Dirty Air and Green Investments: The Impact of Pollution Information on Portfolio Allocations

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ABFER - Sustainable and Green Finance
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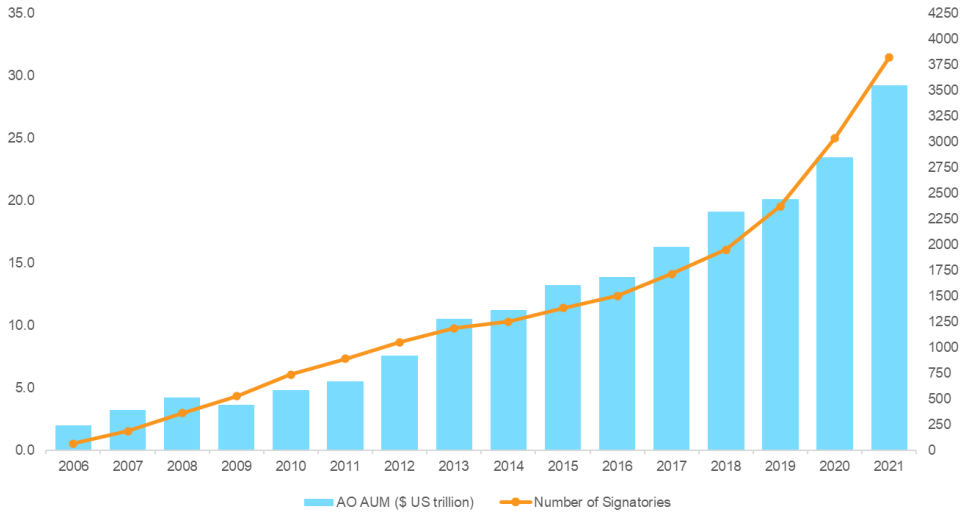
The Rise of ESG Investment



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  - Pastor *et al.* (2023) find that retail investors picked up the "brown" slack left behind by large institutional investors
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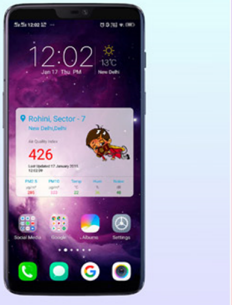
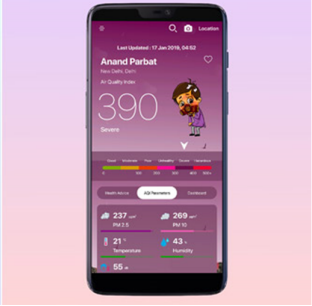
  - Pastor *et al.* (2023) find that retail investors picked up the "brown" slack left behind by large institutional investors
- Prior work suggests that exogenous shifts in climate conditions may increase demand for ESG investments and environmental amenities more generally (e.g., Choi *et al.* (2020))
  - ESG investing has, potentially, some public goods elements – what interventions might increase investor engagement with ESG?

Pollution Salience and ESG Investment

- If concerning environmental conditions impact ESG investment:
  - We conjecture that making these conditions more salient is a potential intervention for increasing ESG engagement (and environmental engagement more generally)

