The Spillover Effects of Real Estate*

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Abstract

We examine the spillover effects of the "Three-Red Lines" policy, a Chinese regulatory measure in 2020 that imposed leverage reduction requirements on the real estate sector. Using a firm-level exposure measure, we find that higher exposure to the real estate sector leads to more pronounced adverse impacts on firms' financing costs and real economic activities. Moreover, these spillover effects transmit through the production network, affecting both upstream and downstream sectors closely connected to real estate. Notably, trade credit plays a significant role in explaining these observed spillover effects.

Keywords: Spillover, Real Estate, Production Network, Trade Credit

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1 Introduction

The real estate sector's extensive industry and financial linkage makes it lie at the heart of a country's macroeconomy. For example, a large collapse in real estate prices can affect both the corporate and household sectors through a collateral or wealth channel (e.g., Gan 2007, Iacoviello and Neri 2010, Mian, Rao, and Sufi 2013). More recently, a few Chinese real estate developers, such as Evergrande and Country Garden, have continuously failed in their debt obligations to international investors, which has generated concerns about the impacts of a burst of China's real estate bubbles on both the domestic and global economies.

How large is the spillover effect of the real estate to the rest of the economy? This question is important as downturns in real estate typically end up with crises and recessions. Famous examples include the Japanese real estate burst and the U.S. subprime crises. Empirically, however, the spillover effect is hard to estimate and subject to endogeneity concerns including reverse causality from other industries to real estate demand and numerous confounding factors (e.g. monetary policy changes and COVID lockdowns).

In this paper, we use a unique Chinese policy announcement of the three-red-line policy to address the above question. China's recent regulation on real estate sector provides an ideal quasi-experiment for the following two reasons. First, the real estate sector is an important part of the Chinese economy. As of 2022, for example, real estate industry accounts for 26% of GDP in China (Rogoff and Yang 2022). Moreover, land sales income is 6.7 trillion RMB, 61% total revenues for local governments. Moreover, the real estate sector is also highly leveraged.

Second, the three-red-line policy was unexpected and unprecedented. It was announced on August 20, 2020, by the Ministry of Housing and Urban-Rural Development and the People's Bank of China (PBOC), and is the first regulatory policy to constrain the liability of real estate developers. Based on the liability structure of the real estate firms, the policy puts restrictions on three accounting variables. Violating each of them is termed as crossing a red line. Depending on the number of lines violated, the policy grouped firms into four categories, red (three lines violated), orange (two lines violated), yellow (one line violated), and green (no line violated). Real estate firms are not allowed to take more leverage depending on their categories, with the cap on the annual growth rate of the liabilities with interest at 0%, 5%, 10%, and 15% respectively.

To identify the causal effects of three-red-line policy, we construct a firm-level exposure to this policy for non-real estate listed firms in China. Our exposure measure utilizes information on the cross-sectional impact of the policy on the real estate firms and the pre-shock stock return correlation with the real estate sector. We then estimate both the financial and real spillover effects on non-real estate firms.

Our identification strategy for the spillover effect relies on the exogeneity of the policy announcement. Our firm-level exposure measure for non-real estate firms is constructed using the number of lines violated by real estate firms and their pre-shock stock return correlation with the non-real firms. We then estimate the spillover effects of the "three red-line regulations" on firms in other sectors of the economy using a difference-in-difference method. We carefully control for the effects of potential confounders such as COVID lockdown and firm-level correlates to our exposure measure.

Our first result is about the financial impact. We find that during the policy period, both stock return and bond spread respond more for firms with a higher exposure measure. Economically, a one-standard-deviation increase in the ex-ante exposure to the policy reduces the 10-day cumulative abnormal stock returns by 0.18% and increases bond spread by 33 bps on a daily frequency.

We also explore the real effect considering that the policy might have a persistent impact on the real economy. We find that firms with more exposure to the policy are affected more negatively. Economically, a one-standard-deviation increase in exposure to the policy reduces real investment by 0.29%, sales growth by 2.20%, and net profit by 0.23%. Correspondingly, the firm also increases leverage by 0.21%.

Our estimated spillover effects are significant in aggregate. Following Mian and Sufi (2012), we conduct a conservative back-of-envelope calculation for the overall investment decline that can be attributed to the spillover effect of the three-red-line policy. We find that our estimation accounts for 42.31% of the total investment decline during 2020Q4-2022Q3. Considering this is a period with COVID lockdowns, our estimated spillover effect is economically important.

What explains our results? We hypothesize that the spillover effects work through the production networks. As the policy forced the real estate firms to decrease leverage, non-real estate firms will be negatively affected because they are in the upstream or downstream sector of the real estate firms and their economic activity will be affected through trade credit. Indeed, we find that sectors closer to the real estate in the production network or more relying on external financing were affected more in terms of investment. Within these sectors, firms advancing more trade credit to the real estate suffered more.

In our work-in-progress, we will provide a simple theoretical framework to rationalize the documented empirical results. We also work to estimate the spillover effects on the regional economy.

Our paper has important policy implications, especially on the spillover effects of the real estate sector on the economy. Given its tight connection to other sectors, policies on the real estate sector can create significant effects on other sectors. Failing to internalize such spillover effect might render the effectiveness of policies and create unintended consequences on the whole economy.

Literature Review Our paper contributes to several strands of the literature. First, our paper belongs to the literature that studies the importance of the real estate sector for the Chinese macroeconomy including Fang, Gu, Xiong, and Zhou (2016), Chen and Wen (2017), Glaeser, Huang, Ma, and Shleifer (2017), Rogoff and Yang (2022), Xiong (2023). Different from those papers, we study the spillover effects of the three-red-line policy. A related paper is Gu (2023) which also studies the effect of the same policy. But his focus is on the real estate firms while we look at non-real estate firms.

Second, our paper is related to the literature on shock transmission through production networks. Di Giovanni and Hale (2022), Lane (2022), and Balboni, Boehm, and Waseem (2023). We focus on a specific policy shock in the real estate sector.

Last, our paper is related to the Literature on the effects of housing market regulations. For example, Greenwald (2018), Berger, Turner, and Zwick (2020), Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru, and Yao (2017), and

DeFusco, Johnson, and Mondragon (2020) focus on the household sector. Jeske, Krueger, and Mitman (2013), Di Maggio and Kermani (2017) and Favara and Imbs (2015) focus on financial institutions. We focus on the Chinese non-real estate sector, similar to those also looking at the regulations for China including Du and Zhang (2015), Deng, Liao, Yu, and Zhang (2022) and Chen, Wang, Xu, and Zha (2020).

2 Institutional Background

In China, there are 99544 real estate firms, of which 112 are listed in the A-share market and 267 are listed in the H-share market in 2022. The market capitalization of listed A-share RE firms is 1501.9 billion yuan, roughly 2% of A-share total market capitalization. The real estate firm plays an important role in driving Chinese growth. Meanwhile, they are highly leveraged and tightly connected to other sectors. As a result, any policy that affects the real estate sector inevitably spills over to other sectors and hence the whole macroeconomy.

The Three Red Lines (TRL) policy was the first important regulatory policy for the real estate sector. It was proposed on August 20, 2020, when the Ministry of Housing and Urban-Rural Development and the PBOC held a symposium with representative real estate constructors in China. The regulators were concerned about the highly indebted property-development sector in China and thus required those firms to meet certain requirements relating to the ratio of debt to cash, equity, and assets. Specifically, there were three requirements for the real estate firms: 1) liabilities should not exceed 70 percent of assets (excluding advance proceeds from projects sold on contract); 2) net debt should not be greater than 100 percent equity; 3) money reserves must be at least 100 percent of short-term debt.[1]

Depending on the number of rules violated, the real estate firms can be grouped into four categories: red category (three rules are violated); orange category (two rules violated); yellow category (one rule violated), and green category (no rule violated). Violating those regulations has consequences for firms to take further leverage. For the most levered firms, the red category, they are not allowed to take

[1] See https://www.gsm.pku.edu.cn/thought_leadership/info/1007/2273.htm.

any liabilities with interest. For the other categories, there will be certain restrictions on the annual growth rate of the liabilities with interest. The caps are 5%, 10%, and 15% respectively for the orange, yellow, and green real estate firms.

The three-red-line policy affects most real estate firms in China. At the end of 2020 Q2, there were 209 listed real estate firms in China (A share and H share markets combined). Based on their balance sheet information in 2020 Q2, we grouped them into four categories following the requirement of the policy in Table 1. 77 of the listed real estate firms are red firms, 36 are orange, 84 yellow, and 12 are green. Moreover, most firms violate both the first line and the third line.

3 Empirical Strategy and Identification

The three-red-line policy arguably affects the real estate sector directly. Even if a firm was tagged as green, its liability (with interest) growth is capped at 15% by the policy. As real estate firms are highly leveraged, the regulation potentially hurts both their financial and investment decisions. Given its pivotal role in the whole economy, firms linked to the real estate sector are likely to be affected, financially and economically. To estimate the spillover effect of the policy on non-real estate firms, we construct an *exposure* measure for the non-real estate firms to the real estate sector as follows.

