The Downstream Effects of Upstream Antitrust Intervention*†

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Abstract

We provide causal evidence that antitrust enforcement in an upstream input market reshapes downstream firm behavior and rebalances pricing power across firms. We examine a 2011 abuse of dominance intervention in the Colombian sugarcane market supplying ethanol. Exploiting the resulting input cost shock, we show that downstream firms increased value added, input use, and employment while measured productivity remained stable. Markup responses were heterogeneous, as low-margin firms raised margins while high-margin firms lowered theirs, narrowing the cross-firm markup distribution. The findings identify a new transmission channel for competition policy that improves resource allocation by rebalancing markups across firms.

Key words: antitrust enforcement, competition

JEL codes: L41, K21, D22

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1 Introduction

Upstream market power can affect strategic behavior and output throughout the value chain [Parente and Prescott, 1999, de Cornière and Taylor, 2021, Gaudin, 2018]. However, empirical evidence on the vertical effects of domestic competition policy in input markets remains limited, especially in developing economies [Vostroknutova et al., 2025]. Few studies examine how antitrust enforcement at the input level impacts firm-level profitability, productivity, or employment. Instead, much empirical policy research has emphasized aggregate welfare effects or consumer prices [Gutierrez and Philippon, 2022, Cavenaile et al., 2021, Baqaee and Fahri, 2020, Baqaee and Farhi, 2019, Barrot and Sauvagnat, 2016]. Firm-level analyses have often focused on competitive pressures from international trade [Edmond et al., 2015a, Mayer et al., 2021, Eslava et al., 2004, 2013, Bloom et al., 2015, Cusolito et al., 2023]. This paper departs from that literature by presenting causal evidence on how an upstream regulatory intervention can propagate through input markets and alter not only average firm outcomes but also the distribution of markups across downstream firms.

We study an abuse-of-dominance case pursued by the Colombian competition authority in the market for sugarcane destined for ethanol production. In 2011, Colombia's Superintendencia de Industria y Comercio (SIC) investigated coordinated conduct in the sugarcane market. The SIC found that two major agro-industry associations had colluded with farmers to affect ethanol prices, which rose by nearly 40 percent despite stable production levels. This behavior harmed downstream users, particularly firms in the chemical manufacturing and alcoholic beverage sectors that rely heavily on ethanol as an input. We exploit the plausibly exogenous timing of the SIC intervention to identify its causal impact on these ethanol-dependent firms.

Our analysis shows that the exogenous intervention led downstream firms to expand production, hire additional workers, and raise input use [Kebede, 2025, Goldberg et al., 2008]. These intensive-margin effects occur even though we find no robust gains in total factor productivity (TFP), regardless of whether TFP is estimated using Cobb–Douglas or translog production functions.

More importantly, we document a pronounced compression in the dispersion of firm-level markups following the intervention. Firms with initially low markups increased their margins whereas firms with initially high markups reduced theirs in response to rivals' cost declines. As a result, the cross-firm distribution of markups in treated sectors becomes markedly more compact over time, consistent with a more balanced and competitive downstream market structure [De Loecker et al., 2016, Lu and Yu, 2015, Loecker et al., 2016, Edmond et al., 2015b, Melitz and Ottaviano, 2008, Gerardi and Shapiro, 2009, Edmond et al., 2023]. The observed behavior accords with a differentiated-product Bertrand competition framework in which strategic interactions and residual demand elasticities shape pricing behavior [de Blas and Russ, 2015]. In this sense the intervention reshaped the distribution of markups across firms. This mechanism illustrates a channel through which upstream input-market regulatory actions propagate downstream and influence firm-level pricing conduct alongside their production and employment decisions.

We validate these findings through multiple robustness checks, including comparisons with the full manufacturing sample, restricting controls to firms within the same sectoral divisions, quartile regressions, and inverse probability weighting based on firm characteristics. Across all specifications, results remain consistent, supporting the reliability of our conclusions.

This study therefore makes three contributions. First, it provides rare causal evidence on the firm-level effects of domestic competition policy in a developing country. Second, it identifies a mechanism through which upstream enforcement redistributes rents and reshapes downstream pricing behavior by compressing markup dispersion across firms. Third, it shows that competition policy can enhance downstream market performance by increasing output and employment and by reducing cross-firm heterogeneity in pricing power, even in the absence of observable productivity improvements, a phenomenon rarely explored in the empirical literature [e.g., De Loecker and Warzynski, 2012, De Loecker et al., 2016, Syverson, 2011].

The remainder of the paper is organized as follows. Section 2 describes the market of analysis. Section 3 details the data. Section 4 outlines the empirical strategy. Section 5 presents the results. Section 6 concludes.

2 Empirical Approach

2.1 Identification Strategy

Sugarcane is a key primary input for ethanol production in Colombia. Since 2008, the sugar industry has been highly concentrated, with 12 large sugar mills, or *ingenios*, controlling not only sugar production but also the allocation of sugarcane for ethanol processing. This gives *ingenios* substantial influence over both sugar and ethanol prices. The Colombian sugar market itself remains largely domestically oriented, with minimal imports and modest exports relative to internal demand. Indeed, according to information reported by the Fondo de Estabilización de Precios del Azúcar (FEPA), ethanol imports to Colombia were zero in 2011 and increased to roughly 3 percent of total supply in 2013. As a result, domestic competition among the *ingenios*—rather than global supply and demand forces—determines pricing and market outcomes, including those for ethanol.

The sugarcane market is regulated by the SIC, Colombia's competition authority that operates with administrative, financial, and budgetary autonomy under Law 1340 of 2009. It oversees competitive practices across all sectors, including finance and transport, despite the presence of specialized regulators. It is subject to external audits and oversight from institutions such as the Attorney General's Office. This institutional framework underpins the agency's independence and enforcement capacity.

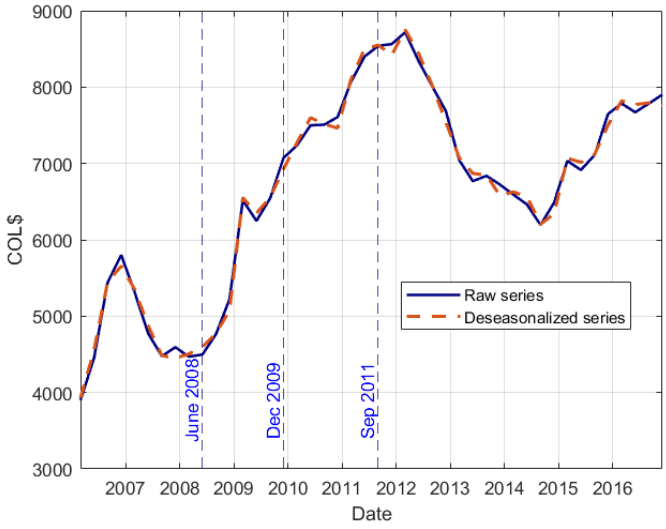
In this paper, we examine the 2011 intervention by the Colombian competition authority, documented in SIC Resolution 33141 of June 21, 2011, which addressed coordinated conduct in the sugarcane market for ethanol production. The investigation focused on two agro-industry business associations that, acting jointly, reached agreements with over 400 sugarcane farmers, representing about 15 percent of all sugarcane farmers in Colombia.[1] According to SIC findings, these agreements enabled the participating farmers to set prices above the level that would have prevailed in a more competitive market. The agreements affected roughly 21 percent of the sugarcane area used for ethanol production.

[1]Ministerio de Agricultura y Desarrollo Rural, Cifras Sectoriales – Cadena de la Caña de Azúcar, 2013.

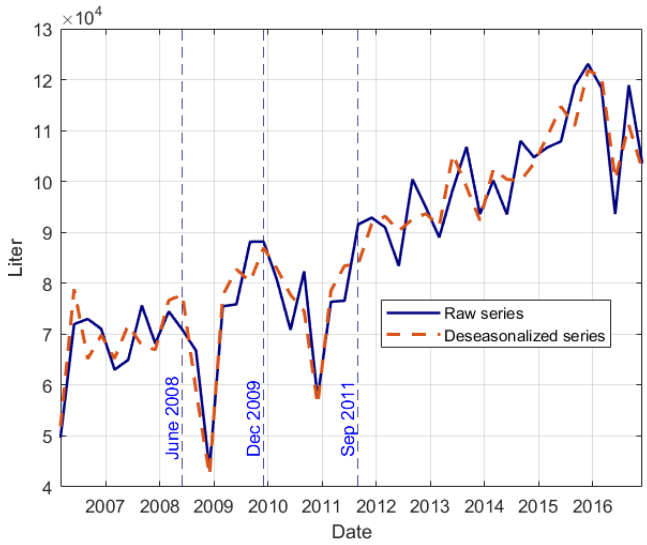
The conduct consisted of coordinating with farmers to ensure that the price of sugarcane remained above levels that individual farmers might otherwise have accepted. SIC considered this conduct an abuse of a dominant position because the associations, through their coordinated agreements with farmers, were able to exert influence over a substantial portion of the market. This influence restricted independent decision making by the farmers and reduced competitive pressure on prices, giving the associations the ability to shape market outcomes in their favor. The authority found that this joint action went beyond legitimate representation of farmer interests, constituting an anti-competitive practice that distorted the market for ethanol sugarcane, and negatively affected the downstream sectors.

