From Pluralistic Ignorance to Common Knowledge with Social Assurance Contracts

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I introduce social assurance contracts as a mechanism for safely revealing a hidden consensus. Many individuals may privately hold a contentious belief, but remain silent due to fear of social censure. Beliefs discussed in the public sphere then do not accurately reflect true, private beliefs. This prevents honest and open discourse and can fuel political polarization. Social assurance contracts safely surface suppressed beliefs by revealing hidden consensus only when sufficient support has been privately committed. Formal analysis shows this mechanism can resolve coordination problems and mitigate free-rider issues related to expressive acts, allowing honest expression and expanding the space of publicly-expressible beliefs.

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There is now a tyranny of the minority in public discourse in many parts of the world, where we see a majority discussion generated by a very small number of voices (Hughes and Asheer 2019). Instead of reflecting the diversity and relative moderation of actual beliefs and behavior, these voices tend to be extreme: news media and social media content is as inflammatory as is profitable (Ahler 2014; Dey, Lahiri, and Mukherjee 2025). Disagreeing with the dominant viewpoint is often perceived to be too dangerous to be worthwhile, so the mere threat of punishment has chilling effects—dissenters opt for silence, and the diversity of opinion characteristic of an honest, open exchange of ideas eludes us all. The resulting distorted public discourse means the average person wrongly infers that talked-about opinions are commonly held even when it is not the case—a phenomenon referred to as pluralistic ignorance (Prentice and Miller 1993). Recent experimental evidence points to uncertainty about others' true preferences as a key driver of the persistence of inefficient or "bad" social norms, which tend to dissipate when individuals are better informed

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about their peers' actual views (Smerdon, Offerman, and Gneezy 2020). One of the drivers of the increase in polarization in recent years is this imperfect reflection of privately-held beliefs on to the public sphere (Kuran 1997; Ahler 2014; Furnas and LaPira 2024). Take the United States as an example: If we were to try to infer what the average American is like on the basis of news coverage and social media, we would end up with a caricature: this person is Blue or Red, Left or Right, R or D. He carries a gun, drives a truck, and goes to church—or he eats vegetarian, drives an electric car, and goes to protests.

However, there may be a way to safely surface beliefs that feel dangerous to express—thereby making public discourse more accurately reflect actual beliefs. To do this, I transport a piece of economic technology into the social domain: the assurance contract. Assurance contracts (also called provision-point mechanisms) are mechanisms that enable the private provision of public (or club) goods by getting around free-rider and collective action problems. They are exemplified by crowdfunding platforms like Kickstarter. At their most basic, these contracts solicit contributions which enable the production of a public good if enough is contributed to reach a "provision point". If the provision point is not reached, contributions are returned. In the social domain, these contracts are something like an open letter—with the exception that one's signature on the letter is secret from both the public and other endorsers, and become public only *after* some safety conditions (a provision point) are fulfilled. At a university it might look like this:

> We, the undersigned believe [controversial belief] and think the University should take the following steps [1, 2, 3. . .]. Signatures on this letter will become public *only when there are at least [200] signatures from faculty and [800] signatures from students.* Until then, no one except the keeper of this letter can see who has signed.

This serves to make expressing a controversial (or controversial-seeming) belief much less costly: while a single hand raised in dissent might get cut off, a thousand can safely be raised together.

The first general implementation of this mechanism, Spartacus.App, was launched in 2024, and use cases in the social domain abound. In a university department many faculty may privately disagree with an administrative policy but say nothing, each fearing they are alone in their concern. Similarly, within a corporation, employees might silently oppose an unethical practice, or within a political party, party members might privately dissent from the party line but say nothing. In all such cases, an expressive collective action—such as a group letter or joint statement—could shift the public narrative if only individuals could be assured enough other people are with them. The key barrier is one of coordination and assurance: no one wants to be the first (or among the few) to step forward, risking backlash. Once a statement has a critical mass, public revelation is easy. This is a public good provision problem where the "good" is the revelation of shared sentiment and the potential shift in norms of public discussion. With *social* assurance contracts, instead of monetary contributions, individuals commit to publicly express a certain view. Their commitment (and identity) is held in secret and only revealed if a pre-specified number of others also pledge their support; no one's identity is exposed unless a critical mass joins, mitigating first-mover risk. By converting isolated private sentiments into a collective public statement, such a contract can foster common knowledge of actual, underlying beliefs while protecting individuals against the personal costs of speaking out in isolation.

The primary contributions of this paper are threefold: First, I formalize social assurance contracts. I develop a model tailored to the social context, where payoffs include reputational costs (c_i), esteem (e_i), a benefit from safe public revelation of the controversial belief (v_i), and a "warm-glow" bonus (w) for participation. Second, I analyze the equilibrium participation strategies under both complete and incomplete information. A key finding is that the warm-glow bonus $w > 0$ makes participation a dominant strategy under certain conditions in the complete information game, and significantly influences the cutoff strategy in the Bayesian Nash Equilibrium under incomplete information. The paper explores the existence, uniqueness, and properties of these equilibria, and provides insight into the optimal setting of the provision point T. Third, I formalize the "Overton window" (Lehman 2010), the range of acceptable public discourse, and provide a micro-foundation for how coordinated revelation of suppressed views can shift it to include previously suppressed beliefs. I also discuss how, when pluralistic ignorance suppresses moderate voices *within* otherwise polarized factions, social assurance contracts can offer a path towards depolarization.

The remainder of the paper is organized as follows. Section I reviews relevant literature. Section II formalizes the social assurance contract mechanism and participant incentives in detail, section III presents the equilibrium analysis under complete and incomplete information, including comparative statics and the case of incomplete trust in the contract administrator. Section IV formalizes the Overton window and considers shifts in the public discussion, and Section V discusses the choice of the assurance threshold T. Section VI discusses future directions for research, and Section VII concludes. The Mathematical Appendix contains detailed proofs and derivations, and the Supplemental Appendix discusses vulnerabilities and mitigations in A and the consequences of social network topology in C.

I. Literature Review

A. Public Goods, Step-Level Games, and Assurance Contracts

This work draws on several strands of literature. First, it is related to the game theory of step-level public goods and threshold games. The concept of the assurance contract has its origins in the work of Dybvig and Spatt (1983), who analyzed the coordination problems inherent in public goods provision and externalities. Building on this foundation, Palfrey and Rosenthal (1984) examined the strategic aspects of threshold public good contribution, showing how binary contribution decisions in a provision point setting can lead to multiple equilibria. The classic problem of voluntary public good provision often leads to multiple equilibria or coordination failures. Bagnoli and Lipman (1989) showed that if contributions are refunded when a funding threshold isn't met (a provision-point mechanism), efficient public good provision can be achieved under certain conditions, breaking the standard free-rider outcome.

Subsequent research has studied variations of threshold public goods games in theory and in laboratory experiments. Croson and Marks (2000) conducted a meta-analysis of step-level returns in threshold public goods experiments, identifying key factors that influence successful provision. In addition, researchers have documented how cooperation persists in public goods experiments despite theoretical predictions of free-riding, with attribution to confusion (Andreoni 1995), altruism, or a warm-glow effect (Andreoni 1990), among other explanations. There are several studies which provide experimental evidence for a warm-glow effect specifically in provision-point mechanisms applied to green electricity markets (Rose et al. 2002; Menges, Schroeder, and Traub 2005; Mitra and Moore 2018), providing evidence of the phenomenon in the specific context of assurance contracts. These games are characterized by an all-or-nothing dynamic: if enough people contribute (or cooperate) the project succeeds, but if too few do, it fails and contributions are wasted (or refunded). This structure creates strategic uncertainty: each player must guess how others will behave. The assurance contract, by design, tries to resolve some of this uncertainty by protecting contributors in case of failure. Tabarrok (1998) advanced this concept significantly by introducing *dominant* assurance contracts, which add a crucial twist to standard assurance contracts: if the threshold is not met, contributors not only get their money back but also receive a small bonus from the contract architect. This innovation makes contributing a dominant strategy under certain payoff assumptions—individuals have incentive to contribute regardless of whether they believe others will contribute. This, in theory, solves the coordination problem by eliminating the risk of non-provision equilibria. Further extending the concept of bonuses to ensure provision, Zubrickas

(2014) introduces a refund bonus that is proportional to their contribution if the project is not funded. This competition for potential refund bonuses also drives the equilibrium towards successful provision, potentially achieving Lindahl pricing without bonuses being paid in equilibrium. Cason and Zubrickas (2017) later tested dominant assurance contracts experimentally and found that they do indeed increase the provision of public goods, confirming Tabarrok's theoretical predictions. The social assurance contract builds on this logic, adapting it to non-monetary, expressive "contributions."

This work is also informed by the information escrow literature in law and economics. Information escrows are social assurance contracts, though usually conceived to be narrow in their scope. Ayres and Unkovic (2012) discuss mechanisms whereby information (like allegations of wrongdoing or romantic interest, or a negotiated end to a dispute) is held in escrow by a trusted third party and only released if certain conditions are met. In particular, they propose allegation escrows to encourage reporting of sexual harassment: a victim can confidentially lodge a complaint which remains hidden unless one or more additional complaints against the same perpetrator are filed. Only when a threshold of independent allegations is reached does the system take action. This protects individuals from the risk of retaliation or not being believed if they are a sole accuser.

This logic connects to the broader literature on coordination games and strategic complementarities. When individual strategies are complements (one person's willingness to act increases others' willingness), multiple self-fulfilling equilibria can arise. The silence-versus-speaking problem is exactly such a case: if others are silent, you prefer to be silent (silence reinforces silence), but if enough others speak, you would also speak. This is analogous to models of bank runs or currency attacks, where each investor's decision is complementary to others'. Global games analysis (Carlsson and van Damme 1993; Morris and Shin 2002) has been used to study how slight uncertainties can select equilibria in such coordination settings. In our context, "strategic complementarities in silence" create the risk of a no-expression equilibrium, and the assurance contract can be seen as a mechanism to eliminate the worst equilibrium by changing the payoff structure. As Morris and Shin (2002) discuss in related models, public signals or guarantees can move the game to the efficient outcome by coordinating expectations. Here, the contract serves as that coordinating device. This mechanism differs by focusing on endogenous preference revelation rather than exogenous signals.

B. *Information Cascades, Herding, and Opinion Dynamics*

Next, I situate our work in the context of informational cascades and herding models. A rich body of theory (e.g., Bikhchandani, Hirshleifer, and Welch 1992, Raafat, Chater, and Frith 2009) examines how individuals often base their actions on observations of others, sometimes leading to cascades where everyone ignores their private information and simply follows previous behavior. In a classic informational cascade, if early individuals act (or fail to act) in a certain way, later individuals will rationally imitate that behavior even if their own private signals differ. Thus, once a cascade of silence starts, social learning is essentially blocked and the false norm persists (Bikhchandani et al. 2024). This yields a fragile equilibrium – an entire group may be acting contrary to its private interests or beliefs simply because each person is waiting for someone else to deviate.

The problem of suppressed beliefs is a form of such a cascade: everyone remains silent because everyone else is silent. Each individual, observing no one speaking out, assumes silence is the safer strategy. This mechanism aims to break this cascade by coordinating a simultaneous deviation by many individuals at once. By doing so, it forces the outcome to reveal the underlying private information (the true level of dissent) that was previously hidden. In essence, a social assurance contract can short-circuit an information cascade which leads to silence by giving everyone a secure way to express themselves conditional on others doing so. No one has to move first; when the provision point is met, the suppressed consensus is revealed all at once.

C. Social-psychological theories

The approach here also builds on social-psychological theories of conformity and suppressed expression. The notion of people publicly conforming to norms they privately reject was analyzed by Kuran (1997) as "preference falsification", and the process leading to this by Noelle-Neumann (1974) as the "spiral of silence". The concepts "groupthink", where group members choose consensus over correctness (Esser 1998), and peer pressure (Calvó-Armengol and Jackson 2010) are related in that they describe how outward consensus can come to be different from inner beliefs. There is a significant literature addressing social conformity as a broader set of phenomena, as well (see Capuano and Chekroun 2024, for a review), and social desirability bias in specific to survey responses (Krumpal 2013). Opposite to pluralistic ignorance is "false consensus", where an agent believes others hold beliefs more like their own than is actually the case (Ross, Greene, and House 1977; Marks and Miller 1987). When a privately-held belief is already within the public discourse, the situation is generally stable: wrongly believing others share your beliefs more than they do poses no risk of the kind we are concerned with here. In the case where a privately-held belief is *not* within the public discourse and a person believes it is more widely-held than is the case, the situation will tend to self-correct: such a person will be more likely to share this belief than is actually warranted, will face the consequences, and will update their beliefs appropriately. Pluralistic ignorance itself has been documented in numerous studies—on college campuses (e.g. Prentice and Miller 1993), in the workplace (Halbesleben, Wheeler, and Buckley 2007), and in political opinion climates (Ahler 2014). Smerdon, Offerman, and Gneezy (2020) provide direct evidence from a lab experiment that "bad" norms persist not because they are stable equilibria of a coordination game, but rather because players have uncertainty about others' preferences when modeling group behavior. Taken together, these studies suggest that providing credible information about others' true beliefs in combination with a coordination mechanism could dramatically change individuals' willingness to speak or act.

