Do different coercive strategies help or hurt deterrence? A tail of three core logics

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Abstract

Powerful states build many coercive tools to manage their broad foreign policy agenda. Do different coercive strategies help or hurt deterrence success? I analyze a simple crisis model where the Defender seeks to deter a Challenger from militarization through hassling and preventive threats. Subtle differences between my core model and the one-shot complete information models of Schram (2020), Bas and Coe (2016) and others generate different core logics. In my model, limited coercive tools that allow for hassling both compliment and undercut the threat of war under different conditions. But the logic of undercutting is more fundamental, adverse, and severe than past scholars have realized. After I detail my model, I connect different core specifications to different empirical domains, and explain empirical and policy implications.

The United States has built many coercive tools to manage its broad foreign policy agenda. Some tools help policy-makers achieve deterrence through credible threats of war (Huth, 1999). Others facilitate hassling strategies (Schram, 2020) that slow down or impose costs on a Challenger without stopping them. Many argue that different coercive tools compliment each other (Arena and Wolford, 2012; Drezner, 2011; Spaniel and Smith, 2015; McGillivray and Stam, 2004; Trager and Zagorcheva, 2005; Fuhrmann and Lupu, 2016). But others argue that hassling tools and strategies can under-cut the threat of war and cause deterrence to fail (Mehta, 2020; Coe, 2018; Narang and Mehta, 2017; Krcmaric, 2018).

Do different coercive strategies help or hurt deterrence success? This question is vital to policy-makers who can build many coercive tools so they can effectively negotiate in a crisis. But it is difficult for researchers to answer because crises are complex, and powerful states build many tools (e.g targeted strike tools, sanctions, institutions, covert operators) that they use to deter across many issue areas (rogue states expansion, territorial control, nuclear proliferation, regional influence, human rights violations). To get empirical leverage, scholars usually focus on one tools and issue-areas. But underpinning this evidence is a common logic of bargaining over policy positions under the threat of different coercive strategies (Fearon, 1995).

In this theory note, I report a crisis bargaining model that is simple enough to capture this common logic (Paine and Tyson, 2020). The Challenger has an opportunity to invest (or not) in a novel coercive technology (i.e. delayed and endogenous arming a-la Bas and Coe, 2016). The Defender can respond with either a peaceful offer, hassling or major war (a-la Schram, 2020).

Even though the model is simple, I find that different coercive tools interact in many different ways. I find that hassling strategies can deter Challengers when the threat of war is not credible. I also find that hassling strategies can under-cut the threat of war and cause deterrence to fail. Even though my model appears similar to the core crisis in past models, I find that the conditions that hassling under-cut the threat of war are more *fundamental*, *adverse* and *severe* than past scholars have realized. The result is *fundamental* because I identify a pure strategy equilibrium in which hassling undercuts the threat of war and causes deterrence to fail in a one-shot, complete information crisis bargaining model.[1] My undercutting result relies on the Defender's simple cost-

[1] As I explain below, Debs and Monteiro (2014); Bas and Coe (2016) and similar models only find undercutting when they iterate the crisis, introduce uncertainty and study mixed strategies. Our results are different because they do not model hassling. Rather, all coercive tools are either one or multi-period preventive threats.

benefit analysis of using different coercive strategies. Hassling is cheaper but less effective than war. Conditions arise where the Defender prefers preventive war over a peaceful offer and hassling to war. The Challenger would be deterred from militarization if she worried about the threat of preventive war. But she knows that if she invests in new military technologies the Defender will only hassle her. She prefers to invest and face hassling than not invest at all.

Undercutting is *adverse* because the Defender's credible hassling threat leaves her worse off. This is different from Schram (2020); McCormack and Pascoe (2015) who argue that undercutting is welfare enhancing because it allows the Defender to avoid preventive war. I find adverse affects because the Challenger's military investment is endogenous. In my model, when hassling undercuts the threat of war, it creates an opportunity for the Challenger to militarize that she otherwise would not have taken because the threat of war would deter her from investment. Hassling not only leaves the Defender worse off, but it creates a double inefficiency because the Challenger pays a cost to increase her power and the Defender pays a cost to hassle (this compounds insights from Coe and Vaynman (2019) and Schultz (2010)).

This difference means that the policy implications for building a diverse tool-kit vary across empirical domains. Undercutting hurts the Defender if the Defender's tools allow her to pursue either hassling or preventive strategies and the Challenger can choose to expand her power and influence through technological investments (Horowitz, 2020), militarization (Powell, 1993) or constructing subversive institutions. In these situations, the Defender's primary goal is to deter the Challenger from increasing her bargaining power in the first place. In contrast, undercutting benefits the Defender when the Challenger's increasing influence cannot be stopped. In cases like this the Defender's goal is to manage the inevitable transition in the most efficient way.

These adverse affects are *severe* because they arise under conditions the Defender hopes they work the most. Specifically, hassling causes deterrence to fail if the Challenger: (1) holds preferences that diverge a lot from the Defender (Spaniel and Bils, 2017; Trager, 2013); (2) is insensitive to the costs of researching and developing novel coercive technologies; and (3) will shift her bargaining influence dramatically if her military investment succeeds. In contrast, hassling compliments the threat of war by creating new opportunities for deterrence when the Challengers have preferences that are aligned with the Defender, is sensitive to research and development costs, and will not shift power much if her program succeeds.

First, I describe the model. Second, I contrast my result with related models and explain how each model is best applied in a different empirical domain. Third, I draw policy and empirical implications.

