The Secrecy Gambit:
Clandestine Power Shifts and Preventive Conflict

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Abstract

Signals of strength enable countries to deter threats during crises and extract favorable bargains during peace. However, countries often forgo signaling opportunities by concealing new weapons and technologies. Why do actors sometimes choose secrecy at the expense of signaling? We present a formal model in which a country first decides whether to pursue a power shift and then whether to announce or conceal its decision. The results show that several common conclusions about crisis behavior should be qualified. First, whereas popular models suggest that incomplete information and credible commitment problems can cause war independently, we demonstrate that the combination of these mechanisms can facilitate peace. Second, we distinguish between two forms of preventive war that create opposing incentives for rising states: *wars of discovery* and *wars of suspicion*. Finally, we show that secret developers and non-developers fall under equal suspicion and must therefore take costly steps to reassure adversaries. While this *reassurance tax* is part of the 'gambit' played by ambitious states, it constitutes a burden for those content with the status quo. The effects generate new predictions for empirical research on arming, allying, and counterinsurgency.

"Hide your strength, bide your time."
—Deng Xiaoping (1990)

1 Introduction

Public signals are part and parcel of international politics. During crises, negotiations, and conflicts, strong actors make costly moves to demonstrate their abilities, announce their intentions, and push observers toward cooperation or conciliation. A broad body of research explains how credible signals of power enable actors to realize success in war and secure more favorable outcomes in peace.[1] However, actors sometimes forgo the benefits of signaling and instead choose to conceal their capabilities and obscure their strength. Whereas many leaders eagerly announce new weapons and military technologies, others prefer to keep such advancements secret.[2] Likewise, although military allies often advertise their partnerships to deter likely rivals, at other times they form clandestine agreements and publicly deny their alignment.[3] Even individuals engage in secretive behavior: while some citizens publicly demonstrate their support for government or rebel forces during civil conflicts, others strive to conceal the extent of their collaboration.

This paper analyzes why political actors sometimes forgo signaling in favor of secrecy. Our answer exposes and resolves an important but under-acknowledged tension in prevailing theories of deterrence and war. According to one view, states can best deter hostile rivals with convincing signals of strength and resolve.[4] Because wars occur when actors possess private information that they are either unable or unwilling to share, costly signals help opponents avoid war by enabling them to reconcile their conflicting beliefs and identify feasible bargains.[5] However, signals of strength are no panacea; a contrasting theoretic literature argues that military demonstrations can

[1] See, for example, Morrow 1989, Fearon 1994, Fearon 1997, and Slantchev 2011.

[2] Many military programs are concealed even well after their completion. Prominent American examples include the F-117 Nighthawk and the Lockheed U-2.

[3] Leeds' et al. 2002 "Alliance Treaty Obligations and Provisions" (ATOP) dataset suggests that 20% of alliances that existed between 1815 and 1956 were forged in secret and were concealed from non-members until after they expired. Similarly, Grosek 2007 identifies 593 secret treaties that existed between 1521 and 2000. Finally, powerful countries clandestinely train, support, and equip military proxies or sub-state allies with increasing frequency. See also Ritter 2003 as well as Bas and Schub 2016, to which we return in the discussion section.

[4] Schelling 1960, Banks 1990, Slantchev 2005.

[5] Blainey 1988, Morrow 1989, Fearon 1995, Powell 1999, Slantchev and Tarar 2011, Fey and Ramsay 2011.

provoke war rather than resolve it. According to the logic of preventive war, a country who discovers that its opponent is rapidly gaining power may doubt the opponent's commitment to peace and may initiate a preventive attack on the basis of this concern.[6] States that seek to minimize the overall risk of war therefore face a dilemma: to successfully deter hostile rivals they must develop military tools that allow them to advertise their strength and resolve, but to reduce the threat of preventive attacks they must avoid the appearance that the acquisition of these capabilities will tilt the balance of power too sharply in their favor.

We assess how actors manage this dilemma by modeling a country's decision to develop and announce military technology that would bolster its future bargaining power. Relative to traditional arming and escalation models, our theory combines two key innovations. First, we allow military developments to produce improvements in power in both the short- and long-term.[7] This choice reflects the empirical reality that advancements in military technology often accrue in phases so that states obtain small benefits early in the development process followed by larger improvements in power as their technologies and manufacturing processes mature.[8] We further augment existing models by allowing players to announce their development once it reaches an intermediate stage of completion or, alternatively, to pursue clandestine development with some risk that their effort will be exposed. We show that the decision to reveal or conceal military improvements is an integral component in a rising state's strategic arsenal. On the one hand, rising states that hide their military capabilities must forgo the full range of deterrent and bargaining benefits that public signals of strength would enable them to claim. On the other hand, a state that keeps its military development secret—even after completing an initial round of arming—may reassure nervous adversaries and reduce the threat of preventive attack. By analyzing how states manage these countervailing incen-

[6] Gilpin 1981, Levy 1987, Fearon 1995, Fearon 1996, Powell 1996, Copeland 2000, Powell 2006, Trachtenberg 2007, Levy 2008, Bell and Johnson 2015, Bas and Coe 2016, Krainin 2017, Tingley 2017.

[7] For traditional military arming models, see Kydd 2000, Baliga and Sjöström 2004, Baliga and Sjöström 2008. For recent work that similarly includes multi-stage development, see Debs and Monteiro 2014 and Bas and Coe 2016.

[8] Countries may, for example, pursue ambitious weapons development programs that produce minimal short-term gains but which yield large improvements in bargaining power upon completion. Nascent alliances may likewise confer only modest improvements in military capability due to information sharing and coordination, but allies realize larger gains over the long run as they develop and produce complementary forces. Finally, states often enjoy economies of scale in the production of conventional weapons.

tives, our theory draws attention to four under-appreciated aspects of international crisis behavior and generates novel predictions for empirical research.

First, we contribute to a growing literature on international secrecy by characterizing conditions in which states will conceal rather than advertise their growing capabilities.[9] Whereas researchers often assume that countries relentlessly strive to enhance or signal their relative strength,[10] we show that states sometimes deliberately conceal—and even intentionally forgo—potential improvements in military power. Although countries may attempt to augment their power by developing in secret, they must balance the potential benefits of success against the costs of premature exposure. In some cases, the expected payoffs of secrecy are sufficiently small that states will eschew viable development options altogether. The prediction that countries sometimes select *out* of powerful alliances and potent military investments should motivate researchers to reconsider the assumption that allying and arming decisions result from states' unrelenting thirst for power.

Second, our results contribute to formal research on the causes of war by showing that existing models overestimate the range of circumstances in which private information and commitment problems lead to fighting. Whereas existing theories imply that asymmetric information increases the likelihood of war, we identify a broad set of conditions under which secrecy instead facilitates peace. Likewise, in contrast to prominent research on commitment problems, we find that the presence of a "large and rapid power shift" is neither a necessary nor sufficient condition for bargaining failure.[11] Instead, countries can sometimes avoid conflict by concealing potential power shifts and then settling disputes after their capabilities mature. Put simply, although private information and commitment problems independently make fighting more likely, in combination they create new opportunities for peace.

Third, we show that suspicion of concealed development can significantly change bargaining and conflict behavior. Because countries cannot discern whether their opponents have opted to forgo development or to develop in secret, they must treat all potential enemies with equal suspi-

[9] Yarhi-Milo 2013, Bas and Schub 2016, Carson 2016, Carson and Yarhi-Milo 2017.

[10] On acquiring power, see Mearsheimer (2001) and Grieco (1988). For the benefits of signaling, see Banks (1990).

[11] Powell 1999, Powell 2004, Powell 2006.

cion. As a result, the possibility of secret behavior provides a boon for states that wish to develop while imposing a burden on those who do not. Just as law-abiding citizens must sometimes make costly adjustments to their behavior to avoid criminal profiling, we show that non-developing states are forced to offer bargaining concessions to assuage the suspicions of their adversaries. This *reassurance tax* constitutes a significant cost that states could avoid if their capacities for clandestine activity were credibly diminished. We argue in Section 4.4 that empirical research on actors under suspicion of illicit activity—ranging from weapons proliferation by rogue states to counterinsurgent cooperation by civilian informants—may benefit from acknowledging this dynamic.

Finally, we distinguish between two types of war that can arise from secrecy, which we term *wars of discovery* and *wars of suspicion*. When the expected benefits of secrecy are large, countries may gamble by engaging in risky clandestine development. If they are caught in the act, however, a *war of discovery* may follow. On the other hand, *wars of suspicion* occur when countries face adversaries who strongly suspect clandestine activity. When such suspicions are sufficiently high, the cost of reassurance may be so large that even non-developing countries are unable or unwilling to signal their benign intentions. By highlighting the difference between these two causal mechanisms, our theory establishes a new framework for analyzing preventive war and also generates new advice for policymakers who are suspicious about the intentions of their adversaries.

2 Signaling, Secrecy, and Preventive War

Whether they arise from the acquisition of territory, the formation of alliances, or the development of new technologies, public shifts in military power enable states to coerce their adversaries. When war occurs, relatively strong countries are more likely than their rivals to win outright and also to impose heavy costs on their enemies. Opponents who recognize that their adversaries have gained strength should therefore be less eager to fight and more willing to settle disagreements peacefully, even if settling requires costly concessions.[12] An important but easily overlooked nuance within

[12] Countries can successfully coerce their enemies without actively engaging in combat, as long as rivals believe that combat *would* occur if negotiations failed.

this framework is that countries do not directly obtain coercive leverage merely by acquiring power. Although military strength is inherently useful once fighting begins, the same is not true during pre-war negotiations, where improved capabilities are only helpful if opponents believe that those capabilities exist. A country whose rivals mistakenly perceive that it is strong may, for example, be better able to coerce its adversaries during a pre-war crisis than a genuinely strong country whose enemies believe that it is weak.[13] Put another way, success in crisis bargaining relies on the mere *perception* of strength, whereas success in war often hinges on whether countries genuinely possess military power when called upon to use it.

Because war and bargaining outcomes rely on the acquisition and appearance of strength, respectively, countries face incentives not only to pursue improvements in military power but also to credibly demonstrate the gains they obtain. A wide theoretical literature therefore identifies mechanisms through which genuinely strong states can separate themselves from weaker imposters.[14] Research on this issue has produced two general conclusions. The first is that credible signals of strength allow strong actors to obtain better bargaining outcomes.[15] The second is that public signals help countries avoid conflict; war is most likely to occur when actors are either incapable or unwilling to share information about their strength or resolve. Speaking loosely, the rationale is as follows: although sufficiently large shifts in the distribution of power may force states to renegotiate the status quo, this process can occur through peaceful compromise rather than conflict. Fighting need only occur when countries disagree about the distribution of power and the extent to which previous agreements must be revised in order to satisfy the interests of the rising side.[16] Public demonstrations of military capacity help opponents avoid war by enabling them to reconcile their conflicting beliefs about relative military strength and then identify appropriate bargains.[17]

[13] The process of fighting can reveal information about each state's genuine capabilities, so genuinely strong countries may eventually achieve favorable settlements after a period of fighting.

