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Capital Outlay Composition and Economic Growth in India: A State-Panel Study

Abeer Badhera
abeerbadhera25@gmail.com

ABSTRACT

There is a growing tendency in Indian fiscal policy debate to distinguish between the quantity and quality of state capital expenditures, with the notion that states with a higher percentage of their capital spending on the acquisition of real assets experience faster growth. This paper puts that assumption to the test. It performs a two-way fixed-effects panel from 2011-12 to 2024-25, with the effect of the lagged Capital Outlay Ratio (COR) (which is used here as a budget-composition indicator rather than a spending quality indicator) on per-capita NSDP growth, controlling for capital-expenditure volume and fiscal capacity. The full sample and sub-samples by special-category status, infrastructure level and the GST regime show no significant short-run relationship between composition and growth (full-sample lagged-COR coefficient is 0.010 (95% CI [−0.025, 0.045]). The null hypothesis is not rejected at the 5% level by an equivalence test for any true effect greater than approximately 0.4 percentage points of annual growth per ten-point increase in the outlay share, and the null hypothesis is accepted by a wild cluster bootstrap for the 28 state clusters. Capital expenditure is negative in the general-state and pre-GST samples, and own-tax intensity is negative pre-GST. The only clear and strong signal in the data is conditional convergence: lower income states grow faster, once initial income is accounted for. The outlay ratio thus functions more as an indicator of the stage of development of a state than as a growth tool, and is not a good indicator for fiscal-devolution purposes.

***Keywords*:** Capital outlay ratio; Indian state panel; fixed effects; GST structural break; budget composition; conditional convergence; economic growth

JEL classification: E62; H72; O47; R11

INTRODUCTION

Infrastructure is the basic architecture, based on which economic development is based. The combination of roads, power grids, irrigation systems, water supply networks, and urban facilities all makes the cost of production and exchange less expensive. In the context of developing countries where the lack of infrastructure facilities is most acute and most decisive, the amount and quality of investment in physical infrastructure is not only a determinant of current output but also a structural precondition to sustained

growth in the long run. India is particularly notable in this regard: despite 40 years of planned state spending on physical infrastructure and a post-1991 explosion of private and government-sponsored partnership financing, in the Global Competitiveness Index, the country is ranked 70 out of 140 countries in terms of quality of infrastructure (Saini and Giri, 2022). To meet this investment need, not only is a greater aggregate flow of capital into infrastructure needed, but also a more precise measure of how state governments spend the capital they do spend.

With the system of federalism in India, state governments are primarily fiscally responsible for bearing the major portion of infrastructure investment that directly impacts citizens: roads, irrigation, power distribution, urban services and social infrastructure. The major analytical prism of this research is the makeup of state government capital expenditure: that is, the extent to which states are directing their capital budgets towards Capital Outlay - expenditure that directly produces new productive assets or augments old ones - instead of towards repayment of their debts. If this is the case, then a state with a higher percentage of its total capital expenditure allocated to Capital Outlay is spending more productively on infrastructure and physical capital, and this study will actually test that proposition, rather than assume it. A state with a greater allocation to financial transfers and debt servicing is limiting its capacity to create infrastructure, even when the headline capital spending numbers it publishes seem to be sufficient. This gap between the amount of capital expenditures made by a state and the productive structure of these expenditures, between the magnitude and the intentionality of the expenditure made by a state, is the main factual question of the current study.

The empirical drive is based on three observations. First, although there is cross-state variation in the per capita expenditure on capital, the relationship between aggregate spending and growth is inconsistent, i.e. some high-spending states have registered modest growth, whereas low-spending states have registered a high growth rate. Second, RBI State Finances repeatedly point out that committed revenue expenditure, such as salaries, pensions, interest, and subsidies, crowds out productive capital outlay (Srivastava, 2017; Kumar and Soumya, 2020) even in cases where the total capital expenditure is nominally increased. Third, the National Infrastructure Pipeline (Department of Economic Affairs, 2020), with a target of ₹111 lakh crore over five years, has created a sense of urgency in policy-making around whether state fiscal architecture can turn capital announcements into the creation of assets on the ground.