Model

I model a crisis between A (Challenger, he) and B (Defender, she), who bargain over setting a policy $q \in (0, 1)$. B's ideal policy is $q = 0$. A's ideal policy is $q = \pi$, where $\pi \in (0, 1]$. High values of π reflect A and B have opposed policy preferences. Both players have linear preferences and so their utility from any bargain is 1 less the linear distance from their ideal policy.

The sequence of moves is presented in Table 1. The crisis ends in one of two ways: costly war or a negotiated settlement. Along the way, A can incur a cost R if he decides to invest in a coercive technology. I model A's choice to invest as an indicator function $r = 1$ if A invests. B can incur costs H if she decides to hassle A. We model B's choice to hassle as an indicator function $h = 1$ if B hassles. Values from a negotiated settlement are:

$$U^A(q) = 1 - |\pi - q| - Rr \tag{1}$$

$$U^B(q) = 1 - q - Hh. \tag{2}$$

I model war as a costly lottery that A wins with probability $p \in [0, 1]$ and B wins with probability $1 - p$. The winner of war gets to impose their preferred settlement. Thus, expected[2] values from war are:

$$EU^A(War) = p + (1 - p)(1 - \pi) - w - Rr \equiv 1 - \pi(1 - p_1) - w - Rr \tag{3}$$

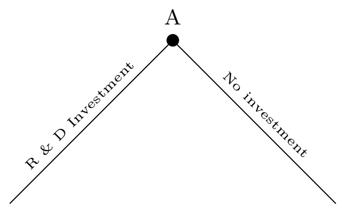
$$EU^B(War) = 1 - p\pi - w - Hh. \tag{4}$$

I assume that p depends on A's investment and B's choice to hassle. If either A does not invest in a new research program, or B declares war on A before A's research is complete, then $p = p_0$.

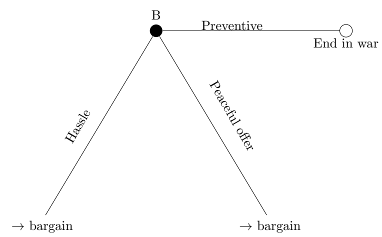
[2]These expected values assume A chooses π. Trivially, each player sets their preferred policy.

Table 1: Modeling stages.

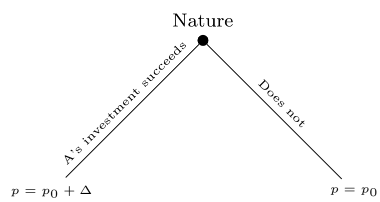
A invests (or not) to expand bargaining power.



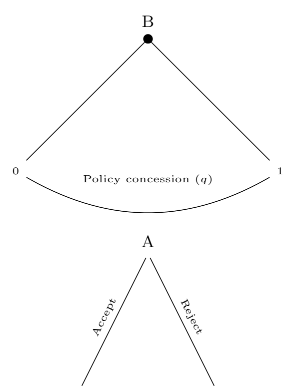
B decides the strategy to manage A's choice: preventive war (game ends in war, $p = p_0$), or to progress to bargaining with or without hassling A's investment.



Nature determines if A's investment succeeds in shifting A's power. The probability of success depends on if A invests/not, and if B hassles/makes peaceful offer.



Player's distribute contested issue in the shadow of war factoring in A's power.



Note: My model yields the same results if: A's invest shifts power with certainty, B's hassling degrades the shift from Δ to Δ_h; or if A's investment shifts power $\Delta \sim f()$ supported on $[p_0, 1 - p_0]$. Hassling shifts density of $f()$ towards p_0; or B selects from many hassling options each with unique costs and effects. See Appendix A.3.

However, if A decides to invest in research and B does not declare war and also B has not hassled A, then nature increases p from p_0 to $p_1 = p_0 + \Delta$ with probability $1 - \lambda$ and keeps $p = p_0$ with probability λ. If instead, B has hassled A, then nature increases p from p_0 to $p_1 = p_0 + \Delta$ with probability $1 - \lambda_h < 1 - \lambda$. In short, hassling reduces the probability that A's research will provide a bargaining advantage.

Results

The solution concept is sub-game perfect equilibria (SPE). Table 2 describes five unique, pure strategy SPE that completely characterize the results. Deterrence can fail in two ways that lead to different observable implications. First, A invests and B does nothing. Second, A invests and is met with hassling. There are two ways that deterrence can succeed. On the surface they look the same. Lurking beneath the surface B's different credible threats are driving the result. In one, A is deterred from investment because B will respond with war. In the other, A is deterred from investment because she prefers to do nothing than invest and face hassling. See Appendix A for technical details.

My main question is: does B profit from an effective hassling threat? To answer this question we first need to evaluate a counterfactual: If hassling was so costly that B would not use it, how would the crisis have unfolded? Table 3 provides the answer focusing on the two equilibria where hassling is B's best strategy. Ultimately, the counter-factual depends on B's next best alternative and the strategic implications for A. In cases where hassling deters A and war is too costly to be credible (5(a)), then hassling compliments the threat of war because it creates deterrence when war cannot. Under these conditions, B strictly benefits from a credible hassling threat it alone deters A's investment.

