

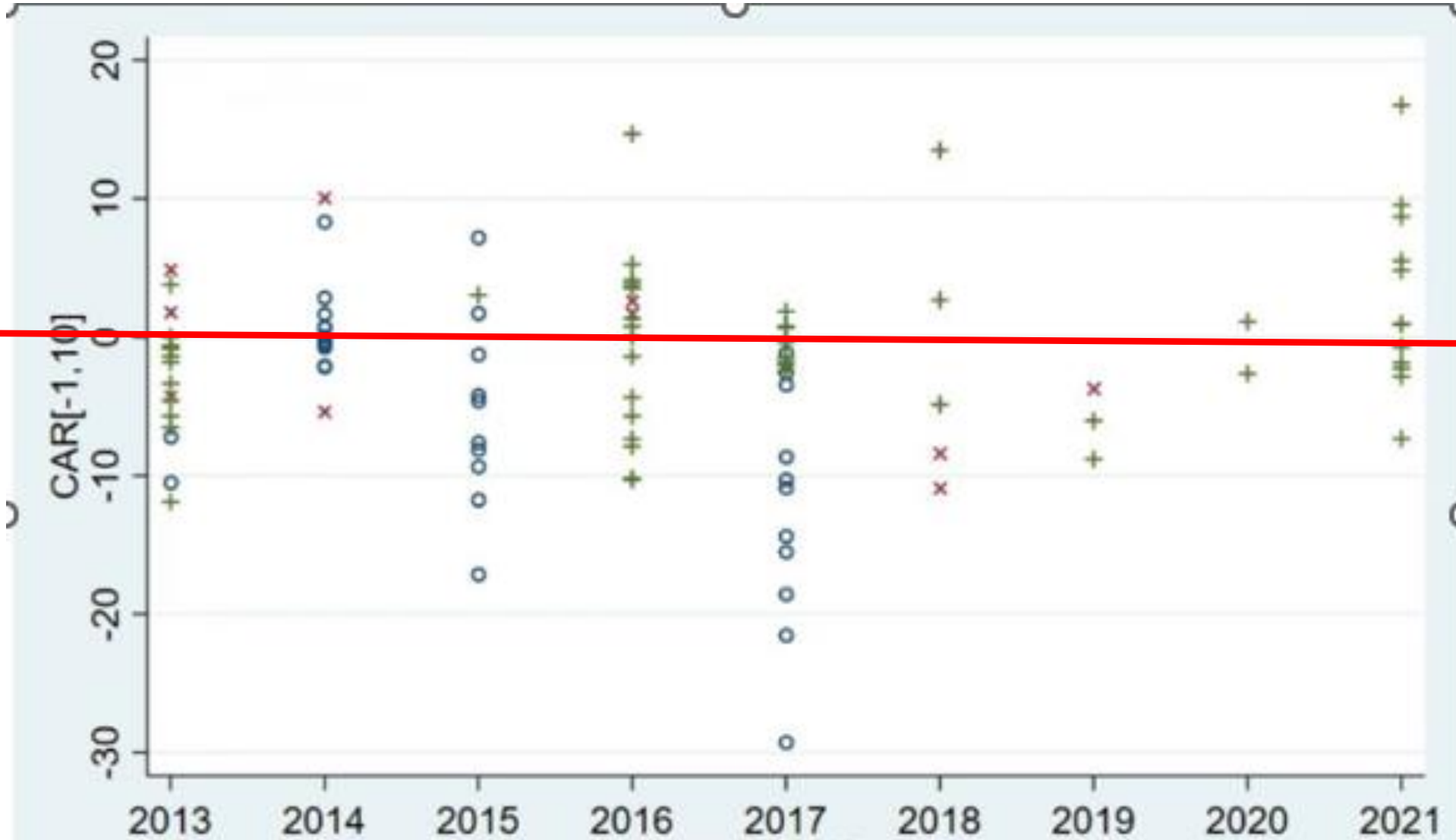
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# **Assessing the Cost of Errors in Antitrust Enforcement: Theory and Empirical Evidence**

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Motivation: Why do firms' stock price (CAR) go up or down after receiving punishments?