The dependence of the composition of capital outlay at the state level on economic growth in India has never been systematically studied using a multi-state panel with current data. This is confirmed by the national-level study of Unnikrishnan and Kattookaran (2020), which establishes that GDP growth in India is driven by investment in public infrastructure, and it uses a 56-year time series, but operates at the aggregate national level and does not capture the cross-state variation in capital expenditure composition. Studies that focus on a specific state or region, such as Singh (2022) on Punjab or Das and Barua (2025) on the Northeastern states, are based on sub-national evidence but are limited to a specific geography and do not attempt to address the productive composition of capital expenditure as a discrete variable. The present study fills such a gap by constructing a panel of 28 Indian states over the period 2011-12 to 2024-25 and testing the hypothesis that states that invest a higher fraction of their capital expenditure in

Capital Outlay experience systematically higher per capita Net State Domestic Product (NSDP) growth, after conditioning on the volume of capital expenditure and fiscal capacity, with state and year fixed effects. To the contrary, the full-sample coefficient on lagged COR is 0.010 (n.s.) and none of the sub-samples - by special-category status, infrastructure level, or GST regime - pick up a positive impact.

This study has three contributions. Substantively, when the amount of capital spending is fixed, there is no measurable difference in the growth rate of states that allocate more or less to outlay, and the outlay ratio is a proxy for the stage of development of a state: poorer states spend a larger share of their budgets on outlay and grow faster from a lower base. It methodologically distinguishes between composition and volume on a harmonised state panel, and demonstrates that the result is stable across estimators, the serial correlation, heteroskedasticity and cross-sectional dependence in the diagnostics and robust to wild-cluster-bootstrap inference and an equivalence bound. For policy, it states that capital-outlay ratios do not provide a defensible basis for fiscal devolution or Finance Commission criteria over this period, as a high share of capital outlays partly reflects a state being at an earlier stage of development and not growing faster. The paper is structured as follows: Section 2 – Literature Review, Section 3 – Data and Methodology, Section 4 – Results, Section 5 – Discussion, and Section 6 – Conclusions.

LITERATURE REVIEW

Theoretical Foundations: Infrastructure as a Driver of Growth

The theoretical argument in support of infrastructure being a source of economic growth is well known in a variety of strands of economic theory, from endogenous growth theory onward (Romer, 1990). The basic contribution of Esfahani and Ramirez (2003) builds a structural model of infrastructure and output growth estimated on a cross-country panel of 75 countries between 1965 and 1995. Their two-equation instrumental variable model shows that the contribution of infrastructure services towards GDP is significant and tends to be more than the cost of provision. More importantly, this effect of infrastructure on growth is not equal: it is dependent on the quality of institutions and their effectiveness. The countries that have more regulatory capacity, and less difficulty in enforcing contracts, realise much larger growth returns on equal amounts of investment in infrastructure-related areas than what is realised by countries with weaker regulatory capacity and less ability to enforce contracts.

Reviewing the accumulated evidence on South Africa, Fedderke and Garlick (2008) find that infrastructure in South Africa impacts growth through five channels: infrastructure is a direct factor of production, infrastructure is a complement to other factors, infrastructure is a stimulus to factor accumulation, infrastructure is an element of aggregate demand, and infrastructure is an industrial policy instrument. This multi-channel model is especially useful in explaining the dependent variable of the present study, the growth of infrastructure, as it has a multi-channel impact at the same time. A road does not just lower transport costs; it stimulates the growth of private property, attracts firms, improves the efficiency of the labour market, and contributes to regional agglomeration, which are reflected in the growth of NSDP. Another issue Fedderke and Garlick (2008) bring up is a consistent challenge of the lack

of credible quality measures of infrastructure in most studies. The COR variable of the present study is directly motivated by their observation that the productive intent of capital expenditure, and not a physical measure of stock, is directly influenced by the level of economic growth.

A particularly significant theoretical and empirical contribution, which is presented by Das and Barua (2025), is that the quality and quantity of infrastructure can have counterproductive growth effects. They estimate, using Pooled Mean Group estimation, a panel of eight Northeastern Indian states to 2020, to find that road quality - the proportion of paved roads to total roads - has a significant positive long-run impact on the per capita NSDP, with a significant negative impact on road density. This quality-beats-quantity result is the direct motivator behind the conceptual approach adopted in the present study: just like road quality is a more effective growth driver than road density, the productive intensity of capital spending - as represented by the Capital Outlay Ratio - is likely to prove an effective growth driver in comparison with aggregate capital expenditure volume. This framing is reaffirmed by Nash, Stading, and Davis (2019) in their political economy view that the strategic composition of infrastructure investment, instead of the volume of investment, determines whether public capital triggers broader economic transformation.

Composition and Quality of Public Investment

It is often confirmed in the literature that there exists a positive correlation between public infrastructure investment and growth, but increasingly, it is emphasised that composition and quality are as important as the volume (Bose, Haque and Osborn, 2007). Analyzing ten new markets, such as India, using multiple regression analysis with data provided by the World Bank and IMF, Tayeng et al. (2024) find that public infrastructure investment has the largest coefficient (0.45, $p < 0.05$) of all the financing types and that the effectiveness of this financing type is strongly moderated by the quality of governance. This finding of governance mediation is especially relevant in the context of the Indian state, where the difference in institutional and administrative capacity across states, i.e. between Kerala and Tamil Nadu on the one hand and Bihar and Jharkhand on the other hand, is substantial and directly influences the conversion of capital outlays into productive infrastructure.

