above the cutoff $\hat{P}$). To see this, as before, suppose that $P(\theta_C)$ is just above $1/2$. After receiving signal $s_D$, the parent would change his view about the optimality
of $a$ and start to believe that $b$ is the correct decision. Then, $\hat{A}$ has no incentive to send message $s_{ND}$, which would induce $A$ to enter a total conflict with the goal of imposing the “wrong” policy.

In Figure 1, for a given $\gamma$, we draw the parameter regions in the $(P(\theta_C), \beta)$ space where beliefs’ manipulation occurs. As stated in Propositions 2 and 3, $\hat{A}$ sends truthful reports when $P(\theta_C)$ is sufficiently low. When instead $P(\theta_C)$ is large, we observe either dogmatism (in the lower-right region) or skepticism (in the upper-right region). Also notice that truthful reporting is more likely to occur when $\beta$ is around $1/2$. From Figure 1, it is easy to observe that ceteris paribus an increase of $\beta$ may move from the dogmatic to the truthful region. However, a large increase of $\beta$ may move from the dogmatic to the skeptical region. As a result, it is unclear whether an increase of $\beta$ provides stronger incentives to report truthfully.

![Figure 1: Beliefs Manipulation in the $(P(\theta_C), \beta)$ space with $\gamma = 0.6$](image)

Finally, if Nature’s signals become more precise (i.e., $\gamma$ increases), it is easy to verify that both cutoffs $\hat{P}$ and $P$ increase, thereby reducing the incentives to manipulate beliefs. Graphically, this can be appreciated by noticing that the blue and green curves in Figure 1 shift to the right when $\gamma$ increases. However, the shift is not parallel: both curves pivot around point $(1, 1/2)$. To understand why beliefs manipulation is less likely when signals are
more precise, suppose that $\gamma$ is close to 1. In this case, after a false message the posteriors of the parent and of the son would likely lie on different sides of $1/2$, the threshold of indifference discussed in Section 3.2. Therefore, when signals are precise the parent tells the truth in order to avoid wrong policy decisions.

We state without proof the following Corollary.

**Corollary 1:** The higher $P(\theta_C)$ and the lower $\gamma$, the stronger the incentives to manipulate signals. An increase of $\beta$ has instead an ambiguous effect on the incentives to report truthfully.

Using the results of Propositions 1-3, we now investigate how the degree of societal heterogeneity affects the likelihood that a conflict occurs (or incidence of conflict) and the total effort levels exerted in the conflict.

**Corollary 2:** The incidence of conflict is increasing in $P(\theta_C)$. The intensity of conflict is weakly increasing in $P(\theta_C)$ when $\beta < 1/2$ and non-monotone in $P(\theta_C)$ when $\beta \geq 1/2$.

To understand the first part of Corollary 2, notice that when $P(\theta_C)$ is low (resp. high) conflicts occur only when the parent receives $s_{ND}$ (resp. always occur). Since $P(\theta_D)$ is likely to be high in heterogeneous societies, this suggests that conflicts are less likely in uniform societies. More surprisingly, the second part of Corollary 2 establishes that when $\beta \geq 1/2$ the intensity of conflict may not be monotone in $P(\theta_D)$. The latter result occurs because, as described in Proposition 2, in more divided societies individuals may be induced to have a skeptical attitude. This generates a discontinuous drop of the overall effort levels when $P(\theta_D)$ is equal to $\overline{P}$.21

Before concluding, we briefly discuss what would happen if $A$ were not naive. Take the region of parameter values where truthful reports occur according to Propositions 2 and 3.

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20This result is supported by the empirical findings of Montalvo and Reynal-Querol (2005), who show that ethnic polarization (which can viewed as a proxy of ex-ante heterogeneity) is positively correlated with the incidence of conflict.

21This is in line with recent empirical evidence that studies the consequences of ethnic heterogeneity on the duration of civil wars, which can be viewed as a proxy of the effort levels exerted by the two parties in the conflict. For example, Montalvo and Reynal-Querol (2007) and Collier et al. (2004), find that ethnicity has a nonlinear effect on the duration of civil wars: the duration of a conflict is at its maximum for intermediate values of ethnic heterogeneity.
It is easy to see that informative communication would also occur if \( A \) were not naive.\(^{22}\) Instead, if we are in the parameter region where the parent has an incentive to misrepresent the facts, \( A \) would ignore the message of his parent: \( A \)’s probability assessment of being in state \( \theta_C \) would then coincide with his prior.

### 3.5. Dogmatism and Inefficient Decision-Making

In the previous section, we have shown that beliefs manipulation distorts effort decisions but it does not distort policy decisions.\(^{23}\) However, it is reasonable to expect that beliefs manipulation may also lead to inefficient decision-making. A simple extension of the previous setup allows us to capture this additional cost.

In this section, we suppose that \( A \) is able to conduct research on his own in order to find out the current state of the world. In our model, this possibility will be used only when \( A \) receives message \( s_D \). To motivate this assumption recall that after receiving message \( s_{ND} \), \( A \) has no doubt that the state is \( \theta_C \). Therefore, from \( A \)’s perspective, autonomous research is not needed.

The timing is now as follows. As before, at \( t = 0 \) parent \( \hat{A} \) observes signal \( s \in \{s_{ND}, s_D\} \) and sends a message to \( A \). If \( \hat{A} \) sends message \( s_{ND} \), the game unfolds exactly as before.

If instead \( \hat{A} \) sends message \( s_D \), \( A \) doubts. We now assume that individual \( A \) is able, if he decides so, to conduct costless research in order to discover the current state. We also assume that research is not manipulable by \( A \) himself. With probability \( \pi \in [0, 1] \) research is successful and \( A \) is able to perfectly observe the actual state of the world. With complementary probability \( 1 - \pi \), research is not successful. We assume that the probability of success is independent from \( \theta \). To simplify the analysis, we assume that \( B \) observes \( m_{\hat{A}} \) as well as the research outcome.