# Motivation: the announced law standard should be in consistent with the standard enforced.

Authority announcing the standards and firms acting accordingly

Expecting punishment according to the announced (expected) standards

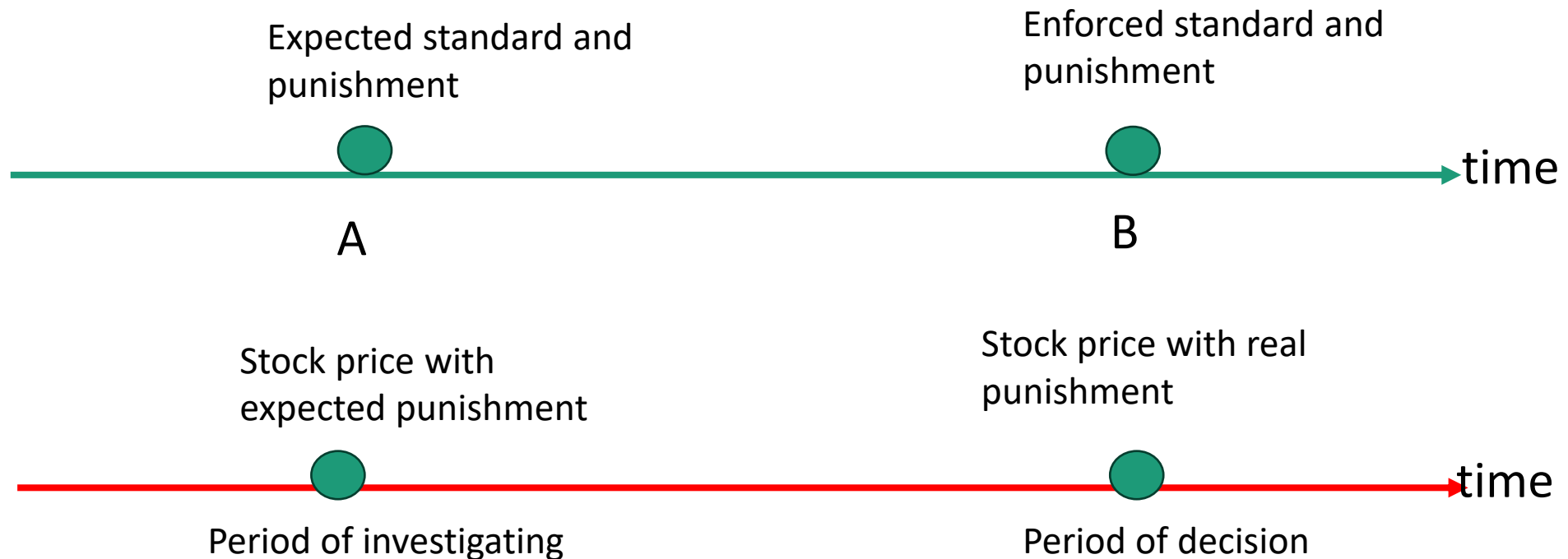
Real standard enforced and punishment



$$\frac{\partial C(|E\bar{\tau} - \bar{\tau}|)}{\partial |E\bar{\tau} - \bar{\tau}|} > 0$$

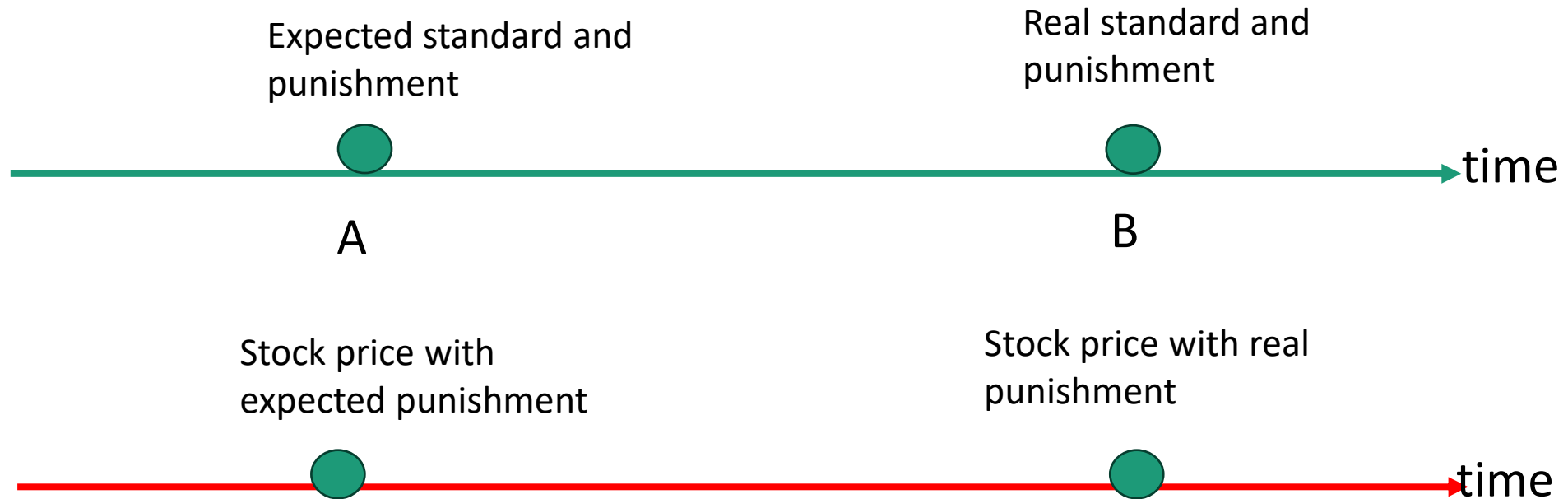
# Motivation: what can we learn from the stock price fluctuations?