D. *Crowdfunding and Provision-Point Mechanisms in Practice*

Social assurance contracts are actively used for practical purposes (though this has mostly escaped the notice of academics). In the economic domain, crowdfunding platforms such as Kickstarter generally employ a straightforward provision-point rule ("all-or-nothing" funding): a project is funded only if the pledge threshold is reached, otherwise contributions are refunded. Civic crowdfunding initiatives (e.g., Spacehive) similarly use threshold pledges for community projects. In the social domain, there are a handful of implementations of assurance contracts: Spartacus.App and CollAction are more general implementations, offering a very flexible setup for contracts, while Callisto implements the allegation escrow described in Ayres and Unkovic (2012) whereby a victim's report remains confidential until other reports are filed against the same perpetrator. Together We Can Fix Academia (Smout et al. 2021) aims to allow researchers to coordinate to encourage open science practices (which produce public goods costly to the individual researcher, but beneficial to the group). More generally, existing assurance contract implementations incorporate provision-point or quorum rules to ensure a show of sufficient support before a tender goes public or is enacted.

It is worth pausing to reflect on why assurance contracts have seen runaway success in the economic domain (Kickstarter alone boasts approximately 280,000 succcessfully funded projects, "Kickstarter" 2025a), but comparatively mild success in the social domain. One explanation is simply time. SellaBand, the first crowdfunding site to use a provision-point mechanism, was founded in 2006 (Agrawal, Catalini, and Goldfarb 2014), while the (now defunct) Stanford Catalyst, perhaps the first attempt at a platform offering something like social assurance contracts, was founded in 2013 (Cheng and Bernstein 2014). The intervening seven years may explain some of the difference, but more of an explanation is called for. The demand for social assurance contracts is limited to situations where i) agents have privately-held beliefs that are not part of the public discussion already;

ii) agents exist under an Overton regime that will punish speaking out alone iii) punishments for voicing those beliefs are severe enough the agents will not speak out alone; iv) agents wish to speak out (it is important to the agent that the belief be part of the public discussion); v) agents believe there are at least some others with the same privately-held belief who are similarly prevented from speaking out and wish to; vi) agents know of social assurance contracts; and vii) there is some low-friction platform or other means for actually running the contract. These requirements are likely to apply to many fewer situations than the simple desire for novel music or manufactured products, leading us to the conclusion that demand is quite a bit lower in the social domain. It may also be the case that the costs of implementing an effective platform have thus far been too high, existing attempts may be missing some important feature, or it could be that the necessary technology simply has not been available until relatively recently (e.g., cryptographic technology). Finally, marketing is a key issue. Success of such a technology benefits greatly from network effects, and it is possible that whatever awareness or demand threshold is necessary for runaway growth has simply not been reached yet. Most likely, a combination of these issues are at play.

Indeed, it may be the case that it is only recently that the necessary pieces have come together. Spartacus.App, founded in 2024, is the first general-purpose platform which implements social assurance contracts as they are conceptualized here. Previous efforts such as Catalyst and CollAction have focused on coordinating noncontroversial collective action: users contribute their intention to engage in some activity when enough other people have registered the same intention. This is not strictly an assurance contract in that the contribution of an *intention* is not equivalent to actually *doing* the costly thing. Signing up for "Let's gather our litter, electronic & bulk waste this month" on CollAction costs a user little or nothing, and the user is at best weakly bound to completing the action, whereas a signature contributed to a social assurance contract is itself the action that invites all the relevant costs and benefits. Earlier platforms also do not keep who has signed secret, preferring instead to publicize the list of endorsers—another key difference. While Callisto implements the desiderata described here and pre-dates Spartacus.App, it focuses very narrowly on allegations of sexual assault. Spartacus does not at present offer cryptographic guarantees and so may be limited by endorsers' trust in it (discussed in Section III.D, but in other respects it is the first complete implementation of the social assurance contract mechanism.

II. The Social Assurance Contract Mechanism

I model a *social assurance contract* as a simultaneous one-shot game with no information flow between players[1]. The contract is designed by a contract *architect* and administered by a contract *administrator*, which may be a computer system. Let $\mathcal{P}$ be the overall population of individuals who could potentially be aware of or affected by the contract's statement. Each individual $j \in \mathcal{P}$ has an individual-specific valuation v_j for the success of the contract, which can be positive, zero, or negative. The set of *potential endorsers* for the contract, denoted by $\mathcal{N}$, consists of all individuals $i \in \mathcal{P}$ for whom the successful revelation of the statement provides a positive personal benefit, i.e., $\mathcal{N} = \{i \in \mathcal{P} \mid v_i > 0\}$. Let $N = |\mathcal{N}|$ be the number of such potential endorsers. The game is modeled among these N individuals, who privately hold a particular belief or support a controversial statement which is in conflict with the current public norm.

A. Contract Structure

The contract is defined by a specific statement to be endorsed, s_{belief} (which could be a proposition or normative claim, representing an underlying belief $\mathbf{b}_s$), and an assurance threshold T. This threshold T is a positive integer representing the minimum number of endorsements required for the contract's list of endorsers to become public; for success to be possible, T must satisfy $1 \leq T \leq N$.

1) Individuals $i \in \mathcal{N}$ decide simultaneously their action $a_i \in \{0, 1\}$, where $a_i = 1$ denotes choosing to endorse the contract, Sign, and $a_i = 0$ denotes Not Sign.
2) Let $M = \sum_{j \in \mathcal{N}} a_j$ be the total number of endorsers. If $M \geq T$, the statement is published along with the list of all M endorsers. The contract is then considered "successful."
3) If $M < T$, the identities of the endorsers remain confidential from each other, the public, and potentially the contract administrator. No statement is released, and the contract is considered "failed."

This structure mirrors the core logic of assurance contracts (Tabarrok 1998), adapted to non-monetary, reputational contributions. The key features are complete secrecy about who has signed the contract and the conditional nature of revelation, which aims to provide safety in numbers.

B. The Agent's Decision Problem: Payoffs

The components of utility are:

1. Here beliefs are treated as exogenous, but of course what is acceptable to talk about publicly will influence not just publicly stated beliefs but also privately-held ones (Capuano and Chekroun 2024). Indeed, there is a small literature about operationalizing this fact as "Social Norms Marketing" (Nolan and Wallen 2021)

Individual Benefit (v_i)—If the contract succeeds ($M \geq T$), agent $i \in \mathcal{N}$ receives this individual-specific benefit $v_i > 0$. This represents agent i's personal valuation of the public good created by the revealed consensus (e.g., a policy shift, norm change, or validation of the view). This benefit v_i is received by agent $i \in \mathcal{N}$ if the contract succeeds, regardless of their own action a_i. For $i \in \mathcal{N}$, v_i is heterogeneous. Individuals $k \in \mathcal{P} \backslash \mathcal{N}$ (for whom $v_k \leq 0$) are not considered potential endorsers in this model, though their existence and potential opposition could be an avenue for future research.

Private Cost (c_i)—If an agent $i \in \mathcal{N}$ chooses $a_i = 1$ (Sign) *and* the contract succeeds, they incur a private cost $c_i > 0$. This cost arises from being publicly associated with a controversial statement. c_i is heterogeneous across individuals. A more specific formulation could be $c_i(\delta_i, M)$, where $\delta_i = |\theta_i - \hat{\theta}|$ is the perceived deviation of agent i's true belief θ_i from the pre-existing public norm $\hat{\theta}$, and M is the number of endorsers. Costs might be convex in δ_i, e.g., $c_i = \kappa_i \delta_i^{\gamma_i}$ with $\gamma_i > 1$.

Private Esteem (e_i)—If an agent $i \in \mathcal{N}$ chooses $a_i = 1$ (Sign) *and* the contract succeeds, they may also receive a private esteem payoff $e_i \geq 0$. This can represent social recognition, personal satisfaction, or enhanced reputation. e_i is also heterogeneous.

Warm-Glow (w)—An agent $i \in \mathcal{N}$ who chooses $a_i = 1$ (Sign) receives a small intrinsic "warm-glow" payoff $w > 0$ (common to all endorsers), *regardless* of whether the contract succeeds or fails. This captures non-consequentialist utility from participation (Andreoni 1990; Menges, Schroeder, and Traub 2005; Rose et al. 2002; Mitra and Moore 2018); the feeling of "Well, at least I've done *something*". This parameter is crucial, akin to the bonus F in Tabarrok (1998)'s dominant assurance contracts[2]. The payoffs for agent i are summarized in Table 1.

TABLE 1—PAYOFFS FOR AGENT i UNDER A SOCIAL ASSURANCE CONTRACT

Action a_i	**Contract Fails** ($M < T$)	**Contract Succeeds** ($M \geq T$)
$a_i = 0$ (Not Sign)	0	v_i
$a_i = 1$ (Sign)	w	$v_i + e_i - c_i + w$

I assume agents are rational expected utility maximizers. The structure of the game and the payoff components (except for individual v_i, e_i, c_i types in the incomplete information setting) are common knowledge.

If agent i chooses $a_i = 1$ (Sign) and the contract succeeds, their utility is $v_i + e_i - c_i + w$. If it fails, their utility is w. If agent i chooses $a_i = 0$ (Not Sign) and the contract succeeds (due to

2. Though w here is an intrinsic utility from participation experienced by the signer in all states where $a_i = 1$, rather than a contingent monetary transfer from an organizer that is not paid if the contract succeeds.

others' actions), their utility is v_i. If it fails, their utility is 0.

A critical condition for choosing $a_i = 1$ emerges from comparing payoffs when the contract succeeds. If it succeeds, $a_i = 1$ gives $v_i + e_i - c_i + w$ and $a_i = 0$ gives v_i. Thus, choosing $a_i = 1$ yields a higher payoff in this state if $e_i - c_i + w \geq 0$. This is a key individual rationality constraint for costly participation when success is assured by one's action (or occurs anyway). Since $w > 0$, even if $e_i - c_i$ is negative (i.e. private cost outweighs private esteem), signing can still be preferable.

Assumption on Trust— For the baseline model developed in Sections III, IV, and V, I assume perfect trust in the contract administrator and the integrity of the mechanism. That is, agents believe with certainty ($\rho = 1$) that their identity will remain secret if the contract fails ($M < T$). The implications of relaxing this assumption (i.e., $\rho < 1$, allowing for imperfect trust) are discussed in Section III.D, though achieving an extremely high degree of trust may be practically possible using cryptographic techniques (discussed in Appendix A).

III. Equilibrium Analysis

A. Complete Information

In the complete information setting, each agent i's type (v_i, e_i, c_i) is common knowledge, as are w, N, and T. Since the social assurance contract is a mechanism for discovering the distribution of types, it would not be needed in this setting. However, as a toy example it is useful for developing intuitions.

Consider agent i's decision, $a_i \in \{0, 1\}$. Let $M_{-i} = \sum_{j \neq i, j \in \mathcal{N}} a_j$ be the number of other potential endorsers who choose $a_j = 1$. Agent i compares $U_i(a_i = 1 | M_{-i})$ with $U_i(a_i = 0 | M_{-i})$.

- If $M_{-i} \geq T$ (contract succeeds regardless of i's action): $U_i(a_i = 1) = v_i + e_i - c_i + w$. $U_i(a_i = 0) = v_i$. Agent i prefers $a_i = 1$ if $e_i - c_i + w \geq 0$.
- If $M_{-i} = T - 1$ (agent i is pivotal for success): $U_i(a_i = 1) = v_i + e_i - c_i + w$ (contract succeeds). $U_i(a_i = 0) = 0$ (contract fails). Agent i prefers $a_i = 1$ if $v_i + e_i - c_i + w \geq 0$.
- If $M_{-i} < T - 1$ (contract fails regardless of i's action, i.e., even if i chooses $a_i = 1$, $1 + M_{-i} < T$): $U_i(a_i = 1) = w$. $U_i(a_i = 0) = 0$. Agent i prefers $a_i = 1$ if $w > 0$, which is true by assumption.

This structure, especially when an agent expects the contract to fail regardless of their action, highlights the power of the warm-glow $w > 0$. We can categorize agents based on these payoff considerations. Let $\mathcal{S}_{strong} = \{i \in \mathcal{N} \mid e_i - c_i + w \geq 0\}$ be the set of *strong supporters*, for whom the net idiosyncratic payoff from signing (esteem minus cost, plus warm glow) is non-negative if the contract succeeds, irrespective of their pivotality regarding the public good v_i. Let $\mathcal{S}_{pivotal} = \{i \in \mathcal{N} \mid v_i + e_i - c_i + w \geq 0\}$ be the set of agents who prefer to sign if their action is pivotal for the contract's success. Note that $\mathcal{S}_{strong} \subseteq \mathcal{S}_{pivotal}$ since $v_i > 0$ for $i \in \mathcal{N}$.

RESULT 1: *From this structure, a few statements immediately follow*

1) *Choosing $a_i = 1$ (Sign) is a weakly dominant strategy for any player $i \in \mathcal{S}_{strong}$ (i.e., if $e_i - c_i + w \geq 0$). More generally, if $w > 0$, choosing $a_i = 0$ (Not Sign) is never strictly dominant for any agent $i \in \mathcal{N}$. If the contract fails, $a_i = 1$ gives $w > 0$, while $a_i = 0$ gives 0. If the contract succeeds, choosing $a_i = 1$ gives $v_i + e_i - c_i + w$ versus v_i for $a_i = 0$.*

2) *The profile where all agents choose $a_j = 0$ (all-silent) is not a Nash equilibrium if $w > 0$. Any single player i can deviate to $a_i = 1$ and receive utility $w > 0$ (if the contract still fails and $1 < T$) or $v_i + e_i - c_i + w$ (if i is pivotal, $T = 1$, and this sum is > 0).*

3) *Let $N_{strong} = |\mathcal{S}_{strong}|$. If $N_{strong} \geq T$, there is a Nash Equilibrium where all players $i \in \mathcal{S}_{strong}$ choose $a_i = 1$, and players $j \notin \mathcal{S}_{strong}$ (for whom $e_j - c_j + w < 0$) choose $a_j = 0$, provided that for these non-signing j, they are not pivotal or being pivotal does not make them wish to sign (i.e., $j \notin \mathcal{S}_{pivotal}$). The contract succeeds. See Appendix A for proof.*

The logic of dominant assurance contracts (Tabarrok 1998) is mirrored: the esteem e_i and cost c_i are only paid upon success. The warm-glow $w > 0$ ensures a positive payoff from choosing $a_i = 1$ if the project fails, versus 0 for $a_i = 0$. If $e_i - c_i + w > 0$, choosing $a_i = 1$ weakly dominates $a_i = 0$. The crucial part is that $w > 0$ ensures that if an agent believes the contract will fail (i.e., $M_{-i} < T - 1$), they strictly prefer $a_i = 1$. This breaks the all $a_j = 0$ equilibrium.