During this period, ethanol prices increased significantly, exceeding levels that could be explained by short-term supply fluctuations, see Figure 1. Sugarcane production remained broadly stable, aside from temporary declines associated with the global financial crisis in late 2008 and the La Niña phenomenon in late 2010, which were quickly reversed. These minor production fluctuations cannot account for the observed price increase. Rather, the coordinated upstream arrangement allowed the associations to set ethanol prices above market levels consistent with unconstrained competition, generating an input-price shock that propagated downstream.

This case is particularly instructive for competition policy research, as it highlights a mechanism by which upstream coordination among suppliers can influence downstream markets. It demonstrates that interventions targeting upstream market power can have measurable effects on downstream firm performance, providing a natural experiment for evaluating the economic impact of competition enforcement.



(a) Price



(b) Production

Figure 1: Ethanol: Prices and Production

Source: Fondo de Estabilización de Precios del Azúcar. Note: The three vertical lines, from left to right, represent the year when the behavior is assumed to have begun, the start of the SIC investigation, and the year the court decision was made. Information is presented on a quarterly basis.

2.2 Identification of the Treatment Group

An important concern in empirical research evaluating competition policy effectiveness is a potential bias that can stem from firms' anticipatory responses to an enforcement action. In particular, firms under investigation may adjust their behavior in anticipation of regulatory actions. For example, once notified of an ongoing investigation, firms may alter pricing strategies, adjust production levels, or modify market conduct. These changes are not necessarily direct responses to the intervention itself but rather strategic reactions to the prospect of enforcement. Such endogenous adjustments can complicate the identification of the true causal impact of the SIC's actions.

To mitigate this limitation, we estimate the response to the intervention in sectors that use ethanol as an input. The underlying assumption is that for firms in these downstream industries, the SIC's intervention in the sugarcane market was exogenous. First, these firms did not know the outcome of the investigation in advance. Second, they had no means to influence or modify the regulatory decision. Thus, their responses reflect broader market effects rather than direct reactions to the investigation itself.

The treatment sectors are selected based on their direct exposure to price changes in sugarcane-derived ethanol, the commodity at the center of the SIC investigation. Note that the input–output matrix would be the ideal source for measuring sectoral exposure to ethanol, but it lacks the level of detail required for such estimation.[2] The manufacturing of chemicals and chemical products is included because ethanol is widely used as a feedstock in chemical synthesis and as an industrial solvent in pharmaceuticals, detergents, cosmetics, and other chemical processes [Palsson et al., 1981, ICIS Compliance & Methodology, 2013]. The production of alcoholic beverages is also treated, since sugarcane ethanol constitutes a key ingredient in spirits and liquors, and upstream price increases in ethanol directly affect production costs in this sector [Encyclopaedia Britannica, 2025]. In summary the ISIC REV.4 sectors considered as the treated group are: 2011, 2021, 2022, 2023, 2029, 1101, and 1102. By selecting sectors with documented dependence on ethanol, we

[2]The available matrix reports inputs only at the aggregate "sugar" level, which is a very imperfect proxy for ethanol use; sectors such as chocolate or bakery would incorrectly appear as ethanol-exposed.

ensure that the analysis targets firms whose input costs were plausibly influenced by the anticompetitive conduct identified by SIC, rather than relying on indirect proxies. This approach aligns the treatment definition directly with the economic mechanism of interest: the transmission of upstream sugarcane price distortions to downstream ethanol-using industries.

2.3 Price Pass-Through to Downstream Sectors

In this section, we examine the extent to which ethanol price changes are transmitted to downstream sectors, distinguishing between consumer-facing prices and intermediate input prices for firms. Understanding these dynamics is crucial for interpreting the effects of the SIC intervention in the sugarcane market on both downstream firms and final consumers. For consumer prices, we consider the CPI for alcoholic beverages (liquor, wine, and spirits) and for chemical-related consumer products, including cleaning and toiletries. Pass-through is estimated via separate OLS regressions for each item i, with the annual change in the CPI index as the dependent variable and the annual change in ethanol prices as the explanatory variable:

$$\Delta \log(\text{CPI}_{i,t}) = \alpha_i + \beta_i \cdot \Delta \log(\text{Ethanol}_t) + \gamma_t + \varepsilon_{i,t}. \tag{1}$$

Here, β_i captures the pass-through rate for item i; a coefficient of one indicates full pass-through, while a value below one indicates incomplete transmission of ethanol price changes to downstream prices. The estimated coefficients for consumer prices are presented in Figure 2a. Across all items, coefficients are at or below 0.1, reflecting a very limited pass-through of ethanol costs to final consumer prices. This suggests that firms do not fully transmit input price increases to consumers. Instead, they likely absorb or adjust costs internally through operational or strategic mechanisms. To assess whether ethanol price changes influence input costs faced by downstream firms, we perform the same regression exercise using producer-level prices for items that intensively use ethanol as an intermediate input: alcoholic beverages, basic chemicals, other chemical products, paints and varnishes, and pesticides. The results, summarized in Figure 2b, indicate

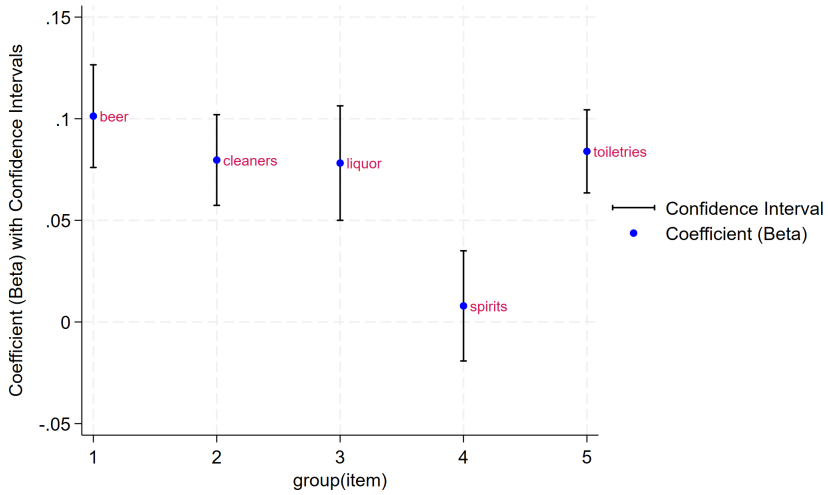
that the pass-through coefficients are substantially higher than for consumer prices, generally exceeding 0.1, with the exception of paints and varnishes, which are slightly below this threshold. This provides clear evidence that ethanol price changes are transmitted to firms' intermediate input costs, even though they are largely muted at the consumer level. Taken together, these findings support the interpretation that ethanol price shocks primarily affect firms' internal cost structures rather than final consumer prices. The observed changes in value added, output, or other firm-level outcomes in the context of the SIC intervention are therefore more plausibly attributed to strategic adjustments, input reallocation, or efficiency responses rather than to cost-driven inflation. This distinction is important for understanding the microeconomic mechanisms at play in the sugarcane market and downstream sectors.