Making Pollution Salient: Real-time Air Quality Information





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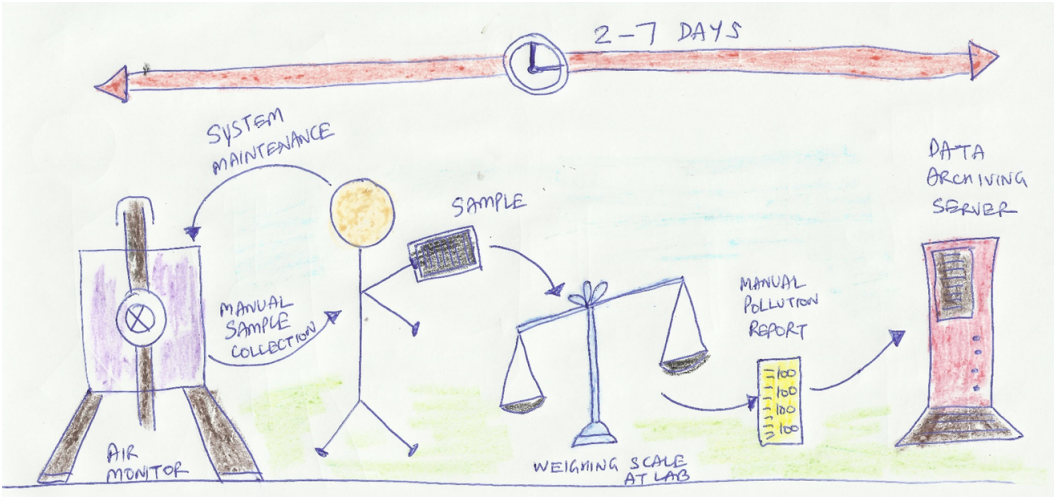
A Brief History of Air Quality Monitoring

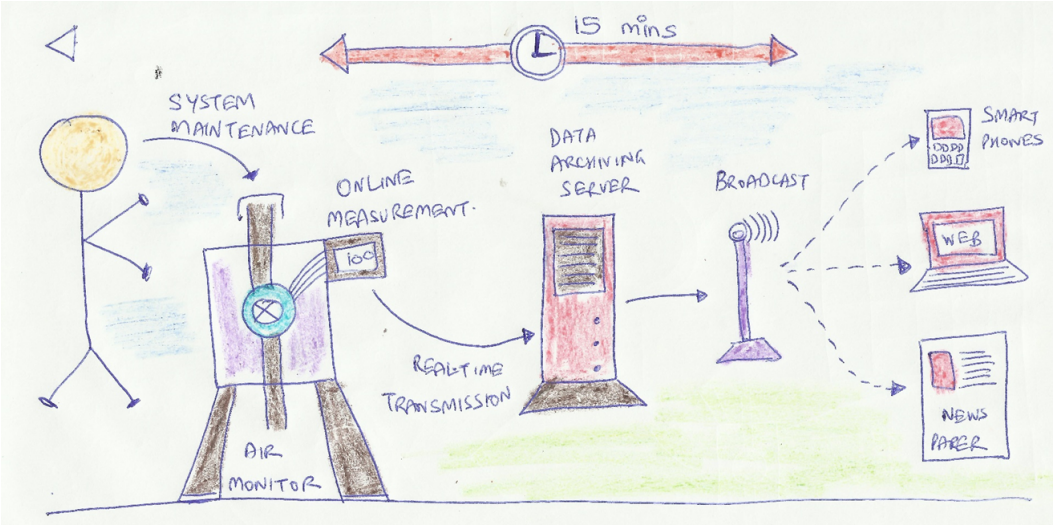
- **1985** – manual air quality monitoring rolled out nationally
  - Time lag in data collection (which made information of limited use to public)
  - Data collected were of questionable quality
  - Information hard to access
- **2006** – CAAQMS pilot in Delhi
- **2016** – Rollout accelerated

Manual Data Collection



Credit: Urbanemissions.info

Continuous Ambient Air Quality Monitoring



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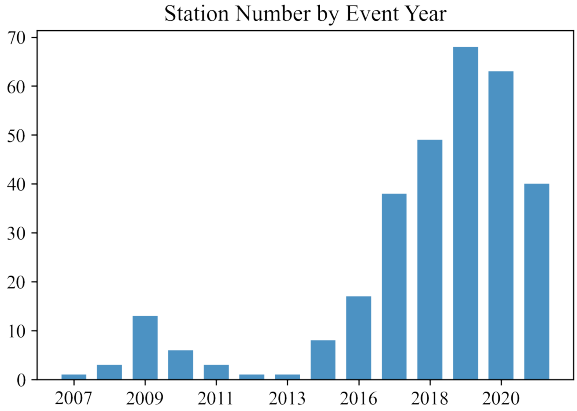
The Rollout of CAAQMS