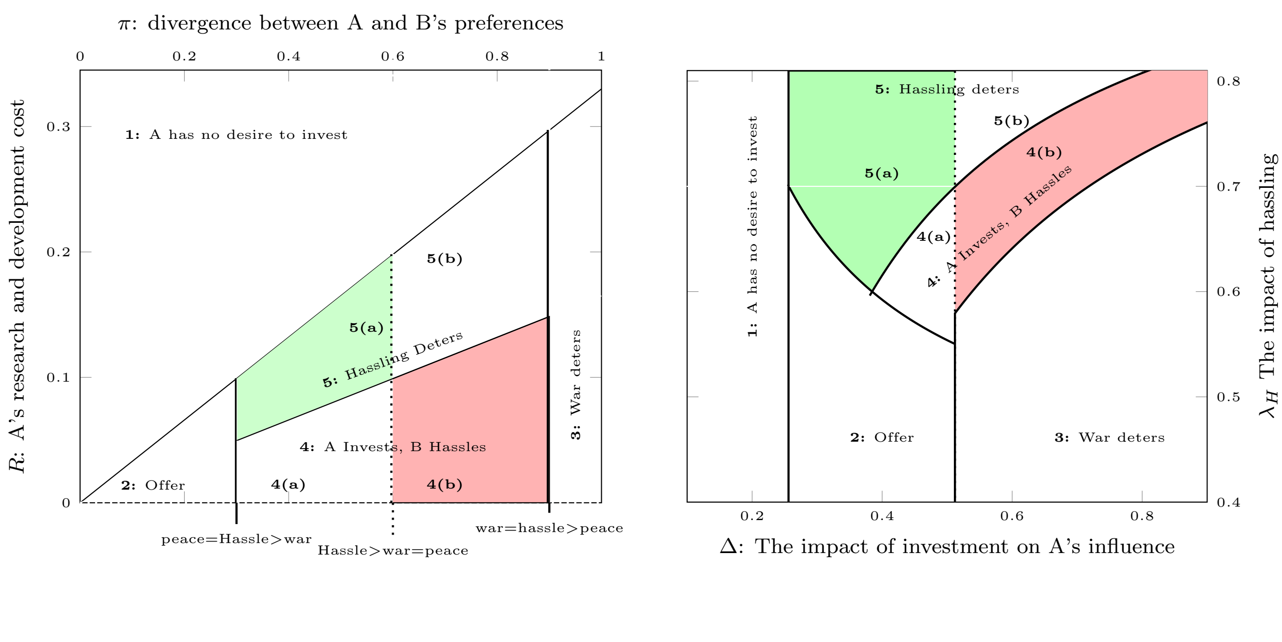
Table 2: Equilibria

Eq	Behavior	Deterrence	pr. p_1	EU^B	Inefficiencies
1	A does not want to invest	NA	0	$1 - p_0\pi + w$	0
2	A invest, B peaceful offer	Fails	$1 - \lambda$	$1 - p_0\pi + w - \Delta\pi(1 - \lambda)$	R
3	A no invest, B threatens war.	Succeeds	0	$1 - p_0\pi + w$	0
4	A invest, B hassle	Fails	$1 - \lambda_c$	$1 - p_0\pi + w - \Delta\pi(1 - \lambda_h) - H$	$R + H$
5	A no invest, B threatens hassle	Succeeds	0	$1 - p_0\pi + w$	0

Table 3: Counterfactual to hassling: Does B profit from an effective hassling threat?

Initial equilibrium	Counter-factual: hassling is expensive/ineffective?	Change in B's Utility	Change in inefficiency.
4 Hassling on path	If B prefers war to peaceful offer, 4(b): war deters	$\Delta\pi(1 - \lambda_h) + H$	$H + R$
	Else, 4(a) A invests, B makes peaceful offer	$-(\Delta\pi(\lambda_H - \lambda) - H)$	$-H$
5 Hassling deters	If B prefers war to peaceful offer, 5(b) war deters	0	0
	Else, 5(a) A invests B makes peaceful offer.	$-\Delta\pi(1 - \lambda)$	$-R$

Figure 1: The conditions under which hassling helps and hurts deterrence



(a) Different types of Challengers

(b) Relative effectivness of state choices

Each plot presents equilibria as a function of two variables. Both assume $w = .1, h = .05, \lambda = .4$. Panel (a) assumes $\Delta = .55, \lambda_h = .7$. Panel (b) assumes $R = .1, \pi = .65$. Panel (b) limits ranges where $p_0 - w \geq 0, p_0 + \Delta \leq 1$ and $\lambda_h - \lambda > 0$. **Dotted line** represents B's point of indifference between preventive war and a peaceful offer. This marks the different counter-factual when hassling is B's preferred strategy (eq. 4, 5). Shaded in **red** hassling causes deterrence to fail. Shaded in **green** hassling creates deterrence because the threat of war is not credible.

However, in a situation where we observe A invest in the face of hassling, and B also prefers war to a peaceful offer (4(b)), then hassling undercuts the threat of war and causes deterrence to fail. In this case, a credible hassling options reduces B's total expected utility in a crisis because A is emboldened to pursue arming when A would have otherwise been deterred. Furthermore, this situation creates a double inefficiency because A pays a cost to arm, and B pays a cost to hassle. Both of these costs would have been avoided if deterrence held.

Now that we know that hassling has both positive and negative affects, we want to know: what are the attributes of Challengers and crises that drive positive and negative affects? We answer this question using the equilibrium plots in Figure 1. Panel (a) plots equilibria based on important attributes of the Challenger: her preferences relative to the Defender's (π), and how sensitive she is to the costs associated with research and development of novel technologies (R). Panel (b) plots the results based on the relative effectiveness of each state's tools: the impact of A's research on bargaining power (Δ); and the affect of hassling (λ_H).