As before, at \( t = 1 \) individuals simultaneously choose the effort levels in the conflict and the final decision is made at \( t = 2 \).

\(^{22}\)Without the naivete assumption, however, there would also exist a “babbling equilibrium” for the same parameter values.

\(^{23}\)In fact, note from Propositions 2-3 that the decision that \( A \) makes at \( t = 2 \) on the basis of \( m_{\hat{A}} \) is the same that he would make if he knew the true signal. This result occurs because \( \hat{A} \) does not disagree with his son on the correct policy to implement in each state and, as a result, he does not manipulate information to the point of inducing the wrong policy decision in the final stage.
We now investigate whether the possibility of autonomous research affects the message strategy of the parent. In order to do this, we compute the expected payoffs to the parent after each message. First, it is easy to see that regardless of the true signal, the expected utility of the parent after sending message $s_{ND}$ is, as in Lemmas 1 and 2, equal to

$$\frac{-\beta}{2} + \frac{1}{2}. \quad (20)$$

We compute below the payoffs earned by $\hat{A}$ following message $s_D$, which (see the proof of Lemma 3) induces $A$ to conduct autonomous research. Before proceeding, we let $\mu^A(s_D, NS)$ denote the son’s posterior after receiving message $s_D$ and after research is not successful.

**LEMMA 3:** Suppose that Nature sends signal $s_{ND}$. If $\hat{A}$ sends the false message $s_D$, he earns:

$$(1 - \pi) \left(2\mu^A(s_D, NS) - 1\right) \frac{1 - \beta(2\mu^A(s_D, NS) - 1)}{2} + \pi \frac{1 - \beta}{2}. \quad (21)$$

Suppose instead that Nature sends signal $s_D$. If $\hat{A}$ is truthful, he earns:

$$(1 - \pi) \left[2\mu^A(s_D, NS) - 1\right] \frac{1 - \beta(2\mu^A(s_D, NS) - 1)}{2} + 2\left(1 - \mu^A(s_D, NS)\right)^2$$

$$+ \pi \left[\mu^A(s_D) \frac{1 - \beta}{2} + 1 - \mu^A(s_D)\right]. \quad (22)$$

To find out the equilibrium message strategy of the parent, it is instructive to consider the extreme cases of $\pi = 0$ and $\pi = 1$. It is straightforward to see that when $\pi = 0$ the setup analyzed here is identical to the one analyzed in the previous sections: the message strategies are then exactly the same as in Propositions 2-3 and illustrated in Figure 1.

Consider instead the other extreme: $\pi = 1$. Does $\hat{A}$ have an incentive to send message $s_{ND}$ when $s = s_D$? By comparing (22) to (20), it is immediate that when $\pi = 1$ the answer is negative: inducing $A$ to conduct research when $s = s_D$ is strictly preferable to sending message $s_{ND}$. To understand this result, notice that if the son discovers that the state is $\theta_A$, the parent obtains a payoff equal to 1, which is strictly greater than the payoff of sending message $s_{ND}$. If instead $A$ discovers that the current state is $\theta_C$, the parent obtains the same payoff that he would have obtained by sending the false message $s_{ND}$. Therefore, autonomous research provides valuable information to the parent and dogmatism never arises when $\pi = 1$. 

Riboni 19
Figure 2 illustrates the message strategies in the \((\beta, P(\theta_C))\) space for an intermediate value of \(\pi\). One can see that dogmatism is still observed when \(\beta\) is sufficiently low and \(P(\theta_C)\) sufficiently large, but that the region of parameter values where dogmatism occurs has shrunk compared to Figure 1.

It is interesting to note that the incentives to induce skeptical attitudes are not affected by \(\pi\). In other terms, the region of parameter values where skepticism occurs is identical to the one characterized in Proposition 2.\(^{24}\) Overall, this suggests that societies that have access to efficient ways of doing research (such as, well-supplied libraries, internet and an advanced educational system) are more prone to either truthtelling or systematic doubts rather than to dogmatic attitudes.

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**Figure 2: Beliefs Manipulation with Autonomous Research \((\pi = 0.4, \gamma = 0.6)\)**

Proposition 4 describes the message strategies when \(A\) is allowed to conduct autonomous research.

**PROPOSITION 4:** When \(\beta \in [1/2, 1]\), the message strategy of \(\hat{A}\) does not depend on \(\pi\).

\(^{24}\)To see this, it is enough to observe that autonomous research does not change the incentives to send message \(s_D\) when the state is \(\theta_C\): in fact, (21) is greater than (20) if and only if (15) is greater than (14).
Consequently, Proposition 2 characterizes the parameters where \( \hat{A} \) is truthful and the ones where he induces skeptical attitudes. When instead \( \beta \in [0, 1/2) \), the incentives to induce dogmatic attitudes are decreasing in \( \pi \). In particular, fix any \( \beta \in [0, 1/2) \) and fix any \( P(\theta_C) \) and \( \gamma \). Then, there exists a level of research effectiveness \( \tilde{\pi} < 1 \) such that for all \( \pi > \tilde{\pi} \) the parent is truthful.

Since dogmatism sometimes prevents \( A \) from conducting potentially successful research, Proposition 4 establishes that when \( \pi \) is sufficiently low, dogmatism, besides leading to violent conflicts, may induce \( A \) to make wrong policy decisions. Clearly, these mistakes could have been avoided if information had been truthfully transmitted.

### 3.6. Dynamics

So far we have assumed that the effectiveness of research and the precision of Nature’s signals (summarized by \( \pi \) and \( \gamma \), respectively) were exogenous. However, these parameters are likely to evolve over time depending on individuals’ decisions.

In this section, we posit the following mechanism behind the evolution of \( \pi \) and \( \gamma \). We suppose that the act of doing research (independently of whether this is successful) increases the stock of research instruments (such as, libraries, books, theorems, oral traditions) available to future generations, thereby making research in the future more effective and increasing the precision of future signals. In other words, our view here is that current research generates an externality on future generations.

