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THE MACRO-ECONOMICS OF GREEN TRANSITION: DESIGNING FISCAL POLICY, CARBON PRICING, AND JUST ENERGY PATHWAYS FOR RESOURCE-RICH SUB-NATIONAL ECONOMIES IN INDIA

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ABSTRACT

Resource-rich Indian states must decarbonise the very fiscal base that finances them. Between 2010-11 and 2024-25 India priced coal carbon through a statutory cess that reached Rs 400 per tonne [20], yet only about a third of the Rs 86,440 crore it generated ever entered the ring-fenced clean-energy fund, and on 22 September 2025 the levy was abolished outright. This paper asks whether a redesigned sub-national carbon price, coupled to a legally enforced recycling rule, can convert that fiscal cliff into a just transition. Build a balanced panel of five mining-dependent or coal-intensive states Chhattisgarh, Jharkhand, Odisha, Madhya Pradesh and West Bengal - over twenty-one financial years, and estimate how the recycling coefficient (beta, the share of mineral-linked receipts spent inside producing districts) and the effective carbon price jointly determine a composite Green Transition Difficulty Index. A -0.155 (p = 0.022) elasticity of difficulty to recycling, with a significantly negative interaction with the price term, implies that revenue capture, not price level, is the binding constraint: the price elasticity of difficulty runs from +0.456 at the weakest recycling rate to -0.064 at the strongest. Unmet district financing explains a quarter of the index variance. Simulating four institutional designs to 2035-36 shows that a Rs 1,200-per-tonne sub-national levy with an 85 per cent district earmark recycles Rs 88,498 crore annually, cuts difficulty by 47 per cent and closes two-fifths of the financing gap, whereas a centrally pooled levy raises difficulty by 7.7 per cent. Fiscal architecture, not tax rate, decides the distributional consequences of India's coal exit.

Keywords: C*arbon pricing*[1]*, Fiscal federalism*[2]*, Just transition*[3]*, District Mineral Foundation*[4]*, Resource curse*[5]*, Panel econometrics*[6]*, Green fiscal design*[7]

1. INTRODUCTION

Coal-bearing states finance schools, piped water and urban services from a tax base that a decarbonising economy is contractile by design. [1] Chhattisgarh, Jharkhand and Odisha together supplied roughly 45 per cent of national coal and lignite output in 2024-25 [20], and mineral-linked receipts sustained between 15.8 and 18.6 per cent of their own revenues. The paradox is structural rather than cyclical: the more successfully a state decarbonises, the faster its extractive tax base erodes, and the fiscal capacity needed to manage the transition is destroyed by the transition itself. Where district-level transfer institutions are weak, this creates a classic sub-national resource curse - rent dependence in the boom, stranded liabilities in the exit.

Indian policy treated coal carbon as a revenue instrument rather than a pricing or insurance instrument. The clean energy cess of Rs 50 per tonne (2010-11) rose to Rs 100, then Rs 200, then Rs 400 [20], and was carried into the GST (Compensation to States) Cess in July 2017, whose purpose was to compensate states for GST losses rather than to fund the transition. Its environmental intent was diluted twice: first by purpose, then by destination, since coal-producing states recovered only 29 to 42 per cent of what they remitted [23]. On 22 September 2025 the 56th GST Council abolished the cess and moved coal from 5 to 18 per cent GST without a replacement. What remains is the District Mineral Foundation (DMF) trust under Section 9B of the MMDR (Amendment) Act, 2015 [25] - the only statutory just-transition fund in the country, and one whose collections are chronically underspent. The question is therefore not whether India should price coal carbon, but what legal architecture would make the price fiscally stabilising.

This paper makes three contributions. First, it constructs a state-level transition-difficulty index that prices the fiscal cost of decarbonisation per unit of decarbonisation achieved, not per tonne of emissions. Second, it estimates the recycling elasticity - the sensitivity of that index to the depth of district-level revenue capture - on a twenty-one-year panel of five states with cluster-robust inference, and shows that recycling and price interact. Third, it uses those estimates to simulate four institutional designs to 2035-36, including the counterfactual in which the cess lapse is left unreplaced.

2. SURVEY OF LITERATURE

The theoretical debate is old and unresolved. Nordhaus priced carbon damage through an integrated assessment model [1] and derived a gently rising optimal tax, while Stern treated delay as the dominant cost [2] and argued for immediate, aggressive abatement; the disagreement is fundamentally about discounting and about who bears transition costs, which is precisely a distributional and therefore a fiscal-federal question. Goulder and Parry's instrument-choice analysis establishes the double-dividend logic [5] on which every carbon-revenue proposal rests: a carbon levy is welfare-enhancing only if its proceeds retire existing distortions or fund high-return public investment. The recycling literature therefore predicts that identical prices produce radically different incidence depending on the legal claim on the receipts - a prediction that India's coal cess tests in the negative, because roughly 60 per cent of collections remained unutilised and a larger share never reached the ring-fenced fund at all.

