

Policy Shocks and Stock Market Returns

Evidence from Chinese Solar Panels

Meredith Crowley & Huasheng Song

University of Cambridge & Zhejiang University

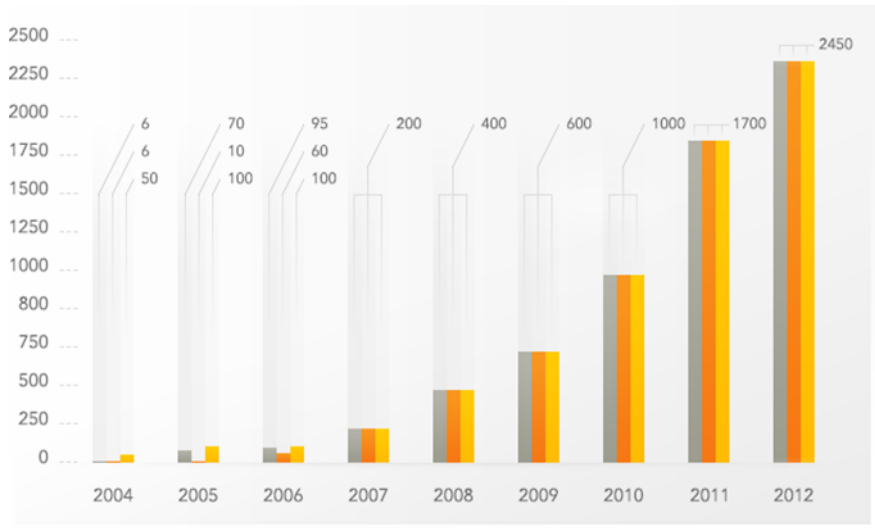
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Introduction: Chinese Solar Panels and Policy Shocks



Introduction: Growth of Yingli Solar's Output (Megawatts)

Grey = Wafers, Orange = PV Cells, Yellow = PV Modules



Chinese Solar Panels and Policy Shocks: Why Care?

In 2011, China's share of the EU market for solar panel modules hit 80%.

In 2012, China exported €21 billion in solar panel products to the EU.

Chinese solar panels comprised about 7% of total Chinese exports to the EU.

In July 2012, a German firm filed an antidumping petition claiming that Chinese firms were pricing their products unfairly and should be subject to antidumping tariffs.

As the EU's antidumping case proceeded over 2012-2013, Chinese solar panel producers were hit with a series trade policy and domestic industrial policy shocks.

What can we learn from the Chinese solar panel case?

The basic facts:

1. The Chinese solar panel industry is large and diverse, comprised of private firms and State Owned Enterprises.
2. Access to financing apparently varies across firms, with Chinese solar panel firms listed in the Hong Kong, Shanghai-Shenzhen, and New York stock markets.
3. The EU antidumping process is characterized by scheduled announcements of tariff increases and/or quota restrictions for “investigated” products.
4. During the EU’s antidumping investigation, the Chinese government announced two policies regarding the development of the Chinese solar panel industry.

What can we learn from the Chinese solar panel case?

The important questions:

1. Do firms that produce the same product experience the same change in value in response to a demand shock?
2. What accounts for the heterogeneity of abnormal returns across firms experiencing the same event?
3. What can we deduce about the effectiveness of stock markets in guiding resource allocation in China?

What do we do in this paper?

We estimate the abnormal returns of Chinese firms that are publicly listed in three different stock markets: Shanghai-Shenzhen, New York, and Hong Kong.

We find that the abnormal returns vary by labor productivity, export share, the market in which a firm lists, a firm's size and corporate structure, and a firm's position on the value chain of production.

The punchline: The EU's import restrictions on Chinese firms had a negative impact on the profitability of private sector firms, especially those which listed in New York, but had no effect on China's publicly listed State Owned Enterprises.

The Chinese government policies benefited firms listed in New York, but had almost no impact on publicly listed State Owned Enterprises.

