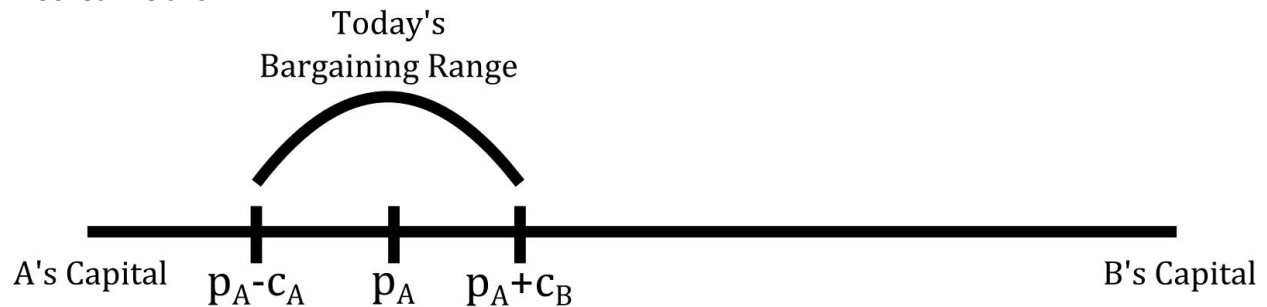
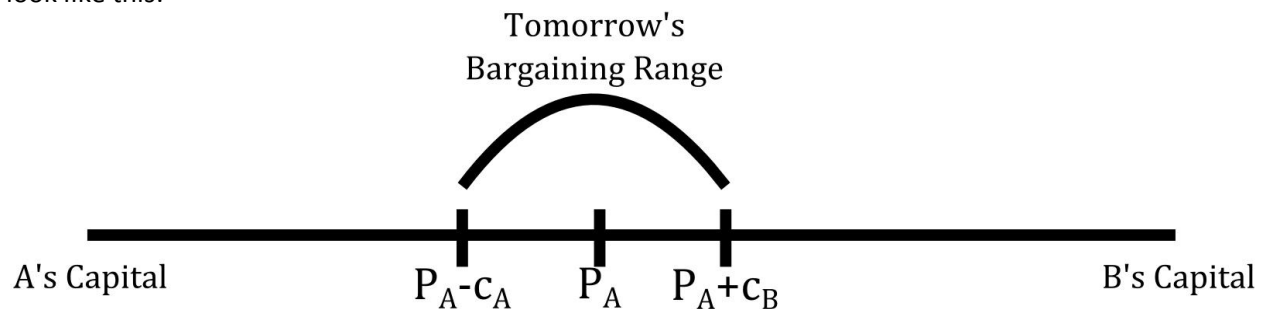


Chapter 3: Preventive War

Recalling back to the geometric bargaining model, suppose today's balance of power between A and B looked like this:

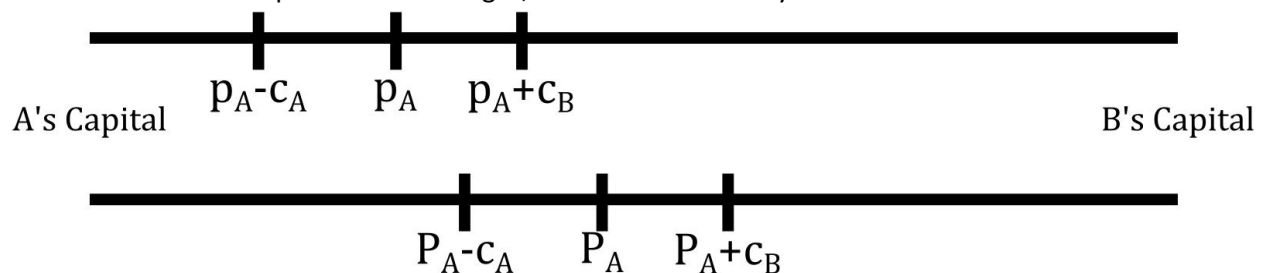


However, A recently developed a new style of tank. Once the assembly lines open, the balance of power will shift in A's favor. Let A's power tomorrow be P_A . Then tomorrow's bargaining range could look like this:



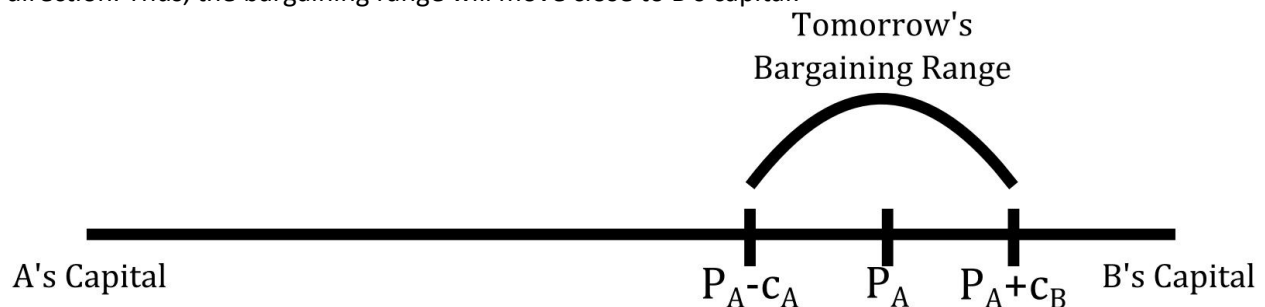
Can the states reach a settlement here?

If we combine the previous two images, the answer is a firm yes:

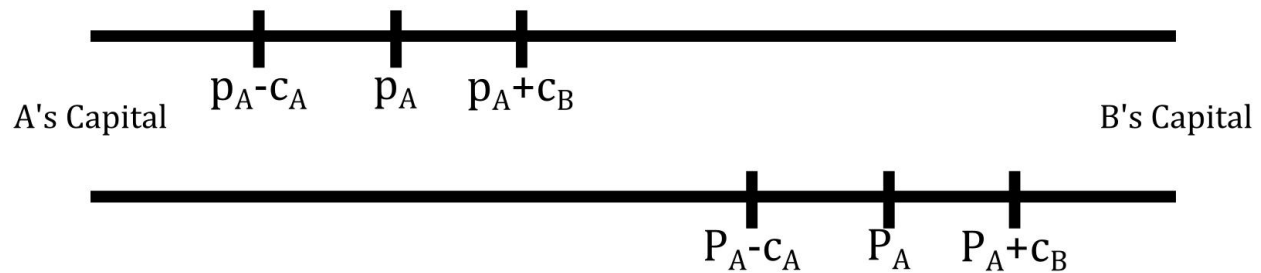


Notice the slight overlap between the bargaining ranges. Any settlement between $P_A - c_A$ and $p_A + c_A$ is mutually preferable to war both and tomorrow.