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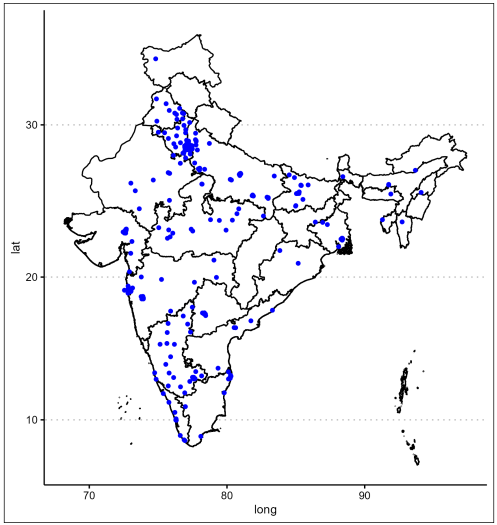
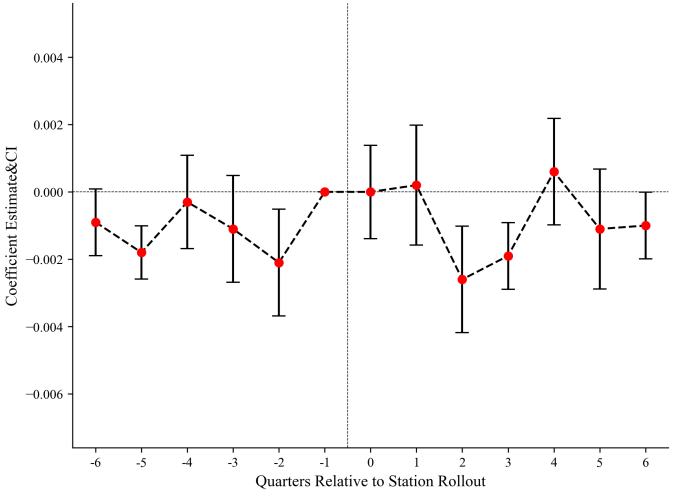


On the Non-exogeneity of CAAQMS Location

- Naturally, more densely populated and polluted locales were first to get monitoring stations
- We argue that:
  - Within a narrow geography there are plausibly random factors – availability of land, obstructions, cost, etc.
  - More importantly, timing is exogenous to the concerns of any particular investor group

Pollution Around Station Rollout



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Air Quality Monitoring

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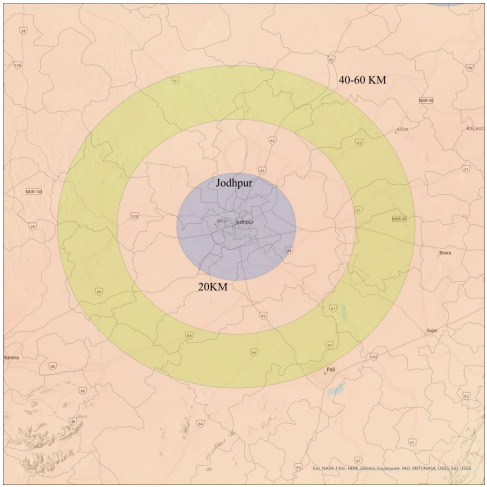
- We assign a PIN Code as in the "treatment" group if its centroid is within 20 km of a monitoring station, and in the "control" group if its centroid is in the 40 – 60 km "donut" around the station

Treatment vs Control



Trader Portfolio Data

- All transactions from India's National Stock Exchange (second-largest in India; ninth in the world), 2004-2020, a total of 19 million investors.
- Notably, transaction data include:
  - Location (PIN code)
  - Platform (web, mobile, or "traditional")
- Trader information include:
  - Stock of portfolio (On the NSE)
  - Type of investor (institutional vs retail)
  - Age and gender