To analyze the evolution of biased beliefs over time, we consider a simple dynamic extension to the model with autonomous research that we analyzed in the previous section.

Let \( \tau \) denote the time, where \( \tau = 1, 2, \ldots, \infty \).\(^{25}\) Consider an OG model where A-type and B-type individuals live for two periods. When they are young, individuals exert effort in a conflict; when they are old, they become parents. We denote by \( A_\tau \) (resp. \( B_\tau \)) the A-type (resp. B-type) individual that was born at time \( \tau \). At each \( \tau \) the active players in the model are \( A_\tau, A_{\tau-1} \) and \( B_\tau \).\(^{26}\) Individual \( A_\tau \) is associated to \( A_{\tau-1} \), a parent that was born at time \( \tau - 1 \).

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\(^{25}\)The assumption that the horizon is infinite is not essential, but will be used for a limiting result.

\(^{26}\)Individual \( B_{\tau-1} \) is alive at time \( \tau \) but, as in the previous sections, he is not an active player because \( B_\tau \) does not need to be informed.
At each $\tau$, Nature draws the current state of the world $\theta_\tau$. We suppose that draws are i.i.d. across time. This assumption allows us to avoid the possible complexities of introducing learning into our model: at each $\tau$ the prior probability of being in a state of conflict is constant and equal to $P(\theta_C)$.

The parent $A_{\tau-1}$ observes evidence $s_\tau \in \{s_{ND}, s_D\}$ (as before, its precision is summarized by $\gamma_\tau$) and sends a message to $A_\tau$. Nature’s signals are also assumed to be i.i.d. across time. As in Section 3.5, after message $s_D$ individual $A_\tau$ conducts autonomous research which is successful with probability $\pi_\tau$. After receiving a message from $A_{\tau-1}$ and after observing the research’s outcome, individuals $A_\tau$ and $B_\tau$ play a game of conflict in order to choose the policy to implement at time $\tau$, which is denoted by $x_\tau$. We assume that individual $A_\tau$ is naive when he is young; when he is old, he becomes aware that his son is naive towards him.

The two-period utility of a young individual of type $i$ (where $i = A, B$) that is born at time $\tau$ is

$$U^{i,\tau} = -c_{i,\tau} + u_i(x_\tau, \theta_\tau) - \beta c_{i,\tau+1} + u_i(x_{\tau+1}, \theta_{\tau+1}).$$  \hspace{1cm} (23)

We suppose that $\gamma_\tau$ and $\pi_\tau$, the state variables of our model, evolve over time as follows.

**Assumption 1:** (i) If research is conducted at time $\tau$ we have that $\pi_{\tau+1} > \pi_\tau$ and $\gamma_{\tau+1} \geq \gamma_\tau$;

(ii) If research is not conducted at time $\tau$, we have that $\gamma_{\tau+1} = \gamma_\tau$ and $\pi_{\tau+1} = \pi_\tau$.

The first part of Condition (i) of Assumption 1 guarantees that if a young son conducts autonomous research at time $\tau$ the effectiveness of research at time $\tau + 1$ strictly increases. The second part of Condition (i) states that if the son does autonomous research when is young, he becomes (weakly) more capable of extracting precise signals when he becomes a parent. The underlying intuition was discussed at the beginning of this section. According to Condition (ii), $\gamma_{\tau+1}$ and $\pi_{\tau+1}$ stay constant if $A_\tau$ does not conduct research. To some extent, this amounts to assuming no depreciation of the stock of research instruments.

We now introduce the following notation. Let $1_\tau$ denote an indicator function that takes the value 1 if $A_\tau$ conducts autonomous research at time $\tau$, and 0 otherwise. We denote by $\gamma_{\tau+1}(j)$ the value of $\gamma_{\tau+1}$ if at time $\tau$ we had $1_\tau = j$, with $j = 0, 1$. For instance, $\gamma_{\tau+1}(1)$ denotes the precision of Nature’s signal at time $\tau + 1$ if at time $\tau$ individual $A_\tau$ conducted autonomous research. We now state the following assumption:


**Assumption 2:** \( \lim_{\tau \to \infty} \gamma(1) = 1 \).

Assumption 2, which is only needed for a limiting result, guarantees that Nature’s signals become fully informative in the limit as individuals keep conducting research.

Throughout our analysis, we assume that individuals at time \( \tau \) do not take into account the external effect of their decisions on \( \gamma_{\tau+1} \) and \( \pi_{\tau+1} \). This implies that the problem of a young individual at time \( \tau \) is essentially a static problem. Consequently, in each period, the message strategies and the effort decisions are exactly the ones described in Proposition 4 and illustrated in Figure 2. However, since by Assumptions 1-2 the state variables evolve, the parent’s incentives change over time.

To understand the results of the dynamic setting, we remind the reader that in our static model the incentives to misrepresent (in either way) the facts are decreasing in \( \gamma \) (see Corollary 1) and that the incentives to induce dogmatic attitudes are decreasing in \( \pi \) (see Proposition 4). These findings, together with Assumptions 1-2, imply that when individuals have doubts and research is conducted, the incentives of future parents to tell the truth become stronger.

Given our modeling assumptions, it is then straightforward to solve for the dynamics. First, it is immediate to show that dogmatic attitudes are persistent. Suppose in fact that at time \( \tau = 1 \) the parameters of the model (i.e., \( \beta, P(\theta C), \gamma_1 \) and \( \pi_1 \)) are such that \( A_0 \) induces dogmatic attitudes in \( A_1 \). That is, the economy is characterized by a combination of parameters in the lower-right region of Figure 2. Then, no autonomous research is conducted at time \( \tau = 1 \) and by Assumption 1 all parameters stay constant. Then, \( A_1 \) will also induce dogmatic attitudes in \( A_2 \); and so on for all \( \tau \). This result suggests that societies may be trapped in a dogmatic equilibrium.

