GAME THEORY APPLIED TO TRADE WARS

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

Game Theory - Sciences Po 2013

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EU - China

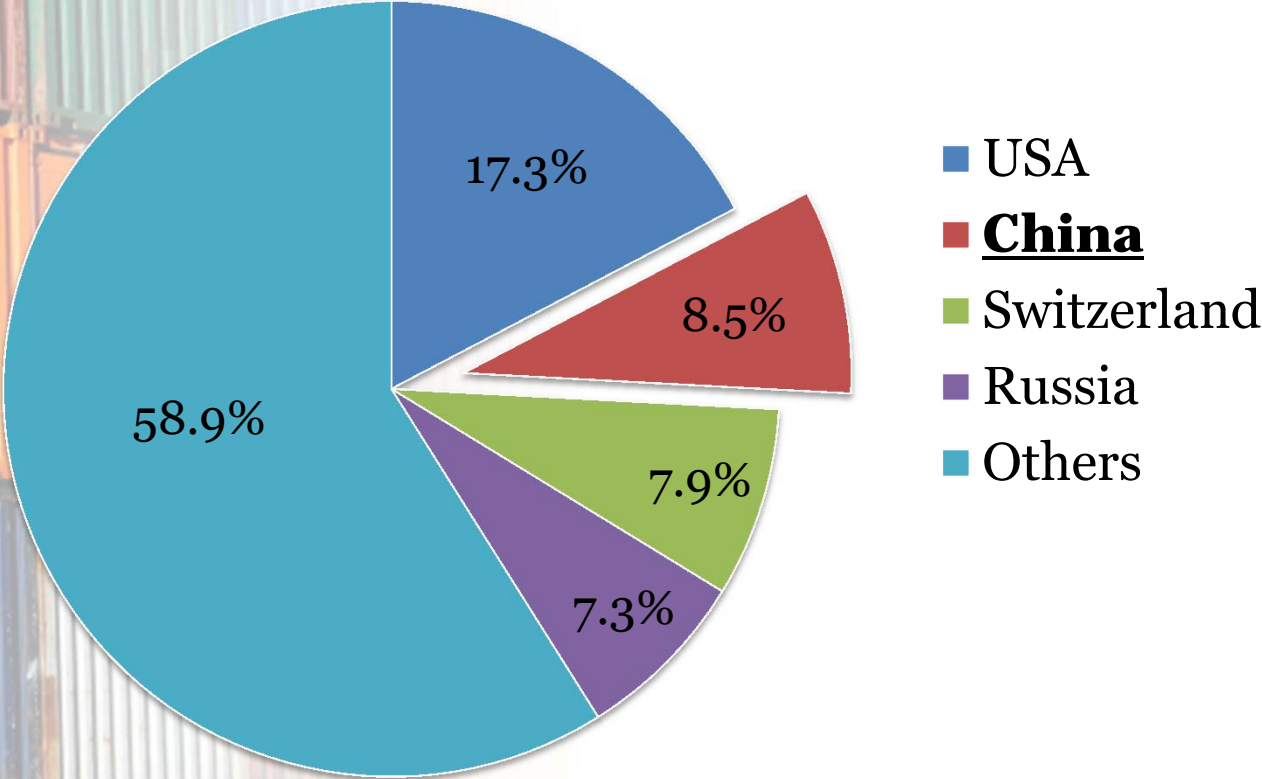## Chinese Exports

- **EU** — 17.8%
- USA — 16.2%
- Hong Kong — 13.4%
- ASEAN — 8.5%
- Others — 44.1%

