The Spillover Effects of Real Estate

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11^{th} ABFER Annual Conference

May 20, 2024

Motivation

Key research question:

- How large are spillover effects from real estate (RE) to other sectors?

  New: Macro implication of regulation on RE developers

Why important?

- Japan, US (e.g., Gan 2017, Iacoviello and Neri 2010, Mian, Rao and Sufi 2013)
- RE sector's role in both input-output and trade credit

Potential challenge

- Endogeneity: reverse causality and other confounders (e.g., monetary policy changes, Covid Lockdowns)

A Chinese Setting

Answer using a unique Chinese policy experiment: **the three-red-line policy**.

- The RE sector is an important part of the Chinese economy. As of 2022,
  - It counts for 26% of GDP in China (Rogoff and Yang 2022).
  - Land sales income is 6.7 tri RMB, 61% total revenues for local governments.
- The three-red-line policy was unexpected and unprecedented.
  - announced on August 20, 2020, by the Ministry of Housing and Urban-Rural Development and the PBOC.
  - the 1^{st} regulatory policy on constraining the liability of real estate developers.

This Paper

- Study the spillover effects of the "three red-line regulations" on firms in other sectors of the economy.
- Estimate both the financial and **real** impacts of the policy.
- Explore the transmission from **production network** and **trade credit**.

Identification of the causal impact of such policy

- Construct a firm-level exposure measure to such regulation using
  (1) the number of violations of each RE developer;
  (2) the stock return correlation between non-real-estate and RE firms.

Preview of Results

- **Real Impacts:**
  - One-standard-deviation increase in exposure to such policy reduces real investment by 0.29%, sales growth by 2.20%, profit by 0.23% but increase leverage by 0.21%.
  - The cumulative decline of total investment due to the three-red-line policy accounts for 42.31% of the total investment decline during 2020Q4-2022Q3.
  - Sectors closer to RE in the production network were affected more in terms of investment.
  - Within these sectors, firms advancing more trade credit to RE suffered more.
- **Take-away:**
  - It suggests that non-RE firms reduce their investment demand due to the complimentary between investment and working capital financed by the trade credit.

Contribution to the Literature

- **Literature on the importance of the RE sector for Chinese macroeconomy:** Fang et.al (2016), Chen and Wen (2017), Glaeser et. al (2017), Rogoff and Yang (2022), Xiong (2023)
- **Literature on the shock transmission through production networks:** Di Giovanni and Hale (2022), Lane (2022), Balboni, Boehm and Waseem (2023)
- **Literature on the effects of housing market regulations:**
  - On households: Greenwald (2018), Berger, Turner, and Zwich (2017), Di Maggio et. al (2017), Defusco, Johnson and Mondragon (2020),
  - On financial institutions: Jeske, Krueger, and Mitman (2013), Di Maggio and Kermani (2016), Favara and Imbs (2015).
  - For China: Du and Zhang (2015), Deng, Liao, Yu and Zhang (2019), Chen et. al (2023)

Key contribution: first paper on the macro implication of RE developers.

Three-Red-Line Policy

- Goal: to curb fast growth of housing prices in some cities and over-leverage of real estate developers.
- Three measures of upper-bound liability for real estate developers
  1. $\frac{\text{Liabilities}-\text{Pre-sales revenue}}{\text{Assets}-\text{Pre-sales revenue}} \leq 70\ \%$
  2. $\frac{\text{Total interest-bearing liability}-\text{ Cash holding}}{\text{Equity}} \leq 100\ \%$
  3. $\frac{\text{Cash holding}}{\text{Short-term or maturing interest-bearing liability}} \geq 100\ \%.$
- Consequence of violation of three red lines
  - All three lines (red): interest-bearing liability cannot increase
  - Two lines (orange): annual growth of interest-bearing liability $\leq 5\%$.
  - One line (yellow): annual growth of interest-bearing liability $\leq 10\%$.
  - No violation (green): annual growth of interest-bearing liability $\leq 15\%$.

Data

Our dataset mainly comes from CSMAR and WIND, including a sample of

- 209 real estate firms in both A and H listed markets.
  - In total, 99544 real estate firms in China, of which 112 are listed in the A-share market and 267 are listed in the H-share market.
  - 1501.9 billion yuan market capitalization for listed A share RE firms, roughly 2% of A-share total market capitalization.
- 2,609 non-real estate firms in the A-share market. Sample Distribution

We use their stock return, bond yield, and balance sheet information.

- Stock return: Jan. 2010–Aug. 2020;
- Bond return: May 2020–Dec. 2020;
- Quarterly balance sheet information: 2019 Q2 to 2022 Q3.

Measures of the Policy Violations by RE Developers

No. of Violation	H share	A share	Combined	Percentage
0	3	9	12	5.8
1	39	45	84	40.2
2	19	17	36	17.2
3	46	31	77	36.8
Total	107	102	209	100

	H share	A share	Combined	Percentage
1^{st} Line Violation	56	46	102	48.8
2^{nd} Line Violation	55	33	88	42.1
3^{rd}Line Violation	104	93	197	94.3

Identification: Firm-level Exposure Measures

We construct firm-level exposure measure to three-red-line policy as follows.

$$\text{expo}_i = \frac{\sum_{h=1}^{H} \text{corr}_{i,h} * N_h}{H} \tag{1}$$

where

- $\text{corr}_{i,h}$: the stock return correlation between non-RE firm i and RE firm h;
- N_h: # of violations for RE firm h.

Preliminary analysis:

- We estimate $\text{corr}_{i,h}$ using daily stock return between 2010 and 2019.
- $H = 209$, including both the A-listed (102) and H-listed (107) RE firms.

Correlates of Exposure to Other Firm-level Variables

	Coefficient	t-stats	R^2 Decomposition	Obs
Size	0.0232***	8.67	0.08	2567
Leverage	-0.0003	-0.22	0.01	2567
ROA	-0.0033	-0.95	0.01	2567
SOE	0.0591***	11.91	0.08	2567
Sales growth	-0.0007	-1.09	0	2567
Cash flow	-0.0010	-0.36	0.01	2567
EBIT	0.0879	0.75	0.01	2567

- The exposure measure is correlated with size (+) and state ownership (+).
- We carefully control for these variables in our regressions.

Real Effects

Empirical Specification

We estimate the following equation in the quarterly frequency data at [-4Q, 8Q].

$$y_{it} = \beta * \text{Expo}_i * \text{Post}_t + \text{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (2)$$

- y_{it}: Our key interest is investment (Capex/Asset). We also look at sales growth, EBIT, and leverage.
- $\text{Post}_t = 1$ if $t \geq$ 2020Q4.
- Control_{it} includes standard controls such as the firm size, ROA, leverage, Tobin's Q, and cash flow.
- In addition to firm fixed effects, we also include
  - Different Size bins $\times$ Time fixed effects
  - Industry $\times$ Time fixed Effects
  - Covid CAR $\times$ Time fixed effects: Covid CAR is estimated in a 7-day window around the Wuhan lockdown intended to capture the different responses of firms to the Covid-related shocks.
- Standard errors are clustered at the firm level.

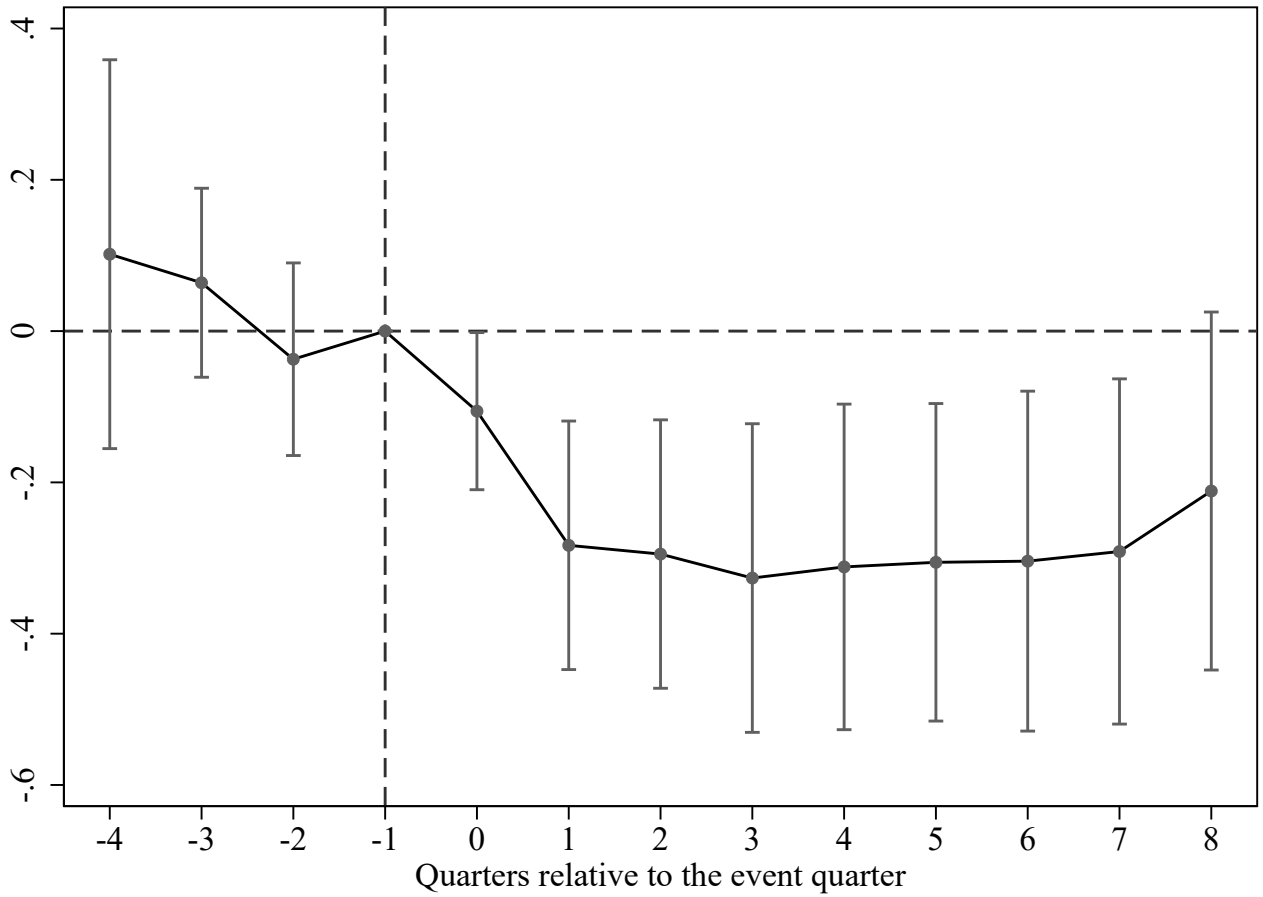
Average Spillover Effects of Three Red Lines Policy

