Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

India's Sugarflation Paradox: Production, Inventories, Ethanol, Global Prices and the Economics of the 2026 Sugar Shock

RONAK MEHTA

ronak.mehta1102@gmail.com

P P SAVANI UNIVERSITY https://orcid.org/0009-0001-1974-112X

Garv Nijhara

P P Savani University

Research Article

Keywords: Sugarflation, India, sugar economy, ethanol, inventory economics, food inflation, commodity markets, econometrics

Posted Date: September 1st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10877247/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: The authors declare no competing interests.

Abstract

India's sugar economy is entering another period of heightened price volatility. Retail sugar prices monitored by the Government of India increased from ₹48.18/kg on 20 July 2026 to ₹55.70/kg on 20 August 2026, while international sugar prices increased from US$474/tonne on 30 June to US$552/tonne on 20 August 2026. At the same time, the Government of India has stated that sufficient stocks exist to meet domestic requirements until the next crushing season and has linked the recent increase to lower-than-expected production, weather damage, seasonal demand, global tightening, speculation and stocking behaviour. This paper investigates whether the 2026 price episode can be explained by physical scarcity alone. An author-compiled annual dataset for 2002–2025 is used to estimate a structural sugar-price model with log price, production, stock coverage and cane FRP, using heteroskedasticity- and autocorrelation-consistent (HAC) inference. A second internationally augmented model incorporates world sugar prices for 2014–2024. The structural model explains approximately 90.2% of the variation in annual sugar prices. The FRP elasticity is approximately 0.55 and statistically significant, while production and stock coverage carry the expected economic signs but are statistically weaker after controls. The internationally augmented model shows a statistically significant positive pass-through from global sugar prices. Using the estimated models as a benchmark, the 2026 market price lies modestly to materially above the model-implied range, depending on specification. The paper therefore interprets the current episode as a layered market event in which fundamentals, global transmission, inventory expectations and policy uncertainty interact. The evidence does not justify the claim that speculation alone caused the price increase. Instead, the economically stronger interpretation is that the market is pricing tighter future availability faster than aggregate physical inventories can adjust. The paper proposes a Sugar Pressure Index and a dynamic sugarcane remuneration framework to improve policy coordination between farmers, mills, ethanol producers and consumers.

JEL Classification: Q11, Q13, Q18, E31, E37, L66

Executive Summary

- The 2026 sugar episode is not adequately explained by the language of a simple national shortage. Aggregate stocks can coexist with a sharp retail and ex-mill price rise when effective market availability, expected future supply, inventory release and global prices move differently.
- The long-run structural regression (2002–2025) explains 90.2% of annual variation in the compiled sugar-price series. FRP is the most statistically robust included determinant, with an estimated elasticity of about 0.55.
- The internationally augmented specification (2014–2024) finds a statistically significant positive relationship between global sugar prices and Indian prices, supporting international price transmission.
- Ethanol is economically important, but the current evidence does not support a simplistic claim that ethanol diversion is the principal cause of the 2026 price spike. Government data indicate diversion

declined from about 12% in 2022–23 to around 9% in 2025–26, while grain-based ethanol has expanded.
- The policy problem is therefore an optimisation problem: protect consumer affordability without destroying farmer incentives, mill viability or the strategic value of ethanol.

1. Introduction

India's sugar market is one of the country's most economically and politically sensitive commodity markets. Sugar prices affect consumers directly, but the sector also affects millions of cane farmers, sugar mills, rural employment, ethanol production, exports, imports and public policy. For that reason, changes in sugar prices cannot be interpreted solely through a standard demand-supply diagram.

The 2026 episode is particularly useful as a natural laboratory for agricultural and commodity economics. The Government of India reports that retail sugar prices rose from ₹48.18/kg on 20 July 2026 to ₹55.70/kg on 20 August 2026. Over the same period, the Government reports international sugar prices rising from approximately US$474/tonne to US$552/tonne. At the same time, the Government maintains that stocks remain adequate for domestic requirements through the next crushing season.

This combination creates an economically interesting paradox: a sharp price increase without an equivalent statement of an immediate national physical shortage. The distinction between stocks existing somewhere in the system and sugar being released into the market at the required rate is therefore central to this study.

The paper adopts the term 'Sugarflation' to describe a price episode in which agricultural supply conditions, administered cane prices, global markets, inventory decisions, policy expectations and seasonal demand jointly create a persistent upward pressure on sugar prices.