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

where N_h is the number of violations of the three red-line regulations for real estate firm h as of August 20, 2020, H is the total number of listed real estate firms in both A and H markets, and $\text{corr}_{i,h}$ is the correlation between non-real estate firm i and the real estate firm h. Ideally, we want to use the "intrinsic" correlation to capture the relationship between a non-real estate firm and a real estate firm. A natural candidate is to use the stock return, assuming that the stock market has reflected the needed information for the relationship between the two firms. We use daily stock returns between 2010 and 2019, i.e., *pre-policy period*, to calculate the correlation.

Our identification of spillover effects on non-RE sectors relies on the exogeneity

Table 1 THE IMPACT OF THREE RED LINES POLICY ON REAL ESTATE FIRMS

# of Violation	H share	A share	Combined	Percentage
0	3	9	12	6
1	39	45	84	40
2	19	17	36	17
3	46	31	77	37
Total	107	102	209	100

	H share	A share	Combined	Percentage
1^{st} Line Violation	56	46	102	49
2^{nd} Line Violation	55	33	88	42
3^{rd}Line Violation	104	93	197	94

Table 2 CORRELATES OF EXPOSURE MEASURES

	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

NOTE. The table presents the potential correlates of the exposure measure in our sample using linear regressions of the exposure measure on firm characteristics including firm size, leverage, ROA, state ownership, cash flow, and EBIT. T-statistics are reported in the parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

of the exposure measure. We assume that it only captures the policy effect of the three-red-lines policy on non-RE firms through their linkage with the RE sector. This is a reasonable assumption because the policy was unexpected and thus its impact on the RE sector. The stock return correlation is estimated using the pre-policy period, which reduces the concern about the endogeneity issue. The exposure measure weighted the correlation by the number of policy violations, an exogenous policy impact on RE firms, which together provide identification for our analysis.

We also investigate potential firm-level correlates in 2020 Q2 with our exposure measure in Table 2. The reported R2s for each variable are the additive Shorrocks-Shapley decompositions of the overall R2 of the regression, which reflects the relative importance of a variable in explaining our exposure measure. We find that only firm size and state ownership are statistically positive. We carefully control for these variables in our regressions.

With the exposure variable, our empirical analysis mainly investigates the financial and real effect of the three-red-line policy on non-RE firms. Specifically, we conduct a difference-in-differences estimation strategy on non-RE firms as follows.

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

where y_{it} is either the financial or real variable for non-RE firm i at time t, Expo_i is constructed as in equation (1), Post_t flags the post-policy period centered at August 2020, and Control_{it} includes important firm-level controls. We also control for time and firm fixed effects to control for any time-variant common shock and time-invariant firm-level heterogeneity. Our key interest is the coefficient β, which captures the spillover effects of the three-red-line policy on the non-RE firm.

4 Data

We collect data from several resources. The stock return and balance sheet information are from China Stock Market & Accounting Research (CSMAR). Bond prices and credit rating data are from WIND. We also use the 2018 Input-Output data published by the National Bureau of Statistics to construct a sector-level measure of upstream/downstream distance to the real estate sector.

We first exclude firms in the finance and utility sectors as conventional. We also require firms to satisfy the following conditions: 1) they have to be listed at least 1 year before 2020Q3; 2) they need to have information for 2 quarters before or after the policy shock period; 3) their stock status should be labeled as normal (e.g., exclude *ST). Our sample thus consists of 2,609 non-real estate firms. The distribution of the sample is in Appendix Table A1.

We focus on several dependent variables in our regression. The abnormal stock

Table 3 SUMMARY STATISTICS

	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

NOTE. Exposure is constructed as in equation (1). Capex/Asset is the capital expenditure divided by the lagged total assets. Tobin's Q is the book value of total assets minus the book value of equity plus the market value of equity scaled by the book value of total assets at the end of the quarter. Cash Flow is the income before extraordinary items plus depreciation and amortization divided by the book value of assets, measured at the end of the quarter. Leverage is The book value of debt divided by the book value of total assets measured at the end of the quarter. ROA is net income divided by the book value of lagged total assets. Sales Growth is a firm's Year-over-Year sales growth rate. EBIT is earnings before interest and taxes which is calculated as net income plus interest expense and taxes. CAR[-5,4] is the cumulative abnormal stock returns over the event window, which starts 5 trading days before the event date (August 20, 2020) and ends 5 trading days after the event (event day included). The daily abnormal return is generated by subtracting each stock return's loadings on market return from its raw return, where the estimated market beta is generated using the period 126 trading days before the event window. Yield Spread is the daily yield difference between each bond traded on the market and the China Development Bank bond with a similar maturity.

returns are constructed by subtracting predicted returns based on a factor model from individual stock's raw returns, where the respective factor loading parameters are estimated using daily return samples that are 126 trading days before the event window. The yield spreads are constructed as the daily yield difference of each bond traded on the market and China Development Bank bond with similar maturity. The corporate investment is constructed using the past four quarters' total capital expenditure divided by the book value of total assets at the last quarter's end. Sales growth is constructed as the firm's Year-over-Year sales growth rate. EBIT is constructed as net income plus interest expense and taxes. Leverage is the book value of debt divided by the book value of total assets at quarter end. We also construct important firm-level control variables, such as firm size (the natural logarithm of total assets), Tobin's Q (the book value of total assets minus the book value of equity plus the market value of equity scaled by the book value of total assets at quarter end), cash flows (the income before extraordinary items plus depreciation and amortization divided by the book value of assets at quarter end) and ROA (the net income divided by the book value of total assets at quarter end). The summary statistics for those variables are provided in Table 3.

5 Empirical Results

5.1 Financial Impacts of the Policy Shock

We start our analysis on the financial impacts of the three-red-line policy, focusing on both stock return and bond spreads. As the policy is unexpected, the response of the financial market can provide useful information on the market response to the spillover effects. We first estimate the following equation for stock returns in a 10-day window [-5, 4] centered on August 21, 2020.

$$\text{CAR}_{it} = \beta * \text{Expo}_i * \text{Post}_t + \gamma * \text{Control}_i * \text{Post}_t + \alpha_i + \alpha_t + \varepsilon_{it} \tag{3}$$

where CAR_{it} is the cumulative abnormal return for non-RE firm i at day t, estimated using three alternative models, the classical CAPM (capital asset pricing model), the FF3 model (Fama and French 1992), and the CH4 model (Liu, Stambaugh, and Yuan 2019). Expo_i is our exposure measure to the policy constructed in (1). We standardize the exposure measure for ease of exposition. Post_t equals one post the policy announcement. We also include $\text{Control}_i * \text{Post}_t$ to control for different sensitivities to the shock in firm size, ROA, and leverage. We include both firm and time-fixed effects. The standard errors are clustered at the firm level.

Table 4 presents the estimation results for the policy spillover effects on stock returns, captured by β, the coefficient on the interaction term of our exposure measure, and the post-dummy variable. In all specifications, the effects are negative and significant, both statistically and economically. Using column (2) as an illustration, a one-standard-deviation increase in ex-ante exposure to the policy reduces the 10-day abnormal stock returns by 0.18%. This suggests that stock return responds

Table 4 STOCK RETURN REACTIONS TO THREE RED LINES POLICY: DIFFERENCE-IN-DIFFERENCES ESTIMATION

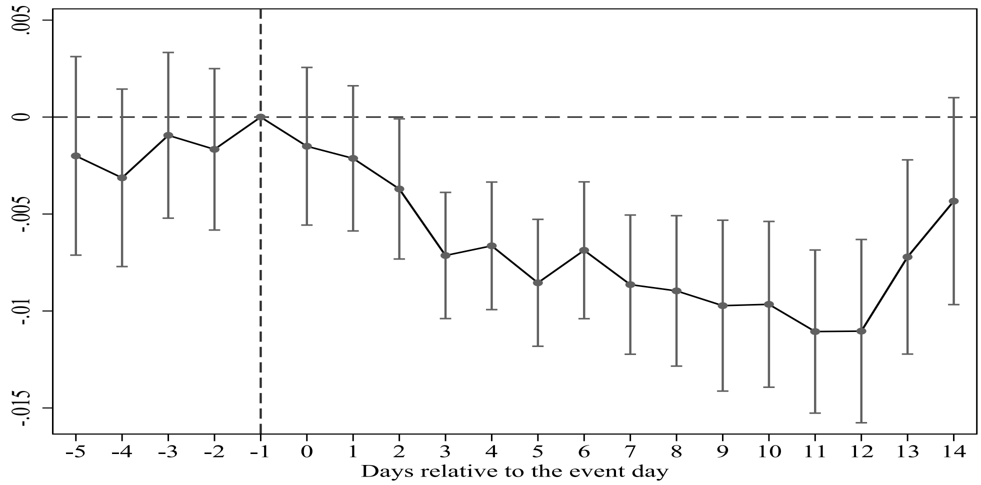
	CAPM		FF3		CH4	
	(1)	(2)	(3)	(4)	(5)	(6)
Expo × Post	-0.276***	-0.180***	-0.222***	-0.173***	-0.493***	-0.336***
	(-4.85)	(-3.45)	(-4.16)	(-3.42)	(-8.82)	(-6.24)
Ln (Asset) × Post		-0.410***		-0.208***		-0.472***
		(-5.68)		(-2.97)		(-6.09)
ROA × Post		0.010		0.024**		0.023**
		(1.03)		(2.42)		(2.29)
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

NOTE. The table reports the difference-in-difference estimation of stock price reactions to the three red-lines policy on 08/20/2020 (day 0). The sample period is from 08/13/2020 to 08/26/2020 and includes 3,355 A-share listed firms. The *Expo* measure is constructed as in equation (1), and normalized by its standard deviation. The dummy *Post* equals one from 08/20/2020. The dependent variables are 10-day cumulative abnormal returns (CAR [-5, 4]) based on CAPM in columns (1)-(2), Fama-French 3-factor model (FF3) in columns (3)-(4), and CH 4-factor model in columns (5)-(6). CARs are estimated using a 126-day window with a minimum observation requirement of 100 days. Firm-level variables on assets, ROA, and leverage are constructed using the balance sheet information in 2020 Q2. Both stock and day fixed effects are included. Standard errors are clustered by industry and date and t-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

more negatively to policy regulation for firms more closely related to the violating RE developers. We also estimate the dynamic effects of the policy to test both the pre-trend assumption for our difference-in-differences estimation and the persistent effects of the policy shock in Figure 1. We find that the policy does not generate a significant effect before the policy shock. The negative differential effect between high and low-exposed firms only shows up post-policy and persists until day 14.