But what if the technology was more powerful than a new tank? Instead, perhaps A was developing nuclear weapons. Tomorrow, A will proliferate, and the balance of power will drastically shift in A's direction. Thus, the bargaining range will move close to B's capital:

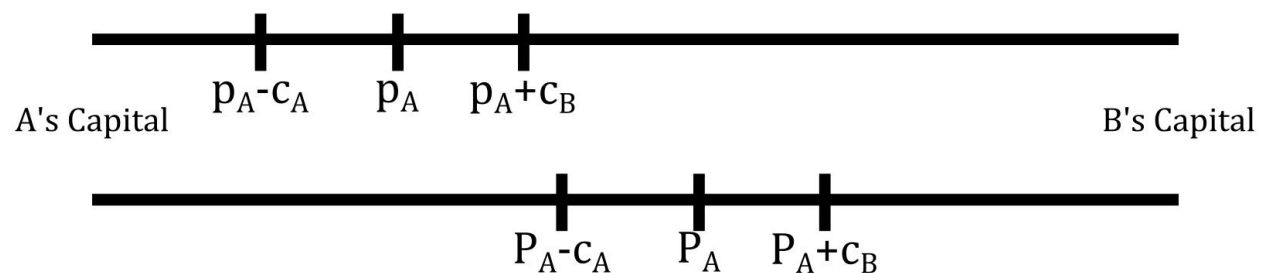


Now the ranges do not overlap:



This time, it appears the states are destined to fight. If B allows the power shift to transpire, it will have to concede a large amount of the good to A. Alternatively, B could start a war before the shift occurs, prevent A from developing the nuclear weapons, and lock in its war payoff of $1 - p_A - c_A$, which geometrically translates to everything to the right of $p_A + c_B$.

Broadly, we define a *preventive war* as a conflict in which a declining state intervenes against a rising state to stunt the rising state's growth. This chapter explores preventive war and its precise causal mechanisms. Although the non-overlapping bargaining ranges argument appears reasonable at first, states can sometimes overcome the problem. Consider a middle case:



The bargaining ranges still do not overlap here. But the states might not be destined to fight. Perhaps they could construct a settlement over time to that would appease both sides. B, for example, could accept a poor offer initially to convince A not to invade. This could potentially satisfy A while B enjoys the benefits of the power shift in tomorrow's world. In fact, such a bargain exists as we will later see.

While the shifting bargaining range suggests an interesting theory of war, the middle case demonstrates how difficult it is to pin down the exact causal mechanisms of conflict. Can states actually construct credible bargains over time to avoid war? Our search for rational preventive war has three steps in this chapter.

First, we will consider a bargaining model in which one state grows more powerful as a function of time. For example, although Iran is comparatively weak today, the country might develop nuclear weapons at a later date. Two things can happen here. First, if the cost of intervening is too great for the declining state, the shift in power is minimal, or the states care only about the present, the declining state allows the rising state to grow and concedes part of the good. However, if the power shift is too great and the cost of intervention is too cheap, the declining state will rationally initiate preventive war.

Such a model assumes the rising state naturally grows more powerful, as though its gun grew on trees. In practice, becoming more powerful requires devoting more sectors of a state's economy to military production, a choice that governments cannot passively make. If we gave the rising state the option to build or not build, we might wonder whether war still occurs in equilibrium. As the second section will show, the war result disappears here. If the declining state can credibly threaten preventive war, the rising state simply maintains the status quo distribution of power. On the other hand, if preventive war is too unattractive, the rising state shifts power and forces concessions out of the declining state. Either way, war never occurs.

The third section adds an element of mystery to the power shifting process. Although rising states can actively choose whether to develop a stronger military, these decisions are often state secrets. Declining states often cannot observe how much power rising states will have in the future. Relaxing the perfect observability assumption once again leads to war. Indeed, the rising state cannot credibly commit to arms treaties if its rival cannot monitor compliance of those treaties. Knowing that the rising state will build, the declining state intervenes.

In each of these sections, we will first explore the interaction between Israel and Iran as Iran possibly seeks a nuclear weapon. This motivating case study will elucidate the model's results similar to the Columbian/Venezuelan oil crisis from the second chapter. Although easier to follow than pure math, a few specific cases fail to show whether the results are consistent with a general trend. As a result, we will consider an all-encompassing model in each section that follows the same underlying story as the conflict between Israel and Iran.

As we explore the possibility of preventive war in this chapter, remember that our goal is to explain why states fight. The previous chapter showed that the assumptions of the basic model were too strong, which resulted in the no-war finding. However, as we relax assumptions, we must be careful to make wise modifications to the game. Exchanging ridiculous assumptions for ridiculous assumptions leads us no closer to understanding why diplomacy ends and gunshots begin.

3.1: Exogenous Power Shifts

To better illustrate this model, let us rename the states R and D, where R represents the rising state and D represents the declining state. The game begins with D choosing whether to launch preventive war or initiate bargaining. If D fights, it prevails in the war with probability P_D but pays a cost $c_D > 0$; R receives a similar payoff, winning with probability $1 - P_D$ but paying a cost $c_R > 0$. If D tries to bargain, it demands x of the good, where $0 \leq x \leq 1$. R can accept or reject that demand. If R rejects, the states fight a war in the same manner had D launched preventive war.

If R accepts, the game takes a new turn. The settlement x is only temporary. After R permits x , the states receive the short-term benefit from that division, and the game moves into a second stage. At this point, power has shifted, and R is more likely to triumph if the states fight. D then demands a new amount y , where $0 \leq y \leq 1$. Again, R accepts or rejects that demand. If R rejects, D wins the war with probability p_D , where $p_D < P_D$; thus, D wins the war less frequently than before. R prevails with probability $1 - p_D$.

If the states fight in the second stage, they still must pay the costs c_D and c_R . In the game we analyze below, these costs remain static over the course of the power transition; relaxing these assumptions to make states' costs smaller or larger will not have a substantive impact on our results.

We will also make an additional assumption about the costs of war to simplify the analysis below. Specifically, assume that $1 - P_D - c_R > 0$ and $p_D - c_D > 0$. Requiring $1 - P_D - c_R > 0$ ensures that state R always finds war to be a profitable venture. Ensuring $p_D - c_D > 0$ means D finds war profitable both pre- and post-shift as well. These assumptions are trivial. If either side's expected utility for war were less than zero, settling the conflict becomes trivial; one side would be willing to give away entire good just to avoid war. By requiring their expected utilities for war to be positive, we merely ensure that the states will consider war to be a viable option.

Before we can explicitly define payoffs, we need a method to define how the states value the good through time. For example, extremely impatient states may place more value on their share of the bargain today than they do in the future. In contrast, if the states are forward looking or the power shift will not take effect for many years, the states would place greater emphasis on the payoffs in the second stage.

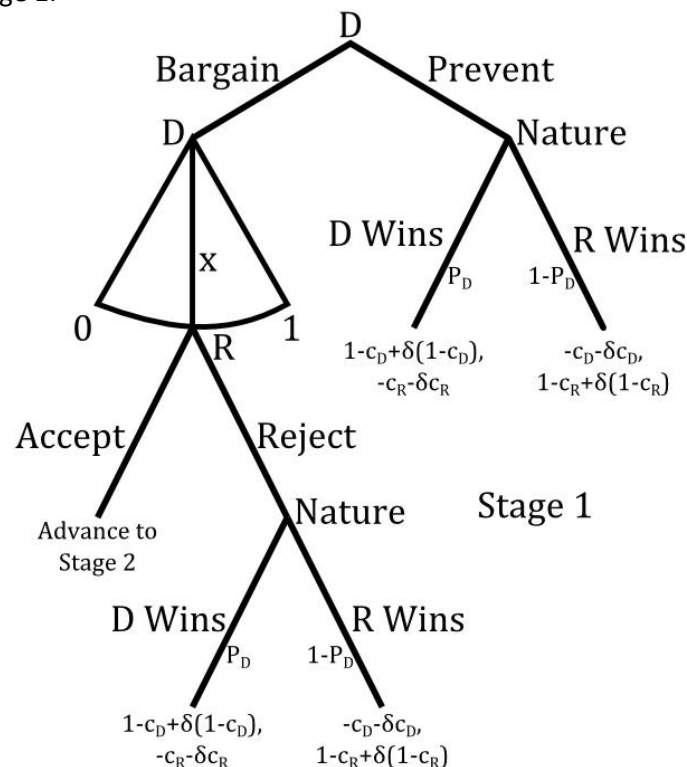
To encompass these aspects, we multiply the states' second stage payoffs by $\delta > 0$. For example, if R accepts both of D's offers, D earns $x + \delta(y)$ and R earns $1 - x + \delta(1 - y)$. Lower values of δ indicate

impatience. In the extreme, if $\delta = 0$, the states would not care at all about the second stage, and we would be left with the original bargaining game from the previous chapter. Thus, we restrict δ to being strictly greater than 0. On the opposite end of the spectrum, as δ approaches infinity, the states only care about the future. In the middle, a δ of 3 means the states care about the future three times as much as they care about the present.