Within each plot, space (4) and (5) identify where B prefers hassling to any other option. These regions are divided into two that represent our relevant counter-factual: what B would have chosen if hassling was too costly or ineffective (or not an option). Shaded in green are the conditions under which hassling helps deterrence because hassling is sufficient to deter B and B's next best option is to do nothing (A would invest if B did nothing in the green range). If hassling cost more, A would invest and B would make a peaceful offer.[3]

We can answer our question by contrasting the parameter ranges for red and green regions. We learn the following: Adverse affects arise when the Challenger is insensitive to the costs of research and development (R is low), the Challenger's preferences depart from the Defender's preferences significantly (π is high), and the affect of the Challenger's investment on her bargaining leverage is large (Δ is large). In contrast, hassling enhances deterrence when Challenger-Defender preferences are closely aligned, the Challenger is sensitive to costs of research and the Challenger's novel technology won't have much of an impact on future bargaining.

The logic behind this result is that adverse affects only arise when the stakes of revision are high for both players: A must care enough about arming to invest in the face of effective hassling, and B must care enough about stopping A to hassle her. This only happens when A wants to revise

[3]In 5b, war also deters.

the status quo substantially, and A's research has a large enough impact to allow A to do it.

Different modeling choices, theoretical predictions and empirical domains

As stated, the possible equilibria, the conditions under which we observe equilibria, and the relevant counterfactual in my core crisis depart from past findings because of subtle differences in my underlying assumptions. Figure 4 plots two common alternatives. The left column describes the similarities and differences. The right column plots the equilibrium expectations in the counterfactual models by re-plotting Figure 1(a). In one way, this plot advances these alternative theories because it explains how their results vary as a function of preference divergence. This dimension is not often explored despite its obvious policy importance.

Some past scholars model limited coercive tools as one-period prevention; and war as prevention that ends bargaining in all future periods. I discuss these alternatives in row 1. This alternative specification ensures that limited and total coercive tools serve the same strategy (prevention). Therefore, the deterrence equilibria are confined to the threat of prevention (Debs and Monteiro, 2014). In contrast, I model limited coercive tools as serving a hassling strategy—a strategy to degrade the Challenger's increasing influence. This creates opportunities for hassling to deter, slow and under-cut deterrence.

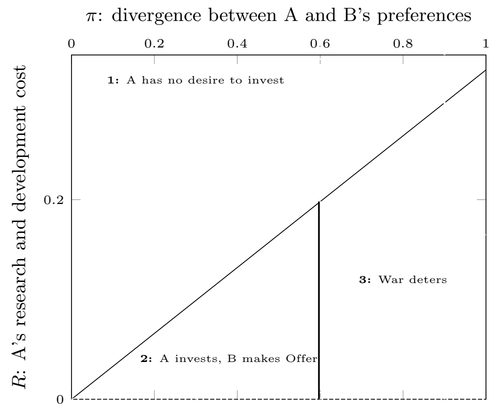
This alternative specification well matches substantive domains where Defenders cannot degrade a Challenger's efforts to militarize. For example, in 1857 France started construction on the first Iron-clad warship. Once constructed, this would shift sea power in France's favor. It is plausible to argue that Britain could not slow down or degrade France's ship-building innovations. However, they could have turned to war.[4] In cases like this, the dynamics suggested by Debs and Monteiro (2014) likely drive the core tension in 1957. However, if Britain had sanctions tools and covert operators to hassle France, then the my model would be more appropriate. Related, in 1949, the United States was not in a position to degrade the pace of Soviet nuclear research because the US had not yet built targeted strike tools or covert operators. The US only seriously considered variants of preventive strategies.

Others model limited coercive tools as a hassling strategy. However, they assume that the Challenger's rise is a foregone conclusion. Unlike the deterrence problems studied in row 1, these

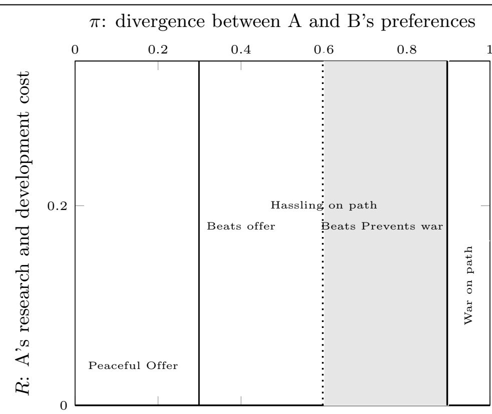
[4] Britain did not coerce France. This matches the plot because Britain and France had reasonably close preferences.

Table 4: Contrast with other theories.

Past models: Bas and Coe (2016); Debs and Monteiro (2014).
Available strategies: Challenger's can choose to invest, Defenders can offer or prevent.
Different assumptions: Defender cannot hassle (i.e. degrade the affect of A's investment). Rather, hassling is modeled as one-period prevention.
Different results: There is no impact of limited coercive tools on core crisis dynamics. Either war deters or it does not.
Empirical domain: Defender's want to deter but have limited coercive tools and therefore must choose between intervention or nothing.



Past models: McCormack and Pascoe (2015); Schram (2020).
Available strategies: Defender can make peaceful offer, hassle or prevent.
Different assumptions: Challenger's investment is assumed exogenous.
Different results: Gray area represents where hassling 'under-cuts' the threat of war. However, it increases the Defender's utility because it allows the Defender to avoid preventive war. Also, war appears on the path in the core crisis.
Empirical domain: The Challenger's rise is a foregone conclusion that the Defender must efficiently manage.



models ask how Defenders can most effectively deal with the Challenger's inevitable rise. I report their equilibrium predictions in row 2. If A and B's preferences diverge considerable, or power shifts are sufficiently large (Δ is large) war is sometimes B's best option (see also models that do not allow hassling Powell, 1999). However, hassling allows B to efficiently manage A's rise by degrading it. Thus, we see hassling under-cut war, but we interpret this as a positive outcome because it allows B to avoid a costlier preventive war. These models well capture a situation where the Challenger has built a new coercive tool and initiates its deployment (e.g. Russian deployment of built hybrid forces in the Ukraine) or where power shifts are driven by latent economic growth (Powell, 1999), or pressures from a third-party competitor (Treisman, 2004).