Constructing Green-share Portfolios

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- What is a "dirty" stock? Examples

ICB code	DataStream industry name	IPCC category code	IPCC industry name
Energy			
1771	Coal	1A2f4	Mining and quarrying
7535	Con. Electricity	1A1a	Power and Heat Generation
0533	Exploration & Prod.	1B2	Flaring and fugitive emissions from oil and Natural Gas
7573	Gas Distribution	1A3e, 1B2	Non-road transport (fossil), Flaring and fugitive emissions from oil and Natural Gas
0537	Integrated Oil & Gas	1A1bc	Other Energy Industries
0573	Oil Equip. & Services	1A1bc	Other Energy Industries
Transport			
5751	Airlines	1A3a, 1C1	Domestic air transport, International aviation
2773	Marine Transportation	1A3d, 1C2	Inland shipping (fossil), International navigation
2775	Railroads	1A3c	Rail transport
2777	Transport Services	1A2f2, 1A3b	Transport equipment, Road transport (includes evaporation) (fossil)
2779	Trucking	1A3b	Road transport (includes evaporation) (fossil)

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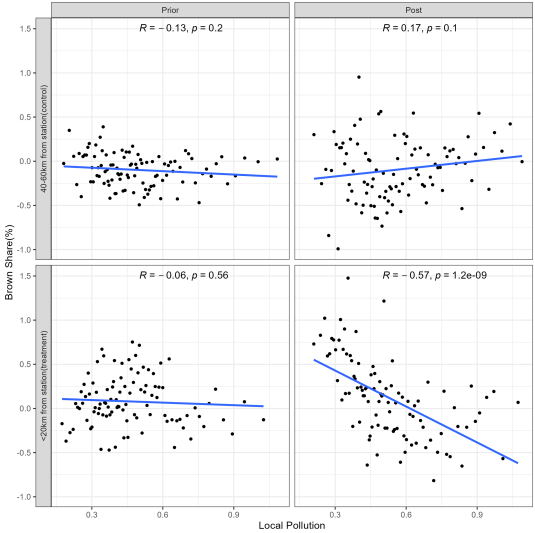
- The natural challenge is we need a consistent measure of pollution after as well as *before* monitoring stations appear
- We use satellite data on aerosol optical depth to measure pollution for a 10 x 10 km grid, assigning a PIN code to the location where its centroid is located
- We aggregate to the monthly level (corresponding to our trading data aggregation)

Main Result – Correlation

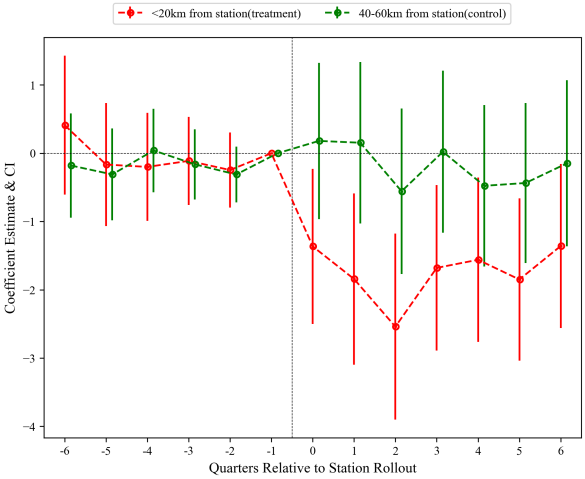


Empirical Specification

$$\begin{aligned} \textit{Brown Share}_{p,c,t} &= \beta \times \textit{Treat}_p \times \textit{Pollution}_{p,t} \times \textit{Post}_{c,t} + \sum_k \alpha_k \times \textit{Other Interactions} \\ &\quad + X'_{p,t}\theta + \gamma_{p,c} + \lambda_{c,t} + \varepsilon_{p,c,t} \end{aligned}$$

