GAME THEORY APPLIED TO TRADE WARS

The dispute between the EU and China over solar panels and its escalation

November 17, 2013  Game Theory - Sciences Po 2013  Fouché, Lepers, Matthioli, Moraud, Nussbaumer
Chinese Exports

- EU: 44.1%
- USA: 16.2%
- Others: 13.4%
- Hong Kong: 8.5%
- ASEAN: 17.8%
EU - China

EU Exports

- USA: 17.3%
- China: 8.5%
- Switzerland: 7.9%
- Russia: 7.3%
- Others: 58.9%

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Solar Dispute

- Chinese subsidized solar panels flood EU markets
- ProSun complains against dumping
- EU sets antidumping measures
  - Tariff of 11.8%
- China responds with threat to tax French wine
Applied to Game Theory

Two strategies:
• X → protectionism i.e. raise tariffs
• Y → cooperate i.e. agree on minimum prices
### Pay-offs for the EU

<table>
<thead>
<tr>
<th>Pay-offs for the EU</th>
<th>Strategy</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>((U_1; C_1))</td>
<td>((U_3; C_0))</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>((U_0; C_3))</td>
<td>((U_2; C_2))</td>
</tr>
</tbody>
</table>

Pay-off order:
\(U_3 > U_2 > U_1 > U_0\) and \(C_3 > C_2 > C_1 > C_0\)
For the EU

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<tr>
<th>Strategy</th>
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<th>Y</th>
</tr>
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<tbody>
<tr>
<td>X</td>
<td>Trade War</td>
<td>China worse off</td>
</tr>
<tr>
<td>Y</td>
<td>EU worse off</td>
<td>Minimum Price</td>
</tr>
</tbody>
</table>
Grim Trigger

- Game if played in infinity
- Player discount their future payoff with $\delta$
- Grim Trigger:
  - Player cooperates in first period & as long as the other player does not defect
  → Cooperation becomes possible if both players are sufficiently patient
### Pay-offs for China

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<tr>
<td>X</td>
<td>(U₁; C₁)</td>
<td>(U₃; C₀)</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>(U₀; C₃)</td>
<td>(U₂; C₂)</td>
<td></td>
</tr>
</tbody>
</table>

Pay-off order: \( U₃ > U₂ > U₁ > U₀ \) and \( C₃ > C₂ > C₁ > C₀ \)
Grim Trigger

Cooperate is a Subgame Perfect Nash Equilibrium if:

\[ U_2 + \delta U_2 + \delta^2 U_2 + \ldots \geq U_3 + (\delta U_1 + \delta^2 U_1 + \ldots) \]

Respectively:

\[ U_2 \cdot \sum_{t=0}^{\infty} \delta^t \geq U_3 + U_1 \sum_{t=1}^{\infty} \delta^t \]

\[ U_2 \cdot \frac{1}{1 - \delta} \geq U_3 + (U_1 \delta \cdot \frac{1}{1 - \delta}) \]
Grim Trigger

Therefore Grim Trigger leads to cooperation if:

\[ \delta \geq \frac{U_3 - U_2}{U_3 - U_1} \]

and \( p \) :

\[ p \leq \frac{U_2 - U_1}{U_3 - U_2} \]
Discussion and Relevance

• The conclusion is in accordance with reality:
  – It is likely that both players face a long-time horizon and therefore low discount rates
  – Therefore cooperation is highly probable
  – EU and China came to an agreement and set a minimum price
Criticism

• Grim Trigger assumes punishment forever
• Tit-for-tat could be a solution

• Other players underneath the level of analysis
  – Solar panel industry
  – Different member countries (Germany)
Thank you for your attention