	Capex /Asset			Sales Growth (%)	EBIT (%)	Leverage
	(1)	(2)	(3)	(4)	(5)	(6)
Expo × Post	-0.423***	-0.432***	-0.291***	-2.204**	-0.229**	0.208***
	(-4.91)	(-4.87)	(-3.47)	(-2.04)	(-2.01)	(5.34)
Size			1.360***	51.351***	-0.815	-0.838***
			(3.61)	(10.03)	(-0.55)	(-6.23)
ROA			-0.01	2.949***		0.019***
			(-1.24)	(19.03)		(5.24)
Leverage			-0.248***	-5.261***	0.110	
			(-6.29)	(-9.73)	(0.88)	
Tobin's Q			0.221***	2.491***	1.222***	-0.029
			(4.48)	(3.74)	(7.97)	(-1.42)
Cash Flow			0.023***			
			(3.20)			
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Size Growth × Time	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Time	No	Yes	Yes	Yes	Yes	Yes
Covid CAR × Time	No	No	Yes	Yes	No	Yes
Adj-R2	0.69	0.69	0.70	0.41	0.43	0.86
Obs	33,522	33,522	33,404	33,202	33,404	33,404

- Firms more exposed to the RE sector had lower investment, sales growth, and profit but increased leverage.

Dynamic Spillover Effects on Investment

$$I_{it} = \alpha + \sum_{s=-4}^{8} \beta_{t+s} * \text{Expo}_i * 1_{t+s} + \gamma * \text{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (3)$$



Aggregate Effect of Three-red-line Policy

- Compute the cumulative decline of investment due to three-red-line policy
  - Divides firms into deciles based on three-red-line policy exposures and treats the lowest decile as the control group as in Mian and Sufi (2012)
  - multiply the dynamic coefficients by each decile's exposure minus the control group's exposure.
  - converts the forgoing estimate into the RMB values of investment declines by multiplying it by the lagged asset.
  - Sum the RMB value of investment decline across all deciles to obtain the aggregate effect for each quarter.
  - The cumulative decline of investment due to the three-red-line policy is 390.536 bn RMB.
- Compute the cumulative decline of total investment relative to the linear pre-policy trend
  - Compute the average quarterly growth rate of investment during 2017Q3-2020Q3 as 3.84%, which we use for trend growth of investment during 20020Q4 and 2022Q3.
  - Estimate a total cumulative nominal investment decline of 923.118 bn RMB.
- The total drop in investment due to the three-red-line policy is 42.31% (390.536/923.118) of the investment decline relative to the trend.

Uncovering Economic Mechanism

Estimate the investment response to the three-red-line policy by different groups.

$$I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_{g} \beta_{t+s}^{g} 1_{g \in G} \right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it} \tag{4}$$

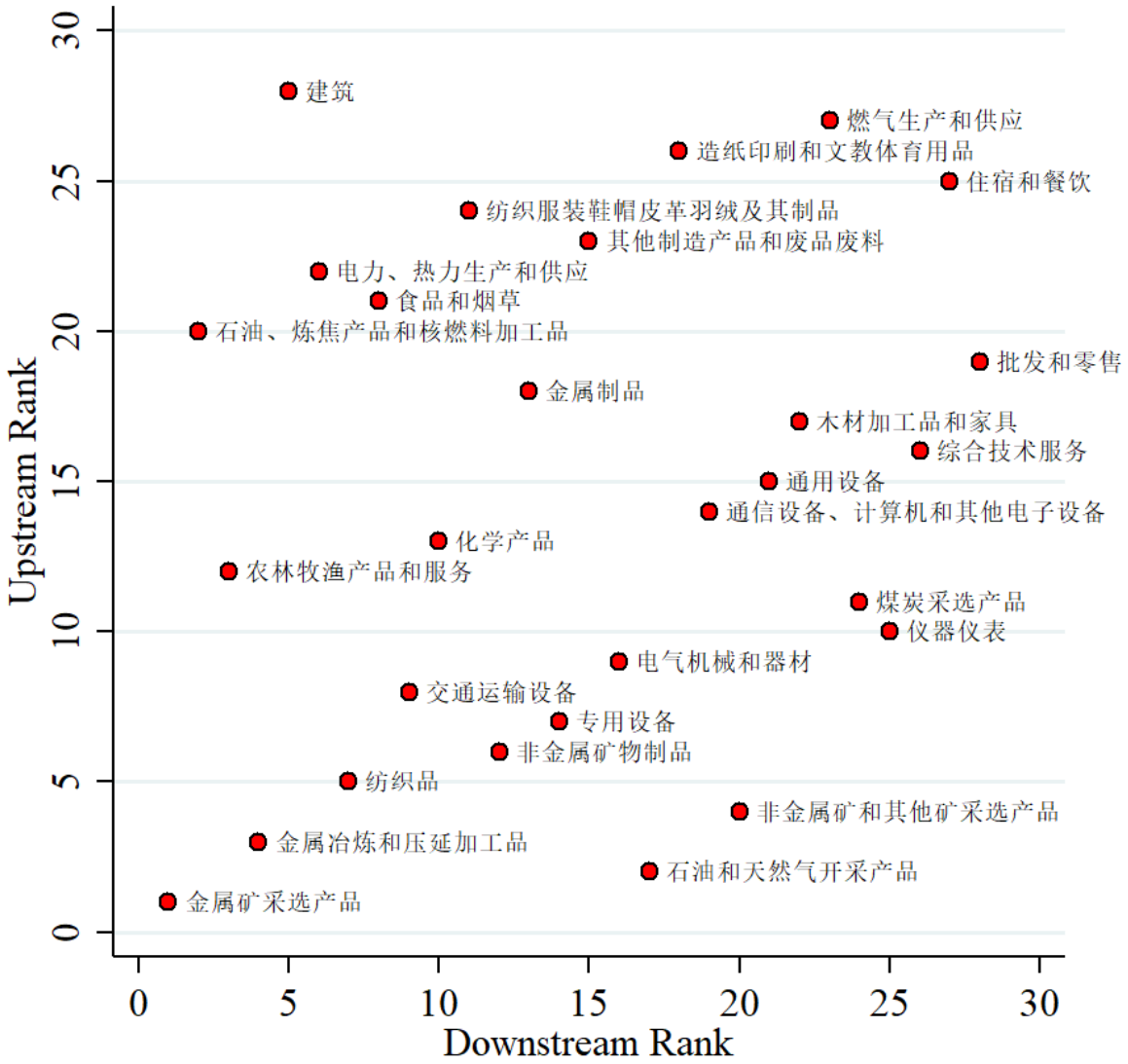
- We divide firms into multiple groups based on pre-policy characteristics.
  - Production networks (Upstream/Downstream)
  - Trade credit
- As robustness, we also check the following dimensions.
  - Financial constraints (measured by WW and SA index)
  - Ownership structure

Measure of Upstream/Downstream Distance to RE Sector

We define production network measures using the Input-Output table in 2018.

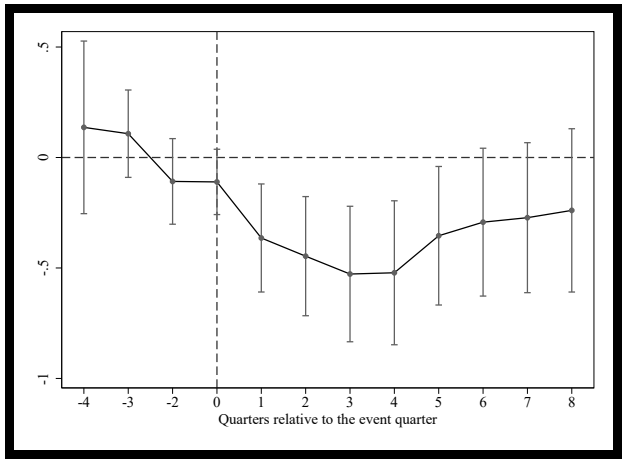
- For sector i, we have information on
  - y_{ik}: output supplied by sector i to sector k
- A sector i's upstream distance to RE is measured by $\text{Up}_i = \frac{y_{i,\text{RE}}}{\sum_k y_{i,k}}$
- A sector i's downstream distance to RE is measured by $\text{Down}_i = \frac{y_{\text{RE},i}}{\sum_k y_{k,i}}$
- We then divide firms into two groups based on their upstream (or downstream) distance to the RE sector.
  - Upstream high sectors: construction design; construction, construction materials, etc.
  - Downstream high sectors: housing sales, room decoration, property management, etc.