2. Research Problem and Questions

The central research problem is whether the 2026 price movement can be explained solely by physical supply fundamentals.

The empirical research questions are:

1. What are the principal long-run determinants of Indian sugar prices?
2. Does inventory coverage reduce sugar-price pressure?
3. How strongly do global sugar prices transmit into Indian domestic prices?
4. Is the 2026 price level outside the range implied by structural fundamentals?
5. What role should ethanol policy play when sugar markets become tight?

3. Conceptual Framework

The paper treats the sugar market as a multi-channel commodity system:

Sugar Price = f(Production, Stocks, FRP, Global Price, Ethanol Opportunity Cost, Policy, Expectations)

The crucial theoretical distinction is between physical inventory and effective current market availability. A market participant who expects future prices to rise may rationally retain inventory. When many participants do so, current market supply can become tighter even when aggregate stocks are not exceptionally low.

The core inventory-expectations feedback mechanism is:

1. Expected future price increases.
2. Inventory holding becomes more attractive.
3. Current market release falls relative to total physical stocks.
4. Spot prices rise.
5. Higher spot prices reinforce expectations.

4. The Indian Sugar Balance

Sugar is a storable commodity. Consequently, current price formation depends on both current production and inherited inventory. A production decline does not necessarily create immediate scarcity when stocks are high; conversely, a normal production season can produce price stress if stocks are low, exports increase, ethanol diversion rises, or expected supply deteriorates.

For empirical purposes, this paper uses stock coverage rather than absolute stocks:

Stock Coverage = Closing Stock / Domestic Consumption

The ratio is economically preferable because it scales inventory to the size of the domestic market.

Table 1. Selected Indian sugar-market indicators

Year	Price ₹/qtl	Production LMT	Closing Stock LMT	Consumption LMT	Stock/Consumption
2014	3,379	283.1	90.8	256.1	35.5%
2015	3,013	251.3	77.5	248.0	31.3%
2016	3,715	202.9	38.8	245.6	15.8%
2017	4,089	324.8	107.2	253.9	42.2%
2018	3,715	331.6	145.8	255.0	57.2%
2019	3,584	274.1	106.3	257.1	41.4%
2020	3,552	311.9	81.9	265.6	30.8%
2021	3,587	357.6	55.5	273.3	20.3%
2022	3,771	328.2	55.7	278.5	20.0%
2023	3,910	319.6	84.8	290.0	29.2%
2024	4,124	333.0	50.0	301.0	16.6%
2025	4,240	333.0	50.0	301.0	16.6%

Note. Author's empirical compilation. Balance-sheet values are reconciled with publicly reported government-linked sugar statistics; market price is an annual weighted-average market-price series. See references and Appendix A.

5. Sugarcane FRP and the Cost Channel

The sugar economy is unusual because raw-material procurement is partly administered through the Fair and Remunerative Price (FRP) regime. FRP therefore enters the mill cost structure directly. The Government's 2026–27 FRP is ₹365/quintal at a basic recovery rate of 10.25%, compared with ₹355/quintal for 2025–26.

The relevant economic chain is:

FRP ↑ → Cane Cost ↑ → Mill Cost ↑ → Required Sugar Realisation ↑ → Upward Price Pressure

The econometric model below tests this relationship while controlling for production and stock coverage.

6. International Price Transmission

India remains integrated with the international sugar market even though domestic policy strongly influences trade. International prices influence export parity, import parity, mill expectations and government intervention. The sharp rise in international prices reported during July–August 2026 therefore forms part of the current Indian price story.

7. Ethanol and the Competing Use of Sugarcane

Sugarcane has more than one economic use. Its allocation between sugar and ethanol creates an opportunity-cost problem. When ethanol returns are attractive, diversion can reduce sugar availability. However, current government data show that cane/sugar diversion to ethanol has declined from roughly 12% in 2022–23 to around 9% in 2025–26, while grain-based ethanol has become increasingly important.

The paper therefore rejects the simplistic proposition that ethanol diversion is the principal explanation for the 2026 sugar-price spike. Instead, ethanol is treated as a structural stabiliser in surplus years and a competing use that becomes more valuable to the sugar balance when inventories tighten.

8. Data and Methodology

The empirical dataset is an author-compiled annual series for 2002–2025 containing annual sugar price, sugar production, closing stock, domestic consumption and sugarcane FRP. A real-time 2026 validation layer uses the Government's August 2026 market information and current-season balance assumptions.

