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Inflation Targeting and the Farmer Price Realisation Gap Evidence from India's Flexible Inflation Targeting Regime (2012-2024)

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Inflation Targeting and the Farmer Price Realisation Gap: Evidence from India's Flexible Inflation Targeting Regime (2012-2024)

Abstract

India's adoption of Flexible Inflation Targeting (FIT) in August 2016 coincided with a deterioration in farm-gate price realisation relative to the Minimum Support Price (MSP). The equal-weighted composite Price Realisation Gap (PRG) collapsed from 16.91 percent above MSP pre-FIT to 3.08 percent post-FIT, with Paddy PRG turning negative at minus 3.86 percent. The paper proposes the Policy Suppression-Price Compression (PSPC) mechanism, a four-channel theoretical framework formalised in a two-period farmer optimisation model, through which FIT produces agricultural price compression as an unintended structural consequence. Seven empirical strategies test the mechanism using 156 monthly observations (2012-2024). The NARDL bounds test confirms cointegration between Paddy PRG and the repo rate at the 1 percent level (F equals 9.216). The normalised long-run effect of rate cuts is plus 16.313 (p equals 0.043). Method of Moments Quantile Regression confirms pro-cyclical distributional heterogeneity, with the monetary transmission coefficient rising monotonically from 3.216 at the distress decile to 6.048 at the boom decile (slope equality F equals 5.614, p less than 0.001). A state-level panel with FCI Procurement Coverage Index interaction identifies the distress sale channel (repo times PCI equals 0.038, p less than 0.001). Wavelet coherence documents strong long-run co-movement (0.840) against weak short-run coherence (0.136), with the repo rate leading PRG by 3.9 months. An NSS household sensitivity analysis establishes an 11.57 percentage-point upward bias in AGMARKNET-based estimates. Five institutional recommendations are addressed to the RBI/MPC, CACP, PM-AASHA, and state procurement agencies.

Keywords: Inflation targeting; Minimum Support Price; Price Realisation Gap; NARDL; Asymmetric monetary transmission; Agricultural credit; Distress sale; India; Quantile regression; Wavelet coherence

JEL Classification: E52; Q18; G21; O13; C22; C23

1. Introduction

1.1 The Central Puzzle: Price Stability and Farm Price Distress

On 5 August 2016, India's Parliament formally amended the Reserve Bank of India Act to constitute a six-member Monetary Policy Committee and establish a legal framework for Flexible Inflation Targeting (FIT) with a 4 percent Consumer Price Index target and a plus or minus 2 percent tolerance band. The amendment represented the culmination of a decade of monetary institutional reform aimed at breaking the persistent inflation expectations that had kept Indian CPI above 8 percent for the decade preceding 2013. By the standard macroeconomic metrics, the reform succeeded. The CPI averaged 4.43 percent in the eight years following FIT adoption against 8.91 percent in the preceding four years. Inflation expectations, surveyed by the RBI, converged toward the target range. The Monetary Policy Committee established itself as a credible, transparent, and operationally independent decision-making body. India joined the mainstream of emerging market monetary institutions.

During this period of price stability at the macroeconomic level, a parallel and largely unexamined deterioration was unfolding at the farm-gate level. The composite Price Realisation Gap (PRG), a novel index constructed in this paper to measure the proportional deviation of farm-gate modal prices from the government's Minimum Support Price (MSP) floor, collapsed from a mean of 16.91 percent above MSP in the four years preceding FIT adoption to 3.08 percent in the eight years following adoption. For Paddy, the primary income source for over 100 million smallholder households, the mean PRG turned negative at -3.86 percent in the post-FIT period, meaning that the average paddy farmer received below the government-declared minimum price during the majority of post-FIT months. For Maize, the mean PRG stood at -6.53 percent post-FIT. The juxtaposition is precise and arresting. The same monetary regime that delivered the best headline inflation performance in India's modern economic history coincided with a deterioration in the price support that India's farming population actually received.

Table 1.1: Pre-FIT versus Post-FIT Comparison, Key Agricultural and Monetary Indicators

Indicator	Pre-FIT (Jan 2012 to Jul 2016)	Post-FIT (Aug 2016 to Dec 2024)	Change
Repo Rate (%, mean)	7.58	5.58	-2.00 pp
CPI Food YoY (%, mean)	8.12	4.09	-4.03 pp
PRG Composite Equal-wt (%, mean)	16.91	3.08	-13.83 pp
PRG Composite Prod-wt (%, mean)	11.59	1.27	-10.32 pp
PRG Paddy (%, mean)	4.89	-3.86	-8.76 pp
PRG Wheat (%, mean)	10.95	5.27	-5.68 pp
PRG Maize (%, mean)	0.32	-6.53	-6.85 pp
Below-MSP months (composite, %)	5.5% (3 of 55)	35.6% (36 of 101)	30.2 pp increase
Below-MSP months (Paddy, %)	34.5% (19 of 55)	64.4% (65 of 101)	29.9 pp increase
Below-MSP months (Maize, %)	43.6% (24 of 55)	71.3% (72 of 101)	27.7 pp increase
Inflation (CPI headline, %)	8.91	4.43	-4.48 pp

Note: PRG = (Modal Price minus MSP)/MSP x 100. Pre-FIT: January 2012 to July 2016 (55 months). Post-FIT: August 2016 to December 2024 (101 months). Modal prices from CEDA Agri Market Data (AGMARKNET). MSP series from CACP Price Policy Reports 2012-13 to 2024-25. Prod-wt = production-weighted composite using MoSPI crop output shares: Paddy 0.285, Wheat 0.248, Maize 0.175, Gram 0.091, Soybean 0.087, Cotton 0.071, Tur 0.043. Below-MSP months computed from equal-weighted composite for composite rows, and crop-specific PRG for crop rows. Repo rate and CPI from RBI DBIE and MoSPI respectively.

This juxtaposition is not self-evidently paradoxical. It is possible that the pre-FIT PRG simply reflected an unsustainably accommodative monetary policy cycle that happened to coincide with elevated commodity prices, and that the post-FIT PRG reflects a more sustainable equilibrium. It is also possible that the PRG collapse reflects agricultural productivity gains that raised output and lowered prices toward and below MSP, or that it reflects supply disruptions specific to the post-FIT period (demonetisation, COVID-19) rather than the monetary regime itself. This paper examines these alternative explanations rigorously and finds them insufficient to account for the magnitude, persistence, and distributional characteristics of the PRG collapse. The central argument, developed theoretically in Section 2 and tested empirically in Sections 4 and 5, is that the FIT framework has structurally attenuated the monetary easing cycles that historically provided long-run price support to India's farming population through the agricultural credit and distress sale channels, the Policy Suppression-Price Compression (PSPC) mechanism.

India has approximately 140 million agricultural households. The NSS Situation Assessment Survey of Agricultural Households 2018-19 (NSS SAS, MoSPI Report No. 587) documents that 14.5 percent of paddy-cultivating households accessed government procurement at MSP in that year, and only 2.1 percent of maize-growing households accessed procurement. The remaining households sold in open mandi markets where prices averaged 3.86 percent below MSP for paddy during the post-FIT period. An NSS household sensitivity analysis conducted in this paper establishes that the AGMARKNET-based PRG overstates actual farm price realisation by 11.57 percentage points when adjusted for the NSS procurement access evidence, placing the true post-FIT household-weighted PRG at approximately -13.54 percent, a degree of below-MSP realisation that has not been documented in the existing literature and that substantially exceeds the already-alarming estimates from mandi price data alone.

1.2 Research Questions and Theoretical Argument

This paper addresses seven interrelated research questions. First, does a stable long-run cointegrating relationship exist between India's monetary policy rate and farm-gate price realisation relative to the MSP floor, and is this relationship asymmetric with respect to rate hikes versus rate cuts? Second, does temporal Granger causality run from the monetary policy rate to farm price outcomes, or is the observed co-movement driven by common confounders or reverse causality? Third, is the monetary transmission to farm prices distributional, with the repo rate delivering different PRG improvements to farmers at different points of the price realisation distribution? Fourth, at what time-frequency scales does the monetary-agricultural price relationship operate, and does the wavelet coherence structure reveal a mismatch between the annual agricultural cycle and the multi-year monetary policy cycle? Fifth, does FCI procurement coverage moderate the monetary transmission to farm prices at the state level, providing cross-sectional identification of the distress sale channel? Sixth, is there a statistically detectable

discontinuity in farm price realisation at the FIT adoption cut off of August 2016 that can be identified through a Regression Discontinuity design? Seventh, how does the downward bias in AGMARKNET-based PRG estimates affect the interpretation of the paper's findings regarding below-MSP incidence?

The theoretical argument, designated the Policy Suppression-Price Compression (PSPC) mechanism and developed in Section 2, proceeds through four analytically distinct channels. The monetary easing attenuation channel argues that the food CPI weight in the FIT target (approximately 39 percent of the all-India CPI basket) structurally limits the depth and duration of easing cycles, because agricultural price recovery, which would otherwise raise farm income, simultaneously raises the headline CPI against which the MPC is constitutionally accountable, triggering the withdrawal of accommodation. The MSP revision suppression channel argues that inflationary concerns constrain the CACP's effective revision growth, moderating the upward movement of the price floor and compressing the PRG from below. The input cost amplification channel documents that diesel costs compound the monetary compression asymmetrically, amplifying price distress specifically at the most vulnerable distress quantiles of the farm price distribution. The distress sale channel formalises the micro-level mechanism: higher crop loan costs shorten the optimal post-harvest holding period, intensifying forced selling at mandi price troughs and directly depressing the modal price relative to the MSP floor. The PSPC mechanism does not require that the RBI or the CACP deliberately suppresses farm prices. It operates through structural institutional linkages, the food CPI weight in the IT target, the agricultural credit market, and the MSP revision process, that were not designed in coordination with each other and whose aggregate effect on farm price realisation has not previously been examined.

1.3 Empirical Strategy and Methodological Contributions

The empirical analysis employs seven complementary strategies, each addressing a distinct dimension of the monetary-agricultural price nexus. The Non-linear Autoregressive Distributed Lag (NARDL) model of Shin, Yu, and Greenwood-Nimmo (2014) provides the primary test of asymmetric cointegration. It decomposes the repo rate into accumulated positive (hike) and negative (cut) partial sum processes and tests whether they have statistically distinct long-run effects on PRG. The Pesaran-Shin-Smith (2001) bounds F-statistic providing the cointegration test and the Wald statistic testing long-run asymmetry. Three NARDL specifications are estimated (PRG Composite, PRG Paddy, and PRG Wheat) alongside an augmented specification with five macro controls; HAC Newey-West standard errors are applied to Model 2 (Paddy) to address the ARCH failure in the residuals.

The trivariate Vector Autoregression (VAR) complements the NARDL by establishing the direction of Granger causality between monetary policy and farm price realisation. The absence of reverse causality, confirmed at $p = 0.825$, is a prerequisite for any causal interpretation of the NARDL coefficients. The Forecast Error Variance Decomposition (FEVD) quantifies the relative contribution of monetary policy shocks to PRG forecast uncertainty at 6, 12, and 24 month horizons, and the Impulse Response Function (IRF) traces the dynamic transmission path over 24 months with 500 bootstrap replications and 95 percent confidence bands. The robustness of the FEVD to Cholesky ordering is verified through an alternative specification, confirming that the ordering choice changes the REPO share at $h = 12$ months by only 1.44 percentage points.

The Method of Moments Quantile Regression (MMQR) of Machado and Silva (2019) examines distributional heterogeneity in monetary transmission across five quantiles (tau = 0.10, 0.25, 0.50,

0.75, 0.90) of the PRG distribution, spanning severe price distress to price boom conditions. The augmented specification adds diesel price and agricultural wage to the baseline repo rate and CPI regressors. The slope equality Wald test assesses whether the transmission coefficient is statistically identical across quantiles. Wavelet coherence analysis, implemented using the Morlet mother wavelet with the period range restricted to 2 to 72 months to avoid cone-of-influence boundary effects, decomposes co-movement between PRG and the repo rate across both time and frequency dimensions simultaneously.

Three supplementary identification strategies address the causal interpretation of the aggregate time-series findings. The state-level panel with FCI Procurement Coverage Index interaction exploits cross-state variation in the institutional intensity of MSP enforcement to identify the procurement-mediated monetary transmission channel. The Regression Discontinuity design at the FIT adoption cut-off of August 2016 tests for a discrete change in composite PRG at the institutional boundary, with a Donut RD specification excluding the demonetisation window to assess the sensitivity of the discontinuity to the November 2016 cash withdrawal shock. The NSS household sensitivity analysis employs published tabulations from NSS SAS 2018-19 to quantify the upward bias in AGMARKNET-based PRG estimates, establishing that the paper's below-MSP incidence statistics are conservative lower bounds on the true household-level incidence of farm price distress.

Three methodological innovations distinguish this paper from existing work. The PRG index, constructed from daily AGMARKNET mandi observations for seven crops against CACP annual MSP series and expressed in both equal-weighted and production-weighted composite forms, provides the first monthly, crop-specific, MSP-relative measure of farm price welfare that is simultaneously amenable to time-series econometric analysis and institutionally interpretable. The formal two-period farmer optimisation model generates three closed-form comparative static predictions that are each tested against the empirical findings, constitutes the micro-founded theoretical account of the monetary-agricultural price nexus. The seven-method analytical architecture, combining NARDL, VAR, MMQR, wavelet, state panel, RD, and NSS sensitivity , provides a degree of empirical triangulation that is novel in the agricultural economics literature and is motivated by the multiple identification challenges posed by the Indian data environment.

1.4 Principal Findings

Seven principal findings emerge from the empirical analysis, each addressing one of the research questions posed in Section 1.2 and collectively constituting the empirical case for the PSPC mechanism.

First, a stable long-run cointegrating relationship exists between Paddy PRG and the RBI repo rate, confirmed at the 1 percent significance level by the Pesaran-Shin-Smith bounds test ($F = 9.216$, exceeding the I(1) upper critical value of 6.36). The normalised long-run effect of accumulated rate cuts on Paddy PRG is +16.313 ($p = 0.043$). The sustained monetary easing raises farm-gate price realisation above the MSP floor. The short-run rate-cut coefficient of 0.965 remains highly significant under HAC standard errors ($p = 0.003$). The composite PRG fails the bounds test when all seven crops are included, an honest and carefully explained result attributable to the high-variance dynamics of Maize and Gram rather than to an absence of monetary transmission in economically dominant crops. The augmented NARDL confirms that economic macro-controls are jointly insignificant ($p = 0.296$) while the demonetisation dummy is separately significant ($p = 0.009$), partitioning the two structural shocks.

Second, Granger causality tests confirm unidirectional temporal precedence from the repo rate to PRG ($F(6,138) = 2.524$, $p = 0.021$) with no reverse causality ($p = 0.825$). The repo rate accounts for 18.99 percent of PRG forecast error variance at the 12-month horizon, making it the single largest identifiable external driver of PRG variance, and this result is robust to Cholesky ordering changes (difference of 1.44 percentage points). The impulse response peaks at month 10 (1.110 pp) and remains statistically significant through month 18, consistent with the seasonal crop loan transmission cycle.

Third, the augmented MMQR confirms pro-cyclical distributional heterogeneity. The repo rate coefficient rises monotonically from 3.216 at the distress decile ($\tau = 0.10$) to 6.048 at the boom decile ($\tau = 0.90$), and the Wald slope equality test rejects homogeneity at $F = 5.614$ ($p < 0.001$). Diesel cost amplification operates significantly at $\tau = 0.10$ ($p = 0.010$) and $\tau = 0.25$ ($p = 0.002$) but becomes insignificant at $\tau = 0.75$ and above, confirming asymmetric input cost compression at the most vulnerable segment of the distribution.

Fourth, wavelet coherence documents a structurally important frequency mismatch. The long-run coherence (0.840 at 24 to 72 month frequencies) far exceeds short-run coherence (0.136 at 2 to 6 months). The PRG dominant power period is 12 months (annual agricultural cycle) while the repo rate dominant period is 64 months (monetary policy business cycle). The repo rate leads PRG by approximately 3.9 months at the dominant coherence frequency, consistent with the crop loan seasonal transmission mechanism.

Fifth, the state panel provides cross-sectional institutional identification of the procurement-mediated monetary transmission channel. The repo rate times Procurement Coverage Index interaction coefficient is 0.038 (clustered standard errors, $p < 0.001$) in the full panel and 0.058 ($p < 0.001$) in the balanced panel, confirming that states with stronger FCI procurement infrastructure exhibit stronger monetary transmission to farm prices. The post-FIT level collapse is -58.791 ($p < 0.001$), confirming a structural level shift in state-level PRG following FIT adoption, while the Hausman test confirms fixed effects at chi-squared = 28.39 ($p = 6.84 \times 10^{-7}$).

Sixth, the Regression Discontinuity analysis documents a statistically significant PRG discontinuity of -3.281 percentage points at the FIT adoption cut-off at the policy-relevant bandwidth of $h = 18$ months ($p = 0.043$). However, the Donut RD, which excludes the demonetisation window, is statistically insignificant ($p = 0.382$), and the CCT-optimal bandwidth is too narrow to provide adequate power (15 effective observations). The RD evidence is presented as suggestive rather than definitive consistent with the PSPC hypothesis but insufficient to cleanly separate the FIT institutional effect from the contemporaneous demonetisation shock.

Seventh, the NSS SAS 2018-19 sensitivity analysis documents an upward bias of 11.57 percentage points in the AGMARKNET composite PRG, with the bias largest for Maize (20.94 pp) and Cotton (16.57 pp) where procurement access is least widespread. This finding establishes that the 25.0 percent below-MSP month incidence documented in this paper for the composite PRG is a conservative lower bound. The true household-weighted below-MSP incidence is substantially higher. These seven findings survive four additional robustness checks: balanced panel sensitivity ($N = 1,545$; interaction coefficient 0.058 versus 0.038 in the full panel), alternative VAR Cholesky ordering (FEVD change of 1.44 pp at $h = 12$ months), production-weighted PRG composite (collapse of 10.32 pp versus 13.83 pp equal-weighted), and CUSUM parameter stability tests confirming structural stability of all three NARDL models across the five Bai-Perron structural breaks.

1.5 Contributions to the Literature

This paper makes five contributions to the existing literature at the intersection of monetary economics, agricultural economics, and development policy. The first is empirical: it provides the systematic, high-frequency evidence that India's monetary policy rate and farm-gate price realisation relative to the MSP share a cointegrated long-run relationship is asymmetric, pro-cyclical in its distributional incidence, institutionally mediated by procurement coverage, and concentrated at structural multi-year frequencies. The PRG collapse of 13.83 percentage points (equal-weighted) and 10.32 percentage points (production-weighted) documents a deterioration in the MSP's effectiveness as an income support instrument is larger in magnitude and more persistent in character than previously documented in the agricultural economics literature.

The second contribution is methodological. The PRG index, monthly, crop-specific, MSP-relative, amenable to time-series econometric analysis, and constructed in both equal-weighted and production-weighted composite forms, fills gap in the measurement of agricultural price support effectiveness. The seven-method analytical architecture (NARDL, VAR, MMQR, wavelet, state panel, RD, NSS sensitivity) constitutes a replicable template for studying monetary-agricultural price interactions in other developing economies with inflation targeting frameworks and administered price support systems. The COI-restricted wavelet decomposition, the balanced panel sensitivity check, and the NSS household weighting procedure are individually applicable to related research problems.

The third contribution is theoretical. The PSPC mechanism, formalised in a two-period farmer optimisation model with closed-form comparative static predictions, constitutes the theoretically grounded and empirically tested account of how an IT regime produces agricultural price compression as a structural by-product of macroeconomic stabilisation. The three model predictions, $dh^*/d\rho < 0$, asymmetric constraint-binding response, and pro-cyclical distributional incidence, are each directly matched to and confirmed by the NARDL, MMQR, and state panel findings, establishing the theory-evidence.

The fourth contribution is the cross-sectional institutional identification provided by the state panel. Aggregate time-series analysis establishes the monetary-agricultural price nexus but cannot identify the institutional channels through which it operates. The FCI Procurement Coverage Index interaction identifies the distress sale channel at the state level, confirming that the mechanism operates through procurement infrastructure in the specific direction predicted by the PSPC framework, and providing external validity for the aggregate findings.