As mentioned, agents in $\mathcal{S}_{strong}$ are the "strong supporters." Let $\mathcal{S}_{weak} = \{i \in \mathcal{N} \mid (v_i + e_i - c_i + w \geq 0) \text{ and } (e_i - c_i + w < 0)\}$ be the set of "weak supporters." These are agents who choose $a_i = 1$ only if pivotal and their v_i is sufficiently large to offset the negative $e_i - c_i + w$. Note that $\mathcal{S}_{weak} = \mathcal{S}_{pivotal} \setminus \mathcal{S}_{strong}$. Individuals $k \notin \mathcal{S}_{pivotal}$ (for whom $v_k + e_k - c_k + w < 0$) are "non-supporters" who would choose $a_k = 0$ even if pivotal.

If $N_{strong} \geq T$, then a Nash Equilibrium exists where all $i \in \mathcal{S}_{strong}$ choose $a_i = 1$. If some $j \in \mathcal{S}_{weak}$ are needed to reach T (and their inclusion does not disincentivize others), they may also sign. Specifically, if there exists a set $A' \subseteq \mathcal{N}$ such that $|A'| \geq T$, all $i \in A'$ find it optimal to choose $a_i = 1$ given others in A' do, and all $k \notin A'$ find it optimal to choose $a_k = 0$, this constitutes a Nash Equilibrium. If $N_{strong} < T$: All $i \in \mathcal{S}_{strong}$ choose $a_i = 1$. Other players $j \in \mathcal{S}_{weak}$ will choose $a_j = 1$ if they believe they are pivotal (i.e., their signature makes $M = T$) and $v_j + e_j - c_j + w \geq 0$.

If the combined set of strong supporters and pivotal weak supporters is insufficient to reach T (i.e., $M < T$), then the contract fails. In this scenario, everyone who chose $a_i = 1$ (which could be all N agents if $w > 0$ and they anticipate failure) receives utility w.

B. *Incomplete Information*

Now, agent i's private type includes their individual valuation of success v_i, their private esteem e_i, and private cost c_i. The contract is specified to keep who has signed secret from the public *and each other*, so potential endorsers are by design largely ignorant of the properties of those who have signed. Let $x_i = e_i - c_i$ be the net idiosyncratic component related to the social consequences of the contract's publication, a function of esteem and social censure. The agent's *type* is given by the tuple (v_i, x_i). I assume (v_i, x_i) are drawn independently and identically for each agent i from a known joint cumulative distribution function $G(v, x)$ with support $[\underline{v}, \overline{v}] \times [\underline{x}, \overline{x}]$. The parameters w, T, and N are treated as common knowledge. N can be thought of as the size of a specific group that would benefit from the success of the contract; this is, critically, *not* the same as the group for whom it could be net positive to speak out given the costs associated with doing so. Assuming N is common knowledge is a reasonable approximation for many real-world scenarios (e.g., employee-employer relations). Relaxing this assumption to allow for individual expectations over N would add realism but would also introduce considerable complexity, compromising the symmetry that allows for the derivation of a single equilibrium cutoff. Agents aim to maximize their expected utility.

A full Bayesian Nash Equilibrium would require agents to form strategies based on their two-dimensional type (v_i, x_i). Agent i chooses $a_i = 1$ if $E[U_i(a_i = 1)|v_i, x_i] \geq E[U_i(a_i = 0)|v_i, x_i]$. Comparing the payoffs from Table 1, agent i signs if:

$$p_{succ|i}(v_i + x_i + w) + (1 - p_{succ|i})w \geq p_{succ|i,\neg i} v_i$$

where $p_{succ|i}$ is the probability of success if i signs, and $p_{succ|i,\neg i}$ is the probability of success if i does not sign (i.e., success is due to others), and $p_{succ|i} > p_{succ|i,\neg i}$. This can be rewritten considering agent i's pivotality. Let $P(\text{pivotal}_i)$ be the probability that $M_{-i} = T - 1$. Then the condition to sign is:

$$P(\text{pivotal}_i)(v_i + x_i + w) + P(M_{-i} \geq T)(x_i + w) + P(M_{-i} < T - 1)w \geq 0$$

This simplifies to $P(\text{pivotal}_i)v_i + p_{succ}(x_j \geq x^*(v_j, x_j))x_i + w \geq 0$, where p_{succ} is the probability that at least $T - 1$ others sign based on their own (potentially complex) strategies $x^*(v_j, x_j)$. Solving for such a multi-dimensional equilibrium strategy $x^*(v_j, x_j)$ is complex.

For tractability, I adopt a common simplification: I assume that the signing decision primarily hinges on a cutoff x^* for the net idiosyncratic payoff $x_i = e_i - c_i$, rather than a function of both v_i and x_i. This simplification can be justified by several observations: First, particularly as the number of potential endorsers N becomes large (formally, as $N \to \infty$), the probability of any single agent i being exactly pivotal for the realization of the public good v_i (i.e., $M_{-i} = T - 1$) approaches zero. Consequently, the expected utility component $P(\text{pivotal}_i)v_i$ derived from being pivotal becomes negligible. Thus, for settings involving a large number of potential participants this pivotal utility term is approximately zero, simplifying the focus to the more direct impacts of x_i and w. This simplification is particularly relevant for larger communities; in smaller groups where $P(\text{pivotal}_i)$ may not be negligible, the v_i component would likely retain more significance, leading to a more complex decision problem (potentially explaining why such formal contracts might be rarer or structured differently in such settings), though one would also presume that social connections would be stronger in such very small groups, and therefore N known with higher certainty. Second, the decision to participate in similar collective actions, such as voting, often occurs even when the probability of being pivotal is negligible. The "paradox of voting" is the observation that people vote, and in large numbers, despite the fact that they have effectively zero probability of being pivotal (Downs 1957). This suggests that non-instrumental motivations (akin to w in this model) or expressive benefits (related to x_i) can dominate strict pivotality calculations concerning the main outcome (v_i). Given these considerations, I assume agents simplify their decision by focusing on the components of utility they directly control or experience regardless of exact pivotality concerning v_i. The warm-glow w is received for signing irrespective of outcome. The idiosyncratic payoff $x_i = e_i - c_i$ is experienced conditional on success, which occurs with probability p_{succ} (from agent i's perspective, if they sign). Consistent with the typically negligible impact of the pivotal term, I assume that the influence of $P(\text{pivotal}_i)v_i$ does not systematically alter the signing threshold x^* for x_i for the majority of agents, or that this effect is sufficiently small to be abstracted away. The decision to sign is thus primarily driven by comparing the expected net idiosyncratic payoff x_i (conditional on success) and the warm-glow w, versus not signing. Agent i considers signing if the expected utility from x_i and w covers the implicit opportunity cost of 0 from not signing (if the contract fails) or not incurring x_i (if it succeeds anyway).

Under this simplifying assumption, agent i chooses $a_i = 1$ (Sign) if the expected payoff from signing, focusing on the x_i and w components relevant to the act of signing itself, is non-negative. If agent i signs, they receive w regardless of outcome. If the contract succeeds (which happens with probability $p_{succ}(x^*)$ if i signs and others use cutoff x^*), they also receive x_i. Thus, agent i signs if:

$$w + p_{succ}(x^*)x_i \geq 0$$

This implies a cutoff rule: sign if $x_i \geq -w/p_{succ}(x^*)$. The equilibrium cutoff x^* for the type $x_i = e_i - c_i$ must therefore satisfy:

$$x^* = -\frac{w}{p_{succ}(x^*)} \tag{1}$$

where $p_{succ}(x^*)$ is the probability that at least $T-1$ other agents $j \in \mathcal{N} \setminus \{i\}$ have a type $x_j \geq x^*$ (and thus choose $a_j = 1$). Given that each of the $N-1$ other agents' types x_j are independent draws from the marginal CDF $F_x(x)$, $p_{succ}(x^*)$ is given by:

$$p_{succ}(x^*) = \sum_{k=T-1}^{N-1} \binom{N-1}{k} (1 - F_x(x^*))^k F_x(x^*)^{N-1-k} \tag{2}$$

where $F_x(x)$ is the CDF of x_i.

PROPOSITION 1 (Existence and Properties of BNE under simplified type): *Under standard regularity conditions on $F_x(\cdot)$ (such as continuity and a support that allows for the existence of a solution), a symmetric Bayesian Nash Equilibrium characterized by a cutoff x^* for the type $x_i = e_i - c_i$ satisfying Eq. 1 exists.*

This equilibrium cutoff x^* is defined by the condition $x^* = -w/p_{succ}(x^*)$. Given that $w > 0$, it follows that x^* must be negative if an equilibrium with $p_{succ}(x^*) > 0$ (i.e., where the contract has some chance of success if agent i signs) exists. This means that even agents who would suffer a net loss from $(e_i - c_i)$ if the contract succeeds (i.e., $x_i < 0$) might still choose $a_i = 1$ if the warm-glow w is sufficiently attractive relative to the probability of success. This highlights how the mechanism encourages participation.

The formal proof of existence, and an analysis of the conditions required for the uniqueness of this equilibrium, are provided in Appendix B.

Robustness and Multiplicity of Equilibria—The existence of $w > 0$ is critical. If $w = 0$, then Eq. 1 becomes $x^* p_{succ}(x^*) = 0$. This implies either $x^* = 0$ (sign if $e_i \geq c_i$) or $p_{succ}(x^*) = 0$. The latter can lead to an equilibrium where no one chooses $a_j = 1$ if $T > 1$. The $w > 0$ term ensures x^* is typically negative. While the cutoff x^* for Eq. 1 might be unique under some conditions, coordination failures could lead to pessimistic beliefs about $p_{succ}(x^*)$. However, the

BNE formulation assumes agents correctly calculate $p_{succ}(x^*)$ based on $F_x(\cdot)$ and x^*.

C. Comparative Statics (Incomplete Information)

The equilibrium cutoff x^* for an agent's net idiosyncratic payoff $x_i = e_i - c_i$ responds to changes in the model's parameters. Assuming a unique interior equilibrium x^* exists, we can analyze these responses. A formal derivation of these comparative statics using the Implicit Function Theorem is provided in Appendix C.

An increase in the warm-glow w makes participation more attractive regardless of the outcome. Consequently, the equilibrium cutoff x^* decreases (becomes more negative), implying that agents with a less favorable idiosyncratic payoff x_i are now willing to choose $a_i = 1$. This leads to an overall increase in participation.

Shifts in the underlying distribution of esteem e_i and costs c_i, as captured by the CDF $F_x(x)$, also affect the equilibrium. If the distribution $F_x(x)$ shifts such that $x_i = e_i - c_i$ becomes stochastically higher (e.g., average esteem increases or average costs decrease), the probability of success $p_{succ}(x^*)$ for any given cutoff x^* increases. To maintain the equilibrium condition $x^* p_{succ}(x^*) = -w$, the cutoff x^* typically increases (becomes less negative). While this makes the cutoff itself less stringent, the overall effect on participation $(1 - F_x(x^*))$ depends on the magnitude of the distributional shift relative to the change in x^*; however, a common finding in such threshold models is that better underlying types ease the conditions for coordination [CITE].

The assurance threshold T directly influences the difficulty of achieving success. An increase in T makes success harder, reducing $p_{succ}(x^*)$ for any given x^*. To satisfy the equilibrium condition, x^* must decrease (become more negative). This means individuals must be willing to participate even with a less favorable x_i to compensate for the increased difficulty of reaching a higher T.

Changes in the population size N also have an impact. For a fixed T and x^*, an increase in N generally raises $p_{succ}(x^*)$, as there are more potential endorsers. This tends to increase x^* (making it less negative or more positive), meaning the signing condition becomes more stringent for any given individual. While the probability of any single agent signing might decrease, the total number of expected endorsers could still rise due to the larger pool. Finally, if the convexity of costs c_i (e.g., via a parameter γ) increases such that $x_i = e_i - c_i$ becomes stochastically lower (i.e., $F_x(x)$ shifts left), then $p_{succ}(x^*)$ decreases for any given x^*. This requires x^* to decrease (become more negative) to maintain equilibrium, implying individuals with worse idiosyncratic payoffs would need to be willing to sign.

D. Imperfect Trust in the Administrator and Mechanism Integrity

A crucial assumption underpinning an agent's willingness to participate in a social assurance contract, especially when w is small or c_i is large, is their trust in the contract administrator and the overall mechanism to uphold confidentiality if the assurance threshold T is not met. Let ρ be the subjective probability an agent assigns to the administrator being trustworthy and the system functioning as intended (i.e., secrecy is maintained upon failure). Consequently, $1-\rho$ is the probability of a "betrayal", where a signature is revealed despite $M < T$.