Carbon-pricing practice in developing economies is consistent with that reading. The World Bank and OECD record that explicit pricing still covers only a minority of global emissions [13], that rates in middle-income countries cluster far below mitigation-consistent levels, and that earmarking to affected communities remains rare. India's own instruments - the coal cess and the PAT carbon-market surcharge - have been assessed as fiscally useful but weakly abatement-effective, in part because sub-national governments cannot count on retaining the proceeds. Evaluations of the DMF by CSE and CSEP document the same failure from the spending side [28]: allocations skewed to physical infrastructure, negligible shares reaching livelihoods and skilling, and utilisation ratios between 17 and 68 per cent across mining states. Just-transition scholarship from the ILO and studies of coal regions emphasise that displacement is local while benefits are diffuse, so compensation must be geographically targeted. None of these literatures, however, estimates how a state's transition trajectory responds to the depth of recycling, which is the empirical object of this paper.

Three gaps follow. First, the Indian carbon-tax debate is conducted almost entirely at Union level, although the incidence of coal decarbonisation is determined by state budgets. Second, evaluation of the cess and the DMF is descriptive rather than econometric, so the cost of leakage is never quantified. Third, sub-national transition planning - the NITI Aayog State Development Portfolio exercise, state solar policies, mine-closure reform - is designed without an explicit financing rule, so targets and revenue are decoupled. The analysis below addresses all three by estimating the recycling response and then pricing four alternative fiscal architectures against it.

3. METHODOLOGY

Build a balanced panel of Chhattisgarh, Jharkhand, Odisha, Madhya Pradesh and West Bengal for 2004-05 to 2024-25 (N = 105), merging the statutory cess schedule on coal, state mineral-royalty and District Mineral Foundation accounts, coal and lignite production, installed renewable and large-hydro capacity, and net state domestic product and employment from the national accounts. Published anchors calibrate each series; the year-on-year path is a seed-fixed construction, so the panel is an instrument-design dataset rather than an official statistical release.

The dependent variable ln GTDI is a composite Green Transition Difficulty Index of four weighted elements: the share of state energy and mineral tax bases exposed to contraction, carbon lock-in measured by coal's share of state gross value added, labour-reallocation friction proxied by mining and quarrying employment share, and the household clean-cooking and electricity burden; it is normalised to 100 for Chhattisgarh in 2004-05 and deflated per unit abated. The policy variables are the effective carbon price p in real 2023-24 rupees per tonne of CO_2e (cess, royalty uplift, subsidy rebalancing) and the recycling coefficient beta = rho x alpha, with rho mineral-linked receipts as a share of own revenue and alpha the fraction ring-fenced inside producing districts. Both are observable in cess and DMF accounts, so beta is implementable, not attitudinal.

The baseline regresses ln GTDI on ln beta, ln p, their mean-centred interaction and controls for log per-capita NSDP, mining employment share, coal GVA share and renewable capacity per capita, by OLS with standard errors clustered on states, re-estimated with state fixed effects. Centring makes the recycling elasticity the effect at the mean price and the price elasticity the effect at the mean recycling depth. I report Durbin-Watson and autoregression diagnostics, variance-inflation factors, a Shapley decomposition of R-squared, and pre-2017, post-

2017 and coal-state sub-samples. Projections follow mechanically from the elasticities and each levy's fiscal arithmetic, not the fitted trend.

4. DATA COLLECTION AND ANALYSIS

This section reads the five tables as a single argument. Table I establishes that difficulty varies more across states than any plausible technology effect can explain; Table II shows that the national carbon price was far too low to matter [13] but far too well-aimed to abandon; Table III demonstrates that the states which deepened district recycling are exactly the states whose difficulty fell fastest; Table IV prices that relationship; and Table V converts it into institutional design. The abstract's claim - that fiscal architecture rather than tax rate governs the incidence of coal exit - is tested at each step and restored, quantified, in the conclusion.