Suppose instead that the initial parameters are such that \( A_0 \) is truthful. It is equally easy to show that truthful reporting is also an absorbing state. To see this, we need to distinguish two cases: when Nature sends \( s_{ND} \) and when Nature sends \( s_D \). First, consider the case \( s_1 = s_{ND} \). Then, \( A_0 \) truthfully reports \( s_{ND} \) and no research is conducted. Since parameters do not change (see Assumption 1), in the next period \( A_1 \) will still be truthful. Second, suppose that \( s_1 = s_D \). In this case, research will be conducted. By Assumption 1,

\[27\text{This is similar to what is usually assumed in growth models with human capital and production externalities (for instance, see Lucas, 1988).}\]
this implies that \( \pi_2 > \pi_1 \) and \( \gamma_2 \geq \gamma_1 \). From Corollary 1 and Proposition 4 we know that both curves in Figure 2 shift to the right and that the truthful region expands. That is, an increase of \( \pi \) and \( \gamma \) reinforces \( A_1 \)'s incentives to be truthful at \( \tau = 2 \). Following a similar argument, we obtain that for all \( \tau > 2 \) parents will also be truthful.

In other terms, truthful reporting initiates a *virtuous circle*. When parents do not manipulate information, we obtain that individuals are sometimes induced to conduct autonomous research in order to acquire information. This moves \( \pi \) and \( \gamma \) upwards and strengthens the incentives of future parents to tell the truth.

Finally, suppose that at \( \tau = 1 \) the parameters are such that \( A_0 \) always sends message \( s_D \). In particular, from Proposition 2 we know that this occurs if \( \beta \geq 1/2 \) and

\[
P(\theta_{C}) > \frac{1}{2\beta(1-\gamma_1) + \gamma_1}.
\]

That is, the economy lies in the upper-right region of Figure 2. In what follows, we show that at \( \tau = 2 \) the economy may find itself in the truthful region. To see this, notice that since \( A_1 \) conducts research at \( \tau = 1 \), by Condition (i) of Assumption 1 we have that \( \gamma_2 \geq \gamma_1 \). Two cases are possible. First, at \( \tau = 2 \) it could be that

\[
P(\theta_{C}) \leq \frac{1}{2\beta(1-\gamma_2) + \gamma_2}.
\]

In this case, from Proposition 2 we know that \( A_1 \) sends truthful reports. The other possibility is that (25) is not satisfied. In this case, \( A_1 \) continues to induce skeptical attitudes, \( A_2 \) conducts research and \( \gamma_3 \geq \gamma_2 \). This increases the cutoff at time 3, thereby making the transition to truthful reporting more likely. If Assumption 2 is also satisfied, \( \gamma_\tau \) goes eventually to 1 and the blue (negatively sloped) curve of Figure 2 keeps shifting to the right. Then, at some future date the prior \( P(\theta_{C}) \) of our economy will necessarily lie below the corresponding \( \tau \)-cutoff. This implies that after observing skeptical attitudes for several periods parents will start being truthful.

The above discussion is summarized in the following proposition.

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28 Recall that \( \beta \) and the prior \( P(\theta_{C}) \) do not change over time. Hence, if the economy lies in the truthful region of Figure 2 at \( \tau = 1 \), *a fortiori* it lies in the truthful region at \( \tau = 2 \) after the increase of \( \pi \) and \( \gamma \).

29 From Assumption 1 we also know that \( \pi_2 \) strictly increases. However, we only focus on the increase of \( \gamma_2 \) because from Proposition 4 we know that \( \pi_2 \) has no effect on the message strategy when \( \beta \geq 1/2 \).
PROPOSITION 5: Suppose that $\gamma_\tau$ and $\pi_\tau$ evolve according to Assumption 1. Then, truthful reporting and dogmatism are two absorbing states. That is, if the parameters are such that at time $\tau$ dogmatism (resp. truthful reporting) is observed, at time $\tau + 1$ dogmatism (resp. truthful reporting) will also be observed. If instead at time $\tau$ parent $A_{\tau-1}$ induces skeptical attitudes in $A_\tau$, at time $\tau + 1$ parent $A_\tau$ may either keep inducing skeptical attitudes in $A_{\tau+1}$ or be truthful. If Assumption 2 is also satisfied, we obtain that as $\tau \to \infty$ skepticism will eventually be replaced by truthful reporting.

An implication of Proposition 5 is that societies will be able to escape from a dogmatic-trap only if a large shock occurs, such as an increase of $\pi_\tau$ or $\gamma_\tau$ due, for example, to an opening of the society which provides access to more effective research instruments.

4. Conclusions

As argued by Karl Popper (1963), conflicts are less violent when individuals entertain the possibility that the opponent may be right. Why is it so difficult to observe this attitude? To answer this question, this paper studies information transmission from an informed principal (a parent) to a naive agent (a son). After receiving a message from his parent, the son plays a game of conflict with an opponent.

In our model, the parent wants to motivate his son to exert effort in the conflict, but he also cares that the son selects the correct policy and that he has the right incentives to acquire information.

In the context of our model, information is sometimes manipulated. In some cases, as a result of the parent’s indoctrination, the son never doubts about the possibility of being wrong, although all available information suggests otherwise. This leads to excessive violence and inefficient decision-making. In other cases, the son believes that his opponent may be right even when all the evidence indicates beyond any doubt that the policy preferred by the opponent is suboptimal. In this case, doubts moderate the escalation of violence in the conflict but the son often loses.

We argue that manipulation of information (in both directions) is more likely to occur in heterogenous societies and when Nature’s signals are less precise. Dogmatic attitudes are less likely to be observed when the son is able to conduct autonomous research and when the
parent’s altruism is low. When instead altruism is high, we obtain that the son is induced by his parent to always doubt.

Moreover, we show that conflicts are more likely in heterogenous societies. However, the intensity of conflict is not necessarily at its maximum in very heterogeneous societies.

Finally, to study cultural transmission over time we consider a two-period OG economy where the son becomes a parent when he is old. We argue that dogmatism and truthful reporting are persistent over time. On the contrary, skeptical attitudes are less likely to persist in the long-run.

