International Relations 101: War as a Bargaining Problem

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http://wjspaniel.wordpress.com/pscir106/
Parallel: Lawsuit

• A man trips and falls in your store and sues you for negligence.
Parallel: Lawsuit

• A man trips and falls in your store and sues you for negligence.

• Your lawyer and his lawyer agree on the following:
  – There is a 60% chance the lawsuit will be successful.
  – If he wins, you will have to pay him $40,000.
  – Going to court will cost each of you $10,000 in lawyers fees.
Possible Resolutions

1. Either you or him concede immediately.
3. You let the court decide the matter.
Possible Resolutions

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3. You let the court decide the matter.
   - How should we expect this matter to be resolved?
Possible Resolutions

1. Either you or him concede immediately.
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Possible Resolutions

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   - Your expected payoff:
     - \((-40,000)(0.6) - 10,000 = -34,000\)
Possible Resolutions

1. Either you or him concede immediately.
3. You let the court decide the matter.
   • Your expected payoff:
     • \((-40,000)(.6) - 10,000 = -34,000\)
   • His expected payoff:
     • \((40,000)(.6) - 10,000 = 14,000\)
Possible Resolutions

1. Either you or him concede immediately.
3. You let the court decide the matter.
Possible Resolutions

1. Either you or him concede immediately.
   - If you concede, you lose $40,000.
   - If he concedes, he receives nothing.


3. You let the court decide the matter.
Possible Resolutions

1. Either you or him concede immediately.
   - If you concede, you lose $40,000.
   - If he concedes, he receives nothing.
     - Each would rather go to court than concede.


3. You let the court decide the matter.
Possible Resolutions

3. You let the court decide the matter.
Possible Resolutions

   - A settlement $x$ is better for you than court if $x < $34,000.
   - A settlement $x$ is better for him than court if $x > $14,000.
   - Therefore, any settlement offer between $14,000 and $34,000 is better for both parties than court!

3. You let the court decide the matter.
Conclusion

• Settlement should be the result!
But This Is Just Like War...

- Wars produce a winner and a loser, perhaps probabilistically.
- Fighting is costly because it kills people and destroys things.
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- Fighting is costly because it kills people and destroys things.
- So why can’t two states settle matters off the battlefield?
But This Is Just Like War...

- Wars produce a winner and a loser, perhaps probabilistically.
- Fighting is costly because it kills people and destroys things.
- So why can’t two states settle matters off the battlefield?
  - We call such a reason a “rationalist explanation for war.”
Big question: Can war be mutually beneficial?
Crisis!

• Venezuela discovers an oil deposit worth $80 billion.
Crisis!

- Venezuela discovers an oil deposit worth $80 billion.
- But Colombia hears about this and declares the oil deposit to be on its side of the border.
Crisis!

- Venezuela discovers an oil deposit worth $80 billion.
- But Colombia hears about this and declares the oil deposit to be on its side of the border.
- The sides call in their militaries and prepare for war.
Venezuela’s Perspective

- Venezuela will win the war (and $80 billion in oil) 60% of the time.
- Cost of death, destruction, and lost oil: $12 billion.
Colombia’s Perspective

• Colombia will win the war (and $80 billion in oil) 40% of the time.
• Cost of death, destruction, and lost oil: $15 billion.
Interactive Question

• Is war inevitable between these two countries?
Venezuela’s Needs

• Expected payoff from war:
  \((80)(.6) - 12 = 36\)

• Venezuela must receive $36 billion to be satisfied.
Colombia’s Needs

- Expected payoff from war:
  \[(80)(.4) - 15 = 17\]
- Colombia must receive $17 billion to be satisfied.
A Rationalist Explanation for War?

• Both countries have positive expected payoffs from fighting.
  – So war is rational for both parties.
A Rationalist Explanation for War?

• Both countries have positive expected payoffs from fighting.
  – So war is rational for both parties. Right?
Bargaining

• War is **not** rational here.
• Venezuela’s and Colombia’s demands sum to $53 billion.
  – But there’s $80 billion in oil revenue to go around!
  – Where did the other $27 billion go?
Bargaining

• War is **not** rational here.

• Venezuela’s and Colombia’s demands sum to $53 billion.
  – But there’s $80 billion in oil revenue to go around!
  – Where did the other $27 billion go?
    • The costs of war ($15 billion and $12 billion) ate it up.
A Better Resolution

• Let $x$ be Venezuela’s share of the settlement.
• Then $x$ satisfies Venezuela if $x > 36$.
• Then $x$ satisfies Colombia if $80 - x > 17$, or $x < 53$. 
A Better Resolution

• Let $x$ be Venezuela’s share of the settlement.
• Then $x$ satisfies Venezuela if $x > 36$.
• Then $x$ satisfies Colombia if $80 - x > 17$, or $x < 63$.
  – Therefore, $x$ is mutually satisfactory if $36 < x < 63$
Conclusion

• Any settlement that gives $36 billion but no more than $63 billion to Venezuela is mutually preferable to war.
  – Such settlements exist.
  – Bargaining is mutually preferable to war.
War’s Inefficiency Puzzle

• Why do states sometimes choose to resolve their differences with inefficient fighting when bargaining, in theory, leaves both better off?
War’s Inefficiency Puzzle

- Was this a quirk with the payoffs for Venezuela and Colombia?
The Model

- Two states: A and B.
The Model

• Two states: A and B.
• Bargain over an object worth 1.
  – This 1 is 100% of the good—whether it is $80 billion in oil, 16 square miles of land, or whatever.
  – Object is infinitely divisible.
The Model

- Two states: A and B.
- Bargain over an object worth 1.
- $p_A$ is the probability A wins a war.
- $p_B$ is the probability B wins a war.
  - No draws, so $p_A + p_B = 1$
The Model

• If the states fight a war, they pay costs $c_A > 0$ and $c_B > 0$.
  – These costs reflect absolute costs (how many people will die) and “resolve” (how much the state cares about the issue).
The Model

• If the states fight a war, they pay costs $c_A > 0$ and $c_B > 0$.
  – These costs reflect absolute costs (how many people will die) and “resolve” (how much the state cares about the issue).
  – The costs can take any functional form, as long as they are positive.
The Model

• If the states fight a war, they pay costs $c_A > 0$ and $c_B > 0$.