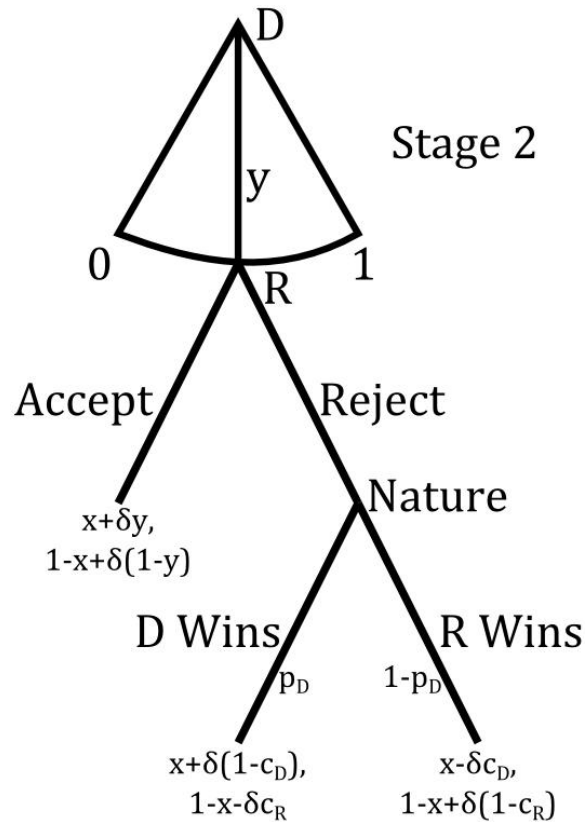
Notably, war payoffs from the first stage carry over into the second stage for both players. For instance, D earns $P_D - c_D$ for launching a preventive war at the start. Thus, it earns $P_D - c_D$ for the first period and $\delta(P_D - c_D)$ for the second. War, in effect, is game ending. The winner takes control of the entire good for the rest of the game while the other state receives none of it.

To be explicit here, the costs carry over into the second period. This may seem counterintuitive at first; after all, states can only spend money on a particular tank once, buildings can only be blown up once, and soldiers can only die once. Rather than thinking of the loss here, however, we ought to consider the alternatives. If a state spends money on a tank, it does not spend money on a park that its citizens could enjoy year after year. Likewise, after the opposing army reduces that building to rubble, its former occupants cannot receive the benefits of living in it every month. And a soldier's death is not tragic because he died—it is because his family will not be able to talk to him today, tomorrow, or any other day in the future. Consequently, although all of the destruction takes place during the war in the first period, the states still feel the after effects into the future.

As always, drawing the game tree helps. For ease of viewing, let's break the tree down into stage 1 and stage 2. Here is stage 1:

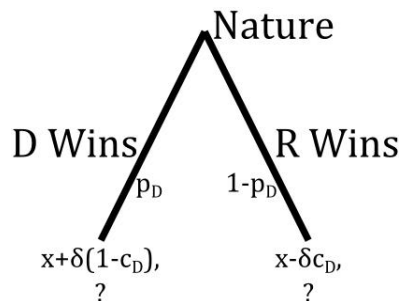


If R accepts D's offer, the states move to stage 2:



The actions of stage two should be familiar—they are exactly the same as in the simple bargaining game in section 2.3.

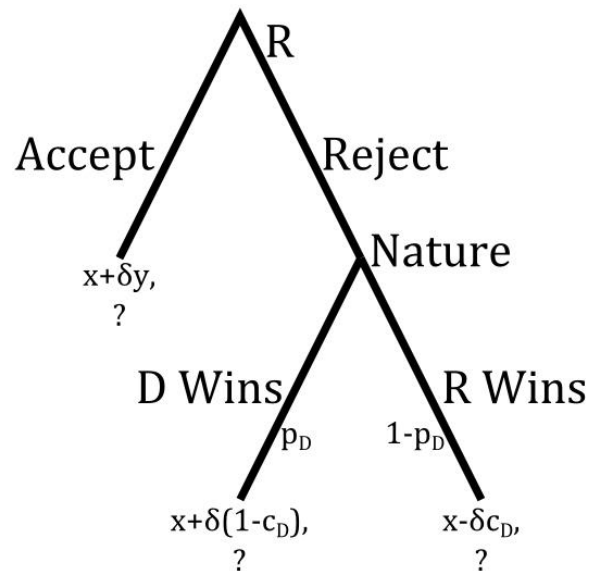
Since we will be considering many specific examples, we should work through the generalized war payoffs first; otherwise, we would have to calculate them repeatedly. To start, consider D's possible war payoffs in the second stage:



D wins the war with probability p_D and earns $x + \delta(1 - c_D)$. With probability $1 - p_D$, it loses the war and earns $x - \delta c_D$. As an equation:

$$\begin{aligned}
 EU_D(\text{war post-shift}) &= (p_D)[x + \delta(1 - c_D)] + (1 - p_D)(x - \delta c_D) \\
 EU_D(\text{war post-shift}) &= p_D x + \delta p_D(1 - c_D) + x - \delta c_D - p_D x + \delta p_D c_D \\
 EU_D(\text{war post-shift}) &= \delta p_D(1 - c_D) + x - \delta c_D + \delta p_D c_D \\
 EU_D(\text{war post-shift}) &= \delta p_D - \delta p_D c_D + x - \delta c_D + \delta p_D c_D \\
 EU_D(\text{war post-shift}) &= \delta p_D + x - \delta c_D \\
 EU_D(\text{war post-shift}) &= x + \delta(p_D - c_D)
 \end{aligned}$$

We can draw a parallel between this war payoff and a state's war payoff from the original bargaining game. Take a look at all of D's payoffs from the second stage:

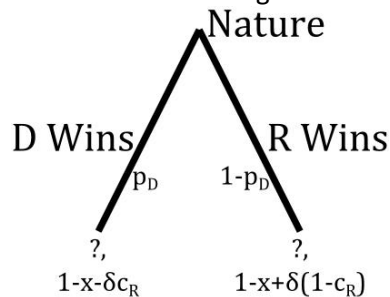


Note that they all begin with x and have a term multiplied by δ . Why the similarities? First, the x is leftover from the first stage. An economist would refer to this as a *sunk* value. D already has x as a payoff and cannot do anything to change that in the second period. As such, the value of x is inconsequential to D 's decision making process in the second stage.