[14] Schelling 1960, Schelling 1966, Fearon 1994, Fearon 1997, Smith 1998, Slantchev 2005, Slantchev 2006, Tomz 2007, Weeks 2008, Slantchev 2011, Slantchev 2012.

[15] Morrow 1989, Banks 1990.

[16] Blainey 1988, Morrow 1989, Fearon 1995, Powell 1999, Slantchev and Tarar 2011, Fey and Ramsay 2011.

[17] For example, after World War II several American military advisors argued that the U.S. should exploit its nuclear advantage by attacking the relatively weak Soviet Union. The likelihood of war decreased when the Soviet Union's own nuclear tests convinced the Americans that war would be costlier than they previously anticipated.

Unfortunately, signals of strength are risky as well as informative. Although states can dispel their opponents' naïve optimism by credibly demonstrating military power, 'preventive war' theories argue that such demonstrations may sometimes provoke war rather than resolve it. Because a rising state can use its growing coercive power to extract concessions from an adversary, a country who discovers that its opponent is rapidly gaining strength may doubt the opponent's commitment to status quo agreements and may initiate a preventive attack on the basis of this concern. By fighting before a power transition is complete, the declining country can enter a war on better terms and, if victorious, forestall the concessions that the emerging power would demand if it completed its rise unchallenged.[18] Today, preventive war is among the most widely invoked concepts in discussions of international conflict.[19]

In short, military power shifts can produce diverging outcomes: in some cases signals of military strength can deter conflict, but in other situations they can provoke preventive attacks. How do growing states manage this tradeoff? When will the fear of preventive war dissuade a state from announcing its military development or even pursuing development in the first place?

One means of answering these questions is with a formal model in which countries endogenously decide not only whether to pursue military development but also whether to announce such development publicly. Because the decision to arm and the decision to signal have thus far been examined separately, existing research largely overlooks the dual risks and benefits of arming. Theorists have identified numerous mechanisms that enable countries to send credible public signals, but relatively little research examines how or why states should conceal their capabilities.[20] Slantchev (2010) and Lindsey (2015) represent two exceptions to this rule; each author analyzes a scenario in which a country has an incentive to "feign weakness." However, their models are

[18] Although preventive conflicts are costly and risky, it is sometimes rational for a declining country to gamble on a short and decisive conflict rather than suffer the inevitable and enduring concessions they would be forced to offer if the transition reached maturity. See Gilpin 1981, Levy 1987, Fearon 1995, Fearon 1996, Powell 2006, Trachtenberg 2007, Debs and Monteiro 2014, Krainin 2017.

[19] A.J.P. Taylor (1954, p. 166) famously claimed that "Every war between the Great Powers [from 1848-1918] started as a preventive war, not a war of conquest."

[20] Even investigations of secret behavior often seek to explain how signaling remains possible in a non-public setting. See, for example, Yarhi-Milo 2013, Carson 2016, and Carson and Yarhi-Milo 2017.

limited to situations in which war is imminent or ongoing and deterrence attempts are of limited value. Likewise, although Baliga and Sjöström (2008), Debs and Monteiro (2014), and Bas and Coe (2016) depict scenarios in which opponents are uncertain about whether military development exists, their models do allow the rising state to deliberately conceal or strategically reveal such development. To fully analyze how growing countries balance their interest in deterrence against the risk that signals of strength will provoke preventive war, a model must incorporate both a state's decision to develop new technology as well as the option to either advertise or hide its power.

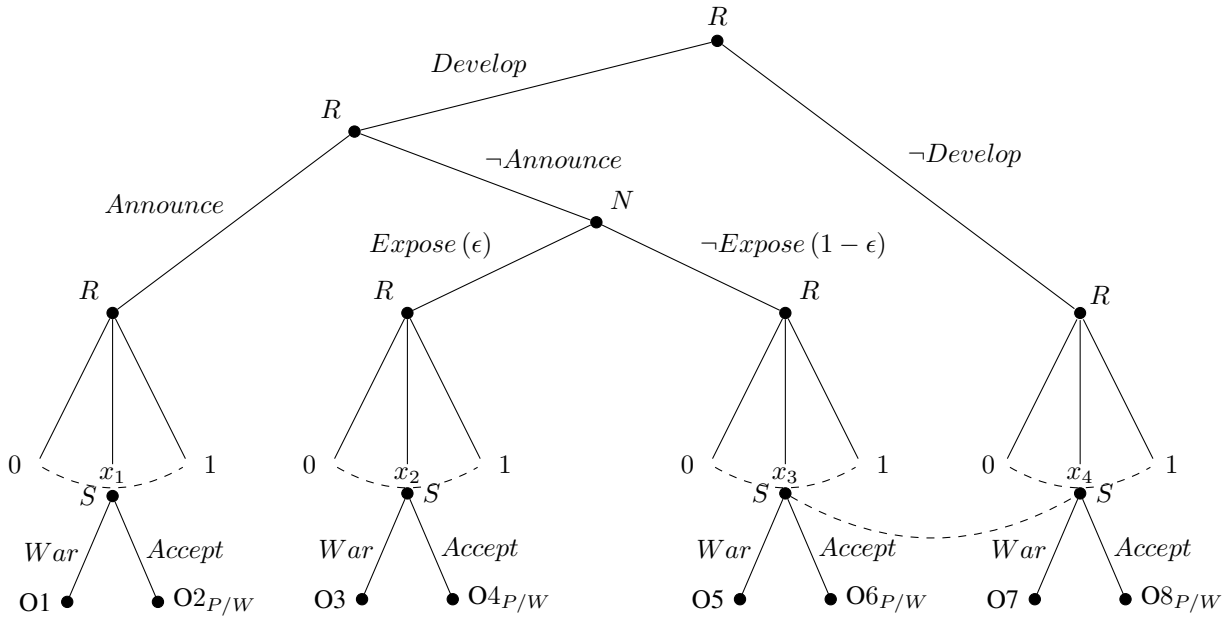
History provides an additional rationale for constructing a model in which actors can announce or conceal their development decisions. The empirical record suggests that countries recognize the strategic tradeoff between signaling and secrecy. Beyond providing an empirical justification for a theory with endogenous secrecy, these historical episodes suggest that when countries engage in secret activity they worry that news of their efforts will leak to the opposing side. Thus, a potential developer faces a choice of three options. They can publicly announce development in hopes of reaping deterrence and bargaining gains, attempt to conceal development—and run a risk that such development will be exposed—or, finally, forgo development altogether. The model we introduce in the following section incorporates each possibility.

3 The Secret Development Model

3.1 Setup

Figure 1: Crisis Bargaining Model with Secret Development

If the suspicious actor (S) accepts the rising actor's (R) proposal (x_i), play proceeds to a second bargaining period in which developed matures and peace or war can occur.



Appendix A lists the payoffs associated with each outcome (O_i).

To analyze how countries decide whether to pursue and announce military development, we present a two-period game between two risk-neutral players, R (the rising actor) and S (the suspicious actor), who contest a continuously divisible good represented by the interval [0,1].

At the beginning of the game, R chooses whether or not to attempt a process of costly "development" that, if successful, would augment her bargaining power. One can envision the potential development as the formation of a military alliance, the initiation of military arms construction, or the fortification of contested territory. If R chooses to develop, she then chooses whether to announce or conceal this decision.[21] Even if she does not deliberately announce the process of

[21] We assume that the announcement of development is both credible and costless. This reflects the fact that countries routinely engage in military demonstrations in order to depict their capabilities, and such demonstrations are often successful. Although countries sometimes face difficulty signaling their abilities, we deliberately remove such challenges from the model for the sake of conceptual clarity. To the extent that actors in the model pursue secret development, their behavior is not attributable to the costs or inefficiency of sending public signals. Instead, the model shows that rational players may pursue secrecy even when signaling is free and perfectly informative.

development, she runs a risk that Nature (N) will expose her development attempt before it is complete. Such exposure occurs with probability ϵ, which represents the collective chance of all forms of potential exposure, including discovery of an alliance via espionage, unauthorized leaking of the clandestine military activity, or accidental revelation of illicit arms construction. The true risk of exposure is privately known by the developing state, because only she is aware of the extent to which she had undertaken measures to avoid discovery.[22] The suspicious player (S) therefore observes R's development in two cases: the first is when R voluntarily announcer her development; the latter is when R's development is prematurely exposed. However, S observes no development in two alternative branches of the tree: when R chooses not to reveal successful development and when R has not attempted development at all. In these cases, S remains uncertain about his location within the game.

Once R attempts development (or not), announces (or not), and exposure occurs (or not), the players engage in ultimatum bargaining.[23] During the bargaining process, player R proposes a division of the contested good. We denote R's proposal as $x_i \in [0, 1]$, with $i \in \{1 - 4\}$ for each possible branch of the tree. The proposal is structured such that R receives x_i while S receives the complement, $(1 - x_i)$. Player S can either reject R's offer by initiating a war or can accept the offer, in which case the game proceeds to a second period in which the process of development that R initiated in the first period confers additional benefits.

If S chooses war, conflict occurs via an all-or-nothing lottery that results in victory for one country at the hands of the other. We represent player R's probability of victory in war as $p \in [0, 1]$, and S's probability of victory as the complement, $(1 - p)$. Each player suffers a one-time cost for fighting, $c_i \in (0, 1]$, with $i \in \{r, s\}$. Because war is an all-or-nothing contest, the probability of victory, p, and the costs that each side would pay for war, c_i, collectively determine each player's expected payoff from fighting. When war occurs, the game ends. The overall payoffs that each state would receive by reaching any terminal node of the game are noted in Appendix A.[24]

[22] S knows the distribution of these risks; his belief is the expectation of the distribution. This is common knowledge.

[23] Fearon 1995, Powell 1999, etc.

[24] Following convention, we discount all payoffs from the second period by $\delta \in [0, 1]$.

All information in the game becomes common knowledge if player R announces her development, if R's development is exposed, or if play progresses into the second period. In that period, either player can once again unilaterally initiate war or, alternatively, both players can mutually agree to a new division of the contested good. If neither player initiates war in the second period, they instead reach a new settlement determined by a generic bargaining technology, which we denote $\beta \in [0, 1]$. The technology selects a division point within the range bounded by either player's minimum payoff from fighting. Thus, if $\beta = 1$, the new division would be set at the maximum bargain R could credibly extract from S, which is defined by S's payoff from fighting in that period. Likewise, if $\beta = 0$, the division would be set at the minimum bargain that R would credibly accept, which is defined by R's own war payoff. Interior values of β scale proportionally within this range.