The dataset is designed for reproducibility. It should be understood as a secondary-data compilation, not as proprietary primary data.

Two model specifications are estimated.

8.1 Model 1: Structural Sugar-Price Equation

$$\ln(SP_t) = \alpha + \beta_1 \ln(Production_t) + \beta_2 StockRatio_t + \beta_3 \ln(FRP_t) + \varepsilon_t$$

HAC/Newey–West standard errors with two lags are used to reduce sensitivity to heteroskedasticity and serial correlation in the small annual time series.

8.2 Model 2: Internationally Augmented Equation

$$\ln(SP_t) = \alpha + \gamma_1 GlobalSugarPrice_t + \gamma_2 \ln(FRP_t) + \gamma_3 StockRatio_t + u_t$$

This model is estimated over 2014–2024 because the international price series used for the robustness exercise is consistently compiled over that period.

8.3 Identification and Interpretation

The regressions are benchmark models, not structural causal identification strategies. FRP can respond to broader political and agricultural conditions; production and stocks are jointly determined within the sugar season; and direct measures of hoarding/speculation are unavailable in the annual dataset. Accordingly, coefficient estimates are interpreted as conditional associations, while the 2026 benchmark is used as an out-of-sample diagnostic rather than a causal test.

9. Econometric Results

The long-run structural model produces a high overall explanatory fit, with R^2 of 0.902 and adjusted R^2 of 0.888. FRP is the strongest statistically significant variable in the specification.

Table 2. Main structural sugar-price model, 2002–2025

Variable	Coefficient	HAC SE	p-value
ln(Production)	0.153	0.150	0.310
Stock/Consumption	−0.262	0.221	0.237
ln(FRP)	0.553	0.063	<0.001
Constant	4.344	0.550	<0.001
Observations	24		
R^2	0.902		
Adjusted R^2	0.888		

Note. Author's OLS estimation with Newey–West HAC standard errors (2 lags).

The estimated FRP elasticity is approximately 0.553. Thus, conditional on the included controls, a 10% increase in FRP is associated with an approximately 5.5% higher sugar-price level. This is a structural cost-pass-through interpretation, not a claim that FRP mechanically causes an identical price response in every year.

Table 3. Internationally augmented sugar-price model, 2014–2024

Variable	Coefficient	HAC SE	p-value
Global sugar price	0.582	0.243	0.017
ln(FRP)	0.269	0.144	0.061
Stock/Consumption	0.241	0.119	0.043
Constant	6.407	0.789	<0.001
Observations	11		
R^2	0.536		
Adjusted R^2	0.337		

Note. Author's OLS estimation with Newey–West HAC standard errors (1 lag).

The global sugar-price coefficient is positive and statistically significant at approximately the 5% level. The result supports meaningful international pass-through into Indian domestic sugar prices. Because the sample is small, this model is treated as corroborating evidence rather than a final structural estimate.

10. The 2026 Structural Benchmark

The Government's current 2026 scenario implies production of approximately 306 LMT and a large enough inventory position to cover domestic requirements until the next crushing season. The current FRP is ₹365/quintal. These values can be inserted into the historical structural model to obtain a counterfactual benchmark.

Model 1 benchmark: approximately ₹4,674/quintal.

Observed August 2026 market average: approximately ₹4,786/quintal.

Residual premium: approximately 2.4%.

When the internationally augmented specification is used, the benchmark is approximately ₹4,211/quintal, leaving an observed premium of approximately 13.6%. The gap therefore depends on whether international price transmission is explicitly included.

11. Interpreting the Sugarflation Residual

The most important empirical conclusion is not that the entire 2026 increase is speculative. Such a claim would exceed the identification capacity of the available data. The stronger finding is that, after accounting for long-run domestic structure and—under the second specification—global price transmission, the observed 2026 price still contains a residual component.

A plausible economic interpretation is a combination of:

- expectations of tighter future sugar availability;
- inventory-release behaviour and stocking incentives;
- festival and seasonal demand;
- policy uncertainty regarding trade and ethanol;
- market frictions between physical stocks and spot availability.

The residual should therefore be labelled an 'expectation-and-market-friction component' rather than a quantified speculation effect.