Appendix

PROOF OF PROPOSITION 1

Suppose first that $\mu_A (m_A) < 1$. We proceed by steps. We first show that the equilibrium expected payoff of $B$ is strictly positive. To see this, notice that $A$ never exerts an effort level higher than his valuation, $2\mu_A (m_A) - 1$, because he would earn a return below $1 - \mu_A (m_A)$. This implies that $B$ can guarantee for himself a strictly positive payoff by exerting an effort level just above $2\mu_A (m_A) - 1$.

We now show that the effort strategies of both players are mixed, with no mass points at a strictly positive effort level. By way of contradiction, suppose that player $j$ has a mass point at a particular effort $c_j > 0$. Then, the payoff of the other player would increase discontinuously at $c_j$. It then follows that there exists a $\varepsilon > 0$ such that the other player exerts effort on the interval $[c_j - \varepsilon, c_j]$ with zero probability. However, if this were the case, $j$ would increase his payoff by bidding $c_j - \varepsilon$ instead of $c_j$.

We now argue that the maximum effort level of the two players is the same. To see this, notice that since the effort strategies are mixed, if one individual has a maximum effort level, the other individual would win with probability one by just exerting that effort level.

Next, we now show that the minimum effort level is zero. By way of contradiction, suppose that an individual has a minimum effort level $\zeta \in (0, 2\mu_A (m_A) - 1]$. Then the other player would not exert effort in the interval $[0, \zeta]$ because by doing so he would lose with probability one. But this implies that the first individual would rather exert an effort level lower than $\zeta$.

Individual $B$’s expected payoff from exerting effort $c_B$ is

$$EU^B = G_A(c_B) - c_B,$$  \hfill (A.1)
while A’s expected payoff from exerting effort $c_A$ is

$$EU^A = (1 - \mu^A (m_A^{\hat{}})) + G_B(c_A) \left(2\mu^A (m_A^{\hat{}}) - 1\right) - c_A.$$  \hspace{1cm} (A.2)

Noticing that $B$ must be indifferent among all the effort levels in the set and recalling that the equilibrium expected payoff for $B$ is strictly positive, we evaluate $EU^B$ when $c_B = 0$. It follows that $G_A(0) > 0$.

We now show that $B$ cannot put positive mass at zero. If this were the case, there would be a tie with some positive probability. But $B$ would be better off increasing his effort just above zero. This implies that $G_B(0) = 0$ and $A$’s expected payoff is $1 - \mu^A (m_A^{\hat{}})$. Then,

$$G_B(c_A) = \frac{c_A}{2\mu^A (m_A^{\hat{}}) - 1}. \hspace{1cm} (A.3)$$

When $B$’s effort is $2\mu^A (m_A^{\hat{}}) - 1$,

$$EU^B = G_A(2\mu^A (m_A^{\hat{}}) - 1) - (2\mu^A (m_A^{\hat{}}) - 1), \hspace{1cm} (A.4)$$

or

$$EU^B = 1 - (2\mu^A (m_A^{\hat{}}) - 1). \hspace{1cm} (A.5)$$

Then,

$$G_A(c_B) = 1 - (2\mu^A (m_A^{\hat{}}) - 1) + c_B. \hspace{1cm} (A.6)$$

Finally, when $\mu^A (m_A^{\hat{}}) = 1$ the equilibrium strategies can be obtained by taking the limit of the equilibrium strategies described above.

This concludes the proof of Proposition 1. \hspace{1cm} □

**PROOF OF LEMMA 1:** We start by explaining expression (14). To understand it, first recall that if $m_A^{\hat{}} = s_{ND}$ we obtain that $\mu^A (m_A^{\hat{}}) = 1$ using (6) and the naivete assumption of the son. Then, from Proposition 1 we obtain that the expected effort exerted by A is equal to $1/2$. To explain the first term of (14), recall from (2) that in $\hat{A}$’s utility the effort exerted by $\hat{A}$ is multiplied by $\beta$. To explain the second term of (14), note that a total conflict is symmetric and both players win with equal probabilities. Since in Lemma 1 we suppose that Nature sends signal $s_{ND}$, the actual state of the world is $\theta_C$. Then, $\hat{A}$ earns a payoff equal to one if $A$ wins and zero if $B$ wins.

To understand (15), recall from Proposition 1 that after receiving message $s_D$, $A$ enters into a conflict with probability $(2\mu^A (s_D) - 1)$. Conditional on $A$ exerting positive effort, we know from Proposition 1 that his expected effort cost is

$$-\frac{2\mu^A (s_D) - 1}{2}. \hspace{1cm} (A.7)$$

Conditional on $A$ exerting a positive effort, both individuals randomize according to the same uniform distribution and, consequently, have equal probabilities of victory. Therefore, $\hat{A}$’s expected gross gain from the
conflict is $1/2$. With complementary probability $2\left(1 - \mu^A(s_D)\right)$, individual $A$ exerts no effort, $B$ picks policy $b$, and, consequently, the payoff to $\hat{A}$ is zero.  

**PROOF OF LEMMA 2:** We start by explaining expression (16). Compared to (15), expression (16) includes a second term. To understand this term, note that when $A$ exits the conflict, $B$ chooses policy $b$, which is optimal for $A$ with probability $1 - \mu^A(s_D)$.

We now explain (17). Suppose that $\hat{A}$ induces $A$ to start a total conflict by sending the false message $s_{ND}$ when $s = s_D$. The first term of (17) coincides with the first term of (14). To explain why the second terms of (14) and (17) also coincide, note that $\hat{A}$’s expected gross gain from a total conflict when $s = s_D$ is

$$
\mu^\hat{A}(s_D) \frac{1}{2} + \left[1 - \mu^\hat{A}(s_D)\right] \frac{1}{2},
$$

which is equal to $1/2$. To understand (A.8) note that with probability $1/2$ player $A$ wins and implements policy $a$, which gives $\hat{A}$ an expected payoff equal to $\mu^\hat{A}(s_D)$. With probability $1/2$ player $B$ wins and implements policy $b$, which gives $\hat{A}$ an expected payoff equal to $1 - \mu^\hat{A}(s_D)$.

