Title of the Presentation

Trade War and Social Welfare: A Structural Model of the US Solar Industry

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Trade War and Social Welfare: A Structural Model of the US Solar Industry

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Motivation

On October 2011, several American manufacturers sued the Chinese solar firms for dumping cheap panels on the US market by using subsidies from the Chinese government. On May 2012, the US Department of Commerce announced anti-dumping duty will be set at 31% - 250% and countervailing duty at 14.8% - 16% for Chinese solar manufacturers.

The anti-dumping policy is a big blow to Chinese firms. Suntech Power, which was once the largest solar manufacturer in China filed for bankruptcy in 2014. The U.S. consumers also suffered welfare losses from facing higher prices in the solar products.

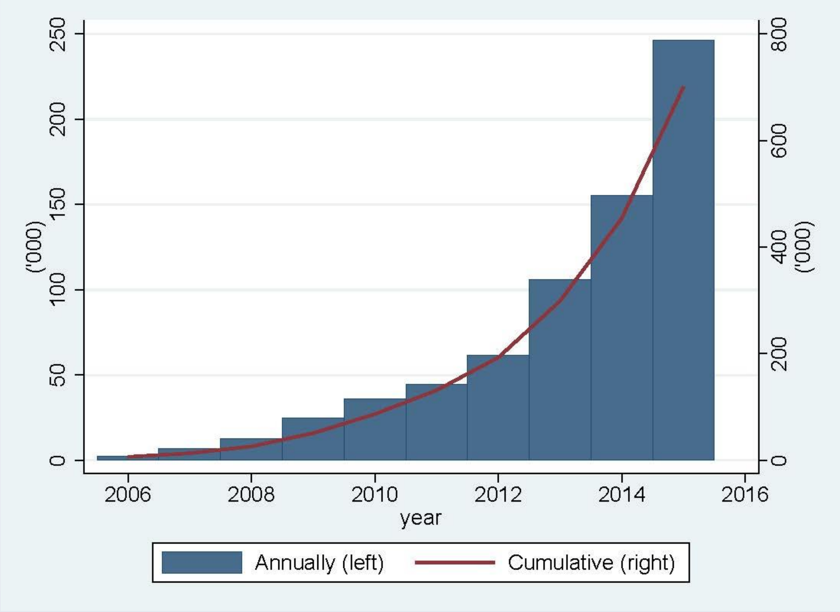

Figure 1 Growth of the residential solar PV installation in U.S.

Research Questions

1) How much do U.S. firms benefit and how much do foreign firms lose from this policy?
2) How much do U.S. consumers presumably lose?
3) Do U.S. installers benefit or lose from this policy?
4) Whether the anti-dumping policy has slowed the expansion of the solar market in the U.S.?

Contribution

Contribution to three different literatures

1) Empirical understanding of the impacts of trade war
  US v.s. Japan on semiconductor industry during late 1980s
  US v.s. Asia on steel industry during late 1990s
  Egger and Nelson (2011), link between antidumping and trade volume
2) Academic discourse on the solar panel market
  Bollinger and Gillingham (2012), diffusion of solar PV panels in CA
  Gillingham and Tsvetanov (2016), demand for residential PV system
3) Literature on learning-by-doing
  Irwin and Klenow (1994) on semiconductor industry
  Levitt et al (2013) on automobile assembly plant
  Bollinger and Gillingham (2014) on solar PV installations

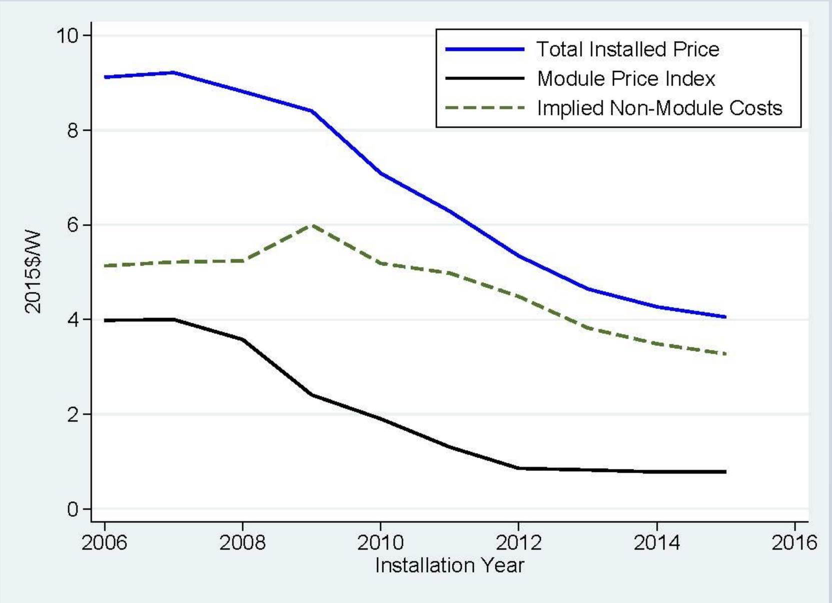

Figure 2 Price decline of the residential solar PV

Data

1) Lawrence Berkeley National Laboratory (LBNL) 's Tracking the Sun report series (2010-2015)
2) 2010 U.S. Census Data and American Community Survey
3) U.S. Energy Information Administration
4) Bloomberg (eight public solar firms)

Model

Demand side is estimated following Berry et al (1995) using discrete choice model:

$$\ln s_{jmt} - \ln s_{0mt} = -p_{jmt}\alpha + x_{jt}\beta + d_{mt}\psi + \xi_{jt}$$

s_{jmt} and s_{0mt} is the market share of inside goods and outside goods respectively; p_{jmt} is after-rebate installed price; x_{jt} is solar product characteristics, including energy conversion efficiency, technology type and whether the solar panel has a black frame; d_{mt} is MSA-level demographic variables;

Supply side is estimated by backing out the firms' profit maximization function and I have the learning-by-doing built in the model:

$$\log(mc_{fjt}) = \gamma X_{fjt} + \theta \ln(Q_{ft}) + \eta_f + \epsilon_{fjt}$$

mc_{fjt} is marginal cost, X_{fjt} is product characteristics for the solar panel, Q_{ft} is firm-level cumulative production of solar panels, η_f is firm fixed effect.