Like those discussed in row 1, my model assumes that the Defender's primary goal is to deter the Challenger from investment in a new technology or institution. But like row 2, the Challenger can use hassling and preventive strategies to do it. I believe that there many empirical domains that fit this basic setting. For example, the United States (and Israel, Australia, Britain, and other Middle Powers with standing militaries and active foreign intelligence services) can pursue both hassling and preventive strategies in dealing with rogue states who seek to expand their influence through the support of terrorists, nuclear proliferation, or the construction of shadow regional institutions or sophisticated technologies such as China's A2AD system. It also well represents situations where long-term shifting power is driven by the Challenger's conscience military investments and not latent economic growth. For example, Hitler borrowed extensively to expand German military power (Wark, 1985).

The different examples illustrate that appropriate crisis model, and the predictions that follow, may not neatly correspond to a specific issue area or coercive tool. It really depends on the technology available to Defenders at that point in history, the Challenger's geographical position, economic dependence and abilities, and the latent economic and structural factors that drive the Challenger's choices. This might help account for unexplained variance in well-specified empirical studies.

Empirical and Policy Implications

I highlight three implications. First, selection into arming provides one of the greatest empirical challenges for measuring the affects of different coercive tools on deterrence (Arena and Joyce, 2015;

Huth, 1999; Huth and Russett, 1990). Some find clever ways to account for these selection issues in their analysis (Fuhrmann and Lupu, 2016; Miller, 2014). However, by modeling a single selection process, even these approaches only examine a single counter-factual to arming for a fixed rate of hassling. I shows that the appropriate counter-factual varies depending on the Challenger's preferences, sensitivity to the costs of arming, and expectations about the affects of militarization. In some cases, the counter-factual to arming in the face of hassling is arming unopposed. In other cases it is deterrence through the threat of war. I also offers a solution for empiricists to account for this more complex selection process by identifying the attributes where these different counter-factuals arise.

Second, most empirical studies examine one coercive tool and issue area. But Defenders use the same coercive tool to deter Challengers in many issue areas. How should we weigh evidence that targeted strike technologies delays and deter nuclear programs on average (Kreps and Fuhrmann, 2011) but embolden rogue states to take territory in some cases (Schram, 2020; Coe, 2018); or that expanding powers of international courts deters some human rights abusers but also lengthen civil wars (Krcmaric, 2018)? Related, states usually use several hassling tools together as part of a broader hassling strategy. For example, president Trump levied sanctions, covert action, targeted strikes and other tools to slow Iran's efforts to construct terrorist proxies in Iraq. How should we think about the independent affect of these tools? My model highlights that each specific tool contributes to the costs and effectiveness associated with deploying either hassling or preventive strategies. Thus, we can think of spending money on a single tool as increasing hassling effectiveness (λ_H) or lowering costs (H) of hassling relative to preventive war fighting. Since the model makes few issue-specific assumptions, it is easy to generalize the logic across cases where the Challenger's choice to raise her influence is endogenous.

Third, my theory calls into question how easily we can derive policy implications from average affects. For example, policy-makers may look at convincing evidence that institutions effectively delay and deter nuclear Aspirants on average (Fuhrmann and Lupu, 2016); and convincing evidence that undercutting persists in specific cases (Mehta, 2020) and correctly say, 'Even if institutions have negative consequences in specific cases, they help in more cases than they hurt.' However, this does not mean that tools that make hassling cheaper and more effective in all crises are welfare enhancing because it fails to account for the kinds of Challengers that pursue these technologies.

If I am right then better hassling technologies embolden our worst rivals to substantially advance their power and influence. Thus, every time that highly effective hassling technologies allow us to deter Israel from exploiting covert operators to advance their interests in the Middle East, we embolden Iran to fund terrorist proxies, or North Korea to develop nuclear weapons, or China to build shadow institutions in Central Asia and supplant our interests.

References

Arena, P. and K. A. Joyce (2015, sep). Challenges to Inference in the Study of Crisis Bargaining. *Political Science Research and Methods 3*(03), 569–587.

Arena, P. and S. Wolford (2012, jun). Arms, Intelligence, and War. *International Studies Quarterly 56*(2), 351–365.

Bas, M. A. and A. J. Coe (2016). A Dynamic Theory of Nuclear Proliferation and Preventive War. *International Organization 70*(4), 655.

Coe, A. and J. Vaynman (2019, dec). Why Arms Control Is So Rare. *American Political Science Review*, 1–14.

Coe, A. J. (2018, oct). Containing Rogues: A Theory of Asymmetric Arming. *The Journal of Politics 80*(4), 1197–1210.

Debs, A. and N. P. Monteiro (2014, jan). Known Unknowns: Power Shifts, Uncertainty, and War. *International Organization 68*(01), 1–31.

Drezner, D. W. (2011, mar). Sanctions Sometimes Smart: Targeted Sanctions in Theory and Practice. *International Studies Review 13*(1), 96–108.