3 Data

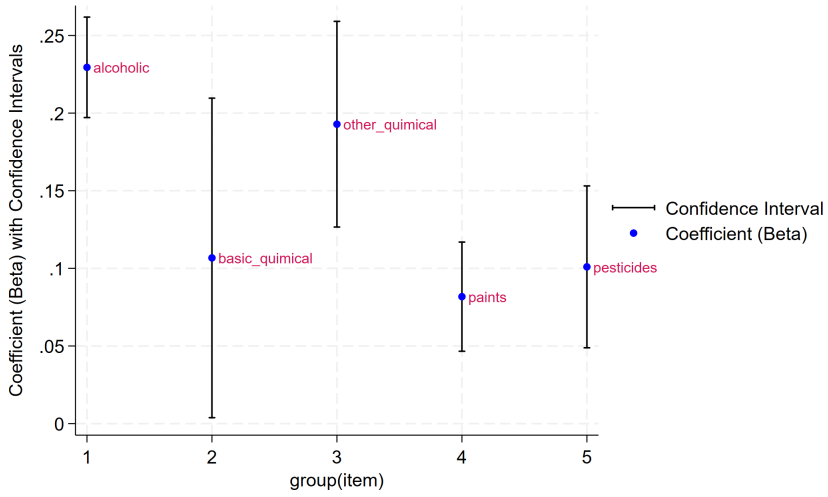
The firm-level data are sourced from the Annual Manufacturing Survey conducted by the National Administrative Department of Statistics (DANE). This census covers all manufacturing establishments employing 10 or more persons across all states, enabling the construction of a firm panel for the 2008–2015 period. The survey is representative of manufacturing activity across sectoral divisions under the ISIC Rev. 4 classification, providing a comprehensive view of the sector.

The dataset employed in this study comprises 70,337 firms, of which 2,290 are classified as treated due to their exposure to the intervention, as determined by their sectoral reliance on ethanol. There is also a similar number of firms, 2,749, that operate in the same divisions as the treated firms. The following sectors are included in the treated group according to ISIC Rev. 4: 2011, 2021, 2022, 2023, 2029, 1101, and 1102. A large share of observations is attributable to the manufacturing of chemicals, while a smaller proportion, nearly 5 percent, comes from the distilling, rectifying, and blending of spirits.

To ensure comparability over time, all monetary variables are deflated using the manufacturing GDP deflator. Finally, as part of the data cleaning process, observations in the bottom 1st and top



(a) Estimated ethanol price pass-through to consumer prices



(b) Estimated ethanol price pass-through to intermediate input prices

Figure 2: Ethanol price pass-through in downstream sectors

Source: Fondo de Estabilización de Precios del Azúcar and Banco de la República de Colombia. Notes: Circles indicate estimated coefficients, while bars represent robust 95% confidence intervals. Each regression is run independently using annual growth rates of monthly indices, includes a time dummy, and spans January 2007 to December 2018.

99th percentiles of the distribution are treated as outliers and excluded from the analytical sample.

Table 1: Firm statistics

	Manufacturing			Same division			Treated		
	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.	Obs	Mean	Std. dev.
ln Valued-added (VA)	68,047	13.88	1.69	2,749	14.61	1.86	2,290	14.51	1.77
ln Stock of Capital	67,888	13.72	1.99	2,742	14.47	2.16	2,289	14.18	2.02
ln Employment	60,149	2.94	1.27	2,586	3.05	1.21	2,162	3.15	1.16
ln Int. cost	68,047	14.13	1.76	2,749	14.69	1.87	2,290	14.66	1.81
ln TFP TL	60,026	15.30	0.70	2,579	15.46	0.63	2,161	15.41	0.64
ln TFP CD	60,026	6.18	0.60	2,579	6.23	0.56	2,161	6.27	0.56
ln Markups TL	59,417	1.45	0.66	2,560	1.53	0.71	2,150	1.42	0.67
ln Markups CD	60,017	0.74	0.80	2,579	0.86	0.84	2,161	0.64	0.77

The treated group includes sectors more exposed to ethanol. The group manufacturing includes all other firms in the sample but the treated group, while same division incldues firms in the same division than the treated firms but excludes the latest. Treated firms includes firms in: Manufacture of chemicals and chemical products and Beverages (2011, 2021, 2022, 2023, 2029, 1101, 1102). TFP refers to total factor productivity, while Markups as the firm price-markups. The use of TL refers to the Translog production function, and CD refers to the Cobb-Douglas production function. Information is presented in logarithms.

4 Empirical Specification

Our empirical strategy builds on a two-way fixed effects panel framework and is designed to capture both the average effect of the SIC's intervention on downstream firms and the heterogeneity of responses across firms with different initial competitive positions. In particular, we investigate how the intervention affected firm markups, production, and input usage, and how these effects vary depending on a firm's pre-intervention markup relative to its sector.

Formally, the model is specified as

$$\log y_{i,j,s,t} = \mu_i + \alpha_t + \gamma_{j*,t} + \gamma_{j*} + \theta_{s,t} + \theta_s + \beta D_{j,t} + \phi(D_{j,t} \times \mathbf{G}_{i,2008}) + \epsilon_{i,j,s,t}, \qquad (2)$$

where $y_{i,j,s,t}$ denotes the performance outcome of firm i in 4-digit sector j and state s at time t. Outcomes include value-added, employment, capital investment, intermediate input costs, total factor productivity, and price markups. The variable $D_{j,t}$ takes the value of 1 if the sector j was

subject to the SIC's intervention in year t and remains equal to 1 thereafter until the last year of observation, while $G_{i,2008}$ measures the pre-intervention markup gap, defined as the difference between the 4-digit sector average markup and firm i's markup in 2008. This variable captures the firm's initial competitive position, distinguishing firms with compressed markups from those with elevated markups within the same sector.

The interaction term between treatment and the pre-intervention markup gap allows us to estimate heterogeneous treatment effects across firms. Economically, a positive coefficient on the interaction implies that firms with initially compressed markups experience larger increases in the outcome variable following the intervention, whereas firms with initially high markups experience smaller increases or even reductions. This specification therefore provides a direct test to assess the impact of the intervention on the distribution of markups across firms, while simultaneously capturing the aggregate average effect in the market.

Firm fixed effects μ_i absorb time-invariant firm characteristics, while year fixed effects α_t account for aggregate shocks common to all firms. Sector-year fixed effects at the 2-digit level, $\gamma_{j*,t}$, control for time-varying sectoral shocks, and state-year fixed effects, $\theta_{s,t}$, capture regional shocks affecting all firms within a state. Sector γ_{j*} and state θ_s fixed effects account for unobserved heterogeneity across sectors and states, respectively. The error term $\epsilon_{i,j,s,t}$ is assumed to have zero mean and be independently distributed across observations.

To ensure the robustness of our estimates, we consider two alternative control group definitions. The baseline specification compares treated firms to all other 4-digit manufacturing firms, while a more restrictive specification restricts the control group to firms within the same 2-digit sector, absorbing unobservable sector-specific demand or technology shocks. In addition, we implement an inverse-probability weighting procedure, based on estimated propensity scores using firm size (employment, input use and capital stock averages before intervention), to ensure that the treated and control groups are balanced along observable characteristics following Rosenbaum and Rubin [1983].

This empirical strategy allows us to disentangle both the average effects of the SIC's interven-

tion and the systematic heterogeneity induced by firms' initial market positions, providing a clear framework to interpret how reductions in input costs propagate through production and pricing decisions. In particular, the interaction term directly captures the redistribution of markups across firms, revealing how initially constrained firms benefit relative to initially unconstrained firms, consistent with theoretical predictions.

5 Results

Table 2 reports the estimated effects of the SIC's intervention on downstream firm outcomes using two alternative control-group definitions. Panel A compares treated firms to the remainder of the manufacturing sector. Panel B restricts the comparison to firms within the same 2-digit industry, thereby absorbing sector-specific demand or technology shocks. The results across the two panels are highly consistent and reveal three main findings. First, we document sizable increases in value added, and intermediate input expenditures. Second, employment increases, consistent with an expansion of production scale. Third, we find no robust effect on total factor productivity (TFP), regardless of whether TFP is estimated using Cobb–Douglas or translog production functions following Ackerberg et al. [2015]. Average markups, estimated following De Loecker and Warzynski [2012], decline modestly when pooling across all treated firms.

These patterns are consistent with a setting in which the intervention relaxed a binding input cost distortion without altering competitive structure, firm entry and exit, or the underlying technology set. The fall in ethanol prices reduced marginal costs for affected firms, enabling them to expand scale and factor demand. Similar intensive-margin expansions in output and input use have been documented in other production environments, for instance in Kebede [2025] and Goldberg et al. [2008], where reductions in input constraints primarily affect scale rather than entry.

While average effects are informative, they mask substantial heterogeneity in firm responses. In particular, we observe considerable variation in post-intervention markups across firms. To systematically analyze this heterogeneity, we introduce the pre-intervention markup gap (G), defined

as the difference between the 4-digit sectoral average markup and a firm's markup in 2008.[3] This measure captures firm's initial competitive position and provides a natural dimension along which to explore differential responses.