Similarly, we also estimate the spillover effects on bond spreads. Stock return and bond spreads might provide different information about the policy impact. As bond trading is less frequent than stocks, we estimate the following equation in a

Figure 1 Dynamics Effects on Stock Return



NOTE. The figure estimates the dynamic effects of the three red-lines policy on stock returns, i.e., $\mathrm{CAR}_{it} = \alpha + \sum_{s=-5}^{14} \beta_s * \mathrm{Expo}_i * 1_{t+s} + \gamma * \mathrm{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it}$. The coefficients $\{\beta_s\}_{-5}^{14}$ along with the 95 c.i. is displayed.

180-day window [-90, 90] centered on August 21, 2020.

$$\mathrm{Spread}_{it} = \beta * \mathrm{Expo}_i * \mathrm{Post}_t + \mathrm{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \tag{4}$$

where Spread_{it} is 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 and $\mathrm{Control}_{it}$ includes standard controls such as the firm size, ROA, leverage, maturity, and trading volume. We estimate the equation (4) at both the individual bond level and issuer (firm) level and thus include fixed effects at different levels such as credit rating, issuers, bonds, and days. Standard errors are clustered at the firm level.

Table 5 presents the average spillover effects on bond spreads. In all specifications, bond spreads rise more for firms more exposed to the violating RE developers, as captured by the positive coefficient on the interaction term between the exposure measure and the post-dummy variable. The effect is both statistically and economically significant. Using column (2) as an illustration, a one-standard-deviation

Table 5 BOND SPREAD REACTIONS TO THREE RED LINES POLICY: DIFFERENCE-IN-DIFFERENCES ESTIMATION

	(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

NOTE. The table reports the secondary bond market yield spread reaction to the three red lines policy on 08/20/2020 during three months before and after the three red lines policy. Regression is conducted at each bond level. The regression sample includes 808 bonds that are issued by 271 A-share listed firms and are traded on the secondary bond market during the sample period. The *Expo* measure is constructed as in equation (1), and normalized by its standard deviation. The dummy *Post* equals one from 2020/08/20. The dependent variable is the bond daily yield spread calculated as the yield difference between bonds in the regression sample and bonds (with the same remaining maturity) issued by the China Development Bank. Firm-level variables on assets, ROA, and leverage are constructed using the balance sheet information in 2019 Q4. Standard errors are clustered by issuer and date and t-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

increase in ex-ante exposure to the policy increases daily bond spread by 33 bps.

The spillover effect estimated from the financial market captures the perception of investors within a short period of the policy announcement. However, as time goes on, there might be more effects from the policy which will not be captured by the financial market response. For example, investment slowly responds to policy shocks, which might manifest itself over the years. For this reason, we explore the real effects of the policy shock next.

5.2 Real Effects of the Policy Shock

We estimate the real effects in a 12-quarter window as it takes time for the real effect to materialize. Our focus is the corporate investment but we also look at other real variables such as sales growth, earnings, and leverage. Specifically, we estimate the following equation in the quarterly frequency data at [-4Q, 8Q].

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

where y_{it} is the corporate investment (Capex/Asset), sales growth, EBIT, and leverage respectively. Expo_i is our exposure measure to the policy constructed in (1). We standardize the exposure measure for ease of exposition. Post_t equals one for quarters after 2020 Q4. $\mathrm{Control}_{it}$ 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 interactive fixed effects between different size bins and time to control for the different trend growth of large and small firms. We also include an interactive fixed effect between industry and time to control for the different time trends across industries. To control for the contemporaneous effect of COVID-19-related news, we add an interactive fixed effect between a COVID-19 CAR and time, where the COVID-19 CAR is estimated in a 7-day window around the Wuhan lockdown. Standard errors are clustered at the firm level.

Table 6 presents the real spillover effects of the three-red-line policy. Consistent with the financial market response, we find that there is a real spillover effect. Firms more exposed to the RE sector had lower investment, sales growth, and profit but increased leverage. The effects are both statistically significant and economically important. A one-standard-deviation increase in exposure to the policy reduces real investment by 0.29% as in column (3), sales growth by 2.20%, and corporate profit by 0.23% but increases leverage by 0.21%.

We also estimate the dynamic effects of the policy to test both the pre-trend assumption for our difference-in-differences estimation and the persistent effects of the policy shock in Figure 2. We find that the policy does not generate a significant effect before the policy shock. The negative differential effect between high and low-exposed firms only shows up post-policy and lasts for eight quarters.

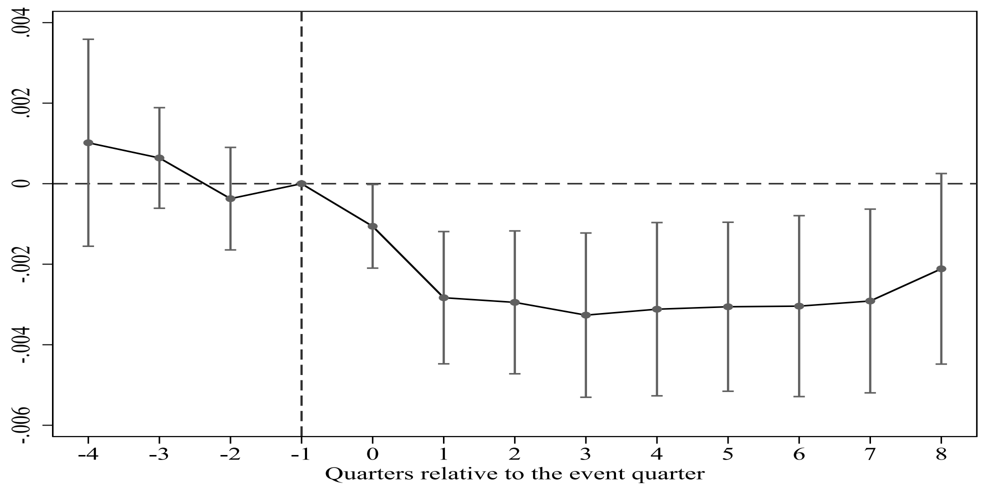
Table 6 REAL EFFECTS OF THREE RED LINES POLICY: DIFFERENCE-IN-DIFFERENCES ESTIMATION

	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

NOTE. The table reports the real impact of the three red lines policy on firm investment, sales growth, profitability, and leverage. The sample period is from 2019 Q3 to 2022 Q3 and includes 2,609 A-share listed firms. The *Expo* measure is constructed as in equation (1), and normalized by its standard deviation. The dummy *Post* equals one from 2020 Q4. *Capex/Asset* is measured as the capital expenditure (in trailing 12 months) normalized by total assets of the last quarter end. Sales Growth is measured as year-over-year sales growth at each quarter end. *EBIT* is measured as net income plus interest and tax normalized by the total assets of the last quarter end. *Size Growth* measures the average total asset growth rate over 12 quarters before 2020 Q3. *Covid CAR* is the cumulative abnormal return (CAR [-10, 9]) centered at the outbreak of Covid-19 in China (Wuhan lockdown) on January 23, 2020, based on the Fama-French 3-factor model, estimated using a 126-day window. Standard errors are clustered by firm and t-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

We have documented a significant negative effect of the policy shock on corporate investment. The difference-in-differences estimation compares the differential impact of high vs. low-exposed firms. How large is the aggregate effect of the policy? Answering this question is important yet challenging. We make progress following Mian and Sufi (2012). First, we divide firms into deciles based on three-red-line policy exposures and treat the lowest decile as the control group. We then multiply the dynamic coefficients by the difference between each decile's exposure

Figure 2 DYNAMICS EFFECTS ON CORPORATE INVESTMENT



NOTE. The table reports $I_{it} = \alpha + \sum_{s=-4}^{8} \beta_s * \text{Expo}_i * 1_{t+s} + \gamma * \text{Control}_{it} + \alpha_i + \alpha_t + \varepsilon_{it}$. The coefficients $\{\beta_s\}_{-4}^{8}$ along with the 95 c.i. is displayed.

and the control group's exposure. This gives the differential effects of policy on corporate investment, assuming that the low-exposed firm is not affected by the policy. This is a conservative estimation, considering that the low-exposed firm is also affected by the policy. We next convert the forgoing estimate (multiplied by lagged assets) into the RMB values and sum across all deciles for each quarter. This gives an estimate of the cumulative decline of investment due to the three-red-line policy at 390.54 billion RMB.