Fearon, J. D. (1995, jun). Rationalist Explanations for War. *International Organization 49*(03), 379.

Fuhrmann, M. and Y. Lupu (2016, sep). Do Arms Control Treaties Work? Assessing the Effectiveness of the Nuclear Nonproliferation Treaty. *International Studies Quarterly 60*(3), 530–539.

Horowitz, M. C. (2020, may). Do Emerging Military Technologies Matter for International Politics? *Annual Review of Political Science 23*, 385–400.

Huth, P. and B. Russett (1990, jun). Testing Deterrence Theory: Rigor Makes a Difference. *World Politics 42*(04), 466–501.

Huth, P. K. (1999). DETERRENCE AND INTERNATIONAL CONFLICT: Empirical Findings and Theoretical Debates. *Annual Review of Political Science 2*(1), 25–48.

Krcmaric, D. (2018, apr). Should I Stay or Should I Go? Leaders, Exile, and the Dilemmas of International Justice. *American Journal of Political Science 62*(2), 486–498.

Kreps, S. E. and M. Fuhrmann (2011, apr). Attacking the Atom: Does Bombing Nuclear Facilities Affect Proliferation? *Journal of Strategic Studies 34*(2), 161–187.

McCormack, D. and H. Pascoe (2015, dec). Sanctions and Preventive War. *Journal of Conflict Resolution*, 0022002715620471–.

McGillivray, F. and A. C. Stam (2004, apr). Political Institutions, Coercive Diplomacy, and the Duration of Economic Sanctions. *Journal of Conflict Resolution 48*(2), 154–172.

Mehta, R. N. (2020, mar). *Delaying Doomsday*. Oxford University Press.

Miller, N. L. (2014, sep). The Secret Success of Nonproliferation Sanctions. *International Organization 68*(04), 913–944.

Narang, N. and R. N. Mehta (2017, sep). The Unforeseen Consequences of Extended Deterrence. *Journal of Conflict Resolution*, 002200271772902.

Paine, J. and S. A. Tyson (2020). Uses and Abuses of Formal Models in Political Science. In *The SAGE Handbook of Political Science*, pp. 188–202. SAGE Publications Ltd.

Powell, R. (1993, mar). Guns, Butter, and Anarchy. *American Political Science Review 87*(1), 115–132.

Powell, R. (1999). *In the Shadow of Power: States and Strategies in International Politics.* Princeton, N.J: Princeton University Press.

Schram, P. (2020). Hassling: How States Prevent a Preventive War. *Working Paper*.

Schultz, K. A. (2010, dec). The Enforcement Problem in Coercive Bargaining: Interstate Conflict over Rebel Support in Civil Wars. *International Organization 64*(2), 281–312.

Spaniel, W. and P. Bils (2017). Policy Bargaining and International Conflict. *Journal of Theoretical Politics*.

Spaniel, W. and B. C. Smith (2015, mar). Sanctions, Uncertainty, and Leader Tenure. *International Studies Quarterly 59*(4), n/a–n/a.

Trager, R. F. (2013, nov). How the scope of a demand conveys resolve. *International Theory 5*(03), 414–445.

Trager, R. F. and D. P. Zagorcheva (2005, dec). Deterring {Terrorism}: {It} {Can} {Be} {Done}. *International Security 30*(3), 87–123.

Treisman, D. (2004, apr). Rational Appeasement. *International Organization 58*(02), 345–373.

Wark, W. K. (1985). *The ultimate enemy : British intelligence and Nazi Germany, 1933-1939.* Cornell University Press.

Appendix

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A Formal analysis

In what follows I characterize the complete set of sub-game perfect equilibria over the parameter space. First I emphasize two features of any sub-game perfect equilibrium that are identical to Debs and Monteiro (2014)'s complete information results. Highlighting these similarities demonstrates that the A's endogenous militarization choice makes the core of our models, making it easier for readers to understand how including different choices builds on existing work. Our final results depart because B has two coercive options: hassling and war. The results also help us focus on a very limited set of bargaining outcomes; which dramatically simplifies our analysis.

Define q^* as the offer that leaves A indifferent to war. A's utility from war is: $U_2^A(war)$: $1 - \pi(1-p) - w$. The offer that leaves A indifferent with this value satisfies: $1 - |\pi - q^*| = 1 - \pi(1-p) - w \implies q^* = p\pi - w$. Then,

Lemma A.1 *If A accepts peace when indifferent with war, there is a unique bargaining sub-game for every SPE in which B makes a peaceful offer q^* that A accepts. Off the path, if B offers $q < q^*$ A rejects in favor of war. If B offers $q > q^*$ B selects war. This yields a total utility*

$$U_2^A(q^*) = 1 - \pi(1-p) - w - rR \tag{5}$$
$$U_2^B(q^*) = 1 - \pi p + w - hH \tag{6}$$

This equilibrium result is identical to the crisis described by Fearon 1995, Powell 1999 and others. In my model players incur costs during the research and hassling phases. However, those costs are incurred pre-bargaining and cannot impact the bargaining incentives once nature has assigned $p \in p_0, p_0 + \Delta$.

Lemma A.2 *War cannot appear on the path in any SPE.*

B's incentives for war come from preventing A from succesful research. If A does not invest in research, B has no incentive to fight a major war. If A does invest in research, B can have an incentive to fight. However, A knows that war is only triggered by her research. A's value for war following research is always less than her expected value from bargaining if $p = p_0$ because A can only assure her minimum demand from fighting in bargaining and research is costly.

Total expected utilities before Nature determines p.