$$P_A - P_B \leftrightarrow f(E\bar{\tau}) - f(\bar{\tau})$$



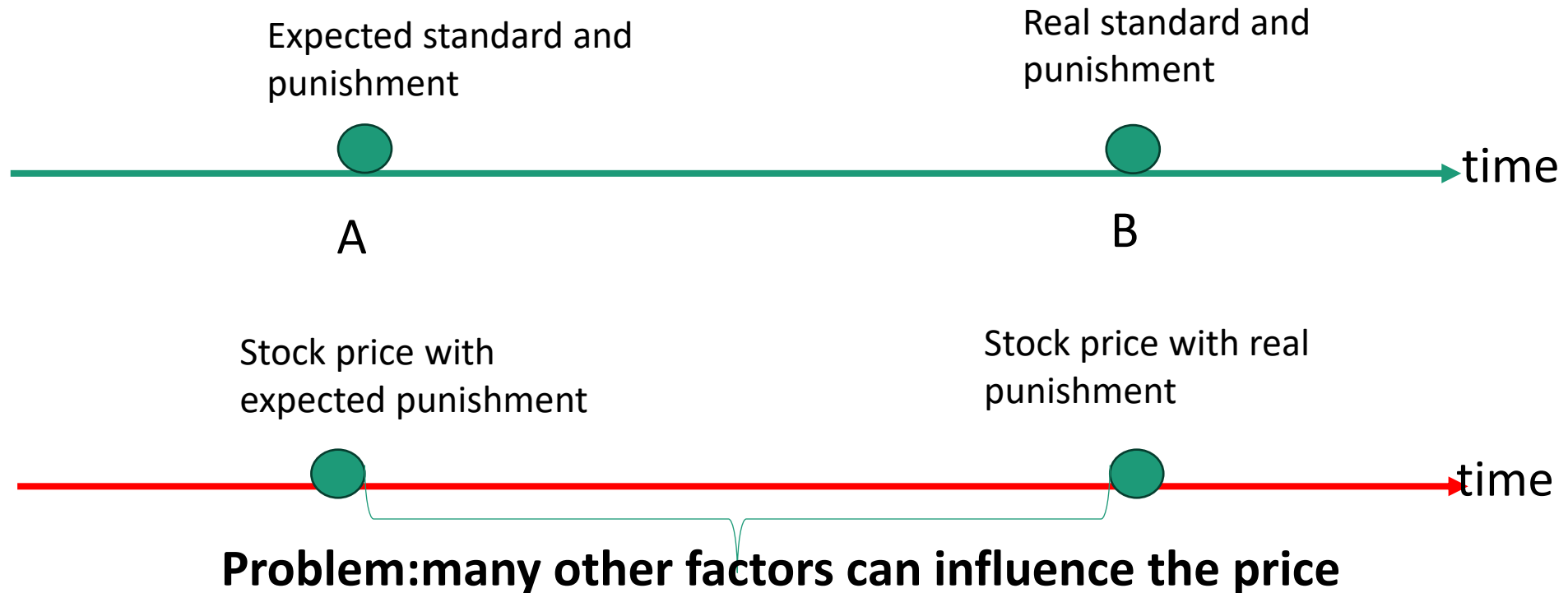
# Motivation: what can we learn from the stock price fluctuations? (continued)