Specifications that interact treatment exposure with the markup gap reveal a clear and systematic pattern. Firms with initially compressed markups raise post-intervention markups, whereas firms with initially elevated markups exhibit reductions. Similarly, value added, employment, and intermediate input consumption expand more strongly among firms whose markups were initially compressed and grow more modestly among firms with initially high markups. These results are robust to alternative assumptions about the production function.

This sign reversal is consistent with the theoretical framework described in a differentiated-product Bertrand environment with limited pass-through [Berry et al., 1995], firms facing more elastic residual demand (typically low-markup firms) adjust their markups more strongly in response to a common input-price decline. Firms facing less elastic residual demand (typically high-markup firms) adjust more moderately and may reduce markups in order to maintain market share when competitors' costs fall. Strategic substitutability amplifies these relative adjustments, generating heterogeneous responses even in the absence of technological or cost heterogeneity. These results are consistent with broader evidence showing that uniform shocks can induce heterogeneous competitive adjustments across firms [Autor et al., 2013, Syverson, 2011].

Figure 3 further documents the evolution of markup distributions in treated and untreated sectors in 2008, 2011, and 2015. Among treated sectors, the distribution of markups becomes markedly more compressed over time, with both tails contracting. In contrast, untreated sectors exhibit widening dispersion, with an expansion of both high- and low-markup tails. These shifts indicate that the intervention not only altered mean markups but also reshaped the entire distribution of pricing power across firms. The compression of the markup distribution among treated sectors is consistent with a reallocation of competitive pressures that reduces cross-firm market

[3]We refer to G TL when the production function used to estimate markups follows a translog specification, and to G CD when it follows a Cobb–Douglas specification.

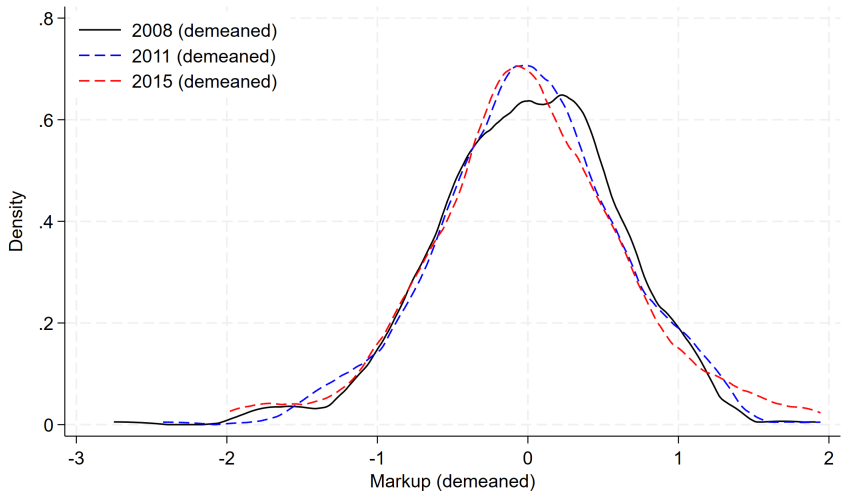
power differentials.

Taken together, the results demonstrate that the SIC's intervention expanded production, increased employment, and, critically, reduced markup dispersion among downstream firms. To further confirm the heterogeneity in the intervention effects across the distribution of markups, we stratified firms into quartiles within each ISIC sector and ran separate regressions for each quartile. This approach allows us to account for variation across different levels of markups while controlling for firm- and time-specific fixed effects. Detailed estimation procedures and additional quartile regression results are presented in the Appendix A. This compression of pricing-power differences reflects stronger and more uniform competitive conditions in the treated sectors. Importantly, these improvements occur even in the absence of measurable productivity gains. The intervention therefore enhanced downstream market performance by simultaneously increasing economic activity and reducing the dispersion of market power, highlighting a distinct channel through which input-market policies can propagate to downstream competitive outcomes.

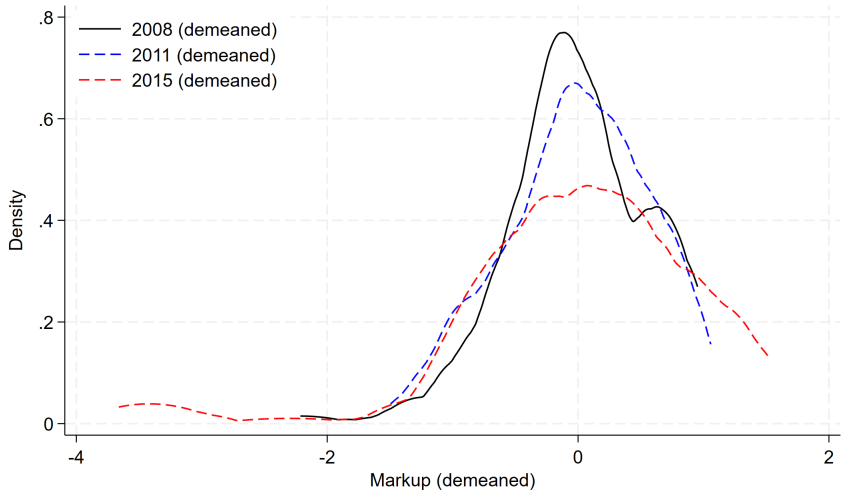
Table 2: Main Results: Antitrust Enforcement

A. Baseline with control group defined by the remaining sectors in the full sample												
	VA	VA	VA	Cap.	Cap.	Cap.	Empl.	Empl.	Empl.	Int. cost	Int. cost	Int. cost
Enforcement	0.0891*	0.0666	0.0768	0.0460	0.0308	0.0566	0.231***	0.212***	0.230***	0.104*	0.0937	0.0939
	(0.0524)	(0.0641)	(0.0647)	(0.0597)	(0.0738)	(0.0766)	(0.0604)	(0.0501)	(0.0579)	(0.0548)	(0.0642)	(0.0646)
Enf × G TL		0.0234			0.0760			0.127***			0.163***	
		(0.0378)			(0.0481)			(0.0439)			(0.0487)	
Enf × G CD			0.0840**			0.0988**			-0.0647**			0.148***
			(0.0337)			(0.0435)			(0.0316)			(0.0413)
Obs.	69,652	44,337	45,350	69,492	44,911	45,279	61,444	43,340	43,656	69,652	44,982	45,350
	TFP CD	TFP CD	TFP CD	TFP TL	TFP TL	TFP TL	Markup CD	Markup CD	Markup CD	Markup TL	Markup TL	Markup TL
Enforcement	-0.0336	-0.0304	-0.0440*	-0.0657*	-0.0485	-0.0667*	-0.190***	-0.146***	-0.167***	-0.0531	-0.0281	-0.0407
	(0.0274)	(0.0258)	(0.0261)	(0.0345)	(0.0338)	(0.0361)	(0.0421)	(0.0396)	(0.0431)	(0.0326)	(0.0339)	(0.0344)
Enf × G TL		0.0456**			0.0472*			0.163***			0.238***	
		(0.0226)			(0.0246)			(0.0382)			(0.0379)	
Enf × G CD			0.0690***			0.105***			0.223***			0.177***
			(0.0179)			(0.0225)			(0.0366)			(0.0310)
Obs.	61,320	42,729	43,596	61,320	42,729	43,596	61,311	42,723	43,590	59,673	42,071	42,453
B. Baseline with control group defined by the remaining sectors in the same division												
	VA	VA	VA	Cap.	Cap.	Cap.	Empl.	Empl.	Empl.	Int. cost	Int. cost	Int. cost
Enforcement	0.232***	0.205***	0.208***	0.0817	0.0741	0.0988	0.221***	0.199***	0.241***	0.185***	0.158**	0.180**
	(0.0619)	(0.0704)	(0.0686)	(0.0570)	(0.0635)	(0.0677)	(0.0671)	(0.0560)	(0.0675)	(0.0598)	(0.0722)	(0.0706)
Enf × G TL		0.00406			0.0610			0.121**			0.130***	
		(0.0372)			(0.0461)			(0.0460)			(0.0429)	
Enf × G CD			0.0790**			0.0790*			-0.0501*			0.117***
			(0.0353)			(0.0414)			(0.0300)			(0.0376)
Obs.	4,835	3,440	3,500	4,826	3,484	3,499	4,547	3,423	3,435	4,835	3,485	3,500
	TFP CD	TFP CD	TFP CD	TFP TL	TFP TL	TFP TL	Markup CD	Markup CD	Markup CD	Markup TL	Markup TL	Markup TL
Enforcement	-0.00138	-0.00190	-0.0114	-0.0241	-0.00743	-0.0228	-0.111**	-0.0733	-0.0971*	-0.00969	0.0143	0.0129
	(0.0295)	(0.0307)	(0.0315)	(0.0403)	(0.0421)	(0.0461)	(0.0472)	(0.0447)	(0.0502)	(0.0374)	(0.0417)	(0.0421)
Enf × G TL		0.0315			0.0343			0.135***			0.217***	
		(0.0221)			(0.0247)			(0.0341)			(0.0369)	
Enf × G CD			0.0505***			0.0813***			0.179***			0.152***
			(0.0176)			(0.0212)			(0.0323)			(0.0320)
Obs.	4,538	3,377	3,434	4,538	3,377	3,434	4,538	3,422	3,434	4,443	3,322	3,353

Robust standard errors in parentheses, with $***$ p <0.01, $**$ p <0.05, $*$ p <0.1. The standard errors are clustered at the 4-digit sector classification at the national level. All regressions control for firm fixed effects, state*year, and sector (2-digit)*year fixed effects as defined in Equation (2).