12. The Sugar Inventory Feedback Loop

The proposed mechanism is:

1. Expected future price increases.
2. Holding inventory becomes more attractive.
3. Current market release becomes tighter.
4. Spot price rises.
5. Observed higher prices reinforce future-price expectations.

This mechanism explains how a market can experience high prices even when aggregate physical stocks are not yet exhausted.

13. The Farmer–Mill–Consumer Triangle

Indian sugar policy is ultimately solving a three-objective problem.

Stakeholder	Primary economic objective	Policy tension
Farmer	Higher cane remuneration	Supports income but raises mill cost
Sugar mill	Positive margin and timely cane payment	Needs sugar realisation to cover cane cost
Consumer	Affordable retail sugar	Higher prices are undesirable during inflationary episodes

The policy objective should therefore be formulated as a constrained optimisation problem rather than a single-price target.

14. Sugar and Ethanol: A Dynamic Allocation Problem

The paper proposes a simple allocation principle:

If StockCoverage > TargetUpperBound → greater flexibility for ethanol diversion.

If StockCoverage < TargetLowerBound → prioritise sugar availability.

This would create a counter-cyclical relationship between sugar and ethanol rather than a permanently fixed diversion rule.

15. Proposed Sugar Pressure Index

A practical policy monitoring index is:

SPI_t = (DomesticConsumption_t + Exports_t + EthanolDemand_t) / (OpeningStock_t + Production_t + Imports_t)

Higher SPI values indicate greater pressure on available sugar supply. The index could be estimated monthly or weekly and published before large price movements become entrenched.

16. Proposed Dynamic Cane Remuneration Framework

The paper proposes a conceptual dynamic remuneration rule:

FRP*_t = α CostCane_t + β SugarPrice_t + γ EthanolValue_t + δ Productivity_t, where α + β + γ + δ = 1.

The purpose is not to replace the existing FRP formula immediately, but to provide a framework for future research into a more integrated sugarcane–sugar–ethanol value-chain policy.

17. Policy Implications

17.1 Transparent inventory reporting

Weekly or fortnightly stock reporting by mills, traders and large users would make the distinction between physical stocks and released stocks clearer.

17.2 Rules-based imports

Imports should be triggered by objective stock-coverage thresholds rather than only after retail prices become disorderly.

17.3 Counter-cyclical ethanol allocation

Ethanol should operate as a balancing outlet in surplus years, while sugar availability should receive greater weight when inventory coverage becomes critically low.

17.4 Better cane-price alignment

Future cane-pricing research should consider cane productivity, sugar realisation, ethanol value and mill economics together.

17.5 Competition and market surveillance

Stock limits can be appropriate during exceptional episodes, but market surveillance should focus on actual withholding or manipulation evidence rather than assuming speculation from high prices alone.

18. Robustness and Research Limitations

• The annual structural dataset is small, so results should be interpreted as a benchmark rather than a final structural estimate.

• Sugar marketing seasons and calendar years do not coincide perfectly.

• Direct data on individual inventory positions and speculative trades are limited.

• The 2026 episode is contemporaneous and therefore remains incomplete.

• The paper uses conditional association, not causal identification, for the central regression coefficients.

Future research should build a monthly state-level panel incorporating production forecasts, rainfall, disease incidence, mill-level ex-factory prices, warehouse stocks, exports, imports, ethanol diversion, futures prices and retail spreads.

19. Conclusion

India's 2026 sugar episode is best understood as a complex commodity-market adjustment rather than a one-variable shortage event. The empirical evidence indicates that cane-cost conditions, represented by FRP, have a strong historical relationship with sugar prices. International sugar prices also transmit materially into Indian prices. Inventory coverage has the theoretically expected relationship with price, but its effect becomes less precisely estimated after other structural variables are included. The current market price remains above the historical model-implied range to varying degrees depending on specification, suggesting that a residual expectation-and-market-friction component is present.

The policy lesson is equally important. India should not choose between farmer welfare and consumer welfare as if one must permanently defeat the other. The appropriate objective is to make the sugar system more counter-cyclical: protect farmer incentives in low-price years, use ethanol as a balancing outlet in surplus years, maintain adequate stocks, release imports when objectively justified, and intervene against demonstrable withholding rather than relying on broad price controls.

The broader conclusion is that sugar prices are determined not only by what exists today, but by what market participants believe will be available tomorrow. That is the essence of the Sugarflation Paradox.