Estimation and Identification

Three types of instrumental variables for the price:

1) Government rebate or grant for the solar PV installation for consumers
2) BLP instruments
3) Hausman-style instrument

Table 1 Result for first-stage estimation

Variables	Price
Rebate	-0.400***
	(0.0470)
BLP_efficiency	0.349***
	(0.0716)
BLP_technology	-0.0604***
	(0.0152)
BLP_black	-0.0790**
	(0.0332)
Hausman	0.617***
	(0.0478)
Constant	1.797***
	(0.213)
Observations	1,647
R-squared	0.131

Estimation Results

Table 2 Demand estimation and price elasticity

Variables	estimate
Price	-1.629***
	(0.261)
Efficiency	21.51***
	(2.915)
Technology	0.630***
	(0.123)
Black Frame	-0.237**
	(0.110)
Electricity Price	0.236***
	(0.0187)
Education	6.117***
	(1.197)
Income	-0.0680***
	(0.00703)
Age	3.983***
	(0.471)
Constant	-19.86***
	(1.763)
Year FE	Yes
Observations	1,647
R-squared	0.207

Table 3 Estimation result for the supply side

Variables	Marginal Cost
Efficiency	2.306
	(1.852)
Technology	0.0342
	(0.0495)
Black Frame	-0.0861**
	(0.0391)
Cumulative Production	-0.370***
	(0.0231)
Constant	3.182***
	(0.224)
Firm FE	Yes
Observations	1,621
R-squared	0.308

Learning-by-doing

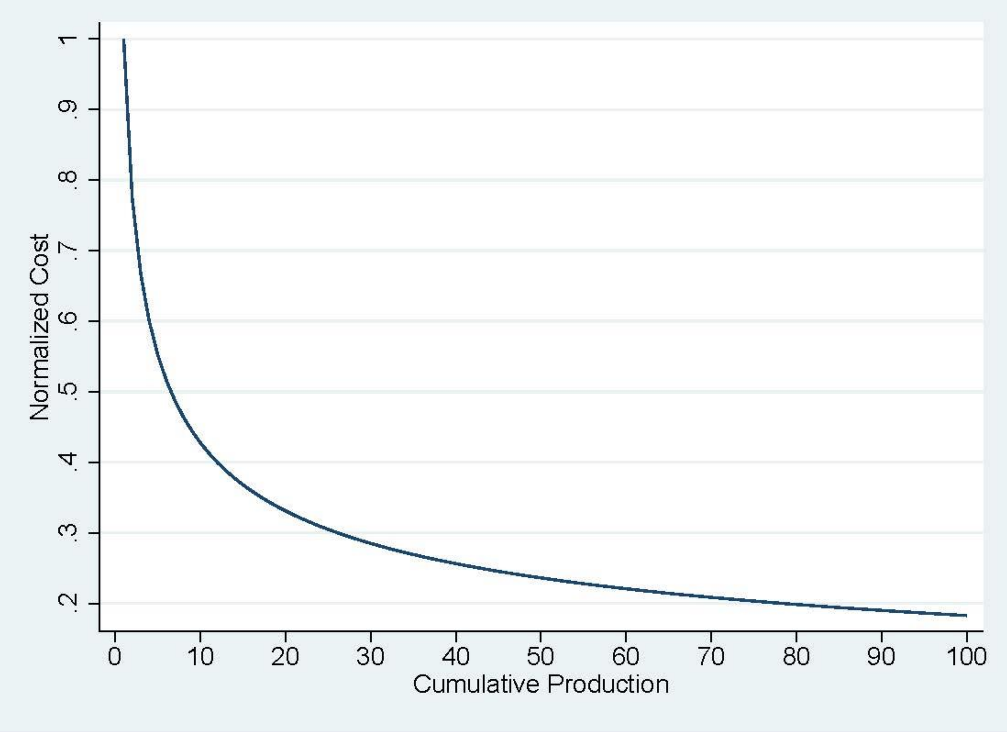

Figure 3 Learning Curve (learning rate=22.6%)

Policy Experiment

Table 4 Anti-dumping duty and countervailing duty (%)

Solar maker	Anti-dumping duty		Countervailing duty	
	2012	2014	2012	2014
Suntech	31.73	52.13	14.78	27.64
Trina Solar	18.32	26.71	15.97	49.79
Canadian Solar	25.96	52.13	15.24	38.72
Yingli Green	25.96	52.13	15.24	38.72
Renesola	-	78.42	-	38.72

1) Gains for the U.S. firms
2) Loss for the Chinese firms
3) Loss for the U.S. consumers
4) The expansion of the solar market in U.S.

Future Research

1) Make the demand side dynamic. The consumers can choose to purchase the solar panels today or tomorrow.
2) How will the manufacturers' investment in production capacity respond to the anti-dumping policy?

Contact

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