Production Network of RE Sector



Investment Response by Upstream (Downstream) Distance

Upstream: High



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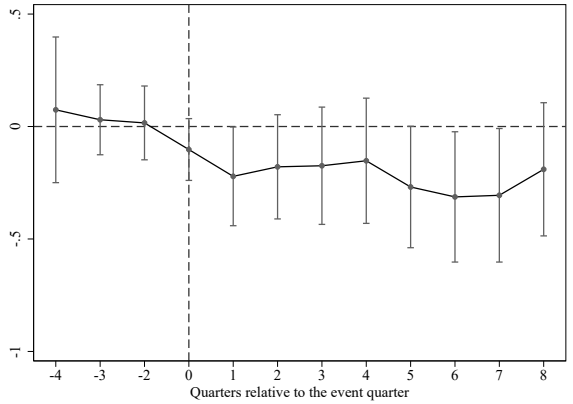
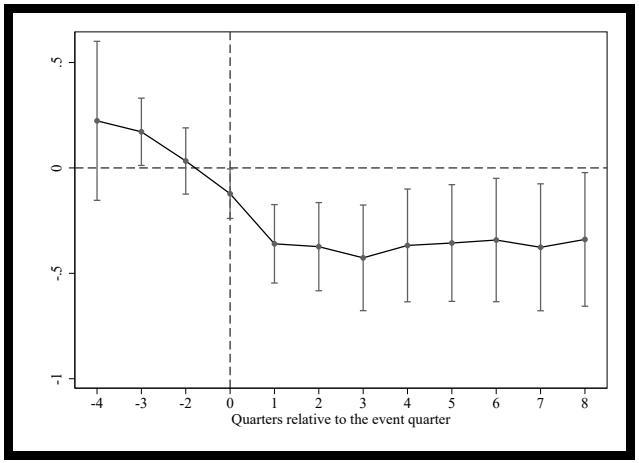


Downstream: High



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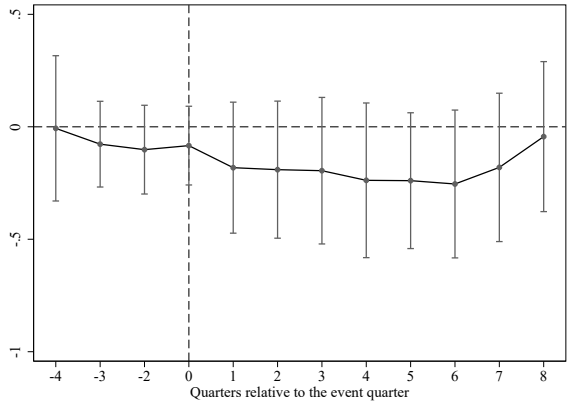


- Sectors closer to RE in the production network were affected more.

Trade Credit

When the RE sectors reduce leverage, they might affect non-RE firms through a trade credit channel, i.e. account receivable, pre-paid sales and account payables.

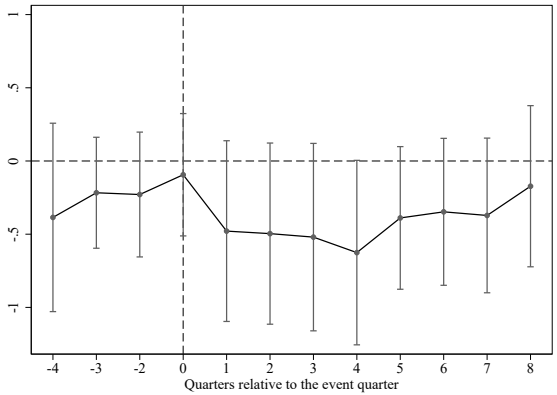
- In 2021, half of Evergrande's total liability were in the form of AP to suppliers for materials and construction projects.

We construct a firm-level trade credit measure as follows

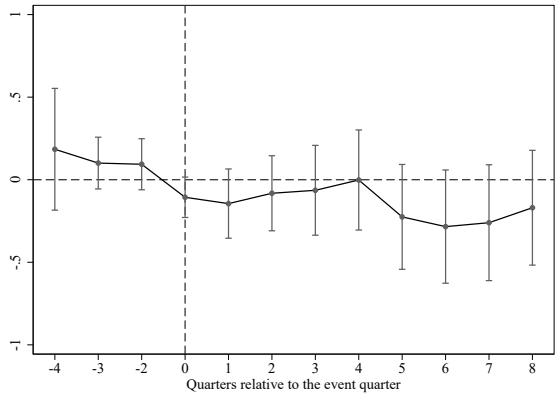
$$\text{TC}_i \equiv \frac{\text{Account Receivables} + \text{Pre-paid Sales} - \text{Account Payables}}{\text{Asset}}$$

Investment Response by Upstream Dist. and Trade Credit

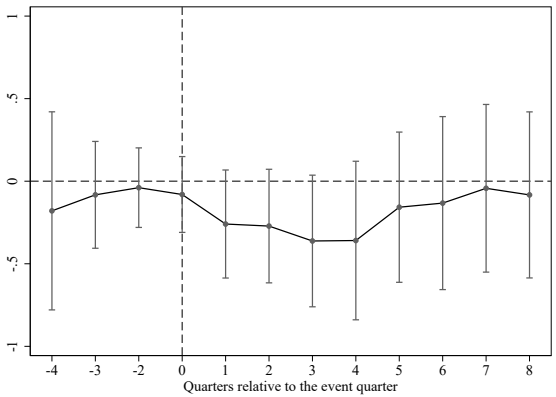
Upstream low & TC low



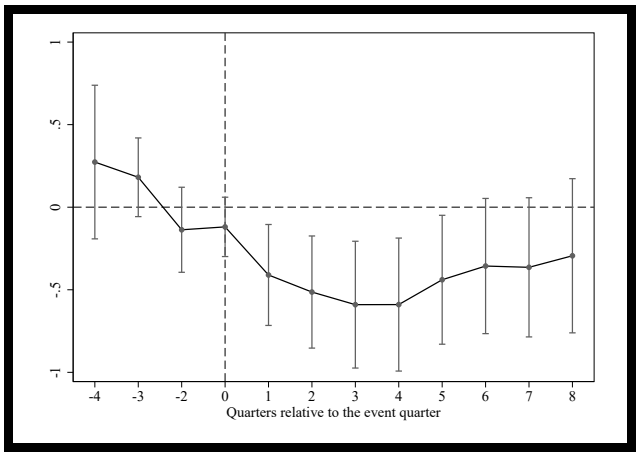
Upstream low, TC high



Upstream high & TC low



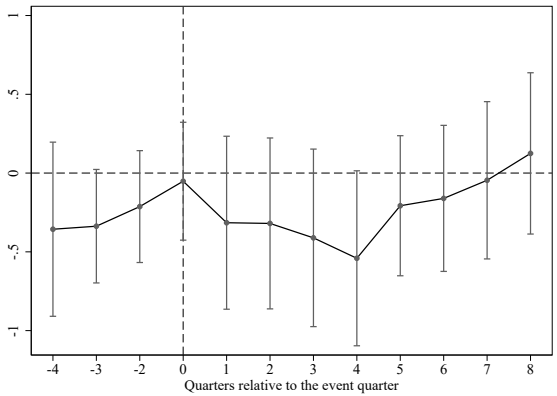
Upstream high, TC high



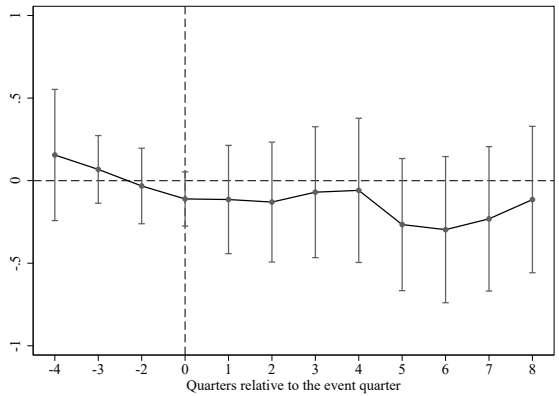
- Within high upstream distance sectors, firms with high trade credit were affected more.

Investment Response by Downstream Dist. and Trade Credit

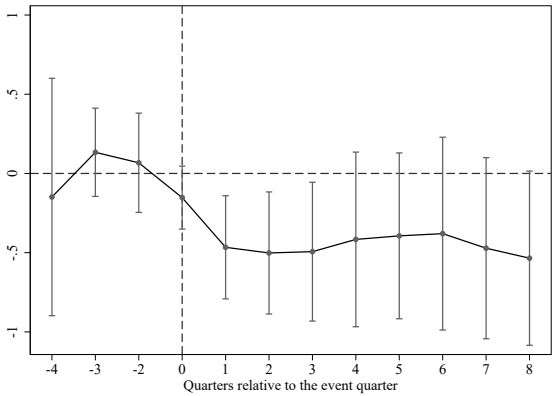
Downstream low & TC low



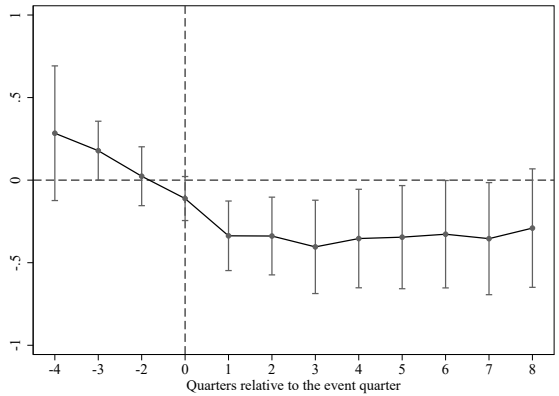
Downstream low, TC high



Downstream high & TC low



Downstream high, TC high



- Within high downstream distance sectors, firms with high trade credit were affected more.

Disentangle Two Channels

Two channels: less trade credit available for non-RE firms $\rightarrow$

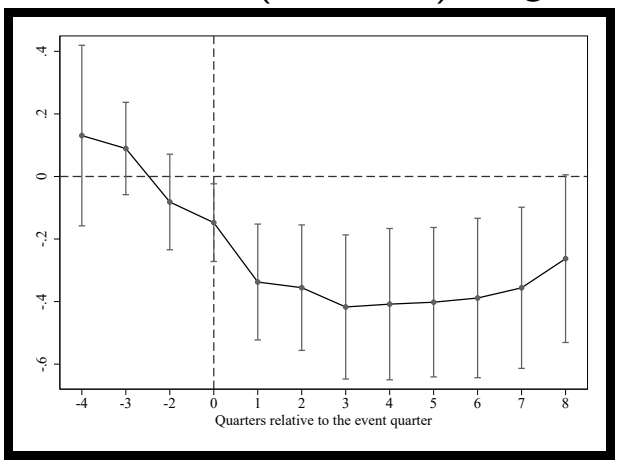
- Less collateral for external finance $\rightarrow$ interest rate $\uparrow$
- Less incentive to conduct investment $\rightarrow$ interest rate $\downarrow$

	Interest Rate (%)		Debt/Liability (%)	
	(1)	(2)	(3)	(4)
Expo $\times$ Post	-0.125**	-0.136**	-1.121***	-0.461*
	(-2.01)	(-2.23)	(-4.41)	(-1.80)
Size		-0.388**		-1.961**
		(-2.13)		(-1.99)
ROA		-0.042***		-0.293***
		(-5.73)		(-9.66)
Leverage		0.088**		-3.244***
		(2.50)		(-8.00)
Tobin's Q		-0.063*		-0.207
		(-1.92)		(-1.25)
Cash Flow		0.014***		0.068***
		(2.93)		(2.87)
Firm FE	Yes	Yes	Yes	Yes
Size Growth $\times$ Time	Yes	Yes	Yes	Yes
Industry $\times$ Time	No	Yes	No	Yes
Covid CAR $\times$ Time	No	Yes	No	Yes
Adj. R^2	0.69	0.70	0.69	0.70
Obs	28,191	28,060	33,404	33,404

- Investment demand declines with less trade credit available.