Second, the δ goes in front of all of the second stage's payoffs for D , as we must factor in D 's preferences over time. Since x is the only payoff leftover from the first stage, δ includes everything but x .

Combined, these two factors imply that D functionally ignores x and δ once it arrives in the second stage. All D cares about is whether it can agree to a bargain in the second period that is better than the alternative of war. Hence, although R 's expected utility for war in the second stage equals $x + \delta(p_D - c_D)$, only the $p_D - c_D$ matters for its final decision. Note that this figure looks very similar to the expected utilities from war in the static bargaining model from section 2.3. The only difference is that we have replaced an A with a D and a B with an R . Given this revelation, we will unsurprisingly find nearly identical results with the second stage of the shifting power model as we did with the static model.

Now let's isolate R 's payoffs for war in the second stage:

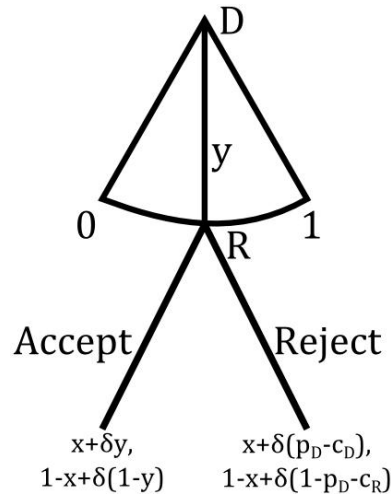


R wins the war with probability $1 - p_D$ and earns $x + \delta(1 - c_R)$. With probability p_D , R loses and earns $x - \delta c_R$. Thus, R 's expected utility for war in the second stage equals:

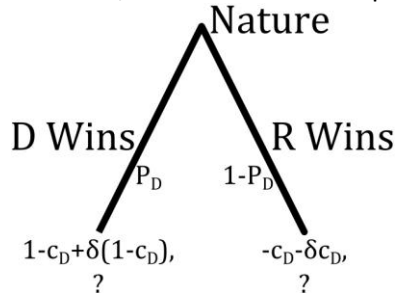
$$\begin{aligned} EU_R(\text{war post-shift}) &= (1 - p_D)[x + \delta(1 - c_R)] + (p_D)(x - \delta c_R) \\ EU_R(\text{war post-shift}) &= 1 - x + \delta(1 - c_R) - p_D x - \delta p_D(1 - c_R) + p_D x - \delta p_D c_R \\ EU_R(\text{war post-shift}) &= 1 - x + \delta(1 - c_R) - \delta p_D(1 - c_R) - \delta p_D c_R \\ EU_R(\text{war post-shift}) &= 1 - x + \delta - \delta c_R - \delta p_D + \delta p_D c_R - \delta p_D c_R \\ EU_R(\text{war post-shift}) &= 1 - x + \delta - \delta c_R - \delta p_D \\ EU_R(\text{war post-shift}) &= 1 - x + \delta(1 - p_D - c_R) \end{aligned}$$

Again, R's possible payoffs in the second period show the sunk cost of the first period. No matter what happens after the shift, it still earns $1 - x$ from the first stage. After factoring out δ , we see R's expected utility for war in the second period equals $1 - p_D - c_R$, which mirrors the static bargaining game.

With both players' expected utilities for war in hand, we can remove nature's move from the second stage and simplify the game to this:



Nature also moves in the first stage if D prevents or R rejects x . These war outcomes are identical, so we only need to run through them once. First, let's calculate D's expected utility for war pre-shift:



With probability P_D , D wins the war and earns $1 - c_D + \delta(1 - c_D)$; $1 - c_D$ represents D's payoff from the first stage while $\delta(1 - c_D)$ calculates D's locked-in war payoff for the second period. With probability $1 - P_D$, D loses and earns $-c_D + \delta(-c_D)$. As an equation:

$$EU_D(\text{war pre-shift}) = (P_D)[1 - c_D + \delta(1 - c_D)] + (1 - P_D)[-c_D + \delta(-c_D)]$$

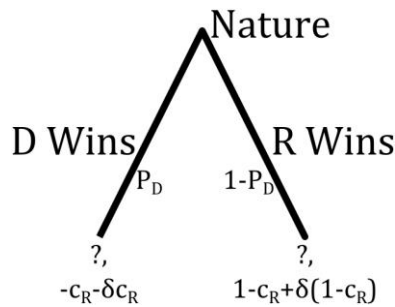
$$EU_D(\text{war pre-shift}) = P_D - P_D c_D + \delta P_D - \delta P_D c_D - c_D - \delta c_D + P_D c_D + \delta P_D c_D$$

$$EU_D(\text{war pre-shift}) = P_D + \delta P_D - c_D - \delta c_D$$

$$EU_D(\text{war pre-shift}) = P_D - c_D + \delta(P_D - c_D)$$

Thus, D earns $P_D - c_D + \delta(P_D - c_D)$ on average if the states fight a war in the first period.

Let's switch to R's pre-shift war payoffs:



R loses the war with probability P_D and earns $-c_R + \delta(-c_R)$. Meanwhile, it wins the war with probability $1 - P_D$ and earns $1 - c_R + \delta(1 - c_R)$. As an equation:

$$EU_R(\text{war pre-shift}) = (P_D)[-c_R + \delta(-c_R)] + (1 - P_D)[1 - c_R + \delta(1 - c_R)]$$

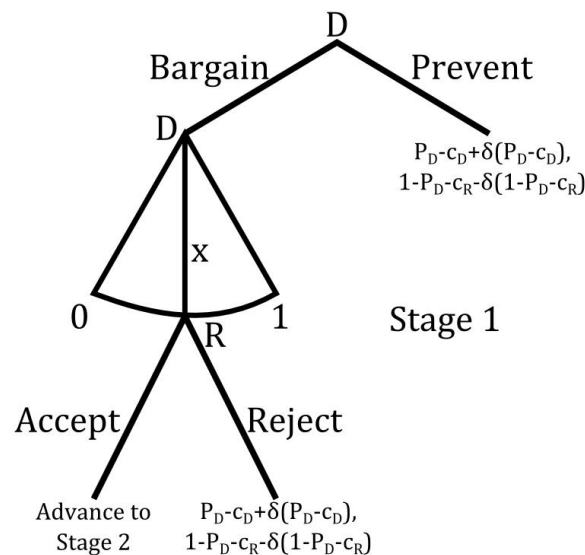
$$EU_R(\text{war pre-shift}) = -P_D c_R - \delta P_D c_R + 1 - c_R + \delta - \delta c_R - P_D + P_D c_R - \delta P_D + \delta P_D c_R$$

$$EU_R(\text{war pre-shift}) = 1 - c_R + \delta - \delta c_R - P_D - \delta P_D$$

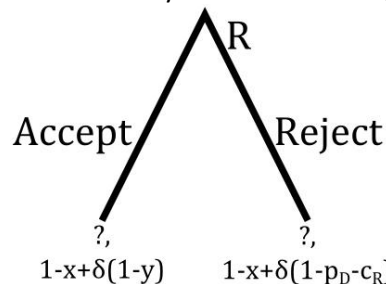
$$EU_R(\text{war pre-shift}) = 1 - P_D - c_R + \delta(1 - P_D - c_R)$$

As such, R earns $1 - P_D - c_R + \delta(1 - P_D - c_R)$ on average for war in the first period.