Since we have already solved for a unique bargaining sub-game we focus on strategies in which B offers $q = q^*$ and A accepts. For notational ease, we write actions as follows $s^A(r, nr), s^B(o, h, w)$. Where A's strategy is to research or not, and B's strategy is to make a peaceful offer, hassle or fight a war (which does not happen on path but which will inform A's choice). I assume that B's offer is q^*.

Suppose A does not invest in the first period, then each player's total expected utility in the first period is:

$$EU^A(nr, o, q^*) = (1 - \pi(1 - p_0) - w) \tag{7}$$

$$EU^B(nr, o, q^*) = (1 - p_0\pi + w) \tag{8}$$

Suppose A invests and B makes peaceful offers, then each player's first period expected utility is:

$$EU^A(r, oq^*) = (1 - \pi(1 - p_0) - w) + \Delta\pi(1 - \lambda) - R \tag{9}$$

$$EU^B(r, oq^*) = (1 - p_0\pi + w) - \Delta\pi(1 - \lambda) \tag{10}$$

The additional $\Delta\pi(1 - \lambda)$ in A's utility (and taken from B's) follows from A's $1 - \lambda$ chance of acquiring more power from succesful reserach. Of course, this comes at a cost R.

Suppose A invests and B hassles, then expected total utilities are:

$$EU^A(r, h, q^*) = (1 - \pi(1 - p_0) - w) + \Delta\pi(1 - \lambda_h) - R \tag{11}$$

$$EU^B(r, h, q^*) = (1 - p_0\pi + w) - \Delta\pi(1 - \lambda_h) - H \tag{12}$$

If A invests in the first round and B chooses war:

$$EU^A(r,w) = (1 - \pi(1-p_0) - w) - R \tag{13}$$

$$EU^B(r,w) = (1 - p_0\pi - w) \tag{14}$$

There are no more outcomes to consider. This covers all the strategy pairs.

A.1 Equilibria.

We use the expected utilities above to characterize the 5 equilibria written in the manuscript.

A.1.1 Equilibrium 1: A does not invest.

Lemma A.3 ***A does not want to invest:*** *If*

$$R > \pi\Delta(1-\lambda) \tag{15}$$

is satisfied, then in every SPE A forgoes investment, B offers $q^*|p_0$.

The best A can do from investment is the condition where B plays $s^B(o,q^*)$. The inequality in Lemma A.3 follows from comparing A's Utility from: $EU^A(nr,o,q^*) > EU^A(r,o,q^*)$. We say deterrence cannot apply in this case beause A's choice is insensitive to B's threats.

A.1.2 Equilibrium 2: A invests, B makes a peaceful offer.

Lemma A.4 ***B never wants to compete:*** *If B prefers a peaceful offer to war,*

$$2w > \Delta\pi(1-\lambda), \tag{16}$$

and a peaceful offer to hassling,

$$H > (\lambda_H - \lambda)\Delta\pi \tag{17}$$

then in any equilibrium where A invests in nuclear research B will make peaceful offers in both periods.

The first condition compares: $EU^B(r, o, q^*) > EU^B(w)$. Inequality 17 follows from comparing $EU^B(r, o, q^*) > EU^B(r, h, q^*)$. Since B only has three options, it follows that when these inequalities are jointly satisfied peaceful offers are better than any form of competition. However, if either fails, then at least one form of competition is better.

A.1.3 Equilibrium 3: war deters

Lemma A.5 ***War deters:*** *When A wants to invest (inequality 15), and B prefers war to both peace (inequality 16 is not satisfied) and hassling,*

$$2w < \Delta\pi(1 - \lambda_h) + H, \tag{18}$$

then B's credible threat of war deters A from nuclear research. In equilibrium, A does not invest and B makes a peaceful offer. Off the path, if A invests B selects war.

Inequality 18 comes from $EU^B(w) > EU^B(r, h, q^*)$. The others have been explained.

A.1.4 Equilibrium 4: Hassling on the path

Lemma A.6 ***Hassling on the path:*** *If B prefers hassling to both war (inequality 18) and a peaceful offer (inequality 17), and A prefers to invest and face hassling rather than not invest at all,*

$$R < \Delta\pi(1 - \lambda_h), \tag{19}$$

then A invests, B selects hassling.

Inequality 19 comes from $EU^A(r, h, q^*) > EU^B(nr, o, q^*)$. The others have been explained.

A.1.5 Equilibrium 5: Hassling deters

Lemma A.7 *If B's best response to A's investment is hassling (see lemma A.6) and A wants to invest if A gets a peaceful offer, but not if she faces hassling:*

$$\Delta\pi\delta(1 - \lambda) > R > \Delta\pi\delta(1 - \lambda_c), \tag{20}$$

then Hassling deters A from investment. On the path, A does not research. If A did research, B would respond with hassling and q^*.

The left side of 20 comes from inequality 15. The right side comes from inequality 19.

A.2 Evaluating the counter-factual: Does a diverse coercive tool-kit help or hurt deterrence?

To appreciate the affects of diverse coercive tools, we need to understand what would have happened if hassling was cost prohibitive/totally inneffective? Thus, if we returned to the world studied by Debs and Monteiro (2014); Bas and Coe (2016) in which the Defender had only a preventive threat, would the Defender be better off?

A.2.1 Hassling can compliment war by creating deterrence when war is not credible

To examine this question we focus on the two equilibria in which we observe hassling on the path. Starting with the equilibrium in which A is deterred by B's credible hassling threat.