Robustness: Investment Response by Financial Constraints

WW Index (firm-level): High



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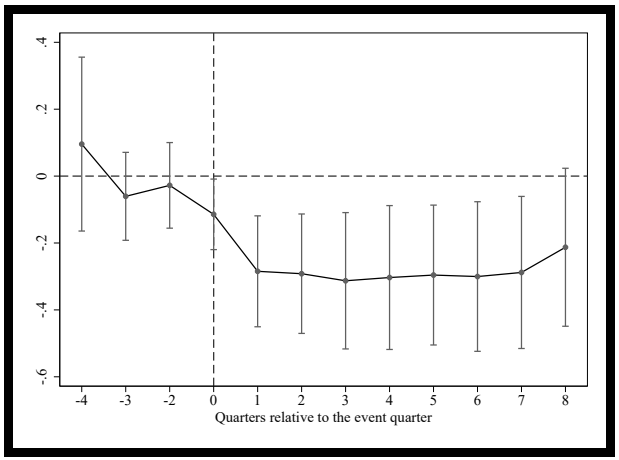
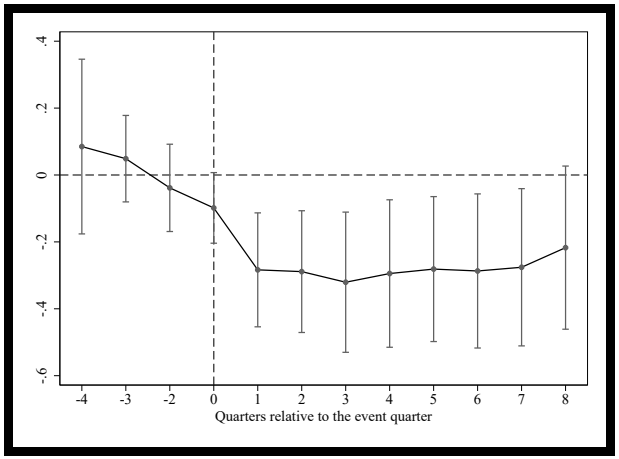


SA Index (firm-level): High



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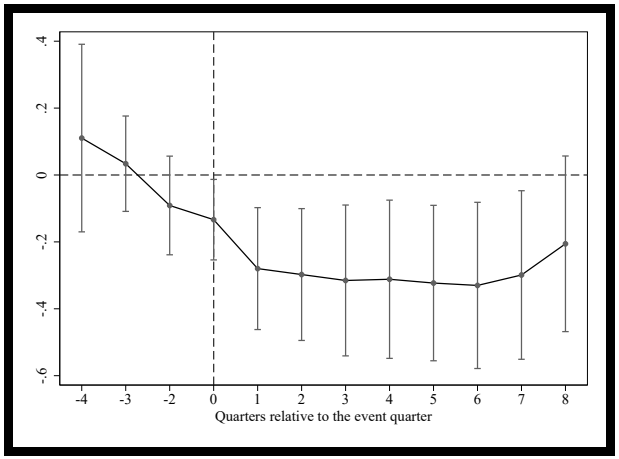
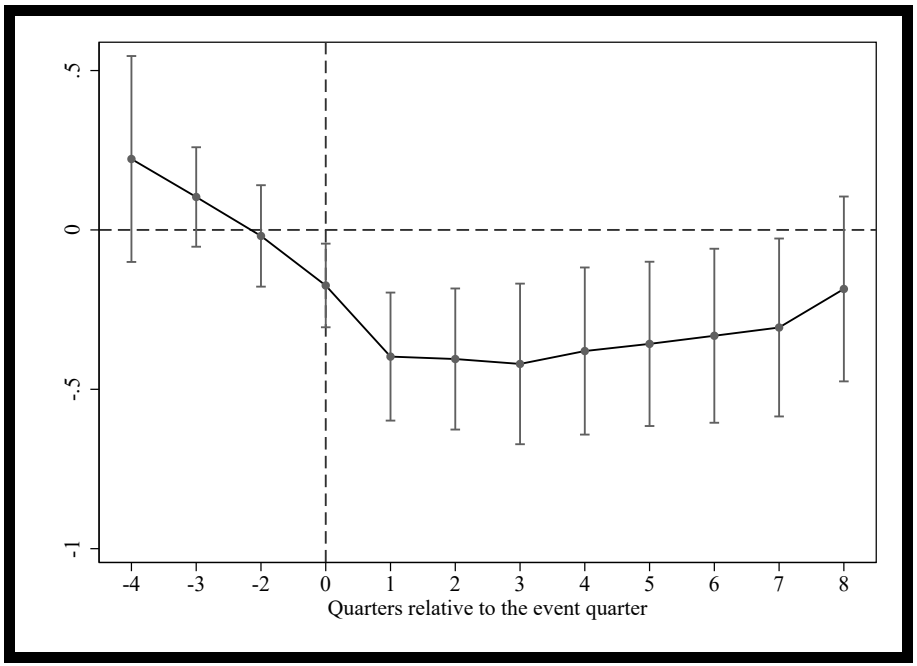


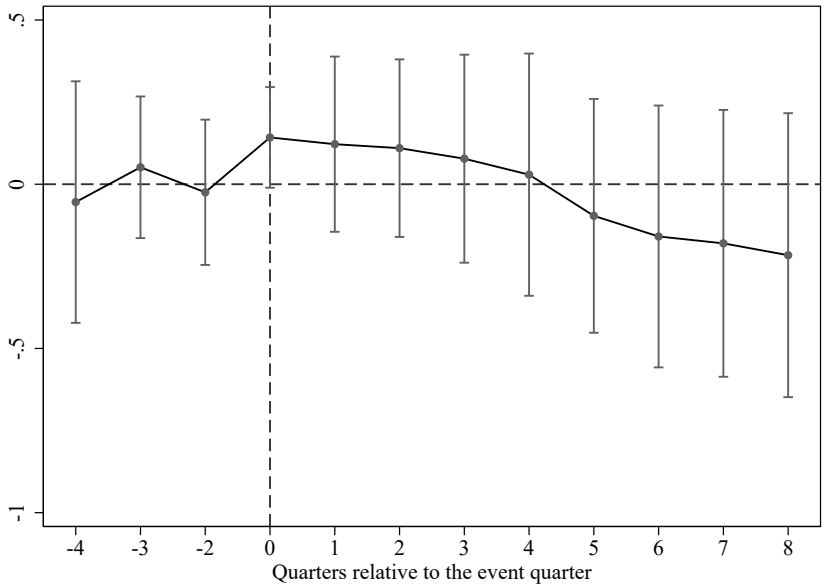
- Financial constraints do not matter.

Robustness: Investment Response by Ownership Type

Private



State



- Firms in the private sector were affected more.

Conclusion and Future Work

In this paper,

- We study the spillover effect of regulation on real estate firms' leverage on the rest of the economy.
- The policy had unintended negative impacts on the real economy.
  - The policy accounts for 42.32% of the aggregate investment decline during 2020Q4-2022Q3.
  - Sectors closer in distance to real estate declines experienced a sharper decline in investment due to such a policy.
  - Within these sectors, firms with large trade credit exposure to RE sectors experienced a sharper decline in investment.

Future work

- A theoretical framework to conduct quantitative analysis
- Construct a regional-level exposure to study the regional real effects

Summary Statistics for None-RE firms

	Obs	Mean	Std.	25%	Median	75%
Exposure	2,567	0.389	0.114	0.32	0.411	0.479
Capex/Asset (%)	33,404	4.716	5.467	1.374	3.331	6.591
Tobin's Q	33,404	2.33	1.976	1.268	1.758	2.635
Cash Flow (%)	33,404	6.431	9.998	3.09	6.261	10.261
Log (Asset)	33,404	22.423	1.322	21.488	22.233	23.129
Leverage	33,404	3.313	3.705	1.773	2.359	3.607
ROA (%)	33,404	2.63	5.535	0.551	2	4.462
Sales Growth (%)	33,404	17.644	46.862	-6.469	9.844	30.693
EBIT (%)	33,404	3.845	6.533	1.051	2.869	5.79
CAR[-5, 4] (%)	2,567	-0.707	9.366	-5.585	-0.76	3.717
Yield Spread (%)	8,608	1.758	2.993	0.394	0.62	1.361

Sample Distribution

Back

- Listed age at least 1 year relative to 2020Q3
- Appear at least 2 quarters prior to & 2 quarters post shock
- Stock's status is labeled as normal (e.g. exclude *ST)

Year-Quarter	Time	# of firms
2019Q3	-4	2558
2019Q4	-3	2607
2020Q1	-2	2568
2020Q2	-1	2570
2020Q3	0	2567
2020Q4	1	2567
2021Q1	2	2567
2021Q2	3	2544
2021Q3	4	2573
2021Q4	5	2578
2022Q1	6	2579
2022Q2	7	2559
2022Q3	8	2567

Financial Impacts

Stock Market Response

We estimate the following equation in a 10-day window [-5, 4].

$$\text{CAR}_{it} = \beta * \text{Expo}_i * \text{Post}_t + \gamma * \text{Control}_i * \text{Post}_t + \alpha_i + \alpha_t + \varepsilon_{it} \tag{5}$$

- CAR_{it}: cumulative abnormal return based on CAPM, FF3 (Fama and French 1992) and CH4 (Liu, Stambaugh, and Yuan 2019).
- We standardize the exposure measure Expo_i.
- $\text{Post}_t = 1$ if $t \geq$ 2020.08.21
- Variable of interest β: the spillover effect of the Three-Red Lines policy.
- $\text{Control}_i * \text{Post}_t$: different sensitivities in firm size, ROA, and leverage.
- Both firm and time-fixed effects are included; Standard errors are clustered at the firm level.