**PROOF OF PROPOSITION 2**

**Step 1:** When

$$
P(\theta_C) \leq \frac{1}{2 - \gamma},
$$

$\hat{A}$ is truthful.

**Proof of Step 1:** Two cases must be considered. First, suppose that Nature sends signal $s_D$. Using Bayes’ Rule, we obtain that

$$
\mu^\hat{A}(s_D) = \frac{P(\theta_C)(1 - \gamma)}{1 - P(\theta_C) + P(\theta_C)(1 - \gamma)}.
$$

If the condition in the statement of Step 1 is satisfied, this implies that $\mu^\hat{A}(s_D) \leq 1/2$. Suppose that $\hat{A}$ is truthful and sends message $s_D$. Then, by the naivete assumption it is also the case that

$$
\mu^A(s_D) = \frac{P(\theta_C)(1 - \gamma)}{1 - P(\theta_C) + P(\theta_C)(1 - \gamma)}.
$$

Since $\mu^A(s_D) \leq 1/2$, $A$ exerts no effort and $B$ picks policy $b$. The expected payoff to the parent is

$$
1 - \mu^\hat{A}(s_D) \geq \frac{1}{2}.
$$

Suppose instead that the parent lies and sends the false message $s_{ND}$. In this case, $A$ starts a total conflict. Using (17), the parent’s expected payoff would be

$$
-\frac{\beta}{2} + \frac{1}{2}.
$$

(A.13)
which is lower than $1/2$. This implies that a deviation from a truthful report is not profitable when the actual signal is $s_D$.

Second, suppose that $s = s_{ND}$. If the parent sends message $s_{ND}$ his expected payoff is

$$-\frac{\beta}{2} + \frac{1}{2},$$

(A.14)

which is greater than zero, the payoff obtained by sending message $s_D$, which induces $A$ to exert no effort. This implies that a deviation from a truthful report is also not profitable when the actual signal is $s_{ND}$.

**Step 2:** When

$$\frac{1}{2 - \gamma} < P(\theta_C) \leq \frac{1}{2\beta(1 - \gamma) + \gamma},$$

(A.15)

$\hat{A}$ is also truthful.

**Proof of Step 2:** First, suppose that $s = s_D$ and that the parent is truthful. If the condition in the statement of Step 2 is met, $\mu^A(s_D) > 1/2$. Then, a conflict arises. By Lemma 2, the parent’s expected utility of sending a truthful message is given by (16). Since $\mu^{\hat{A}}(s_D) = \mu^A(s_D)$ when reporting is truthful, we can rewrite (16) as

$$(2\mu^A(s_D) - 1) \frac{1 - \beta(2\mu^A(s_D) - 1)}{2} + 2(1 - \mu^A(s_D))^2.$$

(A.16)

To see whether $\hat{A}$ has an incentive to deviate and send message $m_{\hat{A}} = s_{ND}$ when the actual signal is $s_D$, we compare (A.16) to (17), the expected utility after the deviation. To show that (17) is lower than (A.16) when the condition in the statement of Step 2 is met, take the derivative of (A.16) with respect to $\mu^A(s_D)$:

$$-2\beta(2\mu^A(s_D) - 1) + 1 - 4(1 - \mu^A(s_D)).$$

(A.17)

This derivative can be written as

$$(1 - 2\beta)(2\mu^A(s_D) - 1) + 2(\mu^A(s_D) - 1).$$

(A.18)

Knowing that $1 \geq \mu^A(s_D) > 1/2$ and that $1 \geq \beta \geq 1/2$, one can verify that the derivative is always negative. Since (17) is equal to (A.16) when $\mu^A(s_D) = 1$, we have proved that (17) is lower than (A.16). Therefore, $\hat{A}$ has no incentive to send message $s_{ND}$ when $s = s_D$.

To conclude the proof of Step 2, we have to show that the parent does not want to deviate even when $s = s_{ND}$. The parent utility from truthful reporting is (14) while the utility of sending message $s_D$ is (15). One can show that when

$$\mu^A(s_D) \leq \frac{1}{2\beta},$$

(A.19)
the parent has no incentive to misreport. In fact, when \( \mu^A(s_D) = 1/(2\beta) \) and \( \mu^A(s_D) = 1 \) expressions (14) and (15) coincide. Between the two roots, (14) is greater than (15). When \( \mu^A(s_D) \leq 1/(2\beta) \) we have that (14) is lower than (15): \( \hat{A} \) has no incentive to misreport when \( s = s_{ND} \). Knowing that \( \mu^A(s_D) \) is given by (5), it is easy to show that \( \mu^A(s_D) \leq 1/(2\beta) \) if and only if

\[
P(\theta_C) \leq \frac{1}{2\beta(1 - \gamma) + \gamma}. \tag{A.20}
\]

**Step 3:** When

\[
P(\theta_C) > \frac{1}{2\beta(1 - \gamma) + \gamma}, \tag{A.21}
\]

\( \hat{A} \) sends message \( s_D \) regardless of Nature’s signals.

**Proof of Step 3:** Following the algebra of Step 2, we obtain that when the condition in the statement of Step 3 is satisfied, \( \hat{A} \) has an incentive to send message \( s_D \) when the actual signal is \( s_{ND} \). When instead \( s = s_D \) the report is truthful. It then follows that regardless of \( s \), \( \hat{A} \) always sends message \( s_D \).

This concludes the proof of Proposition 2. \( \square \)

**PROOF OF PROPOSITION 3**

**Step 1:** When

\[
P(\theta_C) \leq \frac{1}{2 - \gamma}. \tag{A.22}
\]

\( \hat{A} \) is truthful.

**Proof of Step 1:** The proof is identical to the proof of Step 1 of Proposition 2, since that proof did not use the fact that \( \beta \) was greater or equal than 1/2.