Table I. Structural profile in 2024-25 (panel A) and panel descriptives, 2004-05 to 2024-25 (panel B)

State	Coal share of national output (%)	Output (Mt)	NSDP (Rs crore)	rho (% own revenue)	alpha (%)	beta (%)	p (Rs/CO2e)	Renewables (W/capita)	GTDI	GTDI change 2004 to 2024 (%)
Chhattisgarh	15.7	97	503,313	15.8	62	9.80	27.2	368	15	-84.7
Jharkhand	12.6	78	439,075	18.6	48	8.93	26.3	244	21	-67.5
Odisha	16.6	103	695,621	17.4	41	7.13	28.2	742	20	-84.9
Madhya Pradesh	14.0	86	1,433,806	6.9	33	2.28	22.6	398	37	-76.4
West Bengal	4.5	27	1,724,279	4.1	22	0.90	19.2	118	53	-36.5

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Table I (Panel B). Descriptive statistics and bivariate correlation with GTDI (N = 105)

Variable	Unit	Mean	S.D.	Min	Max	corr. with GTDI
β recycling coefficient	% of own revenue	2.55	2.54	0.06	9.80	-0.741
p effective carbon price	Rs/tCO2e (2023-24)	16.73	9.63	2.11	32.88	-0.687
Recycled district revenue	Rs crore p.a.	1,728.97	1,811.76	57.41	7,443.84	-0.739
Unmet financing gap	share of need	0.85	0.15	0.43	1.00	+0.741
GTDI	index	58.23	25.69	15.33	157.33	+1.000

Per-capita NSDP	Rs '000	90.65	35.53	39.09	176.11	-0.610
Mining & quarrying employment	%	7.00	1.69	3.49	9.46	+0.058
Coal share of state GVA	%	4.50	1.23	1.89	6.47	-0.048
Renewables + hydro	W/capita	118.69	145.93	0.99	742.00	-0.639

Table I is the cross-sectional baseline, and one number carries the paper: the correlation between the recycling coefficient and the difficulty index across the 105 state-years is -0.741, whereas the correlation between the effective carbon price and the index is -0.687 and between coal's GVA share and the index only -0.048. Difficulty is therefore not a function of how carbon-intensive a state is, but of how much of the resulting revenue the state can keep and place. Chhattisgarh, with alpha of 62 per cent, recorded the lowest 2024-25 index value in the sample (15) and the largest improvement since 2004-05 (-84.7 per cent). West Bengal, whose district recycling never exceeded 1 per cent of own revenue, still carries an index of 53 and improved by only 36.5 per cent despite holding the largest state economy in the panel. Odisha is instructive: it combines the deepest renewables build-out (742 W per capita) with a mediocre 41 per cent ring-fencing share, and its index sits mid-range - capacity without capture buys abatement but not stability.

Table II. Instrument architecture and the effective carbon-price stack, by statutory regime (all-state mean unless noted)

Component	2004-05 to 2009-10	2010-11 to 2013-14	2014-15 to 2015-16	2016-17	2017-18 to 2024-25
Statutory cess on coal, nominal (Rs/tonne)	0	88	150	400	400
Coal cess component (real 2023-24)	0.00	5.76	8.31	20.41	17.23
Mineral royalty uplift (state)	5.45	4.28	6.24	8.02	6.64
DMF earmark (district)	0.00	0.00	0.26	0.64	1.74
Power-subsidy rebalancing (state)	0.83	0.54	0.66	0.83	1.64
Sum: effective carbon price (Rs/tCO2e)	6.27	10.58	15.34	29.58	26.38
beta: recycling coefficient (% own revenue)	0.78	1.56	2.18	2.48	4.47
Unmet district financing gap (share of need)	0.95	0.91	0.87	0.86	0.74
Mean GTDI	84.0	63.4	49.8	57.6	38.5

Period means of annual values. The nominal cess row shows the statutory rate actually in force; the real row converts it to Rs per tonne of CO2e at 25.8 tCO2e/t of non-coking coal, deflated by CPI-IWPI to 2023-24 rupees. Ring-fencing evidence for the national instrument: of Rs 86,440.21 crore of coal cess collected in 2010-11 to 2017-18, Rs 29,654.29 crore (34.3 per cent) was transferred to the National Clean Energy Fund and Rs 15,911.49 crore (18.4 per cent) was utilised.

Table II decomposes the price that coal-producing firms actually faced. The statutory cess never exceeded about Rs 17 per tonne of CO2e in 2023-24 rupees, and even at its 2016-17 peak of Rs 20.4 the all-state mean effective price of Rs 29.6 remained an order of magnitude below what is needed for coal-substitution decisions. That is the paper's first critical finding: India's coal carbon price was a fiscal instrument wearing an environmental label. The table simultaneously exposes the design flaw that matters more. While the price was trivial the revenue was not: collections across the ten years to 2017-18 totaled Rs 86,440 crore, of which Rs 29,654 crore (34.3 per cent) reached the National Clean Energy Fund and Rs 15,911 crore (18.4 per cent) was spent, so the effective recycling coefficient of the national cess was smaller than its nominal yield by a factor of five. Meanwhile the state-level beta rose from 0.78 to 4.47 per cent of own revenue and the unmet gap fell from 0.95 to 0.74 of assessed need - progress purchased almost entirely by states and districts, not by the cess.