Using these expected war payoffs, we can remove nature from the game and simplify the first stage to this:



Although we will look at specific examples in a moment, we can generally solve for the second stage without issue. As always, we work backward from the very end. The final remaining stage features R deciding whether to accept or reject D's demand y in the second stage:



If R accepts, it earns $1 - x + \delta(1 - y)$. If R rejects, it earns $1 - x + \delta(1 - p_D - c_R)$. So R accepts a bargain y if:

$$\begin{aligned}
EU_R(\text{accept } y) &\geq EU_R(\text{war post-shift}) \\
1 - x + \delta(1 - y) &\geq 1 - x + \delta(1 - p_D - c_R) \\
\delta(1 - y) &\geq \delta(1 - p_D - c_R) \\
1 - y &\geq 1 - p_D - c_R \\
-y &\geq -p_D - c_R \\
y &\leq p_D + c_R
\end{aligned}$$

Thus, R accepts any demand less than or equal to $p_D + c_R$. Such a demand leaves $1 - p_D - c_R$ leftover for R, which is R's expected utility for war. If D demands a y greater than $p_D + c_R$, R receives more by fighting and thus rejects the offer.

Now consider D's demand size. In general, D can demand a great amount to induce R to fight, or it can demand a small amount to induce R to accept.

Let's start with the great demand. If D demands $y > 1 - p_D - c_R$, R rejects, and D earns its war payoff:

$$EU_D(y > 1 - p_D - c_R) = x + \delta(p_D - c_D)$$

Alternatively, D could offer a $y \leq p_D + c_R$, which R accepts. In this case, D earns its payoff for a peaceful settlement in the second stage:

$$EU_D(y \leq p_D + c_R) = x + \delta y$$

Note that D's payoff here decreases as y increases. Thus, the optimal demand for D is the greatest size y that R finds acceptable. Fortunately, we know R accepts any y less than or equal to $p_D + c_R$. Thus, the largest value D can take without inducing war is $y = p_D + c_R$. Substituting $p_D + c_R$ for y in D's expected utility, we arrive at the most D can possibly earn from an acceptable demand:

$$\begin{aligned}
EU_D(y \leq p_D + c_R) &= x + \delta y \\
y &= p_D + c_R \\
EU_D(y = p_D + c_R) &= x + \delta(p_D + c_R)
\end{aligned}$$

D makes the optimal acceptable offer if $y = p_D + c_R$ yields a greater expected payoff than inducing war:

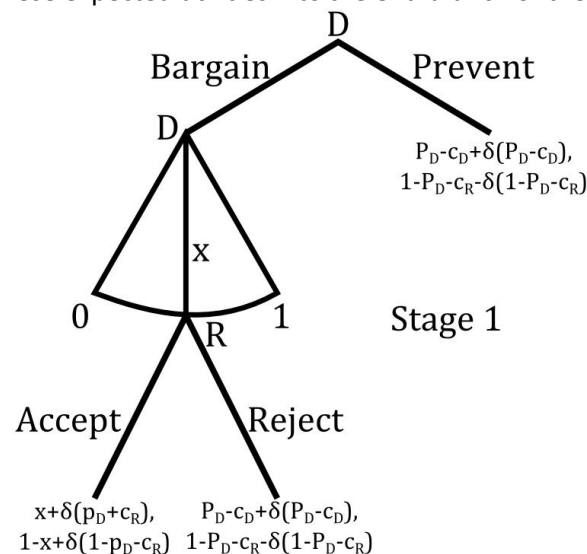
$$\begin{aligned}
x + \delta(p_D + c_R) &\geq x + \delta(p_D - c_D) \\
\delta(p_D + c_R) &\geq \delta(p_D - c_D) \\
p_D + c_R &\geq p_D - c_D \\
c_R &\geq -c_D \\
c_D + c_R &\geq 0
\end{aligned}$$

Since each of the costs of war is individually greater than zero, their sum is also greater than zero. Therefore, D optimally offers $y = p_D + c_R$ to R in the second stage. R accepts and earns $1 - x + \delta(1 - p_D - c_R)$ while D receives $x + \delta(p_D + c_R)$. All told, the states resolve the bargaining problem peacefully in the second stage.

This result fundamentally altered the way political scientists think about preventive war. A long running theory claimed that rising states, upon ascending to power, started wars to take advantage of their newfound strength. That is, rising powers must initiate conflict to receive any concessions.

However, the results from the second stage show that such theories do not hold up under formal scrutiny. After the shift transpires, the declining state could try shortchanging the rising state or recognize the new status quo. If it tries shortchanging, the rising state declares war, and the states pay the inefficient costs of fighting. If the declining state recognizes the new status quo, it can offer just enough concessions to appease the rising state while keeping the costs of war to itself. (Recall that D's equilibrium share of the good was $1 - P_R + c_R$, meaning it earned its probability of victory plus the *rising* state's cost of fighting.) The second option is much better option. Thus, the declining state wisely (if begrudgingly) calculates its offer with the rising state's new power in mind.

Let's turn back to the game. Given that D earns $x + \delta(p_D + c_R)$ and R earns $1 - x + \delta(1 - p_D - c_R)$ in the second stage, we can plug these expected utilities into the end branch of the first stage:

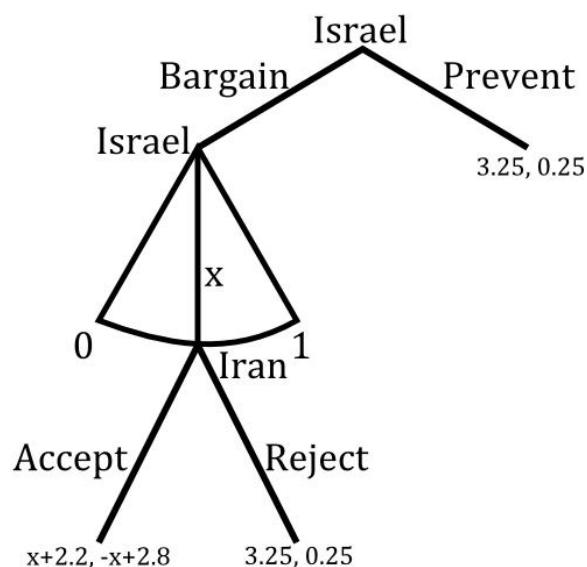


This substitution makes our life much easier. We know the second stage ends in an agreement, so the two stage bargaining game collapses into a one stage bargaining game. The tension remaining is whether the declining state prefers reaching that unfavorable (but peaceful) settlement to fighting a costly war to lock in its share of the good before the shift.

To answer that, we must still work backward. However, the general results from the first stage will not be as crystal clear as the general results from the second stage or the proof for war's inefficiency puzzle from last chapter. Although we will eventually solve for the general model, a few examples will nicely illustrate the overall lessons.

Consequently, to make the intuition of the model clear, let's first consider some examples of the current interaction with Israel and Iran. The international community believes Iran is converting uranium from civilian nuclear power plants into the fuel of an atomic bomb. As a result, Israel's is considering launching preventive raid on Iran to end its nuclear missile program. Of course, any conflict between these two countries will be costly, so the situation follows our model's framework.