In infrastructure development and financing in India in the context of the Eleventh and Twelfth Five-Year Plans (Planning Commission of India, 2012), reviews of which Agrawal (2020) discusses in his article, document that both plans fell well short of what infrastructure investment targets were, despite nominal increases in capital budget allocations. The structural nature of this persistent divergence of capital funds towards debt servicing, administrative disbursements and some of the PPP transfers that have been partly implemented is identified as a structural aspect of Indian infrastructure finance. This finding is supported by Saini and Giri (2022), who note that despite the numerous attempts to implement large capital allocation programmes in India, the country has not yet reached the position of 70th out of 140 countries in a ranking of the quality of infrastructure in various countries. Using a 56-year national time series and applying a Vector Error Correction Model, Unnikrishnan and Kattookaran (2020) confirm that the long-run effect of a public infrastructure investment in India is significantly positive and that impulse response analysis shows that the growth effect of a 56-year national time series is accrued gradually.

Ahmed et al. (2020), using a composite Physical Infrastructure Index and ARDL bounds co-integration on 1985–2019 Bangladeshi data, find that an average growth of more than 20 per cent in economic growth per unit change in the long term is generated by the function of the composite Physical Infrastructure Index. The fact that they find that the development of the financial sector has a negative impact on growth in Bangladesh, due to the inefficiency of the banking sector, further justifies the focus on the Indian states as specific countries rather than cross-country panels, where the inefficiency of the banking sector is more difficult to control.

Infrastructure Financing and Private Participation

The literature on mechanisms of infrastructure financing is directly pertinent to answering the question of why the productive composition of public capital expenditure has become a burning policy question. In a study of the role of the private sector in infrastructure development across the BRIC countries between 1990 and 2010 using the World Bank PPI database, Kateja (2012) records that although the role of the private sector in infrastructure development was significant, it was systematically concentrated in commercially viable sectors - energy and telecommunications - leaving high-need, high-risk sectors such as water supply, rural roads, and social infrastructure to be predominantly publicly funded. This coverage gap would mean that states that are dependent upon the capital of the private sector to augment the investment in infrastructure would experience structural deficits in the very sectors where state funds for infrastructure investment are most needed. This has an implication on COR: the outlay of the misallocated public capital cannot be recouped through the efforts of the privately owned and operated sectors of the economy that are most significant in achieving broad-based growth.

Comparing the PPP frameworks in the United Kingdom and Nigeria, Adeoye and Islam (2019) single out such critical success factors as transparent procurement, risk allocation, and political support. Their conclusion that Nigeria has had fewer than ten full PPP projects despite formal legislation since 2005 - due to failures of governance - supports the argument of institutional mediation: little infrastructure is created by the amount of investment without the quality of governance. Nidziy (2017), in an analysis of transport financing in the regional economies of Russia, records that the variance between the planned and actual infrastructure investment increases year after year without viable financing mechanisms - a structural problem that is similar to the gap between the announcement of the capital budget and productive outlay that persists in Indian states. Reviewing sustainable circular infrastructure financing strategies, Tetteh, Osei-Kyei and Tam (2025) identify green bonds, collaborative financing, and life cycle cost management as the top-ranked instruments - confirming that patient, socially-oriented capital commitments of the kind that state-government capital outlay represents are structurally underprovided by the private markets.

India-Specific and Sub-National Evidence

Agrawal (2020) gives the most detailed picture of the trajectory of infrastructure development in India over the planning period, proving that the issue of the financing gap is not the main one of the lack of budgetary allocations but rather of the ability to transform the allocations into productive capital outlay. Constructing composite indices of Social Infrastructure and Physical Infrastructure based on Principal

Component Analysis of various indicators, Singh (2022) finds that Physical Infrastructure is an important positive predictor of per capita district domestic product, whereas Social Infrastructure does not show a statistically significant relationship (on the financing of social-sector services such as health, see Rao and Choudhury, 2012). He attributes the insignificance of the latter partly to threshold effects -social infrastructure must be of a minimum critical size before it starts yielding measurable economic returns -and partly to inadequacy of provision. This threshold argument is applicable to the variable construction used in the present study: the Capital Outlay Ratio has to be taken into account with the absolute level of capital spending, as having a high ratio applied to a very low budget may not yield much capital spending in terms of infrastructure stock that will be in place to cross the productivity threshold.