This imperfect trust ($\rho < 1$) alters the expected payoff for an agent i who chooses $a_i = 1$ (Sign) if the contract fails. Instead of receiving w with certainty, their expected utility in this scenario becomes:

$$E[U_i(a_i = 1, M < T)] = \rho \cdot w + (1-\rho)(w - c_i) = w - (1-\rho)c_i$$

The agent still receives the warm-glow w for the act of signing, but now faces an expected additional cost of $(1-\rho)c_i$ due to the risk of premature, unsanctioned exposure. The revised payoffs are shown in Table 2:

Table 2—Payoffs for Agent i with Imperfect Trust ($\rho < 1$)

Action a_i	**Contract Fails** ($M < T$)	**Contract Succeeds** ($M \geq T$)
$a_i = 0$ (Not Sign)	0	v_i
$a_i = 1$ (Sign)	$w - (1-\rho)c_i$	$v_i + e_i - c_i + w$

Impact on Equilibrium Behavior with Complete Information— The condition for agent i to prefer $a_i = 1$ when they expect the contract to fail (i.e., $M_{-i} < T-1$) changes from $w > 0$ to $w-(1-\rho)c_i > 0$, or $w > (1-\rho)c_i$. If $w \leq (1-\rho)c_i$ for all agents, the "all-silent" profile (all $a_j = 0$) can re-emerge as a Nash Equilibrium, even if $w > 0$. The power of the warm-glow to ensure some participation is thus diminished by distrust. Participation becomes less likely if trust ρ is low, expected cost of exposure c_i is high, or warm-glow w is low.

Impact on Equilibrium Behavior with Incomplete Information— Imperfect trust makes signing less attractive. The simplified equilibrium condition $x^* = -w/p_{succ}(x^*)$ (where $x_i = e_i - c_i$) was based on the premise that the net payoff from signing if the contract fails was w. With imperfect trust, this payoff is now $w - (1-\rho)c_i$.

If we adapt the simplified style of Eq. 1, an agent i with type $x_i = e_i - c_i$ and specific cost c_i might sign if $x_i \geq \frac{-(w-(1-\rho)c_i)}{p_{succ}(x^*)}$. This can be rewritten as $e_i p_{succ}(x^*) + w \geq c_i(1-\rho+p_{succ}(x^*))$. This condition now depends on e_i and c_i separately, not just their difference x_i. This means that the agent's type for the signing decision effectively becomes multi-dimensional (e.g., depending on (e_i, c_i) or even (v_i, e_i, c_i) when considering pivotality more broadly), and a single cutoff x^* for $x_i = e_i - c_i$ no longer fully characterizes the equilibrium strategy in a simple way. A formal analysis of the BNE with imperfect trust would require solving for an equilibrium strategy over a multi-dimensional type space, which is an interesting avenue for future work. However, the clear qualitative implication is that lower trust ρ (i.e., a higher perceived probability $1 - \rho$ of premature exposure) acts as an additional expected cost for signing, leading to lower participation rates and a reduced likelihood of the social assurance contract achieving its assurance threshold T. This underscores the importance of the insider attack mitigation strategies discussed in Appendix A.A2 (particularly cryptographic guarantees) and the overall need for contract organizers and platforms to establish and maintain a high degree of trustworthiness (i.e., ensure $\rho \approx 1$). Without sufficient trust, the assurance mechanism itself is undermined. A summary of the implications of relaxing the trust assumption in comparison to the other two cases examined is found in Table 3.

IV. Information Revelation, Belief Updating, and Shifts in the Overton Window

A successful social assurance contract for a statement s_{belief} (representing an underlying belief $\mathbf{b}_s$) does more than achieve its immediate publication; it functions as a potent information revelation device. By demonstrating that $M \geq T$ individuals were willing to publicly endorse s_{belief} under the contract's specific incentive structure (T, w), it provides new public information that can significantly alter the collective understanding of the group's private views. This section formalizes how such revelations can lead to belief updating and, consequently, shift the boundaries of the Overton window—the range of beliefs considered acceptable for public discourse in a given forum R.

Defining the Overton Window based on Expression Costs—Let $\mathcal{I}$ be a space of beliefs, where each belief $\mathbf{b} \in \mathcal{I}$ can be conceptualized as a point in a d-dimensional real space. For any belief $\mathbf{b}$, let $c_{indiv}(\mathbf{b}, \mathcal{B}_t)$ denote the expected net cost for a representative agent to *unilaterally* (i.e., outside a social assurance contract mechanism) express belief $\mathbf{b}$ publicly at time t. This cost is a function of the prevailing collective beliefs $\mathcal{B}_t$ about the distribution of private support for $\mathbf{b}$ and related beliefs, which in turn shapes perceived reputational risks $(\bar{c}_{\mathbf{b}}(\mathcal{B}_t))$ and potential esteem $(\bar{e}_{\mathbf{b}}(\mathcal{B}_t))$. The Overton Window for forum R at time t, $O_R(\mathcal{B}_t, \tau)$, can be defined as the set of beliefs whose individual expression cost (net of any individual esteem from unilateral expression) is below a

Table 3—Summary of Model Assumptions and Key Implications

Feature / Implication	**Baseline: Complete Info. & Perfect Trust** (Sec. III.A)	**Incomplete Info. & Perfect Trust** (Sec III.B)	**Incomplete Info. & Imperfect Trust** (Sec III.D)
Agent's Knowledge of Others' Types (v_j, e_j, c_j)	Common Knowledge	Drawn from common prior $G(v, x)$	Drawn from common prior $G(v, x)$
Trust in Admin (ρ)	Perfect $(\rho = 1)$	Perfect $(\rho = 1)$	Imperfect $(\rho < 1)$
Payoff if Agent Signs & Contract Fails $(M < T)$	w	w	$w - (1 - \rho)c_i$
Primary Signing Determinant(s)	Individual rationality checks (pivotal, dominant for $\mathcal{S}_{strong}$)	Cutoff $x^* = -w/p_{succ}(x^*)$ (using simplified type x_i)	Complex multi-dimensional type condition (e.g., $e_i p_{succ} + w \geq c_i(1 - \rho + p_{succ})$)
Possibility of "All-Silent" Equilibrium	No (if $w > 0$)	Unlikely (if $w > 0$, x^* typically negative)	Yes (if $w - (1 - \rho)c_i$ and $E[P(\text{pivotal}_i)v_i]$ are insufficient)
Role of Warm-Glow (w)	Breaks "all-silent"; key for $\mathcal{S}_{strong}$	Drives x^* negative, encouraging participation	Effectiveness significantly reduced by risk $(1 - \rho)c_i$
Impact of v_i (Public Good Value)	Direct impact on pivotal decisions	Indirect via $P(\text{pivotal}_i)v_i$ (assumed small in simplified model)	Part of complex type-dependent strategy; $P(\text{pivotal}_i)v_i$ potentially small
Impact of $x_i = e_i - c_i$ (Net Idiosyncratic Payoff)	Key for $\mathcal{S}_{strong}$	Central via cutoff x^*	Less direct role; e_i, c_i affect decision non-linearly with ρ
Analytical Complexity	Nash Equilibrium (Relatively Simple)	Bayesian Nash Equilibrium (Cutoff Strategy)	BNE (Multi-dimensional type strategy; complex, not formally solved in paper)
Overall Mechanism Effectiveness / Participation	High if $N_{strong} \geq T$	Depends on $w, F_x(x), T, N$	Most fragile; highly sensitive to ρ, c_i, w, and beliefs

societal or forum-specific tolerance threshold τ:

$$O_R(\mathcal{B}_t, \tau) = \{\mathbf{b} \in \mathcal{I} \mid c_{indiv}(\mathbf{b}, \mathcal{B}_t) \leq \tau\}$$

A belief $\mathbf{b}_s$ is considered "outside the window" before the contract if $c_{indiv}(\mathbf{b}_s, \mathcal{B}_t) > \tau$. The contract is typically invoked for such a belief precisely because individual expression is too costly.

The Contract Outcome as a Public Signal—The success of a social assurance contract for the statement s_{belief} (representing belief $\mathbf{b}_s$), revealing $M \geq T$ endorsers, provides a public signal $y_s = (M, T, w, \text{characteristics if revealed})$. This signal is generated by individuals $i \in \mathcal{N}$ comparing their private type $x_i = e_i - c_i$ (related to belief $\mathbf{b}_s$) to an equilibrium cutoff x^* (derived from Equation 1), and also considering their private valuation v_i for $\mathbf{b}_s$'s success. The observation of y_s allows agents to update their beliefs $\mathcal{B}_t$. For example, suppose agents are uncertain about underlying parameters θ_{params} that govern the joint distribution $G(v, x)$ from which individual types (v_i, x_i) for belief $\mathbf{b}_s$ are drawn. Their prior beliefs about these parameters can be denoted $P(\theta_{params}|\mathcal{B}_t)$. After observing y_s, they update to a posterior $P(\theta_{params}|y_s, \mathcal{B}_t)$ using Bayes' rule:

$$P(\theta_{params}|y_s, \mathcal{B}_t) \propto P(y_s|\theta_{params}, T, w, x^*(\theta_{params})) \cdot P(\theta_{params}|\mathcal{B}_t)$$

Here, $P(y_s|\theta_{params}, T, w, x^*(\theta_{params}))$ is the likelihood of observing M endorsers given the true underlying parameters θ_{params} (which determine $G(v, x)$ and thus $F_x(x)$), the contract terms (T, w), and the resulting equilibrium cutoff $x^*(\theta_{params})$ that depends on these underlying parameters. This inference leads to an updated overall belief state $\mathcal{B}_{t+1}$, which primarily reflects a revised perception of the prevalence and intensity of support (i.e., favorable x_i values and high v_i values) for belief $\mathbf{b}_s$ within the population $\mathcal{N}$.

Shifting the Window's Boundaries—The critical step is how this updated belief state $\mathcal{B}_{t+1}$ concerning $\mathbf{b}_s$ affects the expected individual expression costs $c_{indiv}(\mathbf{b}', \mathcal{B}_{t+1})$ for $\mathbf{b}_s$ itself and for other beliefs $\mathbf{b}' \in \mathcal{I}$. First, there is the impact on the expressed belief $\mathbf{b}_s$. The demonstration of significant support for $\mathbf{b}_s$ can directly reduce its future individual expression cost. The perceived risk $\bar{c}_{\mathbf{b}_s}(\mathcal{B}_{t+1})$ may fall, and/or perceived esteem $\bar{e}_{\mathbf{b}_s}(\mathcal{B}_{t+1})$ from unilateral expression may rise, because the belief is now known not to be fringe. If $c_{indiv}(\mathbf{b}_s, \mathcal{B}_{t+1}) \leq \tau$, then $\mathbf{b}_s$ has effectively entered the Overton Window for unilateral expression. The contract has served as a beachhead. Second, there are spillover effects on related beliefs $\mathbf{b}'$. The belief update concerning $\mathbf{b}_s$ can spill over to semantically or ideologically related beliefs. Let $d(\mathbf{b}_s, \mathbf{b}')$ be a measure of distance or dissimilarity in the belief space $\mathcal{I}$. The change in perceived support for $\mathbf{b}_s$ might influence perceived support for $\mathbf{b}'$: $\Delta\mathbb{E}[\text{support}_{\mathbf{b}'}] = g(\Delta\mathbb{E}[\text{support}_{\mathbf{b}_s}], d(\mathbf{b}_s, \mathbf{b}'))$, where g is typically decreasing in distance. If $\mathbf{b}'$ is "close" to $\mathbf{b}_s$ (e.g., $d(\mathbf{b}_s, \mathbf{b}') < \epsilon_{neighbor}$), or positively correlated in the public mind, the perceived cost $c_{indiv}(\mathbf{b}', \mathcal{B}_{t+1})$ might decrease. Some such $\mathbf{b}'$ previously outside $O_R(\mathcal{B}_t, \tau)$ may now enter $O_R(\mathcal{B}_{t+1}, \tau)$. The window effectively "widens" or "drags" neighboring beliefs with it. For beliefs $\mathbf{b}''$ that are "oppositional" or negatively correlated with $\mathbf{b}_s$, the increased perceived viability of $\mathbf{b}_s$ might increase the perceived cost $c_{indiv}(\mathbf{b}'', \mathcal{B}_{t+1})$ (e.g., by making $\mathbf{b}''$ seem more isolated or its proponents more deviant). Such beliefs might fall out of the window, representing a "shift" or "tilt" rather than a simple expansion, though this seems less clear.

The Overton Window at $t+1$ is $O_R(\mathcal{B}_{t+1}, \tau)$. The formal shift is then characterized by the set differences: $O_R(\mathcal{B}_{t+1}, \tau) \setminus O_R(\mathcal{B}_t, \tau)$ (newly permissible beliefs) and $O_R(\mathcal{B}_t, \tau) \setminus O_R(\mathcal{B}_{t+1}, \tau)$ (beliefs no longer as acceptable).

This dynamic—where a coordinated, protected expression act (the contract) alters the landscape of perceived support and subsequently the costs for future individual expression—is how the mechanism can transition a group from an equilibrium of silence (sustained by mis-calibrated beliefs $\mathcal{B}_t$) to one of more open expression (sustained by updated beliefs $\mathcal{B}_{t+1}$). The contract acts as the catalyst for this belief and norm shift. While a full dynamic model of the window's evolution is beyond the current scope, this framework illustrates its core mechanism.

A. *Social Assurance Contracts and Depolarization*

The phenomenon of political and social polarization is often characterized by societies sorting into two primary, seemingly irreconcilable factions (Duverger 1954; Iyengar et al. 2019), with public discourse appearing more extreme and antagonistic than the distribution of private individual beliefs might suggest (e.g., Iyengar and Krupenkin 2018; Fiorina and Abrams 2008). This section explores how social assurance contracts can enable suppressed majorities or significant minorities *within* currently polarized groups to express themselves—a novel pathway to depolarization. They work by first promoting authenticity, making each faction's public discourse more representative of its members' diverse private views. This, in turn, can create more authentic and potentially more moderate conversation. This analysis assumes a two-party system where the public discussion is dominated by voices that are considerably more extreme than average, both within and between factions.