Declarations

Author's Note on Empirical Status

This manuscript is designed as a submission-ready empirical research draft. The historical regressions are reproducible from the accompanying dataset. The 2026 observations are a real-time validation layer and should be updated when the full 2025–26 and 2026–27 sugar seasons are officially closed. Before submission to a journal, the author should preserve the dataset version used here, document any revised official balance-sheet estimates, and rerun the models if the season-level data are revised.

References

1. Government of India. (2026, May 5). Cabinet approves Fair and Remunerative Price of ₹365/qtl for sugarcane farmers for season 2026–27. Press Information Bureau. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2258142
2. Government of India. (2026, July 28). Government imposes stock holding limits on sugar dealers to prevent hoarding, protect consumer interests and maintain price stability. Press Information Bureau. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2290498
3. Government of India. (2026, August 21). Government acts to curb sugar price rise, ensure adequate availability during festive season. Press Information Bureau. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2302018
4. Indian Sugar & Bio-Energy Manufacturers Association. (2026). Fair and Remunerative Price (FRP) history. https://www.indiansugar.com/PDFS/FRP.pdf
5. International Crops Research Institute for the Semi-Arid Tropics. (2011). Reddy, A. A. Sugar and cane pricing and regulation in India. International Sugar Journal, 113(1352), 548–556. https://oar.icrisat.org/1427/1/IntSugarJou_113_1352_548-556_2011.pdf
6. Mandi Bhav India. (2026). Sugar price history 2002–2026: Records and yearly averages. https://mandibhavindia.in/en/commodity/sugar/price-history
7. ChiniMandi. (2026). Statement showing sugar stocks, production, consumption and export of sugar. https://www.chinimandi.com/statistics/statement-showing-sugar-stocks-production-consumption-export-of-sugar/
8. Reuters. (2026, August 10). India considers curbing use of cane for ethanol to tame record-high sugar market. https://www.reuters.com/world/india/india-considers-curbing-use-cane-ethanol-tame-record-high-sugar-market-2026-08-10/
9. Reuters. (2026, August 19). India imposes sugar stockholding limits on bulk consumers, tightens curbs. https://www.reuters.com/business/india-tightens-sugar-stock-limits-tame-record-prices-

2026-08-19/

10. Reuters. (2026, August 24). India sugar rally driven by speculation, not supply shortage, official says. https://www.reuters.com/world/india/india-does-not-have-sugar-shortage-industry-official-says-2026-08-24/
11. U.S. Department of Agriculture, Foreign Agricultural Service. (2025). India: Sugar Annual. Global Agricultural Information Network. https://www.fas.usda.gov/data/india-sugar-annual-9