Das and Barua (2025) additionally find that intergovernmental transfers have a negative effect on growth in Northeastern states, suggesting that heavy Central transfer dependency may reduce incentives for states to optimise capital budget composition — a potential moderation of the COR-growth relationship by fiscal autonomy that the present study's sub-sample analysis explores. Saini and Giri (2022) document that India's PPP investment was concentrated in telecoms and energy post-liberalisation, leaving transport, water, and social infrastructure as near-exclusively public responsibilities, reinforcing the policy centrality of productive capital outlay composition in these domains.

International Comparative Evidence and Methodological Approaches

Based on 46 Sub-Saharan African countries between 2003 and 2017 using system GMM, Nketiah-Amponsah and Sarpong (2019) find that the improvement in electricity infrastructure by one per cent induces the growth of 0.09 per cent of GDP, and that FDI is only growth-enhancing when it interacts with adequate infrastructure, implying a complementary multiplier of productive public capital expenditure through facilitation of private investment. Ma et al. (2025), using Spatial Durbin Models on 31 Chinese provinces (2010–2019), demonstrate that recent infrastructure development leads to a significant spatial spillover growth to the neighbouring regions - a limitation also appreciated in the single-state fixed effects framework used in this study. Based on the Difference-in-Differences method in 130 BRI partner countries, Chen (2023) concludes that infrastructure development accounts for 88.42 per cent of the total positive growth effect of BRI. The generality of the infrastructure-growth relationship across a wide variety of low-income settings is supported by Sun and Kauzen (2023) and Amairia and Amaara (2017) in their Structural Equation Modelling and ARDL, respectively, across Tanzania and Tunisia.

The twenty reviewed studies deploy a wide variety of empirical methodologies — Panel FE/RE, system GMM (Bond, Hoeffler and Temple, 2010; Nketiah-Amponsah & Sarpong, 2019; Tayeng et al., 2024), ARDL bounds testing (Ahmed et al., 2020; Amairia & Amaira, 2017), VECM (Unnikrishnan & Kattookaran, 2020), Spatial Durbin Models (Ma et al., 2025), and PCA index construction (Singh, 2022) — collectively establishing the methodological standards that inform the present study. The specific challenges identified across this literature — non-stationarity of macroeconomic panel variables, potential co-integration between the COR and per capita NSDP (Pedroni, 1999), and unobserved state-level fixed effects — are addressed in the estimation strategy described in Section 3. No existing study examines

whether the productive composition of Indian state capital expenditure differentially drives growth in a panel framework, confirming the gap that this study addresses.

RESEARCH METHODOLOGY

Research Design and Panel Structure

This study employs a quantitative panel data design to examine whether the composition of state capital expenditure has an impact on the economic growth per capita of Indian States. A panel design is selected because it contains variation between states (which allows for comparison of productive and unproductive spenders) and variation over time within each state (which controls for each state's unchanging characteristics). The study is deductive in that it tests theoretically motivated hypotheses against state-level data. The data are taken from the Reserve Bank of India, Handbook of Statistics on Indian States 2024-25.

The panel covers 28 Indian states from 2011-12 to 2024-25. The source does not have a consistent back-cast of the pre-2014 income and expenditure series of the unified Andhra state onto the two successor states, Telangana and Andhra Pradesh. Thus, to avoid the artefactual break, both Andhra Pradesh and Telangana are included from 2014-15 onwards only, and all other 26 states are included from 2011-12 to 2024-25. This gives rise to an unbalanced panel with a maximum of 386 state-years and 351 observations after one-year lags in the dependent variable.

Variables and Measurement

The dependent variable is the growth rate (in logs per year times 100) of per-capita Net State Domestic Product (NSDP) at constant 2011-12 prices. Constant prices are used to ensure the measure reflects real output changes rather than inflation.

The dependent variable is a real growth rate, which is the annual log difference of the NSDP deflated by the price index and multiplied by 100, and thus does not require further deflation. As with the fiscal variables, the fiscal ratios are ratios of the fiscal variables to current-price GSDP (nominal over nominal), and this is also internally consistent and deflation-free. Harmonisation of units before the construction of a ratio: The fiscal aggregates are in ₹ crore, and the GSDP series is in ₹ lakh, with the GSDP series converted to ₹ crore before the construction of CapEx/GSDP and OTR/GSDP. The series should not be combined as such, because it would rescale the ratios by a factor of one hundred, and the reported magnitudes would not be reproducible. The infrastructure sub-sample split is based on the per-capita power available; states are split at the sample median, and power is not used as a regressor but rather as a splitting variable.