- Some notes:
  - Fixed effects for PIN Code, station x time (and in some specifications, PIN Code x time)
  - β captures differential response of "treated" PIN Codes to AQI information after (versus before) a station opens

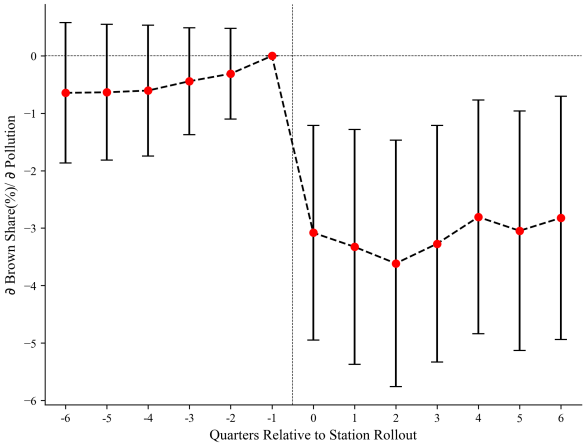
Main Result – Treatment vis-a-vis Control



Main Result

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dep. Var. = Brown Share(%)							
Pollution×Treated×Post	-1.5319**	-2.1017**	-1.7251*	-2.5007***	-1.3634*	-2.0087**	-1.5687	-2.4050**
	(0.7715)	(0.8397)	(0.9762)	(0.9617)	(0.7675)	(0.8365)	(0.9739)	(0.9607)
Lower Order Interactions	Y	Y	Y	Y	Y	Y	Y	Y
Local Trading Controls(No. of Investors, Turnover)	N	N	N	N	Y	Y	Y	Y
Local Weather Controls(Rainfall, Temperature)	N	N	N	N	Y	Y	Y	Y
PIN Code	Y	Y	Y	Y	Y	Y	Y	Y
Year-month	Y				Y			
State×Year-month		Y				Y		
District×Year-Month			Y				Y	
Station×Year-month				Y				Y
Observations	499,036	499,036	488,681	498,310	499,036	499,036	488,681	498,310
R-squared	0.537	0.546	0.599	0.560	0.540	0.548	0.600	0.561

Main Result – Treatment Post



Interpreting the Results

- The relationship between pollution and brown share becomes more negative after a monitoring station appears (but not for non-treated PIN Codes)

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- The relationship between pollution and brown share becomes more negative after a monitoring station appears (but not for non-treated PIN Codes)
- A 0.27 increase in AOD (within-PIN-Code) $\rightarrow$ 0.65 percent decline in brown share (relative to base rate of 42 percent)

Shifts Around a Salient Threshold

- Moderate – those with pre-existing health problems should avoid extended outdoor exposure; no government alerts

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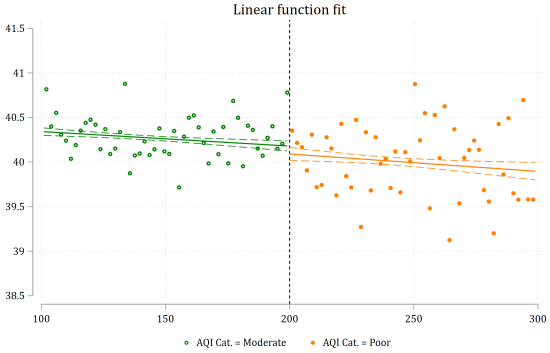
- Moderate – those with pre-existing health problems should avoid extended outdoor exposure; no government alerts
- Poor – outdoor exposure presents health risks for all; government alert

Main Result – Regression Discontinuity

(a) Treated PINCodes



(b) Control PINCodes

Robustness – Other Things Doesn't Change

	(1)	(2)	(3)	(4)
Panel A Local Economic Condition				
	Firm Entry		NightLight Density	
Treat×Post	-0.0208	-0.0399	-0.0943	0.1823
	(0.0420)	(0.0484)	(0.1462)	(0.1416)
Post	0.0983***		1.2520***	
	(0.0346)		(0.0851)	
Observations	32,278	31,904	100,429	100,222
R-squared	0.891	0.908	0.978	0.988
PIN Code	Y	Y	Y	Y
Year-month	Y		Y	
Station×Year-month		Y		Y