Figures

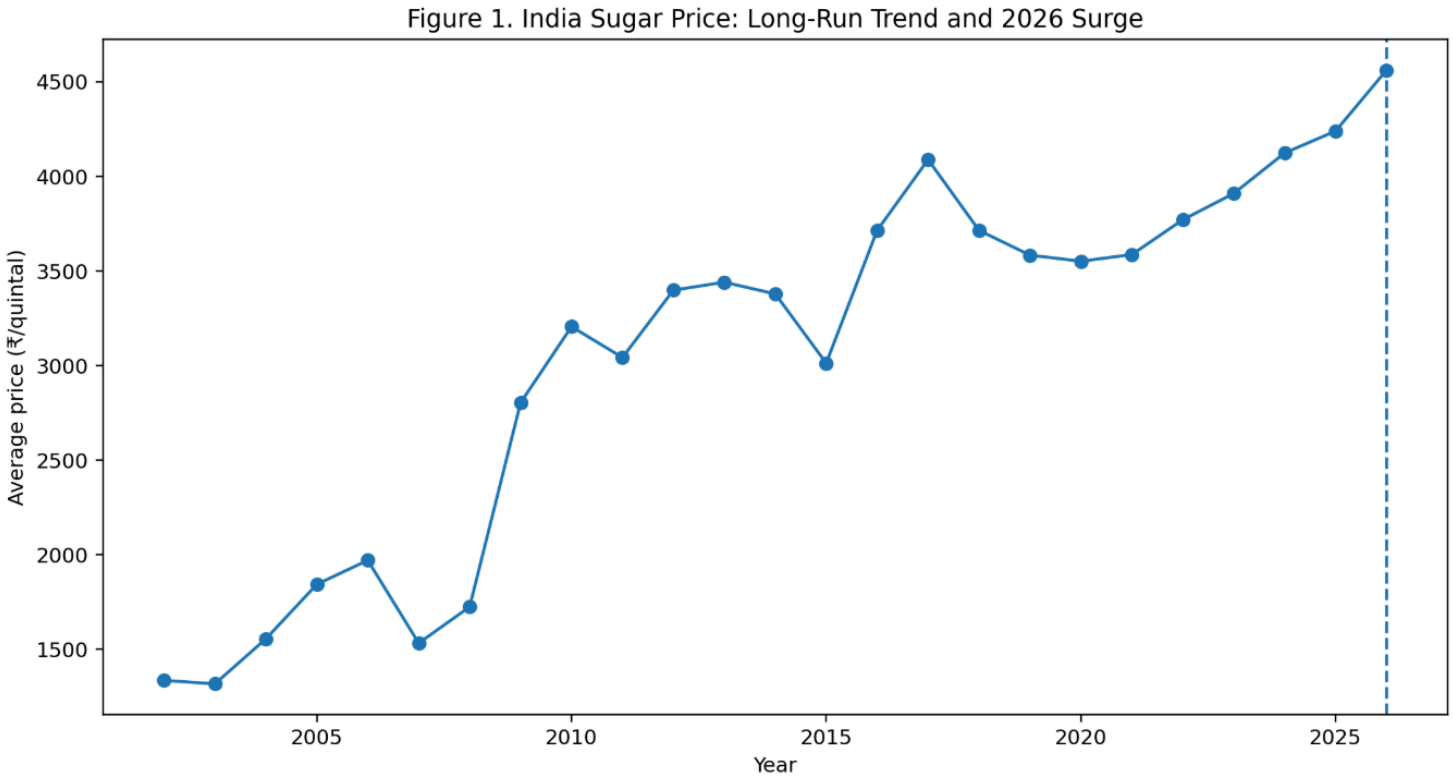


Figure 1

India sugar price: long-run trend and 2026 surge

Note. Author-compiled series from the research dataset; see Appendix A.