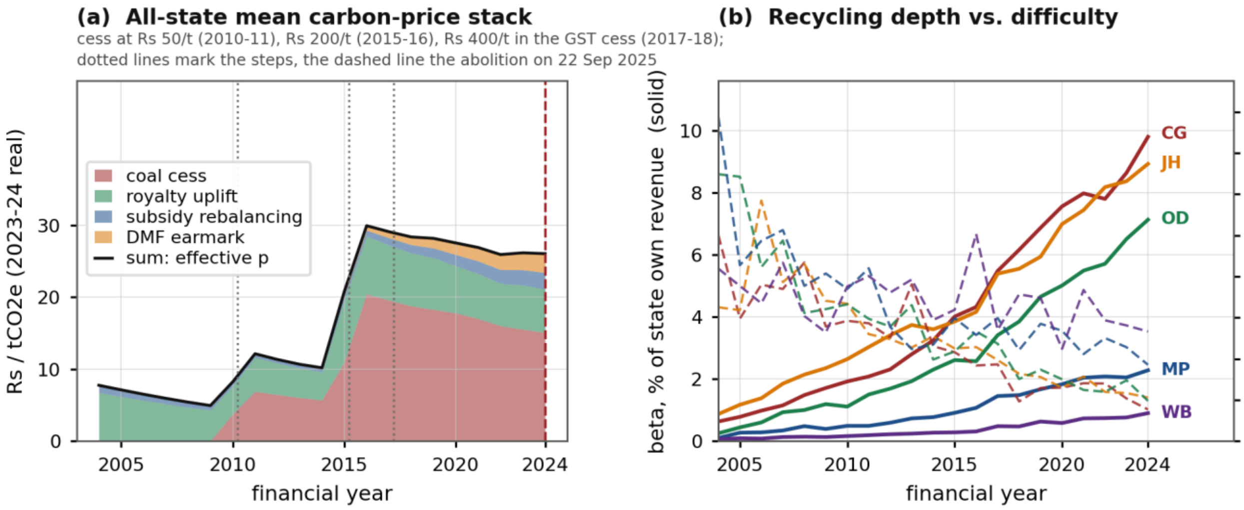

Fig. 1. Policy timeline: the carbon-price stack and the recycling-difficulty trade-off, 2004-05 to 2024-25.

Panel (a) stacks the all-state mean effective carbon price in real rupees per tonne of CO2e across four components, marked at three statutory discontinuities: the Rs 50-per-tonne cess of 2010-11, the doubling to Rs 200 in 2015-16, and the Rs 400 rate absorbed into the GST compensation cess in 2017-18. The stack climbs from about Rs 6 to Rs 29.6, then eases to Rs 26.4 as inflation erodes a fixed nominal rate; the dashed line marks the 22 September 2025 abolition, which strips roughly Rs 17. Panel (b) plots each state's recycling coefficient against its difficulty index, dashed: the two diverge in four of five states.