- $P_A - P_B \leftrightarrow f(E\bar{\tau}) - f(\bar{\tau}) \quad \frac{\partial C(|E\bar{\tau} - \bar{\tau}|)}{\partial |P_A - P_B|} \rightarrow \frac{\partial C(|E\bar{\tau} - \bar{\tau}|)}{\partial |E\bar{\tau} - \bar{\tau}|}$



# Motivation: what can we learn from the stock price fluctuation? (continued)

$$\frac{\partial C(|E\bar{\tau} - \bar{\tau}|)}{\partial |P_A - P_B|} \rightarrow \frac{\partial C(|E\bar{\tau} - \bar{\tau}|)}{\partial |E\bar{\tau} - \bar{\tau}|}$$



## What we find:

- Economic analysis can be an instrument to signal the intensity of punishment.
- Furthermore, by observing the impact of stock price fluctuations on antitrust penalties, we can compare the error costs of antitrust enforcement.

# Literature Review

- Positive false or negative false are inevitable(Easterbrook, 1984).
- Decision errors and stock price.(Bosch and Eckard, Duso et al. 2003; 1991;Aguzzoni et al. 2013)
- More than 75% of the market value losses resulting from antitrust penalties cannot be explained by fines and legal expenses.(Bosch and Eckard ,1991; Günster and van Dijk ,2016)
- What is the proper way to measure the punishments and then error costs?



# Model

- The probability of a firm  $j$ 's action causing monopolistic harm is  $p_j$ , and the efficiency rate is  $1 - p_j$ .
- Welfare loss when this action is monopolistic is  $D_S$ , and welfare increases by  $\pi_E$  when efficient.
- The action is deemed illegal if :
- $(1 - p_j)\pi_E < p_j D_S$
- i.e., the action is illegal if:
- $p_j > \tau^* = \frac{\pi_E}{D_S + \pi_E}$

The punishment is :  $f(p_j - \tau^*), \frac{\partial f(p_j - \tau^*)}{\partial p_j} > 0$

# Adjudication Standard and Error Cost under Conditions of Incomplete Information

- Due to incomplete information, the enforcer can only get estimated values of  $\pi_E$  and  $D_S$ , denoted as  $\bar{\pi}_E$  and  $\bar{D}_S$ . Then the action is deemed illegal if :
- $p_j > \bar{\tau} = \frac{\bar{\pi}_E}{\bar{D}_S + \bar{\pi}_E}$
- let a random variable  $\varepsilon = \tau^* - \bar{\tau}$ , and  $\varepsilon$  follows the cumulative distribution function  $G$ .
- When the action is illegal based on  $p_j > \bar{\tau}$ , the probability that this decision is correct is:
- $P(\tau^* < p_j) = P(\varepsilon < p_j - \bar{\tau}) = G(p_j - \bar{\tau})$

- The total error cost is:

- $C(\bar{\tau}) = GC(\bar{\tau}|\bar{\tau} = \tau^*) + (1 - G)[\int_{\tau^*}^{\bar{\tau}} (1 - p_j)\pi_E dp_j + \int_{\bar{\tau}}^{\tau^*} p_j D_s dp_j]$

- Increasing the economic analysis evidence  $I$  can improve the probability of correct judgment and decreasing error cost, but requires an increase in cost  $C_I$ . The total enforcement cost, including the cost of economic analysis and error cost, is:

- $C = GC(\bar{\tau}|\bar{\tau} = \tau^*) + (1 - G)\Delta C + C_I$

- Where  $\Delta C \equiv \int_{\tau^*}^{\bar{\tau}} (1 - p_j)\pi_E dp_j + \int_{\bar{\tau}}^{\tau^*} p_j D_s dp_j > 0$ ,  $\frac{\partial G}{\partial I} > 0$ ,  $\frac{\partial^2 G}{\partial I^2} < 0$ ,  $\frac{\partial C_I}{\partial I} > 0$ ,  $\frac{\partial^2 C_I}{\partial I^2} > 0$ .