(a) Comparison of market distribution for treated sectors (Translog production function), 2008 vs. 2015



(b) Comparison of market distribution for untreated sectors (Translog production function), 2008 vs. 2015

Figure 3: Markup dispersion.

Note. Panels (a) and (b) show the dispersion of markups in affected sectors compared with those in unaffected sectors within the same division. Markups are normalized to have zero mean for ease of comparability. The number of treated firms for the years 2008, 2011 and 2015 are 431, 494 and 484, respectively, while the number of untreated firms are 125, 134, and 125.

5.1 Explaining the heterogeneous markup responses

Heterogeneous markup responses across downstream firms arise naturally in a Bertrand-type environment once product differentiation or firm-specific residual demand is introduced. In the standard homogeneous-good Bertrand model, firms with substantial productivity differences cannot survive because the market price converges to the level implied by the most efficient producer. This framework does not capture the ethanol downstream markets, where firms differ in product characteristics, market reach, and competitive exposure.

In differentiated-product settings, firms face idiosyncratic demand curves with distinct elasticities. Firms that operate in relatively inelastic segments, for example due to brand capital, product quality, distribution networks, or customer loyalty, can sustain higher markups. Firms that sell in more elastic and price-sensitive segments exhibit lower markups. Local market power, switching costs, and long-term relationships with buyers further shape firm-specific residual demand, generating persistent differences in markups even when underlying technologies are comparable.

These structural features imply not only cross-sectional differences in markup levels but also heterogeneous responses to changes in competitive conditions or policy interventions. The descriptive evidence illustrates this mechanism. Figure 4, which plots average markups in three chemical manufacturing sectors by firm size in 2008, shows a clear positive association between size and markups. This is consistent with larger firms facing less elastic demand and weaker competitive pressure. Following the competition authority's intervention, smaller firms with initially low markups increased them as previously binding competitive constraints relaxed. Larger firms, which initially operated with higher markups, experienced stronger competitive pressure and reduced their markups. This divergent adjustment pattern is consistent with differentiated-product competition, capacity limitations, and localized market power.

A similar pattern arises across space. Figure 5, which reports average markups across the same sectors by region, shows substantial geographic variation in pricing power. These differences reflect distinct market structures, product mixes, and buyer relationships, and they imply that competition policy will naturally generate heterogeneous effects across markets that differ in demand

conditions and competitive environments. Regions with more concentrated downstream buyers, limited competition, or more differentiated output exhibit higher average markups and therefore adjust differently to the policy than more competitive or fragmented regions.

Taken together, these findings indicate that the heterogeneous post-intervention responses arise from differences in demand elasticity, market power, and strategic positioning across firms and regions. The observed size–markup gradient and the pronounced regional dispersion in markups demonstrate how these structural forces generate both heterogeneous markups and heterogeneous responses to competition policy.

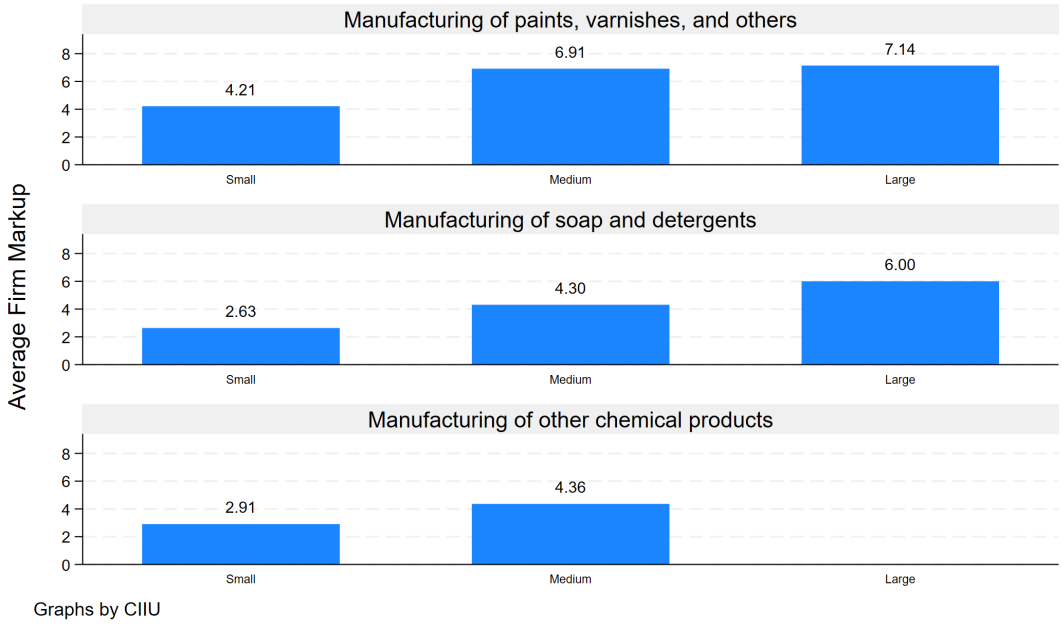


Figure 4: Average firm markup by firm size in three chemical-product manufacturing sectors in 2008.

Note. The figure reports mean markups for Manufacturing of paints, varnishes, and others (ISIC 2022), Manufacturing of soap and detergents (ISIC 2023), and Manufacturing of other chemical products (ISIC 2029) across firm sizes. Markups are estimated assuming a translog production function.

5.2 Theoretical Mechanism

To rationalize the heterogeneous responses of downstream firm markups following the competition authority's intervention in the sugarcane market, we develop a Bertrand pricing model with differ-

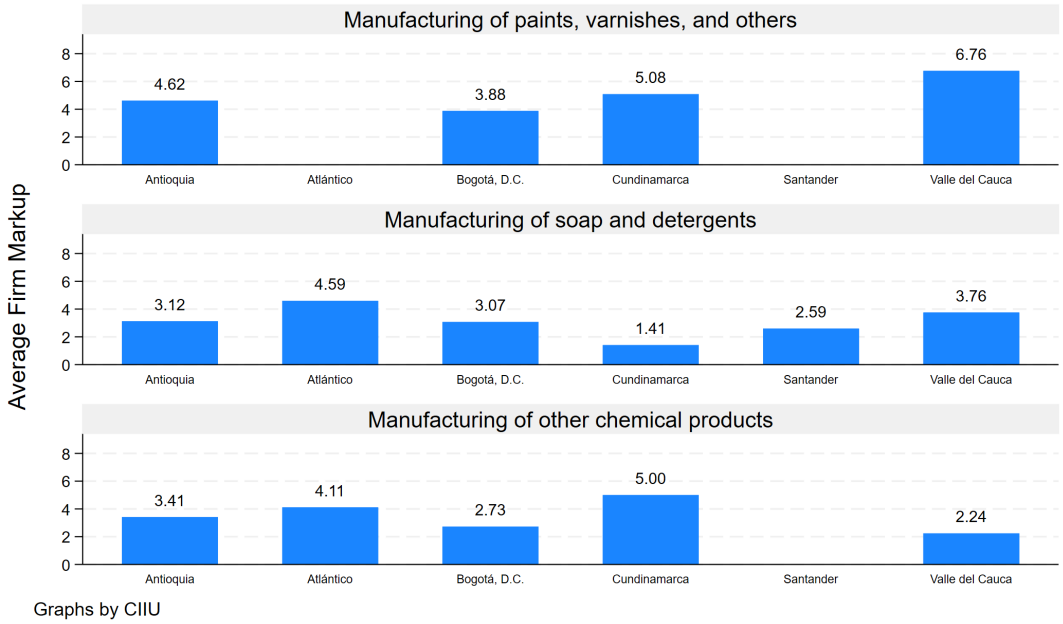


Figure 5: Average firm markup by region in three chemical-product manufacturing sectors in 2008.