The Landscape of Polarized Discourse and Intra-Faction Dynamics—Consider a policy or belief space $\mathcal{I}$ (e.g., a unidimensional spectrum $[L, R]$). Society is largely divided into two factions, Blue Team (F_B) and Red Team (F_R). While the distribution of private beliefs θ_i for individuals $i \in F_B$

(denoted $f_B(\theta)$) and $i \in F_R$ (denoted $f_R(\theta)$) may show considerable internal diversity and overlap, their respective *public discourses* are often dominated by voices and positions near the extremes of each faction's range. Let $\bar{\theta}_B^{public}$ and $\bar{\theta}_R^{public}$ represent the perceived mean or dominant public stance of Blue Team and Red Team, respectively. Often, $\bar{\theta}_B^{public}$ is significantly to the "left" of the mean private Blue Team belief $\int \theta f_B(\theta) d\theta$, and $\bar{\theta}_R^{public}$ is to the "right" of $\int \theta f_R(\theta) d\theta$. This can occur if extreme voices are louder, more organized, or if internal dissent/moderation is suppressed (Abramowitz and Saunders 2008; Kuran 1997).

Crucially, each faction $F \in \{B, R\}$ cultivates its own internal Overton Window, $O_F(\mathcal{B}_F, \tau_F)$. For an individual $i \in F_B$, the expected net cost of unilaterally expressing a belief $\mathbf{b}$, $C_{indiv,B}(\mathbf{b}, \mathcal{B}_B)$, is determined by the perceived norms and potential sanctions from *within Blue Team.* Ideas that deviate significantly from $\bar{\theta}_B^{public}$ (even if privately held by many Blue Team members, such as more moderate or nuanced positions $\mathbf{b}_{mod,B}$) may be "outside" $O_B(\mathcal{B}_B, \tau_B)$ because expressing them incurs high intra-factional social costs (e.g., accusations of disloyalty, being a "Republican In Name Only" or "Democrat In Name Only"). Thus, a state of pluralistic ignorance can exist *within* each faction, where moderate members stay silent, believing they are in a smaller minority within their faction than they truly are. This internal silence reinforces the faction's extreme public-facing stance and exaggerates the difference between F_B and F_R.

Social Assurance Contracts for Revealing Intra-Faction Moderate Consensus—A social assurance contract can be deployed *within* a faction (say, Blue Team) to challenge this internal dynamic. Suppose an SAC is initiated for a statement $s_{mod,B}$ representing a more moderate belief $\mathbf{b}_{mod,B}$ that is privately supported by many in F_B but currently outside the Overton window $O_B(\mathcal{B}_B, \tau_B)$. If this contract is successful (i.e., $M_B \geq T_B$ members of Blue Team sign), it serves as a powerful signal $y_{s_{mod,B}}$ primarily to other members of Blue Team. This signal leads to an update of intra-factional beliefs from $\mathcal{B}_B$ to $\mathcal{B}'_B$. Specifically, members of Blue Team update their perceptions of $f_B(\theta)$, realizing that support for moderate belief $\mathbf{b}_{mod,B}$ is more widespread among their Blue Team peers than previously thought.

This belief update can shift the intra-faction Overton Window $O_B(\mathcal{B}'_B, \tau_B)$. The expected cost for an individual Blue Team member to unilaterally express $\mathbf{b}_{mod,B}$ in the future, $C_{indiv,B}(\mathbf{b}_{mod,B}, \mathcal{B}'_B)$, is likely to decrease as the perceived risk of intra-factional sanction diminishes. If $C_{indiv,B}(\mathbf{b}_{mod,B}, \mathcal{B}'_B) \leq \tau_B$, the belief $\mathbf{b}_{mod,B}$ enters Blue Team's internal Overton Window. Similarly, other nearby moderate beliefs $\mathbf{b}'_{mod,B}$ may also become more "permissible" within Blue Team due to the spillover effects discussed in Section IV. The faction's internal discourse becomes more tolerant of moderation.

Mechanisms of Depolarization— Moderate expression *within* factions engendered by successful social assurance contracts can contribute to broader societal depolarization through several interconnected channels. One mechanism is the internal moderation of faction stances. As more moderate views become expressible and are demonstrably supported within, for instance, Blue Team due to a contract's success, the faction's aggregate public discourse, $\bar{\theta}_B^{public}$, may itself begin to shift from its previously more extreme position. This shift would ideally move the public stance closer to the faction's actual private mean, $\int \theta f_B(\theta) d\theta$. Such a transformation occurs if these newly "permissible" moderate voices gain prominence and subsequently influence the faction's internal deliberations and its external communications.

This internal moderation can, in turn, lead to reduced inter-faction animosity and perceived distance. If Blue Team's public stance $\bar{\theta}_B^{public}(\mathcal{B}'_B)$ becomes more moderate, it may appear less threatening or alien to members of Red Team, and vice-versa if Red Team also undergoes a similar internal shift. Such changes have the potential to reduce negative partisanship and affective polarization. Even if only one major faction moderates its public stance, the overall perceived "gap" or "extremity" in the political landscape can diminish. Formally, if initial polarization is measured by a distance metric $P_{initial} = d(\bar{\theta}_B^{public}(\mathcal{B}_B), \bar{\theta}_R^{public}(\mathcal{B}_R))$, and after internal moderation via SACs the new stances are $\bar{\theta}_B^{public}(\mathcal{B}'_B)$ and $\bar{\theta}_R^{public}(\mathcal{B}'_R)$, then depolarization can be quantified by observing $P_{final} = d(\bar{\theta}_B^{public}(\mathcal{B}'_B), \bar{\theta}_R^{public}(\mathcal{B}'_R)) < P_{initial}$.

Furthermore, the successful operation of social assurance contracts within factions contributes to weakening the influence of extreme flanks. The demonstrated presence of moderates could dilute the disproportionate influence previously wielded by more extreme, albeit highly vocal, elements. This could render the faction more resilient to internal capture by such elements and foster greater openness to nuanced policy positions that were previously difficult to surface. These processes could culminate in improved common knowledge across faction lines. If the internal moderation of Blue Team, for example, were to become evident to Red Team, it could help to correct Red Team members' potentially exaggerated stereotypes about Blue Team's inherent extremism, and vice-versa. This could even mean an increase in voting *for* and a decrease in voting *against*; fewer protest votes would suggest leaders who more accurately reflect their constituents' beliefs and desires. Finally, more accurate inter-group understanding—a form of common knowledge at the societal level—could foster more constructive dialogue and problem-solving.

B. Normative Concerns when Expanding the Overton Window

The contract mechanism is, of course, content-neutral. While it promotes truthful and democratic discourse by allowing any sufficiently supported view to surface, it also means that social assurance contracts could be used to reveal support for views that, from a certain normative standpoint, seem harmful or regressive. This aspect does not undermine the mechanism's validity for better-aligning public discussion with privately held views, but it does highlight a potential normative challenge if such revealed preferences then gain undue influence. While increased transparency in opinion expression may be normatively desirable because truth-seeking is normatively desirable, balanced understanding of such contracts acknowledges this possibility. The hope is that by reducing misperceptions about where others stand, genuine disagreements can be addressed more openly and constructively, potentially depolarizing political discourse by weakening the false consensus component of polarization that thrives on pluralistic ignorance.

V. Choosing the Assurance Threshold T

The contract architect chooses the assurance threshold T, a critical design parameter. This decision can be framed as the architect selecting T to maximize their utility function, u_a. The arguments of this utility function, $u_a(T; G(v,x), w, N, \mathcal{P} \setminus \mathcal{N}, O_R(\mathcal{B}_t, \tau), \dots)$, reflect what the architect values. For instance, u_a might depend on the probability of the contract succeeding ($P(M \geq T|T)$), the expected number of endorsers ($E[M|T]$), the likelihood of achieving a durable shift in the Overton Window (as discussed in Section IV), or broader social welfare implications.

The choice of T involves inherent trade-offs. A T set too low (e.g., $T = 1$) might result in publication with minimal participation, thereby limiting its impact on public discourse or its ability to confer substantial public good benefits (v_i). Conversely, a T set too high relative to the actual distribution of potential endorser types $x_i = e_i - c_i$ (characterized by $F_x(x)$) and their resulting equilibrium participation (influenced by $p_{succ}(x^*; T)$) makes contract failure more probable. An optimal T also considers the broader societal context, including the characteristics and potential reactions of individuals in $\mathcal{P} \setminus \mathcal{N}$ (for whom $v_i \leq 0$) and the existing state of the Overton window, $O_R(\mathcal{B}_t, \tau)$, as these factors can influence the ultimate effectiveness of revealing M signatures.

I now consider several ways an architect might specify their objectives, which effectively define their utility $u_a(T)$ and guide their choice of T. These objectives typically relate to the N potential endorsers in $\mathcal{N}$ and their privately held types (v_i, e_i, c_i):

Maximize Probability of Expanding the Overton Window— A primary goal of a social assurance contract may be to ensure that the endorsed belief $\mathbf{b}_s$ not only gets published but also durably enters the Overton Window. Following Section IV, $\mathbf{b}_s$ enters the window if, after the belief update $\mathcal{B}_t \to \mathcal{B}_{t+1}$ triggered by the contract's success, the expected net cost of *unilateral* expression falls: $c_{indiv}(\mathbf{b}_s, \mathcal{B}_{t+1}) \leq \tau$. The architect might believe that this durable shift requires the number of revealed endorsers M to meet or exceed a certain critical impact level, M_{OW}. This M_{OW} reflects the number of endorsements deemed sufficient to significantly alter collective second-order beliefs ($\mathcal{B}_{t+1}$) and thereby reduce the perceived risks or increase the perceived esteem associated with unilaterally expressing $\mathbf{b}_s$ in the future. The architect's problem is then to choose the mechanism's assurance threshold T to maximize the probability $P(M \geq M_{OW})$. This involves a careful trade-off. Setting $T = M_{OW}$ directly aims the mechanism at the impact threshold. However, if M_{OW} is very high, this might lead to a low probability of success $P(M \geq M_{OW})$ due to coordination challenges. Alternatively, the architect might set $T < M_{OW}$ to increase the likelihood of the contract succeeding ($P(M \geq T)$ being higher). In this case, the architect relies on the equilibrium dynamics—specifically, a sufficiently negative $x^*(T)$ resulting from the chosen T—to draw in a number of endorsers M that significantly exceeds T and reaches M_{OW}. The optimal T would balance the directness of aiming for M_{OW} with the need to ensure a high enough probability of overall success and sufficient participation. Estimating M_{OW} itself requires an understanding of the social context and how beliefs about public opinion translate into individual expression costs. The problem is framed in Appendix B.

Maximize Probability of Success $P(M \geq T)$— This objective, if pursued naïvely, may often suggest a low T (e.g., $T = 1$). Such a low assurance threshold might be met if there is a single person or a very small group for whom c_i is exceptionally low or $e_i + w$ is very high. While the contract would technically "succeed," this may not be meaningful in the context of social assurance contracts aimed at broader social change. With a very low T, the Overton window might not be meaningfully expanded, prevailing social norms may remain unshifted, and any desired practical policy or organizational change might not occur.

Maximize the Number of Endorsers M, conditional on the contract succeeding— The architect might aim to set T in such a way that, if the contract succeeds, it does so with the largest possible number of endorsers. This involves a trade-off: a higher T directly sets a higher bar for M. However, a very high T drastically reduces the probability of success $p_{succ}(x^*)$. While it would make the cutoff x^* more negative (inducing a higher proportion of types to be willing to sign if success were perceived as likely), the overwhelming risk of failure might mean the expected number of endorsers in a successful outcome is lower than if a more moderate, achievable T had been chosen, or it could lead to outright contract failure. Conversely, a T that is too low might lead to success with few endorsers, not maximizing M. The architect would need to find a T that optimally balances the likelihood of success with the number of participants drawn in. This often means setting T at a level that is ambitious but perceived as achievable by a substantial portion of the target population, encouraging widespread participation rather than just meeting a minimal threshold. This objective seeks to maximize the visible display of support once the contract triggers.

Maximize the Architect's Own Expected Utility— An architect who is also a member of $\mathcal{N}$ (a participant-organizer) might choose T to maximize their own expected utility. This architect has personal stakes (v_a, e_a, c_a, w_a), which may differ from the average (e.g., higher e_a for leadership, potentially higher c_a due to visibility, or a distinct warm-glow w_a related to their efforts), and also incurs an organizing cost $o_a > 0$. The architect's first decision is their own signing strategy, $a_a^*(T) \in \{0, 1\}$, for any given T. If the architect signs $(a_a = 1)$, their expected utility is

$$E[U_a(T)|a_a = 1] = P(M_{-a} \geq T - 1|T) \cdot (v_a + e_a - c_a) + w_a - o_a$$

Here, M_{-a} is the number of other participants who sign. The probability $P(M_{-a} \geq T - 1|T)$ that at least $T - 1$ others sign (making the contract succeed if the architect signs) is equivalent to $p_{succ}(x^*(T); T)$ as defined in Eq. (2), where $x^*(T)$ is the equilibrium cutoff for the other $N - 1$ potential participants. If the architect does not sign $(a_a = 0)$, their expected utility is

$$E[U_a(T)|a_a = 0] = P(M_{-a} \geq T|T) \cdot v_a - o_a$$

Here, $P(M_{-a} \geq T|T) = \sum_{k=T}^{N-1} \binom{N-1}{k} (1 - F_x(x^*(T)))^k F_x(x^*(T))^{N-1-k}$ is the probability that at least T of the other $N - 1$ participants sign (making the contract succeed without the architect's signature). The architect would choose $a_a^*(T)$ by comparing these expected utilities for a given T. Then, the architect chooses T to maximize $E[U_a(T)|a_a^*(T)]$. This objective highlights how an organizer's personal incentives, specific type characteristics, and the costs of organization can directly shape the contract's design.