EU - China

EU Exports

Legend:
- USA — 17.3%
- **China** — 8.5%
- Switzerland — 7.9%
- Russia — 7.3%
- Others — 58.9%
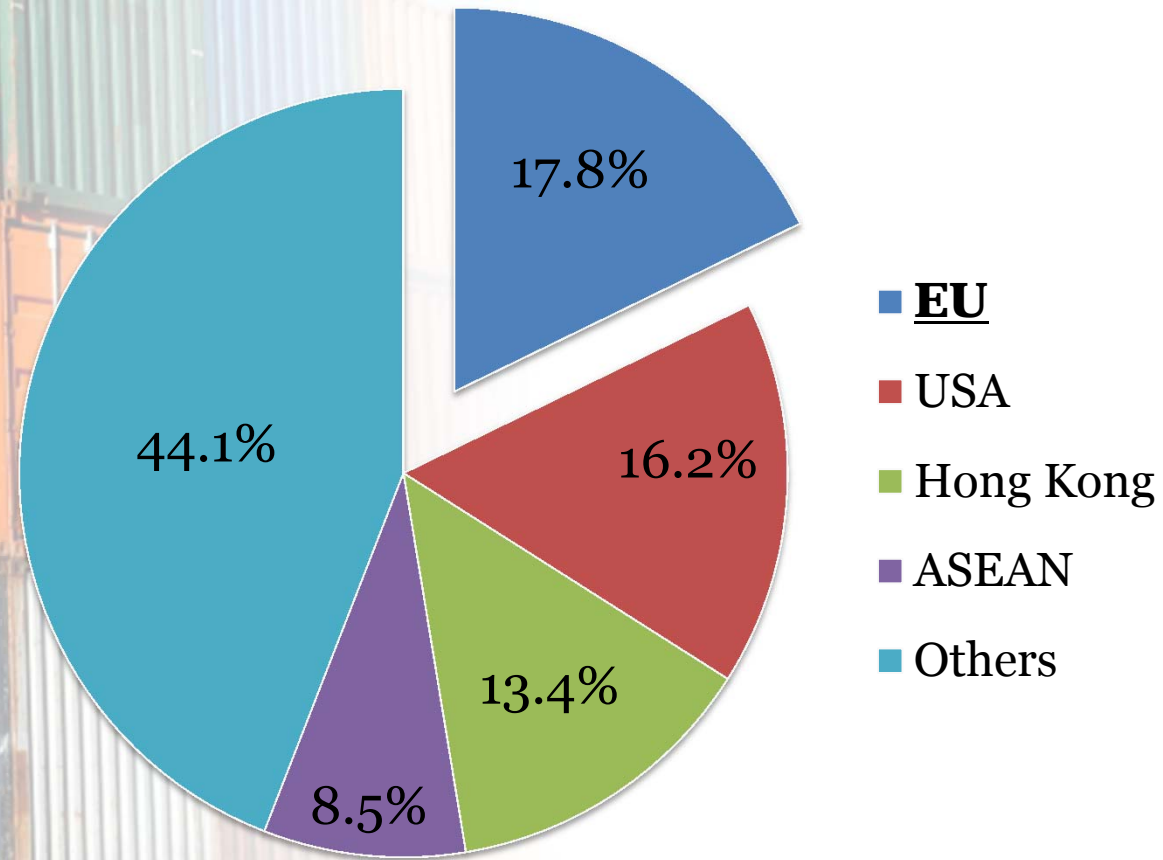
Solar Dispute

- 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

Applied to Game Theory

Pay-offs for China		
Strategy	X	Y
X	$(U_1; C_1)$	$(U_3; C_0)$
Y	$(U_0; C_3)$	$(U_2; C_2)$

Pay-offs for the EU

Pay-off order:

$U_3 > U_2 > U_1 > U_0$ and $C_3 > C_2 > C_1 > C_0$

Applied to Game Theory

Pay-offs for China		
Strategy	X	Y
X	**Trade War**	**China worse off**
Y	**EU worse off**	**Minimum Price**

Pay-offs for the EU

Grim Trigger

- Game if played in infinity
- Player discount their future payoff with δ
- Grim Trigger:
  - Player cooperates in first period & as long as the other player does not defect

  $\rightarrow$ Cooperation becomes possible if both players are sufficiently patient

Grim Trigger

Pay-offs for China			
Pay-offs for the EU	Strategy	X	Y
	X	$(U_1; C_1)$	$(U_3; C_0)$
	Y	$(U_0; C_3)$	$(U_2; C_2)$

Pay-off order:
$U_3 > U_2 > U_1 > U_0$ and $C_3 > C_2 > C_1 > C_0$

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