Background: European trade policy announcements

The events of the EU's antidumping case: 2012-2013

Table 1: Events in the Solar Panel Market, 2012-2013

Event	Date	Description
Petition	24 Jul. 2012	EU PV firms filed petition for AD protection against Chinese imports
Preliminary Ruling	4 Jun. 2013	Provisional AD duty announced
Development Guideline	15 Jul. 2013	Guideline announced by the State Council of China
Amendment	2 Aug. 2013	Provisional AD duty amended to voluntary quota
Subsidy Scheme	30 Aug. 2013	National Development and Reform Commission announced the solar panel subsidy scheme
Final ruling	2 Dec. 2013	Application of voluntary quota & import tariffs

Background: The EU market for solar panels

Table 2: Evolution of the EU solar panel market: 2009-2012

Indicator		2009	2010	2011	IP
Import volume index	Module	100	251	462	408
	Cell	100	303	554	582
	Wafer	100	551	926	748
Market share	Module	63%	71%	80%	80%
	Cell	8%	16%	22%	25%
	Wafer	6%	22%	32%	33%
Price index	Module	100	79	64	36
	Cell	100	73	70	58
	Wafer	100	73	73	60

Source: Commission Regulation (EU) No 513/2013 of 4 June 2013. This document describes the analysis performed by the EC in its preliminary investigation into the allegation of dumping by Chinese firms. Tables 1-a, 2-a, 3-a, 4-a, 5-a, and 7-a of the Commission's report display data in physical units of megawatts and €per kilowatt as well as indices based in 2009. These underlying data were collected by Europressedienst, an independent consultancy employed by the European Commission. The authors reorganized the data reported in Commission Regulation (EU) No 513/2013 to make this table.

Data

- We construct a sample of 37 publicly-listed Chinese producers of photo voltaic (PV) products.
- 18 firms are listed in the Shanghai-Shenzhen stock market.
- 11 are listed in New York.
- 8 are listed in Hongkong.
- These sample are among the largest PV producers in China.
- Stock price information comes from Wind, WRDS, and CRSP.
- Information on assets, employment, revenues, age, leverage, R&D, and products were collected from the annual reports of each firm.
- Information on the EU trade policy investigation were collected from the *Official Journal of the European Union*.
- Information on Chinese industrial policy announcements were collected from Chinese government agencies.

Data: Summary statistics of sample firms

Table 3: Summary Statistics

Market	Statistics	Assets*	Emp.	Revenue*	Age	Leverage	Export Share	R&D Intensity
CN	mean	25	8170	9.8	14.2	0.589	.309	.0334
	sd	46	9747	15	6.31	0.172	.304	.0186
HK	mean	10	3018	3.7	9.25	0.504	.	.025
	sd	18	5046	6.2	5.86	0.225	.	.0277
US	mean	16	9680	7.9	8.5	0.770	.765	.0196
	sd	10	5903	4.9	3.25	0.139	.165	.0133
Total	mean	19	7475	7.9	11.4	0.622	.472	.0275
	sd	34	8200	11	6.05	0.201	.342	.0199

* in billions of Chinese renminbi

Notable points:

- US-listed firms are younger than China-listed firms.
- US-listed firms are larger by employment than China-listed firms.
- Hong Kong-listed firms are smallest by employment.
- China-listed firms are largest by revenues and assets.
- US-listed firms have a higher export share.

Figure 2: The Value-Chain of China-listed Firms

	Silicon	Ingot	Wafer	Cell	Module	System
CSG	Blue		Blue	Red	Red	
Jinggong Science	Blue					
DMEGC		Blue		Red	Red	
Topraysolar			Blue	Red	Red	Blue
Zhongli Group				Red	Red	Blue
Chaoxisolar		Blue		Red	Red	
Yonggao				Blue	Red	Blue
Risen				Blue	Red	Blue
TBEA	Red		Red			Red
Hareonsolar		Blue		Red	Red	Blue
Eging PV					Blue	
Tianwei Baobian	Red		Blue	Red	Blue	
GD Solar	Red					
DEC	Red	Blue	Blue			
Longi		Blue	Blue			
Lu'an EED			Blue	Red		
Yinxing Energy	Blue			Blue	Red	Red
HT-SAAE	Blue			Blue	Red	Blue

Key: Red blocks indicate the main sales activity; blue blocks indicate production line activity.

Figure 3: The Value-Chain of US-listed Firms

	Silicon	Ingot	Wafer	Cell	Module	System
CSIQ					Red	Blue
CSUN					Red	
DQ	Red					
HSOL		Blue			Red	
JASO				Red	Red	Blue
JKS		Blue			Red	Blue
LDK	Blue		Red		Red	Blue
SOL	Blue	Blue	Red	Blue	Red	
STP				Blue	Red	Blue
TSL		Blue	Blue	Blue	Red	
YGE		Blue	Blue		Red	Blue

Key: Red blocks indicate the main sales activity; blue blocks indicate production line activity.