Proposition A.8 *Suppose that the conditions for Lemma A.7 are satisfied. In a counter-factual model where hassling was cost prohibitive, if B prefers war to a peaceful offer,*

$$2w < \Delta\pi(1 - \lambda) \tag{21}$$

, then the on-path strategies revert to equilibrium A.5 where A is deterred by B's credible threat of war (5a). If this inequality is not satisfied then the on path strategies revert to equilibrium A.4 where A researches and B makes a peaceful offer (5b).

Remark Consider the two cases described in proposition A.8. In (5a) hassling has no affect on A's chance of gaining influence through new technoligical investments and player utilities are identical with or without an effective hasslng threat. In (5b) a credible hassling threat reduces the risk that A develops new power and influence by λ by creating an affective deterrent threat. In doing so, the threat of hassling increases B's ex-ante utility by $\Delta\pi(1 - \lambda)$.

Inequality 21 re-states B's incentive for war over peace. The proof of proposition A.8 follows instantly from the Lemmas referenced. The result simply follows from B's next best alternative to hassling. When it is war, A remains deterred. When it is a peaceful offer, A is not deterred.

A.2.2 Hassling can undercut the threat of war and cause deterrence to fail, leading to inefficient outcomes.

Turning to the equilibrium in which A invests and faces hassling.

Proposition A.9 *Suppose that the conditions for Lemma A.6 are satisfied. In a counter-factual model where hassling was cost prohibitive, if B prefers war to a peaceful offer (inequality 21 is satisfied) then the on-path strategies revert to equilibrium A.5 where A is deterred by B's credible* *threat of war (4a). If this inequality is not satisfied then the on path strategies revert to equilibrium A.4 where A researches and B makes a peaceful offer (4b).*

Remark Consider the two cases described in proposition A.9. In (4a) B's credible hassling undercuts deterrence, creating a $1 - \lambda_H$ risk that A will acquire new weapons and use them to affect bargaining. In doing so, B's credible threat of hassling decreases B's ex-ante utility by $\Delta\pi(1-\lambda_h)+H$ and forces players to incur a cumulative inefficiency of $H + R$. In (4b) a credible hassling threat reduces the risk that A develops new power and influence by λ by creating an affective deterrent threat. In doing so, the threat of hassling increases B's ex-ante utility by $\Delta\pi(1 - \lambda)$.

The proof of proposition A.9 follows instantly from the Lemmas referenced.

A.3 Other Specifications that yield the same result

The main model assumes that A's investment best reflects research into a novel technology of influence and that research could succeed or fail. We chose to report this because it matches modern debates where rogue states invest in advanced weapons where their scientists are uncertain if they can get the technology to work. This matches debates about cyber warfare, nuclear weapons, etc.

I now detail a different specification that matches conventional arming. Define $f(\Delta)$ as a density function supported non-negatively on the interval $[p_0, 1-p_0]$. Define μ as the expected value of $\Delta|f$. Define $f_h(\Delta)$ as a density function supported non-negatively on the interval $[p_0, 1-p_0]$. Define μ_h as the expected value of $\Delta|f_h$ such that $\mu_h < \mu$. The sequence of moves is as follows. Notice there is a special case in which f, f_h are supported on a singularity and therefore μ, μ_h are constants.

We study the following sequence of moves.

- A invests or not.
- B selects between hassling, war, an offer.
  - If B selects war, the game ends in war in which $p = p_0$.
  - If B selects hassling, nature draws $\Delta \sim f_h$ and the game proceeds to bargaining.
  - If B selects an offer, nature draws $\Delta \sim f$ and the game proceeds to bargaining.
- If the game proceeds to bargaining, B makes an offer $q \in [0, 1]$,
- A either rejects the offer leading to war in which $p = p_0 + \Delta$ or accepts it leading to peace-payoffs.

The final pay-offs to this game, and the expected values from war are identical to the baseline model. The derivation of q^* is also the same.

The expected values pre-Nature's choice are slightly different. Suppose A does not invest in the first period, then each player's total expected utility in the first period is:

$$EU^A(nr, o, q^*) = (1 - \pi(1 - p_0) - w) \tag{22}$$

$$EU^B(nr, o, q^*) = (1 - p_0\pi + w) \tag{23}$$

There is no difference in this case.

Suppose A invests and B makes peaceful offers, then each player's first period expected utility is:

$$EU^A(r, oq^*) = (1 - \pi(1 - p_0) - w) + \Delta\pi\mu - R \tag{24}$$

$$EU^B(r, oq^*) = (1 - p_0\pi + w) - \Delta\pi\mu \tag{25}$$

The only difference being that $1 - \lambda$ is replaced with μ.

Suppose A invests and B hassles, then expected total utilities are:

$$EU^A(r, h, q^*) = (1 - \pi(1 - p_0) - w) + \Delta\pi\mu_h - R \tag{26}$$

$$EU^B(r, h, q^*) = (1 - p_0\pi + w) - \Delta\pi\mu_h - H \tag{27}$$

The only difference being that $1 - \lambda_h$ is replaced with μ_h.

If A invests in the first round and B chooses war:

$$EU^A(r, w) = (1 - \pi(1 - p_0) - w) - R \tag{28}$$

$$EU^B(r, w) = (1 - p_0\pi - w) \tag{29}$$

There is no difference.

The construction of the proofs is identical to he main model. The only difference is $1 - \lambda$ is replaced with μ, $1 - \lambda_h$ is replaced with μ_h.

Notice, the results only rely on the expected values of f, f_h and not other features of the distribution. It follows that the results instantly specialize to the case in which f is supported on a constant, and f_h is supported on a constant.