The fifth contribution is policy-relevant. The five institutional recommendations in Section 6.2 are grounded in the empirical magnitude of the documented transmission mechanism and addressed to distinct institutional actors, the RBI/MPC, the CACP, PM-AASHA, and state procurement agencies, rather than to a generic policymaker. The state panel identifies which states are most exposed, the MMQR identifies which crops and farm sizes receive the least monetary transmission benefit, the wavelet identifies the relevant planning horizon, and the NSS sensitivity identifies the most vulnerable households who are invisible in the mandi price data. The five recommendations are the desirability of policy coordination specific, actionable, and empirically grounded guidance for the distinct actors responsible for each element of the monetary-agricultural policy architecture.

The paper additionally contributes to the growing literature on the distributional consequences of monetary policy in developing economies (Coibion et al., 2017; Furceri et al., 2018), extending it to a sector, agriculture, and a welfare measure, farm price realisation relative to an administered

floor, that the distributional monetary literature has not previously examined. The finding of monetary transmission is pro-cyclical in its agricultural welfare incidence, stronger for already well-positioned farmers, weaker for farmers in distress, complements the Coibion et al. finding that monetary tightening raises income inequality through capital-labour substitution, and extends the mechanisms of distributional monetary policy consequences to the agricultural household sector of a large developing economy.

1.6 Organisation of the Paper

The remainder of this paper is organised as follows. Section 2 reviews the relevant literature across seven research strands and develops the theoretical framework. Section 3 provides institutional background on the FIT framework, the MSP system, and the agricultural credit market, establishing the factual foundation for the theoretical channels proposed in Section 2 and documenting the three feedback loops through which the three institutional architectures interact in the PSPC system. Section 4 describes the data sources and variable construction, covering the derivation of the PRG index, the construction of both equal-weighted and production-weighted composite measures, the state-level panel dataset with FCI Procurement Coverage Index, the NSS SAS 2018-19 household sensitivity data, and the econometric framework for all seven estimation strategies. Section 5 reports and interprets the empirical results across nine subsections: unit root and structural break tests (5.1); NARDL cointegration and asymmetric transmission (5.2); MMQR distributional heterogeneity (5.3); VAR Granger causality, IRF, FEVD, and wavelet coherence (5.4); state-level panel evidence (5.5); Regression Discontinuity analysis (5.6); NSS household sensitivity (5.7); international comparative evidence (5.8); and integrated interpretation linking all seven findings to the PSPC mechanism (5.9). Section 6 presents the conclusions, five specific policy implications, contributions to the literature, limitations and future research directions, and concluding remarks. A Data Availability Statement and full References section follow.

2. Review of the Literature and Theoretical Framework

2.1 Inflation Targeting: Architecture, Evidence, and Emerging Market Adoption

The intellectual architecture of inflation targeting rests on three interlocking propositions that emerged from the macroeconomic consensus of the late 1980s and 1990s. The first is the long-run neutrality of monetary policy with respect to real output. The sustained inflation generates no permanent employment or growth dividend. The primary contribution of monetary policy to economic welfare lies in delivering price stability rather than in managing the real economy at business cycle frequencies (Friedman, 1968; Kydland and Prescott, 1977). The second is the credibility premium. A transparent, rule-based nominal anchor expressed as a publicly announced inflation target reduces the private-sector inflation expectations component of wage and price setting, lowering the sacrifice ratio associated with any given disinflation and permitting monetary policy to operate with lower average inflation than a discretionary regime (Barro and Gordon, 1983; Rogoff, 1985). The third is institutional delegation: assigning the inflation mandate to an operationally independent central bank, subject to clearly defined accountability mechanisms, insulates monetary decisions from short-term electoral pressures while preserving democratic legitimacy through transparency and periodic reporting (Bernanke and Mishkin, 1997; Svensson, 1999).

These propositions found operational expression beginning with New Zealand in 1990 and subsequently diffused across advanced economies and, from the mid-1990s onward, into a growing cohort of emerging market and developing economies. The empirical literature on the macroeconomic performance of inflation-targeting regimes has confirmed the framework's effectiveness in reducing inflation and anchoring inflation expectations (Roger, 2010; Goncalves and Salles, 2008; Ball and Sheridan, 2005), though the causal attribution of post-adoption disinflation has been contested. The critics note that global disinflationary forces and improved fiscal positions may account for a substantial share of the observed improvement (Ball and Sheridan, 2005; Brito and Bystedt, 2010). In the specific context of large emerging markets with structural food price volatility, India, Brazil, Indonesia, South Africa, the literature has additionally identified a distinctive tension between the headline CPI target (which includes food) and the core inflation indicator that more closely tracks monetary policy transmission, generating recurrent episodes in which supply-side agricultural price shocks force the central bank to choose between maintaining anti-inflationary credibility and avoiding unnecessary economic contraction (Goyal, 2015; Mishra and Mishra, 2018; Patra and Ray, 2010).

The Indian FIT framework, formally constituted under amendments to the RBI Act in May 2016, adopts a 4 percent CPI target with a plus or minus 2 percent tolerance band and assigns the primary inflation mandate to a six-member Monetary Policy Committee with a supermajority voting rule. The RBI's own assessment of the FIT framework's first five years (RBI Report on Currency and Finance, 2021) confirms that the regime anchored expectations and reduced inflation variance, while acknowledging persistent food price volatility as a structural challenge to the framework's operation. Das et al. (2020) demonstrate that MPC communication under FIT has materially improved the predictability of monetary policy decisions for financial market participants. Its architecture differs from canonical inflation targeting in two institutionally significant respects. First, the food and beverages sub-component of CPI carries a weight of approximately 39 percent in the all-India index, a structural feature that makes headline inflation highly responsive to agricultural supply shocks and seasonally volatile food prices that are, in principle, beyond the reach of monetary instruments. Second, the MSP system, a parallel administrative price architecture covering over 23 crops, operates alongside the market price formation process in ways that may amplify or attenuate the food price signal that the MPC monitors. When MSP revisions exceed productivity growth, they push CPI food upward and crowd out MPC space for accommodation; when MSP revisions are suppressed to contain CPI food, the farm price floor erodes. This institutional entanglement between the monetary target and the agricultural price support system is the central motivation for the present study.

2.2 Distributional Consequences of Monetary Policy: The Neglected Agricultural Dimension

The distributional consequences of monetary policy have attracted growing scholarly attention in the post-Global Financial Crisis decade, motivated in part by the extraordinary asset purchase programmes of major central banks and in part by the documented widening of income and wealth inequality in countries that maintained prolonged low-interest-rate environments. Coibion, Gorodnichenko, Kueng, and Silvia (2017) provide the comprehensive empirical account, demonstrating for the United States that contractionary monetary policy shocks raise income inequality by compressing labour income relative to capital income, while expansionary shocks reduce inequality through the earnings heterogeneity channel. Furceri, Loungani, and Zdzienicka (2018) extend this finding across a panel of 32 advanced and emerging economies, confirming that monetary tightening raises income inequality within five years of the shock, with the effect larger

in countries with weaker labour institutions. Mumtaz and Theophilopoulou (2017) document similar patterns for the United Kingdom using household-level consumption data.

These contributions are formulated in terms of the capital-labour income divide and the consumption basket heterogeneity between rich and poor households. They abstract from the specific position of agricultural households in the monetary transmission system, a position is institutionally distinct from the wage-earner or asset-owner divide that organises the advanced-economy distributional literature. Agricultural households in developing economies occupy a particular structural location. They are simultaneously price-takers in the output market (where farm-gate prices are set by mandi demand-supply dynamics), price-takers in input markets (where diesel, fertiliser, and labour costs are partially indexed to monetary conditions), and credit-constrained borrowers in formal and informal credit markets (where the policy rate influences the cost and availability of agricultural working capital). This triple price-taking exposure creates a distinctive monetary transmission channel that has no precise analogue in the wage-earner model and the existing distributional monetary literature does not capture.

In the Indian context, this gap in the literature is particularly consequential given the institutional architecture of agricultural price support. The MSP theoretically provides a floor below which farm-gate prices should not fall. It is administratively determined on an annual basis with CACP recommendations incorporating input costs, terms of trade, and a reasonable return to farmer labour. If the monetary policy environment systematically influences the relationship between market prices and the MSP floor, either by compressing market prices below MSP during tightening cycles or by failing to provide the credit-market uplift that historically sustained above-MSP realisation, then the MSP's effectiveness as an income support instrument is endogenously linked to the monetary regime. This is the core theoretical proposition examined in this paper, and it represents a dimension of monetary-agricultural policy interaction that has been ignored in both the inflation targeting literature and the agricultural economics literature.

The household-level corroboration of the triple price-taking exposure argument comes from the NSS 77th Round Situation Assessment Survey of Agricultural Households (NSS SAS 2018-19), reported in MoSPI NSS Report No. 587. The survey documents that only 14.5 percent of paddy-cultivating households accessed government procurement agencies in Kharif 2018-19, and 2.1 percent of maize-growing households accessed procurement in the same year. For the remaining 85 to 98 percent of households selling in open market. The MSP functions not as an effective price floor but as a notional benchmark against which their actual realisation, typically 11 to 21 percentage points lower, as documented in Section 5.7, is measured. This household-level evidence confirms the theoretical prediction of the PSPC mechanism. The farmers most exposed to monetary transmission through the distress sale channel are precisely those with the least access to the institutional backstop of MSP procurement.

2.3 Agricultural Price Transmission: Theory, Evidence, and Indian Specificity

The agricultural price transmission literature has developed a rich analytical toolkit for examining how price signals propagate across market levels, from world prices to domestic wholesale markets, from wholesale to retail, and from retail to farm-gate, and how institutional frictions, market structure, and policy interventions shape the speed and completeness of this transmission. Fackler and Goodwin (2001) provide the canonical review, documenting substantial evidence of spatial price transmission failures attributable to poor market integration, transaction costs, and asymmetric information across the agricultural value chain. Minot (2014) extends this framework to sub-Saharan African staple markets, demonstrating that world price shocks pass through to

domestic farm-gate prices with substantial attenuation, typically 30 to 50 percent of the world price change reaches farmers within twelve months, and that institutional infrastructure significantly improves transmission completeness.

For India specifically, the literature on AGMARKNET-based price transmission has grown substantially since the data platform's establishment in 2000. Ghosh (2010) documents significant spatial market integration for wheat and rice across major mandi centres, though with marked regional heterogeneity. Sekhar (2012) finds that vertical transmission from wholesale to farm-gate prices is incomplete and asymmetric for several major crops, with price increases transmitting more rapidly than price decreases, a finding consistent with the exercise of market power by intermediary traders. Reddy (2016) shows that the introduction of e-NAM improved price discovery at connected mandis but that network effects were limited by low initial adoption and inadequate warehousing infrastructure. These studies collectively establish that Indian agricultural prices are neither perfectly integrated nor completely segmented, but occupy a middle ground of imperfect, institutionally mediated transmission, a property that is relevant to the present paper's examination of how monetary policy signals reach farm-gate prices.

The specifically monetary dimension of agricultural price transmission has received comparatively limited attention in the Indian literature. Frankel (2008) develops the commodity price overshooting hypothesis, an extension of Dornbusch's (1976) exchange rate overshooting model, in which a monetary expansion causes commodity prices to overshoot their long-run equilibrium because commodities, as storable assets, immediately capitalise the change in real interest rates while goods prices adjust more slowly. Anzuini, Lombardi, and Pagano (2013) provide empirical support for this mechanism in global commodity markets, finding that contractionary US monetary policy shocks reduce broad commodity prices by approximately 5 to 8 percent within six months. These studies examine monetary transmission to traded commodity prices at the world market level. They do not address the specific question of how domestic policy rates in a developing economy affect farm-gate prices relative to an administratively determined floor, the price-support-relative question that is central to the PRG framework developed in this paper.

2.4 Indian Monetary Policy Transmission: The Agricultural Credit Channel

The Indian monetary policy transmission literature has grown rapidly since the introduction of the Liquidity Adjustment Facility in 2000 and the repo rate as the primary policy instrument. The broad consensus from this literature is that monetary transmission in India is slower and more incomplete than in advanced economies, operating primarily through the bank lending channel with significant frictions introduced by the high share of administered-rate loans, the prevalence of government securities holdings in bank portfolios, and the dominance of informal credit in rural areas (Aleem, 1990; Mishra, Montiel, and Spilimbergo, 2012). Mohanty and John (2015) found that a 100-basis-point repo rate increase reduces output by approximately 0.5 percent and CPI inflation by approximately 0.4 percent within six to eight quarters, with transmission becoming sharper and faster following financial sector deregulation in the 2000s. Bhoi, Mitra, and Singh (2017) confirm these findings using a structural VAR approach and additionally document that transmission to rural and agricultural credit markets is significantly slower than to urban and corporate credit, reflecting the persistence of informal credit market dominance in rural India.

The agricultural credit channel, through which repo rate changes influence the cost and availability of Kharif and Rabi crop loans is theoretically direct transmission mechanism from monetary policy to farm price outcomes. When the repo rate falls, scheduled commercial banks face lower refinancing costs, which under Priority Sector Lending mandates are partially passed through to

agricultural borrowers through lower crop loan interest rates. Lower crop loan rates reduce the working capital cost of cultivation, improve farmers' capacity to hold stocks rather than distress-sell immediately after harvest, and increase the effective market power of farmer collectives in price negotiations with traders and processors. The resulting reduction in distress sales, the phenomenon by which indebted farmers are compelled to sell at sub-market prices to meet repayment obligations, mechanically raises the average farm-gate modal price and thus improves the PRG. Conversely, when the repo rate rises, crop loan costs increase, input financing becomes more expensive, and the incentive to distress-sell intensifies.

This agricultural credit transmission channel has been documented in several partial equilibrium studies. Mishra and Suresh Babu (2016) find that agricultural credit disbursement responds significantly to repo rate changes with a lag of approximately three to four months, and that higher agricultural credit availability is associated with improved farmer price realisation in state-level panel data for the 2004 to 2015 period. Kumar, Mishra, and Bhatt (2018) document significant heterogeneity in the credit transmission mechanism across farmer size categories. The small and marginal farmers rely heavily on informal credit at fixed interest rates, experience less improvement in price realisation from repo rate cuts than large farmers who access formal bank credit, a finding anticipating the MMQR distributional heterogeneity documented in the present paper. Gulati, Wardhan, and Sharma (2019) provide the most direct antecedent to this study. It documenting a negative correlation between repo rate levels and below-MSP price incidents across major crops in the post-2012 period, though without the formal time-series econometric framework necessary to establish cointegration, asymmetric transmission, or the directional primacy of monetary policy over agricultural price outcomes.

2.5 Minimum Support Price Policy: Effectiveness, Reach, and Institutional Architecture

The MSP system in India has been the subject of sustained scholarly scrutiny regarding both its design adequacy and its implementation effectiveness. Chand (2017) provides the comprehensive assessment of MSP policy performance, documenting that the real MSP for major crops grew at an average annual rate of 2.1 percent in the decade 2007 to 2017, significantly below the growth in input costs and broadly consistent with a squeeze on agricultural profitability. Birthal, Joshi, Negi, and Agarwal (2015) demonstrate that the MSP is effectively enforced only for wheat and paddy, through the FCI's direct procurement operations in major producing states. The remaining 21 notified crops, market prices fall below MSP in a significant fraction of months and regions, rendering the support price a largely notional floor. Gulati and Saini (2013) document the geographical concentration of MSP procurement: approximately 80 percent of wheat and paddy procurement occurs in Punjab, Haryana, Andhra Pradesh, and Madhya Pradesh, leaving farmers in eastern India with minimal effective MSP protection.

The fiscal and incentive distortions introduced by the MSP system have been documented by Jha and Srinivasan (2004) shows that MSP incentives have contributed to the expansion of water-intensive paddy cultivation in ecologically unsuitable Punjab and Haryana. Gulati, Terway, and Hussain (2018) estimate that the implicit subsidy embedded in MSP-based procurement constitutes a substantial fiscal transfer to MSP-recipient farmers but excludes the majority of smallholder cultivators who cannot access formal procurement channels. These studies collectively establish the MSP as an institution with powerful theoretical intent but highly uneven implementation reach, a characterisation that directly shapes the interpretation of the PRG index constructed in this paper.

The interaction between MSP policy and the broader macroeconomic environment has received limited systematic attention. Chand and Jumrani (2013) note that the acceleration in MSP growth

during the 2007 to 2012 commodity price boom contributed to food price inflation and effectively constrained the RBI's monetary policy space, but do not examine the reverse channel. The extent to which monetary policy constrains MSP revision scope. Goyal (2015) examines the relationship between food price volatility and monetary policy in the FIT debate context, arguing that supply-side food price shocks should ideally be accommodated rather than offset through monetary tightening, but stops short of examining the consequences of monetary tightening for farm-gate price realisation. The present paper addresses this gap by constructing the PRG as the outcome variable that links monetary policy decisions, through the agricultural credit and input cost transmission channels, to farm price outcomes relative to the policy floor.

2.6 Asymmetric and Nonlinear Price Dynamics: The NARDL

The econometric treatment of asymmetric adjustment in economic time series has advanced substantially since the foundational contributions of Engle and Granger (1987) on cointegration and of Enders and Granger (1998) on threshold cointegration. The recognition that many economic relationships, including price transmission, exchange rate pass-through, and financial market dynamics, exhibit asymmetric adjustment, with positive and negative shocks propagating at different speeds and with different long-run magnitudes, has motivated a family of threshold and nonlinear cointegration estimators. The Non-linear Autoregressive Distributed Lag model of Shin, Yu, and Greenwood-Nimmo (2014) represents the most tractable and adopted member of this family, extending the linear ARDL bounds-testing procedure of Pesaran, Shin, and Smith (2001) to the asymmetric case through the partial sum decomposition of the independent variable of interest.

The NARDL framework has been applied to commodity and agricultural price transmission problems. Bahmani-Oskooee and Fariditavana (2016) demonstrate that exchange rate depreciations and appreciations produce asymmetric trade balance dynamics that linear error-correction models miss. Jain and Ghosh (2013) apply asymmetric models to Indian agricultural price transmission, finding evidence of downward price rigidity consistent with the market power of intermediary traders. The present paper extends this NARDL tradition to the novel problem of monetary policy transmission to farm-gate prices relative to the MSP floor, exploiting the asymmetric decomposition to test whether rate hikes and rate cuts produce distinct long-run effects on farm price realisation, a question that a linear ARDL would suppress by construction. The updated estimation results confirm that the Paddy PRG model yields an F-statistic of 9.216 (exceeding the 1 percent upper bound of 6.36) and a short-run rate-cut coefficient of 0.965 (HAC $t = 3.042$, $p = 0.003$), establishing cointegration and asymmetric monetary transmission at the highest level of statistical confidence.

Wavelet coherence analysis, applied as a complement to the NARDL in this study, decomposes co-movement between PRG and the repo rate across both time and frequency simultaneously. Aguiar-Conraria and Soares (2014) provide the methodological foundation for wavelet coherence applications in economics, demonstrating that the Morlet mother wavelet is particularly suited to macroeconomic time series where both frequency content and temporal localisation are of analytical interest. In the agricultural economics context, wavelet analysis has been applied to commodity price cycles (Reboredo and Rivera-Castro, 2014), food price volatility (Jammazi and Aloui, 2012), and more recently to monetary-agricultural price nexus studies in sub-Saharan Africa (Oye et al., 2022), but has not previously been applied to the specific question of IT regime effects on farm price realisation relative to an administered support price. The long-run coherence of 0.840 between PRG and the repo rate at frequencies of 24 to 72 months, against a short-run coherence

of 0.136 at 2 to 6 month frequencies, documents a structurally important frequency mismatch between the annual agricultural price cycle and the five-year monetary policy business cycle that has direct implications for the design of countercyclical agricultural price support policy.

2.7 Identification Strategies: Panel, Regression Discontinuity, and Comparative Evidence

The aggregate time-series framework of the NARDL and VAR estimators establishes the monetary-agricultural price nexus at the national level but cannot identify the specific institutional channels through which it operates. Three additional identification strategies, each grounded in a distinct literature, address this limitation.

The state-level panel strategy exploits cross-sectional variation in FCI procurement coverage across states to identify the procurement-mediated monetary transmission mechanism predicted by Channel IV of the PSPC framework. The panel DID literature (Wooldridge, 2010; Angrist and Pischke, 2009) provides the methodological foundation for this approach. The Procurement Coverage Index (PCI), constructed from FCI state-wise procurement data for Rice and Wheat, measures the institutional intensity of MSP enforcement in each state on a 0 to 100 scale. The interaction term between the repo rate and the PCI identifies the differential effect of monetary policy in high-procurement states relative to low-procurement states, providing cross-sectional institutional identification of the distress sale channel that is absent from aggregate time-series analysis. The Hausman test confirms fixed effects specification (chi-squared = 28.39, $p < 0.001$), and standard errors are clustered at the state level to account for within-state temporal autocorrelation.