How large is the investment decline compared to the overall investment behavior in China? To answer this question, we need to estimate the overall investment dynamics in the same period. We first compute the average quarterly growth rate of investment (3.84%) for the same non-RE firms during 2017Q3-2020Q3, the pre-policy period. We then use 3.84% as the counterfactual trend growth rate of investment during 20020Q4 and 2022Q3. The difference between the actual and the counterfactual investment growth rate is the overall investment decline, which is 923.118 billion RMB. Based on this estimation, the total drop in investment due to the three-red-line policy is 42.31% (=390.536/923.118) of the overall investment decline in the same period.

6 Inspecting the Economic Mechanism

How does the three-red-line policy affect non-RE firms? We investigate this question through a heterogeneity analysis. Specifically, we estimate the investment response to the three-red-line policy by different firm groups.

$$I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_{g} \beta_{t+s}^{g} 1_{g \in G} \right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it} \quad (6)$$

We divide firms into multiple groups based on their pre-policy characteristics. We consider four dimensions, including production networks, external financing dependence, financial constraints, and ownership structure.

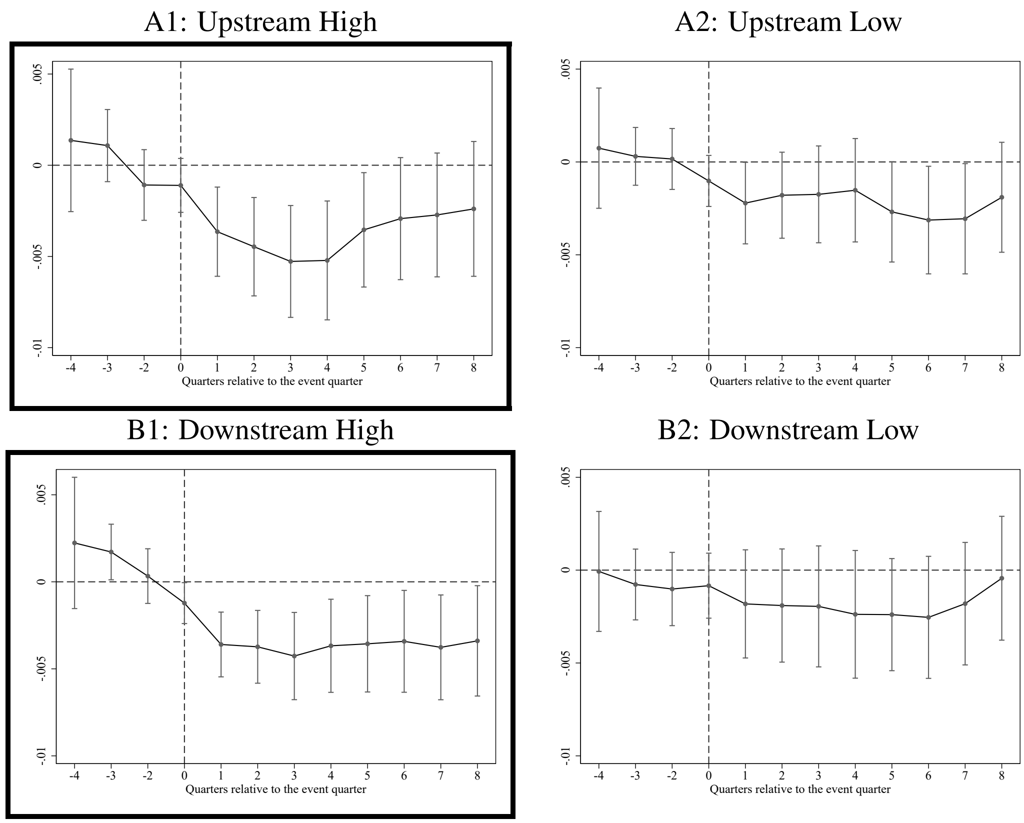
Non-real firms can be affected by the three-red-line policy through production networks. RE firms play an important role in the Chinese economy as they are either in the upstream or downstream of other firms. Our estimated spillover effects could be explained by the link through production networks. To capture this channel, we constructed production network measures using the Input-Output table in 2018 as follows. For sector i, its upstream distance to the real estate is measured by $\text{Up}_i = \frac{y_{i,\text{RE}}}{\sum_k y_{i,k}}$, where y_{ik} is output supplied by sector i to sector k. Correspondingly, 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 divide firms into two groups based on their upstream (or downstream) distance to the RE sector. Upstream high sectors include construction design, construction, construction materials, etc while downstream high sectors include housing sales, room decoration, property management, etc (see Figure A1).

Figure 3 presents the dynamic effects of the policy shock on the corporate investment of non-RE firms based on their distance to the RE sector. We find that our documented spillover effect is driven by the distance to the RE sector and thus the production networks. The spillover effects only show up in firms closer to RE sectors either upstream or downstream.

We also explore the firm heterogeneity through external financing dependence (EFD). We construct the EFD measure following Rajan and Zingales (1998) and conduct the estimation in Figure 4. We find that our documented spillover effect is driven by the high EFD firms.

Figure 3 DOWNSTREAM AND UPSTREAM



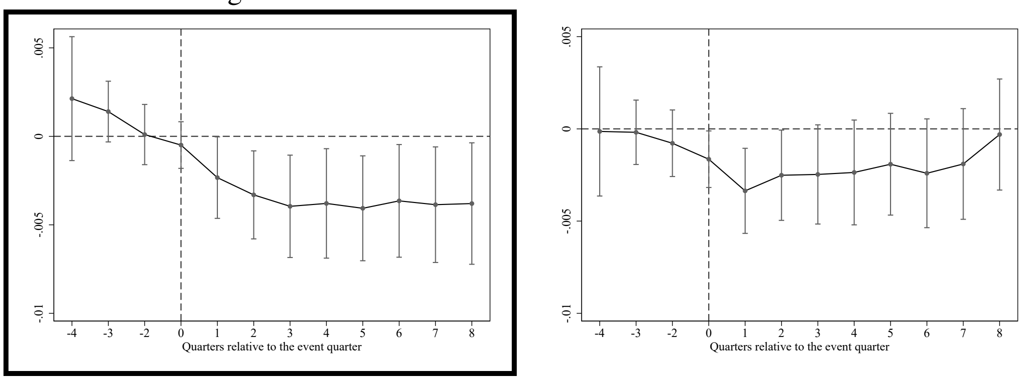
NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g\in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A1 and A2 group firms based on the upstream distance to the RE sector, Up_i and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. for upstream high and upstream low groups respectively. Panel B1 and B2 group firms based on the downstream distance to the RE sector, Down_i and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. for downstream high and downstream low groups respectively.

To explore the role of financial constraint, we group firms based on the measure of financial constraints following Whited and Wu (2006) and Hadlock and Pierce (2010), i.e. the WW index and the SA index. Figure 5 presents the estimation results, which suggests that financial constraints do not matter. Our spillover effects are not driven by the degree of financial constraints.

One unique feature of Chinese firms is the ownership structure. We group firms into private and state-owned firms and conduct the difference-in-differences estimation in Figure 6. We find that our spillover effects are driven by private firms.

Figure 4 External Financing Dependence

A1: High RZ Index A2: Low RZ Index



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A1 and A2 group firms based on the EFD measure as in Rajan and Zingales (1998) and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. for EFD high and EFD low groups respectively.