- The first-order condition of minimizing C is:

- $$-\frac{\partial G}{\partial I} \Delta C + \frac{\partial C_I}{\partial I} = 0$$

- Deriving both side with respect to I, we know that:

- 

- $$\frac{\partial p_j}{\partial I} = \left( -\frac{1}{\Delta C} \frac{\partial^2 C_I}{\partial I^2} - \frac{\partial^2 G}{\partial I^2} \right) / \frac{\partial^2 G}{\partial I \partial p_j} < 0$$

- **Proposition 1:** Given the harmful probability of a certain action  $p_j$ , the quantity of economic analysis evidence  $I$  employed by the enforcer during judgement is inversely proportional to  $p_j$ .
- For  $p_j > \bar{\tau}$ , the enforcement agency determines it to be illegal and imposes a penalty  $f(p_j - \bar{\tau})$ ,  $\frac{\partial f(p_j - \bar{\tau})}{\partial p_j} > 0$ .
- Since  $p_j$  and  $\bar{\tau}$  are all difficult to observe, we could use  $I$  as a substitute for  $p_j$ .

## 2. Transmission Bias in Enforcement Standards and Error Costs

- One important duty of enforcers is to "communicate" the enforcement standard  $\bar{\tau}$  and the corresponding penalty  $f(p_j - \bar{\tau})$  as well as  $\varepsilon$  to market participants.
- **Proposition 2:** The greater the transmission bias, the higher the error costs.
- Given  $\varepsilon \in (-\varepsilon_0, +\varepsilon_0)$ , the cost without transmission bias is:
  - $C(\varepsilon_0) = \int_{\tau^* - \varepsilon_0}^{\tau^*} (1 - p_j)\pi_E d\bar{\tau} + \int_{\tau^*}^{\tau^* + \varepsilon_0} p_j D_s d\bar{\tau}$
  - The cost with bias of  $\varepsilon_1 > \varepsilon_0 > 0$  is:
    - $C(\varepsilon_1) = C(\varepsilon_0) + \int_{\tau^* + \varepsilon_0}^{\tau^* + \varepsilon_1} p_j D_s d\bar{\tau} > C(\varepsilon_0)$
    - The cost with bias of  $\varepsilon_0 > \varepsilon_2 > 0$  is:
      - $C(\varepsilon_2) = \int_{\tau^* - \varepsilon_0}^{\tau^* - \varepsilon_2} p_j D_s d\bar{\tau} + \int_{\tau^* - \varepsilon_2}^{\tau^*} (1 - p_j)\pi_E d\bar{\tau} + \int_{\tau^*}^{\tau^* + \varepsilon_2} p_j D_s d\bar{\tau} + \int_{\tau^* + \varepsilon_2}^{\tau^* + \varepsilon_0} (1 - p_j)\pi_E d\bar{\tau} > C(\varepsilon_0)$

### 3. Stock Price Fluctuations and Enforcement Bias Identification

- We divide the antitrust decision into stages of :

- Investigation  $\pi_1 = V_1 - f(E\bar{\tau})$

- Punishment:  $\pi_2 = V_2 - f(\bar{\tau})$

- The market observes that the change in valuation for the firm after the punishment is:

- $\pi_2 - \pi_1 = V_2 - V_1 + f(E\bar{\tau}) - f(\bar{\tau})$

Deriving both side with respect to I:

- $\frac{\partial(\pi_2 - \pi_1)}{\partial I} = -\frac{\partial f(\bar{\tau})}{\partial p_j} \frac{\partial p_j}{\partial I} > 0$

- Thus, we arrive at Proposition 3:
- **Proposition 3:** After the announcement of an antitrust ruling, if stock price changes are related to the strength of economic analysis, it can be inferred that the corresponding stock price fluctuations are a response to antitrust rulings. The greater the fluctuation in the stock price, the higher the cost of errors.



# • Econometric Model and Empirical Results

- The regression model is as follows:
- $CAR_i = \alpha_0 + \alpha_1 score_i + \alpha_2 ctrl_i + \sigma_{ind} + \delta_{ctry} + \tau_{year} + \varepsilon_i$
- Here,  $CAR_i$  is calculated based on the event study method, with the penalty date in the judgment document as the event date. This paper mainly uses the market model (**CAPM**) to calculate abnormal returns.
- $r_{it} = \beta_{0i} + \beta_{1i}rm_t + \varepsilon_{it}$
- $AR_{it} = r_{it} - \widehat{\beta}_{0i} - \widehat{\beta}_{1i}rm_t$

Table 1: Classification and Scoring of Economic Analysis in Antitrust Judgment Documents

Economic Analysis Type	Content	Feature Description	Score
A	Discussion of the nature and characteristics of illegal conduct	This analysis is required in all cases, so a score of 0 is not discussed	0/1
B	Market Analysis	Review	0/1
B.1	Analyzing market characteristics based on existing information	This is a necessary economic analysis for antitrust authorities, typically involving information on industry structure, firm structure, market demand structure, and firm market share.	
Or B.2	Formal market segmentation and market share determination	Based on more complex economic tests (such as market share index calculations, demand substitutability analysis, etc.)	
C	Evidence of restricting competition / causing harm	Review	0/1