Note. The figure reports mean markups for Manufacturing of paints, varnishes, and others (ISIC 2022), Manufacturing of soap and detergents (ISIC 2023), and Manufacturing of other chemical products (ISIC 2029) across regions. Markups are estimated assuming a translog production function.

entiated products, linear demand, and limited input-cost pass-through [Tirole, 1988, Varian, 1992]. Firms in downstream sectors compete in prices and rely on ethanol as a key production input. The price of ethanol, denoted P_E, is taken as exogenous from the perspective of downstream firms and enters directly into marginal cost $MC_i(P_E)$, which is assumed to increase with P_E.

Demand for firm i is linear and partially responsive to the rival's price

$$q_i = \alpha_i - \beta_i p_i + \gamma p_j, \qquad i \neq j, \quad \alpha_i, \beta_i > 0, \quad \gamma \in (\min\{\beta_i, \beta_j\}, \max\{\beta_i, \beta_j\}),$$

so that a competitor's higher price increases the demand for firm i's product [Tirole, 1988, Singh and Vives, 1984]. Profit maximization under Bertrand competition implies the first-order condition

$$\alpha_i - 2\beta_i p_i + \gamma p_j + \beta_i MC_i = 0,$$

which yields equilibrium prices of the form

$$p_i = a_i + b_i MC_i + c_i MC_j,$$

with

$$a_i = \frac{2\beta_j\alpha_i + \gamma\alpha_j}{4\beta_i\beta_j - \gamma^2}, \quad b_i = \frac{2\beta_j\beta_i}{4\beta_i\beta_j - \gamma^2}, \quad c_i = \frac{\gamma\beta_j}{4\beta_i\beta_j - \gamma^2}.$$

Equilibrium markups are $\mu_i = p_i - MC_i = a_i + (b_i - 1)MC_i + c_i MC_j$. The term a_i captures intrinsic demand advantages so that a firm with a higher α_i naturally achieves a higher markup even if marginal costs are identical across firms.

Differentiating the equilibrium markup with respect to the input price P_E gives

$$\frac{d\mu_i}{dP_E} = (b_i - 1)\frac{\partial MC_i}{\partial P_E} + c_i\frac{\partial MC_j}{\partial P_E}.$$

Because $b_i - 1 < 0$ and $c_i > 0$, the sign and magnitude of $\frac{d\mu_i}{dP_E}$ depend on the relative elasticity of firm i compared to its competitor and on the cross-price effect γ. Notably, heterogeneous responses can arise even if $MC_i = MC_j$, in which case the derivative's sign is governed by $b_i - 1 + c_i$. Firms facing demand that is more elastic relative to the rival experience a larger negative contribution from their own cost pass-through, implying that their markup increases more when input prices decline and decreases more when input prices rise. Conversely, firms facing less elastic demand relative to the rival experience a smaller negative contribution from their own cost and a larger positive contribution from the rival's cost change. The cross-price parameter γ governs the strength of this strategic interaction. When γ is small, the influence of the rival's cost is limited and heterogeneous responses are muted. When γ is large, strategic interdependence amplifies differences in markup responses.

This framework explains the empirical patterns. Smaller, low-markup firms typically face demand that is more elastic relative to competitors and adjust markups more strongly following input price changes, whereas larger, high-markup firms with less elastic demand relative to rivals adjust

more moderately. Differences in α_i also imply that some firms naturally attain higher markups even without cost differences. Heterogeneity in markups is therefore generated by a combination of intrinsic demand differences and relative demand elasticities rather than marginal-cost heterogeneity alone. The model is consistent with evidence that firms adjust markups to absorb cost shocks [Nakamura and Zerom, 2010] and with observed markup heterogeneity under Bertrand competition with differentiated products [Tirole, 1988, Varian, 1992, Singh and Vives, 1984].

5.3 Robustness

In this section, we conduct a series of robustness checks to validate our main findings. Our first approach implements a parallel-trends exercise designed to assess whether the intervention systematically targeted the treated sectors. Specifically, we estimate the coefficient on the intervention indicator, D, from our main specification by shifting the dummy one, two, and three years prior to the intervention and extending the post-intervention horizon up to five years. Figure 6 presents the results for firm value added and markups, while Annex C reports the corresponding estimates for all other variables. The event-study evidence indicates that firm-level value added declined modestly prior to the ethanol price increase associated with the upstream abuse of dominance in 2008, then rose sharply following the intervention and stabilized at an elevated level. This pattern suggests that the market was operating at a lower production equilibrium before the intervention. Crucially, the absence of pre-trends in the coefficients provides reassurance that firms did not anticipate the intervention. A complementary exercise, reported in Appendix B, further supports this conclusion: a simple logit regression shows that pre-treatment covariates are not systematically predictive of treatment assignment, reinforcing the exogeneity of the intervention.

Our second robustness strategy leverages an inverse probability weighting (IPW) approach, which assigns higher weights to firms with comparable characteristics in terms of capital stock, employment, and intermediate input consumption. Propensity scores are estimated using a logit model in which the intervention dummy serves as the dependent variable and firm-level character-

istics enter as covariates, following the framework of Rosenbaum and Rubin [1983].[4]

The results are reported in Table 3. Panel A presents estimates using the full manufacturing sector as the control group, while Panel B restricts the comparison to firms within the same 2-digit division as treated firms. All specifications are reweighted by IPW to account for potential compositional differences. The weighted estimates confirm the patterns documented in the main analysis. The elimination of anti-competitive practices that previously kept ethanol prices elevated led to significant expansions in production, employment, and intermediate input use, suggesting that firms had been operating below capacity due to input constraints.

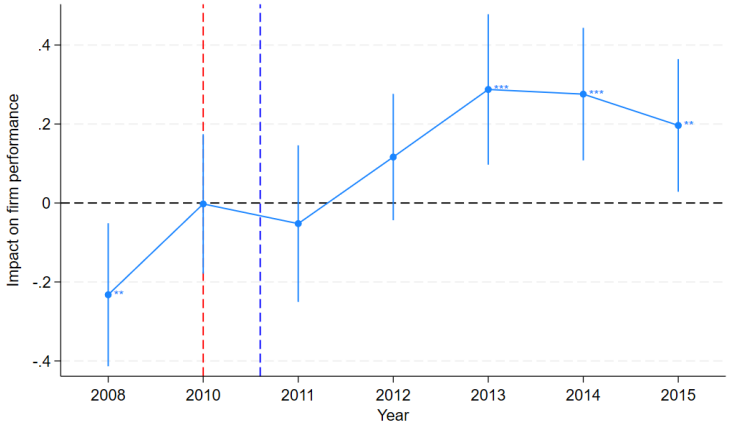
Heterogeneous effects on markups remain pronounced. Firms with initially low markups experienced substantial post-intervention increases, whereas firms with initially high markups moderate their margins. These patterns are robust across production function assumptions and control-group definitions. In contrast, effects on productivity are inconclusive, as results are not significant across all specifications.

Taken together, these weighted robustness exercises reinforce our confidence in the identification strategy and emphasize the mechanism identified in this study. Input-market interventions propagate downstream and lead to systematic heterogeneity in firm-level markups in a competitive pricing environment.

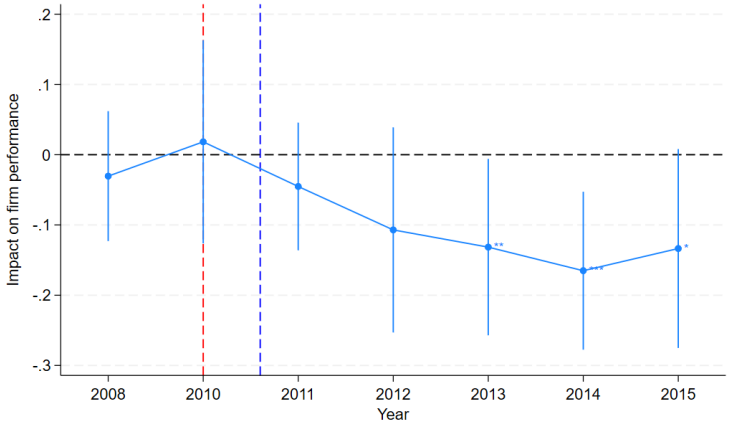
[4]We implement IPW using estimated propensity scores following Rosenbaum and Rubin [1983], with weights defined as $w_i = 1$ if $D_i = 1$ and $w_i = \frac{\hat{p}(X_i)}{1-\hat{p}(X_i)}$ if $D_i = 0$, where $\hat{p}(X_i)$ is obtained from a logit regression.