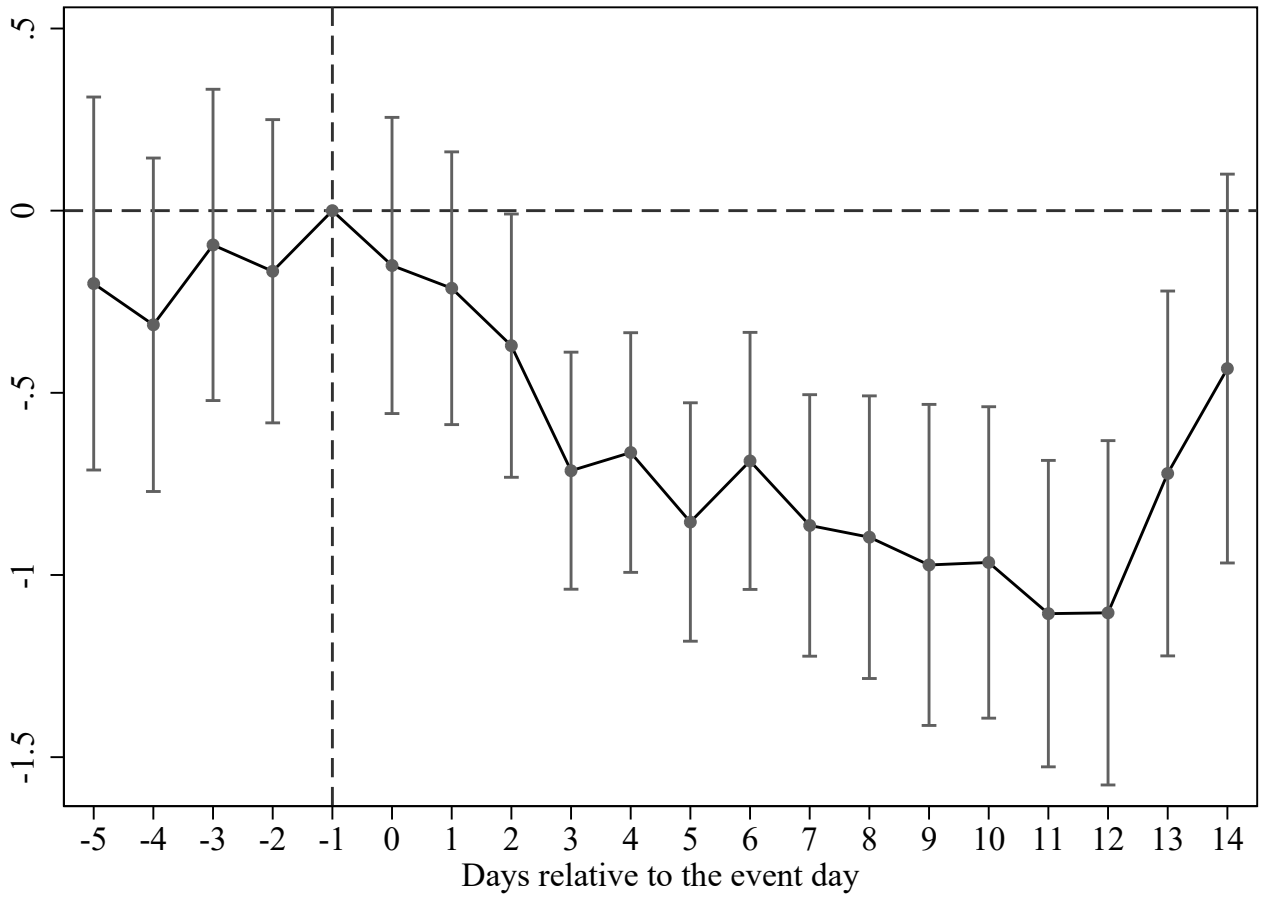
Average Spillover Effects on Stock Returns

	CAPM		FF3		CH4	
	(1)	(2)	(3)	(4)	(5)	(6)
Expo × Post	-0.276***	-0.180***	-0.222***	-0.173***	-0.493***	-0.336***
	(-4.85)	(-3.45)	(-4.16)	(-3.42)	(-8.82)	(-6.24)
Ln (Asset) × Post		-0.410***		-0.208***		-0.472***
		(-5.68)		(-2.97)		(-6.09)
ROA × Post		0.010		0.024**		0.023**
		(1.03)		(2.42)		(2.29)
Leverage × Post		0.010**		0.009**		0.005
		(2.50)		(2.25)		(1.25)
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R2	0.65	0.65	0.65	0.65	0.65	0.65
Obs.	33,558	33,558	33,558	33,558	33,588	33,588

- CAR responds more negatively to policy regulation for firms more closely related to the violating RE developers.

Dynamic Spillover Effects on Stock Returns

$$\text{CAR}_{it} = \alpha + \sum_{s=-5}^{14} \beta_{t+s} * \text{Expo}_i * 1_{t+s} + \gamma * \text{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (6)$$



Bond Spread Response

Similarly, we estimate the following equation in a 180-day window [-90, 90].

$$\text{Spread}_{it} = \beta * \text{Expo}_i * \text{Post}_t + \text{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \tag{7}$$

- Spread_{it}: the yield difference between the yield of bond i traded on day t and the yield of China Development Bank bond traded on the same day with the same remaining maturity.
- We estimate the equation (7) at both the individual bond level and issuer (firm) level.
- Control_{it} includes standard controls such as the firm size, ROA, leverage, maturity, and trading volume.
- We tried fixed effects at different levels such as credit rating, issuers, bonds, and days.
- Standard errors are clustered at the firm level.

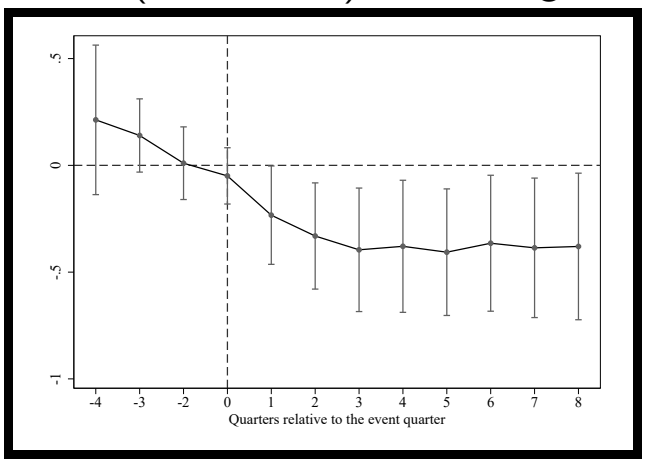
Average Spillover Effects on Bond Spread

	(1)	(2)	(3)	(4)
Expo × Post	0.322***	0.333***	0.298***	0.266***
	(3.91)	(3.95)	(7.51)	(6.30)
Expo	0.418***	0.252***		
	(8.81)	(5.05)		
Post	-0.851**	-1.260***		
	(-2.19)	(-2.97)		
Ln (Asset)		0.072		
		(1.25)		
ROA		-0.217***		
		(-8.22)		
Leverage		0.010*		
		(1.89)		
Maturity		-0.412***	-0.431***	-0.720***
		(-8.62)	(-10.30)	(-4.70)
Ln (Trading Volume)		-2.503***	0.221***	0.628***
		(-24.11)	(3.52)	(8.22)
Credit Rating FE	Yes	Yes	Yes	Yes
Issuer FE	No	No	Yes	No
Bond FE	No	No	No	Yes
Date FE	No	No	Yes	Yes
Adj. R2	0.12	0.27	0.85	0.91
Obs.	9,085	9,085	9,083	9,076

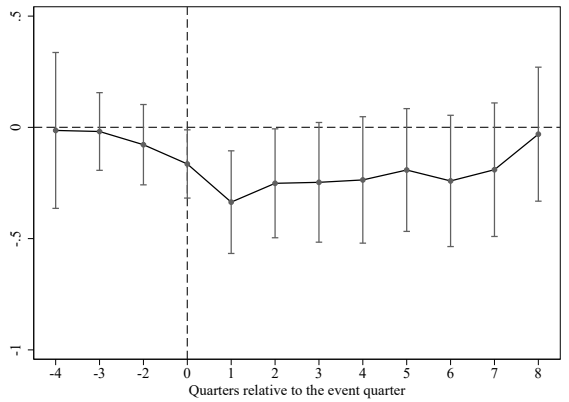
- Spread rises more for firms more exposed to the violating RE developers.