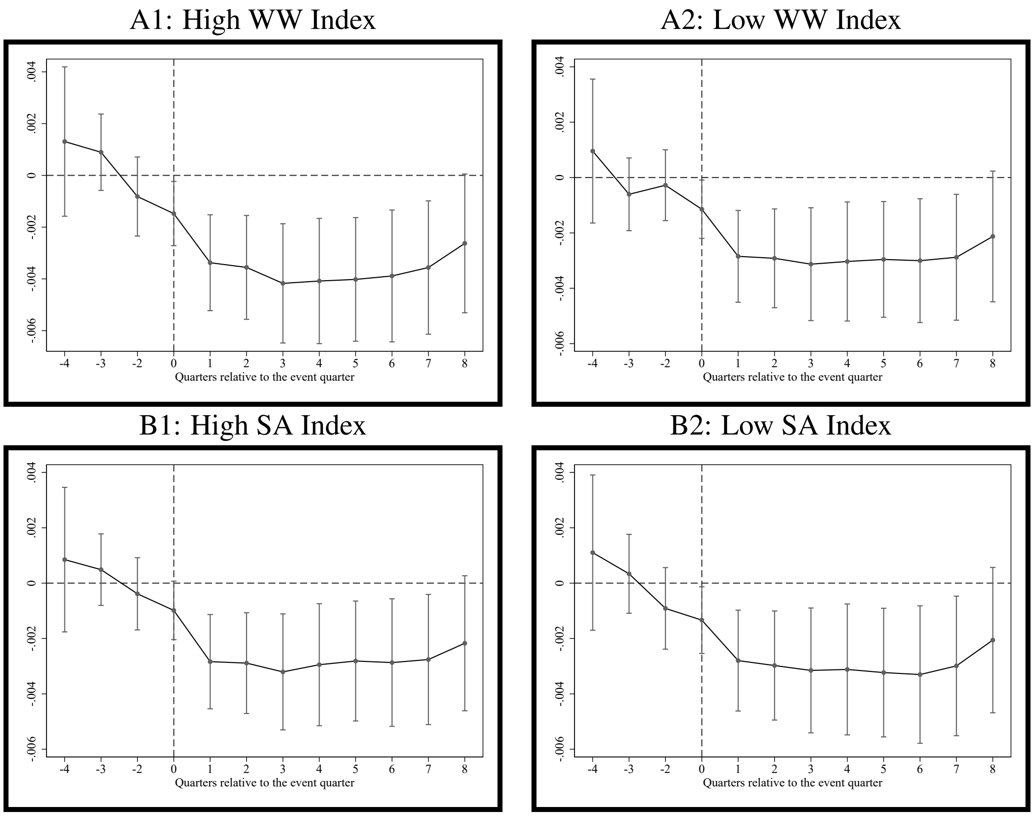
State-owned firms, however, are not affected by the three-red-line policy.

As we find that our results are driven by the production network distance, external finance dependence, and state ownership, we also conduct a horse race test to see whether they capture the same information. Specifically, we group firms into four groups based on whether they belong to a high/low production network distance to the RE sector and whether they have a high/low EFD/ownership measure. We did not include the financial constraints measure as they do not seem to matter for our spillover effects as shown in Figure 5.

We delegate the detailed analysis in the Appendix to save space. The key message suggests that our results are driven by the distance to the RE sector and the EFD/ownership measure. In particular, only firms with a high upstream/downstream distance to the RE sector and having a high EFD/private ownership are affected more by the three-red-line policy.

How to rationalize our results? We conjecture that when the RE sectors reduce leverage due to the policy they might affect non-RE firms through a trade credit channel. As the trade credit works through the production network, firms closer to the RE sector in the production network (upstream or downstream) are affected more. To test this hypothesis, we conduct a firm-level measure for net trade credit,

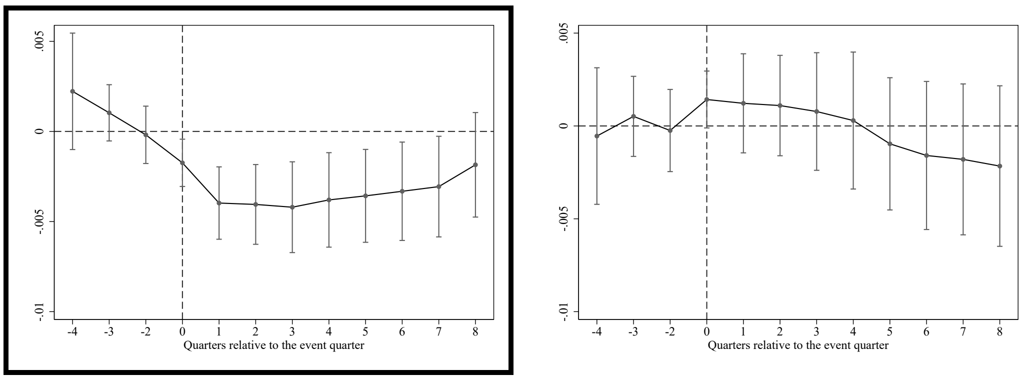
Figure 5 FINANCIAL CONSTRAINT



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G} \right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A1 and A2 group firms based on the WW-index in Whited and Wu (2006) and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. for high and low WW index groups respectively. Panel B1 and B2 group firms based on the SA-index in Hadlock and Pierce (2010) and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. for high and low SA index groups respectively.

Figure 6 STATE OWNERSHIP

A1: Private Firms — A2: State Firms

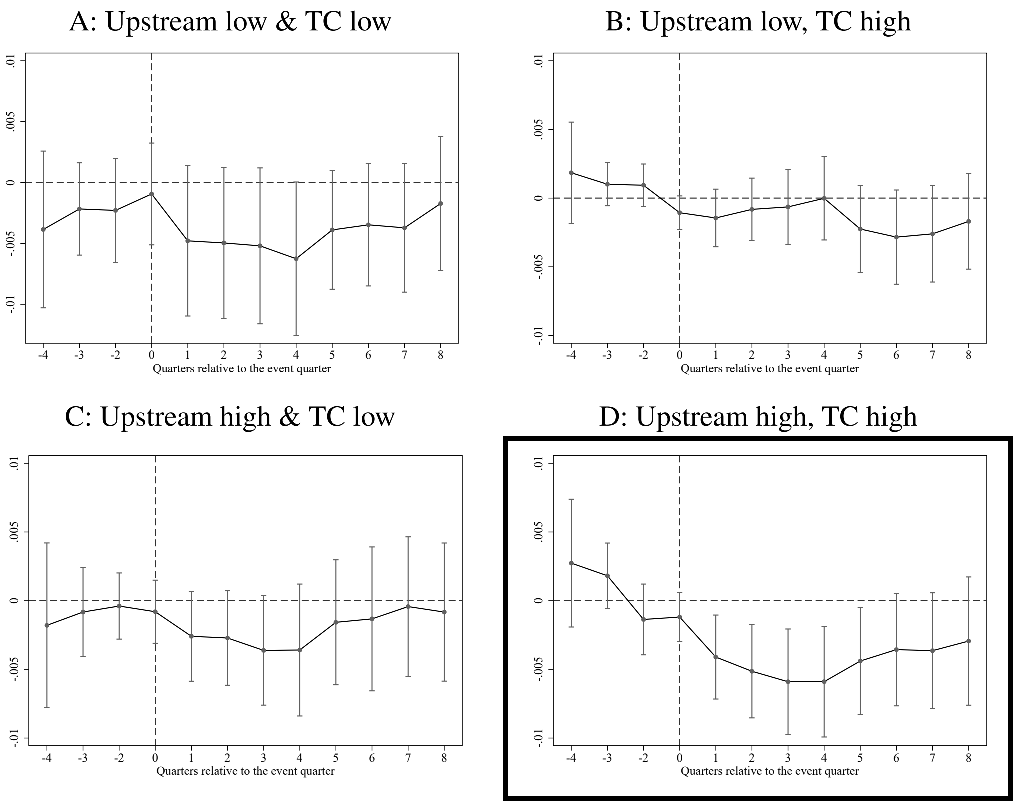


NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A1 and A2 group firms based on the state ownership and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. for private and state firms respectively.

i.e., $\text{TC}_i \equiv \frac{\text{Account Receivables}+\text{Pre-paid Sales}-\text{Account Payables}}{\text{Asset}}$ as in Cun et al. (2022). We estimate our dynamic effects by grouping firms based on the production network distance and the net trade credit measure in Figure 7 and 8. Consistent with our prior, we find that only firms closer to the RE sector in the production network and with a higher net trade credit are affected more by the policy shock.

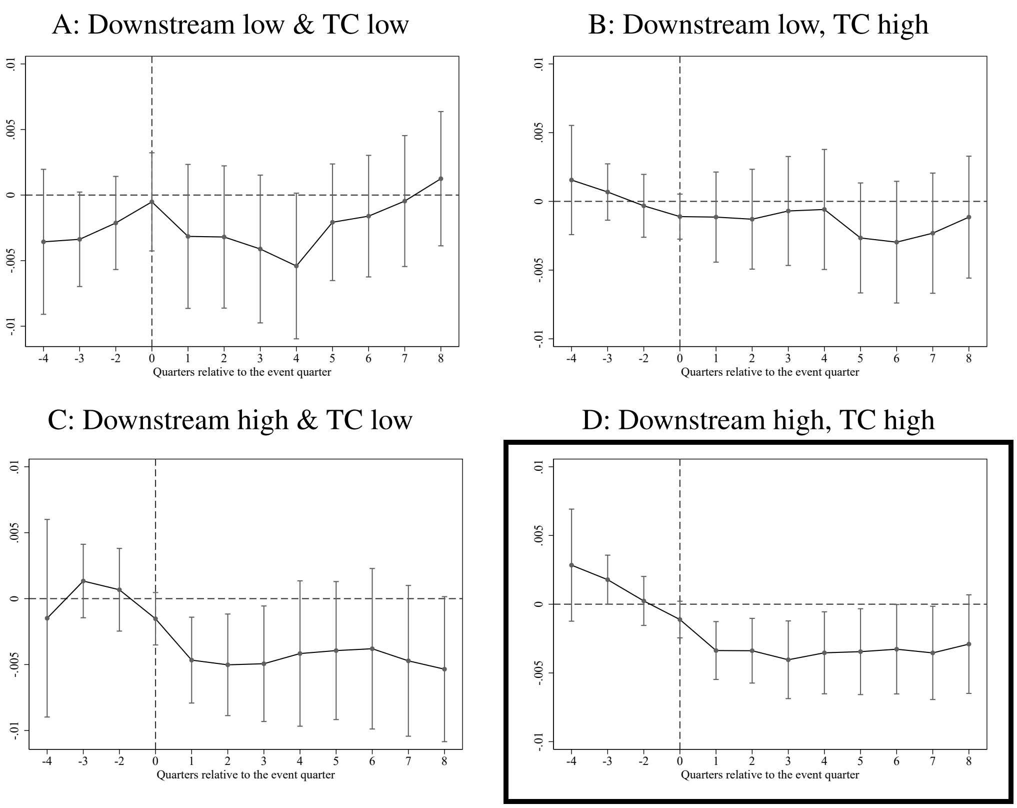
Why are financial constraints irrelevant to our spillover effects while external financing dependence or ownership matters? We conjecture that it has to do with the nature of the shock. The three-red-line policy affects non-RE firms through a production network. When it happens, it tightens the short-term cash flow for up-stream and downstream firms, i.e. the working capital constraint. This explains our results on external financing dependence, private firms, and trade credit measures. Financial constraints do not matter because they capture more about the difficulty in raising funds for long-term investments. The transmission channel of the three-red-line policy affects more about short-term rather than long-term borrowing.