Figure 6: The recursive impact of antitrust enforcement on value-added and price markups

(a) Value added



(b) Markups-CD



We graphically present the yearly estimate of β in Equation (2) relative to the year prior to investigation. The standard errors are clustered at 4-digit sector, while the control group is defined by firms operating in the same division than treated firms. The dashed lines indicate key event years: the year the investigation began, and the year of court resolution. All regressions control for firm fixed effects, state and sector (2-digit) fixed effects.

Table 3: Robustness: Inverse probability weighting

A. Baseline with control group defined by the remaining sectors in the full sample												
	VA	VA	VA	Cap.	Cap.	Cap.	Empl.	Empl.	Empl.	Int. cost	Int. cost	Int. cost
Enforcement	0.0861	0.0775	0.0446	-0.00148	-0.0268	-0.0172	0.361***	0.285***	0.314***	0.0219	0.0684	-0.0143
	(0.0894)	(0.0912)	(0.0963)	(0.106)	(0.114)	(0.124)	(0.115)	(0.0716)	(0.117)	(0.0888)	(0.0826)	(0.102)
Enf × G TL		0.119*			0.204***			0.193***			0.209***	
		(0.0687)			(0.0783)			(0.0607)			(0.0678)	
Enf × G CD			0.138***			0.157**			-0.00825			0.205***
			(0.0470)			(0.0611)			(0.0400)			(0.0563)
Obs.	50,665	40,544	41,467	50,591	40,480	41,402	48,131	39,146	39,941	50,665	40,544	41,467
	TFP CD	TFP CD	TFP CD	TFP TL	TFP TL	TFP TL	Markup CD	Markup CD	Markup CD	Markup TL	Markup TL	Markup TL
Enforcement	-0.104**	-0.0518	-0.104**	-0.173***	-0.0811**	-0.158**	-0.280***	-0.163***	-0.241***	-0.0483	-0.000647	-0.0422
	(0.0434)	(0.0317)	(0.0478)	(0.0586)	(0.0382)	(0.0629)	(0.0722)	(0.0555)	(0.0800)	(0.0466)	(0.0442)	(0.0546)
Enf × G TL		0.00903			0.0230			0.160***			0.244***	
		(0.0298)			(0.0356)			(0.0512)			(0.0408)	
Enf × G CD			0.0652***			0.0969***			0.217***			0.176***
			(0.0224)			(0.0259)			(0.0415)			(0.0364)
Obs.	48,068	39,092	39,886	48,068	39,092	39,886	48,061	39,086	39,880	46,863	38,515	38,868
B. Baseline with control group defined by the remaining sectors in the same division												
	VA	VA	VA	Cap.	Cap.	Cap.	Empl.	Empl.	Empl.	Int. cost	Int. cost	Int. cost
Enforcement	0.292***	0.250***	0.255***	0.132	0.109	0.163*	0.342**	0.262***	0.351**	0.189**	0.163**	0.194**
	(0.0781)	(0.0711)	(0.0808)	(0.0948)	(0.0699)	(0.0963)	(0.130)	(0.0663)	(0.141)	(0.0761)	(0.0756)	(0.0789)
Enf × G TL		0.0569			0.122**			0.154**			0.141***	
		(0.0585)			(0.0596)			(0.0649)			(0.0485)	
Enf × G CD			0.111**			0.0905*			-0.0304			0.115***
			(0.0466)			(0.0490)			(0.0438)			(0.0389)
Obs.	4,138	3,220	3,280	4,136	3,219	3,279	3,969	3,159	3,216	4,138	3,220	3,280
	TFP CD	TFP CD	TFP CD	TFP TL	TFP TL	TFP TL	Markup CD	Markup CD	Markup CD	Markup TL	Markup TL	Markup TL
Enforcement	-0.0580	-0.0427	-0.0638	-0.0870	-0.0247	-0.0747	-0.206**	-0.121*	-0.176*	-0.0175	0.0122	0.0130
	(0.0463)	(0.0337)	(0.0487)	(0.0666)	(0.0434)	(0.0725)	(0.0837)	(0.0609)	(0.0900)	(0.0450)	(0.0450)	(0.0499)
Enf × G TL		0.00546			0.0218			0.139***			0.233***	
		(0.0279)			(0.0354)			(0.0487)			(0.0441)	
Enf × G CD			0.0443*			0.0763**			0.171***			0.145***
			(0.0229)			(0.0291)			(0.0458)			(0.0459)
Obs.	3,967	3,158	3,215	3,967	3,158	3,215	3,967	3,158	3,215	3,898	3,120	3,151

Robust standard errors in parentheses, with $***$ p <0.01, $**$ p <0.05, $*$ p <0.1. The standard errors are clustered at the 4-digit sector classification at the national level. All regressions control for firm fixed effects, state*year, and sector (2-digit)*year fixed effects as defined in Equation (2).

6 Conclusion

This paper provides new evidence on how upstream antitrust interventions propagate downstream and shape firm-level outcomes. We study a 2011 abuse-of-dominance intervention in the sugarcane market in Colombia. The intervention targeted collusion among producers that had driven up ethanol prices. We exploit the timing of the intervention as an exogenous input-cost shock for ethanol-dependent manufacturing firms in downstream sectors.

Our analysis shows that downstream firms responded with expanded production, increased capital investment, additional hiring, and higher intermediate input use. Importantly, these scale expansions occurred even though we detect no gains in productivity. Markup responses varied across firms. Firms with initially low markups raised their margins, while firms with initially high markups moderated theirs. This dynamic is consistent with a pricing environment in which firms adjust strategically to rivals' cost changes.

Robustness checks including alternative control groups, inverse probability weighting, and event-study specifications confirm the stability of these results. Quartile regressions return the same pattern of heterogeneous markup adjustments, which supports the validity of our identification strategy.

Overall, the findings highlight a previously scarcely documented channel through which domestic competition policy affects downstream markets. By removing distortions in upstream input markets, antitrust enforcement can relax production constraints and reshape the distribution of pricing power. The heterogeneous effects demonstrate that upstream interventions not only influence average firm outcomes but also systematically reorder competitive positions within downstream industries. More broadly, this study shows that competition policy in developing economies can generate substantial effects across production networks and reduce distortions.

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Appendix

A Quartile regression on markups

To explore heterogeneous responses in markups across firms, we stratified firms into quartiles of pre-intervention markups within each 4-digit ISIC sector. For each ISIC, firms were ranked by their markup in 2008 and assigned to quartiles Q1–Q4 (from lowest to highest). Separate regressions of markups on enforcement exposure were then estimated for each quartile, controlling for firm fixed effects, state*year fixed effects, and sector (2-digit)*year fixed effects. Standard errors are clustered at the 4-digit sector level. Panel A uses the control group defined as the remainder of the manufacturing sector, while Panel B restricts the control group to firms within the same 2-digit division. Both Cobb–Douglas (CD) and translog (TL) specifications for markups are reported.

Table A1: Quantile Regressions of Markups (Cobb–Douglas and Translog)

	Markups Cobb-Douglas				Markups translog			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
A. Baseline with control group defined by the remaining sectors in the full sample								
Enforcement	0.018	-0.0142	-0.237***	-0.381***	0.123	0.000345	0.0691	-0.162***
	(0.0944)	(0.0841)	(0.0797)	(0.079)	(0.076)	(0.0588)	(0.0637)	(0.0453)
Obs.	11,371	10,840	10,841	27,988	10,741	10,279	10,611	27,788
B. Baseline with control group defined by the remaining sectors in the same division								
Enforcement	-0.0392	0.0325	-0.196*	-0.257***	0.111	-0.0226	0.0832	-0.0898
	(0.103)	(0.0902)	(0.109)	(0.0894)	(0.09)	(0.0611)	(0.0779)	(0.0573)
Obs.	901	818	841	1,925	879	761	803	1,941

Robust standard errors in parentheses, with $***$ p <0.01, $**$ p <0.05, $*$ p <0.1. The standard errors are clustered at the 4-digit sector classification at the national level. All regressions control for firm fixed effects, state*year, and sector (2-digit)*year fixed effects as defined in Equation (2). Q1–Q4 denote quartiles from lowest to highest pre-intervention markups. CD = Cobb–Douglas; TL = Translog.