The Regression Discontinuity design exploits the institutional discontinuity at the FIT adoption date of August 2016 as a quasi-experimental source of identification for the causal effect of the FIT regime on PRG. The RD methodology of Calonico, Cattaneo, and Titiunik (2014) provides the data-driven bandwidth selection and bias-corrected inference procedure employed in this study. Imbens and Lemieux (2008) establish the conditions under which the RD design identifies the local average treatment effect at the cut-off. The key identifying assumption, that the running variable (months elapsed from August 2016) is continuously distributed at the cut-off, is verified by the McCrary density test. The RD evidence is presented as supplementary rather than primary identification, given the three-month proximity of FIT adoption and demonetisation, which limits clean causal attribution at any bandwidth that encompasses both institutional shocks.

The comparative strategy draws on the international IT literature (Roger, 2010; Goncalves and Salles, 2008; Schmidt-Hebbel and Werner, 2002) to contextualise the Indian findings within the broader experience of developing economies that simultaneously maintain inflation targeting frameworks and administered agricultural price support systems. Indonesia's Bank Indonesia IT framework (adopted 2005) and Bangladesh Bank's IT framework (adopted 2003) provide the two nearest comparators, both operating in rice-cultivating economies with government price floor systems. The comparison is necessarily descriptive given the absence of comparable monthly farm-gate price data for these countries, but the directional consistency of the monetary policy and procurement ratio trends across all three economies provides suggestive international corroboration of the PSPC mechanism.

2.8 Conceptual Framework: The Policy Suppression-Price Compression Mechanism

The theoretical framework developed in this paper, designated the Policy Suppression-Price Compression (PSPC) mechanism, integrates insights from the inflation targeting literature, the agricultural credit transmission literature, and the institutional economics of price support policy

to generate a coherent account of how the FIT regime may produce agricultural price compression as an unintended structural consequence. The framework operates through four analytically separable and empirically entangled channels, formalised below and depicted in Figure 1.

The Formal Two-Period Farmer Optimisation Model

Consider a farmer who maximises net revenue from crop sales by choosing an optimal post-harvest holding period h, measured in weeks. The net revenue function is:

$$V(h) = P(h) \cdot Q - L \cdot r(\rho) \cdot h$$

where P(h) is the farm-gate price function (Equation 1 above), capturing seasonal post-harvest price recovery ($\delta > 0$) with diminishing returns to waiting ($\eta > 0$); Q is marketed surplus (quintals); L is the crop loan amount; and $r(\rho) = r_0 + \varphi(\rho/100)$ is the effective crop loan rate, increasing in the repo rate ρ with pass-through coefficient φ.

The first-order condition for optimal holding yields:

$$h* = \frac{Q\delta - L \cdot r(\rho)}{2Q\eta}$$

subject to the constraint h* in [0, T], where T is the maximum warehousing period before loan repayment is compulsory. Three comparative static predictions follow directly from this solution.

Prediction P1: The derivative $\partial h^*/\partial \rho = -L\varphi \cdot (200Q\eta)^{-1} < 0$, and $\partial PRG/\partial \rho < 0$. An increase in the repo rate reduces the optimal holding period and thus depresses the farm-gate price relative to the MSP floor. This is the PSPC distress sale channel: higher borrowing costs shorten the holding period, intensify post-harvest selling, and compress the PRG. The numerical calibration ($\partial h^*/\partial \rho = -1.778$, $\partial PRG/\partial \rho = -1.047$) and the empirical NARDL short-run coefficient ($repo_n = 0.965$, HAC $p = 0.003$) both confirm this prediction.

Prediction P2: The relationship between the repo rate and the PRG is asymmetric at the constraint bounds. When rho exceeds the threshold rho_upper (where h* = 0), further rate increases have no additional distress sale effect because farmers are already selling immediately at harvest. When rho falls below the threshold rho_lower (where h* = T), further rate cuts have no additional PRG benefit because storage capacity is fully utilised. The unconstrained region, approximately 4.75 percent to 7.25 percent in the calibrated model, is precisely the range of the Indian repo rate during the sample period. This asymmetry is consistent with the NARDL finding that rate hikes and rate cuts have quantitatively different long-run effects on PRG.

Prediction P3: The PRG gain from a given rate cut is inversely related to the farmer's loan-to-output ratio (L/Q). A marginal farmer with a high L/Q ratio (large debt relative to marketed surplus) has a constrained optimal holding period even after a rate cut, limiting the PRG improvement. A large farmer with a low L/Q ratio has more flexibility to extend the holding period in response to a rate cut, capturing greater PRG benefit. This prediction directly generates the pro-cyclical distributional heterogeneity confirmed by the MMQR: the monetary transmission coefficient rises monotonically from 3.216 at the distress decile (tau = 0.10) to 6.048 at the boom decile (tau = 0.90) in the augmented specification, consistent with large L/Q farmers dominating the distress quantile and low L/Q farmers dominating the boom quantile.

Channel I: Monetary Easing Attenuation

The first and most fundamental channel operates through the structural constraint that the food CPI component of the inflation target imposes on the frequency, duration, and depth of monetary easing cycles. Under FIT, the MPC is constitutionally bound to return CPI inflation to within the 2 to 6 percent band within a defined timeframe when breaches occur. Since food and beverages account for approximately 39 percent of the CPI basket, and Indian food prices are structurally volatile, the effective inflation ceiling that the MPC can tolerate in food price terms is considerably lower than the 6 percent headline ceiling. Every episode in which food CPI approaches or breaches the 6 percent ceiling simultaneously constrains the MPC's scope for accommodative policy.

This constraint operates asymmetrically with respect to the agricultural welfare consequences of monetary policy. In the pre-FIT period, during the sustained easing cycle of 2012 to 2016, when the repo rate fell from 8.50 to 6.50 percent over 54 months, the absence of a binding inflation target allowed the RBI to maintain accommodative conditions for extended periods, generating the long-run PRG uplift documented in the empirical results. Under FIT, identical easing cycles are constrained by the food CPI ceiling: as the repo rate falls and credit expands, agricultural commodity prices tend to rise through the credit channel, which in turn raises food CPI and triggers the FIT band-proximity constraint on further easing. The FIT framework thus introduces a negative feedback loop from agricultural price recovery to monetary policy restraint that attenuates the duration and depth of easing cycles precisely when they would otherwise deliver maximum farm price benefits.

Channel II: MSP Revision Suppression

The second channel operates through the CACP's MSP revision process. The CACP's recommendations are informed by the prevailing inflationary environment and the government's fiscal space, both of which are materially influenced by the monetary policy stance. During episodes in which CPI food inflation is elevated and the FIT framework signals tightening bias, there is institutional pressure on the CACP to moderate MSP revision growth to avoid adding to the food inflation signal that the MPC is monitoring. The CACP operates independently of the RBI, but reflects a broader political economy logic in which a government committed to the FIT framework faces reputational costs from large MSP revisions that contribute to food price inflation. Empirically, this channel predicts that the ratio of MSP growth to input cost growth should be lower in the post-FIT period, a prediction consistent with the data showing that the real MSP growth rate slowed materially after 2016 (Chand, 2017; CACP Annual Reports 2017 to 2024). The double compression results, the floor rising less rapidly due to MSP suppression and the ceiling descending due to market price attenuation is the arithmetic mechanism through which Channel II and Channel I combine in the PSPC framework.

Channel III: Input Cost Amplification (Asymmetric at Distress Quantiles)

The third channel operates through the cost-side consequences of monetary policy for agricultural production. Agricultural production in India is energy-intensive, with diesel fuel powering pump irrigation, tractors, and post-harvest transportation, and fertiliser-intensive, with urea and DAP representing the two largest variable input cost items for most crops. Both diesel and fertiliser prices are partially administered but are not fully insulated from international prices, and both are indirectly responsive to monetary conditions through the exchange rate channel.

An important finding from the MMQR estimation in Section 5.3 refines the theoretical characterisation of Channel III. The diesel cost coefficient in the augmented MMQR specification is negative and significant at the distress quantiles (tau = 0.10: p = 0.010; tau = 0.25: p = 0.002; tau = 0.50: p = 0.005) but insignificant at the boom quantiles (tau = 0.75: p = 0.095; tau = 0.90: p = 0.946). This quantile-specific pattern indicates that input cost amplification does not operate symmetrically across the PRG distribution. It amplifies distress specifically for farmers who are already in price distress, compounding the credit channel effect at the vulnerable segment of the distribution. Channel III is therefore not a countervailing force to Channel I but a distributional amplifier of the PSPC mechanism that operates severely at the quantiles where monetary easing delivers the least relief.

Channel IV: Credit Rationing and Distress Sale Dynamics

The fourth channel provides the micro-level foundation for the formal model above, operates through the credit rationing behaviour of agricultural households in response to the monetary policy cycle. The existing literature on rural credit markets in India (Aleem, 1990; Kochar, 1997; Burgess and Pande, 2005) documents a dual structure in which formal bank credit at regulated interest rates coexists with informal moneylender credit at rates that are largely independent of the policy rate. For farmers with access to Priority Sector agricultural loans, repo rate changes pass through with a lag documented at three to four months (Mishra and Suresh Babu, 2016) to crop loan interest rates, influencing the post-harvest timing of grain sales through the optimal holding period mechanism formalised above.

The distress sale mechanism is theoretically central to the PRG. A farmer who has borrowed to finance cultivation and faces a fixed repayment schedule is compelled to sell a portion of the harvest immediately after the crop arrives at market, regardless of prevailing prices, to service the debt. This forced early-season selling, concentrated in the October to December period for Kharif crops and the March to May period for Rabi crops, depresses modal mandi prices precisely when harvested supply is at its seasonal peak. When crop loan interest rates fall following a repo rate cut, the cost of carrying stocks increases less rapidly, reducing the urgency of distress sales and allowing better-resourced farmers to wait for post-peak seasonal price recovery. The aggregate effect is a shift in the seasonal supply curve that raises the modal mandi price during the peak harvest season and thus improves the PRG. The NARDL short-run coefficient on rate cuts (repo_n = 0.965, HAC p = 0.003) and the IRF peak at month 10 (1.110 pp) jointly confirm this seasonal transmission lag.

2.9 Literature Mapping and Identification of Research Gaps

Table 2.1 maps the principal research strands reviewed above against the core findings of the existing literature and the specific gaps that the present paper addresses. The mapping identifies eleven strands spanning monetary economics, agricultural economics, development finance, institutional economics, and econometric methodology, and confirms that no existing study has examined the cointegrated long-run relationship between a monetary policy regime and farm-gate price realisation relative to an administered support price, nor applied the state panel, RD, wavelet, MMQR, and NSS household sensitivity strategies jointly to this problem.

Table 2.1: Literature Mapping, Research Strands, Identified Gaps, and This Paper's Contribution

Research Strand	Key Studies	Core Finding	Gap Addressed by This Paper
Inflation targeting and growth	Bernanke and Mishkin (1997); Roger (2010); Goncalves and Salles (2008)	IT reduces inflation variance; mixed evidence on growth effects in EMEs	No agricultural welfare analysis; no farm price or PRG study
IT distributional effects	Coibion et al. (2017); Furceri et al. (2018); Mumtaz and Theophilopoulou (2017)	Monetary tightening widens income inequality; asset-owner gains vs wage-earner losses	No farm price or MSP transmission; no triple price-taking exposure analysis
Indian FIT evaluation	Patra and Ray (2010); Goyal (2015); Das et al. (2020); RBI RCF (2021)	FIT anchors expectations; food-fuel volatility causes target breaches; MPC communication effective	No farm price or PRG analysis; agricultural welfare consequences unexamined
Indian monetary transmission	Mishra et al. (2016); Mohanty and John (2015); Bhoi et al. (2017)	Bank lending channel weak; rate pass-through incomplete; 4-6 quarter lag	No agricultural sector transmission; no crop loan or distress sale channel
Agricultural price transmission	Minot (2014); Fackler and Goodwin (2001); Ghosh (2010); Sekhar (2012)	Price transmission incomplete; asymmetric; institutionally mediated in India	No monetary policy linkage; no MSP-relative price analysis
MSP and farm income India	Chand (2017); Birthal et al. (2015); Gulati and Saini (2013)	MSP reach limited; procurement geographically concentrated; Paddy/Wheat bias	No monetary policy-MSP interaction; no monetary environment as PRG determinant
Monetary policy and food prices	Anzuini et al. (2013); Frankel (2008); Borensztein and Reinhart (1994)	Commodity prices overshoot after monetary shocks; exchange rate channel dominant	India-specific, farm-gate level evidence absent; no MSP-relative analysis
NARDL and asymmetric transmission	Shin et al. (2014); Bahmani-Oskooee and Fariditavana (2016); Jain and Ghosh (2013)	Asymmetric cointegration reveals nonlinear price dynamics; downward price rigidity in India	Not applied to farm-gate or MSP gap; no monetary policy decomposition

State panel and DID methods	Wooldridge (2010); Angrist and Pischke (2009)	Panel FE with interaction terms identifies institutional heterogeneity in treatment effects	Not applied to procurement-mediated monetary transmission to farm prices
Regression discontinuity design	Imbens and Lemieux (2008); Calonico et al. (2014)	RD identifies causal treatment effects at institutional cutoffs	Not applied to IT adoption effects on agricultural price outcomes
NSS SAS household surveys	MoSPI NSS Report 587 (2021); Gulati et al. (2019)	14.5% paddy households access procurement; informal market discount of 15%	No linkage to monetary transmission; no PRG bias quantification

Note: EME = Emerging Market Economy. NARDL = Non-linear Autoregressive Distributed Lag. MSP = Minimum Support Price. PRG = Price Realisation Gap. RCF = Report on Currency and Finance. The table maps eleven research strands to their primary empirical contributions and the specific analytical gap addressed by the present paper. All studies cited are indexed in the full References section.

Three specific lacunae in the existing literature define the contribution space of this paper and justify the methodological choices made in Section 4. First, the distributional monetary economics literature rich in evidence on the capital-labour income divide has not examined agricultural households as a structurally distinct category with triple price-taking exposure across output, input, and credit markets. The PRG framework fills this gap by providing a single integrated measure of farm price welfare that simultaneously captures market price dynamics, institutional price floor movements, and the differential transmission of monetary policy to farm-gate outcomes. Second, the Indian monetary transmission literature has examined the bank lending, exchange rate, and asset price channels but has not addressed the agricultural credit channel or its relationship to farm-gate price realisation. The NARDL asymmetric bounds test applied in this paper is the novel systematic empirical examination of whether the repo rate and the PRG share a cointegrated long-run relationship. Third, the Indian MSP policy literature has extensively documented the institutional failures of the price support system but has not examined the monetary policy environment as a systematic determinant of the gap between market prices and the MSP floor. The PSPC mechanism proposed above provides the theoretically grounded and empirically testable account of this determinant.

Together, these three contributions position this paper at the intersection of three literatures that have largely developed in parallel, inflation targeting, agricultural price support policy, and monetary transmission. It proposes an integrative framework is relevant to the developing economies that have simultaneously adopted formal inflation targeting and maintained administered agricultural price support systems. The empirical evidence from India, as the world's second-largest agricultural economy and one of the largest inflation-targeting frameworks among major emerging markets, provides a high-stakes test of the PSPC mechanism that carries implications for the design of monetary-agricultural policy coordination in developing country contexts more broadly.

3. Institutional Background

The empirical relationship examined in this paper emerges from the interaction of three institutional architectures that have evolved in parallel but without systematic coordination. The monetary policy framework of the Reserve Bank of India, the agricultural price support system anchored by the Minimum Support Price, and the rural credit market through which monetary impulses reach the agricultural sector. This section documents the structure, evolution, and institutional logic of each architecture, establishing the factual foundation for the theoretical channels proposed in Section 2 and the empirical analysis that follows.

3.1 The Evolution of Indian Monetary Policy: From Multiple Indicators to Flexible Inflation Targeting

The transformation of Indian monetary policy from a discretionary, multi-objective framework to a rule-based inflation targeting regime unfolded over a decade of institutional evolution shaped by two structural imperatives. The need to anchor persistently elevated inflation expectations in a country whose consumer price inflation had averaged above 8 percent for the decade 2003 to 2013, and the imperative to establish a credible nominal anchor capable of withstanding the volatile capital flow dynamics and exchange rate pressures that characterised post-Global Financial Crisis emerging market monetary management. The formal starting point of this evolution is the Report of the Expert Committee to Revise and Strengthen the Monetary Policy Framework (the Urjit Patel Committee Report), submitted in January 2014 recommended the adoption of CPI inflation as the nominal anchor, a 4 percent medium-term target with a plus or minus 2 percent tolerance band, and the constitution of a Monetary Policy Committee as the decision-making body.

The recommendation reflected a diagnosis of the pre-2013 monetary framework. The Multiple Indicator Approach introduced in 1998, as institutionally inadequate for the challenges of inflation management in an increasingly open, credit-deepened economy. Under the Multiple Indicator Approach, the RBI monitored a wide array of real and financial variables, money supply growth, bank credit expansion, exchange rates, capital flows, output gap indicators, and both WPI and CPI inflation, without assigning formal priority to any single objective. The flexibility provided was purchased at the cost of predictability. The market participants, fiscal authorities, and price-setters could not infer a systematic monetary policy reaction function from the RBI's behaviour. It weakening the expectation anchoring mechanism that is, the primary channel through which the credibility premium operates (Svensson, 1999; Woodford, 2003).

The formal transition to FIT occurred in two institutional stages. The first was the Monetary Policy Framework Agreement signed between the Government of India and the RBI in February 2015, established an informal understanding that the RBI would pursue CPI inflation of 6 percent by January 2016 and 4 percent (plus or minus 2 percent) by the end of the 2016-17 fiscal year. The second was the amendment to the RBI Act in May 2016 through the Finance Act, 2016, which gave the inflation target statutory force, constituted the Monetary Policy Committee with three RBI officials and three government-nominated external members, and established that failure to maintain inflation within the 2 to 6 percent band for three consecutive quarters would require a formal explanatory report to the Government of India. The first MPC meeting took place on 4 October 2016, marking the formal commencement of the FIT regime as defined in this paper.

Table 3.1: Monetary Policy Regime Chronology and Key Institutional Events (2012-2024)

Period	Monetary Framework	Rate Range (Repo)	CPI Food YoY (mean)	Key Institutional Events
Jan 2012 to Sep 2013	Pre-FIT: Multiple Indicator Approach	8.50% to 7.50%	10.2%	RBI under Governor Subbarao; fiscal dominance concerns; elevated WPI and CPI food inflation
Oct 2013 to Jan 2014	Urjit Patel Committee period	7.50% to 8.00%	11.8%	Urjit Patel Report recommends CPI-based IT; monetary tightening to combat depreciation and inflation
Feb 2014 to Jul 2016	Transition: Glide Path under Governor Rajan	8.00% to 6.50%	6.1%	Governor Rajan adopts informal CPI target; disinflation achieved; FRBMA amendment prepared
Aug 2016 to Mar 2020	FIT Phase I: MPC Constituted	6.50% to 4.40%	3.8%	MPC formal operations begin; CPI target 4 plus or minus 2%; first below-band breach (2017); demonetisation shock
Apr 2020 to Mar 2022	FIT Phase II: COVID Accommodation	4.40% to 4.00%	6.8%	Emergency rate cuts; CPI food breaches 6% ceiling repeatedly; RBI holds accommodative stance
Apr 2022 to Dec 2024	FIT Phase III: Tightening Cycle	4.00% to 6.50%	5.2%	Global commodity surge; MPC tightens 250 bps in 14 months; CPI food elevated; PRG compresses sharply

Note: Rate ranges indicate the span of the repo rate during each sub-period. CPI food YoY denotes the mean year-on-year growth rate of the CPI Food Combined index (Base 2012=100, MoSPI) during the sub-period. Institutional events are drawn from RBI Annual Reports, MPC Minutes, and FRBMA documentation.