Table 2: Utilization of Economic Analysis in Judgments for Different Monopolistic Behaviors

Type of Behavior	Economic Analysis Score						Sum
	1	2	3	4	5	6	
Total Horizontal Price Monopoly Agreements	20	21	6	11	0	0	58
Vertical Price Monopoly Agreements	7	1	1	2	0	1	12
Abuse of Market Dominance	0	12	11	17	3	1	44

Table 3: Descriptive Statistics of Variables

Variable Name	Variable Definition	Mean	Standard Deviation	Minimum	Maximum
CAR[-1,5] (%)	Cumulative Abnormal Returns from -1 to 5 trading days	-1.72	4.78	-26.17	9.43
CAR[-1,10] (%)	Cumulative Abnormal Returns from -1 to 10 trading days	-2.36	7.24	-29.26	16.75
Economic Analysis Score	Quantified score for economic analysis intensity	2.25	1.31	1	5
Weak Economic Analysis	=1, economic analysis score below 2; =0, others	0.58	0.50	0	1
Fine (CNY billions)	Fine amount (logarithm)	6.17	3.32	0	14.42

Table 4: Impact of Economic Analysis Intensity on Cumulative Excess Returns

Variable	(1) CAR[-1,5]	(2) CAR[-1,10]	(3) CAR[-10,-5]
Economic Analysis Score	1.545*** (0.560)	2.261*** (0.801)	0.732 (0.639)
Fine Logarithm	-0.0758 (0.223)	-0.399 (0.319)	-0.224 (0.255)
Central SOE	-3.061 (2.112)	-6.544** (3.021)	1.142 (2.408)
Local SOE	0.508 (3.183)	-2.665 (4.555)	3.170 (3.630)