Figure 4: The Value-Chain of Hong Kong-listed Firms

	Silicon	Ingot	Wafer	Cell	Module	System
Junyang Solar						Red
Hanergy Solar						Red
United PV				Blue		Blue
COMTEC		Blue				
China Singyes					Blue	Red
Solargiga	Red	Red	Red	Red	Blue	
Shunfeng PV			Blue	Red	Blue	
GCL-Poly	Blue	Blue	Blue	Blue	Blue	

Key: Red blocks indicate the main sales activity; blue blocks indicate production line activity.

Model: Estimating Abnormal Returns (MVRM)

$$(1) R_{it} = \alpha_i + \beta_i R_{mt} + \sum_{s=t-2}^{t+4} \theta_{is} D_s + \epsilon_{it}$$

where

R_{it} = the return on firm i 's security

α_i = intercept

β_i = systematic risk of firm i 's security

R_{mt} = market return

D_s = dummy variable equal to one on dates s around the event date

θ_{is} = excess return for stock i on date s

ϵ_{it} = regression residual for security i in t

Model: Estimating Abnormal Returns, market model

$$(2) R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}$$

where

R_{it} = the return on security i on day t

α_i = the intercept

β_i = systematic risk of security of period t

R_{mt} = market return

ϵ_{it} = regression residual for security i in t

Model: Estimating Abnormal Returns

From regression (2) we obtain the expected or predicted return, $E(R_{it})$.

Then the abnormal return, AR_{it} , is calculated as the difference between the observed return and the predicted return:

$$(3) \quad AR_{it} = R_{it} - E(R_{it})$$

The cumulative abnormal return (CAR) for firm i during the event window $(-k, +l)$:

$$(4) \quad CAR_i = \sum_{t=-k}^{+l} AR_{it}$$

We construct the CAR for each firm in our sample for each of the events in the EU's antidumping investigation and for the Chinese government's policy announcements.