To begin our analysis, let's designate Israel as the declining state and Iran as the rising state. Suppose $P_{\text{Israel}} = .75$, $p_{\text{Israel}} = .35$, $c_{\text{Israel}} = .1$, $c_{\text{Iran}} = .2$, and $\delta = .4$. Having numbers is helpful here, as we can substitute them for the variables in the game tree:



Ignore Iran's decision to accept or reject for the moment. If Israel bargains to begin the game, the largest payoff it can obtain is 3.2. To reach that amount, Israel must demand $x = 1$ and Iran must accept. However, Israel can launch preventive war instead and earn 3.25. Since 3.25 is slightly greater than 3.2, Israel must fight during the first stage. Thus, we have encountered our first rationalist explanation for war.

Interestingly, this outcome is unfortunate for *both* parties. Note that Israel earns 3.25 and Iran earns 0.25 through fighting, for a sum of 3.5. In contrast, the game has 5 units of the good to be distributed throughout—1 from the first period and 1 multiplied by 4 (the discount factor) from the second period.

Consequently, there exist bargained resolutions through time that both states prefer to war in the first period. 3.25 units appease Israel while 0.25 units appease Iran. Any split of the additional 1.5 units satisfies both parties.

However, time interferes with the bargaining process. In period 1, Israel and Iran can only split 1 unit. And no matter how they divide the good, the states know how the second stage of bargaining will end: the declining state must give the rising state its payoff for war post-shift. But because Iran has nuclear weapons in the second period, Israel must give Iran more of the good at that time. Yet Israel knows it can lock in a war payoff in the first period. If preventive war is sufficiently tempting because the power shift will be too great (as is the case in the example), Israel prefers to fight.

In game theory, we call this a *commitment problem*. If Iran could credibly commit to not demanding more of the good after it acquires nuclear weapons, Israel has no need to launch preventive war. In Western democracies, citizens can sign contracts that bind them to similar types of agreements. Unfortunately, contracts on the international stage hold no such power. Once Iran proliferates, if it breaks the contract, no police force will go into the country and "arrest" it as would be the case in a democratic country. Recognizing that Iran will want to break any contract, Israel must intervene.

Still, we have only looked at set of specific values for the variables. If we picked a different arrangement, perhaps the interaction would end in peace rather than war.

Indeed, this is the case. If the shift in power increases, the risk of war increases. If the declining state's cost of war increases, the risk of war also decreases. Perhaps counterintuitively, if the rising state's cost of war increases, the risk of war also decreases. Finally, if the states place greater value on the future (that is, as δ increases), the risk of war increases.

How Increasing Variables Affects Outcomes	
Variable	Risk of War
Magnitude of Power Shift	Increases
Declining State's War Cost	Decreases
Rising State's War Cost	Decreases
Value of the Future	Increases

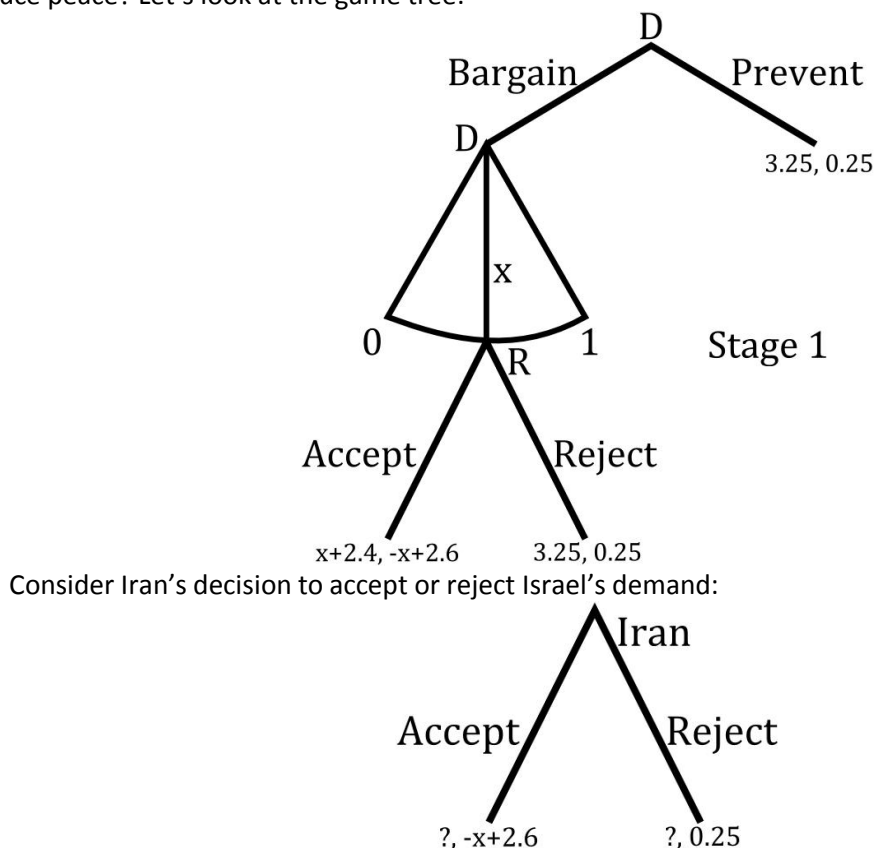
Note that given any specific set of variables, the outcome is *always* peace or *always* war. So when we say “the risk of war is increasing in δ ,” we mean that if the outcome of a particular set of variables is peace, if we keep increasing δ , we may reach a critical value that switches the outcome to war.

To illustrate how manipulating these variables changes the outcome of the game, we will now look at four variations of the Israel/Iran example.

When the Shift Is Minimal

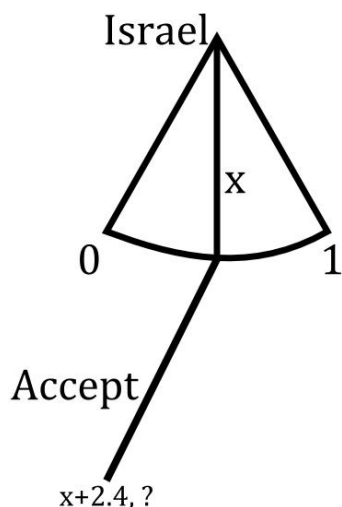
Recall that the original parameters were $P_{\text{Israel}} = .75$, $p_{\text{Israel}} = .35$, $c_{\text{Israel}} = .1$, $c_{\text{Iran}} = .2$, and $\delta = 4$. As the magnitude of a power shift increases, the risk of war increases. Thus, if we decrease the magnitude of the shift, the states could possibly find a peaceful resolution.

As such, suppose instead that $p_{\text{Israel}} = .4$. Israel now faces a shift of .35 instead of .4. Is that enough to induce peace? Let’s look at the game tree:



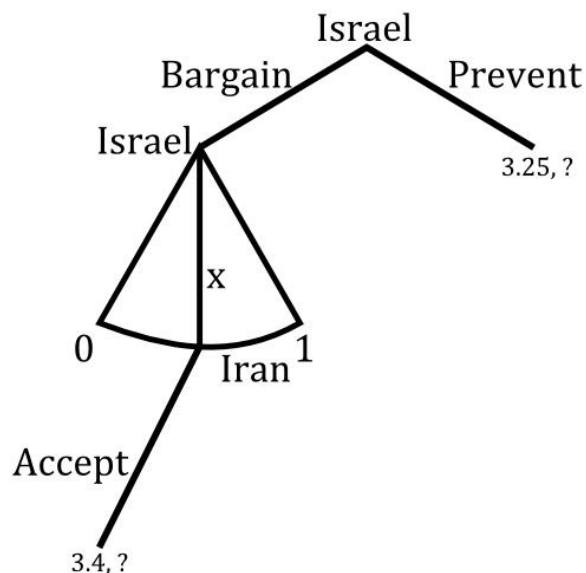
In the worst case scenario for Iran, Israel demands all of the good, or $x = 1$. However, Iran still wants to accept in that scenario; it earns 1.6 accepting but only 0.25 for rejecting. Consequently, Iran will accept any demand Israel makes.