Finally, military development should boost a country's likelihood of success in war. Thus, when player R pursues development, R's probability of victory in the first period rises from p to $(p + D)$, with $D \in [0, 1]$ and $(p + D) \leq 1$. We assume that whatever development R pursued in the first period will mature in the second period unless interrupted by war. As a result, player R continues to obtain this benefit in the second period but enjoys an additional increase in its military capacity such that its probability of victory is now $(p+D+\Delta)$, with $\Delta \in [0, 1]$ and $(p+D+\Delta) \leq 1$. One can therefore interpret D as the short-term military benefit of development and Δ as the long-term military benefit of development. To encompass different varieties of military development, we allow the relative size of D and Δ to differ.[25]

[25] For example, nuclear weapons programs grant very small immediate military benefits but produce large shifts in military power upon completion. They therefore represent a case where $D < \Delta$. Military alliances, on the other hand, may facilitate immediate cooperation and intelligence sharing between countries and, as a result, may yield significant immediate benefits with smaller long-term gains ($D > \Delta$). Other military actions, such as the capture of contested territory or the development of new conventional arms may produce alternative ratios between D and Δ.

3.2 Analysis

We show that Perfect Bayes Equlibria (henceforth, equilibria or PBE) exist that yield five distinct behaviors: (1) *public development* in which the rising state (R) publicly reveals her development and derives a bargaining benefit in the first period; (2) *wars of discovery*, in which the suspicious player (S) becomes aware of secret development by R and initiates a preventive attack on the basis of this information; (3) *wars of suspicion*, in which player S merely suspects that player R is developing in secret and launches a preventive attack as a result of this belief; (4) *successful secrecy* in which R's secret development is not exposed and R gains a second-period bargaining advantage as a result; and, (5) the case in which R engages in *no development*.

Public Development

Consider the case in which player R publicly announces her development and proposes a division at x_1. Let $\bar{x_1}$ represent the largest demand that R can make that will not lead her opponent to choose preventive war. Because player S prefers war when his payoff from fighting equals or exceeds his continuation payoff from peace,[26] it follows that he will choose war when:

$$x_1 > p + c_s + D - \delta\Delta + \delta[c_r - \beta(c_r + c_s)] \equiv \bar{x_1} \tag{1}$$

Below this threshold, S prefers to accept R's offer rather than initiate war. R can therefore make S weakly prefer peace over war by offering $\bar{x_1}$. However, note that the size of R's proposal is bounded from below by two values. The first reflects R's preferences: she will never propose a value of x_1 that, if accepted, would leave her worse off than war. As a result, $x_1 \geq p - c_r + D - \delta[\Delta - c_r + \beta(c_r + c_s)]$. The second constraint is directly imposed by the bargaining technology at play: the most generous proposal that R can credibly make in the first period is to offer her opponent the entirety of the contested good. As a result, it must be the case that $x_1 \geq 0$. Let $\underline{x_1}$ represent the higher of these two boundaries, or the minimum credible offer that R can make when publicly-developing. For R to propose a feasible division that also appeases player S, it must be

[26] In the second period, the players will agree on a peaceful division because fighting is costly and bargains are efficient. When β is equal to either 0 or 1, the bargaining technology results in the war payoff for the player against whom the bargaining process is biased. In this case, the disfavored player is indifferent between war and peace.

the case that $\bar{x_1} \geq \underline{x_1}$. This is true as long as $p + c_s + D + \delta(c_r) \geq \delta[\Delta + \beta(c_r + c_s)]$. Collectively, these results yield Lemma 1:

> ***Lemma 1:*** In the region of the parameter space where $p + c_s + D + \delta(c_r) \geq \delta[\Delta + \beta(c_r + c_s)]$, R can publicly announce her development and then propose $\bar{x_1}$ without provoking preventive war.

Lemma 1 demonstrates that an area of the parameter space exists in which R can publicly announce development without causing S to initiate war. We now ask whether making such an announcement is optimal for R or if she can gain an advantage by keeping her development secret. If R declines to announce development, she can either attempt secret development—and run the risk that Nature will reveal her actions—or forgo development altogether. When R attempts secret development and is exposed by Nature, S becomes aware of R's development just as if R had announced the development herself. Thus, by the time R proposes a division, $\bar{x_2} = \bar{x_1}$ and the analysis from Lemma 1 applies equally to this branch of the game. As such, in the part of the parameter space characterized by Lemma 1, R gains no advantage by attempting secret development that is revealed by Nature. On the other hand, if R pursues clandestine development and Nature does not reveal this activity, then S remains uncertain whether R declined to develop or if R is developing secretly. In this case, the largest demand that R can extract from S without triggering preventive war is $\bar{x}_{3/4}$, where σ depicts S's posterior belief about the likelihood of secret development:

$$\bar{x}_{3/4} \equiv p + c_s + \sigma(D - \delta\Delta) + \delta[c_r - \beta(c_r + c_s)] \tag{2}$$

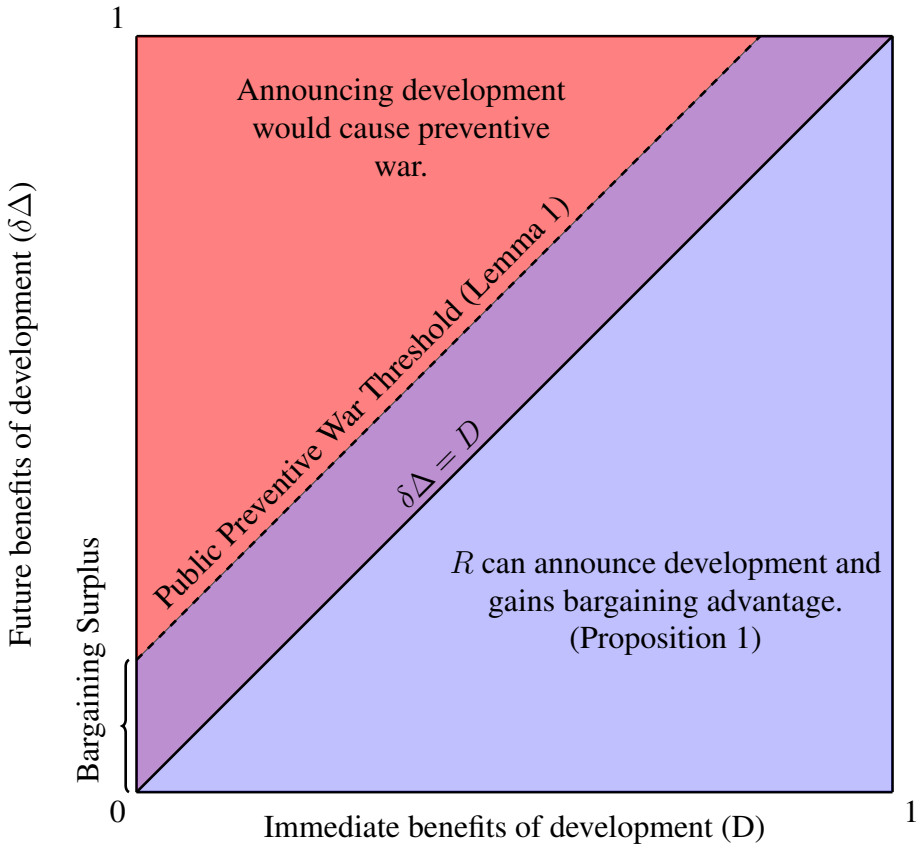
Notice that if $D > \delta\Delta$ then $\bar{x}_{3/4} < \bar{x_1} = \bar{x_2}$ except when $\sigma = 1$. Thus, if the immediate benefit of developing (D) outweighs the discounted future benefits of development ($\delta\Delta$) and Lemma 1 is satisfied, player R should announce her development rather than conceal it. Conversely, if $D < \delta\Delta$ then $\bar{x}_{3/4} > \bar{x_1} = \bar{x_2}$, and player R may be able to obtain a better payoff from secrecy than by publicly announcing her development. Finally, when Lemma 1 is not satisfied, player S will always choose war if Nature reveals R's secret development because R will be unable to credibly offer a division of sufficient size to appease S. Collectively, these results yield Proposition 1:

Proposition 1: Public Development. If $D > \delta\Delta$ and parameter values satisfy Lemma 1, there exists an equilibrium in which player R publicly announces her development and offers $\bar{x_1}$. Player S accepts all $x_1 \leq \bar{x_1}$ and rejects all $x_1 > \bar{x_1}$, so S accepts R's offer. In the second period, both countries implement a peace agreement such that R receives $\delta(p + D - c_r + \beta[c_r + c_s])$ and S receives $\delta(1 + c_r - p - D - \Delta - \beta[c_r + c_s])$.

Proposition 1 establishes the existence of a *public development equilibrium* in which a country can gain a bargaining advantage by publicly announcing its military development. For this to be the case, the immediate benefits of development must exceed the future returns and the announcement of development must not directly provoke preventive action by an opponent. Figure 2 depicts this result visually. When the values of $\delta\Delta$ and D fall in the lower-right (blue) area of the parameter space, player R can publicly announce her development without provoking a preventive war. In the upper-left (red) area of the parameter space, R cannot announce public development without provoking preventive war. The intermediate (purple) region depicts an area of the parameter space in which the advent of war depends on the size of the bargaining surplus.[27] When the surplus is larger, the upper boundary on this region moves upward and player R can announce a larger range of military developments without provoking war. Conversely, when the surplus is smaller, the upper boundary on this region moves downward toward the $\delta\Delta = D$ diagonal.

[27] This surplus is player R's probability of victory, plus the costs that either side would incur while fighting.

Figure 2: Immediate (D) vs. Future Development ($\delta\Delta$) Returns



Wars of Suspicion

Henceforth, we analyze what will occur when public development is *not* player R's optimal strategy. In other words, we examine the red area of Figure 2, where public development would trigger war. In this area of the parameter space, R may pursue development but will not publicly announce her decision. Unless N reveals development, S remains uncertain whether R has developed. To satisfy S, R must propose $x_{3/4} \leq \bar{x}_{3/4}$. However, as in the public alliance example, R's minimum demand is bounded below by her own war payoff. Let $\underline{x}_3$ and $\underline{x}_4$ represent the minimum amount that R can credibly propose when secretly developing and not developing, respectively:[28]

$$\underline{x}_3 \equiv p - c_r + D - \delta\Delta + \delta[c_r - \beta(c_r + c_s)] \tag{3}$$

$$\underline{x}_4 \equiv p - c_r + \delta[c_r - \beta(c_r + c_s)] \tag{4}$$

[28] Because R's most generous demand in the first period is to offer S the entire contested good, $\underline{x}_3$ and $\underline{x}_4$ must also equal or exceed 0. In addition, because $\delta\Delta > D$ in this area of the parameter space, $\underline{x}_4 > \underline{x}_3$.