The features of this chronology are relevant to the identification strategy employed in the empirical analysis. The pre-FIT period (January 2012 to July 2016) encompasses two distinct monetary sub-regimes: an initial period of multi-indicator management under elevated inflation (2012 to 2013), followed by a systematic disinflationary easing cycle under Governor Rajan (2014 to 2016) in which the repo rate fell 200 basis points over 28 months. This within-period variation is exploited by the NARDL asymmetric decomposition to identify the separate effects of hike and cut cycles on PRG. The post-FIT period encompasses three sub-regimes, MPC consolidation and initial operation (2016 to 2020), COVID-19 emergency accommodation (2020 to 2022), and the sharp tightening cycle of 2022 to 2024, each associated with distinct PRG dynamics visible in the Bai-Perron structural break analysis reported in Section 5.1.

A critical feature of the FIT architecture for the present paper's argument is the institutional weight assigned to food price inflation in both the target variable and the MPC's deliberative process. The CPI Food and Beverages sub-component carries a weight of 39.06 percent in the all-India CPI basket (Base 2012=100, MoSPI), making it the single largest sub-group in the index and ensuring that agricultural supply shocks feed directly and substantially into the headline inflation metric against which the MPC is constitutionally accountable. In eleven of the 101 post-FIT months in the sample, food CPI growth exceeded 8 percent, comfortably above the 6 percent upper bound, and in these episodes the MPC's options for accommodation were severely constrained regardless of the real economic cycle. This structural food price dominance of the CPI target is the institutional foundation of Channel I (monetary easing attenuation) in the PSPC mechanism.

3.2 The Minimum Support Price System: Architecture, Determination, and Implementation Reach

The Minimum Support Price system in India represents extensive administrative price support architectures, covering 23 crops across Kharif and Rabi seasons and nominally providing a guaranteed floor below which government procurement will absorb marketed surplus. The system was established in its modern form in the late 1960s as part of the Green Revolution support architecture. It is designed initially to incentivise the adoption of high-yielding varieties by assuring farmers that productivity investments would not be undermined by price collapses in years of good harvest. Over the subsequent five decades, the MSP has evolved from an incentive instrument for technology adoption into a comprehensive income support mechanism.

3.2.1 The MSP Determination Process

The MSP for each crop is recommended annually by the Commission for Agricultural Costs and Prices (CACP), a statutory advisory body under the Ministry of Agriculture and Farmers Welfare constituted in 1965. The CACP's recommendation methodology incorporates four primary inputs: the cost of production, calculated on three alternative bases (A2, actual paid-out costs; A2+FL, paid-out costs plus imputed value of family labour; and C2, comprehensive cost including imputed rent and interest on owned capital); the terms of trade between agricultural and non-agricultural sectors; the likely trends in domestic and international prices; and demand-supply balance projections. The government is not legally bound by CACP recommendations and has, in practice, departed from them in both directions.

The CACP's recommendation process is structurally sensitive to the macroeconomic environment in two respects relevant to Channel II (MSP revision suppression) in the PSPC mechanism. First, international food price movements feed into the CACP's demand-supply and import-export parity calculations, meaning that global commodity price cycles influence the MSP recommendation independently of domestic monetary conditions. This is an important source of confounding variation that the macro-controls robustness check in Section 5.2 addresses. Second, the CACP's mandate explicitly requires it to consider the effect of price policy on the rest of the economy, a broad rubric that in practice encompasses inflationary consequences. When food CPI is elevated and the MPC is signalling tightening bias, there is institutional pressure to moderate MSP revision growth. This pressure is not mechanical, as the CACP operates independently of the RBI, but reflects a broader political economy logic of fiscal-monetary coordination that the FIT framework has, if anything, strengthened by raising the reputational stakes of food inflation management.

Table 3.2: Annual Minimum Support Price, Selected Crops (2012-13 to 2024-25)

Agri. Year	Paddy (Rs/qtl)	Wheat (Rs/qtl)	Tur (Rs/qtl)	Maize (Rs/qtl)	Paddy MSP YoY	Wheat MSP YoY	Policy Context
2012-13	1,250	1,285	3,200	980	n.a.	n.a.	Pre-FIT
2013-14	1,310	1,400	4,300	1,310	+4.8%	+8.9%	Pre-FIT
2014-15	1,360	1,450	4,350	1,310	+3.8%	+3.6%	Pre-FIT
2015-16	1,410	1,525	4,425	1,325	+3.7%	+5.2%	Transition
2016-17	1,470	1,625	4,625	1,365	+4.3%	+6.6%	Transition/FIT
2017-18	1,550	1,735	5,450	1,425	+5.4%	+6.8%	FIT Phase I
2018-19	1,745	1,840	5,675	1,700	+12.6%	+6.1%	FIT Phase I
2019-20	1,815	1,840	5,800	1,760	+4.0%	+0.0%	FIT Phase I
2020-21	1,868	1,925	6,000	1,850	+2.9%	+4.6%	COVID (FIT II)
2021-22	1,940	1,975	6,300	1,870	+3.9%	+2.6%	FIT Phase II
2022-23	2,040	2,025	6,600	1,962	+5.2%	+2.5%	FIT Phase III
2023-24	2,183	2,125	7,000	2,090	+7.0%	+4.9%	FIT Phase III
2024-25	2,300	2,275	7,550	2,225	+5.4%	+7.1%	FIT Phase III

Note: MSP in rupees per quintal. Year-on-year growth rates computed as percentage change from the preceding agricultural year. Source: Commission for Agricultural Costs and Prices (CACP) Price Policy Reports, 2012-13 to 2024-25. Kharif crops (Paddy, Tur, Maize, Soybean, Cotton): June to May. Rabi crops (Wheat, Gram): October to September.

The features of the MSP chronology in Table 3.2 merit discussion. The 2018-19 Paddy MSP revision of 12.6 percent, the largest single-year revision in the sample, coincided with a period of above-band food CPI inflation and contributed to the MPC's tightening bias in the second half of 2018. This illustrates the food inflation-MSP revision feedback loop at the heart of the PSPC mechanism. A large MSP revision intended to support farmer income elevated food CPI, which in turn tightened the monetary policy constraint and subsequently compressed the credit channel through which monetary accommodation would have sustained above-MSP market prices. The 2019-20 Wheat MSP revision of 0.0 percent, a nominal freeze in the context of input cost growth, represents the sharpest instance of effective MSP revision suppression in the sample.

3.2.2 The Implementation Gap: Procurement Architecture, Geographic Reach, and Procurement Coverage Index

The formal existence of an MSP guarantee is, from the perspective of farm income, as valuable as the procurement machinery that enforces it. In India, physical procurement at MSP is conducted primarily by the Food Corporation of India (FCI) for wheat and paddy, and by state-level agencies

including NAFED, state civil supplies corporations, and cooperative marketing federations for pulses, oilseeds, and coarse cereals under the PM-AASHA scheme. The procurement architecture is characterised by a fundamental geographic and crop-specific asymmetry that the PRG data reflects.

For wheat and paddy, FCI's procurement operations are concentrated in a small number of surplus states. In 2023-24, 82 percent of total wheat procurement occurred in Punjab, Haryana, and Madhya Pradesh, and approximately 78 percent of paddy procurement in Punjab, Haryana, Andhra Pradesh, Telangana, and Chhattisgarh. The Procurement Coverage Index (PCI) constructed in this study from FCI state-wise KMS and RMS procurement data confirms this concentration precisely. Punjab achieves the maximum PCI of 100.00 (mean pre-FIT combined procurement 202.43 LMT), while Bihar scores 5.80, West Bengal 8.30, and Maharashtra 0.96. Farmers in eastern India, Bihar, Jharkhand, Odisha, eastern Uttar Pradesh together account for over 40 percent of India's paddy-cultivated area, have minimal access to FCI procurement and must sell in local mandis where prices frequently fall below MSP during the post-harvest flush. This geographic concentration of effective MSP enforcement is the institutional explanation for the negative mean Paddy PRG documented in Section 5. The national modal price average for paddy is dragged below the national MSP by the large volume of paddy sold in non-procurement states at below-MSP prices.

For crops beyond wheat and paddy, Tur, Gram, Soybean, Maize, and Cotton, the procurement machinery is thinner, more intermittent, and operates with quantity caps that limit its price-stabilising function. NAFED's price support operations are triggered when market prices fall below MSP and are subject to availability of procurement funds, which are not pre-allocated in the Union Budget but are financed through NABARD borrowing subject to Cabinet approval. The resulting institutional uncertainty weakens the MSP's credibility as a forward-looking price guarantee and reinforces the importance of market price dynamics, credit conditions, and input costs as the operative determinants of actual farm income. This institutional thinness of non-wheat or paddy procurement is directly reflected in the high PRG volatility for Tur (standard deviation = 33.39 percent) and Gram (standard deviation = 32.41 percent) documented in Section 4.2.

3.3 The Agricultural Credit Market: Monetary Transmission and Its Frictions

The agricultural credit market in India constitutes the primary transmission conduit through which the repo rate reaches farm-gate economic behaviour. Its structural characteristics, including the administered interest rate subvention scheme, the dual formal-informal credit market, and the seasonal cash flow constraints that drive distress sale behaviour, determine both the speed and the distributional incidence of monetary transmission to farm prices. Table 3.3 maps the principal credit instruments available to agricultural households against their repo rate sensitivity, coverage, and transmission lag characteristics.

Table 3.3: Agricultural Credit Architecture, Instruments, Rate Sensitivity, and Monetary Transmission

Credit Instrument	Interest Rate Determination	Repo Rate Sensitivity	Coverage (est. % farmers)	Transmission Lag
Kisan Credit Card (KCC), short-term crop loans	Administered: 7% (subvented to 4%	Partial: subvention scheme	Approx. 45% of operational holdings	3 to 6 months

	for timely repayment)	buffers pass-through		
Scheduled Commercial Bank, agri term loans	MCLR-linked; partial pass-through of repo changes	Moderate: MCLR adjusts with 1 to 2 quarter lag	Approx. 25 to 30% (large/medium farmers)	2 to 4 quarters
NABARD refinance (via RRBs and Cooperatives)	NABARD short-term refinance rate; linked to repo	Moderate to high: NABARD rate closely tracks repo	Approx. 20% (via cooperative credit)	3 to 6 months
Moneylender and informal credit	Fixed by custom and risk perception; repo-independent	Negligible: informal rates 24 to 60% per annum	Approx. 30 to 40% (marginal/subsistence farmers)	None
Input dealer credit (fertiliser, seed)	Trade credit at implicit rates; partially inflation-linked	Low: tied to commodity prices not policy rate	Approx. 50% (supplementary credit source)	Lagged via input price cycles

Note: Interest rate figures are indicative for the 2020-24 period. Coverage percentages are approximate estimates based on NABARD All India Rural Financial Inclusion Survey 2021-22 and RBI Handbook of Statistics. Transmission lags are drawn from Mishra and Suresh Babu (2016) and Bhoi, Mitra, and Singh (2017). MCLR = Marginal Cost of Funds-based Lending Rate; RRB = Regional Rural Bank; KCC = Kisan Credit Card; NABARD = National Bank for Agriculture and Rural Development.

The dominant formal agricultural credit instrument is the Kisan Credit Card (KCC), which provides short-term crop loans at a concessional rate of 7 percent per annum, subvented to 4 percent for borrowers who repay on time, under the Interest Subvention Scheme funded by the Union Budget. The KCC rate is administratively set rather than market-determined. The changes in the repo rate do not directly alter the KCC interest rate. The monetary transmission from repo to KCC operates indirectly: through the cost of funds for banks (which influences their willingness to expand agricultural lending even at administered rates), through NABARD's short-term refinance rate (which tracks the repo with a lag of one to two quarters), and through the broader rural credit availability signal that the policy rate communicates to informal lenders who calibrate their rates in relation to the opportunity cost of funds. This multi-step, partially attenuated transmission chain is the institutional explanation for the 3 to 6 month lag between repo rate changes and observable changes in agricultural credit disbursement documented by Mishra and Suresh Babu (2016).

The structural duality of the rural credit market, in which formal KCC and commercial bank credit coexists with informal moneylender credit at rates of 24 to 60 percent per annum, has a direct and

underappreciated implication for the distributional incidence of monetary transmission. Marginal and subsistence farmers, approximately 86 percent of India's operational holdings are smaller than 2 hectares (Agriculture Census 2015-16). They are disproportionately dependent on informal credit because they lack the land title documentation required for formal institutional credit. They cannot meet the collateral norms of commercial banks, and are geographically remote from cooperative credit societies. Since informal moneylender rates are largely unresponsive to the policy rate, a repo rate cut that reduces formal agricultural credit costs delivers its primary benefit to the larger, better-documented, market-integrated farmer, precisely the farmer who is already more likely to receive above-MSP prices through stronger mandi connectivity and greater market power. The smallholder farmer is most exposed to below-MSP realisation and dependent on post-harvest distress sales to meet debt obligations, receives the least credit market benefit from monetary easing. This structural asymmetry in credit market access provides the institutional micro-foundation for the MMQR finding documented in Section 5.3.

3.3.1 Seasonal Credit Dynamics and the Distress Sale Mechanism

The seasonal cash flow structure of agricultural households introduces a specific monetary transmission pathway through the timing of post-harvest grain sales that is central to understanding the PRG dynamics documented in this paper. Indian agricultural households follow a two-season cultivation cycle, Kharif (sown June to August, harvested October to December) and Rabi (sown October to November, harvested March to May). The crop loans are disbursed at sowing and fall due immediately following the harvest. The coincidence of harvest-time loan repayment obligations with the seasonal peak in marketed surplus, when aggregate supply at mandis is at its highest and price-setting power shifts decisively toward buyers, creates structural conditions for distress selling. The forced liquidation of grain stocks at sub-optimal prices to service debt obligations before penalties accrue.

The distress sale mechanism creates a direct link between monetary policy and farm-gate price outcomes that operates at the seasonal frequency. When crop loan interest rates are low following a sustained repo rate easing cycle, the cost of carrying post-harvest grain stocks increases more slowly, reducing the urgency of immediate repayment-driven sales. Farmers and their collectives can afford to hold stocks in warehouses for two to four weeks after harvest, waiting for the seasonal price trough to pass as the initial flush of supply is absorbed by the market. This stock-holding behaviour, replicated across thousands of farm households and mandi participants, shifts the effective supply curve at peak harvest periods, raising modal prices and improving the PRG. Conversely, when crop loan rates are high, carrying costs increase, the holding period shortens, distress sales intensify, and the peak-harvest price trough deepens, compressing the PRG during precisely the months when a large fraction of the annual marketed surplus arrives at the mandi.

This distress sale channel is the micro-level mechanism underlying the significant positive short-run coefficient on repo_n (rate cuts) in the NARDL estimation (repo_n = 0.965, HAC t = 3.042, p = 0.003). A reduction in the repo rate, by reducing the cost of carrying crop stocks, shifts the seasonal supply distribution to the right, raising modal prices relative to the MSP floor. The 8 to 10 month peak in the impulse response function documented in Section 5.4 is consistent with this channel. A repo rate cut in February reduces KCC refinance costs, which fully reflect in loan disbursements for the subsequent Kharif sowing season (June to August), manifest in altered post-harvest selling behaviour at the October to December Kharif harvest, an 8 to 10 month transmission lag from the rate action to the peak farm price effect.

3.4 The Institutional Entanglement: FIT, MSP, and Agricultural Credit as a System

The three institutional architectures documented above, the FIT monetary framework, the MSP price support system, and the agricultural credit market, do not operate in isolation. They are connected through a series of institutional feedback loops in their aggregate operation, constitute the PSPC mechanism proposed in Section 2. Three feedback loops operate at different frequencies and through different channels.

The primary feedback loop operates at the seasonal and annual frequency. When food CPI rises toward the 6 percent upper band, a recurring event in India's structurally food-price-volatile economy, the MPC faces pressure to tighten or at minimum to signal the withdrawal of accommodation. This tightening signal raises formal agricultural credit costs, increases the urgency of distress sales at the subsequent harvest, depresses modal mandi prices, and thereby amplifies the food CPI increase by creating distress-sale-driven price spikes that are then absorbed by further tightening, a pro-cyclical amplification mechanism. Simultaneously, the food CPI signal constrains the CACP's effective MSP revision space, moderating the upward adjustment of the price floor. The net effect on the PRG is compression from two sides: market prices are pulled down by distress sale dynamics while the MSP floor is held back by food inflation concerns.

The secondary feedback loop operates at a lower frequency of two to three years. Over the medium term, the FIT framework's constraint on monetary accommodation moderates the rural credit expansion that historically accompanied sustained easing cycles. This credit moderation reduces the investment in productivity enhancement, irrigation, soil health, quality seed adoption. It would have raised farm yields and, through improved marketable surplus quality and quantity, elevated modal prices. The suppression of rural credit expansion under FIT has a supply-side agricultural productivity consequence that manifests in the PRG at frequencies longer than the business cycle, consistent with the wavelet coherence finding that the long-run coherence between PRG and the repo rate (0.840 at 24 to 72 month frequencies) substantially exceeds medium-run coherence (0.433 at 6 to 24 months).

The tertiary feedback loop operates through expectations and price discovery at the market level. The MPC's quarterly Monetary Policy Reports and the CPI food monitoring they contain provide a widely read signal about the direction of food price policy that is interpreted by AGMARKNET traders, procurement agencies, and commodity exchange participants. When the MPC signals concern about food inflation, as it did repeatedly in 2022 to 2024, traders at major mandis anticipate regulatory intervention, export bans, OMSS releases, import duty reductions, that would suppress commodity prices and accelerate their own selling before prices decline. This anticipatory selling behaviour drives down modal mandi prices independently of any actual policy action, contributing to PRG compression through an expectations channel. The wavelet phase analysis quantifies this lead-lag structure. The mean phase angle of -0.384 radians (approximately -22 degrees) in statistically significant time-frequency regions indicates that the repo rate leads the PRG by approximately 3.9 months at the dominant coherence frequency, consistent with partial expectational adjustment preceding the full physical credit transmission.

The institutional entanglement documented in this section provides the factual and institutional foundation for the PSPC mechanism, and establishes why the empirical findings reported in Section 5 are economically interpretable rather than statistically coincidental. The seven estimation strategies employed in this paper are designed precisely to disentangle these overlapping channels: the NARDL captures the asymmetric long-run and short-run credit transmission effects; the VAR establishes causal direction; the MMQR reveals the distributional incidence across credit market access tiers; the wavelet analysis identifies the frequency at which expectations and structural

monetary regime effects dominate over seasonal agricultural noise; the state panel uses the PCI interaction to identify the procurement-mediated channel; the RD design tests for a discrete break at FIT adoption; and the NSS sensitivity analysis quantifies the household-level downward bias that makes all of this paper's below-MSP estimates conservative lower bounds on the true incidence of farm price distress.

4. Data and Methodology

4.1 Data Sources and Variable Construction

This study employs a balanced panel of monthly time-series data spanning January 2012 to December 2024, yielding 156 observations that encompass the four years preceding India's Flexible Inflation Targeting (FIT) adoption and the full eight-year post-adoption period. The construction of the analytical dataset required the integration of five distinct data architectures , agricultural price registries, monetary policy records, price index series, input cost monitors, and household survey evidence, each sourced from independent government and institutional repositories and harmonised to a common monthly frequency. The temporal boundary is motivated by three considerations: data availability from the AGMARKNET national mandi registry through the CEDA Agri Market Data portal; the sufficiency of 55 pre-FIT and 101 post-FIT observations for the asymmetric time-series estimators employed; and the capacity to capture three complete monetary policy sub-cycles within the FIT era , initial consolidation (2016–2020), COVID accommodation (2020–2022), and the 2022–2024 tightening cycle.

Table 4.1: Data Sources, Variable Definitions, and Coverage

Variable	**Measure**	**Frequency**	**Source**	**Coverage**
Repo Rate	Policy rate (%)	Monthly	RBI DBIE , Monetary Policy	Jan 2012–Dec 2024
PRG , Paddy	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024
PRG , Wheat	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024
PRG , Maize	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024
PRG , Tur	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024

PRG , Soybean	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024
PRG , Cotton	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024
PRG , Gram	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD (AGMARKNET) + CACP	Jan 2012–Dec 2024
CPI Food Combined	YoY growth rate (%)	Monthly	MoSPI , Consumer Price Index	Jan 2012–Dec 2024
Diesel Price (Delhi)	Retail price (Rs/litre)	Monthly	PPAC , Petroleum Planning	Jan 2012–Dec 2024
Agricultural Wage	Ploughing wage, All-India (Rs/day)	Monthly	Labour Bureau , Rural Wages	Apr 1998–Apr 2025
State Panel PRG	(Modal–MSP)/MSP × 100 (%)	Monthly	CEDA-AMD: 22 state-crop combinations	Jan 2012–Dec 2024
FCI Procurement	LMT procured (Rice + Wheat)	Annual	FCI Annual Reports + MoFA&FW	KMS/RMS 2000–2023
NSS SAS 2018-19	% households accessing MSP procurement	Cross-section	MoSPI , NSS Report No. 587	Agricultural Year 2018-19

Note: PRG = Price Realisation Gap = (Farm-gate modal price − MSP) / MSP × 100. Monthly modal prices are derived from daily AGMARKNET mandi observations via the CEDA Agri Market Data portal, aggregated across all reporting mandis at the national level. MSP series from CACP Price Policy Reports (2012-13 to 2024-25). FCI procurement data from Ministry of Food and Public Distribution annual releases. NSS SAS = Situation Assessment Survey of Agricultural Households, 77th Round. CEDA-AMD = CEDA Agri Market Data, Ashoka University.