Figure 7 Upstream Distance to the RE Sector and Trade Credit



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the upstream distance to the RE sector and the net trade credit and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.

Figure 8 Downstream Distance to the RE Sector and Trade Credit



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G} \right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the downstream distance to the RE sector and the net trade credit and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.

7 Conclusion

In this paper, we study the spillover effect from real estate to non-real estate sectors by studying an important policy announcement in China, the three-red-line policy regulating real estate developers. We find that the three-red-line policy had unintended negative impacts on both financial markets and the real economy.

Our documented spillover effects are economically significant, which account for 42.32% of the aggregate investment decline during 2020Q4-2022Q3. The spillover effect transmits through a production network. Sectors closer to real estate either upstream or downstream experienced a sharper decline in investment. Moreover, firms with large trade credit exposure are more affected.

Our paper has important policy implications, which suggest an unintended consequence of regulatory policies. In ongoing work, we will provide a theoretical model to rationalize the empirical results. We also work on a regional-level exposure to study the regional real effects.

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Internet Appendix

‘The Spillover Effects of Real Estate Sector’

(Intended for online publication only)

by K. Chen, H. Du, and C. Ma

January 2024

Table A1 FIRM DISTRIBUTION IN OUR SAMPLE

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

Figure A1 UPSTREAM AND DOWNSTREAM

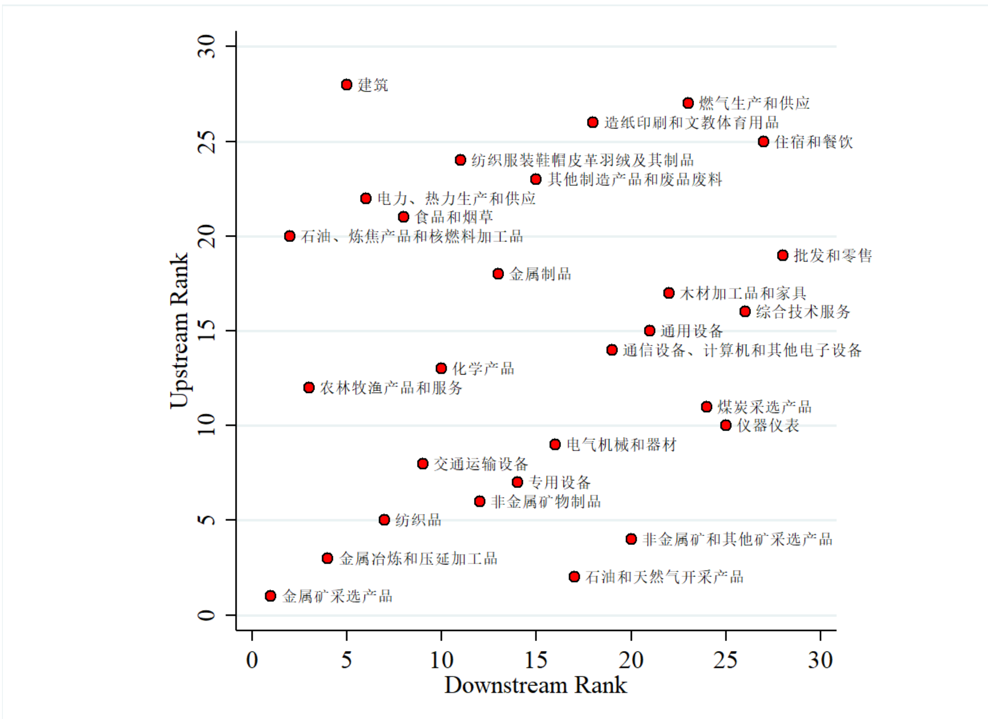
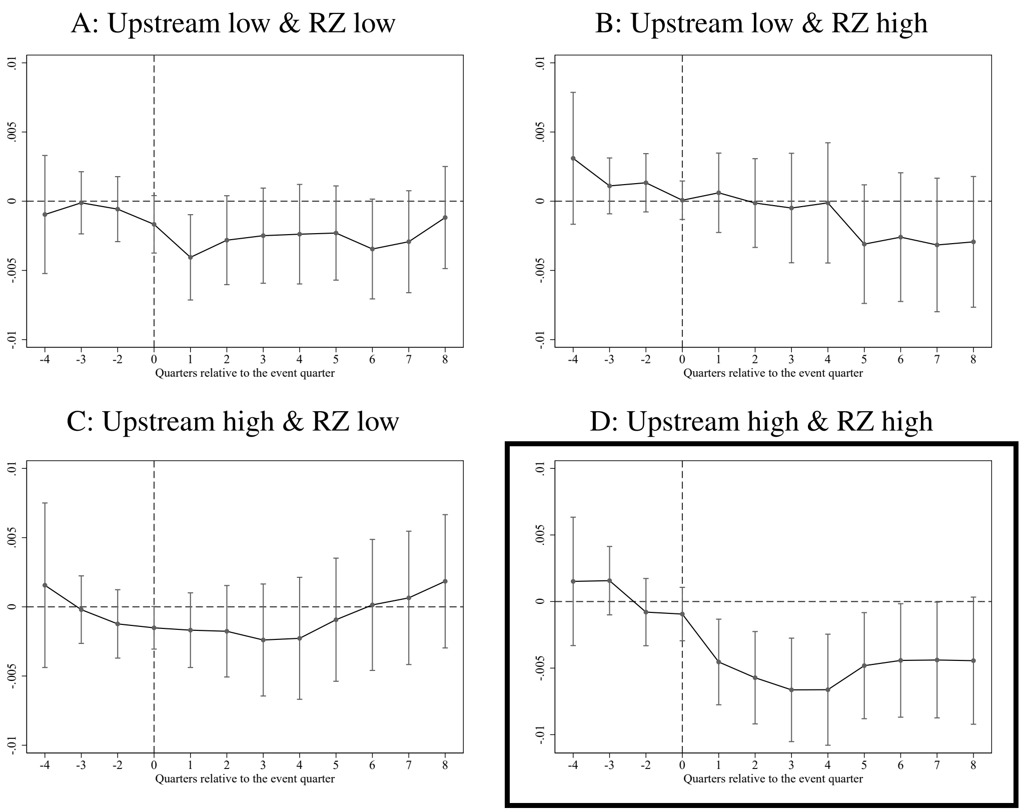


Figure A2 Upstream Distance and EFD



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the upstream distance to the RE sector and the EFD measure (Rajan and Zingales 1998) and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.