Let $\sigma_0 \in [0,1]$ denote S's belief that A is engaged in secret development.[29] Using $\underline{x}_3$ and $\underline{x}_4$ we can identify thresholds on σ above which player R cannot propose a division that S would accept in lieu of preventive war. Let $\bar{\sigma}_{Dev}$ represent the point on σ above which the minimum credible demand from secretly-developing country R ($\underline{x}_3$) would exceed any division that S would accept ($\bar{x}_{3/4}$). Likewise, let $\bar{\sigma}_{Non}$ represent the value of σ above which $\underline{x}_4 \geq \bar{x}_{3/4}$ and the smallest credible demand from non-developing country R exceeds the maximum proposal that S would accept:[30]

$$\bar{\sigma}_{Dev} \equiv \frac{c_r + c_s}{\delta\Delta - D} + 1 \tag{5}$$

$$\bar{\sigma}_{Non} \equiv \frac{c_r + c_s}{\delta\Delta - D} \tag{6}$$

In the area of the parameter space in which $\sigma \geq \bar{\sigma}_{Non}$, S will reject all credible offers from R and initiate preventive war with certainty.[31] Because when D is positive R obtains an equal or better first-period war payoff from developing than from not-developing, she always chooses to develop—though she is indifferent between developing publicly or secretly because both choices lead to preventive war with certainty. This result yields Proposition 2:

> ***Proposition 2: Wars of Suspicion.*** If $D < \delta\Delta$, $\sigma > \bar{\sigma}_{Non}$, and the conditions of Lemma 1 are not satisfied, then player R will develop when D is positive and can mix between developing and not-developing when $D = 0$. R will be indifferent between developing publicly or developing secretly, and R will offer $x_i > \underline{x}_3$. However, S rejects all $x_i > \bar{x}_3$, and in this area of the parameter space $\underline{x}_3 > \bar{x}_3$, so war will occur.

Proposition 2 establishes the existence of *war of suspicion equilibria*. Put simply, there exists an area of the parameter space in which player S is sufficiently suspicious of secret development that no credible offer from R can ever satisfy player S. Above this threshold, war will always occur.

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[29] Following Bayes' rule, S updates σ_0 to the posterior σ based on all it observes before responding to R's initial offer. Thus, in the branches of the game where R publicly announces her development or this development is credibly exposed by nature, $\sigma = 1$. When R either chooses not to develop or succeeds in concealing her development, S remains uncertain about whether development has occurred and σ takes an intermediate value.

[30] Notice that $\bar{\sigma}_{Non} < \bar{\sigma}_{Dev}$. Furthermore, because in this area of the parameter space $D < \delta\Delta$, it must be the case that $\bar{\sigma}_{Non}$ is positive and that $\bar{\sigma}_{Dev}$ falls outside the interval $[0,1]$. $\bar{\sigma}_N$ is therefore the relevant condition.

[31] War will occur above this threshold if player R chooses not to develop because R's smallest credible demand ($\underline{x}_3$) would still be too large to satisfy player S. Likewise, if R develops secretly and issues a bargaining demand greater than $\underline{x}_3$, this offer will fail to satisfy player S. Finally, a secretly-developing R could attempt to offer $x_4 < \underline{x}_3$, but a rational S will conclude that only a secretly-developing R could credibly make such an offer. Thus, when S observes $x_i < \underline{x}_3$ he will Bayesian update, realize that R has developed secretly, and initiate preventive war.

The Secrecy Gambit: Wars of Discovery, Successful Secrecy, and Non-Development

Finally, we consider the region of the parameter space in which $D < \delta\Delta$, Lemma 1 is not satisfied, and wars of suspicion will not occur. Thus, R cannot announce development without provoking preventive war, but the value of σ is not so high that S will initiate preventive war even in the absence of exposure by Nature. Within this range of the parameter space, player S will initiate war if Nature reveals secret development. This framework creates the possibility of *wars of discovery*, which we characterize in Proposition 3:

> ***Proposition 3: Wars of Discovery*** In the area of the parameter space where the conditions of Proposition 1 and Proposition 2 are not satisfied, a player R whose secret development is revealed by Nature will never make a demand (x_2) that would make her worse off than war. Thus, $\underline{x}_2 \geq p - c_r + D - \delta\Delta + \delta[c_r - \beta(c_r + c_s)]$. However, if Nature reveals R's secret development then S will reject all $\bar{x}_2 \geq p + c_s + D - \delta\Delta + \delta[c_r - \beta(c_r + c_s)]$. Because $\bar{x}_2 < \underline{x}_2$, R's demand will never satisfy S if Nature reveals R's secret development and war will always occur.

Thus, war occurs whenever Nature reveals secret development. We refer to this outcome as a "war of discovery" because the advent of war hinges on the exposure of secret development.

We now show that there exists an area of the parameter space in which the benefits of *successful secrecy* are sufficiently large that R will risk a war of discovery in hopes of obtaining them. Likewise, there exist areas of the parameter space in which R believes the risk of exposure is sufficiently high that R will forgo secret development in order to avoid exposure and war. When selecting behavior, player R weighs the expected payoffs of secret development against those of non-development while estimating the risk of exposure as ϵ_R. As we show in Appendix B, the expected benefits of secret development are an increasing function of S's posterior, σ, which both players are able to calculate using S's prior, σ_0, and S's estimate, ϵ_S, of the likelihood of exposure. From these we can construct ϵ_R^*, which denotes the threshold value of ϵ_R at which player R is indifferent between secretly developing and not developing. Furthermore, for $\epsilon_R < \epsilon_R^*$, R prefers to develop secretly whereas when $\epsilon_R > \epsilon_R^*$, R prefers to forgo development. S therefore calcu-

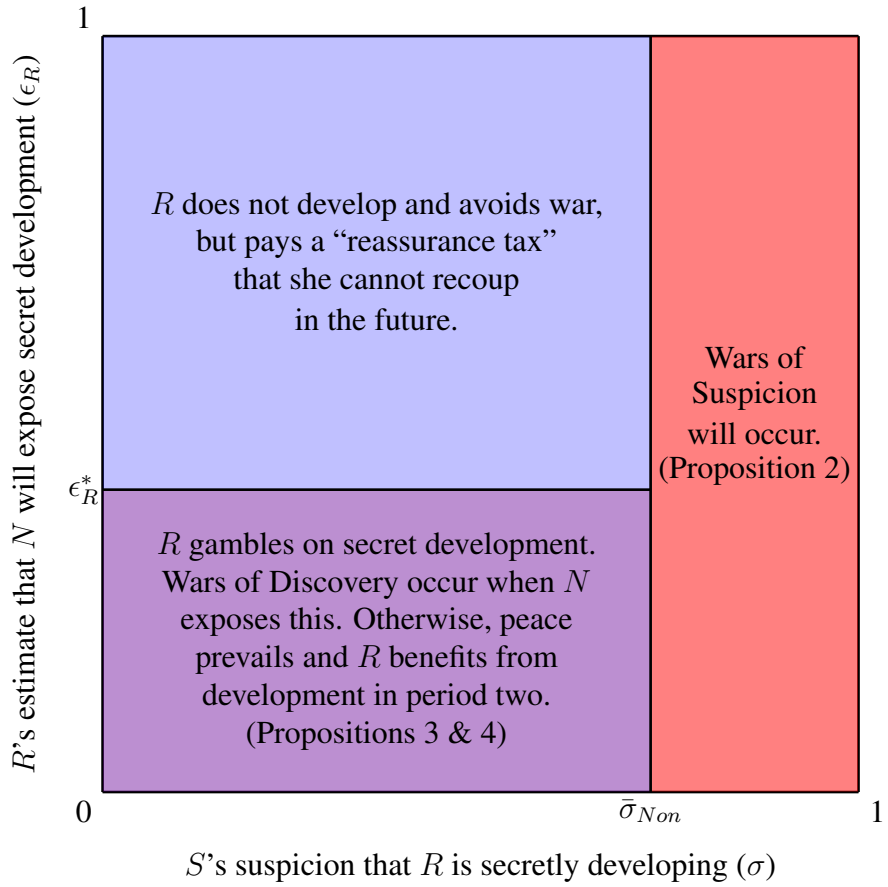
lates R's probability of secretly developing as $F(\epsilon_R^*)$. In equilibrium, S's prior belief and $F(\epsilon_R^*)$ codetermine each other: $\sigma_0 = F(\epsilon_R^*)$. This leads to Proposition 4 (proof in Appendix B):

> ***Proposition 4: The Secrecy Gambit.*** In the area of the parameter space where the conditions of Proposition 1 and Proposition 2 are not satisfied, a pure strategy PBE exists in which player R secretly develops when $\epsilon_R < \epsilon_R^*$ and chooses not to develop when $\epsilon_R > \epsilon_R^*$. When $\epsilon_R = \epsilon_R^*$, a mixed strategy PBE exists in which R secretly develops with probability σ and forgoes development with complementary probability. In all cases, R will offer $\bar{x}_{3/4}$, which makes S indifferent between initiating war or accepting. S responds by mixing between rejecting the offer with probability σ and accepting with probability $1 - \sigma$. If S accepts and play progresses to the following period, the players agree to a peaceful division.

Figure 3 provides a graphical interpretation of the main results from Propositions 2-4. The figure depicts the upper-left area of the parameter space from Figure 2, in which public announcements of military development would provoke war. Although previous analyses of preventive conflict suggest that power shifts in this region should trigger war,[32] the figure shows that preventive war will not occur with certainty unless player S's suspicion level exceeds $\bar{\sigma}_{Non}$. For example, in the upper-left (blue) area of the parameter space, the risk of exposure (ϵ) is sufficiently high that player R is deterred from ever attempting development and war will not occur. The lower-left (purple) area of the parameter space shows another area where war may not occur. Here, the risk of exposure is sufficiently low that player R is willing to "gamble" by attempting secrecy, and war only occurs when exposure occurs. The result demonstrates that large and rapid power shifts are not a sufficient condition for war. Instead, peaceful power shifts are possible when an opponent's suspicion level falls below the $\bar{\sigma}_{Non}$ threshold.

[32] Fearon 1995, Powell 2006.