The main explanatory variable used is the Capital Outlay Ratio (COR), that is, calculated as:

COR = Capital Outlay ÷ (Capital Outlay + Loans and Advances + Repayment of Debt) × 100 …. (1)

Capital outlay is the amount spent that will lead to the creation of physical assets. It is a component of capital expenditure, which includes capital outlay, loans and advances disbursed by the state government and repayment of debt. COR, therefore, reflects the proportion of the capital budget that goes on asset creation versus lender- and debt-related expenditures. A higher COR means that a larger share of the capital budget goes toward asset creation. COR should be interpreted as a budget-composition indicator, not as an indicator of the quality of the spending: it tells where the capital budget is spent, not how productive the assets created are. Part of the denominator is also largely non-discretionary, specifically scheduled debt repayment, and the present data do not distinguish between loans and advances and debt repayment, which is discussed in the limitations. COR is introduced as a one-year time lag (L1_COR) to minimize simultaneity in fiscal and growth decisions. The estimates below represent conditional associations; lagging will help rule out reverse causation, but cannot prove that a causal effect exists.

There are two controls in the model. The first is capital expenditure as a percentage of GSDP. However, controlling for the volume of spending is essential since it enables COR to capture the composition (quality) of the capital budget net of its size (quantity)—the central distinction this study proposes to test. Without it, COR can quietly stand in the way of how much a state spends. The second control is fiscal capacity, which is calculated as:

Own Tax Revenue/GSDP …. (2)

Model Specification

The estimating equation is a two-way fixed-effects model:

$$g_NSDP(it) = \alpha_i + \lambda\square + \beta_1\, L1_COR(it) + \beta_2\, CapEx/GSDP(it) + \beta_3\, OTR/GSDP(it) + \varepsilon(it) \ldots. (3)$$

where α_i are state fixed effects that capture everything that is time-invariant about a state (such as geography, institutions, history); $\lambda\square$ are year fixed effects that capture nationwide shocks affecting all states in a given year (the GST rollout, COVID-19, national policy); and $\varepsilon(it)$ is the idiosyncratic error. The coefficient of interest is β_1, the relationship between last year's capital-outlay ratio and current growth, while keeping the volume of spending, fiscal capacity, and both sets of fixed effects constant. The theoretical prior is $\beta_1 > 0$.

Estimator and Diagnostic Tests

The two-way fixed-effects estimator is kept as the conservative, theory-driven option. Diagnostics of the data by the panel reported in Table 1 reflect a more nuanced picture than what a single estimator would suggest. The poolability F test does not reject pooled estimation, and there are no significant random effects with the Breusch-Pagan LM test and only marginal ones with the Hausman test. There is no cross-sectional dependence (Pesaran CD test), and the Breusch-Godfrey/Wooldridge test reveals serial correlation. All reported models use standard errors that are robust to autocorrelation, heteroskedasticity and cross-sectional dependence, according to the Driscoll-Kraay method, as confirmed by the test. The state-level effects are statistically weak, and the central result is in practice not very sensitive to the choice between pooled, random-effects, and fixed-effects estimation. Given the panel has only 28 clusters, the main coefficient is also tested using a wild cluster bootstrap (Cameron, Gelbach and Miller, 2008; Rademacher weights, 1,999 replications), and the precision of the null is summarised with an equivalence (two one-sided tests) bound (Lakens, 2017); both are reported in Section 4.

Table 1. Panel Diagnostic Tests

Test	Statistic	p-value	Inference
Poolability F (H_0: pooling adequate)	$F = 0.849$	0.686	Do not reject; pooling adequate
Breusch-Pagan LM (H_0: no random effects)	$\chi^2 = 1.580$	0.209	Do not reject; no RE
Hausman (H_0: RE consistent)	$\chi^2 = 6.819$	0.078	Marginal; FE retained on theory
Breusch-Godfrey/Wooldridge (H_0: no AC)	$\chi^2 = 28.294$	0.002	Reject; serial correlation present
Pesaran CD (H_0: no cross-sec. dependence)	$CD = -0.623$	0.533	Do not reject; no CD

Given serial correlation, Driscoll-Kraay standard errors are used throughout. All models use two-way (state + year) fixed effects.

In this design, there is no unit-root problem with the panel: the dependent variable is a growth rate while the regressors are fixed, bounded fiscal ratios which are stationary by construction. Results of the unit-root test for the growth series using an Im-Pesaran-Shin panel test strongly reject the unit-root null (W-t-bar = −9.22, $p < 0.001$), which ensures that the series is stationary. The non-stationarity and cointegration issues discussed in several of the time-series papers reviewed are thus not relevant to this growth-rate panel and do not necessitate performing cointegration testing.