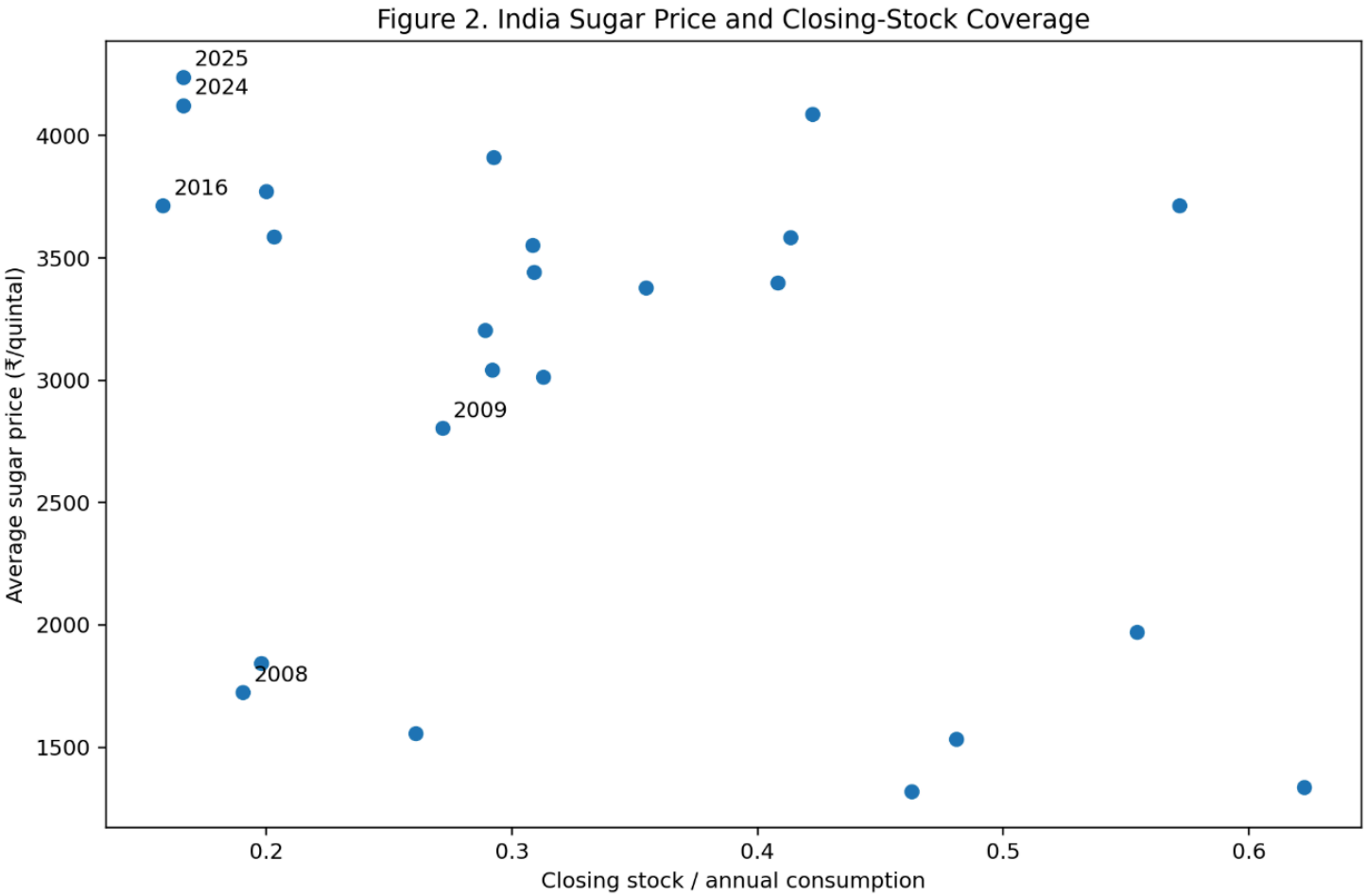


Figure 2

Sugar price and inventory coverage

Note. Author's calculations from the compiled 2002–2025 dataset.

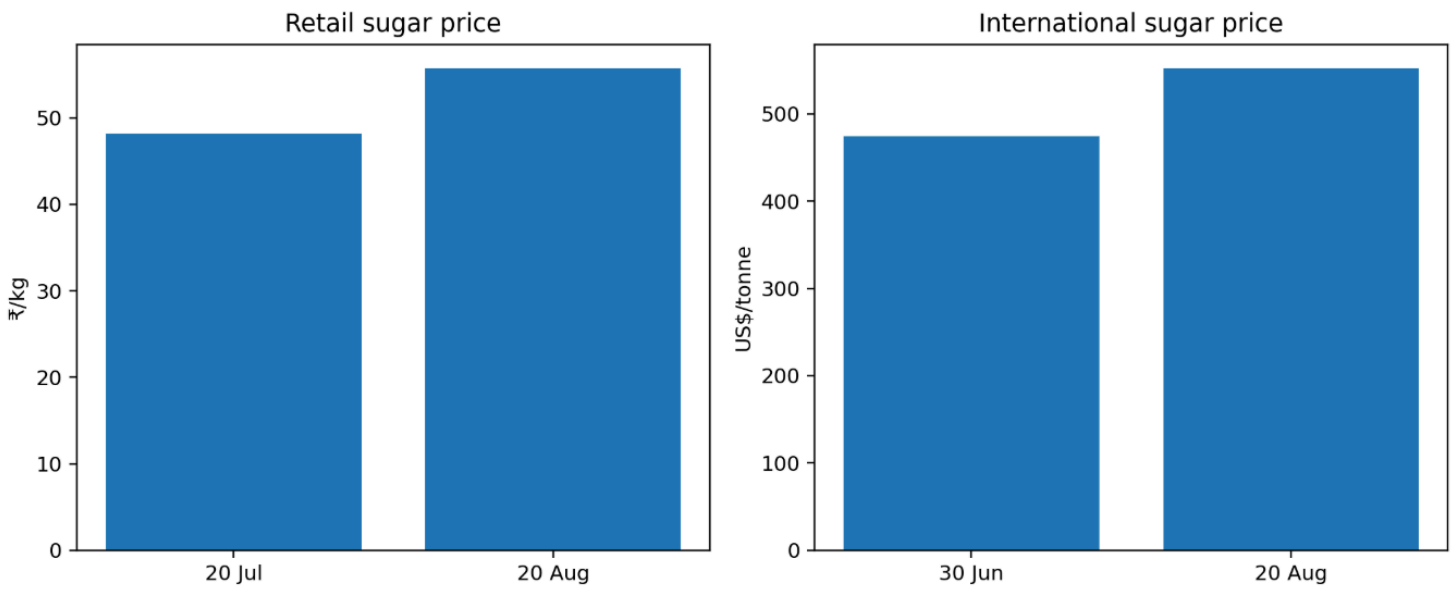


Figure 3

The 2026 sugar shock: domestic and international prices

Note. Government of India retail sugar and international sugar price observations reported in the 21 August 2026 intervention statement.