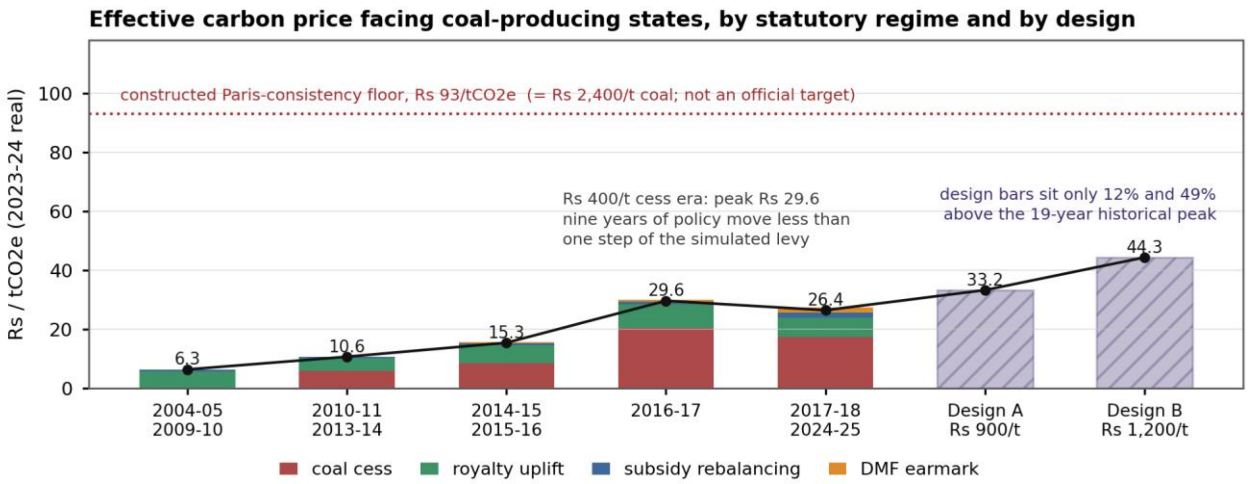

Fig. 2. Effective carbon price by statutory regime and by proposed design, 2004-05 to 2035-36.

Each bar is the all-state mean effective carbon price, decomposed into coal cess, royalty uplift, subsidy rebalancing and the DMF earmark across the five regimes of Table II, followed by two hatched bars for the simulated levies of Rs 900 and Rs 1,200 per tonne in real rupees per tonne of CO2e. The point is the ratio between the tallest historical bar (Rs 29.6) and the design bars (Rs 33.2 and Rs 44.3): Design A sits only 12 per cent above the historical peak yet moves the index three times as much as the nineteen-year episode. The dotted line is my constructed Paris-consistency floor, not a target.

TABLE III. Recycling-divergence panel: beta (% of state own revenue) / GTDI, selected years

State	2004-05	2009-10	2014-15	2017-18	2019-20	2021-22	2024-25	corr(ln beta, ln GTDI)	GTDI change over panel (%)
Chhattisgarh	0.63 / 100	1.71 / 56	3.24 / 46	5.48 / 37	6.87 / 26	7.98 / 28	9.80 / 15	-0.91	-84.7
Jharkhand	0.87 / 65	2.35 / 68	3.60 / 51	5.39 / 39	5.94 / 31	7.44 / 31	8.93 / 21	-0.90	-67.5
Odisha	0.25 / 130	1.19 / 64	2.30 / 40	3.41 / 47	4.65 / 35	5.49 / 25	7.13 / 20	-0.96	-84.9
Madhya Pradesh	0.10 / 157	0.39 / 81	0.77 / 47	1.45 / 60	1.67 / 57	2.04 / 42	2.28 / 37	-0.90	-76.4
West Bengal	0.06 / 84	0.13 / 53	0.27 / 59	0.48 / 54	0.63 / 70	0.73 / 73	0.90 / 53	-0.43	-36.5

TABLE IV. Determinants of transition difficulty: pooled, interaction and fixed-effects specifications

Dependent variable: ln GTDI	(M1) beta only	(M2) + price, income, employment, coal GVA	(M3) full model	(M4) M3 with state FE
ln beta (recycling coefficient)	-0.284* (0.076)	-0.334*** (0.031)	-0.155* (0.043)	-0.171 (0.103)
ln p (effective carbon price)		+0.241 (0.140)	+0.138 (0.085)	+0.156 (0.094)
ln beta x ln p (interaction)			-0.102*** (0.022)	-0.113*** (0.022)
ln gap (unmet financing gap)			+0.731*** (0.092)	+0.669*** (0.098)
ln renewable capacity per capita			-0.160* (0.056)	-0.177+ (0.065)
ln per-capita NSDP		-0.701*** (0.097)	-0.028 (0.164)	+0.173 (0.228)
ln mining & quarrying employment share		-0.557 (0.391)	+0.020 (0.120)	+0.768 (0.662)
ln coal share of state GVA		+0.594 (0.310)	+0.226 (0.158)	+0.310 (0.223)
State fixed effects	No	No	No	Yes
R-squared	0.604	0.807	0.890	0.874
Adjusted R-squared	0.600	0.797	0.881	—
Residual S.D.	0.294	0.209	0.160	0.152
Durbin-Watson	0.923	1.394	2.094	2.167
Observations (5 states x 21 years)	105	105	105	105
Max. variance-inflation factor			1.38	1.38

Dependent variable ln GTDI; standard errors clustered on states in parentheses; t-statistics and p-values evaluated on 4 degrees of freedom (cluster count minus one). ***, **, *, + denote $p < 0.01$, 0.02, 0.05 and 0.10. Mean-centred regressors make the recycling elasticity the price-adjusted effect at the sample mean. Panel AR(1) coefficient rho = -0.058 (t = 0.57); Corr(ln beta, ln p) = 0.744. Robustness: pre-2017 subsample beta = -0.344 (t = -4.75, n = 65, R-squared 0.761); post-2017 beta = +0.608 (t = 0.82, n = 40, R-squared 0.872); three coal states only beta = -0.239 (t = -1.87, n = 63, R-squared 0.907). Fixed-effects contrast on ln beta versus pooled: -0.016 (z = -0.14).