Investment Response by External Financing Dependence

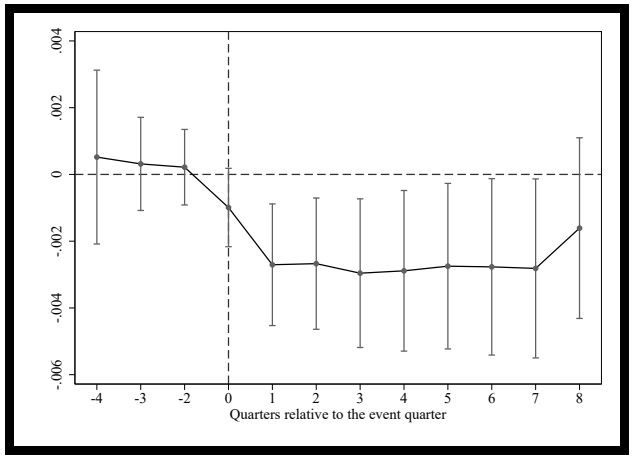
RZ (sector-level) Index: High



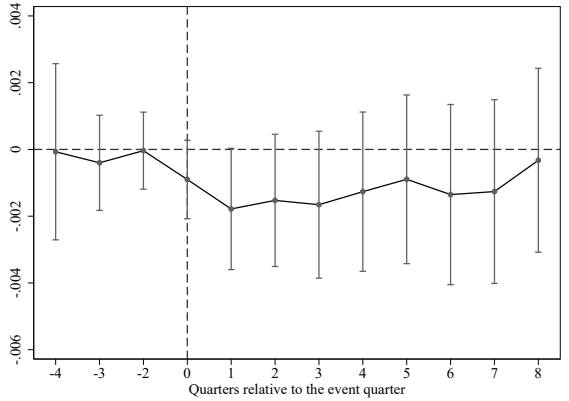
Low



KZ (firm-level) Index: High



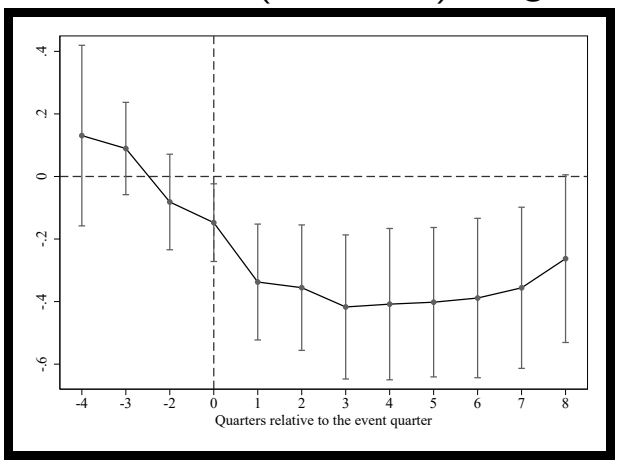
Low



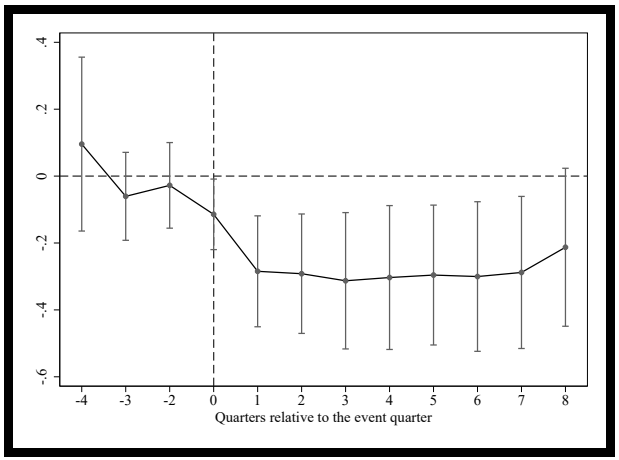
- Sectors/firms relying more on external financing were affected more.

Investment Response by Financial Constraints

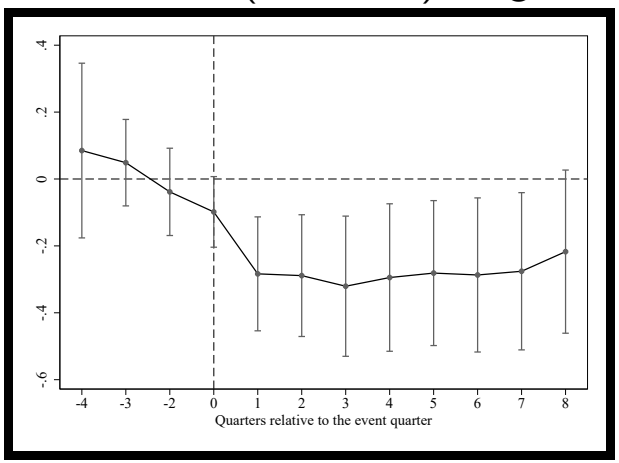
WW Index (firm-level): High



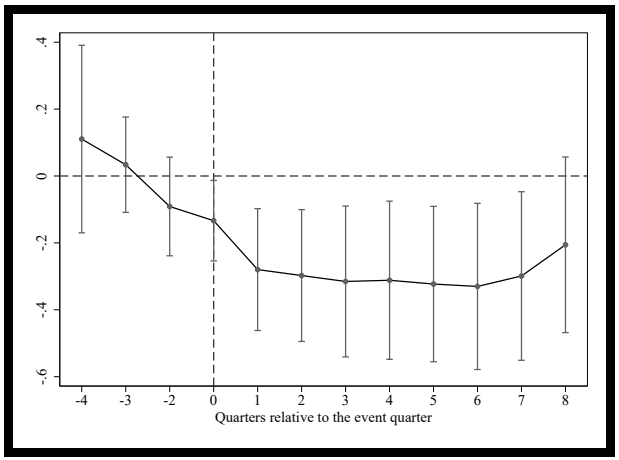
Low



SA Index (firm-level): High



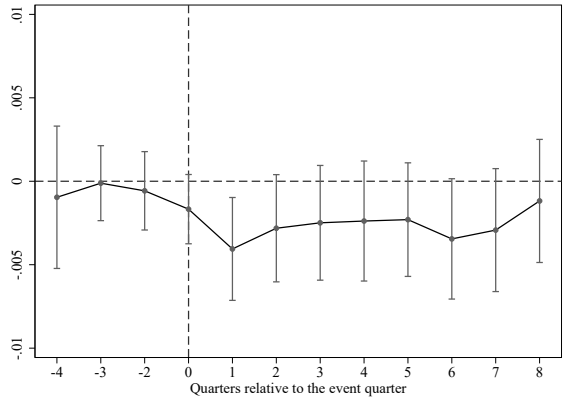
Low



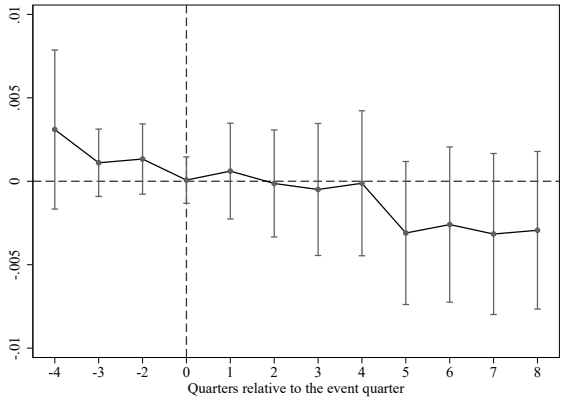
- Financial constraints do not matter.

Investment Response by Upstream Dist. and EFD (RZ)

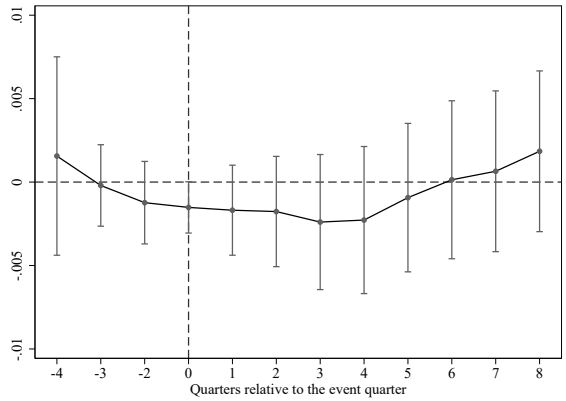
Upstream low & RZ low



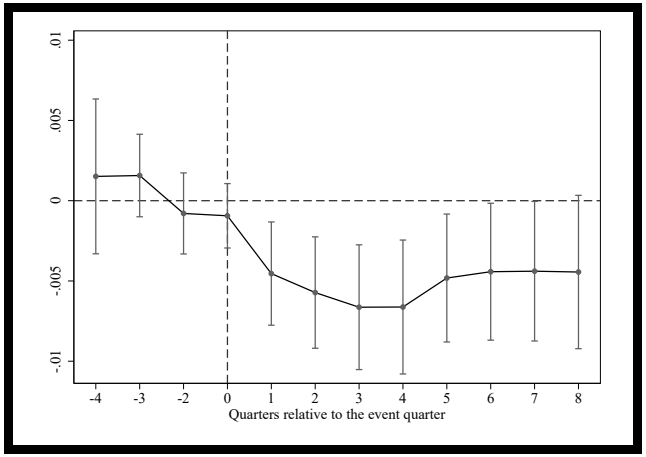
Upstream low, RZ high



Upstream high & RZ low



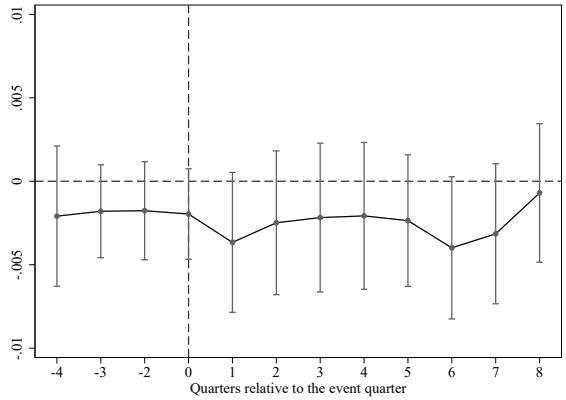
Upstream high, RZ high



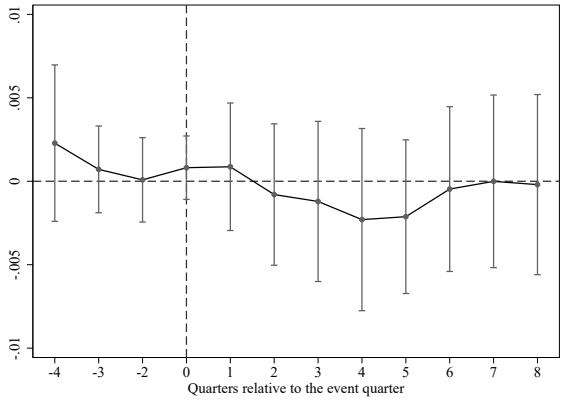
- Sectors with high upstream distance and EFD were affected more.