Research Hypotheses

Three hypotheses are tested. The single coefficient on lagged COR addresses both the question of whether composition predicts growth and whether it does so over and above volume, so they are presented as a

single hypothesis. H_1: There is a positive relationship between the per-capita growth of NSDP and the COR, beyond the amount of capital spending. H_2: This association is stronger in states with the least public capital, low-infrastructure and special-category states. H_3: There is a change in the capital-growth relationship around the 2017 GST.

DATA ANALYSIS AND FINDINGS

Descriptive Statistics

Table 2 summarises the variables. NSDP growth per capita, with an average of 4.64 per cent (SD 5.43), oscillates between −16.6 per cent (due to the COVID-19 contraction in 2020-21) and 24.7 per cent. The lagged Capital Outlay Ratio, which measures the proportion of capital expenditure that is used productively, has an average of 66.1 per cent and a standard deviation of 16.5 percentage points, indicating that there is significant variation across states. The average of capital expenditure is 5.4 per cent of GSDP, and own tax revenue is 5.7 per cent. These magnitudes are in line with the state-finance aggregates reported, making them a representative sample.

Table 2. Descriptive Statistics

Variable	N	Mean	SD	Min	Max	Skew	Kurtosis
g_NSDP (%)	351	4.642	5.433	−16.571	24.679	−0.920	3.104
L1_COR (%)	358	66.068	16.523	8.734	95.082	−0.762	0.529
CapEx/GSDP (%)	379	5.384	3.592	1.412	26.197	2.697	9.631
OTR/GSDP (%)	379	5.739	1.494	1.976	9.972	−0.517	−0.170
Power (kWh)	386	953.734	641.621	108.200	3417.600	1.128	1.222

Source: RBI Handbook of Statistics on Indian States 2024-25; author calculations. Power is used for the infrastructure split, not as a regressor.

Correlation and Multicollinearity

Table 3 reports pairwise correlations, and Table 4 reports the variance inflation factors. The bivariate correlation between growth and the lagged COR is small and positive (r = 0.057), providing only weak preliminary evidence for H_1. COR has a moderate positive correlation with capital-expenditure intensity (0.381) and a moderate negative correlation with power (−0.344) and own tax revenue (−0.319). All inter-regressor correlation values are low, and all variance inflation factors are well below the traditional threshold of 5 (O'Brien, 2007), confirming that COR, capital-expenditure intensity, and own tax revenue are aspects of different dimensions of state fiscal policy.

Table 3. Pairwise Correlation Matrix

Variable	g_NSDP	L1_COR	CapEx/GSDP	OTR/GSDP	Power
g_NSDP	1.000	0.057	0.004	0.024	0.023

L1_COR	0.057	1.000	0.381	−0.319	−0.344
CapEx/GSDP	0.004	0.381	1.000	−0.367	−0.325
OTR/GSDP	0.024	−0.319	−0.367	1.000	0.500
Power	0.023	−0.344	−0.325	0.500	1.000

Table 4. Variance Inflation Factors

Variable	VIF
L1_COR	1.229
CapEx/GSDP	1.244
OTR/GSDP	1.184

All VIFs < 1.3, well within the threshold of 5.

Regression Results

Table 5 is the full sample and the six sub-samples' two-way fixed effects results. The central finding is null. For all the specifications, the lagged Capital Outlay Ratio is small and statistically insignificant: full sample $\beta = 0.010$, special-category $\beta = 0.023$, general $\beta = 0.004$, low-infrastructure $\beta = 0.034$, high-infrastructure $\beta = -0.013$, pre-GST $\beta = -0.003$, and post-GST $\beta = 0.009$. All of these are below conventional significance, and the within-R^2 are low (0.001 to 0.10). The outlay ratio is much better estimated than the null: a ten-percentage-point increase in the outlay ratio corresponds to an annual per-capita growth between −0.25 and +0.45 percentage points, which is economically insignificant. So, in terms of COR, the hypotheses are not supported: there is no apparent short-run relationship between composition and growth; the relationship is not confined to capital-scarce states; and the relationship is not different on either side of the GST break. The problem of false positives due to multiple comparisons is recognised, but this operates only against the null, and no COR coefficient is significant in any sub-sample; thus, this is not an artefact of multiple testing. The heterogeneity splits are not selected post hoc but based on the capital-scarcity hypothesis.

The pattern is different for the two controls. In the general-state sample, the volume of capital expenditure has a negative and significant coefficient ($\beta = -0.285$, $p < 0.10$) and strongly so in the pre-GST period ($\beta = -0.463$, $p < 0.01$), and is insignificant elsewhere. The pre-GST period is significantly negative ($\beta = -3.217$, $p < 0.05$), while the post-GST period is not ($\beta = -0.204$), which means that there is no sign change towards a positive/significant post-GST effect. The pre-GST model has the best explanatory power (within-$R^2 = 0.10$).