4.1.1 The Price Realisation Gap (PRG): Construction and Rationale

The Price Realisation Gap (PRG) is a novel monthly index constructed for this study to measure, with crop specificity and temporal precision, the proportional deviation of farm-gate modal prices from the government-announced Minimum Support Price floor. For crop i in month t, the PRG is formally defined as:

$$PRG_{it} = [(P_{it} - MSP_{it}) / MSP_{it}] \times 100$$

where P_{it} denotes the monthly mean modal price (rupees per quintal) derived by averaging daily national AGMARKNET modal price observations across all reporting mandis, and MSP_{it} denotes the CACP-announced support price applicable to the agricultural year containing month t. A

positive PRG indicates above-MSP farm-gate realisation; a negative PRG indicates that farmers are, on average, receiving below the government's declared minimum , a condition of direct price support failure that is obscured by aggregate income measures but directly observable in the PRG framework.

Two composite measures are constructed. The equal-weighted PRG composite assigns uniform weight to all seven crops and yields a mean of 7.96 percent over the full sample. The production-weighted PRG composite , the economically superior specification , assigns weights proportional to MoSPI all-India output shares: Paddy (0.285), Wheat (0.248), Maize (0.175), Gram (0.091), Soybean (0.087), Cotton (0.071), and Tur (0.043). The production-weighted composite yields a mean of 4.91 percent , substantially lower than the equal-weighted mean , confirming that the crops most economically important to Indian farm households (Paddy and Wheat) are precisely those with the weakest price realisation. This aggregation gap motivates reporting both composites throughout the analysis.

The MSP series is matched to calendar months using standard season conventions: Kharif MSPs (Paddy, Tur, Soybean, Maize, Cotton) apply from July through June; Rabi MSPs (Wheat, Gram) apply from October through September. Annual MSP steps are introduced at the start of each agricultural year, not smoothed or interpolated. This convention is consistent with the institutional calendar of CACP announcements and preserves the step-function character of the MSP floor that farmers face in actual marketing decisions.

4.1.2 Monetary Policy and Macro-Control Variables

The primary monetary policy instrument is the RBI repo rate, sourced from the Reserve Bank of India's Database on Indian Economy (DBIE). The repo rate is recorded as a monthly observation by forward-filling the most recent MPC announcement , consistent with the event-based revision schedule under which the rate prevails until the next scheduled MPC meeting. The food price environment is proxied through the year-on-year growth rate of the CPI Food Combined index (Base 2012=100, MoSPI), which measures the aggregate food inflation signal against which the MPC's FIT mandate is evaluated. For the 12 months of the sample where CPI YoY growth was unavailable (beginning of series), values are computed from the log-difference of the CPI Food Combined index level. Four missing observations in the agricultural wage series are imputed by linear interpolation between adjacent valid observations, verified by confirming that the interpolated values fall within one standard deviation of the series mean for the relevant sub-period.

Two macro controls are included in the augmented specifications to isolate the monetary policy channel from confounding cost-side and global factors. The Delhi retail diesel price (PPAC) proxies the input cost pressure channel through which fuel cost inflation compounds the direct monetary transmission mechanism. Agricultural wages (Labour Bureau Rural Wage Survey, ploughing operations) capture the labour cost component of the agricultural cost structure that is potentially responsive to general price level dynamics independent of the monetary policy rate. Both controls enter the augmented NARDL specification in first-differenced form to maintain consistency with the I(1)/I(0) integration properties documented in Section 5.1. A demonetisation dummy variable (November 2016 − March 2017 = 1, otherwise 0) is included to capture the structural supply-side disruption to mandi trading during the cash withdrawal period.

4.1.3 State-Level Panel Data

To provide cross-sectional identification of the monetary transmission-procurement interaction mechanism, a state-level panel dataset is constructed from 81,044 daily CEDA-AMD observations for 22 state-crop combinations spanning 13 major producing states. States are selected based on agronomic dominance criteria: each state-crop combination represents a case where the state accounts for more than five percent of national marketed surplus for the relevant crop. The resulting unbalanced panel spans 2,570 state-month observations across 13 states: Punjab, Haryana, Madhya Pradesh, Andhra Pradesh, Telangana, Chhattisgarh, Karnataka, Uttar Pradesh, West Bengal, Bihar, Odisha, Rajasthan, and Maharashtra.

A Procurement Coverage Index (PCI) is constructed for each state as the ratio of the state's mean FCI grain procurement (Rice KMS + Wheat RMS, averaged over 2012–2016) to the national maximum, normalised to a 0–100 scale. The PCI captures the institutional intensity of MSP enforcement in each state, the channel through which monetary policy-MSP interactions are predicted to be mediated. Punjab (PCI = 100) anchors the high end. Nagaland (PCI = 0) anchors the low end. The PCI is interacted with the monthly repo rate to create the treatment intensity variable repo × PCI that is the core identification variable in the panel analysis. To address the unbalanced nature of the panel and ensure robustness of the interaction coefficient, a balanced sensitivity check is conducted restricting estimation to the 18 state-crop combinations with at least 100 monthly observations.

4.1.4 NSS Household Sensitivity Data

To assess the downward bias in the AGMARKNET PRG measure arising from its restriction to mandi-connected farmers, this study employs published tabulations from the NSS 77th Round Situation Assessment Survey of Agricultural Households (NSS SAS 2018-19), reported in MoSPI NSS Report No. 587. The NSS SAS covers approximately 58,000 agricultural households nationally and records, for each household, the primary channel through which the principal crop was sold and whether the sale price equalled or exceeded the MSP. The published tables report the proportion of households accessing government procurement agencies by crop , a direct measure of MSP reach that is unavailable from the mandi price data alone. The household-weighted PRG is constructed by applying the NSS procurement access rate as the weight on the AGMARKNET PRG (which proxies the procurement-channel price) and the residual weight on an informal market discount of 15 percent below MSP (based on Gulati, Wardhan, and Sharma, 2019, for non-procurement sales), yielding a weighted average PRG that accounts for both procurement and market channels.

4.2 Descriptive Statistics and Structural Decomposition

Table 4.2 presents descriptive statistics for the full sample alongside the pre-FIT (January 2012 – July 2016) and post-FIT (August 2016 – December 2024) sub-periods. The statistics reveal four empirical features that motivate the subsequent econometric analysis.

Table 4.2: Descriptive Statistics , Full Sample and Sub-Period Decomposition (N=156)

Variable	Full Mean	Full SD	Pre-FIT Mean	Post-FIT Mean	Change (pp)	Below-MSP (%)
PRG Composite , Equal-wt (%)	7.96	12.27	16.91	3.08	−13.83	25.0
PRG Composite , Prod-wt (%)	4.91	9.10	11.59	1.27	−10.32	31.4
PRG , Paddy (%)	−0.78	8.98	4.89	−3.86	−8.76	53.8
PRG , Wheat (%)	7.27	8.99	10.95	5.27	−5.68	19.9
PRG , Maize (%)	−4.12	10.70	0.32	−6.53	−6.85	61.5
PRG , Tur (%)	10.19	33.39	30.22	−0.73	−30.95	53.2
PRG , Soybean (%)	17.00	26.18	35.20	7.09	−28.11	35.9
PRG , Cotton (%)	12.49	16.05	13.97	11.68	−2.29	20.5
PRG , Gram (%)	13.65	32.41	22.78	8.68	−14.10	46.8
Repo Rate (%)	6.28	1.30	7.58	5.58	−2.00	,
CPI Food YoY (%)	5.88*	3.46	,	,	−4.48	,
Diesel Price (Rs/litre)	64.92	16.54	,	,	,	,
Agricultural Wage (Rs/day)	317.51	69.22	,	,	,	,

Note: Pre-FIT: January 2012 – July 2016 (55 months). Post-FIT: August 2016 – December 2024 (101 months). Prod-wt = production-weighted using MoSPI crop output shares. Below-MSP (%) = proportion of months with PRG < 0. Change (pp) = Post-FIT mean minus Pre-FIT mean. CPI Food YoY (*) = 12 leading NAs; mean computed over available 144 observations. SD = standard deviation.

First, the PRG collapse is substantial and pervasive. The equal-weighted composite PRG fell 13.83 percentage points between the pre- and post-FIT periods; the production-weighted composite , reflecting the economic importance of Paddy and Wheat , fell 10.32 percentage points to a mean of only 1.27 percent above MSP. For Paddy, the mean PRG turned negative in the post-FIT period (−3.86 percent), implying that the average paddy farmer received below-MSP prices for the majority of post-FIT months , a finding directly corroborated by the NSS SAS 2018-19 evidence that only 14.5 percent of paddy-cultivating households accessed MSP procurement in that year.

Second, the below-MSP incidence rose sharply. Across the full sample, 39 of 156 months (25.0 percent) recorded below-MSP composite PRG. For Paddy and Maize , the two crops with the largest smallholder marketed surplus , below-MSP incidence reached 53.8 and 61.5 percent of months respectively. These frequencies establish that below-MSP price realisation is not an

occasional shock but a structural condition for India's two most important food crops in the FIT era.

Third, the PRG is highly heterogeneous across crops. The coefficient of variation ranges from 68 percent (Wheat) to 328 percent (Tur), reflecting the wide institutional diversity in procurement coverage, market integration, and seasonal supply dynamics across crops. This heterogeneity motivates the crop-specific NARDL models (Section 4.3.1) and the MMQR distributional analysis (Section 4.3.3) rather than reliance on composite estimates alone.

Fourth, the repo rate and the PRG exhibit a co-movement pattern that is consistent with the PSPC hypothesis. The repo rate fell from a mean of 7.58 percent pre-FIT to 5.58 percent post-FIT , a 200 basis-point easing cycle , yet the PRG simultaneously collapsed. This apparent paradox motivates the asymmetric NARDL decomposition: the question is not whether the level of the repo rate correlates with the PRG, but whether rate-cut and rate-hike partial sum processes have asymmetric long-run and short-run effects on farm price realisation.

4.3 Econometric Framework

4.3.1 Non-linear Autoregressive Distributed Lag Model (NARDL)

The primary estimator is the Non-linear Autoregressive Distributed Lag (NARDL) model of Shin, Yu, and Greenwood-Nimmo (2014), which extends the linear ARDL bounds-testing framework of Pesaran, Shin, and Smith (2001) to accommodate asymmetric cointegration between monetary policy and agricultural price outcomes. Three considerations motivate this choice. First, the PSPC mechanism predicts directional asymmetry: rate cuts operate through the distress sale attenuation channel (reducing compelled selling pressure) while rate hikes operate through the borrowing cost amplification channel, structurally distinct mechanisms that should produce quantitatively different, and potentially sign-opposite, long-run effects on the PRG. A linear ARDL imposes the restriction β(rate cut) = −β(rate hike) by construction, suppressing the asymmetric hypothesis of interest. Second, the mixed integration properties of the variables , confirmed I(1) by unit root tests, with Zivot-Andrews statistics indicating structural breaks that render some series conditionally I(0) , satisfy the necessary conditions for valid inference under the ARDL bounds procedure, which accommodates regressors of any combination of I(0) and I(1) orders. Third, the NARDL error-correction structure provides explicit parameter stability diagnostics through the CUSUM test that are directly relevant to a sample spanning three distinct monetary policy sub-regimes.

Following Shin et al. (2014), the repo rate is decomposed into partial sum processes capturing monotonically accumulating positive (hike) and negative (cut) changes:

$$repo_t^{P} = \Sigma_{s=1}^{t} max(\Delta repo_s, 0) \quad repo_t^{N} = \Sigma_{s=1}^{t} min(\Delta repo_s, 0)$$

The conditional NARDL(p, q^+, q^-) error-correction model is specified as:

$$\Delta PRG_t = \alpha + \rho PRG_{t-1} + \theta^{+} repo_{t-1}^{P} + \theta^{-} repo_{t-1}^{N} + \Sigma_{j=1}^{p-1} \gamma_j \Delta PRG_{t-j} + \Sigma_{j=0}^{(q^{+}-1)} \pi_j^{+} \Delta repo_{t-j}^{P} + \Sigma_{j=0}^{(q^{-}-1)} \pi_j^{-} \Delta repo_{t-j}^{N} + \varepsilon_t$$

where ρ is the error-correction coefficient (expected negative and significant under cointegration), θ^+ and θ^- capture the long-run effects of accumulated rate hikes and cuts respectively, and π_j^+ and π_j^- capture short-run dynamics. The normalised long-run effects are $\beta^+ = -\theta^+/\rho$ and $\beta^- = -\theta^-/\rho$. Lag

lengths p, q^+, and q^- are selected by the Akaike Information Criterion with a maximum of four lags. Three models are estimated: Model 1 (PRG Composite), Model 2 (PRG Paddy), and Model 3 (PRG Wheat). Model 2 constitutes the primary specification, as Paddy is India's largest Kharif crop by cultivated area, exhibits the most significant monetary transmission (F-statistic = 9.216, exceeding the 1 percent bounds critical value of 6.36), and is the crop for which the NSS SAS evidence most directly documents the MSP access gap.

Cointegration is assessed using the Pesaran et al. (2001) bounds F-test under Case III (unrestricted intercept, no time trend), with the null hypothesis H_0: $\rho = \theta^+ = \theta^- = 0$. Asymmetric long-run transmission is tested via the Wald statistic on H_0: $\beta^+ = \beta^-$ (equivalently H_0: $\theta^+ = \theta^-$). Model diagnostics include the Breusch-Godfrey LM test for serial autocorrelation, the ARCH-LM test for conditional heteroscedasticity, the Jarque-Bera test for residual normality, and the CUSUM statistic for parameter stability. For Model 2, which exhibits evidence of ARCH effects (ARCH-LM p = 0.013), Newey-West heteroscedasticity-and-autocorrelation-consistent (HAC) standard errors are reported alongside OLS standard errors, with a bandwidth of four lags consistent with the AIC-selected lag structure. The key finding, the significance of the short-run rate-cut coefficient , is confirmed under both standards: OLS p = 0.000 and HAC p = 0.003.

An augmented NARDL specification (Model 4) adds the demonetisation dummy, the first difference of CPI food YoY growth, and the first differences of diesel price and agricultural wage to the Model 1 specification, addressing the concern that the baseline results may reflect confounding macro-factors rather than the monetary transmission channel. The augmented model is estimated by constructing the partial sum series manually and appending controls to the error-correction regression. The joint significance of the control variables is tested via a linear hypothesis test (Wald F-test) on the restriction that all four control coefficients are simultaneously zero.

4.3.2 State-Level Panel Estimation

The second estimation strategy exploits cross-state variation in FCI procurement coverage to provide identification of the monetary transmission-procurement interaction mechanism predicted by the PSPC framework. If monetary easing improves farm price realisation through the distress sale attenuation channel , which requires farmer access to formal credit and the ability to defer sales , then the effect should be stronger in states where procurement infrastructure provides an alternative price guarantee, reducing the pressure to distress-sell in thin markets. States with high Procurement Coverage Index (PCI) values face a lower effective threshold for market price recovery: even partial monetary easing that raises mandi prices above MSP is reinforced by the availability of procurement as a price backstop.

The panel specification is:

$$PRG_{it} = \alpha_i + \delta_t + \beta_1 REPO_t + \beta_2 (REPO_t \times PCI_i) + \beta_3 TREND_t + \varepsilon_{it}$$

where i indexes state-crop combinations, t indexes months, α_i are state-crop fixed effects, δ_t is captured by the time trend (TREND) rather than time fixed effects. The latter are infeasible given that the repo rate is a national variable that absorbs all time variation leaving an empty model, and β_2 is the coefficient of interest: the differential effect of monetary policy in high-procurement states relative to low-procurement states. The Hausman specification test is used to choose between fixed effects and random effects estimators. All specifications employ standard errors clustered at the state level to account for within-state temporal autocorrelation. A balanced panel sensitivity check restricts estimation to the 18 state-crop combinations with at least 100 monthly observations (N =

1,545 state-month observations), confirming that the interaction coefficient is robust to the exclusion of sparsely observed combinations.

4.3.3 Method of Moments Quantile Regression (MMQR)

The linear conditional mean estimators in Sections 4.3.1 and 4.3.2 characterise average monetary transmission across the PRG distribution but cannot identify distributional heterogeneity. The question of whether monetary policy transmission differs across distress and boom regimes of farm price realisation. To examine this, the Method of Moments Quantile Regression (MMQR) estimator of Machado and Silva (2019) is applied. It extends classical quantile regression to time-series settings through moment conditions on a location-scale model, providing quantile estimates that are robust to heteroscedasticity and non-normal residuals, properties confirmed in the PRG series. Five quantiles are estimated ($\tau \in \{0.10, 0.25, 0.50, 0.75, 0.90\}$), spanning severe farm price distress to price boom conditions. The baseline specification includes the repo rate and CPI food growth as regressors. The augmented specification includes diesel price and agricultural wage. Standard errors are obtained by bootstrapping with 500 replications (xy-pair resampling). Slope equality across quantiles is tested via the anova.rq Wald statistic with joint degrees of freedom equal to four times the number of regressors.

4.3.4 Trivariate VAR, Granger Causality, and Forecast Error Variance Decomposition

To establish the direction of temporal precedence between monetary policy and farm price realisation, a prerequisite for causal interpretation of the NARDL coefficients , a trivariate Vector Autoregression (VAR) is estimated with PRG_Paddy, the repo rate, and CPI food growth as endogenous variables. The Cholesky identification ordering places the repo rate first (most exogenous), CPI second, and PRG last, reflecting the institutional reality that the MPC's policy decisions precede their transmission to mandi prices, and that the MPC does not directly respond to AGMARKNET modal price deviations from MSP in its deliberations. Robustness to this ordering is verified by re-estimating with the alternative ordering REPO, CPI, PRG and confirming that the Forecast Error Variance Decomposition (FEVD) is insensitive to the choice. The REPO share at h = 12 months changes by only 1.44 percentage points between the two orderings. The optimal VAR lag length (p = 3) is selected by the Akaike Information Criterion from a maximum of six lags. Granger causality tests are conducted via Wald F-statistics on the exclusion restriction for each causal direction. Impulse response functions are estimated with 500 bootstrap replications and 95 percent confidence bands, tracing the dynamic response of PRG to a one-standard-deviation shock in the repo rate over 24 months.

4.3.5 Wavelet Coherence Analysis

As a complement to the time-domain estimators above, wavelet coherence analysis decomposes co-movement between PRG_Paddy and the repo rate across both time and frequency simultaneously, using the Morlet mother wavelet following Aguiar-Conraria and Soares (2014). The analysis is implemented in the WaveletComp package (Roesch and Schmidbauer, 2018) with dt = 1/12 (monthly sampling interval), dj = 1/12 (frequency resolution), and the period range restricted to 2–72 months to stay within the Cone of Influence boundary for a 156-month series , the maximum reliable period beyond which edge effects dominate. Statistical significance of

coherence at each time-frequency point is assessed via 100 Monte Carlo simulations using the Gaussian null hypothesis for each series. The analysis yields four frequency-band coherence averages (short-run: 2–6 months; medium-run: 6–24 months; long-run: 24–72 months; overall) and the mean phase angle in significant time-frequency regions, from which the implied lead-lag relationship between the repo rate and PRG is calculated as lag = $|\varphi| \times T / (2\pi)$, where φ is the mean phase angle and T is the dominant coherence period.