Investment Response by Downstream Dist. and EFD (RZ)

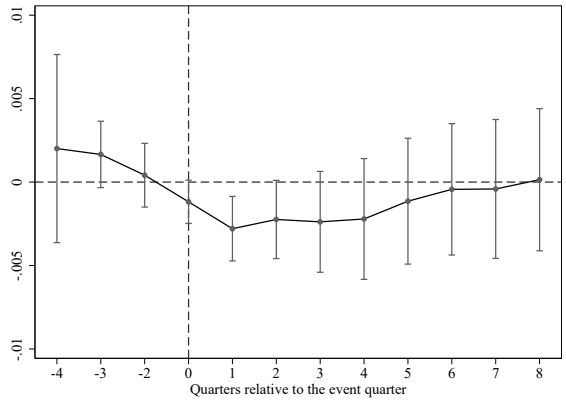
Downstream low & RZ low



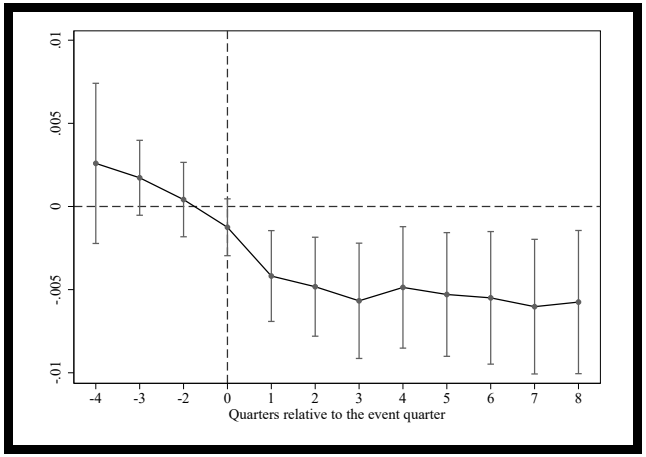
Downstream low, RZ high



Downstream high & RZ low



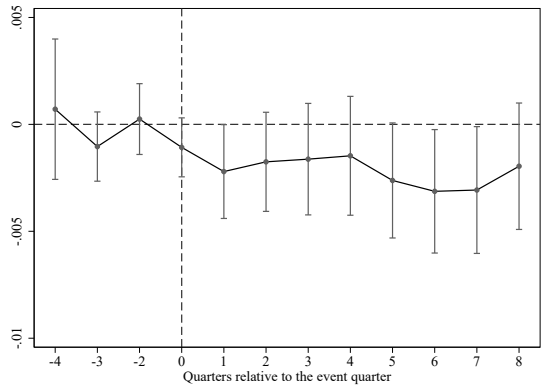
Downstream high, RZ high



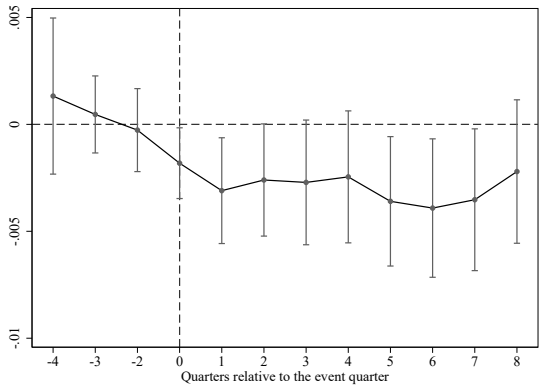
- Sectors with high downstream distance and EFD were affected more.

Investment Response by Upstream Dist. and FC (WW)

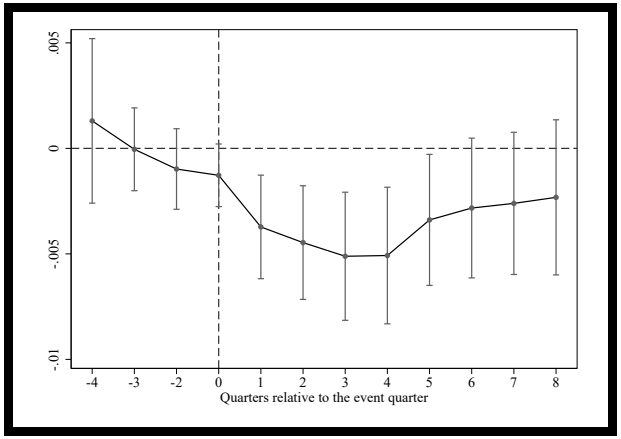
Upstream low & WW low



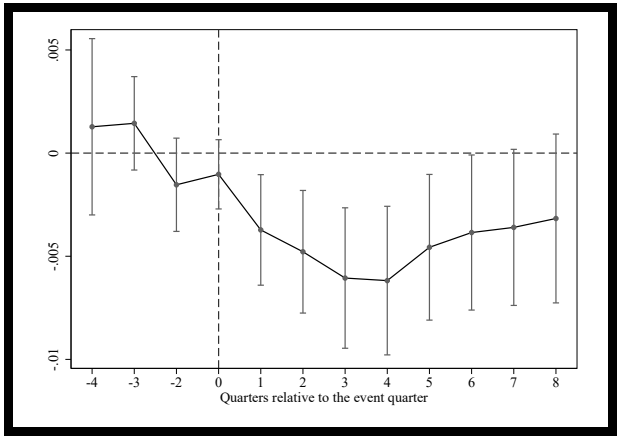
Upstream low, WW high



Upstream high & WW low



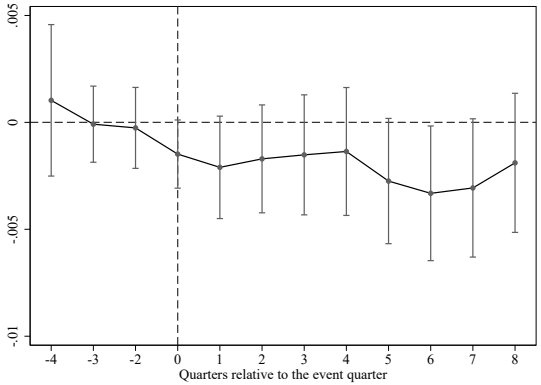
Upstream high, WW high



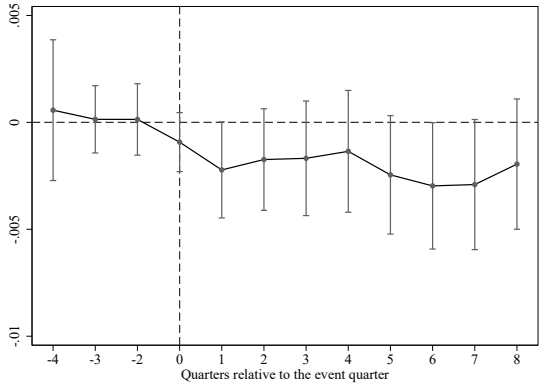
- Sectors with high upstream distance were affected more, indep. of FC.

Investment Response by Upstream Dist. and FC (SA)

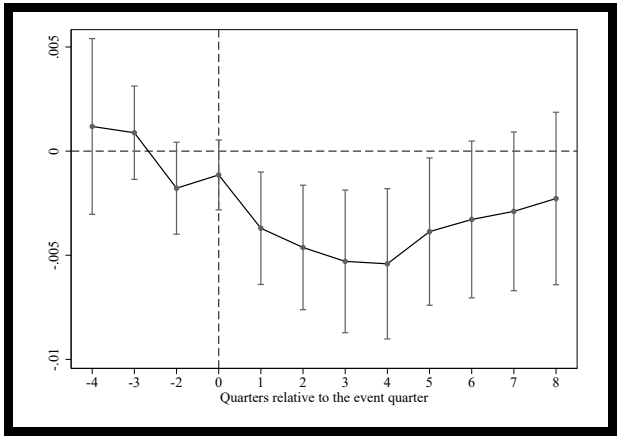
Upstream low & SA low



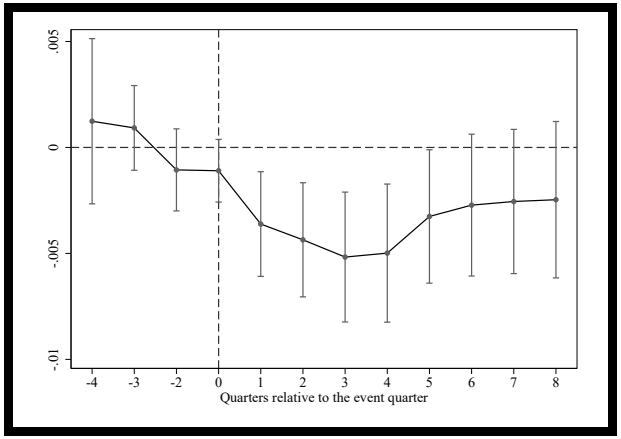
Upstream low, SA high



Upstream high & SA low



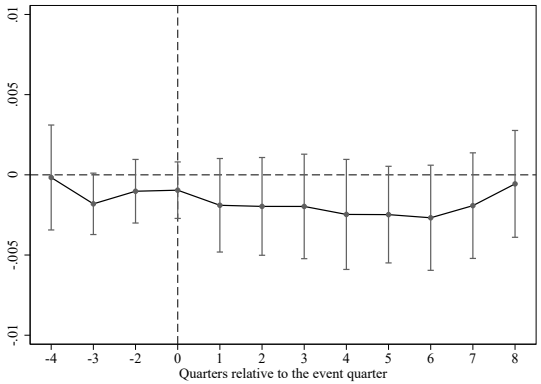
Upstream high, SA high



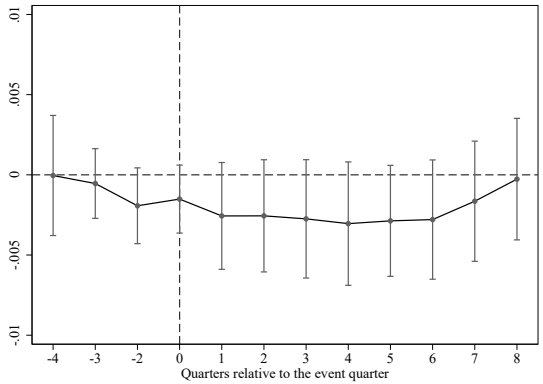
- Sectors with high upstream distance were affected more, indep. of FC.