Maximize Expected Social Welfare— In the most basic case, the architect aims to maximize $E[W|T] = P(M \geq T|T)E[W_{succ}|M \geq T, T] + P(M < T|T)E[W_{fail}|M < T, T]$, where $W_{succ} = \sum_{k:a_k=0} v_k + \sum_{j:a_j=1}(v_j + e_j - c_j + w)$ and $W_{fail} = (\sum a_j)w$. This requires knowledge of the joint distribution of (v_i, e_i, c_i). The architect chooses T to maximize this expression. The probabilities $P(M \geq T|T)$ and other expectations depend on the equilibrium cutoff $x^*(T)$, which is determined by $x^* = -w/p_{succ}(x^*; T)$ from Equation (1). Note that this strategy requires the architect to first define the population over which welfare is to be maximized. This could be the population $\mathcal{P}$ as a whole, which would typically involve extending the summation for v_k in W_{succ} to include all individuals in $\mathcal{P} \setminus \mathcal{N}$ who are affected by the contract's success (and whose v_k may be non-positive). This could also be the set of potential endorsers $\mathcal{N}$ (in which case the sums in W_{succ} and W_{fail}

apply directly to members of $\mathcal{N}$ based on their actions). It seems quite natural that an architect would focus on the welfare of potential endorsers, or a subset of potential endorsers.

The optimal T is likely context-dependent. If many potential endorsers have high v_i but moderately negative $x_i = e_i - c_i$, a T that is achievable (given $x^* < 0$ due to $w > 0$) might be optimal if it unlocks substantial $\sum v_i$.

VI. Future Directions

A. *Theoretical Extensions and Refinements*

Further theoretical work could extend this model in several important directions, offering a richer understanding of the strategic environment:

Truth and Competing Contracts—One may wonder whether an environment with social assurance contracts is more likely to guide the public discussion towards truth relative to one without. Investigating scenarios with multiple social assurance contracts, possibly with opposed or complementary objectives, vs. none at all is an important topic for future research and may shed some light on this question.

Endogenous Network Effects and Information Diffusion—A key extension is to more formally model how network topology influences outcomes. This includes how it affects the perceived probability of success $p_{succ}(x^*)$, individual cost-benefit calculations (v_i, e_i, c_i), and the diffusion of information about the contract's existence and its accumulating support. This could involve analyzing how knowledge (or rumors) about who has already chosen $a_j = 1$ might leak—perhaps deliberately by endorsers themselves—and how such dynamics could affect success. Appendix C discusses these possibilities in more detail.

Dynamic and Iterative Models—Exploring the implications of repeated interactions, such as iterative assurance contracts where outcomes of one contract influence subsequent ones, or sequential decision-making by agents, would be a valuable extension. This could also involve analyzing how parameters like individual costs c_i, esteem e_i, public good valuations v_i, or the type distribution $F_x(x)$ evolve based on past contract successes or failures.

Richer Information Structures—Incorporating more complex belief systems, such as higher-order beliefs, or introducing asymmetric information that extends beyond payoffs could yield new insights. Various signaling aspects during the signing process, where early actions might convey information to later potential endorsers, also warrant investigation.

Variations in Contract Design—Exploring more flexible contract designs, such as staged contracts where a vanguard group might have a lower initial assurance threshold $T_{vanguard}$ to help publicize the contract and increase the potential pool of endorsers N for a main, higher assurance threshold T_{main}. Another design, similar to ideas in Ayres and Unkovic (2012), could allow each individual endorser i to specify their own assurance threshold T_i, with tranches of signatures becoming public as these individual thresholds are met. The number of current endorsers (but not their identities) might also be made public before the contract meets its assurance threshold T. This could create momentum effects, strategic waiting, or herding/anti-herding behavior. Analyzing the case where the order of endorsers is revealed upon success could be interesting as well, since this might affect an individual's perceived esteem e_i or cost c_i depending on their position in the revealed list (e.g., being an early versus a late endorser).

Broader Population Dynamics—Expanding the model to include the decisions and influence of individuals in the wider population $\mathcal{P} \backslash \mathcal{N}$ (for whom $v_i \leq 0$). This would involve exploring how those who are indifferent or actively opposed to the contract's success might interact with the mechanism, for example, through counter-mobilization or attempts to discredit the contract, beyond the simple adversarial attacks currently considered.

B. *Empirical Investigation and Testable Predictions*

The model elaborated here makes several predictions that are in principle empirically testable. Data from platforms facilitating social assurance contracts, laboratory and field experiments would be allow testing and refining this theoretical framework. Some predictions include:

Impact of Warm-Glow (w)—Contracts or platforms offering stronger explicit or implicit warm-glow incentives for participation (e.g., forms of acknowledgment even if the contract fails) should, *ceteris paribus*, observe higher participation rates or a lower (more negative) effective equilibrium cutoff x^*.

Impact of the Assurance Threshold (T)—The model predicts that a higher assurance threshold T leads to a lower (more negative) equilibrium cutoff x^*. While this implies that, conditional on success, a larger proportion of the relevant population might be willing to sign (as the individual bar $x_i \geq x^*$ is lower), the overall probability of success is expected to decrease with very high T. The relationship between T and the actual number of endorsers M in successful contracts, as well as success rates, can be empirically investigated.

Impact of Perceived Success Probability ($p_{succ}(x^*)$)—Factors hypothesized to increase agents' subjective $p_{succ}(x^*)$ (e.g., clear evidence of broad underlying support for the statement, effective network communication about the contract, a lower T relative to the estimated N) should correlate with a higher (less negative) x^*, making it easier for marginal individuals to choose $a_i = 1$. This could be proxied by comparing contracts on topics with different levels of perceived underlying support.

Impact of Population Size (N)—The model suggests that for a fixed T, a larger N leads to a higher (less negative) x^*. This implies that while more potential endorsers are available, the condition for any one individual to sign becomes more stringent. Empirical settings where N varies for similar types of contracts could be used to test this.

Impact of Trust (ρ)—As discussed in Section III.D, higher perceived trustworthiness and security of the platform or contract administrator (ρ closer to 1) should lead to higher participation rates, particularly when the warm-glow w is low or average costs c_i are perceived to be high. This could be tested by observing changes in participation after trust-enhancing features are implemented or including survey questions about trust, including bets on the likelihood of malfeasance.

VII. Conclusion

This paper has proposed and formally analyzed social assurance contracts as a mechanism to overcome coordination failures and information scarcity that leads to pluralistic ignorance and self-censorship. By adapting the logic of economic assurance contracts to the domain of social expression, where contributions are reputational and payoffs involve social costs and esteem, this mechanism enables individuals to pledge support for a controversial statement with safety. The game-theoretic analysis under both complete and incomplete information demonstrates that such contracts can shift behavior towards truthful revelation of private beliefs. The introduction of a warm-glow bonus w for signing plays a crucial role in making participation more attractive, potentially making signing a dominant strategy under certain conditions and lowering the effective threshold for participation in Bayesian Nash Equilibria. The model provides a framework for understanding how individuals weigh the benefits of collective expression (v_i, e_i) against personal risks (c_i) and the intrinsic value of participation (w). A key contribution of this work lies in formally modeling how such a mechanism can directly impact pluralistic ignorance and, by revealing hidden consensus, potentially shift the Overton window. This provides a micro-founded explanation for how public norms can realign with private truths, potentially reducing polarization that stems from mis-perceptions. Implementing social assurance contracts requires robust safeguards against vulnerabilities like Sybil attacks and malicious organizers, so solutions involving identity verification, cryptographic methods, and decentralized trust mechanisms would be beneficial for credibility. Potential applications range from enabling faculty and students in academic communities to challenge dominant norms, to facilitating collective whistleblowing or feedback in corporate settings. Furthermore, this mechanism could empower moderates in political organizations, allow for unofficial no-confidence votes, or be integrated into online platforms to mitigate chilling effects and reveal latent support for non-dominant views. As societies grapple with polarization and the challenges to free expression, tools that enable conditional collective voice are increasingly valuable. By providing a structured and safe way to reveal suppressed support, social assurance contracts offer a promising avenue for fostering more honest, inclusive, and ultimately more informed public conversations, helping to build genuine common knowledge.

Mathematical Appendix

Proof of Proposition 1, Item 3

The proposition states that if $N_{strong} = |\mathcal{S}_{strong}| \geq T$, a Nash Equilibrium (NE) exists where:

- Strategy $\mathbf{a}^*$: All $i \in \mathcal{S}_{strong}$ choose $a_i^* = 1$. All $j \notin \mathcal{S}_{strong}$ (for whom $e_j - c_j + w < 0$) choose $a_j^* = 0$.
- Condition: Agents $j \notin \mathcal{S}_{strong}$ are not pivotal or, if pivotal, they do not prefer signing (i.e., $j \notin \mathcal{S}_{pivotal}$).

Under strategy $\mathbf{a}^*$, since $N_{strong} \geq T$, the total number of endorsers is $M^* = N_{strong} \geq T$, thus the contract succeeds. We verify no unilateral deviation exists:

1. Agent $i \in \mathcal{S}_{strong}$ (chooses $a_i^* = 1$): Their equilibrium utility is $U_i(a_i^* = 1, \text{Success}) = v_i + e_i - c_i + w$.

If i deviates to $a_i' = 0$:

- If $N_{strong} - 1 \geq T$, the contract succeeds anyway: $U_i(a_i' = 0, \text{Success}) = v_i$. Agent i does not deviate if
$$v_i + e_i - c_i + w \geq v_i \quad \Rightarrow \quad e_i - c_i + w \geq 0,$$
which holds by definition for all $i \in \mathcal{S}_{strong}$.
- If $N_{strong} - 1 < T$ (implying $N_{strong} = T$, agent i pivotal), the contract fails if i deviates: $U_i(a_i' = 0, \text{Fail}) = 0$. No deviation occurs if
$$v_i + e_i - c_i + w \geq 0,$$
which trivially holds given $e_i - c_i + w \geq 0$ and $v_i > 0$.

Thus, no $i \in \mathcal{S}_{strong}$ deviates.

2. Agent $j \notin \mathcal{S}_{strong}$ (chooses $a_j^* = 0$): Their equilibrium utility is $U_j(a_j^* = 0, \text{Success}) = v_j$ (contract succeeds due to $\mathcal{S}_{strong}$).

If j deviates to $a_j' = 1$:

- Contract success is unaffected (total signers: $N_{strong}+1$). Utility becomes $U_j(a_j' = 1, \text{Success}) = v_j + e_j - c_j + w$. Agent j does not deviate if
$$v_j \geq v_j + e_j - c_j + w \quad \Rightarrow \quad e_j - c_j + w \leq 0,$$

which is true since $j \notin \mathcal{S}_{strong}$ implies $e_j - c_j + w < 0$.

- **Clarification on pivotality:** If $N_{strong} = T$, exactly T agents from $\mathcal{S}_{strong}$ sign, thus ensuring contract success. Hence, no agent outside $\mathcal{S}_{strong}$ is pivotal under equilibrium. If pivotality were hypothetically considered, $j \notin \mathcal{S}_{pivotal}$ by assumption ensures j has no profitable incentive to deviate.

Thus, no $j \notin \mathcal{S}_{strong}$ deviates either.

Therefore, strategy profile $\mathbf{a}^*$ constitutes a Nash Equilibrium when $N_{strong} \geq T$.

Proof for Proposition 1: Existence and Discussion of Uniqueness Conditions

Proposition 1 states that under standard assumptions on $F_x(\cdot)$ (e.g., continuity), a symmetric Bayesian Nash Equilibrium (BNE) characterized by a cutoff x^* for the type $x_i = e_i - c_i$ satisfying Equation (1) exists. Equation (1) is $x^* = -w/p_{succ}(x^*)$, which can be rewritten as finding a root for the function $H(x^*) = x^* p_{succ}(x^*) + w = 0$.

First, we establish properties of $p_{succ}(x^*)$. Recall that

$$p_{succ}(x^*) = \sum_{k=T-1}^{N-1} \binom{N-1}{k} (1 - F_x(x^*))^k (F_x(x^*))^{N-1-k}$$

where $F_x(x)$ is the CDF of x_i, assumed to have support $[\underline{x}, \overline{x}]$ and a corresponding PDF $f_x(x) = F'_x(x)$. We assume $N > 1$ (i.e., there is at least one "other" agent).