Figure 3: Player B's Suspicion (σ) and Player A's Estimate of Exposure (ϵ_R)



4 Discussion and Implications

4.1 Power Shifts and Preventive War

Several enduring political questions ask how actors respond to shifts in the balance of power. Robust literatures explore whether new alliances deter or provoke conflict,[33] how actors choose between arming or allying in response to threats,[34] and why countries sometimes accommodate emerging rivals but in other cases initiate war.[35] Central to all these discussions is the assumption that power shifts may provoke adversaries to adopt preventive behavior or even engage in pre-

[33] Levy 1981, Huth 1988, Smith 1995, Leeds 2003, Kenwick, Vasquez, and Powers 2015, Morrow 2017.

[34] Morrow 1993, Glaser 2004, Monteiro and Debs 2014, Yarhi-Milo, Lanoszka, and Cooper 2016.

[35] Gilpin 1981, Levy 1987, Powell 1996, Copeland 2000, Powell 2006, Levy 2008, Debs and Monteiro 2014, Bell and Johnson 2015, Bas and Coe 2016.

ventive attacks.[36] In recent decades, formal theorists have identified specific mechanisms through which such wars can arise. Fearon (1995) introduced an analytic stylization of preventive war as a result of impending shifts in power, Powell (2004, 2006) identified a general condition by which "large and rapid" power shifts should guarantee conflict, and Krainin (2017) generalized this result to also include slower, long-term shifts.[37]

However, in contrast to Powell, our model demonstrates that the existence of a "large and rapid power shift" is neither a necessary nor sufficient condition for bargaining failure. First, preventive wars can occur even in the absence of genuine arming as long as an opponent *suspects* that military development will occur. Second, even the presence of a genuine power shift may not cause war when the opponent is unaware or uncertain that a shift is imminent. Put simply, developments that exceed the "Public Preventive War Threshold" in Figure 2 need only cause war if they are openly revealed. Countries will therefore attempt to keep such developments hidden or will eschew them entirely if the risks of exposure loom too large.

Finally, the model shows that military developments that provide large immediate benefits can attenuate the threat posed by future power shifts. As illustrated in Figure 2, developments that yield large future returns ($\delta\Delta$) may not trigger war when accompanied by similarly large short-term changes in the distribution of power (D). On the other hand, even relatively small changes in future power may provoke preventive attacks when they occur in the absence of immediate arming. In short, although large future power shifts may cause war, immediate shifts in the distribution of power should be associated with peace.

These results produce important implications for studies of military arming, power shifts, and preventive conflict. Empirical researchers should not assume that large swings in the balance of power will predict war. First, potential power shifts may not be apparent to adversaries until they are publicly revealed. Second, countries engaged in long-term development may deter their rivals from preventive action by revealing new capabilities that are immediately available.

[36] Thucydides 1954, p. 1.23 famously attributed the cause of the Peloponnesian War to "the growth of Athenian power and the fear which this caused in Sparta." Other prominent discussions of power shifts and war include Gilpin (1981), Levy (1987), Walter (1997), Copeland (2000), Trachtenberg (2007), and Bell and Johnson (2015).

[37] See also Powell 1999, Leventoğlu and Slantchev 2007, and Schub 2017.

Hitler's behavior during the 1938 Munich Crisis exemplifies this reasoning. At the time, Britain and France worried that Germany would soon seize Czechoslovakia and in doing so would gain access to foreign reserves, raw materials, and additional arms production that would greatly strengthen its military position in Europe. As a result, British and French leaders considered taking preventive action to halt the occupation.[38] To dissuade such an attack, Hitler enlisted the help of Mussolini, who announced support for Germany.[39] The de facto alliance *immediately* shifted Germany's apparent military strength, which not only raised the costs that Britain and France would face if they initiated preventive war, but also reduced the relative size of the power shift that Germany would obtain if its long-term occupation plans succeeded. Hitler was so confident that the announcement of Italian support would force his enemies to tolerate a large power shift that he rejected British and French offers of appeasement and began preparations for wholesale invasion.[40] However, less than a week after Hitler's refusal to negotiate, Mussolini withdrew his support. To forestall his adversaries from launching a preventive attack, Hitler also changed tactics. Rather than demand the entirety of Czechoslovakia, he agreed that Germany would occupy only the Sudetenland. This proposal reduced the size of the power shift that Germany was poised to achieve and dissuaded the British and French from attempting preventive war.[41]

4.2 The Risks of Signaling

Conventional wisdom suggests that strong countries have incentives to signal their military strength and resolve. Credible and convincing signals should persuade bargaining opponents that (1) the strong country is unwilling to grant large concessions, so the onus for compromise rests with the weaker actor, and (2) the relatively weak adversary should expect to perform poorly in the event

[38] Prime Minister Edouard Daladier argued that failure to defend Czechoslovakia would cause a brief delay followed by war that "the Western Powers would not win," and that "our own blindness [would provide] Germany with the very supplies she required for the long war which she... was not now in a position to wage" Ripsman and Levy (2007, p. 51).

[39] Corvaja 2008.

[40] Press 2004.

[41] By limiting his initial occupation to the Sudetenland, Hitler also created doubt in Britain and France about his overall territorial ambitions. In effect, the move enabled Germany to prepare in secret for the invasion of Czechoslovakia in early 1939, by which point the western countries were no longer able to threaten preventive action.

that negotiation fails and war begins. Indeed, Banks (1990) showed that costly signals of strength enable actors to claim deterrent and bargaining benefits in a broad range of models.

We show that countries also face incentives to forgo signaling in appropriate circumstances. Although states should eagerly announce their military development when they find themselves in the lower-right (blue) area of Figure 2, signaling strength is *not* useful when such announcements would provoke preventive attacks—as in the upper-left (red) area of Figure 2.[42] These findings contribute to our understanding of the risks and benefits of signaling. Whereas previous work recognizes the risks of signaling when war is already imminent—Slantchev (2010), for example, observes that signaling can enable opponents to prepare better for war, while Lindsey (2015) shows that signals may allow adversaries to respond with better tactics *during* war—our model demonstrates that sharing information can directly provoke war where none would otherwise occur.[43]

The difference between our model and prior theoretic accounts is evident in the case of the 1786 defense of the U.S. Federal Armory. In late September of that year, approximately 2,000 citizens assembled outside of a courthouse in Springfield, Massachusetts, to protest the state's extractive tax policies and poor economic conditions. Several hundred local militia members turned out to defuse the protestors, but demonstrations continued for several weeks. Eventually, Massachusetts Governor James Bowdoin and U.S. Secretary of War Henry Knox grew concerned that the protestors might arm themselves with weapons from the nearby Armory, and, once emboldened, might take to violence. Although the two men agreed to seek federal support to defend the armory, they worried that if the demonstrators learned of the move they might react by seizing weapons before troops could arrive. As a result, Knox wrote a widely published, public letter to

[42] This result may help explain why North Korean made little effort to hide its interest in nuclear weapons, whereas many other potentially proliferating states seek to conceal their intentions. Prior to its acquisition of nuclear weapons, Pyongyang already possessed relatively strong conventional military capabilities. These military forces effectively reduced the size of the power shift North Korea obtained by acquiring nuclear weapons. As a result, North Korea made minimal effort to obscure its pursuit of nuclear weapons throughout the late 1990s and early 2000s. Countries with smaller conventional militaries or for whom nuclear weapons would cause a larger shift in military capability relative to an adversary may need to devote greater effort to maintaining secrecy.

[43] A related empirical implication of our model relates to the correlation between signals of military strength during crises and lower rates of war. This result may not demonstrate that countries are successfully deterring enemies with signals of strength, but rather than signals are more likely to be issued in situations where the costs of war already dissuade all parties from escalation and so signaling is unlikely to provoke conflict. The signals that we observe during crises may, for example, be directed toward domestic audiences rather than foreign adversaries.

Congress in which he recommended diverting nearly the entire standing U.S. army to the Ohio Valley. Knox followed this with a private report explaining that the troops were actually required to defend the armory.[44] Whereas the Slantchev (2010) and Lindsey (2015) models argue that actors refrain from sending signals to prevent opponents from preparing for war when conflict is already due to occur, our model better depicts the logic of Bowdoin and Knox, who hoped that violence could be avoided altogether if the deployment of federal troops could be kept secret.

Our observation that concealing strength can enable countries to avoid war also yields important predictions for quantitative empirical research. In an important recent empirical paper, Bas and Schub (2016) identify a relationship between secret military alliances and conflict, which the authors attribute to mutual optimism. In other words, they argue that clandestine nature of secret alliances enables opposing actors to remain optimistic about their relative capabilities and therefore participate in wars they might avoid if they were fully-informed. However, their account raises the question of why allied countries persist in keeping their alliances secret if doing so raises the likelihood of unnecessary war. According to conventional explanations, the allies should attempt to reveal their partnership in order to extract peaceful concessions, deter adversaries, and avoid the cost of fighting. Our paper makes two contributions to this analysis. First, the empirical relationship between secret alliances and war that Bas and Schub (2016) detect may not result from wars of mutual optimism but instead from preventive wars that occur when opponents discover or are highly suspicious of secret alliances.[45] Second, our paper rationalizes the allies' decision for secrecy by showing that allies who expect to grow rapidly in the future have incentives to hide their alliances for fear that an announcement would trigger preventive conflict.[46]

[44] Congress approved the plan, stating publicly that the U.S. would act "on account of the hostile proceedings of several nations of the western Indians," while acknowledging in secret committee reports that "a dangerous insurrection [had] taken place in... Massachusetts" but that it was "not expedient" to explain to the public that troops were needed for this purpose Condon 2015, p. 63.

[45] We show in a separate analysis that the relationship Bas and Schub identify is strongly associated with significant improvements in the allied states' collective power relative to their adversary in the years immediately preceding conflict, a result that is consistent with the forms of preventive war predicted by our model.

[46] For example, the two allies' individual military growth may fall below the public preventive war threshold, but announcing an alliance may provoke a mutual rival into war if the allies' *collective* growth exceeds this condition.

4.3 Wars of Discovery and Wars of Suspicion

Our model further demonstrates that when actors develop clandestinely preventive wars can arise for two distinct reasons. *Wars of discovery* can occur when clandestine activities are prematurely exposed. Consider the Soviet behaviors that provoked the 1962 Cuban Missile Crisis. Concerned about a potential U.S. invasion of Cuba, Khrushchev decided to deploy weapons on the island in hopes that such weapons would equalize "what the West likes to call the 'balance of power."'[47] To avoid American preventive actions, the Soviets sought to keep the extent of their military relationship with Cuba a secret.[48] Indeed, when Cuban leaders proposed that the two countries announce their partnership in order to establish an immediate deterrent benefit, Khrushchev refused the request and instead promised to reveal the extent of Soviet-Cuban military cooperation one the deployments were fully operational.[49] The Soviets therefore acknowledged the riskiness of their military buildup in Cuba: war could occur if the activity was exposed prematurely, but if they were able to maintain secrecy until the development was complete they could announce the move in a fait accompli. The gambit backfired on October 14, when U-2 reconnaissance identified offensive missile sites in San Cristobal. Although Khrushchev eventually chose to withdraw the missiles, his actions very nearly provoked a *war of discovery* with the United States.[50]

On the other hand, *wars of suspicion* arise when threatened states are highly suspicious of clandestine activity—regardless of whether such activity actually exists. One prominent example of high suspicion relates to the United States' invasion of Iraq in 2003. Substantial debate exists in the literature as to why the United States concluded that Iraq possessed WMD and, more im-

[47] Quoted in George and Smoke (1974, p. 462). President Kennedy's statements reflect a similar sentiment, including his lament that "The Soviet move had been undertaken so swiftly, so secretly, and with so much deliberate deception... that it represented a provocative change in the delicate status quo" (Quoted in Lebow 2000, p. 15).