Table 5. Panel Regression Results: Capital Outlay Ratio and Per-Capita NSDP Growth

Variable	Full	Special	General	Low Infra	High Infra	Pre-GST	Post-GST
L1_COR	0.010	0.023	0.004	0.034	−0.013	−0.003	0.009
	(0.018)	(0.028)	(0.024)	(0.032)	(0.028)	(0.030)	(0.027)

CapEx/GSDP	−0.086	−0.063	−0.285*	−0.161	−0.091	−0.463***	−0.012
	(0.150)	(0.204)	(0.166)	(0.242)	(0.128)	(0.143)	(0.241)
OTR/GSDP	−0.238	0.338	−0.525	−0.121	−0.980	−3.217**	−0.204
	(0.495)	(0.627)	(0.655)	(0.569)	(0.936)	(1.463)	(0.849)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	351	126	225	173	178	134	217
Within R^2	0.004	0.004	0.015	0.009	0.018	0.100	0.001

*Driscoll-Kraay SE in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Special = 10 special-category states; General = 18 others. Infra split at the median per-capita power. Pre-GST = 2011-12 to 2016-17; Post-GST = 2017-18 to 2024-25.*

Robustness of Inference

Two additional tests show that the null is not due to a simple lack of precision or to how the standard errors are calculated. First, since the panel has only 28 clusters, the full-sample model was re-estimated using a wild cluster bootstrap (Rademacher weights, 1,999 replications, clustered by state); the bootstrap p-value for lagged COR is 0.57, with a 95 per cent interval of [−0.026, 0.046], which is very similar to the Driscoll-Kraay value. Second, any true effect larger than about 0.04 percentage points of annual growth per one-point increase in the outlay share (or about 0.4 percentage points per ten-point increase) is rejected at the 5 per cent level by an equivalence test (two one-sided tests). The data are consistent with equivalence at the smallest effect of policy interest of 0.5 percentage points per ten-point increase (two one-sided tests, p = 0.014). The data cannot rule out effects smaller than this, so the finding is a bounded one rather than a claim of exactly zero: any effect is too small to matter at the scale a ten-point shift in budget composition represents.

DISCUSSION

Composition versus Quantity of Capital Spending

The key result is that the composition of capital budgets, over 2011-12 to 2024-25, for the states of India does not have any discernible independent association with per-capita growth when the level of capital expenditure is kept constant, or in any theoretically motivated sub-sample. This helps to defuse the notion that, as a measure of productive intensity, capital expenditures are a growth lever which states could use on an annual basis. This reduces the chances that the state will use capital spending as a growth tool annually in terms of productive intensity. There are three reasons that help to understand and explain the finding. First, year-to-year state growth is noisy and only poorly forecast by fiscal ratios, as shown by the low within-R^2 values, which are consistently low. Second, the amount of capital expenditures is correlated with COR, and, after accounting for capital expenditures volume, there is little additional information in the composition of capital expenditures. Third, the null is estimated on unit-harmonised data where both the fiscal and income series are in the same unit, and on a panel where Andhra Pradesh and Telangana are

only added after bifurcation; the failure to find an effect cannot be blamed on a scaling artefact or unmodelled structural break. There is a caveat when interpreting. COR is an accounting share of the capital budget, rather than a measure of the productivity of the assets that are built: A state that spent a great deal on low-return assets has the same ratio as another state that spent a great deal on higher-return assets. The finding is that this budgetary ratio does not have a growth signal at the state-year level, not that the composition of public investment is not important for growth. The latter would need to be disaggregated by functional head to establish.

Capital Expenditure Volume, Own Tax Revenue, and the GST Period

The negative and significant coefficient on the volume of capital expenditure in the general-state and pre-GST samples can best be interpreted as reverse causation or composition effects: a smaller state is more likely to have a high capital-expenditure ratio, and to do so does not necessarily mean that the money was used effectively to create productive capacity. This coefficient should not be interpreted as an adverse impact on growth from capital spending; rather, it is more likely convergence or reverse causality– lower-growing states raising their capital-expenditure ratios over a short annual time horizon- and is secondary to the paper's composition question. The pre-GST own-tax coefficient is significantly negative, and in line with the cascading, multi-rate pre-GST tax environment, which places real costs on activity. But the data do not support the positive post-GST reversal, so the GST-formalisation interpretation must be interpreted with caution and is not a strong result of this study.