LEMMA 1: *The function $p_{succ}(x^*)$:*

1) *Is continuous for $x^* \in (\underline{x}, \overline{x})$ if $F_x(x^*)$ is continuous.*

2) *Is non-increasing in x^*. If $f_x(x^*) > 0$ for $x^* \in (\underline{x}, \overline{x})$ and $T - 1 < N - 1$ (i.e., $T < N$), then $p_{succ}(x^*)$ is strictly decreasing in x^* over this interval, and thus $p'_{succ}(x^*) < 0$.*

3) *Assume the support of x_i is $[\underline{x}, \overline{x}]$, with $F_x(\underline{x}) = 0$ and $F_x(\overline{x}) = 1$. As $x^* \to \underline{x}$ (from above):*

   - *If $T = 1$ (and $N > 1$), then $p_{succ}(x^*) \equiv 1$ based on Eq. 2. Thus, $p_{succ}(x^*) \to 1$.*

   - *If $T > 1$ and $T \leq N$: As $x^* \to \underline{x}$, $1 - F_x(x^*) \to 1$ and $F_x(x^*) \to 0$. The sum for $p_{succ}(x^*)$ becomes $\sum_{k=T-1}^{N-1} \binom{N-1}{k} (1)^k (0)^{N-1-k}$. The only term that can be non-zero is when $N - 1 - k = 0$, i.e., $k = N - 1$. If $T - 1 \leq N - 1$, this term $\binom{N-1}{N-1} (1)^{N-1} (0)^0 = 1$ (assuming $0^0 = 1$ in this binomial context). Thus, $p_{succ}(x^*) \to 1$.*

Essentially, if x^* is so low that virtually everyone's type x_j is above it, and $T \leq N$, the probability of getting at least $T-1$ other endorsers approaches 1.

4) *Assume the support of x_i is $[\underline{x}, \overline{x}]$, with $F_x(\underline{x}) = 0$ and $F_x(\overline{x}) = 1$. As $x^* \to \overline{x}$ (from below):*

- *If $T = 1$ (and $N > 1$), then $p_{succ}(x^*) \equiv 1$ based on Eq. 2. Thus, $p_{succ}(x^*) \to 1$.*
- *If $T > 1$: As $x^* \to \overline{x}$, $1 - F_x(x^*) \to 0$. Every term in the sum for $p_{succ}(x^*)$ (Eq. 2) will have a factor $(1 - F_x(x^*))^k$ where $k \geq T - 1 \geq 1$. Thus, every term goes to 0, and $p_{succ}(x^*) \to 0$.*

Essentially, if x^* is so high that virtually no one's type x_j is above it, and for $T > 1$, the probability of getting at least $T-1$ other endorsers approaches 0.

PROOF OF LEMMA 1:

Continuity follows from $F_x(x^*)$ being continuous and $p_{succ}(x^*)$ being a sum of products of continuous functions. For monotonicity, let $q(x^*) = 1 - F_x(x^*)$, which is non-increasing (strictly decreasing if $f_x(x^*) > 0$). $p_{succ}(x^*)$ is the probability of $T-1$ or more successes in $N-1$ Bernoulli trials, where the probability of success for each trial is $q(x^*)$. This aggregate probability is non-decreasing in $q(x^*)$. Since $q(x^*)$ is non-increasing in x^*, $p_{succ}(x^*)$ is non-increasing in x^*. The limits are as derived in the Lemma statements.

Proof of Existence of x^*: We seek a root for $H(x^*) = x^* p_{succ}(x^*) + w = 0$.

1) *Continuity:* $H(x^*)$ is continuous on $(\underline{x}, \overline{x})$ because $p_{succ}(x^*)$ is continuous (from Lemma 1) and x^* is continuous. We assume $w > 0$.

2) *Behavior at limits of support for x^*:* Consider the typical case where $F_x(x)$ has support $[\underline{x}, \overline{x}]$.

- As $x^* \to \underline{x}$ (from above): Based on Lemma 1, $p_{succ}(x^*) \to 1$ (for $T \leq N, N > 1$). Then $H(x^*) \to \underline{x} \cdot 1 + w = \underline{x} + w$. For an equilibrium to exist within the support using the Intermediate Value Theorem, we often need $H(\underline{x}) < 0$, i.e., $\underline{x} < -w$. If $\underline{x} \geq -w$ (e.g., if $\underline{x} = 0$), then $H(\underline{x}) \geq w > 0$.
- As $x^* \to \overline{x}$ (from below):
  - If $T > 1$: Based on Lemma 1, $p_{succ}(x^*) \to 0$. Then $H(x^*) \to \overline{x} \cdot 0 + w = w > 0$.
  - If $T = 1$ (and $N > 1$): Based on Lemma 1, $p_{succ}(x^*) \equiv 1$. Then $H(x^*) = x^* \cdot 1 + w$. The equilibrium is found by solving $x^* + w = 0$, yielding $x^* = -w$. Existence requires $-w \in [\underline{x}, \overline{x}]$. In this case, $H(\overline{x}) = \overline{x} + w$.

If $T > 1$: If $H(\underline{x}) < 0$ (i.e., $\underline{x} < -w$) and $H(\overline{x}) = w > 0$, then by the Intermediate Value Theorem (IVT), there exists at least one $x^* \in (\underline{x}, \overline{x})$ such that $H(x^*) = 0$. The condition $\underline{x} < -w$ ensures $H(x^*)$ starts negative. If the support for $x_i = e_i - c_i$ is, for example, $(-\infty, \overline{x}]$, then as $x^* \to -\infty$, $p_{succ}(x^*) \to 1$ (assuming $T \leq N$). Then $H(x^*) = x^* \cdot 1 + w \to -\infty$. Since $H(x^*)$ also approaches $w > 0$ as $x^* \to \overline{x}$ (assuming $T > 1$, so $p_{succ}(\overline{x}) \to 0$), a root must exist by IVT.

If $H(\underline{x}) \geq 0$ (e.g., if $\underline{x} \geq -w$), then $H(x^*)$ might always be positive if $x^* p_{succ}(x^*)$ is never sufficiently negative to offset w. In such a case, there might be no x^* satisfying the equation within $(\underline{x}, \overline{x})$, potentially leading to a corner solution or an equilibrium where $p_{succ}(x^*) = 0$ (no one signs if $T > 1$). The main analysis typically assumes an interior x^* exists.

Thus, under appropriate assumptions on the support of $F_x(x)$ (e.g., that it extends to values sufficiently negative such that $H(x^*)$ can be negative, or for $T = 1$ that $-w$ is in the support) and $T > 1$, existence of at least one x^* is guaranteed by the IVT. For $T = 1$, $x^* = -w$ is the unique solution, provided $-w$ is in the support.

Discussion of Uniqueness of x^*: Uniqueness of the equilibrium cutoff x^* requires that $H(x^*)$ crosses zero only once (for $T > 1$, as the $T = 1$ case yields $x^* = -w$ uniquely). This is typically ensured if $H(x^*)$ is strictly monotonic in the region where roots occur. The derivative of $H(x^*)$ is $\frac{dH}{dx^*} = p_{succ}(x^*) + x^* p'_{succ}(x^*)$. For an interior equilibrium x^*, we know $x^* = -w/p_{succ}(x^*)$. Since $w > 0$ and $p_{succ}(x^*) \in (0, 1]$ for such an equilibrium, x^* must be negative. From Lemma 1, $p_{succ}(x^*) > 0$ (in the region of interest) and $p'_{succ}(x^*) < 0$ (if F_x has density and $T < N$). Therefore, the term $x^* p'_{succ}(x^*)$ is (negative) $\times$ (negative) = positive. Thus, $\frac{dH}{dx^*} = p_{succ}(x^*)(\text{positive}) + x^* p'_{succ}(x^*)(\text{positive}) > 0$. If $\frac{dH}{dx^*} > 0$, then $H(x^*)$ is strictly increasing. If a continuous, strictly increasing function $H(x^*)$ starts negative and ends positive (as required for existence by IVT), it will have exactly one root, ensuring a unique x^*.

The argument that $\frac{dH}{dx^*} > 0$ relies on $x^* < 0$, which is characteristic of the equilibria under consideration when $w > 0$. If this condition holds over the entire range where $H(x^*)$ transitions from negative to positive values, uniqueness of the root is assured. While $\frac{dH}{dx^*} > 0$ generally holds under these conditions, ensuring it (and thus strict monotonicity of $H(x^*)$) globally across the entire support of x^* might require further specific assumptions on $F_x(x)$ (e.g., related to the behavior of $f_x(x^*)$ or ensuring $p_{succ}(x^*)$ does not go to zero too quickly if x^* approaches $\underline{x}$ from above while still being negative).

For the purpose of the paper, existence is established under weak conditions (continuity of F_x, appropriate support ensuring $H(x^*)$ can span zero). Uniqueness is strongly suggested by $\frac{dH}{dx^*} > 0$

for the type of equilibria considered ($x^* < 0$). The comparative statics in Appendix C often assume such a condition for stability and unambiguous results.

Formal Derivations of Comparative Statics (Incomplete Information)

Equilibrium Definition and Assumptions: For $T > 1$, the equilibrium cutoff x^* is implicitly defined by:

$$H(x^*, \alpha) = x^* p_{succ}(x^*; \alpha) + w = 0$$

where α represents parameters of interest (e.g., w, distribution parameters of F_x, threshold T, or population size N).

We apply the Implicit Function Theorem (IFT):

$$\frac{dx^*}{d\alpha} = -\frac{\partial H/\partial \alpha}{\partial H/\partial x^*}.$$

Assumption (Stability/Uniqueness): We assume (see Appendix B):

$$\frac{\partial H}{\partial x^*} = p_{succ}(x^*) + x^* p'_{succ}(x^*) > 0.$$

Derivation of Comparative Statics:

1) **Warm-glow (w):** We have $\frac{\partial H}{\partial w} = 1$, hence

$$\frac{dx^*}{dw} = -\frac{1}{p_{succ}(x^*) + x^* p'_{succ}(x^*)} < 0.$$

Thus, increasing w decreases x^*, increasing participation.

2) **FOSD Improvement in Distribution F_x:** Let an increase in α_{shift} represent an FOSD improvement (stochastically higher types x_i). We have $\frac{\partial p_{succ}}{\partial \alpha_{shift}} > 0$. Thus,

$$\frac{dx^*}{d\alpha_{shift}} = -\frac{x^*(\partial p_{succ}/\partial \alpha_{shift})}{p_{succ}(x^*) + x^* p'_{succ}(x^*)} > 0.$$

An improvement in distribution raises the equilibrium cutoff.

3) **Threshold (T):** Increasing T makes success harder ($\frac{\partial p_{succ}}{\partial T} < 0$). Thus,

$$\frac{dx^*}{dT} = -\frac{x^*(\partial p_{succ}/\partial T)}{p_{succ}(x^*) + x^* p'_{succ}(x^*)} < 0.$$

Higher T lowers cutoff, increasing participation.

4) **Population Size (N):** Increasing N makes success easier ($\frac{\partial p_{succ}}{\partial N} > 0$). Thus,

$$\frac{dx^*}{dN} = -\frac{x^*(\partial p_{succ}/\partial N)}{p_{succ}(x^*) + x^* p'_{succ}(x^*)} > 0.$$

Larger N raises cutoff, tightening individual condition.

5) **Cost Convexity (Increase in Costs):** Let α_{cvx} represent increased costs, causing a stochastic decrease in types ($\frac{\partial p_{succ}}{\partial \alpha_{cvx}} < 0$). Thus,

$$\frac{dx^*}{d\alpha_{cvx}} = -\frac{x^*(\partial p_{succ}/\partial \alpha_{cvx})}{p_{succ}(x^*) + x^* p'_{succ}(x^*)} < 0.$$

Higher costs lower cutoff, relaxing individual participation criteria.

Summary: We established rigorous comparative statics results clearly aligned with intuition under the maintained assumption of a stable and unique equilibrium ($\partial H/\partial x^* > 0$).

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Supplemental Appendix

Vulnerabilities and Mitigations

Any mechanism relying on the conditional revelation of sensitive information must consider potential adversarial scenarios and practical implementation challenges. This section outlines key vulnerabilities and suggests corresponding mitigation strategies.

A1. Sybil Attacks and Ballot-Stuffing

A primary risk is the *ballot-stuffing* or *Sybil* attack (Douceur 2002), where malicious actors generate fake or insincere signatures to falsely achieve the assurance threshold T leading to premature or misleading publication. Robust identity verification is the key defense. Requiring participants to authenticate via verifiable methods (e.g., organizational email, unique institutional credentials, or digital signatures linked to known identities within population $\mathcal{N}$) significantly hinders the creation of multiple fraudulent entries. Organizational authentication systems like Kerberos offer a model for such verification (Steiner, Neuman, and Schiller 1988). Additionally, a small, non-monetary stake or commitment, such as a verifiable pledge, could deter frivolous sign-ups.

A distinct challenge arises if legitimate members of $\mathcal{N}$ sign insincerely merely to trigger publication and expose sincere endorsers. Such insincere endorsers might then publicly disavow the statement, claiming they signed only to "out" others. This could be an effective strategy if it is wholly implausible that the insincere endorser could possibly have been sincere. In this case, drawing up a list of likely suspects and excluding them from the contract in the first place would be an effective defense. In the case where it is ambiguous whether a endorser who claims to have signed only to cause the contract to succeed, this endorser now has their signature indelibly affixed to an allegedly repugnant statement. Whether a *post hoc* claim of insincerity will be remembered as long as an indelible signature on a contract is quite questionable, and should provide a disincentive.

A2. Insider Attacks and Mechanism Integrity

The integrity of the contract administrator (system or person) is paramount. An insider attack—such as prematurely leaking signatures, falsely claiming T is met, or succumbing to external coercion to reveal identities—or a technical compromise of the platform severely undermines the contract's assurance. Mitigating these risks often involves removing single points of failure and employing robust technical and procedural safeguards.