Robustness – Other Things Doesn't Change

	(1)	(2)	(3)	(4)
Panel B local investor composition				
	Investor Growth Rate(%)		Number of New Traders	
Treat×Post	-0.0174	0.0043	-0.0016	-0.0028
	(0.0398)	(0.0427)	(0.0095)	(0.0099)
Post	-0.1200***		0.0150***	
	(0.0292)		(0.0036)	
Observations	498,624	497,898	499,036	498,310
R-squared	0.129	0.165	0.954	0.957
PIN Code	Y	Y	Y	Y
Year-month	Y		Y	
Station×Year-month		Y		Y

Robustness – Removing Metropolitan

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dep. Var. = Brown Share(%)							
Pollution×Treated×Post	-2.1120**	-2.4027***	-2.2073**	-2.7009***	-1.9294**	-2.2359**	-2.0348*	-2.5553**
	(0.8453)	(0.8945)	(1.0572)	(1.0153)	(0.8392)	(0.8907)	(1.0551)	(1.0140)
Lower Order Interactions	Y	Y	Y	Y	Y	Y	Y	Y
Local Trading Controls(No. of Investors, Turnover)	N	N	N	N	Y	Y	Y	Y
Local Weather Controls(Rainfall, Temperature)	N	N	N	N	Y	Y	Y	Y
PIN Code	Y	Y	Y	Y	Y	Y	Y	Y
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Link to Earlier Works

- **Salience**
  - Conceptually, our work relates to past work on the importance of salience in driving investment and asset prices (Bordalo et al (2013, etc), Huberman and Regev (2001), Cosemans and Frehen (2021))
  - From a policy perspective: salience nudges (e.g., Thunström, 2019)

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- **"Environmental" preferences**
  - There are various papers that look at, e.g., higher local temperatures increasing belief in global warming (and willingness to donate to climate charities)
  - We tie more directly to work linking environmental concerns and ESG investment directly, suggesting in particular a role for salience

Preferences versus Beliefs

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- We cannot fully distinguish between the two but present some results that favor preference-based explanations

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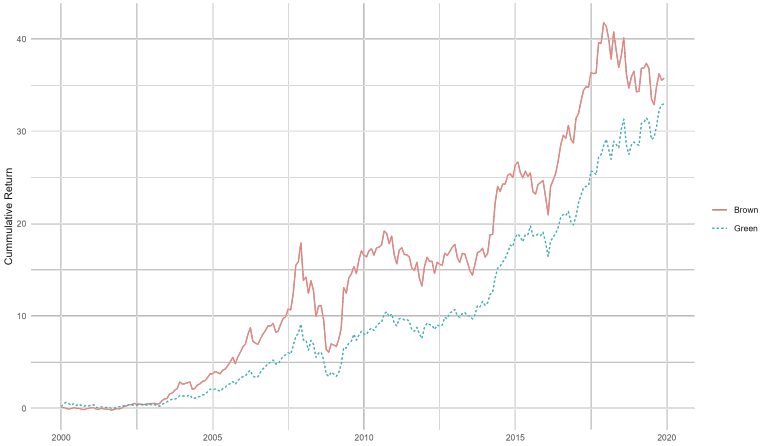
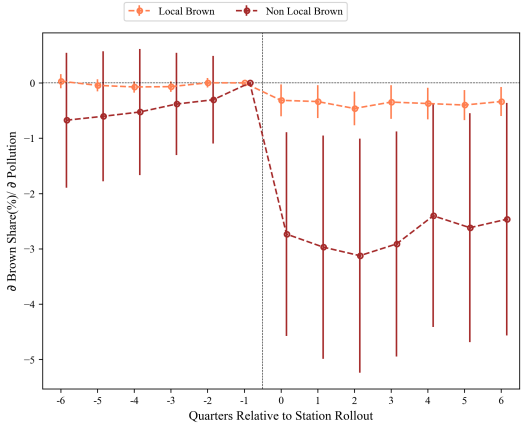
- Heterogeneity by investor type
  - Gender
  - Age
  - Technology