Now consider Israel's optimal demand size:



Israel knows Iran will accept any demand it issues. Since Israel's payoff increases as function of x , it wants to demand all 1 of it. Thus, Israel selects $x = 1$ and R accepts.

Now we can check whether Israel prefers advancing to the bargaining stage or preventing at the start:



Israel earns 3.4 for bargaining and 3.25 for preventing. Therefore, Israel bargains.

Why does reducing the extent of the power shift alter Israel's optimal strategy? The bigger the power shift, the worse the declining state's bargaining leverage is post-shift. Although Israel paid a cost upfront to fight a preventive war in the original example, it preferred conflict to a poor bargained settlement later on. Here, however, the shift is great enough to justify paying those costs of war.

Note that the bargaining ranges do not overlap in this example, yet peace prevails. In the first stage, Israel's power equals .75 and its cost of fighting is .1, while Iran's cost is .1. Thus, if no power shift were to occur, the mutually preferable bargained settlements give Israel at least .65 of the good but no more than .95. In the second stage, Israel's power equals .4, while both sides' costs remain the same. Here, the Israel needs at least .3 but no more than .6.

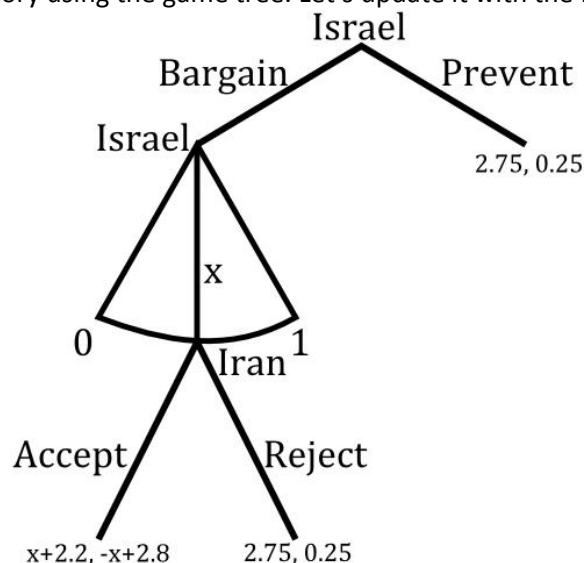
Despite the lack of overlap, Israel does not want to fight because it takes all of the good during the first stage. Israel cannot count on Iran to give Israel a good deal in the future. However, Israel also knows that Iran really wants to advance to the second stage, as Iran earns 2.6 for that half of the game alone. In contrast, if Israel prevents or Iran rejects Israel's initial offer x , Iran earns a pitiful 0.25. Israel

leverages Iran's poor bargaining position early on to steal all of the good at first before conceding some of it to Iran later on. Iran, left with no better alternative, accepts Israel's initial demand. Fortuitously, because Israel receives so much early on, it does not want to start a war in the first period either. As a result, the states maintain the peace despite their seemingly unsolvable war trap.

When the Declining State Faces High Costs

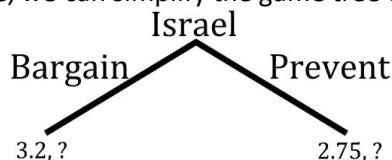
Let's move on to the next example. Again, recall that the original parameters were $P_{\text{Israel}} = .75$, $p_{\text{Israel}} = .35$, $c_{\text{Israel}} = .1$, $c_{\text{Iran}} = .2$, and $\delta = 4$. Let's tweak Israel's cost of war to .3. Intuitively, we should think this will also switch the outcome from war to peace because the bargaining ranges overlap here; the first stage's range requires Israel receive at least .55 but no more than .95, while the second stage's range requires Israel receive at least .3 but no more than .6. Thus, the overlap appears on the interval between .55 and .6.

We can confirm our theory using the game tree. Let's update it with the new cost of war:



Once again, Iran accepts any demand x Israel makes; even if Israel demands $x = 1$, Iran optimally accepts because 1.8 is greater than 0.25. In turn, Israel knows it can demand everything and still induce Iran to accept, so its optimal demand is $x = 1$.

From there, Israel only needs to decide whether bargaining is better than preventing. Substituting $x = 1$ and foreseeing Iran's acceptance, we can simplify the game tree to this:



Israel earns 3.2 for bargaining but only 2.75 for launching preventive war. Therefore, it pursues peace. Iran accepts its offer, and the peace continues through the second stage.

Why does increasing the declining state's cost of fighting decentivize preventive war? The idea is clearest when taken to the extreme. Suppose Israel's expected utility for war in the first period was some *negative* amount. Intervening clearly is the best option, as Israel could instead offer Iran everything in both the first and second period, receive nothing from the entire game, and still perform better.

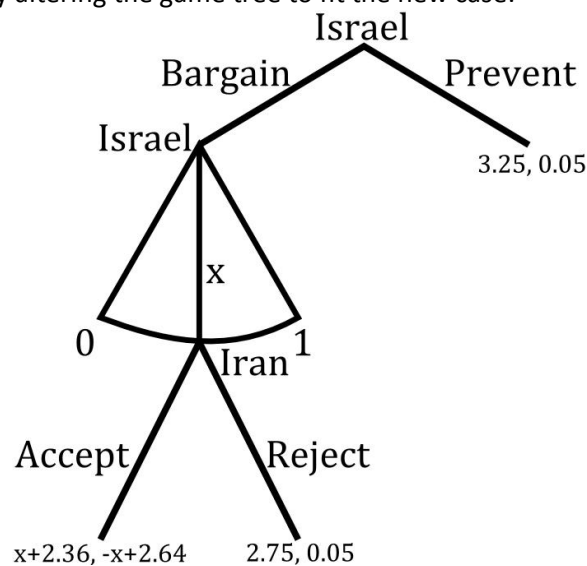
A similar story holds when Israel's expected utility for war in the first period was some tiny amount. Israel could demand just a tiny amount, Iran would be inclined to accept, and Israel's overall payoff would beat its preventive war payoff.

But when costs are near zero, preventive war becomes a viable option, particularly if there is a large gap between the bargaining ranges of the two periods. That being the case, some cost value must switch Israel's optimal strategy. Consequently, as costs increase, the likelihood of preventive war decreases.

When the Rising State Faces High Costs

The same is true for the rising state's cost of war, though the reason is not as clear. After all, the declining state's war payoff does not change regardless of the rising state's war cost. However, the declining state's payoff for bargaining increases as the rising state's war cost increases, as the declining state can demand more without inducing the rising state to reject. In turn, war becomes comparatively less attractive.

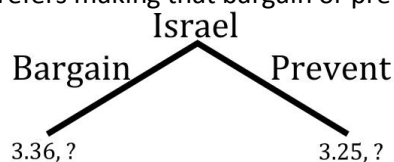
To see the logic in action, recall once more that the original parameters were $P_{\text{Israel}} = .75$, $p_{\text{Israel}} = .35$, $c_{\text{Israel}} = .1$, $c_{\text{Iran}} = .2$, and $\delta = 4$. Let's increase Iran's cost of war to .24 and investigate whether the change leads to peace. We begin by altering the game tree to fit the new case:



In the original example, Israel's payoff from the second period was 2.2. Now it has increased to 2.36. That small difference is enough to change Israel's optimal strategy.