B Testing the exogeneity of the intervention

Table B1: Probability of SIC Intervention

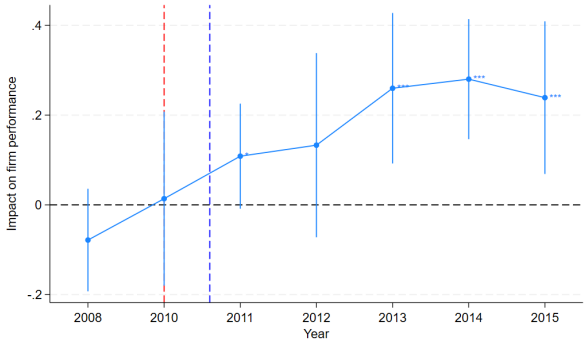
Avg. 2008–10	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Avg. VA	0.358							
	(0.244)							
Avg. Capital		0.191						
		(0.216)						
Avg. Employment			0.0543					
			(0.426)					
Avg. Int. cost				0.230				
				(0.197)				
Avg. TFP CD					0.543			
					(0.692)			
Avg. TFP TL						1.003*		
						(0.541)		
Avg. Markups CD							-0.0641	
							(0.460)	
Avg. Markups TL								-0.0390
								(0.532)
Obs.	116	116	116	116	116	116	116	116

Robust standard errors in parentheses, with $***$ p <0.01, $**$ p <0.05, $*$ p <0.1. The standard errors are clustered at the 4-digit sector classification at the national level. The average of each variable considers the pre-intervention period. All regressions control for region fixed effects.

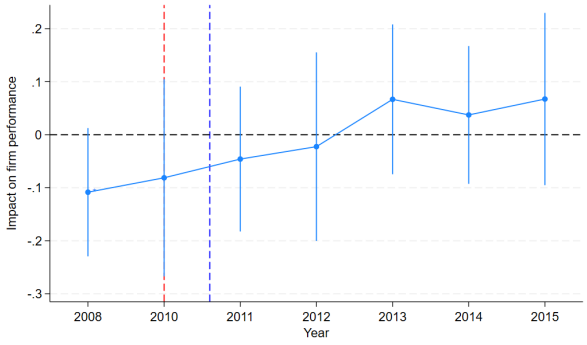
C Additional parallel trend results

Figure C1: The recursive impact of antitrust enforcement on employment and capital stock

(a) Employment



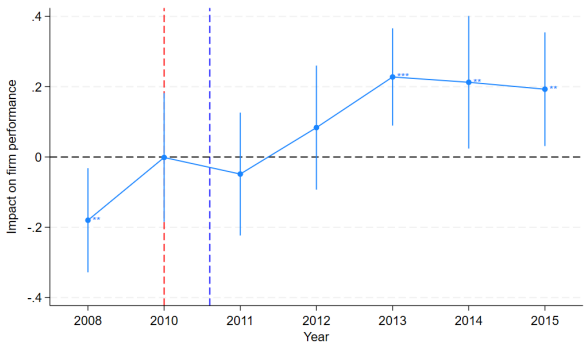
(b) Capital Stock



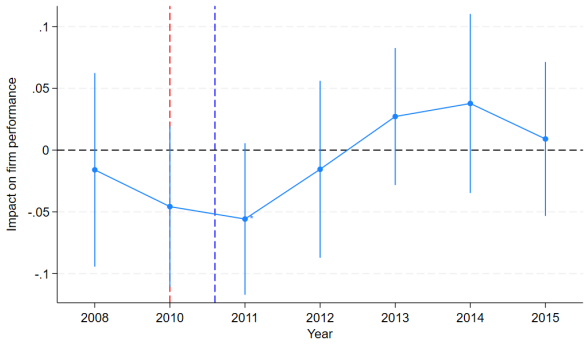
We graphically present the yearly estimate of β in Equation (2) relative to the year prior to investigation. The standard errors are clustered at 4-digit sector, while the control group is defined by firms operating in the same division than treated firms. The dashed lines indicate key event years: the year the investigation began, and the year of court resolution. All regressions control for firm fixed effects, state and sector (2-digit) fixed effects.

Figure C2: The recursive impact of antitrust enforcement on capital production costs

(a) Intermediate Input Cost



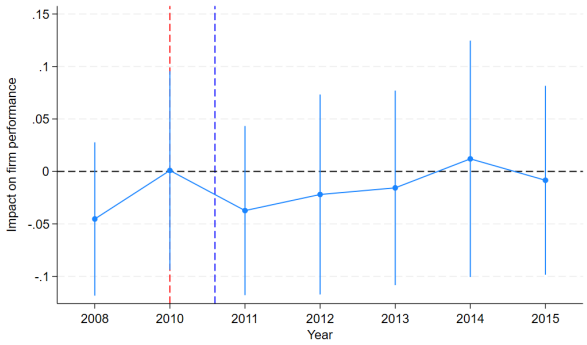
(b) Average Wages



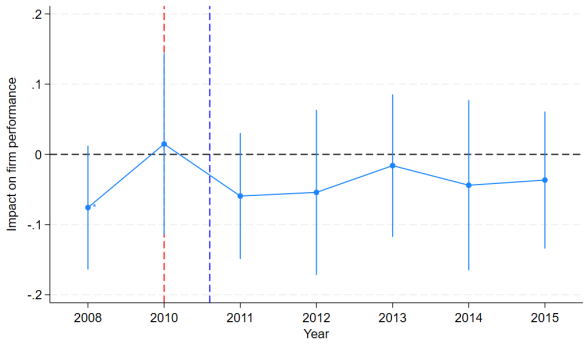
We graphically present the yearly estimate of β in Equation (2) relative to the year prior to investigation. The standard errors are clustered at 4-digit sector, while the control group is defined by firms operating in the same division than treated firms. The dashed lines indicate key event years: the year the investigation began, and the year of court resolution. All regressions control for firm fixed effects, state and sector (2-digit) fixed effects.

Figure C3: The recursive impact of antitrust enforcement on productivity

(a) TFP - CD



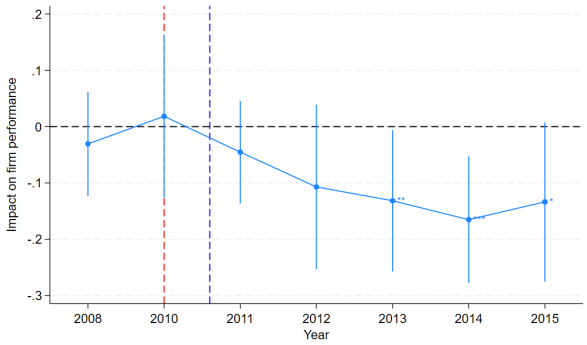
(b) TFP - TL



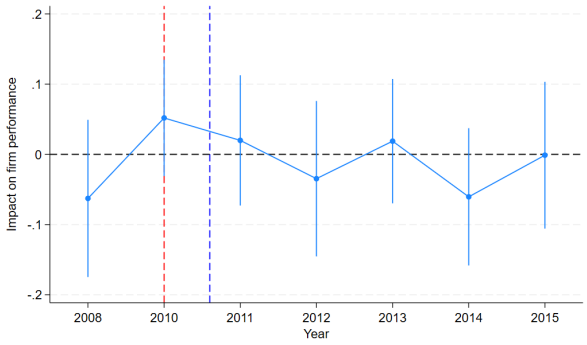
We graphically present the yearly estimate of β in Equation (2) relative to the year prior to investigation. The standard errors are clustered at 4-digit sector, while the control group is defined by firms operating in the same division than treated firms. The dashed lines indicate key event years: the year the investigation began, and the year of court resolution. All regressions control for firm fixed effects, state and sector (2-digit) fixed effects.

Figure C4: The recursive impact of antitrust enforcement on markups

(a) Markups - CD



(b) Markups - TL



We graphically present the yearly estimate of β in Equation (2) relative to the year prior to investigation. The standard errors are clustered at 4-digit sector, while the control group is defined by firms operating in the same division than treated firms. The dashed lines indicate key event years: the year the investigation began, and the year of court resolution. All regressions control for firm fixed effects, state and sector (2-digit) fixed effects.