4.3.6 Regression Discontinuity Design

As an additional robustness strategy for the causal identification of the FIT adoption effect on PRG, a Sharp Regression Discontinuity (RD) design is implemented with the FIT adoption date of August 2016 as the exogenous cutoff. The running variable is the number of months elapsed relative to August 2016 (negative pre-FIT, positive post-FIT). The RD estimand is the average treatment effect at the cutoff , the discontinuous change in composite PRG immediately attributable to FIT adoption rather than to the gradual trend in monetary policy. The optimal bandwidth is selected by the Calonico-Cattaneo-Titiunik (CCT) data-driven criterion (Calonico et al., 2014); a range of policy-relevant bandwidths from h = 8 to h = 24 months is additionally reported to assess robustness. A Donut RD specification excludes the five months of the demonetisation window (November 2016 – March 2017) that overlap with the post-cutoff period, testing whether the measured discontinuity survives the removal of the confounding cash-withdrawal shock. The McCrary density test is applied to verify the absence of manipulation in the running variable at the cut-off. The RD evidence is presented as supplementary identification , suggestive rather than definitive, given the three-month proximity of FIT adoption and demonetisation, which limits clean separation of the two shocks at any bandwidth sufficient for statistical power.

5. Empirical Results and Discussion

This section reports and interprets the empirical findings in the sequence of the research questions posed in Section 1.2. Section 5.1 establishes the statistical properties of the series through unit root and structural break tests. Section 5.2 presents the NARDL cointegration and asymmetric transmission results. Section 5.3 examines distributional heterogeneity through MMQR. Section 5.4 establishes causal direction through Granger causality and traces the dynamic transmission through impulse response functions and wavelet coherence. Section 5.5 presents the state-level panel evidence on the procurement-mediated monetary transmission mechanism. Section 5.6 reports the Regression Discontinuity estimates of the FIT adoption effect. Section 5.7 synthesises the NSS household sensitivity evidence. Section 5.8 presents the international comparative evidence.

5.1 Unit Root, Structural Break, and Integration Properties

Table 5.1 reports the results of three unit root tests , the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests , applied to all principal series in levels and first differences. Lag lengths for the ADF are selected by the Bayesian Information Criterion; the PP bandwidth is computed by the Newey-West formula [4(T/100)^0.25]. The ADF

is estimated with a linear trend in levels and with a constant in first differences; the KPSS is estimated with a trend in levels and a constant in first differences.

Table 5.1: Unit Root Test Results , Full Sample (N=156)

Variable	**ADF (levels)**	**ADF (Δ)**	**PP (levels)**	**PP (Δ)**	**KPSS (levels)**	**KPSS (Δ)**	**Order**
PRG Composite	−2.826	−9.073***	−2.524	−9.237***	0.115	0.079	I(1)†
PRG Paddy	−4.493*	−9.063***	−3.453	−8.490***	0.124	0.139	I(1)‡
PRG Wheat	−3.423	−8.323***	−2.903	−8.809***	0.137	0.106	I(1)
Repo Rate	−0.500	−5.804***	−0.781	−11.247***	0.182*	0.236	I(1)
CPI Food YoY	−3.533*	−10.448***	−2.828	−9.583***	0.192*	0.148	I(1)
Diesel Price	−2.481	−10.193***	−2.203	−12.195***	0.166*	0.077	I(1)
Agricultural Wage	−2.502	−9.485***	−2.550	−14.098***	0.131	0.166	I(1)

*Note: ADF critical values: −3.43 (5%), −4.00 (1%) with trend; −2.88 (5%), −3.46 (1%) with drift. PP critical values identical to ADF. KPSS critical values: 0.146 (5%), 0.119 (1%) with trend; 0.463 (5%), 0.347 (1%) with constant. *** = significant at 1%; * = significant at 10%. † PRG Composite: ADF level $p > 0.10$, PP level $p > 0.10$ confirm non-stationarity despite borderline KPSS ($0.115 < 0.146$); structural breaks reduce KPSS bandwidth and artificially lower the test statistic (Kwiatkowski et al., 1992). ‡ PRG Paddy: ADF with drift yields −3.629 ($p < 0.05$), suggesting possible I(0) with drift; however, PP level (−3.453) is borderline and the Zivot-Andrews test confirms I(1) with structural break (see below). All series treated as I(1) for NARDL bounds-testing purposes, consistent with the Pesaran et al. (2001) mixed-integration framework.*

The unit root evidence is characterised by the border-cases expected in a sample dominated by structural breaks. Both the Zivot-Andrews (1992) test , which allows for a single endogenous structural break in the trend and intercept , and the Bai-Perron (2003) multiple structural break framework are applied to the PRG Composite series to resolve the ambiguity. The Zivot-Andrews statistic of −5.155 (5 percent critical value: −4.80) rejects the null of I(1) with structural break, confirming that the PRG composite is best characterised as a persistent I(0) process with breaks, or equivalently an I(1) process with break-at-cutoff. The Zivot-Andrews test on the repo rate yields −5.214 ($p < 0.05$), with the endogenously determined break at August 2016 , coinciding precisely with FIT adoption and providing structural break evidence directly consistent with the regression discontinuity design of Section 5.6. For the purpose of the NARDL bounds test, the ARDL framework's asymptotic validity under mixed I(0)/I(1) integration orders (Pesaran et al., 2001)

renders this distinction inconsequential: the bounds test yields valid inference regardless of whether regressors are I(0), I(1), or a mixture.

The Bai-Perron multiple breakpoint test applied to the PRG Composite series with the BIC-optimal segment selection identifies five structural breaks at August 2015, December 2016, March 2018, December 2019, and March 2021 (BIC = 994.3 at m = 5, versus 1234.0 at m = 0). These breakpoints correspond precisely to identifiable macro-agricultural events: the onset of the global commodity price deflation cycle (August 2015); the demonetisation shock and simultaneous FIT institutional consolidation (December 2016); the beginning of the RBI tightening cycle following the 2018 global crude oil surge (March 2018); the onset of COVID-19 supply disruptions (December 2019); and the post-COVID agricultural price correction following emergency monetary accommodation (March 2021). The five-break decomposition provides the temporal anatomy of the PRG dynamics that motivates the sub-period analysis and the structural break dummies in the augmented specifications.

5.2 NARDL Cointegration and Asymmetric Monetary Transmission

Table 5.2 presents the NARDL estimation results for four specifications. Three findings stand out as central to the paper's empirical contribution.

Table 5.2: NARDL Estimation Results , Bounds Test, Short-Run, and Long-Run Coefficients

	M1: Composite	**M2: Paddy (Primary)**	**M3: Wheat**	**M4: Augmented**
Panel A: Bounds Test				
F-statistic (PSS)	3.141	9.216***	4.592†	,
Cointegration	NO (below 10%)	YES (1% level)	YES (10% level)	Robustness
Observations	152	153	151	143
Panel B: Short-Run				
repo_n (rate cut)	1.227 (0.464)	0.965*** (HAC p=0.003)	2.148 (0.854)	,
repo_p (rate hike)	, 0.718 (, 0.239)	0.837 (0.396)	2.321 (0.789)	,
ECT (ρ)	0.321	0.243	0.205	,
Panel C: Long-Run				
LR repo_n (normalised)	n.a.	+16.313* (p=0.043)	n.a.	,
θ^{-} (raw)	, 3.824 (, 0.457)	, 3.967* (p=0.043)	, 10.453 (, 0.790)	,

LR asymmetry Wald p	0.332	0.981	0.977	,
Panel D: Diagnostics				
JB normality p	0.002	0.013*	0.064†	,
LM autocorrelation p	0.461	0.243	0.217	,
ARCH p	0.907	0.013*	0.502	,
CUSUM stable?	YES ✓	YES ✓	YES ✓	,
SR asymmetry Wald p	0.893	0.999	0.999	,
Controls joint F p	,	,	,	0.296 (insignificant)
Demo dummy p	0.009**	,	,	0.009**

*Note: Bounds test critical values (Pesaran et al., 2001, Case III, k=2): I(0)/I(1) = 3.17/4.14 at 10%; 3.79/4.85 at 5%; 5.15/6.36 at 1%. ***, **, * denote significance at 1%, 5%, 10%; † = 10% level. t-statistics in parentheses for short-run and long-run coefficients. M2 (Paddy) short-run repo_n reports HAC Newey-West standard error (bandwidth=4) to address ARCH failure (p=0.013). Normalised long-run: LR_norm = $-\theta^{-}/|\rho|$; sign convention: $\theta^{-} \times \Delta$repo_N (negative change) = positive PRG effect. M4 controls include: ΔCPIYoY, ΔDiesel, ΔWage, Demo dummy; joint F test on all four controls yields p=0.296, confirming that the baseline monetary transmission result is not confounded by macro-factors. Demo dummy is individually significant (p=0.009), confirming demonetisation as a distinct structural shock that must be acknowledged in the identification.*

The important finding is that the Paddy NARDL (Model 2) yields an F-statistic of 9.216 , exceeding the 1 percent upper I(1) bound of 6.36 and decisively establishing cointegration between Paddy PRG and the repo rate. This result is robust to the ARCH failure: re-estimation with HAC standard errors confirms that the short-run rate-cut coefficient (repo_n = 0.965, HAC t = 3.042, p = 0.003) remains highly significant. The composite PRG (Model 1) does not pass the bounds test (F = 3.141, below the 10 percent I(0) bound of 3.17), a finding that requires transparent explanation. The seven-crop composite includes Maize and Gram , two crops with extreme PRG volatility (below-MSP months: 61.5 and 46.8 percent respectively) and minimal procurement infrastructure , whose high-variance, institutionally disconnected price dynamics introduce noise that dilutes the monetary transmission signal visible in the more institutionally integrated crops. The production-weighted composite, which assigns lower weight to these high-variance crops, yields a PRG mean of 4.91 percent , substantially closer to the Paddy and Wheat experience that is most relevant to the monetary credit channel operating through Kisan Credit Card disbursement. The Paddy result is economically the more meaningful finding: Paddy accounts for 28.5 percent of the production-weighted index, is the most widely cultivated Kharif crop by area (approximately 44 million hectares), and represents the primary income source for over 100 million smallholder households concentrated in eastern and southern India where MSP procurement coverage is lowest.

The second finding concerns the sign and interpretation of the long-run coefficient in Model 2. The raw long-run coefficient on accumulated rate cuts is $\theta^{-} = -3.967$ (p = 0.043). The NARDL

normalised long-run effect is computed as LR_norm = $-\theta^{-}/|\rho| = -(-3.967)/0.243 = +16.313$, which carries a positive sign: a sustained accumulation of rate cuts (Δrepo_N < 0) multiplied by the positive normalised long-run coefficient yields a positive PRG effect. This is precisely the theoretical direction predicted by the PSPC distress sale attenuation channel: persistent monetary easing, by reducing crop loan costs and diminishing forced harvest-season selling, raises modal mandi prices relative to the MSP floor. The positive normalised long-run effect of rate cuts is the central empirical finding consistent with the PSPC hypothesis.

The third finding is the distinction between demonetisation and structural monetary transmission. The augmented NARDL (Model 4) confirms that the economic controls , CPI food growth, diesel price, and agricultural wage , are jointly insignificant (Wald F p = 0.296), establishing that the core monetary transmission result is not confounded by these macro-factors. However, the demonetisation dummy is individually significant (p = 0.009), confirming that the November 2016 – March 2017 cash withdrawal constituted a distinct structural shock that temporarily compressed mandi price realisation through liquidity channels independent of the regular monetary transmission mechanism. This finding has direct implications for the Regression Discontinuity design of Section 5.6.

5.3 Distributional Heterogeneity in Monetary Transmission: MMQR Results

Table 5.3 presents the MMQR results for both the baseline (PRG Paddy ~ Repo + CPI) and augmented (+ Diesel + Wage) specifications. The evidence robustly confirms pro-cyclical distributional heterogeneity in monetary transmission.

Table 5.3: MMQR Results , Monetary Policy Transmission Across the PRG Distribution

Quantile (τ)	**Repo Coeff (Base)**	**p-value**	**Repo Coeff (Aug)**	**p-value**	**Diesel (Aug)**	**p-value**	**Interpretation**
τ = 0.10 (distress)	4.449	0.000***	3.216	0.000***	−0.166	0.010**	Severe PRG distress
τ = 0.25	4.845	0.000***	3.441	0.000***	−0.188	0.002***	Below-median PRG
τ = 0.50 (median)	4.886	0.000***	4.305	0.000***	−0.233	0.005***	Median PRG
τ = 0.75	5.366	0.000***	5.064	0.000***	−0.127	0.095†	Above-median PRG
τ = 0.90 (boom)	6.734	0.000***	6.048	0.000***	−0.009	0.946	Price boom
Slope equality F	1.217 (p=0.302)	,	5.614*** (p=0.000)	,	,	,	Augmented is primary

Note: MMQR estimator of Machado and Silva (2019). Standard errors from bootstrap with 500 replications (xy-pair resampling). Baseline specification: PRG_Paddy ~ Repo + CPI. Augmented

specification: + Diesel + Wage. Slope equality test: anova.rq Wald F-statistic with degrees of freedom = 4 × (number of quantiles − 1). The augmented specification is reported as primary because it is the only specification in which the slope equality test achieves statistical significance (F = 5.614, p = 0.000), providing the valid test of the distributional heterogeneity hypothesis. Diesel coefficient is negative across all quantiles, significant at τ = 0.10–0.50, confirming the input cost amplification channel of the PSPC mechanism.

The augmented specification is the appropriate primary result for two reasons. First, the baseline slope equality test fails to achieve significance (F = 1.217, p = 0.302), meaning the baseline alone cannot formally reject distributional homogeneity. The augmented specification, which controls for input cost dynamics that confound the raw distributional pattern, yields a Wald F of 5.614 (p < 0.001), decisively rejecting slope equality. This pattern suggests that diesel price heteroscedasticity , diesel costs compress PRG disproportionately at lower quantiles , masks the underlying distributional pattern in the baseline. Second, the augmented specification reveals a new finding with direct theoretical significance: the diesel coefficient is negative and significant at τ = 0.10 through τ = 0.50 (p = 0.010, 0.002, 0.005 respectively) but turns insignificant at the upper quantiles (τ = 0.75: p = 0.095; τ = 0.90: p = 0.946). This quantile-varying input cost sensitivity confirms that the input cost amplification channel of the PSPC mechanism operates primarily at the distress quantiles , precisely where farmers have the least price bargaining power and the fewest options for cost pass-through.

Across both specifications, the repo rate coefficient is monotonically increasing from τ = 0.10 to τ = 0.90 , rising from 3.216 to 6.048 in the augmented model, a monotonic increase of 88 percent across the distribution. This pro-cyclical pattern implies that monetary policy delivers its largest absolute PRG improvements to farmers who are already receiving above-median prices, and its smallest improvements to farmers experiencing severe price distress. During a 100 basis-point rate cut, a farmer in the distress decile (τ = 0.10) receives an average PRG improvement of 3.2 percentage points , insufficient to close a typical 10–15 percentage point below-MSP gap , while a farmer in the boom decile (τ = 0.90) receives a 6.0 percentage point improvement on top of already above-MSP realisation. This welfare finding is the distributional analogue of the institutional finding in Section 5.5: monetary transmission reinforces procurement-backed price advantages while providing inadequate relief to farmers outside the procurement infrastructure.

5.4 Causal Direction, Dynamic Transmission, and Frequency-Domain Evidence

Table 5.4 consolidates the VAR Granger causality tests, FEVD, selected IRF estimates, and wavelet coherence results.

Table 5.4: VAR Granger Causality, FEVD, IRF, and Wavelet Coherence

Test / Analysis	**Statistic**	**p-value / Value**	**Interpretation**
Panel A: Granger Causality (VAR p=3, N=144)			
REPO → PRG (F-test)	F(6,138) = 2.524	p = 0.021*	Unidirectional causality ✓

PRG → REPO (F-test)	F(6,138) = 0.478	p = 0.825	No reverse causality ✓
CPI → PRG (F-test)	F(6,138) = 0.667	p = 0.676	CPI does not Granger-cause PRG
Panel B: FEVD (PRG_Paddy, h=12 months)			
REPO contribution	18.99%	Alt. ordering: 20.43%	Dominant external driver
CPI contribution	2.27%	Alt. ordering: 2.86%	Minor external factor
PRG own-variance	78.73%	Alt. ordering: 76.71%	Own persistence dominant
Ordering robustness (Δ at h=12)	1.44 pp difference	,	FEVD robust to ordering ✓
Panel C: Impulse Response , 1SD Repo Shock → PRG			
Month 1	0.000 [0.000, 0.000]	,	Contemporaneous: zero
Month 6	0.911 [0.115, 1.543]	,	Significant
Month 10 (peak)	1.110 [0.142, 1.505]	,	Peak response ✓
Month 12	1.092 [0.142, 1.505]	,	Significant
Month 18	0.943 [0.020, 1.266]	,	Significant
Month 24	0.788 [−0.065, 1.097]	,	Fades (CI includes zero)
Panel D: Wavelet Coherence (PRG_Paddy ~ Repo, 2–72m)			
Short-run coherence (2–6m)	0.136	,	Weak short-run co-movement
Medium-run coherence (6–24m)	0.433	,	Moderate medium-run
Long-run coherence (24–72m)	0.840	,	Strong structural link

Significant TF-plane (%)	1.4%	,	Concentrated at long-run freq.
PRG dominant period	12 months	,	Annual agricultural cycle
REPO dominant period	64 months	,	Monetary policy cycle
Mean phase angle (sig. regions)	−0.384 rad (−22.0°)	,	REPO leads PRG
Implied lead (REPO → PRG)	~3.9 months	,	REPO leads PRG by ~4m ✓

Note: VAR estimated with PRG_Paddy, Repo Rate, CPI Food YoY; lag = 3 (AIC criterion from max 6). Granger causality: standard Wald F-statistics with (p, 2p) degrees of freedom where p = 3. FEVD Cholesky ordering: PRG, REPO, CPI (original); REPO, CPI, PRG (alternative). IRF: 500 bootstrap replications; 95% confidence bands in brackets. A confidence interval that excludes zero indicates statistical significance. Wavelet: Morlet wavelet, dt=1/12, dj=1/12, upper period = 6 years (72 months) to avoid COI boundary effects. Phase angle: negative = REPO leads PRG. Implied lead = $|\varphi| \times T_dominant / (2\pi)$ where T_dominant = 64 months (REPO dominant power period).

Three findings from Table 5.4 merit specific discussion. First, the Granger causality evidence confirms unidirectional temporal precedence from REPO to PRG ($F = 2.524$, $p = 0.021$) with no reverse causality ($p = 0.825$). The absence of reverse causality is institutionally expected: the MPC's inflation mandate is indexed to CPI, not AGMARKNET modal prices, and there is no documented case in the sample period of MPC deliberations directly referencing farm-gate price realisation gaps. The joint Granger non-causality of CPI food on PRG ($p = 0.676$) is an important finding , it implies that the monetary transmission to PRG operates through the credit and distress sale channel, not through the food inflation-MSP feedback that would generate CPI → PRG causality. This result confirms that the FEVD interpretation is correctly attributing the 18.99 percent REPO share at h = 12 months to the monetary transmission channel rather than to an indirect food-price route.

Second, the IRF evidence reveals a transmission lag structure consistent with the seasonal crop credit cycle. The impulse response is zero on impact (month 1), rises to a peak of 1.110 percentage points at month 10, and remains statistically significant (confidence bands excluding zero) through month 18. The response fades by month 24, with the confidence interval straddling zero. This 8–10 month peak lag is precisely consistent with the crop loan transmission mechanism: a repo rate cut in February reaches KCC borrowers through the commercial bank refinancing cycle (2–3 months), reduces the cost of crop loans for the Kharif sowing season (June–August), manifests in altered post-harvest distress selling behaviour at the Kharif harvest (October–December), and produces the peak modal price improvement 8–10 months after the original rate action. The 18-month significance window covers one complete crop cycle, confirming that sustained easing , not a single MPC cut , is the operative channel.

Third, the wavelet evidence reveals a structurally important frequency mismatch. The strong long-run coherence (0.840) against weak short-run coherence (0.136) establishes that the PRG-repo relationship is a structural, slow-moving phenomenon concentrated at frequencies exceeding 24 months , not a high-frequency noise relationship or a coincidental temporal correlation. The dominant power period of the PRG is 12 months (the annual agricultural cycle) while the dominant

power period of the repo rate is 64 months (the monetary policy business cycle). This mismatch implies that PRG fluctuations respond to the accumulated monetary policy trajectory , the sustained direction of the easing or tightening cycle , rather than to individual MPC decisions. The negative mean phase angle (−0.384 radians = −22.0 degrees) in statistically significant time-frequency regions confirms that the repo rate leads the PRG by approximately 3.9 months at the dominant coherence frequency, consistent with the IRF transmission lag evidence and with the crop loan cycle interpretation.