We can begin again by noting that Iran accepts any demand Israel makes; even if Israel chooses $x = 1$, Iran earns 1.64 for accepting as opposed to 0.05 from rejecting. As such, Iran accepts all demands. Knowing that, Israel demands the most it possibly can and therefore sets x equal to 1.

Now we check whether Israel prefers making that bargain or preventing:



The extra 0.16 Israel earns in the second stage is enough to turn the tide. Israel's optimal choice is to bargain, as 3.36 is greater than 3.25. The states complete the interaction peacefully.

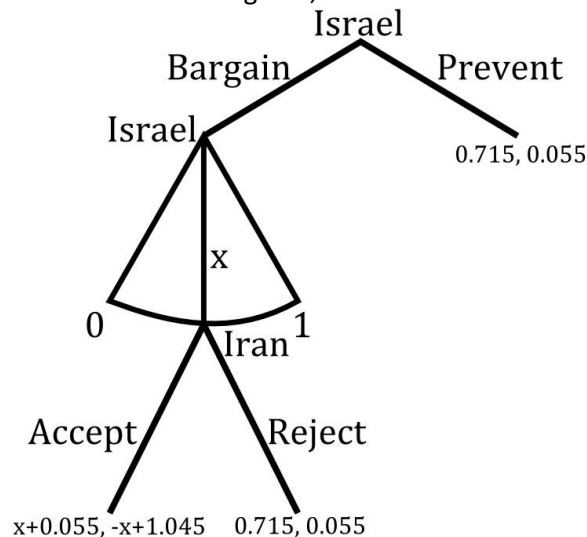
We can see why increasing the rising state's cost of war facilitates peace by considering the extreme case. Imagine the rising had such high costs of war that its expected utility for rejecting an offer was always negative. Then the declining state could always demand the entire good. But if the declining state could successfully demand everything, war serves no purpose; it would only pass unnecessary costs onto the declining state.

In contrast, if the rising state has virtually no cost of war, the declining state's optimal demand in the second stage must be very close p_D instead of 1. Since the declining state knows it will not be able to extract much of the good later on, preventive war looks more attractive at the start.

When the Future Is Unimportant

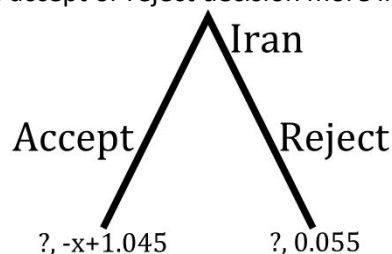
Finally, war is unlikely if the declining state cares mostly about the present. The original parameters were $P_{\text{Israel}} = .75$, $p_{\text{Israel}} = .35$, $c_{\text{Israel}} = .1$, $c_{\text{Iran}} = .2$, and $\delta = 4$. The value of δ meant the states placed four times as much value on the future as they do on the present. Let's shrink that to $\delta = .1$ instead. Now the states only value the future to be worth a tenth of the value of the present. In other words, the states care a lot about the first stage's payoffs and virtually ignore the second period payoffs.

After we substitute those numbers into the game, our tree looks like this:



These numbers may appear jarringly small compared to the previous versions. The small value of δ is the reason. When $\delta = 4$, the total value of the good over time was 5—1 from the first stage and 4 from the second. While the states still batter for 1 in the first stage, the δ value of .1 means the good is only worth .1 in the second period. Consequently, 1.1 is the most the states can collectively earn in this game.

Changing δ has also made Iran's accept or reject decision more interesting:



Previously, Iran always accepted regardless of what Israel offered. Here, Iran earns 0.055 for rejecting and going to war versus $-x + 1.045$ for accepting an offer x . But if $x = 1$, Iran earns 0.045 for accepting, which is less than its payoff for war. As such, Iran only accepts if its war payoff is at least as great as its expected utility for bargaining:

$$EU_{\text{Iran}}(\text{accept}) \geq EU_{\text{Iran}}(\text{reject})$$

$$EU_{\text{Iran}}(\text{accept}) = -x + 1.055$$

$$EU_{\text{Iran}}(\text{reject}) = 0.055$$

$$-x + 1.045 \geq 0.055$$

$$-x + 1.045 \geq 0.055$$

$$x \leq 0.99$$

Thus, Iran accepts any demand x less than or equal to 0.99 and rejects anything greater.

In turn, Israel has two choices. If it makes an offer greater than 0.99, Iran rejects, and Israel earns its war payoff of 0.715. Alternatively, if it makes an offer less than or equal to 0.99, Iran accepts, and Israel earns $x + 0.055$. Since Israel's payoff is increasing in x , its optimal acceptable demand is the most Iran is willing to tolerate without rejecting, or $x = 0.99$. Israel prefers making that optimal acceptable demand if its expected utility for it is greater than its expected utility for war. Thus, Israel selects $x = 0.99$ if:

$$EU_{\text{Israel}}(x = 0.99) \geq EU_{\text{Israel}}(x > 0.99)$$

$$EU_{\text{Israel}}(x = 0.99) = 0.99 + 0.055$$

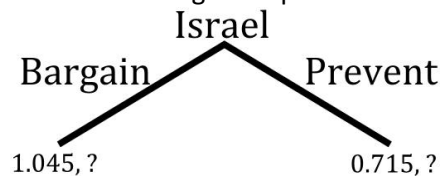
$$EU_{\text{Israel}}(x > 0.99) = 0.715$$

$$0.99 + 0.055 \geq 0.715$$

$$1.045 \geq 0.715$$

The inequality holds, so Israel demands 0.99, which induces Iran to accept. D earns 1.045 for this outcome.

Lastly, we must look at Israel's decision to bargain or prevent:



Israel's decision is redundant here. It earns the same payoff for preventing as it earns for inducing Iran to reject the demand and fighting. We already know Israel prefers having Iran accept its demand of $x = 0.99$, so we also know that Israel prefers bargaining to preventing. The game ends peacefully once again.

The extreme case reveals the declining state's strategic logic in this circumstance. When δ becomes very small—perhaps even 0—the game converges to the one stage bargaining problem from chapter 2. But we know what happens in a one stage bargaining problem—there exist peaceful settlements that simultaneously satisfy both parties. The declining state's incentive for preventive war throughout this section is its ability to lock-in an appealing payoff for the long-term. Yet, when δ is extremely small, the long-term is irrelevant. As a result, the states can agree on one of those mutually satisfactory settlements.

As a final note, this example illuminates an extremely counterintuitive result. Intuitively, we might think that the power shift must allow the rising state to earn more than what it would receive if it just fought a war in the first period. Our intuition is wrong here. In equilibrium, Israel demands 0.99 and Iran accepts, leaving Iran with a payoff of 0.01 for the first stage and 0.045 for the second stage, for a total of 0.055. Yet, this is exactly the same amount Iran earns from fighting in the first stage!

Israel cleverly took more than we might have thought possible by grabbing for the most it possibly could in the first stage without inducing war. By leveraging Iran's future power against it, Israel received as much as it would have had there been no power shift. The only difference is that Israel receives more of the good in the first stage and less of it in the second.