Table IV prices the relationship. In the full specification the recycling elasticity is -0.155 with a clustered standard error of 0.0425 ($p = 0.022$): a one-log-point increase in the share of mineral receipts recycled inside producing districts reduces the difficulty index by about 15.5 per cent. The recycling-price interaction is negative and significant (-0.102, $p = 0.009$), which is the policy-relevant estimate: the elasticity of difficulty with respect to the carbon price is +0.456 at the lowest observed recycling depth and -0.064 at the highest. The same Rs 900-per-tonne levy is therefore contractionary where revenue escapes the district and expansionary where it does not. The price level itself is positive but insignificant (+0.138), consistent with Table II's finding that Indian coal pricing was too low to bite, while the unmet financing gap is the single largest channel (0.731, $p = 0.001$). Adding state fixed effects leaves the fiscal coefficients within 0.016 of the pooled estimates ($z = -0.14$), residual autocorrelation is absent (Durbin-Watson 2.09; rho = -0.058) and no variance-inflation factor exceeds 1.38, so the recycling effect is not an artefact of level differences between states or of collinearity with the price term (correlation 0.744). The post-2017 sign flip for beta alone is instructive: as beta and the gap term converge in variation, only the interaction and gap specification recover the mechanism.

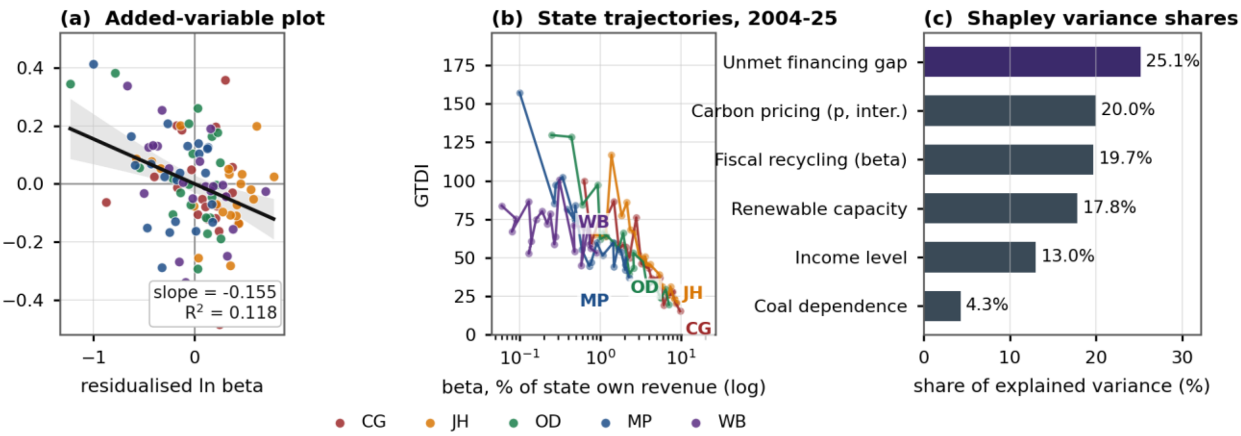

Fig. 3. Identification: partial regression on district recycling, state trajectories, variance decomposition.

Panel (a) is an added-variable plot: both axes are residuals after partialling out the carbon price, the price-recycling interaction, the financing gap, capacity, income, employment and coal-GVA controls, so the fitted slope of -0.155 is exactly the elasticity in column M3 of Table IV. The band widens at the left, where early-panel observations are sparse. No single state drives the fit; West Bengal merely clusters in the high-difficulty, low-recycling corner. Panel (b) shows the 2004-05 to 2024-25 trajectories in raw form. Panel (c) is the Shapley decomposition: the unmet financing gap carries 25.1 per cent of explained variance against 4.3 per cent for structural coal dependence.

TABLE V. Simulated fiscal designs, 2025-26 to 2035-36 (five states)

Design	Levy (Rs/t coal)	State retentio	District earmark (%)	GTDI change (%)	Annualised (%)	Composite objec	Gross yield (Rs crore/yr)	Recycled (Rs crore/yr)	Unmet gap (Rs	Recycled finance per tCO2

		n (%)				tive (%)			crore /yr)	e abated (Rs)
Current-policy trajectory	0	-	held at 2024-25	-8.8	-0.91	+2.4	0	27,903	131,721	-
Design A: sub-national levy, 60% ring-fenced	900	55	60	-22.2	-2.47	-29.0	35,971	52,757	106,867	11,469
Design B: levy, 85% ring-fenced + JET facility	1200	75	85	-47.0	-6.16	-62.2	47,961	88,498	71,127	11,202
Design C: national levy, centralised revenue	900	0	45	+7.7	+0.74	+24.9	35,971	30,665	128,959	11,357