Investment Response by Downstream Dist. and FC (WW)

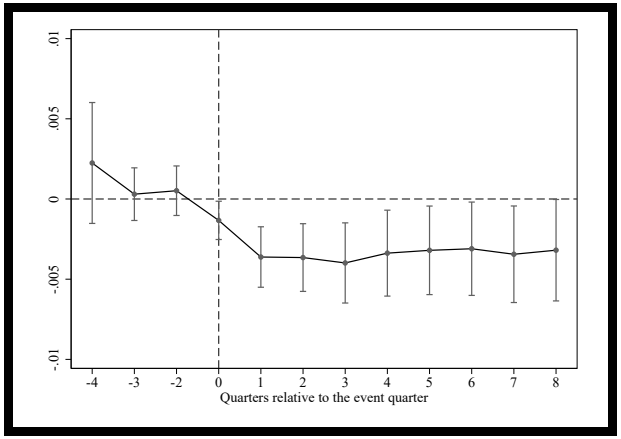
Downstream low & WW low



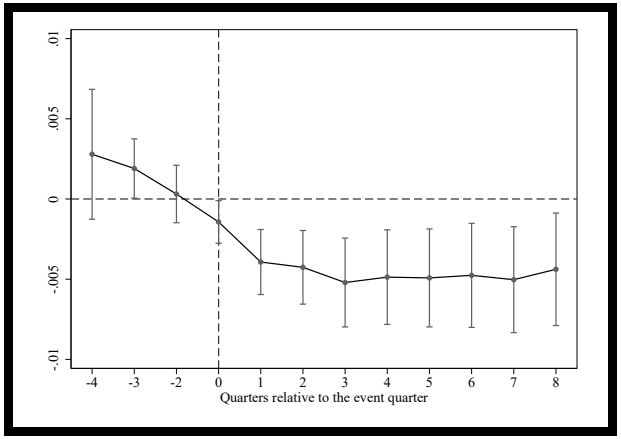
Downstream low, WW high



Downstream high & WW low



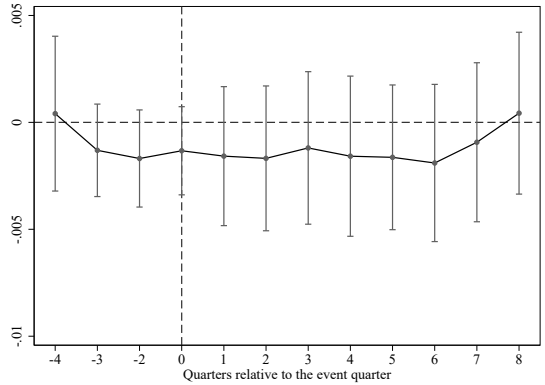
Downstream high, WW high



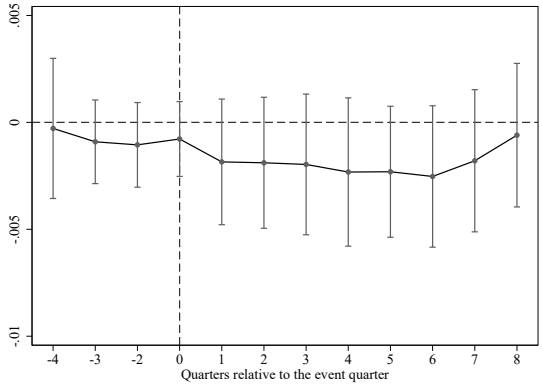
- Sectors with high downstream distance were affected more, indep. of FC.

Investment Response by Downstream Dist. and FC (SA)

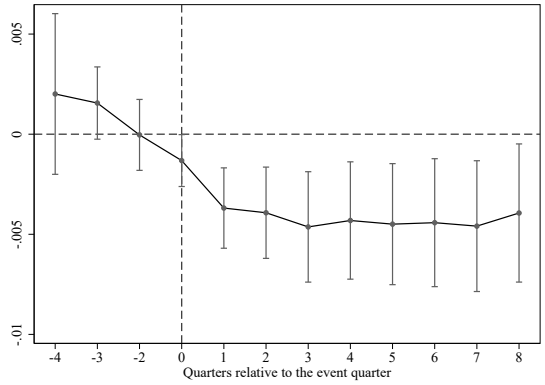
Downstream low & SA low



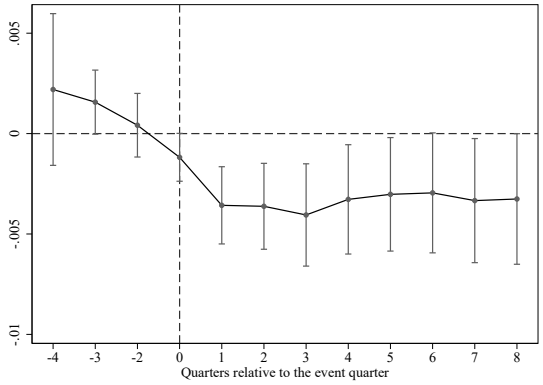
Downstream low, SA high



Downstream high & SA low



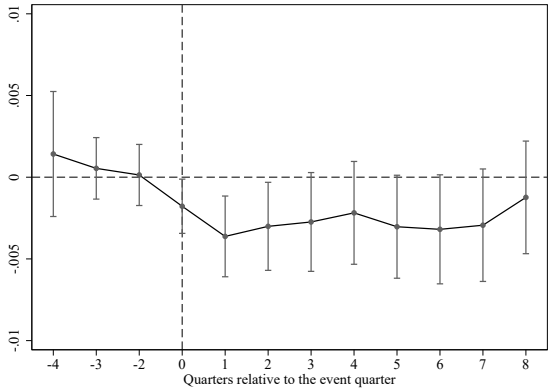
Downstream high, SA high



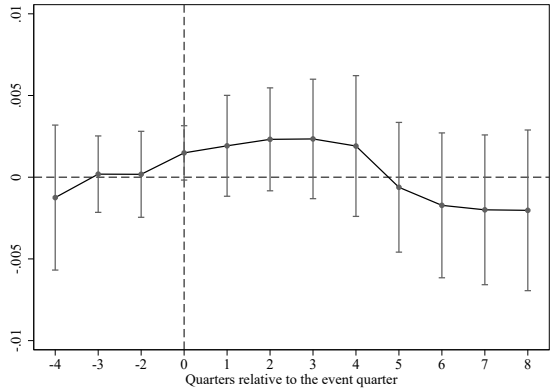
- Sectors with high downstream distance were affected more, indep. of FC.

Investment Response by Upstream Dist. and Ownership

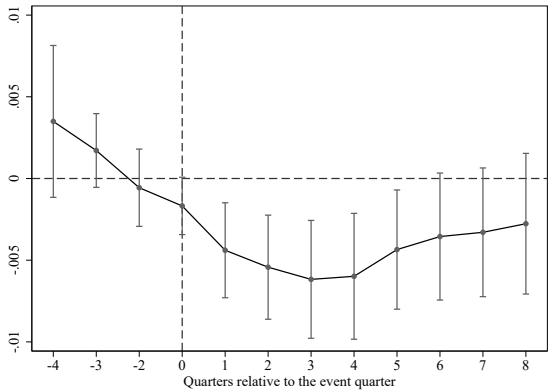
Upstream low & POE



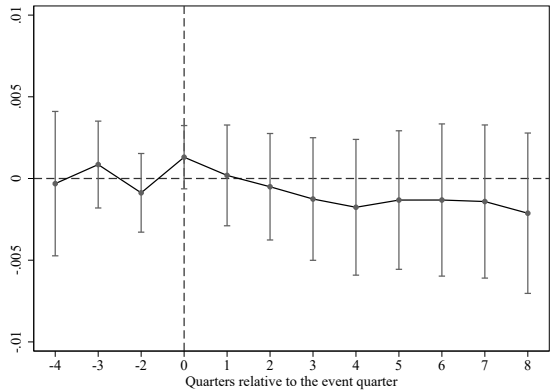
Upstream low, SOE



Upstream high & POE



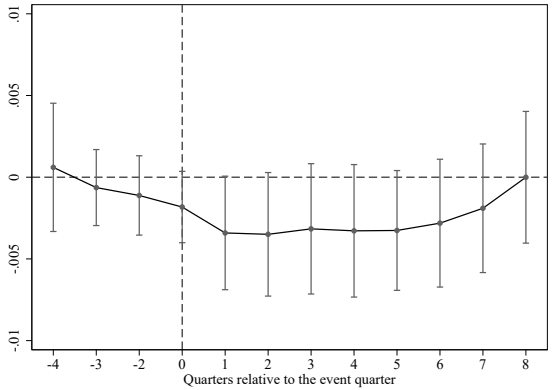
Upstream high, SOE



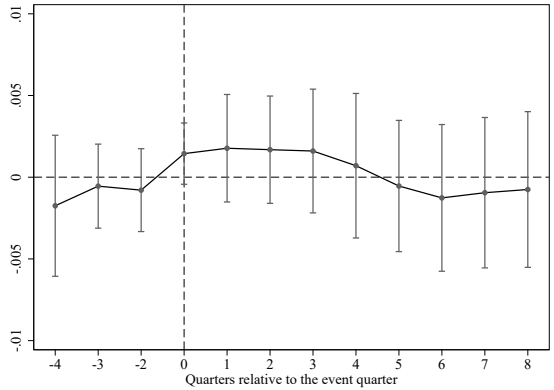
- Within high upstream distance sectors, private firms were affected more.

Investment Response by Downstream Dist. and Ownership

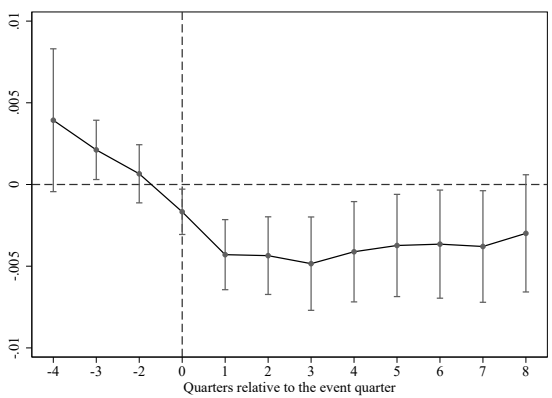
Downstream low & POE



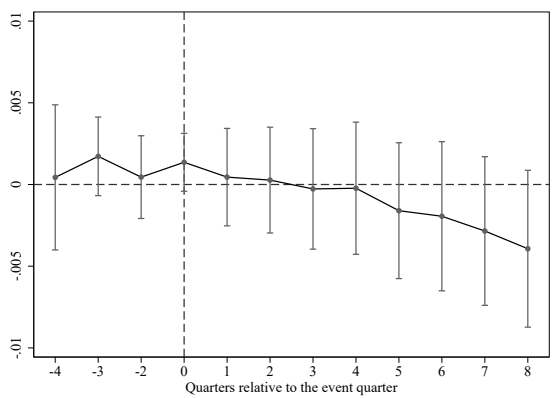
Downstream low, SOE



Downstream high & POE



Downstream high, SOE



- Within high downstream distance sectors, private firms were affected more.