## (2) Identification of the Cost of Errors in China's Antitrust Enforcement

- 1. Comparison of Antitrust Enforcement Costs before and after 2018 In 2018

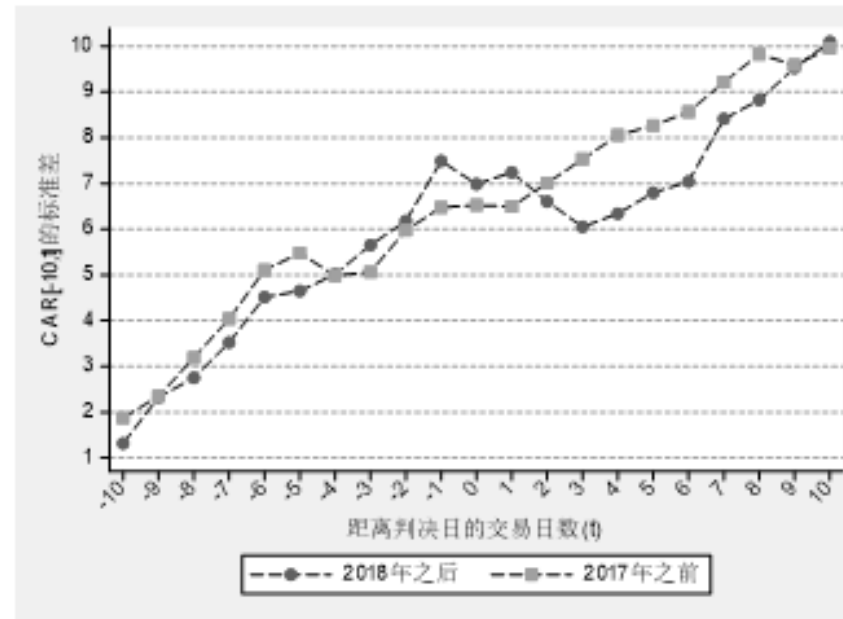
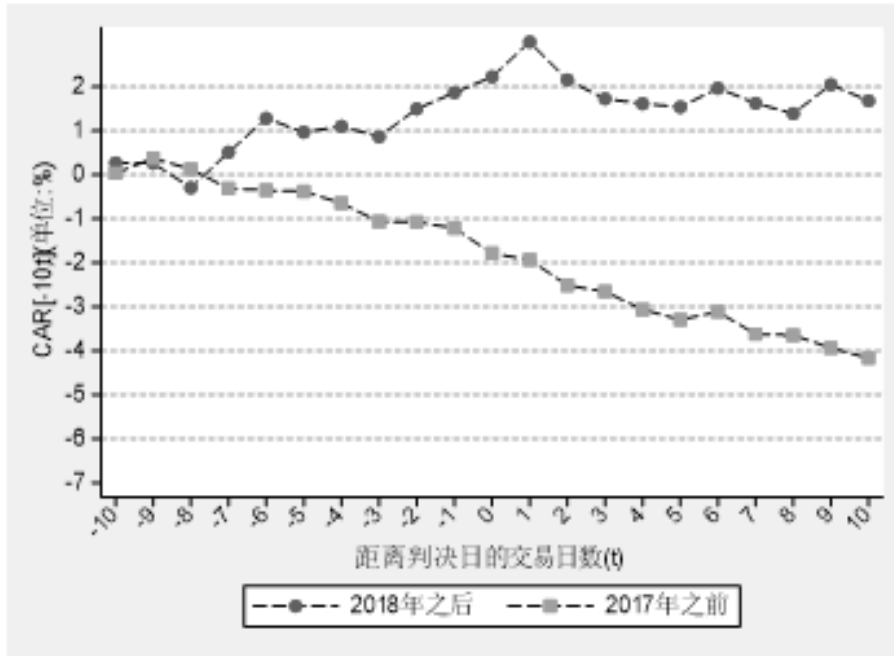
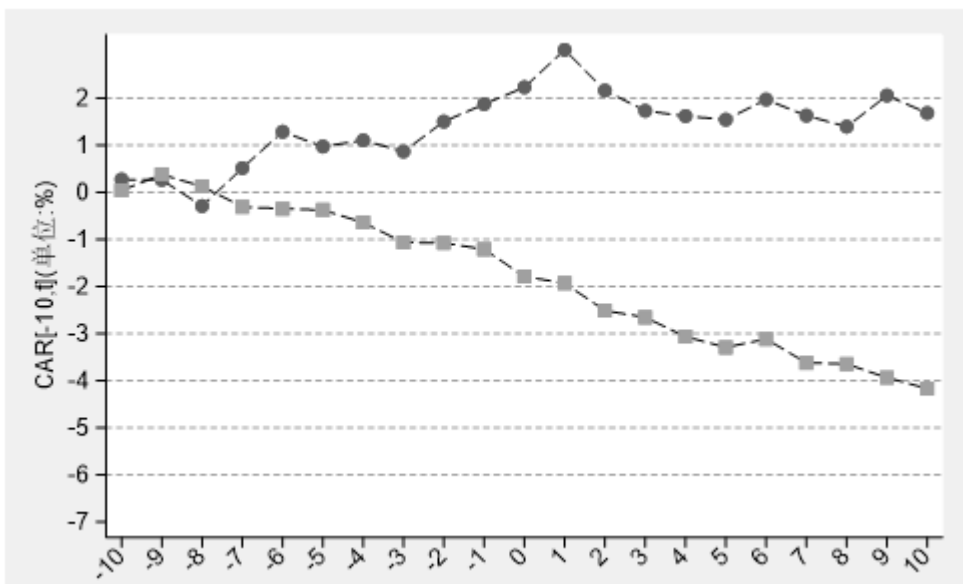


Figure 3: Mean and standard deviation of market reactions in different periods: The left chart shows the mean of cumulative market reactions (CAR[-10,t]) from the -10th day to the tth day in the corresponding group, and the right chart shows the standard deviation of cumulative market reactions (CAR[-10,t]) from the -10th day to the tth day in the corresponding group.

Table 5: CAR[-10,10] mean t-test by time grouping (H0: mean=0)



	obs	Mean	Std. Err	t value
Post-2018	22	.18	1.55	.12
Pre-2017	77	-3.09	.81	-3.82

The average and variance of stock price fluctuations for horizontal, vertical, and abuse of market dominance behaviors.