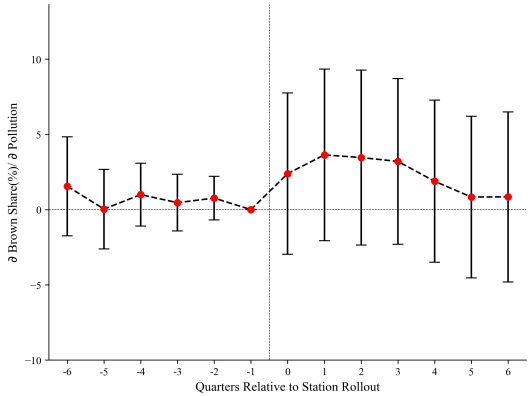
If Beliefs, Not Correct on Average



Expectation of Regulation Should be Strongest on Local Firms



Not Much Effect on Institutions



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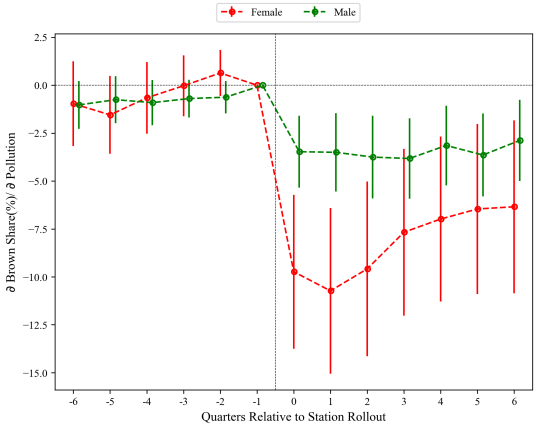
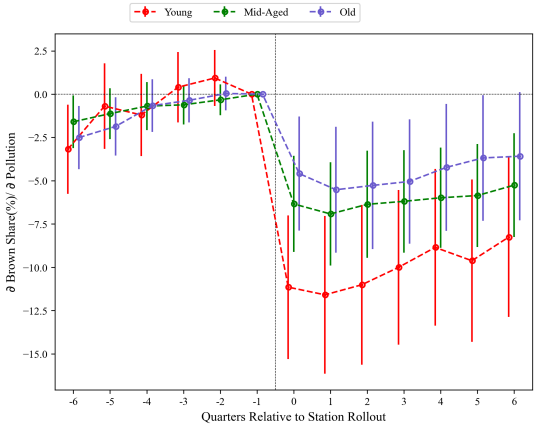
- (Note that this does not fully rule out beliefs if this is similarly correlated with age and gender)

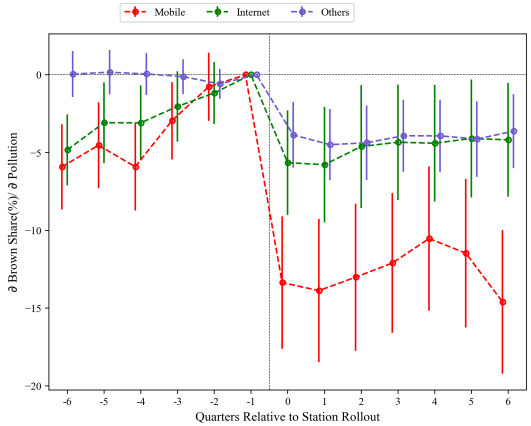
Effect is Larger for Women



And For Younger Traders



Tech-savvy Traders



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