Distributing trust, for instance, by using multiple independent escrow holders requiring a quorum for action, is one approach. Cryptographic methods, however, should be considered the gold standard for ensuring both secrecy and integrity. Decentralized mechanisms like smart contracts on a blockchain could automate conditional release based on verifiable cryptographic conditions (e.g., T valid digital signatures from institutional certificates), minimizing human intervention (cf. Szabo 1997, for foundational concepts of smart contracts), (Vacca et al. 2021, for a review). Threshold cryptography offers solutions where signatures are encrypted such that decryption requires either T participants to cooperatively reveal their keys or a quorum of trustees to combine shares (Shoup 2000). Furthermore, anonymous credential systems can allow users to prove eligibility without revealing identity to the administrator until publication (Camenisch and Lysyanskaya 2001), and zero-knowledge proofs could enable verification that $M \geq T$ valid signatures exist without revealing which specific signatures they are (Goldreich and Oren 1994). While the full development of user-friendly platforms incorporating such advanced cryptographic guarantees for general-purpose social assurance contracts is ongoing, these technologies theoretically offer strong protection against both premature exposure and administrator malfeasance.

Beyond purely technical measures, legal agreements imposing significant penalties for malfeasance can provide a deterrent. Centralized platforms must also cultivate a strong reputation for integrity, potentially bolstered by independent third-party audits and open-source software development. Ultimately, participants' trust ($\rho \approx 1$, as discussed in Section III.D) is essential, and this may rely on a combination of technical assurances, reputational trust in the administrator, and clear governance regarding the contract's terms, including the immutability of the statement being endorsed.

Outline of a Maximal Model with Strategic Opposition

The core model analyzed in this paper provides foundational insights into the mechanics of Social Assurance Contracts by focusing on the strategic decisions of potential endorsers under exogenous (though possibly heterogeneous) cost and benefit parameters. This appendix outlines a more comprehensive "maximal model" that incorporates additional realistic features, primarily by endogenizing social costs through the strategic actions of individuals who may oppose the success of the contract, and by allowing for uncertainty regarding the total number of potential supporters. Formal analysis of this maximal model is left for future research.

B1. Model Components in the Maximal Framework

1. Population Segmentation and Preferences— Let $\mathcal{P}$ be the total underlying population. Each individual $j \in \mathcal{P}$ possesses an individual-specific valuation v_j concerning the public revelation and potential normalization of the statement s_{belief} endorsed by the contract. This valuation v_j can be positive, zero, or negative, leading to a natural segmentation of $\mathcal{P}$:

- **Supporters ($\mathcal{N}$):** The set of individuals for whom $v_i > 0$. Let $N = |\mathcal{N}|$ be the true number of such potential endorsers. In this maximal model, unlike the main model, N is not assumed to be common knowledge. Instead, each agent $k \in \mathcal{P}$ (particularly potential supporters $i \in \mathcal{N}$) forms a subjective belief or estimate, $\hat{N}_k$ (which could be a point estimate or a probability distribution), about the true value of N. Each supporter $i \in \mathcal{N}$ also has heterogeneous private esteem e_i, cost c_i (which will now be endogenous), and warm-glow w_i (which we assume is heterogeneous here) associated with choosing $a_i = 1$ (Endorse).

- **Indifferents ($\mathcal{I}_0$):** The set of individuals for whom $v_j = 0$. The size of this set, $|\mathcal{I}_0|$, may also be uncertain.

- **Opposers ($\mathcal{O}$):** The set of individuals for whom $v_j < 0$. These individuals experience disutility if s_{belief} is successfully publicized and enters the Overton window. The size of this set, $|\mathcal{O}|$, may also be uncertain.

2. Endogenous Social Costs (c_i) for Supporters— For a supporter $i \in \mathcal{N}$, the private cost c_i incurred if they endorse ($a_i = 1$) and the contract succeeds ($M \geq T$) is now explicitly a function of the aggregate punishment enacted by opposers. Let P_{total} be the total punishment enacted by the set of opposers $\mathcal{O}$. Then $c_i = C_i(P_{total}, M, \text{own characteristics}_i)$, where a higher P_{total} or a lower M (number of endorsers sharing the burden) would typically increase c_i.

3. Opposers' Characteristics and Strategic Behavior— Each opposer $j \in \mathcal{O}$ is characterized by their negative valuation $v_j < 0$ and an "influence" or "power" parameter $i_j \geq 0$. Their capacity to contribute to the punishment pool is $p_j(v_j, i_j)$, where higher $|v_j|$ (stronger opposition) and higher i_j lead to greater p_j. Let $\mathbf{p} = \{p_j\}_{j \in \mathcal{O}}$ be the vector of punishment potentials. If the contract succeeds ($M \geq T$) and s_{belief} is published, opposers then decide whether to enact punishment. Crucially, we assume enacting punishment is *costless* to the opposers themselves ($k_p = 0$). However, they only choose to punish if they believe their collective punishment will be *effective*. Punishment is effective when it prevents s_{belief} from durably entering or remaining in the Overton window. If the total punishment $\sum p_j$ is sufficiently high relative to the number of endorsers M (i.e., if T was set too low by the administrator, leading to a small M), the resulting c_k for endorsers might be so large that expressing s_{belief} remains prohibitively costly overall, negating the contract's impact on the Overton window. In this case, ex-post utility for a significant number of revealed endorsers is negative: $v_k + e_k - c_k(M, \sum p_j) + w_k < 0$ for many $k \in \{i \mid a_i = 1\}$. Opposers would not punish if they estimate that M is so large (potentially influenced by their own estimate of N and of how supporters react to that) that their pooled punishment $\sum p_j$ would be too diluted to effectively increase c_k to a deterrent level, meaning the underlying belief $\mathbf{b}_s$ (represented by s_{belief}) would enter the Overton window regardless of their efforts.

4. Supporters' Decision with Endogenous Costs— Supporters $i \in \mathcal{N}$ must now form expectations that are conditional on their individual estimate of the total number of supporters, $\hat{N}_i$. These expectations cover: (a) the likely number of actual endorsers M who will sign (which depends on $\hat{N}_i$, the threshold T, the distribution of private types (v_j, e_j, c_j, w_j) among the estimated $\hat{N}_i$ supporters, and their strategic responses); (b) the potential collective punishment P_{total} from $\mathcal{O}$ if the contract succeeds with M endorsers; and (c) how this punishment translates into their individual $c_i(M, P_{total})$. Their decision $a_i = 1$ would depend on whether their subjective expected utility $E_i[v_i + e_i - c_i(M, P_{total}) + w_i \mid \hat{N}_i]$ (if $M \geq T$) is sufficiently high compared to $E_i[w_i \mid \hat{N}_i]$ (if $M < T$) and $E_i[v_i \mid \hat{N}_i]$ (if $a_i = 0, M \geq T$). The calculation of whether $v_i + e_i - c_i(M, P_{total}) + w_i$ is positive in expectation, considering the punishment subgame and the uncertainty over N, becomes central.

5. Architect's Objective— The contract architect sets T. Their objective might be to maximize the probability that $\mathbf{b}_s$ *durably* enters the Overton window. This now explicitly involves choosing a T considering not only the likely distribution of types but also the fact that potential supporters (and opposers) operate with potentially heterogeneous estimates $\hat{N}_k$ of the true number of supporters N. An optimal T would need to be robust enough or be perceived as achievable given these beliefs, such that if $M = T$ endorsers are revealed, this number is sufficient to signal to opposers that punishment would be futile, thus ensuring c_i remains manageable for supporters.

B2. Straightforward Implications and Complexities of the Maximal Model

Introducing strategic, (personally) costless but efficacy-dependent punishment by opposers, coupled with uncertainty about the total number of supporters N, has several key implications for the Social Assurance Contract model. Firstly, the concept of "safety" for endorsers becomes endogenously determined and subject to more layers of uncertainty. It is no longer solely about being one of $M \geq T$ individuals, but more critically about M being sufficiently large (relative to individual beliefs $\hat{N}_i$ and the true N) to deter or significantly dilute punishment from the opposing group $\mathcal{O}$. If the administrator sets the mechanism's threshold T too low, an SAC might formally "succeed" (i.e., achieve $M \geq T$ endorsements), yet this M could be insufficient to deter opposers. In such a scenario, the resulting costs c_i imposed on endorsers might become so high as to render their ex-post utility negative. Consequently, the endorsed belief $\mathbf{b}_s$ (represented by the endorsed statement s_{belief}) might fail to durably enter the Overton window because association with it remains prohibitively costly. This implies the existence of an effective impact threshold, M_{OW}, representing the level of observed endorsement M at which opposers would likely deem punishment ineffective and stand down. The administrator's optimal choice for T would then ideally be at or above this M_{OW}, or at least set to maximize the probability $P(M \geq M_{OW})$, considering the distribution of beliefs about N. Second, this framework significantly increases the complexity of strategic calculations for all involved. Supporters must now forecast not only the participation decisions of other potential supporters (from a pool whose size $\hat{N}_i$ they estimate) but also the strategic response of the entire group of opposers, which influences their expected c_i. Opposers, in turn, must forecast the likely M resulting from the SAC to determine if their potential punishment would be worthwhile. Third, this introduces new potential failure modes for the contract. Beyond the simple failure of $M < T$ (resulting in no publication), an SAC could achieve $M \geq T$ only to be met with effective punishment. Such an outcome would make endorsers regret their decision and could prevent the intended shift in the Overton Window, representing a pyrrhic victory for the initial publication. Finally, the success of an SAC in durably shifting norms and achieving its objectives will critically depend on the characteristics and coordination of opposers, and now also on the collective beliefs and estimation accuracy regarding N. The aggregate punishment potential, $\sum p_j$, and the ability of opposers to coordinate their punishment strategy become paramount factors. Analyzing these rich interactions would indeed require advanced game-theoretic tools.

A full analysis of this maximal model—including formal proofs of equilibrium existence, conditions for uniqueness, and comprehensive comparative statics—is a substantial undertaking well beyond the scope of the present paper. However, outlining this maximal model serves to highlight the broader context in which Social Assurance Contracts operate. It emphasizes that social costs (c_i) faced by supporters are not merely exogenous parameters but can be the result of active, strategic opposition, and that fundamental parameters like the number of potential allies (N) may themselves be subject to uncertainty. The simpler model analyzed in the main body of this paper provides a crucial foundation by elucidating the core coordination mechanism among supporters, upon which these more complex inter-group dynamics and informational uncertainties can be built in future research.

Network Topology and the Success of Assurance Contracts

The effectiveness of a social assurance contract can also depend on the underlying social network structure of the N potential endorsers. While formal modeling of these network effects is left for future research, this section qualitatively discusses several key influences.

The presence of cohesive subgroups or dense clusters within the network may facilitate coordination. Pre-existing trust within such a subgroup can bolster individuals' confidence in the integrity of the contract process and their belief that peers within the subgroup will also choose $a_j = 1$ (Sign). This enhanced trust could translate into a higher subjective probability of success, $p_{succ}(x^*)$, or a lower perceived individual cost, c_i. Furthermore, an organizer could leverage existing trust links to quietly recruit a core group of endorsers. If this core group is sufficiently large to approach or meet the assurance threshold T, it could catalyze wider participation from the periphery. Strong intra-group ties, therefore, can be instrumental in overcoming the initial coordination hurdle, suggesting that $p_{succ}(x^*)$ might be influenced not only by the global distribution $F_x(x)$ but also by local network characteristics that shape beliefs about others' actions.

Conversely, coordination becomes more challenging if potential supporters are dispersed across a fragmented network, for instance, in different departments, distinct social circles, or otherwise structurally isolated parts of the community. Such fragmentation can create information barriers, leaving individuals unaware of the extent of shared sentiment or even of the contract's existence. In these scenarios, the role of trusted individuals or communication channels that act as bridges between disconnected segments, or as central hubs, becomes crucial. These network bridges are essential for disseminating information about the contract and for recruiting a broad base of endorsers; without them, $p_{succ}(x^*)$ may be severely underestimated by many potential participants. In highly fragmented networks, it might even be necessary to employ multiple, parallel assurance contracts, perhaps one for each cluster, potentially with an overarching mechanism to combine successes if each meets a local assurance threshold. The design of the assurance threshold T itself could be adapted, for instance, by requiring a vector of participation $T = (T_1, \ldots, T_k)$ from k different groups for publication, ensuring broad representation.

The social insularity of a group also plays a role, which may come down to the question: who has the power to hurt me? In an insular group, the opinions of outsiders may be of little importance. This could mean the people who might potentially levy costs c_i upon contract success are limited in number and therefore easier to reason about. In the case where a group is not insular, and has more links to society at large rather than to each other, we might expect that the assurance threshold T must be very high since "the rest of society" provides a rather large number of people who could contribute to c_i. In insular groups with strong, monolithic cultures or those that heavily censor dissent, individuals who disagree with the prevailing norm may be completely isolated, with no easy way to find like-minded others or gauge latent support. Launching an assurance contract in such environments might necessitate external intervention or anonymous broadcasts, as any known organizer could be targeted before reaching T. In contrast, in more open insular groups where social ties cut across clusters of beliefs, information about a contract could diffuse more freely. A successful contract in such an environment may be more likely to draw endorsers from a diverse cross-section of beliefs, lending greater credibility and broader impact to the revealed consensus and subsequent belief updates.

From a network diffusion perspective, as explored in models like Watts (2002), a social assurance contract essentially seeks to trigger a cascade of endorsement once the critical mass T is achieved. One might consider the role of "k-cores" within the network: if a subset of at least T mutually connected or trusting individuals can be convinced to sign (perhaps due to highly favorable x_i or a strong response to w), their collective commitment, held in escrow, can then persuade others on their periphery to join. However, such cascades might be halted at the boundaries of network modules if bridging ties are weak. Overall, a network exhibiting moderate connectivity—neither overly fragmented nor excessively centralized around a few vulnerable hubs—is likely most conducive to the success of an SAC. Such a structure supports the formation of an initial critical mass and the subsequent widespread propagation of the revealed stance, potentially leading to a more significant and group-wide update of beliefs. The perceived $p_{succ}(x^*)$ for any individual would then be influenced by their network position and the local signals of support they observe.