[48] Several Soviet personnel argued that exposure could provoke war with the United States. See Lebow and Stein (1995) and Lebow (2000).

[49] Hansen 2002.

[50] It is possible that Khrushchev initially underestimated the likely American response and then chose to withdraw when he realized his error. When Khrushchev decided to deploy missiles, Kennedy had not yet publicly pledged to prevent Cuba from obtaining offensive military capabilities. As such, Khrushchev might initially have assumed that exposure would result in preventive U.S. action but that any such behavior would fall far short of nuclear war. As the crisis elapsed, a series of unauthorized incidents and Kennedy's reactions led Khrushchev to believe that widespread nuclear engagement was much more likely than he originally believed.

portantly, why Iraq was unable to quell American suspicions.[51] Although other researchers blame the United States for its failure to gather accurate intelligence about Iraqi WMD development,[52] their explanation raises the question of why Iraq was unable to "clear the air." As President George W. Bush lamented in his memoirs, "If Saddam [Hussein] didn't have WMD, why wouldn't he just prove it to the inspectors?"[53] Our model provides a formal explanation for both Hussein's failure to provide information and the United States' decision to invade: the strategic environment inhibited Iraq from easily sharing information that might have reassured the U.S.[54]

In the language of our model, American suspicion (σ) that Iraq was developing WMD was extremely high in the prelude to the invasion. The United States developed a perception throughout the 1990s that "Iraq would never be forthcoming, and that if it was blocking access to the UN [inspectors], then it must have something to hide."[55] Unfortunately, Hussein was unwilling to offer convincing evidence that he had dismantled his nuclear program for fear that doing so would also alert his domestic and regional opponents to his military weakness.[56] When Hussein finally attempted to offer concessions by allowing United Nations (UN) inspectors to return in November 2002, the United States remained suspicious that he was still concealing his capabilities. In short, the largest credible concessions that Hussein could make in terms of inspections were insufficient

[51] For recent examples, see Duelfer and Dyson (2011), Lake (2010), McKoy and Lake (2011), Lake (2013), Debs and Monteiro (2014).

[52] See Kaufmann (2004), Flibbert (2006), Lake (2010), and Debs and Monteiro (2014) for arguments that the U.S. failed to optimally gather and process information.

[53] Bush 2010, p. 269. Note that although there is still much debate about whether members of the Bush administration maintained additional interest in the conflict, the overriding question is why Iraq did not demonstrate that the United States' publicly-stated rationale for war was built on flawed estimations of Iraqi WMD production.

[54] This corresponds to Lake's (2010) conclusion that Hussein chose not to reveal his lack of WMD because by doing so he would have incurred steep domestic costs and been constrained from deterring other opponents.

[55] Duelfer and Dyson 2011, p. 97. Following the terrorist attacks of September 11, 2001, members of the U.S. intelligence community also became acutely aware that they lacked the capabilities to detect all potential security threats in a timely manner (Debs and Monteiro 2014). As a result, the Bush administration adopted its "one percent" doctrine, according to which it treated even a one percent chance that Iraq could develop nuclear weapons as an unacceptable risk (Lake 2010).

[56] As Gordon and Trainor (2006, p. 63) explain, Hussein's "top priority was protecting his government against potential coups and internal threats... Iran, an adversary with whom he had fought a bloody eight-year war, was next on the list of dangers." The Iraqi leader appears to have believed that maintaining ambiguity over his WMD arsenal would simultaneously quell domestic unrest and deter attacks from Tehran. Duelfer (2004, p. 32) likewise argues that "This led to a difficult balancing act between the need to disarm to achieve sanctions relief while at the same time retaining a strategic deterrent. The Regime never resolved the contradiction inherent in this approach."

to reassure the United States, while the level of information that would have satisfied the Bush administration was too costly for Hussein to grant. In the end, Iraq was unwilling to provide reliable information about its own activities, the Bush administration remained suspicious of Iraqi development, and the U.S. embarked upon a war of suspicion.

By identifying this distinction between wars of discovery and wars of suspicion, we make three contributions. First, we bring formal models of preventive war into closer harmony with historical accounts. Whereas canonical formalizations depict wars of discovery in which actors become aware of ongoing or imminent power shifts, historians often describe wars of suspicion in which states remain uncertain but suspicious of their rivals' developments. Our model not only draws attention to both causal logics but also identifies conditions in which each category of preventive war is likely to occur.

Second, distinguishing between these separate mechanisms allows us to clarify the means by which states may attempt to avoid preventive war. Countries can eliminate the risk of wars of discovery by forgoing development—after all, development cannot be exposed if no development has occurred. However, countries cannot always eliminate the threat of wars of suspicion: when player S's suspicion exceeds the threshold $\bar{\sigma}_{Non}$, player R will lack any credible means of demonstrating that she has eschewed secret development.

Finally, acknowledging the difference between discovery and suspicion improves our understanding of how uncertainty relates to preventive conflict, an issue that is much debated in recent work. Whereas Debs and Monteiro (2014, p. 2) claim that "when power shifts are endogenous... preventive war requires uncertainty," their view is contested by Krainin (2017, p. 106), who argues that "incomplete information is not necessary to cause war using the logic of commitment problems." Our model shows that uncertainty yields different effects across each category of preventive conflict. Wars of suspicion are indeed caused by uncertainty: adversaries could avoid conflict if only R could credibly prove that it was not developing. However, wars of discovery are not caused by uncertainty but rather by the removal thereof: if player S remained uncertain about R's ongoing development, no discovery would occur and S would refrain from fighting.

4.4 Empirical Generality and the Reassurance Tax

Throughout this paper we refer to "war," "countries," and "military development" in order to facilitate intuition. However, the mechanisms we identify should apply to interactions beyond full-scale interstate wars. For example, although we discuss "preventive war," the action could describe any activity—violent or otherwise—in which risky or costly actions by one actor can thwart the relative gains of another. A country who discovers an adversary's secret research lab could, for example, attempt to destroy the lab or its employees with airstrikes, covert sabotage, cyberattacks, etc. None of these actions constitute "war" in popular parlance, but all fit the mould of our model by depicting costly and risky actions that can prevent the rise of an adversary.

Likewise, the players in our model could include any strategic actors who are locked in bilateral conflict with one another, ranging from states and insurgents to businesses and labor unions. Consider the example of businesses, which face the decision of whether to patent the technologies they develop. A firm that submits a patent can lock in a small flow of benefits in the form of licensing fees that competitors must pay if they adopt similar technology. However, patents also sometimes expose development pathways by making technological solutions public to attentive competitors. In some cases, the information contained within a public patent can allow competing firms to catch up in the research and development race in ways that counteract the revenue gained via licensing. As a result, businesses sometimes choose to delay or even forgo patent filings to avoid giving the competition an opportunity to react.[57] Similarly, when a labor union discovers pro-business lobbies are secretly advancing anti-union legislation, the union may take preventive action by carrying out strikes or counter-lobbying to quash the bill. Although such forms of competition are not "war" in the colloquial sense, and "legislation" is not the same as "military development," the situation parallels the strategic calculus laid bare by our model.

The wide applicability of our model is particularly helpful for making intuitive sense of one of our key discoveries, the *reassurance tax*. The option of secrecy, as noted earlier, is a boon to

[57] Elon Musk refuses to patent technologies developed by his company SpaceX, arguing that "Our primary long-term competition is in China. If we published patents, it would be farcical, because the Chinese would just use them as a recipe book." Quoted in Chris Anderson, "Elon Musk's Mission to Mars," Wired Magazine, October 21, 2012.

actors wishing to pursue ambitious power shifts, but a burden to those happy with the status quo. To see this latter point, imagine a citizen living in a surveillance state, where citizens' actions are constantly monitored for signs of radicalization or criminality. Under such circumstances, citizens must curtail their behavior in various ways in order to avoid drawing suspicion. If they think the government is for some reason suspicious of a particular religious group, for example, citizens may choose not to convert to that religion, nor to associate with its members. Or if they are already members, they may choose to eschew outward signals of devoutness either in public or on social media for fear of being profiled. We think of these self-imposed curtailments as a 'tax' paid by citizens to 'reassure' authorities.

The same idea applies in reverse to the burgeoning research on civilian wartime informants.[58] In this literature, a government wants to crush an insurgency embedded in a civilian population, but requires strategic information from the civilians on the whereabouts of insurgent weapons caches or hideouts. Models in this literature have so far treated the interaction as a one-off game: the civilian chooses whether or not to snitch, and the game ends.[59] In reality, of course, intelligence agencies cultivate informants to provide a flow of information over time. As a repeated game, secrecy becomes paramount, since the insurgents have a reason and opportunity to attempt "prevention" by killing or turning the informant. The importance of secrecy in these situations is sufficiently intuitive that researchers might assume that there is no need to model the interaction formally. However, this paper demonstrates that the process of modeling reveals non-obvious results such as the reassurance tax: non-informants live under the same weight of suspicion as informants, and must take steps to reassure the insurgents that they are not cooperating with the government. Such steps may range from avoiding places frequented by government officials, to refusing government services for fear of them being viewed as compensation, to actively helping the insurgency. In all cases this implies a polarizing effect, where civilians are forced to take sides in ways that may help or hinder the government. Technological shocks that facilitate secrecy, such as the introduction of mobile phones or counterinsurgency hotlines, raise the *reassurance tax* and exacerbate civil-

[58] Condra and Shapiro 2012, Shapiro and Weidmann 2015.

[59] Berman, Shapiro, and Felter 2011.

ian polarization.[60] Empirically, this polarization is also problematic for difference-in-differences (DID) studies that hope to capture the effect of snitching on outcomes like incidence of attacks or government casualties. In particular, wherever snitching is observed, there is also 'reassurance' activity that is unobserved, so DID estimates automatically conflate these two effects.