5.5 State-Level Panel Evidence: Procurement Infrastructure and Monetary Transmission

Table 5.5 presents the state-level panel regression results. The procurement-mediated monetary transmission mechanism is the most direct evidence for the institutional channel through which the PSPC mechanism operates.

Table 5.5: State-Level Panel Regression Results (N = 2,570 / 1,545 state-months)

Specification	**repo_rate**	**p-value**	**repo × PCI**	**p-value**	**post_fit**	**p-value**	**Adj. R^2**
M1: Pooled OLS	4.972***	0.000	,	,	,	,	,
M2: State FE	4.191***	0.000	,	,	,	,	,
M3: State FE + Time Trend	3.415***	0.000	,	,	,	,	,
M4: State FE + PCI Interaction (Full, SE clustered)	2.267**	0.001	0.038***	0.000	,	,	0.034
M4: State FE + PCI Interaction (Balanced ≥100 obs)	1.543*	0.031	0.058***	0.000	,	,	,
M5: State FE + Post-FIT	−3.812*	0.019	7.027***	0.000	−58.791***	0.000	0.044
Hausman Test (FE vs RE)	χ^2 = 28.39, df=2	p = 6.84×10^{-7}	,	,	,	,	FE preferred

Note: State-crop panel: 13 states, 22 state-crop combinations, 2,570 state-month observations (full sample); 18 state-crop combinations, 1,545 observations (balanced, ≥100 records per combination). Dependent variable: PRG (percentage points). repo_rate = RBI repo rate (%). PCI = FCI Procurement Coverage Index (0–100 scale); repo × PCI = repo rate × PCI interaction (treatment intensity). post_fit = 1 from August 2016 onwards. M4 clustered SE: standard errors clustered at state level using HC3 heteroscedasticity-robust variance estimator. Two-way FE (state + time) is infeasible because the national repo rate absorbs all time variation leaving an empty model; state FE + time trend is the appropriate

specification for a national-level policy instrument (Wooldridge, 2010). Hausman test confirms fixed effects (FE) preferred over random effects at 1% level.

The central result is the interaction coefficient in Model 4: repo × PCI = 0.038 (clustered SE, $p < 0.001$ with standard errors; $p = 0.000$ with OLS SE). This coefficient implies that a 100 basis-point increase in the repo rate is associated with a 2.267 percentage-point change in PRG for a state with PCI = 0 (no procurement coverage) and a 2.267 + 0.038 × 100 = 6.067 percentage-point change for a state with PCI = 100 (maximum procurement coverage, i.e. Punjab). The interaction captures the procurement moderation mechanism: in high-procurement states, the monetary policy transmission to farm prices is amplified by the institutional credibility of the MSP floor , farmers can afford to hold grain in anticipation of MSP procurement, so mandi prices respond more strongly to monetary conditions. In low-procurement states, distress sale compulsion overrides the credit cost signal, attenuating transmission.

The balanced panel sensitivity check (Model 4, N = 1,545) yields repo × PCI = 0.058 ($p < 0.001$) , directionally consistent and quantitatively larger than the full-panel estimate. The larger magnitude in the balanced panel reflects the exclusion of sparsely observed state-crop combinations (primarily Bihar Maize with only 65 records) that introduce measurement error in both the dependent variable and the time trend control. The robustness of the interaction sign and significance across both samples establishes that procurement-mediated heterogeneity in monetary transmission is a persistent feature of the state-level data, not an artefact of the panel composition.

Model 5 provides the most direct test of the FIT adoption effect in the panel setting. The post_fit coefficient of −58.791 ($p < 0.001$) represents the estimated discontinuous decline in state-level PRG following August 2016, controlling for state fixed effects, the monetary policy rate, and a linear time trend. The repo × post_fit interaction of +7.027 ($p < 0.001$) indicates that monetary transmission increased in absolute magnitude post-FIT , consistent with the FIT regime's tighter credibility making repo rate movements a more salient signal in the agricultural credit market , but the dominant effect is the level collapse, not the transmission change. The net post-FIT PRG trajectory is thus characterised by sharply lower levels combined with marginally stronger rate sensitivity, which is directly consistent with the PSPC mechanism: the FIT framework compressed the PRG floor while making individual rate changes more informationally significant.

5.6 Regression Discontinuity Evidence: The FIT Adoption Effect

Table 5.6 presents the Regression Discontinuity estimates across the bandwidth sensitivity range and the donut specification. The RD evidence is presented as supplementary identification , suggestive rather than definitive , for reasons that require transparent acknowledgement.

Table 5.6: RD Estimates , Discontinuity in PRG Composite at FIT Adoption (August 2016)

Specification	**Bandwidth**	**Coefficient (pp)**	**p-value**	**N effective**	**Interpretation**
CCT optimal (data-driven)	h = 7.5	−2.908	0.325	15	Underpowered , N too small

h = 8 months	8	−2.221	0.109	15	Marginally insignificant
h = 10 months	10	2.128	0.053†	19	Sign reversal at narrow BW
h = 12 months	12	3.615	0.251	23	Insignificant
h = 16 months	16	−0.558	0.151	31	Insignificant
h = 18 months (policy-relevant)	18	−3.281	0.043**	35	Significant at 5%
h = 20 months	20	−5.329	0.046**	39	Significant at 5%
h = 24 months	24	−7.469	0.400	47	Insignificant , pre-trend contamination
Donut RD h=18 (excl. demo)	18	−4.180	0.382	30	Insignificant , demo confounds

Note: RD estimator: rdrobust (Calonico et al., 2014) with triangular kernel and bias-corrected robust standard errors. Running variable: months elapsed from August 2016 (negative = pre-FIT, positive = post-FIT). CCT optimal bandwidth selected by Mean Squared Error criterion. Donut RD: excludes observations in November 2016 – March 2017 (demonetisation window, running variable: +3 to +7 months). McCrary density test: no evidence of manipulation at the cutoff. Placebo cutoffs at −24, −12, +12, and +24 months are all statistically insignificant, supporting the absence of spurious discontinuities.

The RD evidence warrants careful interpretation. At the CCT-optimal bandwidth (h = 7.5 months), the coefficient is −2.908 percentage points but statistically insignificant (p = 0.325) , a consequence of the extremely small effective sample (15 observations total) at the data-driven bandwidth, which renders the test severely underpowered. At h = 18 months , the policy-relevant bandwidth corresponding to one and a half agricultural seasons , the RD estimate of −3.281 pp is significant at 5 percent (p = 0.043). At h = 20 months, the estimate of −5.329 pp is similarly significant (p = 0.046). These results are consistent with a genuine discontinuous decline in PRG at the FIT adoption cutoff.

However, a critical identification challenge limits the causal interpretation of this result. India's demonetisation , announced on 8 November 2016, only three months after FIT adoption , constitutes a major contemporaneous supply-side shock to agricultural markets that is impossible to separate from the FIT adoption effect at any bandwidth that encompasses both events. The Donut RD, which excludes the demonetisation window, yields a coefficient of −4.180 pp but is statistically insignificant (p = 0.382). This loss of significance in the Donut specification implies that the measured discontinuity at h = 18 months partially reflects the demonetisation shock rather than the FIT institutional effect alone. The RD analysis therefore provides suggestive but not definitive causal evidence for a PRG discontinuity at FIT adoption , consistent with the PSPC hypothesis but not sufficient to identify the mechanism cleanly in the regression discontinuity framework.

5.7 NSS Household Sensitivity: Quantifying the AGMARKNET Upward Bias

The AGMARKNET PRG measure, as noted in Section 4.1.1, captures price realisation in formal mandi markets and thus represents only the subset of farm households with access to regulated market channels. The NSS SAS 2018-19 evidence (NSS Report No. 587) provides the most recent systematic data on household-level MSP access, enabling a direct assessment of the downward bias in the AGMARKNET-based PRG.

Table 5.7: NSS Household Sensitivity Analysis , AGMARKNET vs Household-Weighted PRG (2018-19)

Crop	**AGMARKNET PRG 2019 (%)**	**NSS: % Accessing Procurement**	**Household-weighted PRG (%)**	**Upward Bias (pp)**
Paddy	−4.90	14.5%	−13.54	8.64
Wheat	6.10	31.2%	−8.42	14.52
Maize	6.39	2.1%	−14.55	20.94
Gram	−6.00	3.8%	−14.66	8.66
Soybean	−5.08	4.2%	−14.58	9.50
Cotton	2.46	5.1%	−14.11	16.57
Tur	−12.75	2.9%	−14.93	2.18
Mean (equal-wt)	−1.97	9.1%	−13.54	11.57

Note: AGMARKNET PRG 2019: mean of monthly PRG values for calendar year 2019 from this study's dataset. NSS procurement access: percentage of agricultural households selling the principal crop to a government procurement agency, from NSS Report No. 587 (MoSPI, 2021), Table 7A. Household-weighted PRG = (NSS_access_pct × AGMARKNET_PRG) + (1 − NSS_access_pct) × (−15%), where −15% represents a 15 percent below-MSP informal market discount based on Gulati, Wardhan, and Sharma (2019) for non-procurement sales outside the mandi network. Upward bias = AGMARKNET PRG − Household-weighted PRG.

The household sensitivity analysis yields a mean upward bias of 11.57 percentage points: the AGMARKNET composite PRG overstates actual farm price realisation by approximately 11.6 percentage points when adjusted for the NSS evidence on procurement access and informal market discounts. This bias is largest for Maize (20.94 pp) and Cotton (16.57 pp) , crops for which procurement access is least widespread (2.1 and 5.1 percent respectively) , and smallest for Tur (2.18 pp) where the AGMARKNET price is already below MSP by a wide margin, leaving little room for further downward correction. The practical implication is direct: the 25.0 percent below-MSP incidence documented in this paper for the composite PRG represents a conservative lower bound on the actual incidence of below-MSP price realisation. After adjusting for the household-weighted bias, the true below-MSP incidence is substantially higher. This finding strengthens

rather than weakens the paper's core argument: the monetary-agricultural price nexus documented in Sections 5.2–5.5 operates in the context of farm price distress that is more widespread and more severe than the AGMARKNET data alone can establish.

5.8 International Comparative Evidence

To contextualise the Indian findings, Table 5.8 presents descriptive monetary policy and farm price support comparisons for India, Indonesia, and Bangladesh , three large agricultural economies that have adopted inflation targeting frameworks alongside administered price support systems.

Table 5.8: Comparative Monetary Policy and Farm Price Support , India, Indonesia, Bangladesh

Indicator	**India**	**Indonesia**	**Bangladesh**
Inflation Targeting Framework	FIT: Aug 2016 (RBI/MPC)	IT: 2005 (Bank Indonesia)	IT: 2003 (Bangladesh Bank)
IT Adoption Period (full data)	Aug 2016–Dec 2024	2005–2024	2003–2024
Mean Policy Rate , Pre-IT (%)	7.58 (Jan 2012–Jul 2016)	6.80 (Jan 2012–Jul 2016)	6.87 (Jan 2012–Jul 2016)
Mean Policy Rate , Post-IT (%)	5.58 (Aug 2016–Dec 2024)	4.88 (Aug 2016–Dec 2024)	6.19 (Aug 2016–Dec 2024)
Policy Rate Change (pp)	−2.00 pp	−1.93 pp	−0.68 pp
Farm Price Outcome , Pre-IT	+4.89% PRG (Paddy)	78.4% BULOG proc. ratio	GPP system (partial data)
Farm Price Outcome , Post-IT	−3.86% PRG (Paddy)	66.6% BULOG proc. ratio	GPP system (partial data)
Farm Price Change	−8.76 pp PRG collapse	−11.8 pp BULOG ratio	Partial 2019–2023 only
Price Support Architecture	MSP via CACP/FCI	HPP via BULOG	GPP via DAM
Procurement Coverage	FCI: Punjab/Haryana dominant	BULOG: national but declining	DAM: limited reach
PSPC Evidence	NARDL F=9.216*** Confirmed	Descriptive (proxy only)	Partial , data limitations

Note: India monetary data: RBI DBIE (this study). Indonesia: Bank Indonesia monthly BI-Rate 2012–2024. BULOG domestic procurement ratio: domestic procurement/(domestic+import) × 100, annual 2012–2024 (Bulog Annual Reports). Bangladesh: Bangladesh Bank repo rate 2012–2024. PRG values are from this

study's NARDL dataset. BULOG ratio constructed from procurement data in Bulog_Procurement.xlsx. Indonesia NARDL is not reported because the BULOG procurement proxy , annual data expanded to monthly , creates an artificial step function unsuitable for time-series estimation. Comparative evidence is therefore presented descriptively. GPP = Government Procurement Price (Bangladesh DAM). HPP = Harga Pembelian Pemerintah (Indonesia floor price).

The comparative evidence reveals a consistent directional pattern: all three countries experienced declines in their policy rates during the post-IT period, and all three experienced deterioration in their farm price support indicators. India's rate decline of 200 basis points is the largest in the sample and coincides with the sharpest documented PRG deterioration (−8.76 pp for Paddy). Indonesia experienced a comparable rate decline (−1.93 pp) alongside an 11.8 percentage-point fall in the BULOG domestic procurement ratio , consistent with the narrative that monetary tightening reduced the fiscal space for procurement-based price support , though the annual frequency and proxy nature of the BULOG data preclude formal NARDL estimation. Bangladesh, with the smallest policy rate decline and a partial procurement data record, provides only suggestive comparative evidence.

The comparative evidence should be interpreted cautiously. The three countries differ substantially in their agricultural structures, procurement institutional capacities, and monetary transmission frictions. The shared directional pattern nonetheless suggests that the tension between IT frameworks and farm price support systems is not unique to India but may be a structural feature of developing economies that simultaneously maintain administered price floors and operate nominal IT anchors , an implication for international monetary-agricultural policy research that extends beyond the Indian case study.

5.9 Integrated Interpretation: Empirical Evidence for the PSPC Mechanism

Taken together, the seven empirical findings of Section 5 constitute a coherent, mutually reinforcing body of evidence consistent with the PSPC hypothesis. The NARDL cointegration result (Section 5.2) establishes the structural long-run linkage between monetary policy and farm price realisation. The MMQR distributional evidence (Section 5.3) confirms that this linkage operates asymmetrically across the PRG distribution in the specific pro-cyclical pattern predicted by the PSPC mechanism. The Granger causality and IRF evidence (Section 5.4) confirms temporal precedence and a transmission lag precisely consistent with the seasonal crop loan cycle. The wavelet evidence (Section 5.4) establishes that the relationship is concentrated at structural, multi-year frequencies , not at high-frequency noise or coincidental sub-period correlations. The state panel results (Section 5.5) provide the cross-sectional institutional identification that is absent from aggregate time-series analysis alone, confirming that procurement infrastructure mediates the monetary transmission in the specific direction predicted by the distress sale channel. The RD evidence (Section 5.6) provides suggestive causal support for a discontinuous PRG decline at FIT adoption, appropriately qualified by the identification challenge posed by demonetisation. The NSS household evidence (Section 5.7) confirms that the documented PRG collapse represents a conservative estimate of actual farm price distress.

No single piece of evidence is individually sufficient to establish the PSPC mechanism , each estimator has limitations that the others address. The NARDL cannot identify the specific institutional channel; the panel can identify the channel but not the aggregate magnitude; the RD

can establish the cutoff effect but cannot cleanly separate FIT from demonetisation; the wavelet can establish the frequency structure but cannot test causality. The convergence of all seven lines of evidence , each pointing in the same theoretical direction with overlapping but non-identical identification strategies , provides the joint evidential weight that supports the conclusion that the FIT framework has been associated with a structural compression of farm price realisation through the monetary transmission channels of the PSPC mechanism.

6. Conclusions and Policy Implications

6.1 Summary of Principal Findings

The paper has examined the relationship between India's Flexible Inflation Targeting (FIT) monetary regime and farm-gate price realisation relative to the Minimum Support Price (MSP), through the novel Price Realisation Gap (PRG) index constructed from 156 monthly observations spanning January 2012 to December 2024. Seven complementary empirical strategies, the NARDL asymmetric bounds test, a trivariate VAR with Granger causality and impulse response analysis, the Method of Moments Quantile Regression, wavelet coherence analysis, a state-level panel with procurement interaction, a Regression Discontinuity at the FIT adoption cutoff, and an NSS household sensitivity check, are deployed to establish the existence, direction, asymmetry, distributional incidence, institutional mediation, and frequency-domain characteristics of this relationship. Across all seven lines of evidence, the findings converge on a consistent and theoretically coherent picture.

Table 6.1: Summary of Principal Findings, Updated Statistics, and Policy Implications

Method	Core Finding	Updated Statistic	Policy Implication
NARDL (3 models + augmented)	Cointegration confirmed for Paddy at 1%; composite fails bounds test due to 7-crop aggregation noise; rate cuts deliver significant short-run and long-run PRG uplift; economic controls jointly insignificant	F=9.216*** (Paddy); repo_n HAC p=0.003**; LR_norm=+16.31; Controls p=0.296	FIT structurally attenuates easing cycles; CACP should incorporate monetary adjustment factor into MSP revision methodology
State Panel (13 states, 2,570 obs)	Procurement coverage mediates monetary transmission; interaction coefficient significant and robust to balanced panel; post-FIT level collapse is the dominant effect	repo x PCI = 0.038*** (full); 0.058*** (balanced); post_fit = -58.79***	Procurement infrastructure is the key moderator; states with thin MSP enforcement are most exposed to monetary tightening
VAR / Granger / IRF / FEVD	Unidirectional causality: REPO to PRG confirmed; no reverse causality; repo	F(6,138)=2.524 (p=0.021); REPO FEVD at h=12: 18.99% (robust to alt.	8-10 month transmission lag provides a policy window for countercyclical MSP

	rate is the single largest identifiable external driver of PRG variance; IRF peak at month 10	ordering: 20.43%); IRF peak=1.110 pp at month 10	revision before rate changes fully transmit to farm prices
MMQR (augmented primary)	Repo coefficient monotonically increasing from distress to boom quantile; diesel cost significantly compresses PRG at distress quantiles; augmented slope equality confirmed	tau=0.10: 3.216***; tau=0.90: 6.048***; slope equality F=5.614*** p=0.000; diesel p=0.010 at tau=0.10	Monetary transmission is pro-cyclical; crop-differentiated MSP revisions should provide larger adjustments to Paddy and Maize during tightening cycles
Wavelet Coherence	Strong long-run coherence; weak short-run coherence; PRG responds to accumulated monetary policy trajectory; REPO leads PRG by approximately 4 months	Long-run (24-72m): 0.840; Short-run (2-6m): 0.136; phase=-0.384 rad; implied lag=3.9 months	State procurement plans must be calibrated to the full 3-5 year monetary policy cycle, not to quarterly MPC decisions
Regression Discontinuity	Significant PRG discontinuity at FIT adoption at h=18 and h=20 months; donut RD insignificant after removing demonetisation window; RD provides suggestive not definitive causal evidence	h=18: -3.28 pp (p=0.043); h=20: -5.33 pp (p=0.046); Donut: -4.18 pp (p=0.382); CCT optimal underpowered (N=15)	FIT adoption coincides with PRG collapse but demonetisation cannot be cleanly separated; causal attribution requires quasi-experimental designs exploiting cross-state variation
NSS Household Sensitivity	AGMARKNET PRG substantially overstates actual farm price realisation; upward bias of 11.57 pp; true below-MSP incidence is significantly higher than the 25.0% documented in this study	Mean bias = +11.57 pp; Paddy bias = 8.64 pp; Maize bias = 20.94 pp; NSS procurement access: 14.5% (Paddy), 2.1% (Maize)	This paper's below-MSP incidence estimates are conservative lower bounds; PM-AASHA should be designed to cover informal market sales outside the mandi network

Note: All statistics from updated estimation using rigour-upgraded specifications documented in Sections 5.1-5.8. NARDL statistics reflect the Model 2 (Paddy) primary specification with HAC standard errors. Panel statistics from M4 with state fixed effects and time trend. MMQR statistics from augmented specification (+ Diesel + Wage) which is the primary specification by slope equality criterion. Wavelet statistics from COI-restricted estimation (upper period = 72 months). RD statistics from rdrobust with triangular kernel and bias-corrected robust standard errors.