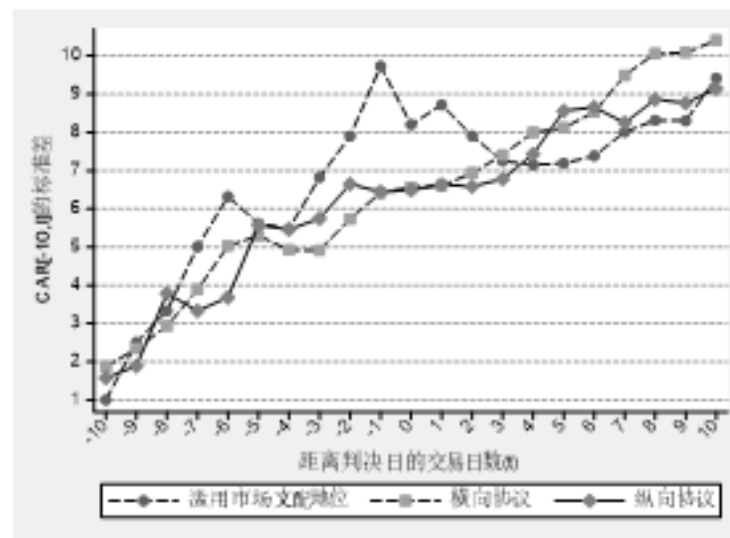
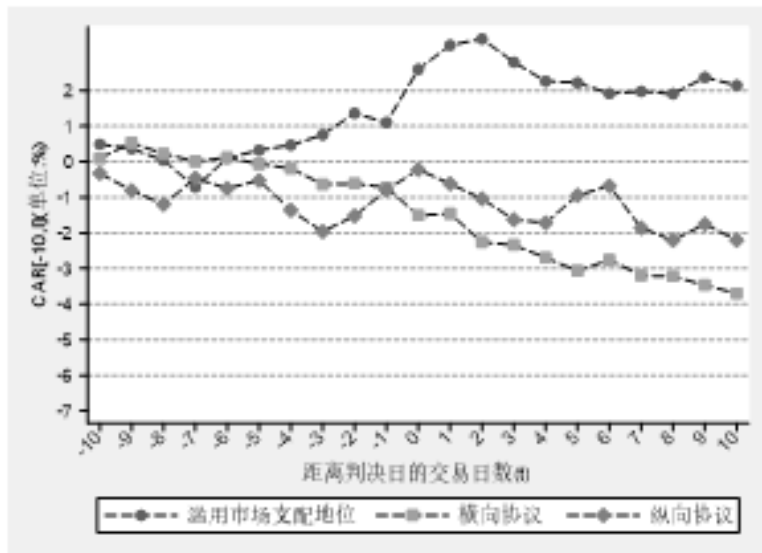
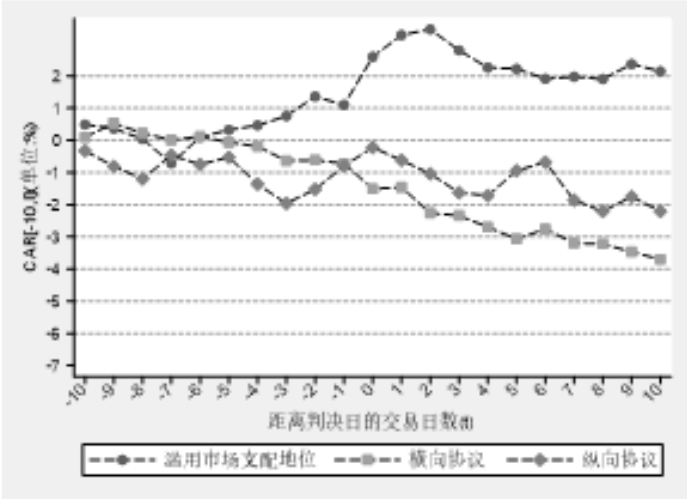


Figure 4: Mean and standard deviation of market reactions for different types of monopolies: The left chart shows the mean of cumulative market reactions ( $CAR[-10,t]$ ) from the -10th day to the  $t$ th day in the corresponding group, and the right chart shows the standard deviation of cumulative market reactions ( $CAR[-10,t]$ ) from the -10th day to the  $t$ th day in the corresponding group.



The average and variance of stock price fluctuations for horizontal, vertical, and abuse of market dominance behaviors.



**Table 6:** CAR[-10,10] mean t-test by monopoly type grouping (H0: mean=0)

	obs	Mean	St Err	t value
Abuse of Market Dominance	11	.79	1.84	.43
Horizontal Agreements	76	-3.09	.86	-3.61
Vertical Agreements	12	-.69	1.76	-.39

## Concluding Remarks:

- Economic analysis can be an instrument to signal the intensity of punishment.
- Furthermore, by observing the impact of stock price fluctuations on antitrust penalties, we can compare the error costs of antitrust enforcement.

Thanks!