5 Conclusion

This article presents several major claims. First, the ability to announce or conceal military development is an important strategic tool. Whereas previous research suggests that signals of strength enable states to access deterrent and bargaining benefits, we show that such displays can also provoke conflict. As a result, countries have incentives to hide their capabilities even when signaling is credible and costless. Similarly, states should not always pursue the largest long-term improvements in military capability. To minimize the risk of preventive war, countries may rationally avoid forming alliances with strong partners or developing potent military technologies—even if such options are free to implement. Researchers should revisit theoretical and empirical research that assumes increases in military power are either universally desirable or are consistently associated with favorable conflict and bargaining outcomes.

Our second finding is that the *threat* of clandestine development can itself provoke war and create significant distributional consequences. Whereas previous theoretical research on preventive conflict focuses largely on complete-information environments where one actor becomes aware of an imminent power shift by the opposing side, we demonstrate that the mere suspicion of such a shift can compel an enemy to fight. Likewise, all actors under suspicion of development must pay concessions to their opponents in order to achieve peace, even if development has not actually occurred and will not occur in the future. Thus, the possibility that some actors are engaged in secret behavior creates negative externalities for those who do not participate in secret development.

Critics may complain that our stylized description of military arming abstracts too far from the complexity of the international environment. Indeed, we acknowledge that the model does

[60] See Shapiro and Weidmann (2015) for an example of such a shock.

not incorporate several realistic nuances that may yield interesting behaviors. Future researchers may investigate how the strategic behavior may change when opponents can invest resources in either intelligence or, alternatively, counter-arming. Identifying how states balance these options could prove a worthwhile extension. Likewise, our model considers a strategic interaction between only two players, whereas in reality military technologies are fungible and countries often confront several adversaries simultaneously. How might countries behave when arming promises to deter aggression from one opponent but risks inciting aggressive action from another opponent? Finally, our model provides actors with a decision to pursue or avoid a development whose scale is exogenously determined. This accurately reflects the fact that many power shifts are beyond states' ability to select,[61] but future work should investigate how states behave when they can endogenously determine the scale and speed of their developments. Although our model abstracts away from these and many other potential extensions, the cases suggest that it usefully describes a series of important historical episodes and, perhaps more importantly, demonstrates that events as seemingly diverse as civilian cooperation with counterinsurgents, Hitler's negotiation tactics at Munich, and firms' decisions to file patents are well explained within a consistent theoretical framework.

Finally, the results should inform our thinking about the relationship between information, secrecy, and war. Dominant theories of international conflict suggest that war is most likely when actors are unable to share information, but our model shows that in some circumstances strategic concealment allows states to maintain peace. Thus, whereas Blainey (1988, p. 56) lamented that war sometimes "provides the stinging ice of reality" that eliminates optimism and enables states to settle, we show that an alternative is also true. When states are initially uncertain about the presence of an upcoming power shift, the "stinging ice of reality" can alert them to a potential threat and, as a result, may itself provoke war.

[61] See Krainin (2017) and Schub (2017) for examples.

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Online Appendix A: Payoffs

Payoff #:	Outcome:	Player A:
1:	Public Dev., War at T_1	$p - c_r + D + \delta(p + D)$
2_W:	Public Dev., War at T_2	$x_1 + \delta(p - c_r + D + \Delta)$
2_P:	Public Dev., Peace	$x_1 + \beta[\delta(p + c_s + D + \Delta)] + (1 - \beta)[\delta(p - c_r + D + \Delta)]$
3:	Exposure, War at T_1	$p - c_r + D + \delta(p + D)$
4_W:	Exposure, War at T_2	$x_2 + \delta(p - c_r + D + \Delta)$
4_P:	Exposure, Peace	$x_2 + \beta[\delta(p + c_s + D + \Delta)] + (1 - \beta)[\delta(p - c_r + D + \Delta)]$
5:	Secret Dev., War at T_1	$p - c_r + D + \delta(p + D)$
6_W:	Secret Dev., War at T_2	$x_3 + \delta(p - c_r + D + \Delta)$
6_P:	Secret Dev., Peace	$x_3 + \beta[\delta(p + c_s + D + \Delta)] + (1 - \beta)[\delta(p - c_r + D + \Delta)]$
7:	No Dev., War at T_1	$p - c_r + \delta(p)$
8_W:	No Dev., War at T_2	$x_4 + \delta(p - c_r)$
8_P:	No Dev., Peace	$x_4 + \beta[\delta(p + c_s)] + (1 - \beta)[\delta(p - c_r)]$

Payoff #:	Outcome:	Player B:
1:	Public Dev., War at T_1	$1 - p - c_s - D + \delta(1 - p - D)$
2_W:	Public Dev., War at T_2	$1 - x_1 + \delta(1 - p - c_s - D - \Delta)$
2_P:	Public Dev., Peace	$1 - x_1 + \beta[\delta(1 - p - c_s - D - \Delta)] + (1 - \beta)[\delta(1 - p + c_r - D - \Delta)]$
3:	Exposure, War at T_1	$1 - p - c_s - D + \delta(1 - p - D)$
4_W:	Exposure, War at T_2	$1 - x_2 + \delta(1 - p - c_s - D - \Delta)$
4_P:	Exposure, Peace	$1 - x_2 + \beta[\delta(1 - p - c_s - D - \Delta)] + (1 - \beta)[\delta(1 - p + c_r - D - \Delta)]$
5:	Secret Dev., War at T_1	$1 - p - c_s - D + \delta(1 - p - D)$
6_W:	Secret Dev., War at T_2	$1 - x_3 + \delta(1 - p - c_s - D - \Delta)$
6_P:	Secret Dev., Peace	$1 - x_3 + \beta[\delta(1 - p - c_s - D - \Delta)] + (1 - \beta)[\delta(1 - p + c_r - D - \Delta)]$
7:	No Dev., War at T_1	$1 - p - c_s + \delta(1 - p)$
8_W:	No Dev., War at T_2	$1 - x_4 + \delta(1 - p - c_s)$
8_P:	No Dev., Peace	$1 - x_4 + \beta[\delta(1 - p - c_s)] + (1 - \beta)[\delta(1 - p + c_r)]$

Note: "Exposure" = Secret development that is exposed by Nature.

Online Appendix B: Proof of Proposition 4

Both players calculate R's expected payoff R_{Dev} of secretly developing, and S's expected payoff S_{Non} of not developing, conditional on ϵ_R and ϵ_S:

$$R_{Dev} = \epsilon_R[p - c_r + D + \delta(p + D)] + (1 - \epsilon_R)[p + c_s + \sigma(D - \delta\Delta) + \delta(p + D + \Delta)] \quad (7)$$

$$R_{Non} = p + c_s + \sigma(D - \delta\Delta) + \delta p \quad (8)$$

In these equations, $\sigma = \dfrac{(1 - \epsilon_S)\sigma_0}{1 - \epsilon_S\sigma_0}$, which depicts S's publicly-known Bayesian update of σ_0. Given A_S and A_N, the value of ϵ_R that makes R indifferent between pursuing secret development and not developing is just

$$\epsilon_R^* \equiv \frac{\delta(\Delta + D)}{c_r + c_s + (1 - \sigma)(\delta\Delta - D)} \quad (9)$$

Since $D < \delta\Delta$ in this part of the parameter space, we see that ϵ_R^* must be non-negative. Crucially, both players can calculate ϵ_R^* since it does not depend on the private value ϵ_R. R calculates ϵ_R^* and chooses to pursue secret development whenever $\epsilon_R < \epsilon_R^*$, to eschew development when $\epsilon_R > \epsilon_R^*$, and can mix between the two when $\epsilon_R = \epsilon_R^*$. Player S, not knowing ϵ_R but knowing its distribution F, thus calculates the probability that R is secretly developing as $F(\epsilon_R^*)$. In equilibrium, S adopts this as his publicly known prior: $\sigma_0 = F(\epsilon_R^*)$. This then induces the anticipated posterior σ, which both R and S use to calculate ϵ_R^*. Thus the calculation of ϵ_R^* and S's choice of σ_0 co-determine each other in equilibrium.

Given that R pursues secret development a fraction $F(\epsilon_R^*)$ of the time, the probability with which play reaches the *No Exposure* node is determined by the true rate of exposure ϵ:

$$\sigma^* \equiv \frac{(1 - \epsilon)F(\epsilon_R^*)}{1 - \epsilon F(\epsilon_R^*)} \quad (10)$$

In equilibrium, S's belief σ as to whether play has advanced to the *No Exposure* node should match reality: $\sigma = \sigma^*$. Thus we require $\dfrac{(1 - \epsilon_S)F(\epsilon_R^*)}{1 - \epsilon_S F(\epsilon_R^*)} = \dfrac{(1 - \epsilon)F(\epsilon_R^*)}{1 - \epsilon F(\epsilon_R^*)}$. Clearly this equality is satisfied exactly when S's estimate of the likelihood of exposure matches the true likelihood: $\epsilon_S = \epsilon$. Player R's estimate ϵ_R may also be correct in equilibrium, but it is not a requirement.

If it so happens that $\epsilon_R = \epsilon_R^*$, then player R is indifferent between secretly developing and not

developing. In that case, it is easy to identify a mixed-strategy PBE. Assuming $\sigma < \bar{\sigma}_{Non}$, we can let R choose a mixture between secret development and no-development such that she reaches the *No Exposure* node σ proportion of the time. This strategy satisfies the requirement that $\sigma = \sigma^*$.