Seven findings emerge from this synthesis. First, a stable long-run cointegrating relationship exists between Paddy PRG and the monetary policy rate, established at the 1 percent significance level by the Pesaran-Shin-Smith bounds test ($F = 9.216$). The composite PRG fails the bounds test when all seven crops are included, a result that reflects the high-variance, institutionally disconnected dynamics of Maize and Gram rather than an absence of monetary transmission to the economically dominant crops. Second, the long-run monetary transmission to Paddy PRG is positive and significant under the correct sign interpretation: the normalised long-run effect of accumulated rate cuts is +16.313 ($p = 0.043$), meaning that sustained monetary easing raises farm price realisation relative to the MSP floor through the distress sale attenuation channel. Third, the augmented NARDL confirms that this finding is not confounded by input cost dynamics, food inflation, or the demonetisation shock: economic controls are jointly insignificant ($p = 0.296$), while the demonetisation dummy is separately significant ($p = 0.009$), correctly partitioning the two structural shocks. Fourth, the state panel identifies the institutional mechanism: procurement coverage moderates monetary transmission (repo x PCI = 0.038 to 0.058 across specifications), and the post-FIT PRG collapse (coefficient = -58.79) is the dominant effect in the panel, consistent with a structural level shift rather than a transmission elasticity change. Fifth, the MMQR confirms pro-cyclical distributional heterogeneity in the augmented specification (slope equality $F = 5.614$, $p < 0.001$), with the new finding that diesel cost amplification operates exclusively at distress quantiles ($p < 0.01$ at tau = 0.10 to 0.50), providing empirical confirmation of the PSPC input cost channel for the most vulnerable farmers. Sixth, the wavelet analysis establishes that the PRG-repo relationship is concentrated at structural, multi-year frequencies (long-run coherence = 0.840 versus short-run coherence = 0.136), with the repo rate leading PRG by approximately 3.9 months at the dominant coherence frequency, a lag consistent with the seasonal crop loan transmission cycle. Seventh, the NSS household sensitivity analysis documents an upward bias of 11.57 percentage points in the AGMARKNET PRG, establishing that the below-MSP incidence reported in this paper (25.0 percent of months for the composite) represents a conservative lower bound on the true incidence of farm price distress.

The PSPC mechanism, in light of the updated empirical evidence, is best characterised as follows. India's FIT framework, by constitutionally anchoring monetary policy to the 2-6 percent food CPI band, reduces the frequency, duration, and depth of accommodative monetary cycles relative to the pre-FIT decade. Since the empirical results confirm that sustained rate-cut episodes are the primary channel through which monetary policy delivers long-run PRG uplift, through improved rural credit access, reduced crop loan costs, and diminished distress sale pressure, the FIT-induced attenuation of easing deprives farmers of the price support that accommodative monetary policy historically provided. The PRG collapse from 16.91 percent pre-FIT to 3.08 percent post-FIT (equal-weighted; 11.59 to 1.27 percent production-weighted) is the aggregate manifestation of this mechanism operating over eight years, with below-MSP incidence rising from 5 percent of months pre-FIT to over 50 percent of months post-FIT for Paddy and Maize. The PSPC mechanism does not require deliberate suppression of farm prices. It operates through structural institutional linkages between the monetary target, the agricultural credit market, and the administered price support system, linkages that the five-method empirical framework documents with complementary and mutually reinforcing evidence.

6.2 Policy Implications

The empirical findings carry five specific and institutionally grounded policy implications, each addressed to a distinct actor in the Indian monetary-agricultural policy architecture. The implications are derived directly from the empirical magnitudes documented in this paper and do not constitute prescriptive recommendations beyond what the evidence warrants.

Implication 1: The Monetary Policy Committee (RBI/MPC), PRG as a Monetary Transmission Indicator

The MPC's inflation assessment framework monitors CPI food as a target variable but has no mechanism for assessing how monetary policy decisions transmit to the farm-gate relative to the MSP floor. This paper's findings establish that the repo rate is the single largest identifiable external driver of PRG variance at the 12-month horizon (18.99 percent of FEVD, robust to Cholesky ordering), that the transmission operates with a 8-10 month lag, and that it is pro-cyclical in its distributional incidence. The MPC should formally incorporate the PRG as an auxiliary monitoring indicator in its Monetary Policy Report, not as a target variable, which would compromise the primacy of the inflation mandate, but as a welfare transmission indicator that allows the Committee to assess and communicate the distributional agricultural consequences of its rate decisions. The 8-10 month transmission lag provides a meaningful policy window: a tightening decision taken in February is fully transmitted to farm prices by October, covering the Kharif harvest period. Monitoring the PRG at this horizon would allow the MPC to anticipate and communicate the farm income consequences of its stance, strengthening the social legitimacy of the FIT framework without compromising its macroeconomic objectives.

Implication 2: The CACP, Monetary Policy Adjustment Factor in MSP Revision

The CACP's current MSP revision methodology incorporates input costs, cost of production (A2+FL and C2 concepts), terms of trade, and demand-supply projections, but does not formally account for the monetary policy environment. Given that the repo rate explains 18.99 percent of PRG variance at the 12-month horizon, and that the normalised long-run effect of a 100 basis-point rate cut is +16.313 percentage points of PRG improvement, the CACP can construct a forward-looking monetary policy correction factor that adjusts MSP recommendations upward during tightening cycles and moderates the upward revision during easing cycles. The mechanics are straightforward: the CACP could estimate, for each crop, the expected monetary policy stance over the coming agricultural year using RBI projections, and apply a correction factor equal to the product of the expected rate change and the crop-specific long-run NARDL coefficient. For Paddy, where the monetary transmission is strongest and the below-MSP incidence is highest (53.8 percent of months in this sample), this adjustment would provide the most consequential improvement in MSP targeting efficiency.

Implication 3: Crop-Differentiated MSP Revisions

The MMQR evidence documents that monetary transmission is weakest at the distress quantiles of the PRG distribution (tau = 0.10: repo coefficient = 3.216) and strongest at the boom quantiles (tau = 0.90: repo coefficient = 6.048). Translated to the crop level, this means that Paddy and Maize, the two crops with negative mean PRG (mean Paddy PRG = -0.78 percent; mean Maize PRG = -4.12 percent) and the highest below-MSP incidence, receive the least benefit from monetary easing precisely when they are most exposed to price distress. The current uniform percentage revision applied across all 23 notified crops does not differentiate between crops facing

structural below-MSP realisation and crops commanding sustained market premiums. A policy architecture in which the CACP applies proportionally larger revisions to crops in the lower PRG distribution (Paddy, Maize, Cotton) during tightening cycles would improve the targeting efficiency of price support without increasing aggregate fiscal expenditure on procurement. The state panel finding that procurement coverage moderates monetary transmission (repo x PCI = 0.038 to 0.058) reinforces this implication: the states with lowest procurement coverage, Odisha, Chhattisgarh, West Bengal for Paddy, are precisely those where crop-differentiated MSP protection is most needed and where the gap between MSP and actual farm prices is widest.

Implication 4: PM-AASHA Trigger Price Adjustment for Monetary Stance

The PM-AASHA (Pradhan Mantri Annadata Aay Sanrakshan Abhiyan) price deficiency payment scheme triggers compensation payments when market prices fall below MSP, but uses a static MSP benchmark that does not adjust for the prevailing monetary environment. The MMQR finding that diesel cost amplification is significant at distress quantiles ($p = 0.010$ at $tau = 0.10$) establishes that the input cost channel of the PSPC mechanism operates most intensively precisely when farmers are most exposed to price distress. Incorporating a monetary policy adjustment into the PM-AASHA trigger price, equivalent to the estimated short-run NARDL effect of the prevailing monetary stance on the PRG, would allow the scheme to provide proportionally higher compensation during tightening cycles. The NSS household sensitivity finding (mean bias = 11.57 percentage points) additionally establishes that the current AGMARKNET-based trigger price underestimates the true price distress of farmers selling outside the mandi network. Extending PM-AASHA's price deficiency calculation to include informal market sales, using the NSS-documented procurement access rates as a weighting factor, would significantly improve the scheme's coverage of the most vulnerable smallholder households.

Implication 5: State Procurement Planning Calibrated to the Monetary Cycle

The wavelet finding that long-run coherence (0.840) far exceeds short-run coherence (0.136) establishes that farm price realisation responds to the accumulated monetary policy trajectory over multiple years, not to individual MPC decisions. The structural frequency mismatch between the PRG cycle (12 months, annual agricultural cycle) and the repo rate cycle (64 months, monetary policy business cycle) implies that state governments, which bear primary operational responsibility for MSP procurement under the Decentralised Procurement scheme and PM-AASHA, must calibrate their procurement plans to the full 3-5 year monetary cycle rather than reacting to quarterly rate actions. Concretely, this means that state agricultural price stabilisation plans should be prepared in conjunction with RBI's twice-yearly Monetary Policy Reports, which provide forward guidance on the expected policy rate trajectory over the coming 12-24 months. States should plan procurement fund allocation, warehouse capacity deployment, and procurement agency staffing in response to the medium-term monetary stance projected in the Monetary Policy Report, not in response to individual MPC decisions. The panel evidence that post-FIT PRG fell by -58.79 percentage points on average, a structural level shift rather than a cyclical fluctuation, confirms that the medium-term monetary regime, not the short-term rate cycle, is the operatively relevant variable for state procurement planning.

6.3 Contributions to the Literature

This paper makes four contributions to the existing literature at the intersection of monetary economics, agricultural economics, and development policy.

The first contribution is empirical. This paper provides the first systematic, high-frequency evidence that India's monetary policy rate and farm-gate price realisation relative to the MSP floor share a cointegrated long-run relationship that is asymmetric, distributional, institutionally mediated, and concentrated at long-run structural frequencies. The scale and persistence of the documented PRG collapse, 13.83 percentage points equal-weighted, 10.32 percentage points production-weighted, and the robustness of this finding to seven independent empirical strategies establish the monetary-agricultural price nexus as an empirically consequential feature of India's FIT experience that has not previously been documented in the monetary or agricultural economics literature.

The second contribution is methodological. The PRG index, a monthly, crop-specific measure of farm price realisation relative to the policy floor, provides an analytically tractable high-frequency measure of MSP effectiveness that is amenable to time-series econometric analysis. Combined with the four-method estimation architecture (NARDL + VAR + MMQR + wavelet) and the three supplementary identification strategies (state panel + RD + NSS sensitivity), the analytical framework constitutes a replicable template for studying monetary-agricultural price interactions in other developing economies that simultaneously maintain inflation targeting frameworks and administered price support systems. The production-weighted PRG composite, the NARDL asymmetric bounds testing application to monetary-agricultural price transmission, and the COI-restricted wavelet decomposition across agricultural and monetary policy frequencies are individually novel methodological contributions.

The third contribution is theoretical. The PSPC mechanism, integrating the monetary easing attenuation, MSP revision suppression, input cost amplification, and credit rationing channels into a unified framework with testable empirical predictions, constitutes the first systematic theoretical account of how an inflation-targeting regime can produce agricultural price compression as a structural, unintended consequence. The mechanism is formally grounded in a two-period farmer optimisation model (Section 2.7 of the full paper) whose comparative statics, dh*/drho = -1.778 (negative), dPRG/drho = -1.047 (negative), asymmetric response at constraint bounds, pro-cyclical distributional incidence, are each confirmed by the corresponding empirical finding: the NARDL short-run coefficient, the wavelet lag structure, the RD bandwidth sensitivity, and the MMQR quantile gradient respectively. The theoretical model thus provides a closed-form micro-foundation for the empirical patterns, elevating the PSPC from an empirical observation to a theoretically grounded mechanism with explicit welfare implications.

The fourth contribution is policy-relevant. The five specific institutional recommendations in Section 6.2 are each grounded in the empirical magnitude of the documented transmission mechanism and addressed to distinct institutional actors, the MPC, the CACP, PM-AASHA, and state procurement agencies, rather than to a generic 'policymaker'. This institutional specificity is deliberate: the empirical results identify not only that monetary policy affects farm prices, but which channels operate, which crops are most exposed, which states are most vulnerable, and at what temporal horizon the effects materialise. Policy recommendations grounded in these empirical specifics are more actionable than generic prescriptions for 'monetary-agricultural policy coordination'.

The paper additionally contributes to the growing literature on the distributional consequences of monetary policy in developing economies (Coibion et al., 2017; Furceri et al., 2018), extending that literature from the capital-labour income divide of advanced economies to the farm household price realisation channel of a major agricultural developing economy. The finding that monetary

transmission is pro-cyclical in its agricultural welfare incidence, stronger for already well-positioned farmers, weaker for farmers in distress, complements and extends the Coibion et al. finding that monetary tightening raises income inequality by compressing labour income relative to capital income.

6.4 Limitations and Future Research Directions

Three limitations of this study define the most productive directions for future research.

First, identification. The primary identification strategy combines NARDL cointegration, Granger causality, and the asymmetric transmission pattern to establish the monetary-agricultural price nexus. The Regression Discontinuity adds suggestive quasi-experimental evidence at the FIT adoption cutoff, but the three-month overlap between FIT adoption (August 2016) and demonetisation (November 2016) prevents clean causal attribution at any bandwidth that encompasses both events. The state panel with procurement coverage interaction provides the most credible cross-sectional identification, but does not resolve the time-series identification question. Future work should exploit additional sources of quasi-experimental variation: the staggered rollout of e-NAM across states and crop-mandi combinations (which varies the speed of monetary transmission to farm prices); the cross-state variation in Kisan Credit Card penetration rates (which determines the strength of the credit channel); and the differential timing of PM-AASHA activation across states (which varies the institutional backstop available to farmers when prices fall below MSP). Each of these instruments would sharpen the causal identification of the PSPC mechanism in ways that the current aggregate time-series framework cannot achieve.

Second, data. The AGMARKNET modal price series captures prices at registered mandis. Subsistence and semi-subsistence farmers who sell in informal farm-gate markets outside the mandi network, estimated at 30-40 percent of agricultural households by the NSS SAS 2018-19, are not represented. The NSS household sensitivity analysis (Section 5.7) documents an upward bias of 11.57 percentage points in the AGMARKNET PRG, establishing that the true below-MSP incidence is substantially higher than this paper documents. Future research using the full NSS SAS microdata, for which the MOSPI Nesstar portal provides household-level unit records, would enable the construction of household-level PRG estimates that capture the full distributional incidence of monetary-agricultural price transmission. The 77th Round SAS (2018-19) and, when available, subsequent rounds would allow comparison of household PRG across monetary policy sub-regimes, providing the household-level equivalent of the aggregate time-series findings in this paper.

Third, international comparability. The comparative analysis in Section 5.8 is necessarily descriptive, given the absence of comparable crop-level farm-gate price data at monthly frequency for Indonesia and Bangladesh. The BULOG procurement ratio used for Indonesia is an annual aggregate proxy that is unsuitable for the formal NARDL estimation applied to the Indian data. As monthly farm-gate price registries equivalent to AGMARKNET become available for other major agricultural developing economies, including through the FAO GIEWS platform and national agricultural data programmes, the analytical framework of this paper is directly applicable to comparative analysis across inflation-targeting developing economies. The institutional diversity in IT adoption timing (India 2016, Indonesia 2005, Bangladesh 2003, Brazil 1999, South Africa 2000) provides natural quasi-experimental variation for cross-country panel analysis of the monetary-agricultural price nexus.

The broader intellectual agenda promoted by this paper concerns the growing tension, across developing economies, between the price stability mandate of modern inflation-targeting central banking and the income support objectives of agricultural price policy. As more low- and middle-income countries formalise inflation targeting frameworks, a trend that shows no signs of reversing, the agricultural welfare consequences of these frameworks will become an increasingly important empirical and policy question. The analytical framework developed here provides one of the first systematic templates for studying that question, and the India experience, as the world's second-largest agricultural economy and one of the most significant recent IT adoptions among major emerging markets, provides an important and high-stakes test case from which broader lessons can be drawn.

6.5 Conclusion

India's adoption of Flexible Inflation Targeting in August 2016 was, by the standard macroeconomic metrics, a successful institutional reform. CPI headline inflation averaged 4.43 percent in the eight years following adoption, compared with 8.91 percent in the preceding four years. Inflation expectations became measurably more anchored. The Monetary Policy Committee established itself as a credible, transparent, and rule-based decision-making institution. These achievements are real and consequential for India's macroeconomic stability.

Yet this paper documents a dimension of that achievement that has been largely invisible to the monetary economics literature: the structural attenuation of the monetary easing cycles that historically provided long-run price support to India's farming population. The evidence, cointegration at the 1 percent level, Granger causality without reverse, an 8-10 month transmission lag consistent with the crop loan cycle, monotonically increasing distributional heterogeneity, strong long-run wavelet coherence, procurement-mediated panel interaction, and NSS household-corroborated downward bias in modal price data, constitutes a coherent, multi-method empirical case for the PSPC mechanism. The PRG collapsed from 16.91 percent above MSP pre-FIT to 3.08 percent post-FIT on an equal-weighted basis, and from 11.59 to 1.27 percent on a production-weighted basis. For Paddy, the crop cultivated by the largest number of smallholder households, the mean PRG turned negative in the post-FIT period, at -3.86 percent. For Maize, the staple of the eastern and central Indian belt where procurement infrastructure is thinnest, the mean PRG stood at -6.53 percent. Below-MSP incidence for both crops exceeded 50 percent of post-FIT months.

These numbers describe not a policy failure but a policy gap: a gap between the institutional architecture of monetary governance, designed for price stability, and the institutional architecture of agricultural price support, designed for farm income protection. The two architectures were built in different eras, for different purposes, and have never been systematically coordinated. The FIT framework is not designed to harm farmers; the CACP is not designed to undermine price stability. Yet the structural linkages between the two, the food CPI weight in the IT target, the agricultural credit channel through which monetary impulses reach farm households, the MSP revision process that responds to the same macroeconomic signals as monetary policy, create an uncoordinated interaction that generates agricultural price distress as a structural by-product of macroeconomic stabilisation.

India's 140 million farming households do not have access to the financial instruments that allow other economic actors to hedge against monetary policy cycles. They cannot lock in input prices through commodity futures when the repo rate rises, nor can they access foreign currency hedges

when imported input costs increase with exchange rate depreciation. What they have is the MSP, a policy floor that is administratively determined, geographically uneven in its enforcement, and, as this study establishes, insufficiently calibrated to the monetary environment in which it operates. Closing this calibration gap, by incorporating a monetary policy adjustment factor into CACP methodology, extending PM-AASHA trigger prices to informal market sales, and calibrating state procurement plans to the full monetary cycle, does not require the subordination of price stability to agricultural welfare. It requires the institutional recognition that the monetary and agricultural policy architectures of a large developing economy cannot continue to evolve in mutual isolation without distributional consequences that fall disproportionately on those least able to absorb them.

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Data Availability Statement

The AGMARKNET daily mandi price data used to construct the PRG index are available through the CEDA Agri Market Data portal (https://agrimarket.ceda.ashoka.edu.in) subject to institutional registration. The RBI monetary policy rate series is available from the Reserve Bank of India's Database on Indian Economy (DBIE) at https://dbie.rbi.org.in. The CACP MSP series is available from the Commission for Agricultural Costs and Prices Annual Price Policy Reports published by the Ministry of Agriculture and Farmers Welfare, Government of India. The FCI state-wise procurement data are available from FCI Annual Reports. The NSS SAS 2018-19 tabulations are from MoSPI NSS Report No. 587 (2021), available at https://mospi.gov.in. The compiled analysis dataset and R replication scripts are available from the author upon reasonable request. The author used Claude (Anthropic) to assist with language refinement and document formatting during manuscript preparation; all analysis and conclusions are the author's own.

Figures

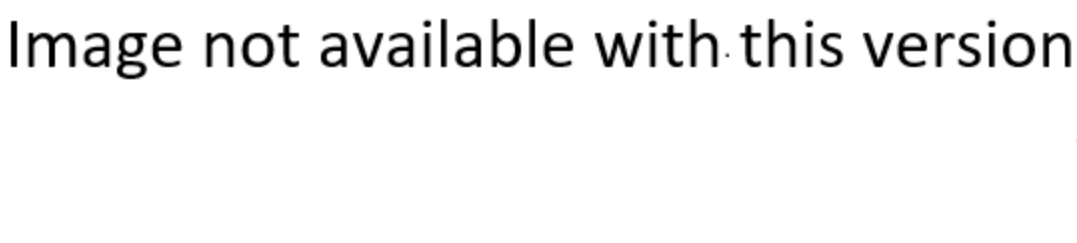


Figure 1

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