Figure A3 Downstream Distance and EFD

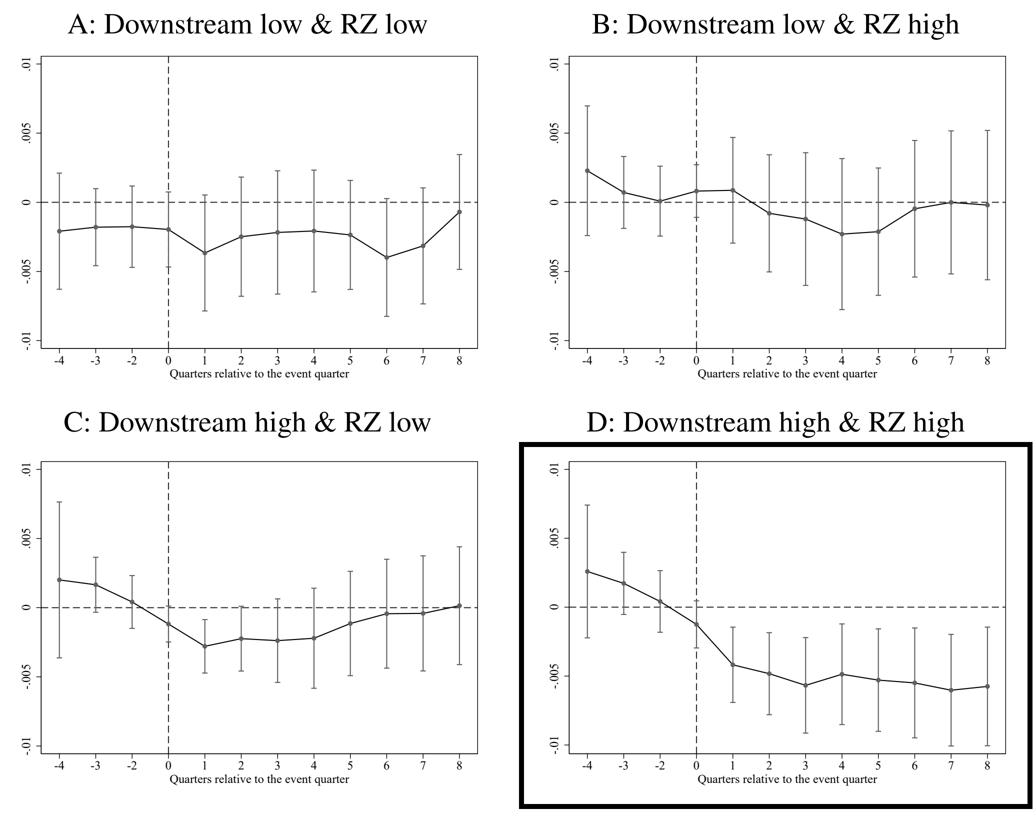


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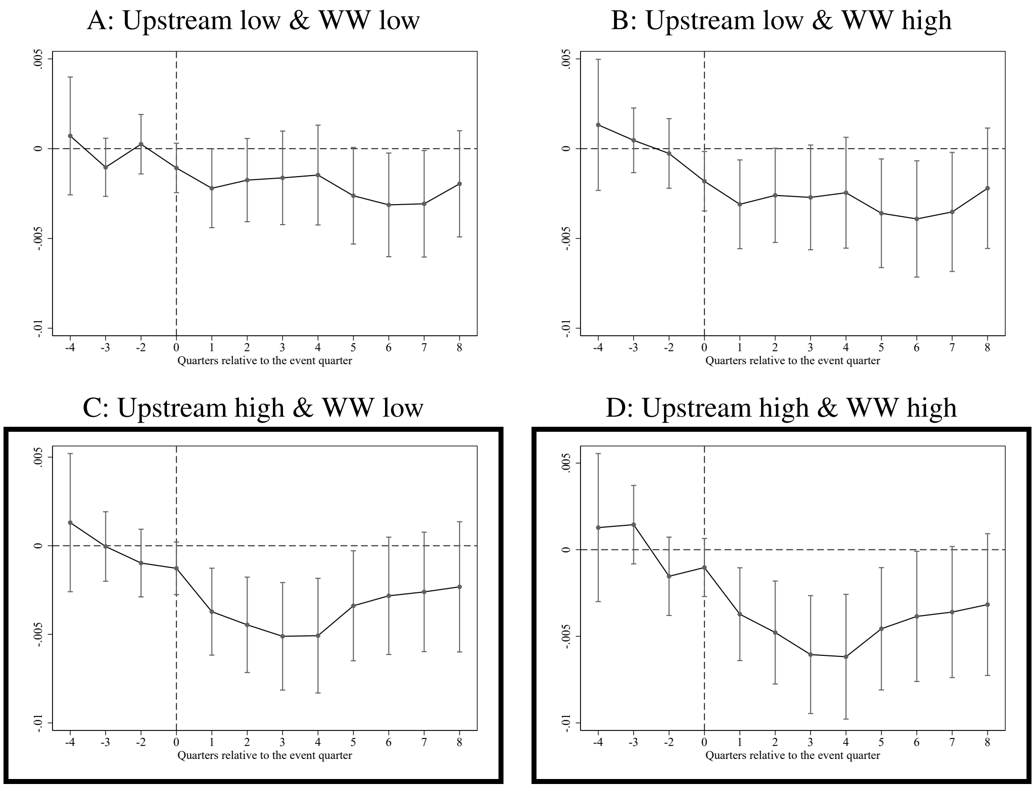
Figure A4 Upstream Distance and WW Index



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g\in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the upstream distance to the RE sector and the WW index (Whited and Wu 2006) and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.

Figure A5 Upstream Distance and SA Index

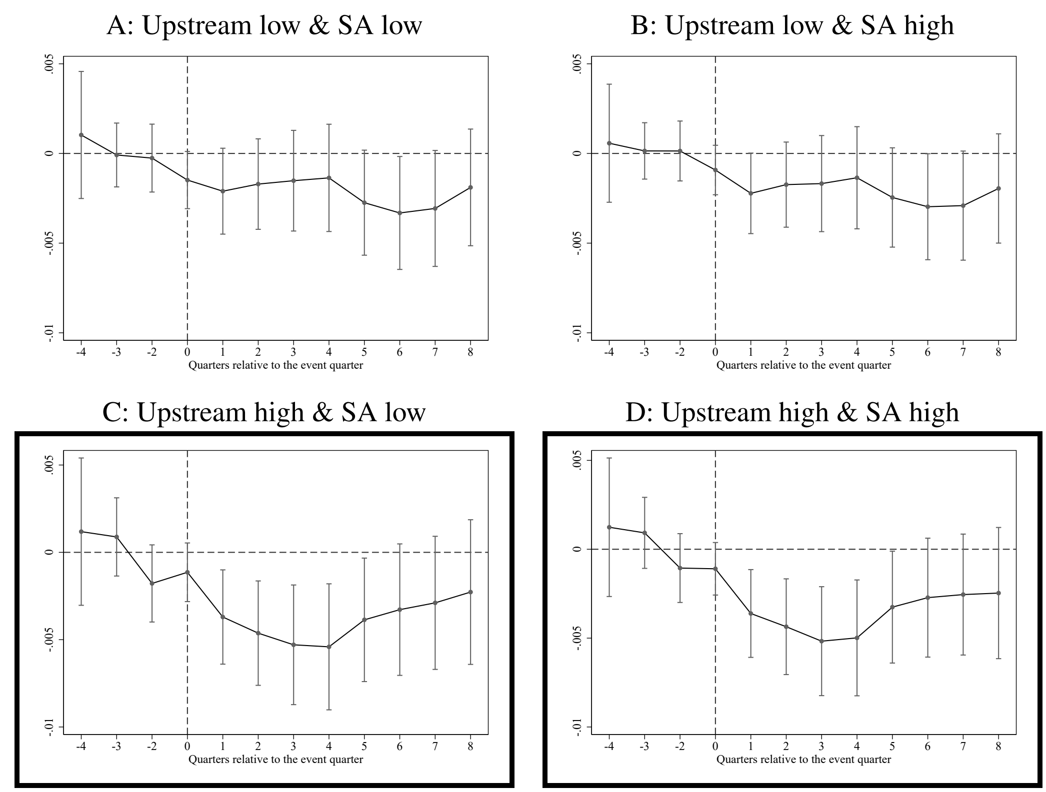


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Figure A6 Downstream Distance and WW Index