• Question: Is bargaining always an effective means of resolving the dispute?
A’s Peace Constraint

• Let $x$ be A’s share of the bargained settlement.
• A is satisfied if:
  $$x \geq p_A(1) - c_A$$
A’s Peace Constraint

• Let $x$ be A’s share of the bargained settlement.
• A is satisfied if:
  \[ x \geq p_A(1) - c_A \]
  \[ x \geq p_A - c_A \]
B’s Peace Constraint

- $1 - x$ is B’s share of a peaceful settlement.
- B is satisfied if:
  $$1 - x \geq p_B(1) - c_B$$
B’s Peace Constraint

• $1 - x$ is B’s share of a peaceful settlement.

• B is satisfied if:
  
  $1 - x \geq p_B(1) - c_B$
  
  $1 - x \geq p_B - c_B$

  $x \leq 1 - p_B + c_B$
Is Peace Possible?

• A is satisfied if: \( x \geq p_A - c_A \)
• B is satisfied if: \( x \leq 1 - p_B + c_B \)
Is Peace Possible?

- A is satisfied if: $x \geq p_A - c_A$
- B is satisfied if: $x \leq 1 - p_B + c_B$
- $x$ is mutually satisfactory if:
  $$p_A - c_A \leq x \leq 1 - p_B + c_B$$
Is Peace Possible?

• A is satisfied if: \( x \geq p_A - c_A \)
• B is satisfied if: \( x \leq 1 - p_B + c_B \)
• \( x \) is mutually satisfactory if:
  \[ p_A - c_A \leq x \leq 1 - p_B + c_B \]
• Such an \( x \) exists if:
  \[ p_A - c_A \leq 1 - p_B + c_B \]
Is Peace Possible?

- A is satisfied if: \( x \geq p_A - c_A \)
- B is satisfied if: \( x \leq 1 - p_B + c_B \)
- \( x \) is mutually satisfactory if:
  \[
  p_A - c_A \leq x \leq 1 - p_B + c_B
  \]
- Such an \( x \) exists if:
  \[
  p_A - c_A \leq 1 - p_B + c_B
  \]
  - \( p_A + p_B = 1 \)
  - \( p_B = 1 - p_A \)
Is Peace Possible?

- A is satisfied if: \( x \geq p_A - c_A \)
- B is satisfied if: \( x \leq 1 - p_B + c_B \)
- x is mutually satisfactory if:
  \[
  p_A - c_A \leq x \leq 1 - p_B + c_B
  \]
- Such an x exists if:
  \[
  p_A - c_A \leq 1 - (1 - p_A) + c_B
  \]
Is Peace Possible?

- A is satisfied if: \( x \geq p_A - c_A \)
- B is satisfied if: \( x \leq 1 - p_B + c_B \)
- \( x \) is mutually satisfactory if:
  \[
  p_A - c_A \leq x \leq 1 - p_B + c_B
  \]
- Such an \( x \) exists if:
  \[
  p_A - c_A \leq 1 - (1 - p_A) + c_B \\
  p_A - c_A \leq p_A + c_B \\
  c_A + c_B \geq 0
  \]
Conclusions

• Peace is possible.
• But how do we interpret this result?
  – Geometric model will help us understand what’s going on here.
The Model

- Two states: A and B.
The Model

- Two states: A and B.
- Bargain over an object worth 1.
<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td>A’s Capital</td>
<td>B’s Capital</td>
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The Model

- Two states: A and B.
- Bargain over an object worth 1.
- $p_A$ is the probability A wins a war.
- $1 - p_A$ is the probability B wins a war.
A’s Expected Share of Territory

B’s Expected Share of Territory

0
A’s Capital

\( p_A \)

1
B’s Capital
The Model

• If the states fight a war, they pay costs $c_A > 0$ and $c_B > 0$. 
A’s Expected Share of Territory

0
A’s Capital

$p_A - c_A$
A’s Costs Of War

$p_A$

1
B’s Capital
A’s Expected War Payoff

\[ p_A - c_A \]

A’s Costs Of War

0
A’s Capital

1
B’s Capital
A’s Expected War Payoff

A’s Costs Of War

Settlements A Prefers to War

0
A’s Capital

$p_A - c_A$

$p_A$

1
B’s Capital
A’s Capital

B’s Capital

0

A’s Capital

B’s Expected Share of Territory

$\boldsymbol{p_A}$

$\boldsymbol{p_A + c_B}$

B’s Costs Of War

1

B’s Capital
A’s Capital

B’s Capital

0

$p_A$

$p_A + c_B$

1

B’s Expected War Payoff

B’s Costs Of War

A’s Capital

B’s Capital
Settlements B Prefers to War

B’s Expected War Payoff

0
A’s Capital

p_A

B’s Costs Of War

p_A + c_B

1
B’s Capital
Settlements B Prefers to War

$\text{A's Costs Of War} = p_A - c_A$

Settlements A Prefers to War

$\text{B's Costs Of War} = p_A + c_B$
A’s Expected War Payoff

Bargaining Range

B’s Expected War Payoff

0
A’s Capital

\( p_A - c_A \)
A’s Costs Of War

\( p_A \)

\( p_A + c_B \)
B’s Costs Of War

1
B’s Capital