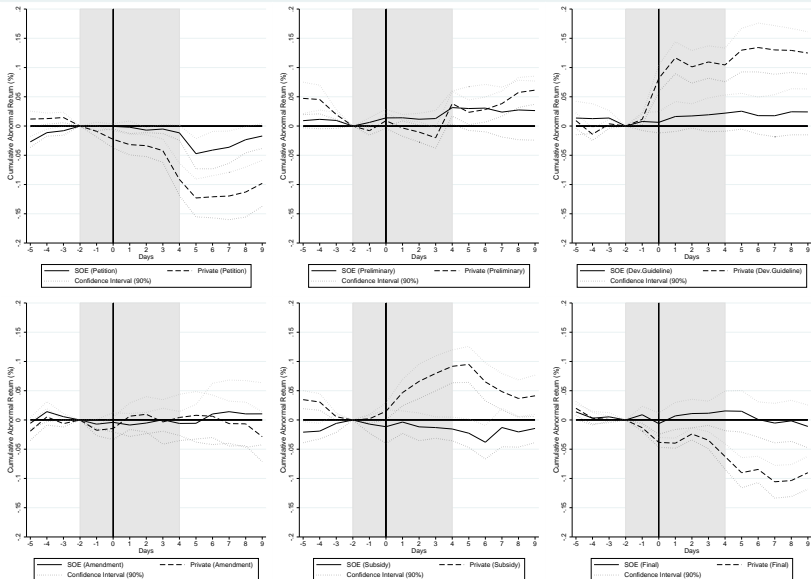


Figure 5: CAR Evolution, Organization Effect

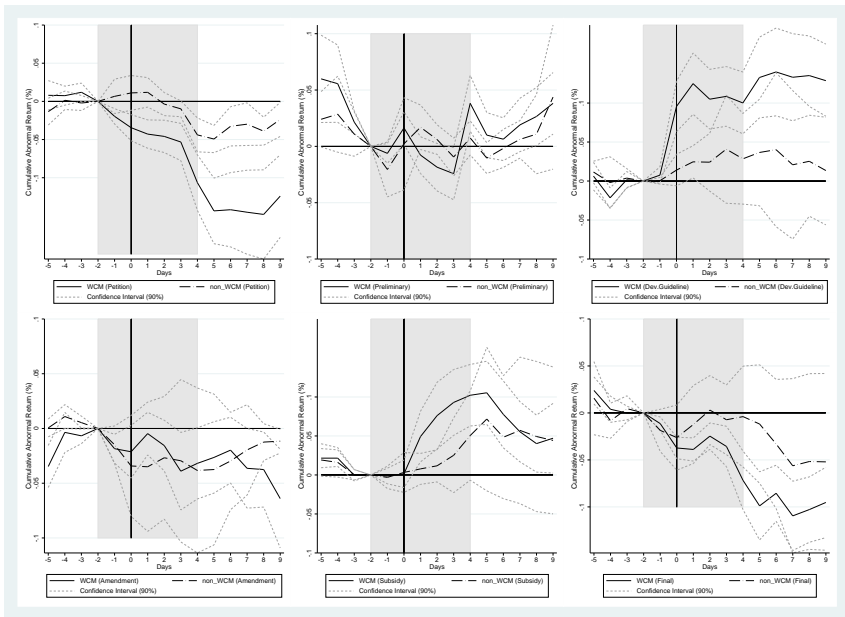


Figure 6: CAR Evolution, Product Effect

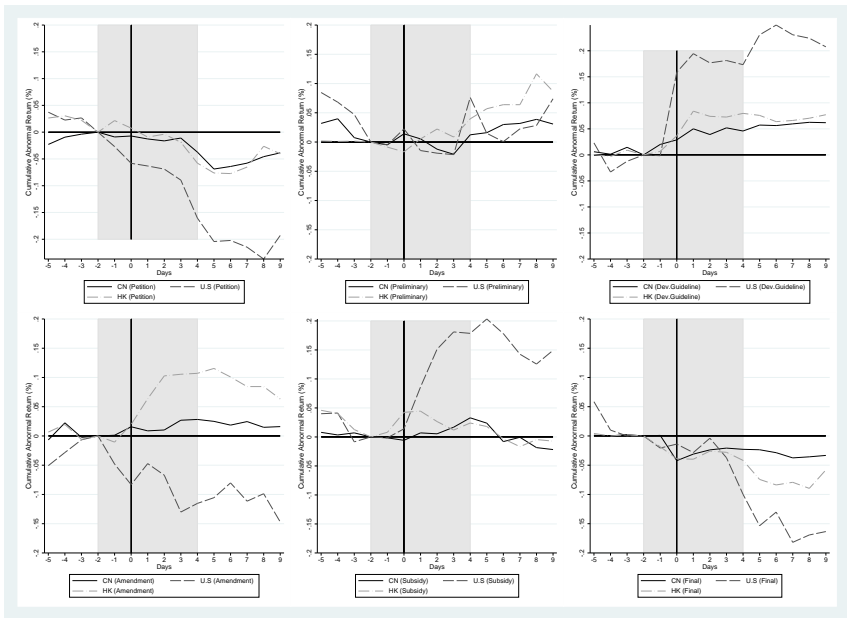
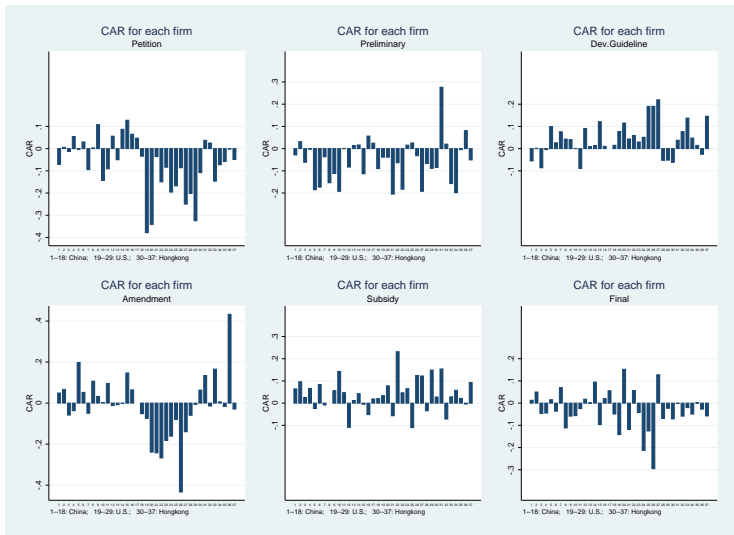
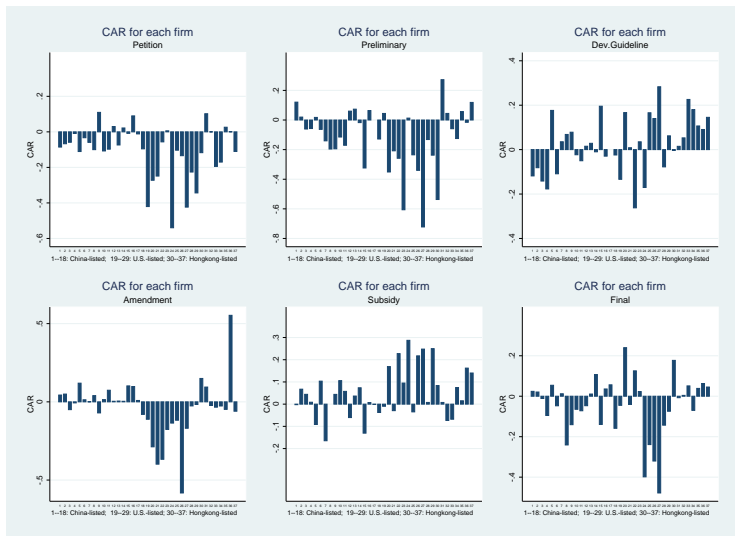