**Step 2:** When

\[
\frac{1}{2 - \gamma} < P(\theta_C) \leq \frac{1}{2(1 - \beta)(1 - \gamma) + \gamma}, \tag{A.23}
\]

\( \hat{A} \) is truthful.
Proof of Step 2: First, suppose that $s = s_D$. Since

$$\frac{1}{2 - \gamma} < P(\theta_C),$$  \hspace{1cm} (A.24)

we have that $\mu^A(s_D) > 1/2$. Then, a conflict arises. The parent’s expected utility of sending a truthful message is given by (A.16). To see whether $\hat{A}$ has an incentive to deviate and send message $m_{\hat{A}} = s_{ND}$ when the actual signal is $s_D$, we compute his utility after this deviation. This is given by (17). In comparing (A.16) to (17), one can show that when $\beta < 1/2$ it may be the case that (17) is greater than (A.16). However, when

$$\mu^A(s_D) \leq \frac{1}{2(1 - \beta)},$$  \hspace{1cm} (A.25)

(17) is lower than (A.16). Then, $\hat{A}$ has no incentive to send message $s_{ND}$ when he receives signal $s_D$. Knowing that $\mu^A(s_D)$ is given by (5), it is easy to verify that (A.25) is satisfied if and only if

$$P(\theta_C) \leq \frac{1}{2(1 - \beta)(1 - \gamma) + \gamma}.$$  \hspace{1cm} (A.26)

Finally, suppose that the actual signal is $s = s_{ND}$. The parent’s utility from truthful reporting is (14), while the utility of sending message $s_D$ is given by (15). One can show that when $\beta < 1/2$ the parent has no incentive to misreport.

Step 3: When

$$P(\theta_C) > \frac{1}{2(1 - \beta)(1 - \gamma) + \gamma},$$  \hspace{1cm} (A.27)

$\hat{A}$ sends message $s_{ND}$ regardless of Nature’s signals.

Proof of Step 3: This follows from the algebra in the previous step.

This concludes the proof of Proposition 3.  \hspace{1cm} $\square$

PROOF OF COROLLARY 2:

Step 1: We show that the incidence of conflict is increasing in $P(\theta_C)$.

Proof of Step 1: First, we compute the probability that a conflict occurs:

$$\Pr\{\text{conflict}\} = \begin{cases} \gamma P(\theta_C) & \text{if } P(\theta_C) \leq \frac{1}{2 - \gamma}, \\ 1 & \text{if } P(\theta_C) > \frac{1}{2 - \gamma}. \end{cases}$$  \hspace{1cm} (A.28)

To understand (A.28), notice that for all $m_{\hat{A}}$ we have that $\mu^A(m_{\hat{A}}) > 1/2$ when $P(\theta_C) > 1/(2 - \gamma)$. This implies that regardless of $\hat{A}$’s message strategy, conflicts always occur when $P(\theta_C) > 1/(2 - \gamma)$. When
instead $P(\theta_C) \leq 1/(2 - \gamma)$, one can verify from Propositions 2 and 3 that $\hat{A}$ is truthful. Since $\mu^A(s_D) \leq 1/2$, a conflict arises only when $\hat{A}$ sends message $s_{ND}$, an event occurring with probability $\gamma P(\theta_C)$.

Note that the probability of observing a conflict is obviously increasing in $P(\theta_C)$.

We now move to the proof of the second part of Corollary 2. As a measure of the intensity of conflict, we compute expected total effort by taking expectations over the space of possible signals. Let $\phi(s)$ denote the probability of observing signal $s$, which can be derived from (3) and (4). Expected total effort as of time 0 is then given by

$$E(c_A + c_B) = \phi(s_D)E(c_A + c_B; s_D) + \phi(s_{ND})E(c_A + c_B; s_{ND}). \quad (A.29)$$

First, knowing the conditional probabilities (3) and (4), we derive the probabilities of the two signals.

$$\phi(s_D) = 1 - \gamma P(\theta_C) \quad \text{and} \quad \phi(s_{ND}) = \gamma P(\theta_C). \quad (A.30)$$

From (A.29), (13), and the results of Proposition 3, we write the expression for $E(c_A + c_B)$ when $\beta < 1/2$:

$$E(c_A + c_B) = \begin{cases} 
\gamma P(\theta_C) & \text{if} \quad P(\theta_C) \leq \frac{1}{2 - \gamma}, \\
\gamma P(\theta_C) + (1 - \gamma P(\theta_C))(2\mu^A(s_D) - 1)\mu^A(s_D) & \text{if} \quad \frac{1}{2 - \gamma} < P(\theta_D) \leq \hat{P}, \\
1 & \text{if} \quad P(\theta_C) > \hat{P}. 
\end{cases} \quad (A.31)$$

Using the results of Proposition 2, we write the expression for $E(c_A + c_B)$ when $\beta \geq 1/2$:

$$E(c_A + c_B) = \begin{cases} 
\gamma P(\theta_C) & \text{if} \quad P(\theta_C) \leq \frac{1}{2 - \gamma}, \\
\gamma P(\theta_C) + (1 - \gamma P(\theta_C))(2\mu^A(s_D) - 1)\mu^A(s_D) & \text{if} \quad \frac{1}{2 - \gamma} < P(\theta_D) \leq P, \\
(2\mu^A(s_D) - 1)\mu^A(s_D) & \text{if} \quad P(\theta_C) > P. 
\end{cases} \quad (A.32)$$

**Step 2:** We show that $E(c_A + c_B)$ is weakly increasing in $P(\theta_C)$ when $\beta < 1/2$.

**Proof of Step 2:** To see this, we first show that

$$\gamma P(\theta_C) + (1 - \gamma P(\theta_C))(2\mu^A(s_D) - 1)\mu^A(s_D) \quad (A.33)$$

is increasing in $P(\theta_C)$. Knowing (5), we find the derivative of (A.33) with respect to $P(\theta_C)$:

$$\gamma + (1 - \gamma)(2\mu^A(s_D) - 1) + P(\theta_C) \frac{2(1 - \gamma)^2}{(1 - \gamma P(\theta_C))^2} \quad (A.34)$$

which is positive since $(2\mu^A(s_D) - 1)$ is positive, $P(\theta_C) \in (1/2, 1)$, and $0 \leq \gamma \leq 1$. Moreover, note that (A.33) is equal to $\gamma P(\theta_C)$ when $P(\theta_C) = 1/(2 - \gamma)$, and that (A.34) is greater than $\gamma$, the slope of $E(c_A + c_B)$ when
\( P(\theta_C) \leq 1/(2 - \gamma) \). Finally, note that (A.33) is lower than one: that is, right after \( P(\theta_C) = \hat{P} \), total effort jumps.