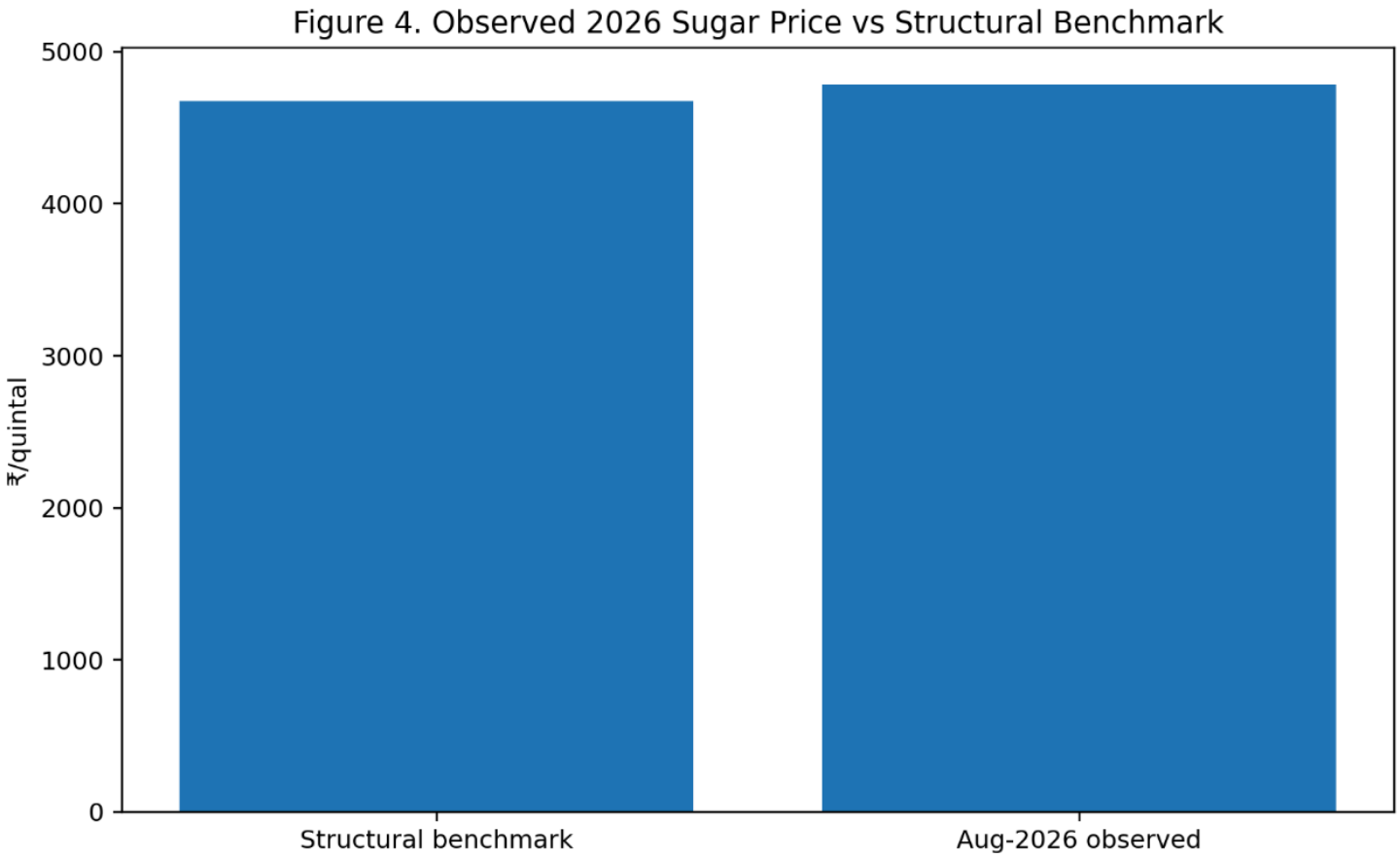


Figure 4

Observed August 2026 sugar price versus structural benchmark

Note. Author's calculations using the two empirical benchmark frameworks.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix.docx