Figure 7: CAR Evolution, Market Effect

CARs of all firms, $[R_{it} - E(R_{it})]$ -based CAR Distribution



CARs of all firms, MVRM-based CAR Distribution



Results: Summary of findings on abnormal returns

1. There is variation across China-listed firms in the impact of an EU trade policy event on stock prices.
2. The impact of EU trade policy events on US-listed firms is overwhelmingly negative.
3. The Chinese industrial policy announcements have the largest positive impact on US firms.
4. The returns of SOEs generally do not move much in response to any policy announcement.
5. The trade policy announcements are priced into the stocks of US-listed firms BEFORE they are priced in to China-listed firms. (Note: Institutional investors held 67% of market capitalization in the US in 2010, but only 10.9% of market capitalization in China in 2013).

Results: Cumulative Average Abnormal Return

We calculate the cumulative average abnormal return (CAAR).

$$(5) \quad CAAR = \frac{1}{N} \sum_{i=1}^N CAR_i$$

By calculating the cumulative average abnormal return over different subsamples of firms, we can begin to see which observable features of firms responded positively or negatively to policy announcements.

Results: Cross-sectional variation in the CAR

As noted above, we observe that some firms experience positive abnormal returns when trade restrictions are announced, while others experience negative abnormal returns.

We estimate a cross-sectional regression of the CAR on a variety of explanatory variables.

$$(6) \quad CAR_{ij} = \theta + \sum \Omega X_{ij} + E_{ij}$$

where θ is the intercept, X_{ij} is a matrix of explanatory variables, Ω is a vector of estimated parameters, and E_{ij} is a normally distributed error term

Results: Cross-sectional variation in the CAR

Model based on export share

Table 6: CAR from MVRM for US and China-listed firms by export share

	(1) Petition	(2) Prelim	(3) Dev.Plan	(4) Amend	(5) Subsidy	(6) Final
Export share	-0.225*** (0.0696)	-0.182* (0.102)	-0.0848 (0.0776)	-0.223** (0.0896)	0.162** (0.0662)	-0.0525 (0.0910)
Constant	-0.00784 (0.0433)	-0.0458 (0.0546)	0.0293 (0.0417)	0.0389 (0.0481)	-0.0227 (0.0355)	-0.0370 (0.0488)
Observations	27	26	26	26	26	26
r2	0.295	0.118	0.0474	0.206	0.199	0.0137

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results: Cross-sectional variation in the CAR

Model based on labor productivity

Table 7: CAR from MVRM for all Chinese firms by labour productivity

	(1) Petition	(2) Prelim	(3) Dev.Plan	(4) Amend	(5) Subsidy	(6) Final
Ln labor productivity	0.0566*** (0.0181)	0.0876*** (0.0238)	0.0293 (0.0182)	0.0975*** (0.0235)	-0.0285* (0.0157)	0.0241 (0.0202)
Ln labor prod'y*SOE	0.00540 (0.00414)	0.00378 (0.00518)	-0.00359 (0.00397)	-0.00292 (0.00511)	-0.00155 (0.00342)	0.00167 (0.00440)
Constant	-0.880*** (0.242)	-1.257*** (0.309)	-0.359 (0.237)	-1.304*** (0.305)	0.421** (0.204)	-0.354 (0.263)
Observations	37	36	36	36	36	36
r2	0.293	0.344	0.0774	0.350	0.118	0.0578