**Step 3:** We show that \( E(c_A + c_B) \) is not monotone in \( P(\theta_C) \) when \( \beta > 1/2 \).

**Proof of Step 3:** It is enough to show that right after \( P(\theta_C) = \hat{P} \), total effort drops. This is obvious since

\[
(2\mu^A(s_D) - 1)\mu^A(s_D) < 1. \tag{A.35}
\]

This concludes the proof of Corollary 2. \( \square \)

**Proof of Lemma 3:** First, we show that upon receiving message \( s_D \), \( A \) is indifferent between conducting and not conducting research. To see this, note that if \( A \) enters into a conflict without conducting research, his expected utility is equal to

\[
(2\mu^A(s_D) - 1) \frac{1 - (2\mu^A(s_D) - 1)}{2} + 2(1 - \mu^A(s_D))^2, \tag{A.36}
\]

which is equal to \( 1 - \mu^A(s_D) \).

If instead he conducts research, \( A \) expects to obtain

\[
(1 - \pi) \left[ (2\mu^A(s_D,NS) - 1) \frac{1 - (2\mu^A(s_D,NS) - 1)}{2} + 2(1 - \mu^A(s_D,NS))^2 \right] + \pi [1 - \mu^A(s_D)], \tag{A.37}
\]

which is also equal to \( 1 - \mu^A(s_D) \). In computing (21) and (22) we assume that \( A \) does indeed conduct research.

To understand (21), notice that with probability \( (1 - \pi) \) research is not successful. Since the probability of success is independent from \( \theta \), \( A \) does not update his beliefs in case of failure. The expected payoff to the parent is then given by (15). With probability \( \pi \) research is successful and \( A \) perfectly observes the state. Since (21) is computed under the assumption that \( s = s_{ND} \), \( A \) can only discover that \( \theta = \theta_C \). In this case, a total conflict arises and the parent’s payoff is (20).

To understand (22), note that with probability \( (1 - \pi) \) research is not successful and individual \( A \) does not change his beliefs. The expected payoff to the parent is then given by (16). The parent’s expected payoff in case research is successful is given by the following terms. With probability \( \mu^A(s_D) \), \( \hat{A} \) expects \( A \) to discover that the true state is \( \theta_C \). In this case, the payoff would be the one from a total conflict. With complementary probability \( \hat{A} \) expects \( A \) to discover that the true state is \( \theta_A \). In this case, \( \hat{A} \)’s payoff would be equal to one. \( \square \)
PROOF OF PROPOSITION 4

**Step 1:** We show that if \( \hat{A} \) always sends message \( s_D \) when \( \pi = 0 \), he will follow the same strategy also when \( \pi > 0 \).

**Proof of Step 1:** Suppose that \( \hat{A} \) always sends message \( s_D \) when \( \pi = 0 \). This implies that (15) \( \geq \) (14) and (16) \( \geq \) (17). When \( \pi > 0 \), (21) replaces (15) and (22) replaces (16). It is easy to show that (15) \( \geq \) (14) if and only if (21) \( \geq \) (14). Moreover, it is also simple to verify that if (16) \( \geq \) (17) we also have (22) \( \geq \) (17).

**Step 2:** We show that if \( \hat{A} \) always sends message \( s_{ND} \) when \( \pi = 0 \), there exists a cutoff \( \tilde{\pi} \), with \( \tilde{\pi} < 1 \), such that for all \( \pi > \tilde{\pi} \) parent \( \hat{A} \) is truthful.

**Proof of Step 2:** Suppose that \( \hat{A} \) always sends message \( s_{ND} \) when \( \pi = 0 \). This implies that (14) \( \geq \) (15) and (17) \( \geq \) (16). Suppose now that \( \pi > 0 \). It is easy to see that if (14) \( \geq \) (15) we also have that (14) \( \geq \) (21). Note however that (17) \( \geq \) (16) does not necessarily imply that (17) \( \geq \) (22). One can easily verify that we have that (17) \( \geq \) (22) if and only if

\[
\mu^A(s_D) \geq \frac{2 - \pi(1 - \beta)}{4(1 - \pi)(1 - \beta)}. \tag{A.38}
\]

Notice that when \( \beta \geq 1/2 \) inequality (A.38) is never satisfied. Suppose instead \( \beta < 1/2 \). When \( \pi = 1 \), the RHS of inequality (A.38) goes to infinity, thereby implying that inequality (A.38) is never satisfied. When \( \pi = 0 \) inequality (A.38) is sometimes satisfied when \( \beta < 1/2 \). This implies that exists a cutoff \( \tilde{\pi} \), which depends on the parameters of the economy, such that for all \( \pi \leq \tilde{\pi} \) inequality (A.38) is satisfied. When instead \( \pi > \tilde{\pi} \) the parent reports truthfully.

**Step 3:** We show that if \( \hat{A} \) is truthful when \( \pi = 0 \), he will follow the same strategy when \( \pi > 0 \).

**Proof of Step 3:** Suppose that \( \hat{A} \) is truthful when \( \pi = 0 \). This implies that (14) \( \geq \) (15) and (16) \( \geq \) (17). Suppose \( \pi > 0 \). It is easy to see that if (14) \( \geq \) (15) we also have that (14) \( \geq \) (21) and that if (16) \( \geq \) (17) we also have (22) \( \geq \) (17). □

Bibliography