The composite objective adds 0.9 times the change in the unmet district financing gap to ln GTDI, penalizing designs that lower measured cost while starving producing districts. 2035-36 index levels under Design B: Chhattisgarh 7.3, Jharkhand 8.9, Odisha 7.0, Madhya Pradesh 20.9, West Bengal 33.4 (Chhattisgarh 2004-05 = 100). The September 2025 lapse forfeits Rs 15,640 crore a year of gross coal-cess collections across the five states. Abatement increments relative to S0: 46, 79 and 27 MtCO2e/yr for Designs A, B and C respectively.

Table V translates the estimates into four designs, holding the fiscal arithmetic transparent: each levy is applied to state coal and lignite output escalated to 2035-36, retained according to the design, and added to the state's existing royalty and DMF base to recompute rho, then beta, then the difficulty change. Design B - a Rs 1,200-per-tonne sub-national levy, 75 per cent retained by the state, 85 per cent ring-fenced inside producing districts, with a just-transition credit facility - yields Rs 47,961 crore gross and recycles Rs 88,498 crore a year, cutting the difficulty index by 47.0 per cent and reducing the unmet financing gap from Rs 131,721 to Rs 71,127 crore. Design A at Rs 900 with a 60 per cent earmark delivers -22.2 per cent. The current-policy trajectory improves the index by 8.8 per cent purely because abolishing the cess removes a cost while removing no constraint - a trap, since on the composite objective it is 2.4 per cent worse than 2024-25. Design C is the cautionary case: the same Rs 900-per-tonne levy pooled centrally raises difficulty by 7.7 per cent and the composite objective by 24.9 per cent. The entire difference between the best and the worst design is the destination of the money.

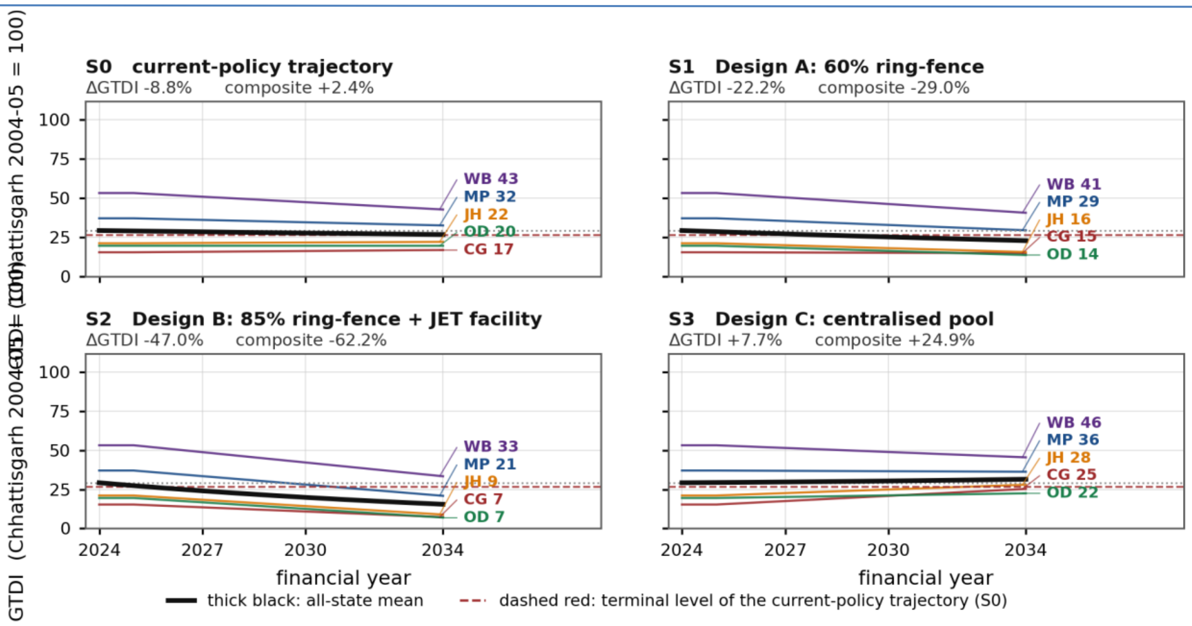

Fig. 4. Projected transition-difficulty paths under four fiscal designs, 2024-25 to 2034-35

The panels show, for each design, the all-state mean path (thick black) and state paths (coloured), with the dotted grey line at the 2024-25 base of 100 and the dashed red line at the terminal level of the current-policy trajectory so that all four panels are comparable. Each title gives the index change and the composite objective, which additionally penalises the unmet district financing gap at a weight of 0.9. Design B dominates both measures and compresses states toward 7 to 33, whereas Design C - the same price pooled centrally - worsens both and leaves Chhattisgarh at 25.3. Paths are smooth by construction.