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results: Cross-sectional variation in the CAR

Model based on operating costs

Table 8: CAR from MVRM for all Chinese firms by operating costs to sales ratio

	(1) Petition	(2) Prelim	(3) Dev.Plan	(4) Amend	(5) Subsidy	(6) Final
Operating Costs/Sales	-0.242* (0.141)	-0.106 (0.103)	0.0233 (0.0687)	-0.245** (0.0968)	0.0142 (0.0596)	-0.138* (0.0717)
(Op. Costs/Sales)*SOE	0.140* (0.0724)	0.109 (0.0771)	-0.0270 (0.0513)	0.0826 (0.0723)	-0.0526 (0.0445)	0.0417 (0.0536)
Constant	0.0737 (0.116)	-0.0202 (0.0985)	-0.00121 (0.0656)	0.182* (0.0924)	0.0395 (0.0569)	0.0881 (0.0685)
Observations	37	36	36	36	36	36
r2	0.139	0.0663	0.00920	0.165	0.0412	0.102

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results: Cross-sectional variation in the CAR

Model based on firm size

Table 9: CAR of Petition Filing for all Chinese firms

	(1) Petition	(2) Petition	(3) Petition	(4) Petition	(5) Petition
Ln labor productivity	0.0477*** (0.0152)	0.0516*** (0.0161)	0.0343** (0.0150)	-0.0409 (0.0361)	0.0363** (0.0153)
Leverage	-0.134 (0.0989)	-0.0545 (0.113)	-0.235** (0.0995)	0.0403 (0.104)	-0.137 (0.0936)
R&D Expenses/Sales		2.218* (1.265)			
State Owned Firm			0.125** (0.0481)		
US listed Firm IV				-0.298*** (0.115)	
Product Mix					-0.0810** (0.0364)
Constant	-0.631*** (0.230)	-0.783*** (0.252)	-0.413* (0.229)	0.548 (0.489)	-0.424* (0.237)
Observations	37	32	37	37	37
r2	0.317	0.413	0.432	0.526	0.406

Results: Cross-sectional variation in the CAR

Model based on firm size with state owned enterprises

Table 10: CAR for all Chinese firms by size and firm type

	(1) Petition	(2) Prelim	(3) Dev.Plan	(4) Amend	(5) Subsidy	(6) Final
State Owned Firm	0.139** (0.0516)	0.0585 (0.0449)	-0.0212 (0.0330)	0.0742 (0.0680)	-0.0635* (0.0327)	0.0758** (0.0372)
Ln employment	-0.0290* (0.0148)	-0.00935 (0.0124)	0.00524 (0.00911)	-0.0354* (0.0188)	0.00733 (0.00902)	-0.00569 (0.0103)
Constant	0.150 (0.122)	0.0148 (0.101)	-0.00235 (0.0746)	0.249 (0.154)	-0.0131 (0.0738)	-0.00166 (0.0840)
Observations	37	36	36	36	36	36
r2	0.210	0.0546	0.0179	0.108	0.106	0.112

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results: Cross-sectional variation in the CAR

Model based on firm size with listing market IV

Table 11: CAR for all Chinese firms by stock market listing (IV results)

	(1) Petition	(2) Prelim	(3) Dev.Plan	(4) Amend	(5) Subsidy	(6) Final
US listed Firm IV	-0.237*** (0.0654)	0.0504 (0.0927)	0.131* (0.0723)	-0.292*** (0.0878)	0.113 (0.0755)	-0.0559 (0.0713)
Ln employment	0.0139 (0.0143)	-0.0103 (0.0151)	-0.00855 (0.0118)	-0.00285 (0.0143)	-0.00756 (0.0123)	0.00460 (0.0116)
Constant	-0.112 (0.108)	0.0181 (0.112)	0.0709 (0.0876)	0.0752 (0.106)	0.0671 (0.0915)	-0.0579 (0.0864)
Observations	37	36	36	36	36	36
r2	0.503	.	.	0.601	.	0.125

Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Conclusions

Larger, more export-oriented firms suffered larger losses from European trade restricts, consistent with Melitz (2003).

More productive firms had more positive or less negative abnormal returns in reponse to policy announcements.

The EU's trade restrictions harmed the expected profitability of private sector firms but had little impact on SOEs. The stock prices of SOEs are largely immune to changes in policy.

US listed firms were more responsive to news announcements than firms listed in other markets.