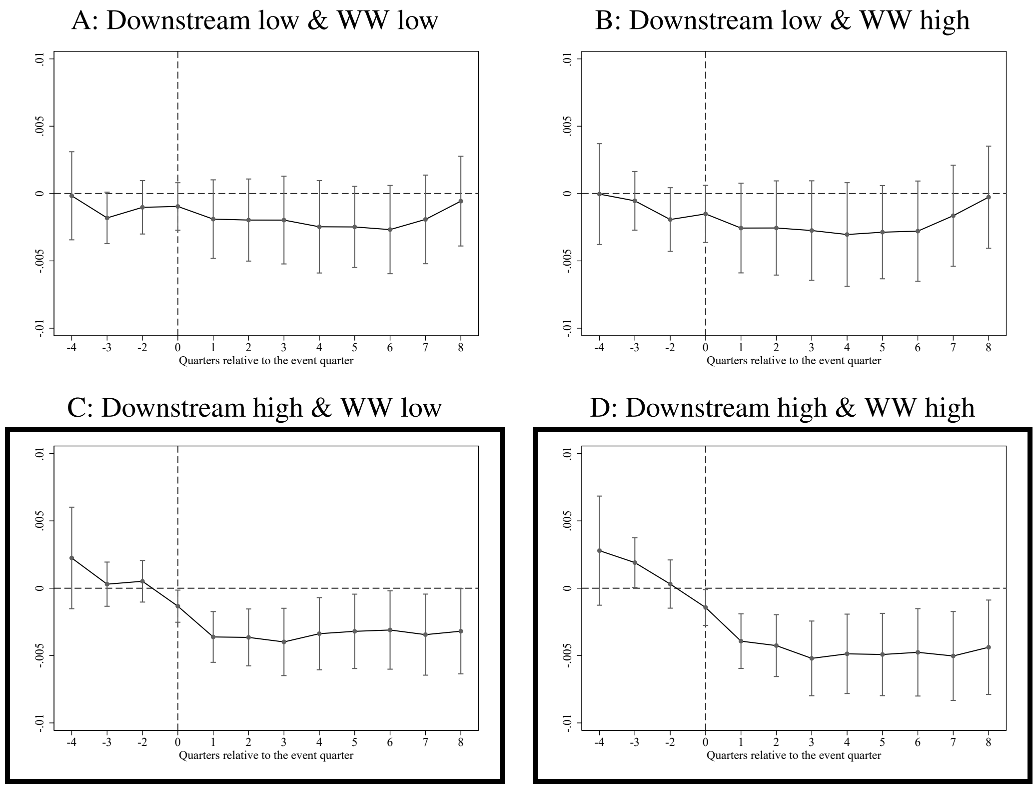

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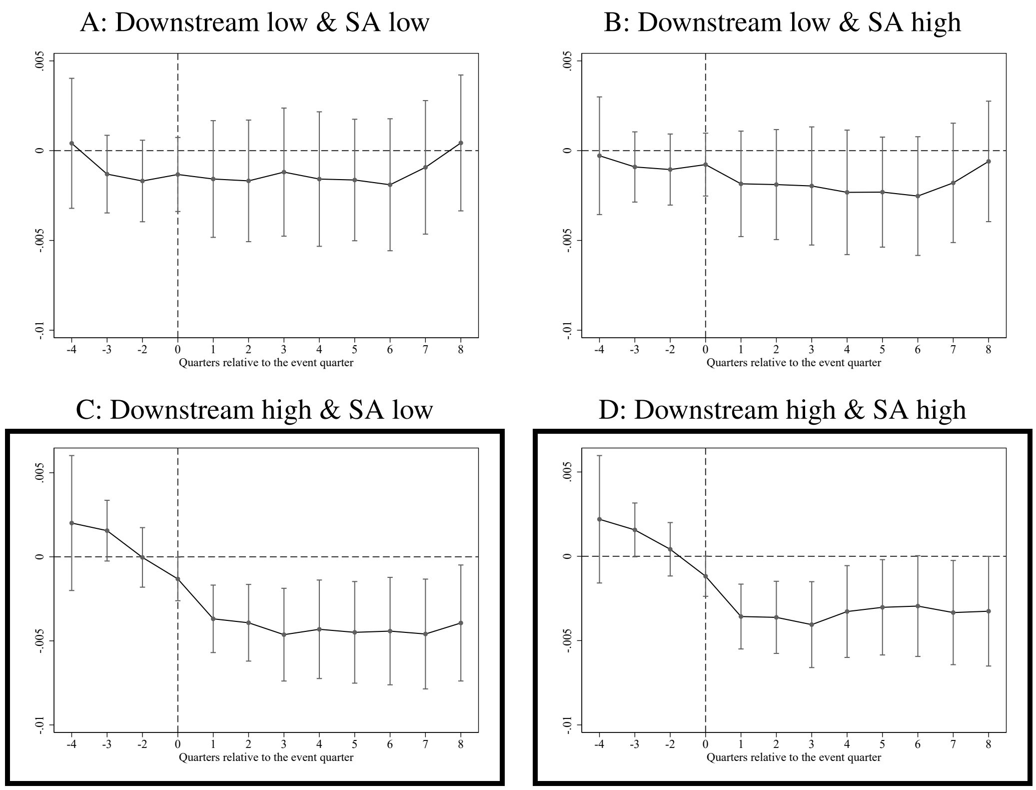
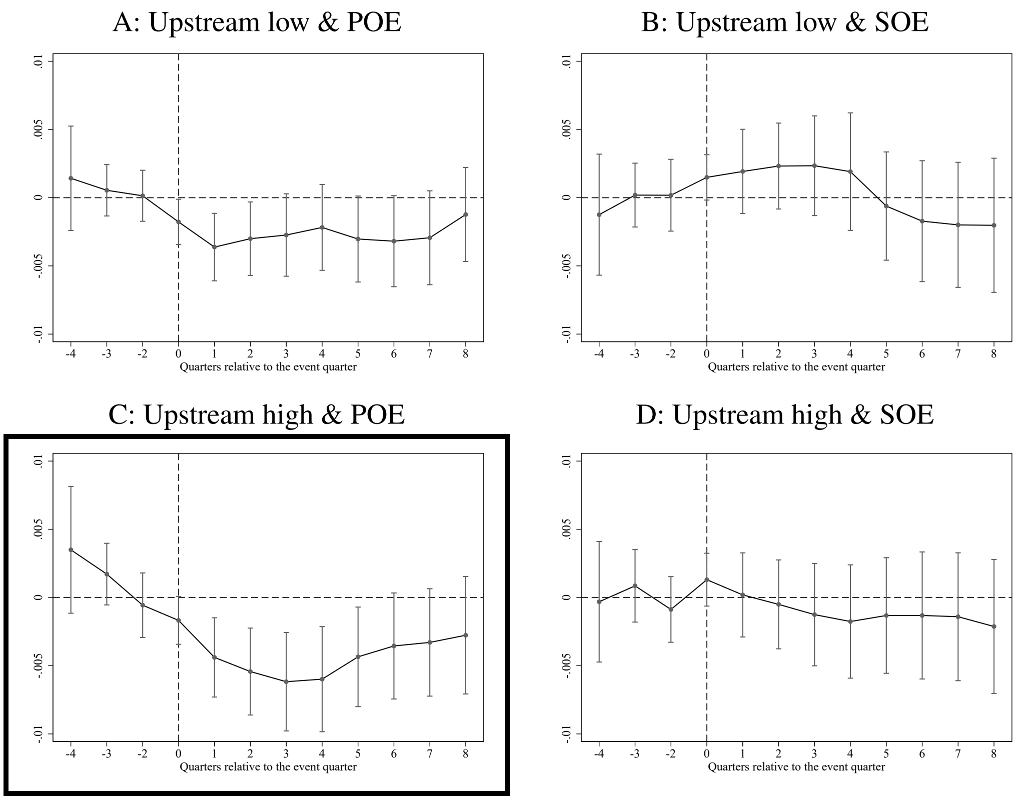
Figure A7 Downstream Distance and SA Index



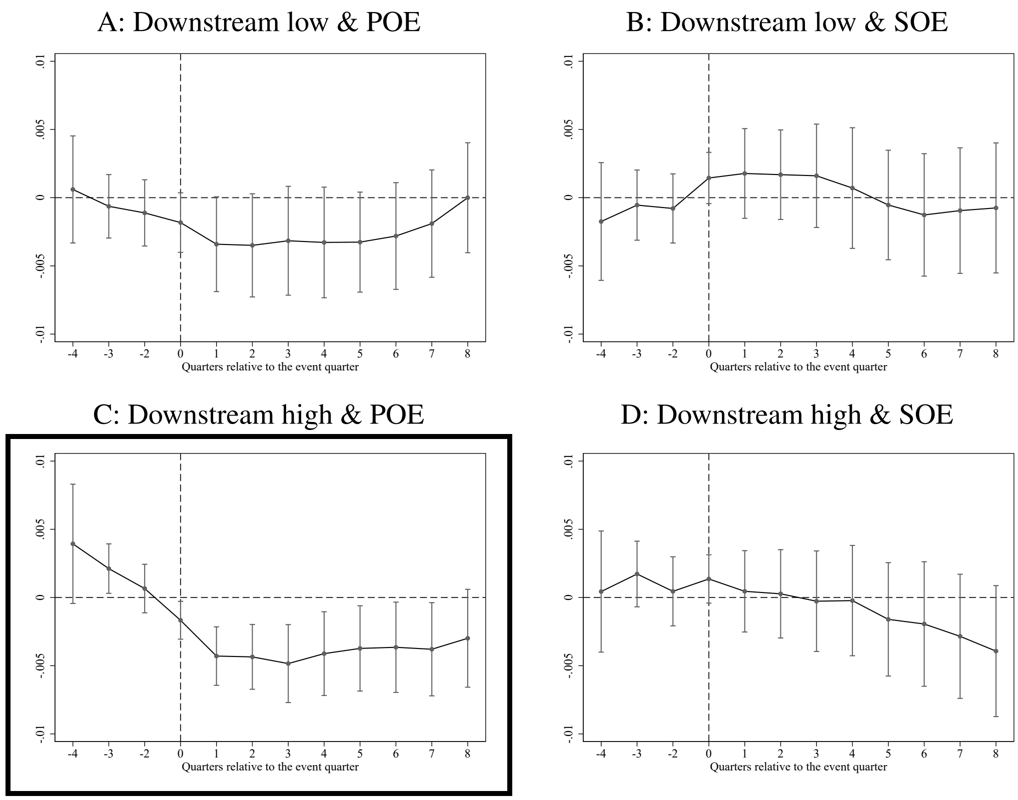
NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G} \right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the downstream distance to the RE sector and the SA index (Hadlock and Pierce 2010) and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.

Figure A8 Upstream Distance and Ownership



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G} \right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the upstream distance to the RE sector and the ownership structure and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.

Figure A9 Downstream Distance and Ownership



NOTE. This figure estimates the difference-in-differences equation $I_{it} = \alpha + \sum_{s=-4}^{8} \left(\sum_g \beta_s^g 1_{g \in G}\right) * \text{Expo}_i * 1_{t+s} + \Gamma Z_{it} + \varepsilon_{it}$ based on different firm groups. Panel A to D group firms based on the downstream distance to the RE sector and the ownership structure and display the coefficients $\{\beta_s^g\}_{-4}^{8}$ along with the 95 c.i. respectively.