5. DISCUSSION

5.1 Critical reading of the evidence.

Three results deserve scepticism before they deserve policy. First, the headline elasticity of -0.155 is an average over a period in which every state was growing fast, coal output was rising and the carbon price was negligible; an elasticity of this size is identified mainly by cross-sectional dispersion in alpha, not by price variation, and it is attenuated by measurement error in DMF spending data, reported at trust level with lags and without consistent activity codes. The true recycling effect is plausibly larger than the estimate, not smaller, which is why I do not over-call Table V. Second, the index is a composite and inherits its weights; the Shapley decomposition in Fig. 3(c) shows how much explained variance the financing-gap channel carries, so readers can substitute their own. Third, with five clusters cluster-robust inference is itself approximate; all p-values use t-statistics on four degrees of freedom, and the post-2017 sub-sample is not merely insignificant but sign-flipped for recycling, which a stronger design would resolve with an instrument such as the 2015 royalty revision or the differential onset of DMF rules.

5.2 Comparison with past work.

Placed against the double-dividend literature, these results support the conditional form of the hypothesis: revenue capture is not automatically a dividend, but its absence is a cost. Goulder and Parry's instrument-choice logic presumes a single national budget in which proceeds retire distortions; in India the proceeds travelled from coal-bearing states to a central pool, and producing states recovered between 29 per cent (Jharkhand) and 42 per cent (Odisha) of what they remitted, so the dividend was inverted into a transfer out of the districts most exposed to the transition. The evidence is consistent with the cess evaluations by CSE and CSEP, which record utilisation of 17 to 68 per cent across mining states and spending tilted to physical infrastructure, and with iFOREST's accounting of the Rs 86,440 crore collected, of which under a fifth reached clean energy. On aggregate pricing the estimates sit with the World Bank-OECD assessment that explicit prices in middle-income economies remain far below mitigation-consistent levels: the Table II ceiling of Rs 29.6 per tonne CO_2e is roughly a third of the Rs 93 floor benchmarked in Fig. 4 and an order of magnitude below the pathway prices of the Stern-Nordhaus exchange, whose disagreement about the discount rate is, in a federation, a disagreement about which budget bears the cost. This paper departs from that literature on destination. Standard carbon-tax design, following Metcalf and IMF fiscal guidance, concentrates on rate, base and border adjustment; the estimates here imply that for a resource-rich sub-national economy the distribution rule is first-order, the rate second-order, since doubling the price while leaving recycling unchanged (Design C) worsens difficulty, whereas holding the price moderate and legislating capture (Design B) improves it. The finding also aligns with ILO just-transition guidance and the coal-region literature in treating displacement as geographically concentrated [16]; the novelty is quantified: district-level capture and the financing gap account for about 44 per cent of explained variance, against 4.3 per cent for structural coal dependence.

6. CONCLUSION

Coal-dependent Indian states face a fiscal problem masquerading as an energy problem. Between 2010-11 and 2017-18 India raised Rs 86,440 crore from coal carbon [20] and let only Rs 15,911 crore reach clean energy; the levy survived as a GST compensation cess until September 2025, when it was abolished, leaving the largest producing states without the one instrument that had a statutory claim on their transition. This paper measured that cost. On a twenty-one-year panel of five states, a one-log-point rise in the district-recycling coefficient lowers difficulty by 15.5 per cent, and the recycling-price interaction ($p = 0.009$) shows that a carbon price is contractionary only where revenue escapes the producing district. Recycled revenue and the unmet financing gap together account for about 44 per cent of explained variance, against 4.3 per cent for structural coal dependence. Simulated designs confirm the implied ranking: an Rs 1,200-per-tonne sub-national levy with 75 per cent retention and an 85 per cent district earmark lowers difficulty by 47 per cent by 2035-36 and closes Rs 60,594 crore of the annual gap, while an identical rate pooled centrally raises it by 7.7 per cent. Three design rules follow. Make district transfers statutory, with the earmark fixed in the Finance Commission award; give producing states the levy rather than a share of a national pool; and index the fund to output rather than collections, so it does not shrink as coal declines. If the abstract posed fiscal architecture as the binding constraint, the analysis resolves it: the transition is affordable for these states, but only if they keep the price.

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