When $\epsilon_R \neq \epsilon_R^*$, however, R is not indifferent about his choice to develop or not. For pure-strategy PBE to exist, we require $\sigma^* < \bar{\sigma_N}$, or in other words $\frac{(1-\epsilon)F(\epsilon_R^*)}{1-\epsilon F(\epsilon_R^*)} < \frac{c_r + c_s}{\delta\Delta - D}$. Re-arranging, we can express the requirement as $\epsilon < \frac{c_r + c_s - (\delta\Delta - D)F(\epsilon_R^*))}{(c_r + c_s)F(\epsilon_R^*) - (\delta\Delta - D)F(\epsilon_R^*)}$. Since $0 \leq F \leq 1$, one way to satisfy this inequality is if the denominator exceeds zero, since in that case the numerator exceeds the denominator, and so the fraction exceeds 1, whereafter $\epsilon < 1 < \frac{c_r + c_s - (\delta\Delta - D)F(\epsilon_R^*))}{(c_r + c_s)F(\epsilon_R^*) - (\delta\Delta - D)F(\epsilon_R^*)}$. For the denominator to exceed zero, we require $c_r + c_s > \delta\Delta - D$, from which it follows that $\bar{\sigma_N} > 1 > \sigma$. The existence of a pure-strategy PBE, therefore, hinges upon whether the sufficient condition for avoiding wars of suspicion, $c_r + c_s > \delta\Delta - D$, can ever be satisfied in this part of the parameter space. Indeed, in this part of the parameter space we must have $\delta\Delta > D$, and Lemma 1 must be violated: $p + c_s + D + \delta c_r < \delta[\Delta + \beta(c_r + c_s)]$. Combining these three conditions, we obtain:

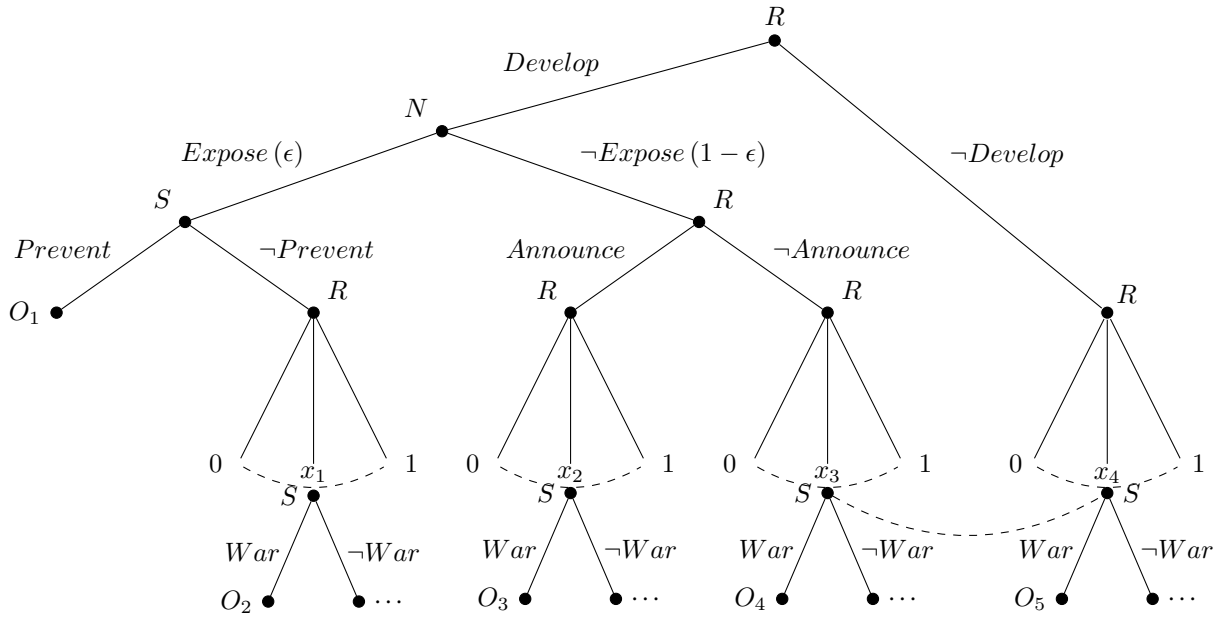
$$p + \delta(1-\beta)c_r + (1-\delta\beta)c_s < \delta\Delta - D < c_r + c_s \tag{11}$$

The question is whether we can choose the parameters δ, Δ, D, c_R, and c_S to satisfy the second inequality without violating the first inequality. To see that we can, notice in the left-hand-side expression that $0 < \delta(1-\beta) < 1$ and $0 < (1-\delta\beta) < 1$, so the coefficients on c_R and c_S have a deflationary effect on both quantities. If, therefore, we choose δ, Δ, D, c_R, and c_S, so that $c_r + c_S$ does not exceed $\delta\Delta - D$ by too much, then for a small choice of p the deflationary effects of $\delta(1-\beta)$ and $1-\delta\beta$ satisfy the first inequality. As a numerical example, let F be the uniform distribution on $[0,1]$, so that $F(\epsilon_R^*) = \epsilon_R^*$. Let $p = 0.1$, $c_r = c_s = 0.2$, $D = 0.04$, $\Delta = 0.7$, and $\delta = \beta = 0.5$. With these parameter values, $\delta\Delta > D$ and $p + c_s + D + \delta(c_r) < \delta[\Delta + \beta(c_r + c_s)]$, so Lemma 1 is violated. Suppose that both R and S have the correct estimates of ϵ such that $\epsilon = \epsilon_R = \epsilon_S = 0.5$. If $\sigma_0 = \frac{2}{3}$, then $\epsilon_R^* = \frac{2}{3}$, so S has the correct prior about R's propensity to secretly develop. As a result, $\sigma = \sigma^* = 0.5$. Because $\sigma < 1 < \bar{\sigma_N}$, there will be no war of suspicion.

Appendix C: Alternative Secrecy Model

Model with Pre-Announcement Exposure, Prevention, and Repeated Arming

If the suspicious actor (S) accepts the rising actor's (R) proposal (x_i), the structure repeats in Period 2.



Appendix D and E list the payoffs associated with each outcome (O_i).

Appendix D: Player R Payoffs (Alternative Model)

Payoff #:	Outcome:	Player R:
O_1:	P_1: D, E, P.	$p - c_r - c_{d1} + \delta(p)$
O_2:	P_1: D, E, ¬P, W.	$p + D - c_r - c_{d1} + \delta(p + D)$
O_3:	P_1: D, ¬E, A, W.	$p + D - c_r - c_{d1} + \delta(p + D)$
O_4:	P_1: D, ¬E, ¬A, W.	$p + D - c_r - c_{d1} + \delta(p + D)$
O_5:	P_1: ¬D, W.	$p - c_r + \delta(p)$
O_{6D}:	P_2: D, E, P.	$1 - x_i - c_{d1} + \delta(p + D - c_r - c_{d2})$
$O_{6\neg D}$:	P_2: D, E, P.	$1 - x_i + \delta(p - c_r - c_{d2})$
O_{7D}:	P_2: D, E, ¬P, W.	$1 - x_i - c_{d1} + \delta(p + D + \Delta_H - c_r - c_{d2})$
$O_{7\neg D}$:	P_2: D, E, ¬P, W.	$1 - x_i + \delta(p + \Delta_L - c_r - c_{d2})$
O_{8D}:	P_2: D, E, ¬P, ¬W.	$1 - x_i - c_{d1} + \delta(1 - y_1 - c_{d2})$
$O_{8\neg D}$:	P_2: D, E, ¬P, ¬W.	$1 - x_i + \delta(1 - y_1 - c_{d2})$
O_{9D}:	P_2: D, ¬E, A, W.	$1 - x_i - c_{d1} + \delta(p + D + \Delta_H - c_r - c_{d2})$
$O_{9\neg D}$:	P_2: D, ¬E, A, W.	$1 - x_i + \delta(p + \Delta_L - c_r - c_{d2})$
O_{10D}:	P_2: D, ¬E, A, ¬W.	$1 - x_i - c_{d1} + \delta(1 - y_2 - c_{d2})$
$O_{10\neg D}$:	P_2: D, ¬E, A, ¬W.	$1 - x_i + \delta(1 - y_2 - c_{d2})$
O_{11D}:	P_2: D, ¬E, ¬A, W.	$1 - x_i - c_{d1} + \delta(p + D + \Delta_H - c_r - c_{d2})$
$O_{11\neg D}$:	P_2: D, ¬E, ¬A, W.	$1 - x_i + \delta(p + \Delta_L - c_r - c_{d2})$
O_{12D}:	P_2: D, ¬E, ¬A, ¬W.	$1 - x_i - c_{d1} + \delta(1 - y_3 - c_{d2})$
$O_{12\neg D}$:	P_2: D, ¬E, ¬A, ¬W.	$1 - x_i + \delta(1 - y_3 - c_{d2})$
O_{13D}:	P_2: ¬D, W.	$1 - x_i - c_{d1} + \delta(p + D - c_r)$
$O_{13\neg D}$:	P_2: ¬D, W.	$1 - x_i + \delta(p - c_r)$
O_{14D}:	P_2: ¬D, ¬W.	$1 - x_i - c_{d1} + \delta(1 - y_4)$
$O_{14\neg D}$:	P_2: ¬D, ¬W.	$1 - x_i + \delta(1 - y_4)$

Appendix E: Player S Payoffs (Alternative Model)

Payoff #:	Outcome:	Player S:
O_1:	P_1: D, E, P.	$1 - p - c_s + \delta(1 - p)$
O_2:	P_1: D, E, ¬P, W.	$1 - p - D - c_s + \delta(1 - p - D)$
O_3:	P_1: D, ¬E, A, W.	$1 - p - D - c_s + \delta(1 - p - D)$
O_4:	P_1: D, ¬E, ¬A, W.	$1 - p - D - c_s + \delta(1 - p - D)$
O_5:	P_1: ¬D, W.	$1 - p - c_s + \delta(1 - p)$
O_{6D}:	P_2: D, E, P.	$x_i + \delta(1 - p - D - c_s)$
$O_{6\neg D}$:	P_2: D, E, P.	$x_i + \delta(1 - p - c_s)$
O_{7D}:	P_2: D, E, ¬P, W.	$x_i + \delta(1 - p - D - \Delta_H - c_s)$
$O_{7\neg D}$:	P_2: D, E, ¬P, W.	$x_i + \delta(1 - p - \Delta_L - c_s)$
O_{8D}:	P_2: D, E, ¬P, ¬W.	$x_i + \delta(y_1)$
$O_{8\neg D}$:	P_2: D, E, ¬P, ¬W.	$x_i + \delta(y_1)$
O_{9D}:	P_2: D, ¬E, A, W.	$x_i + \delta(1 - p - D - \Delta_H - c_s)$
$O_{9\neg D}$:	P_2: D, ¬E, A, W.	$x_i + \delta(1 - p - \Delta_L - c_s)$
O_{10D}:	P_2: D, ¬E, A, ¬W.	$x_i + \delta(y_2)$
$O_{10\neg D}$:	P_2: D, ¬E, A, ¬W.	$x_i + \delta(y_2)$
O_{11D}:	P_2: D, ¬E, ¬A, W.	$x_i + \delta(1 - p - D - \Delta_H - c_s)$
$O_{11\neg D}$:	P_2: D, ¬E, ¬A, W.	$x_i + \delta(1 - p - \Delta_L - c_s)$
O_{12D}:	P_2: D, ¬E, ¬A, ¬W.	$x_i + \delta(y_3)$
$O_{12\neg D}$:	P_2: D, ¬E, ¬A, ¬W.	$x_i + \delta(y_3)$
O_{13D}:	P_2: ¬D, W.	$x_i + \delta(1 - p - D - c_s)$
$O_{13\neg D}$:	P_2: ¬D, W.	$x_i + \delta(1 - p - c_s)$
O_{14D}:	P_2: ¬D, ¬W.	$x_i + \delta(y_4)$
$O_{14\neg D}$:	P_2: ¬D, ¬W.	$x_i + \delta(y_4)$