Robustness across Horizons, Lags, and Conditional Convergence

Since public capital may affect growth over longer time horizons, longer horizons were added to the one-year-ahead baseline, along with longer and distributed lags and a convergence control, with the same two-way fixed-effects Driscoll-Kraay approach used for the one-year horizon. The coefficient of the COR is found for these alternatives in Table 6. Three- and five-year-forward annualised growth of the same dependent variable has no discernible positive composition effect; a 2-year lag and 3-year trailing-average COR also have no solid positive impact. The only slightly positive estimate is the three-year average COR in the full sample ($p = 0.10$), but not in the low-infrastructure sub-sample.

When comparing the three- and five-year horizons, COR is negative and significant in both the special-category and low-infrastructure sub-samples – seemingly the opposite of the productive-composition hypothesis. This pattern is, however, an artefact of conditional convergence and does not necessarily imply that capital outlays have bad effects on growth. When initial per-capita income is included, the COR coefficient is not significant for any of the three scenarios described above (full $p = 0.72$, special $p = 0.22$, low-infrastructure $p = 0.36$), but initial income is large, negative, and highly significant (around -21, $p < 0.001$). There is also a strong and negative correlation between capital outlay and growth, particularly in poorer states, and thus the capital outlay ratio provides a negative signal on its own, independent of budget composition, as poorer states, which are disproportionately the special category and low-infrastructure states, spend a larger share of their budgets on capital outlay and grow more slowly for other reasons. This null finding is thus relatively insensitive to the choice of the growth horizon, the choice of lags, and the presence of a convergence control.

Table 6. Robustness of the COR Coefficient across Horizons, Lags, and Convergence Control

Specification (dependent variable / COR measure)	COR coef.	p-value	N
3-year-forward growth ~ COR (full)	−0.009	0.31	295
3-year-forward growth ~ COR (special category)	−0.071	0.001	106
3-year-forward growth ~ COR (low infrastructure)	−0.027	0.07	155
5-year-forward growth ~ COR (full)	−0.010	0.05	239
5-year-forward growth ~ COR (low infrastructure)	−0.019	<0.001	130
Next-year growth ~ two-year-lagged COR (full)	−0.008	0.51	323
Next-year growth ~ three-year-average COR (full)	0.033	0.10	323
3-year-forward growth ~ COR + convergence (full)	0.003	0.72	295
3-year-forward growth ~ COR + convergence (special)	−0.020	0.22	106
3-year-forward growth ~ COR + convergence (low infra.)	0.014	0.36	155

Two-way FE, Driscoll-Kraay SE. The negative long-horizon coefficients lose significance once initial per-capita income (conditional convergence) is controlled, indicating they reflect convergence rather than a capital-composition effect.

The Outlay Ratio and a State's Stage of Development

One natural question that arises in review is whether the outlay ratio is capturing not a budgetary decision, but how "developed" a state already is. Two results speak to this. First, there is a weak correlation between higher COR and lower initial income across the panel (correlation −0.15): poorer states spend a somewhat larger share of their capital budget on outlay. Second, following the specification suggested by the reviewer, dropping the volume control and adding initial income leaves lagged COR insignificant ($\beta = 0.017$, $p = 0.25$), while initial income is large and strongly negative ($\beta = -32.5$, $p < 0.001$), the familiar signature of conditional convergence (Table 8). As would be expected, this one-year convergence coefficient is greater than the one of around −21 found in the multi-year-forward models reported above, because one-year growth is more volatile than growth averaged over several years. Taken together, these place the growth signal in convergence rather than in budget composition: the outlay ratio carries little independent information about growth, and the association it does have with development stage is that poorer states, growing faster from a lower base, happen to spend a larger share on outlay. This is the deeper reason the ratio is a weak devolution criterion, because rewarding a high outlay share would partly reward being at an earlier stage of development, and it may help explain why some earlier studies that did not separate composition from development stage reported positive effects. The association is weak, so the point is made with due caution rather than as a strong proxy claim.

Table 8. The Outlay Ratio, the Volume Control, and Initial Income

Specification	Lagged COR: coef (SE), p	Initial income: coef (SE), p	N
Baseline (volume + fiscal capacity)	0.010 (0.018), p = 0.58	—	351
Drop volume control, add initial income	0.017 (0.015), p = 0.25	−32.5 (6.85), p < 0.001	351
COR + initial income only	0.014 (0.015), p = 0.34	−27.4 (6.04), p < 0.001	351

Two-way fixed effects, Driscoll-Kraay SE. Initial income is lagged log per-capita NSDP. Dropping the volume control and adding initial income (the specification suggested in review) leaves COR insignificant, while conditional convergence is strong.

Estimator Robustness and Positioning in the Literature

The null COR result is not an artefact of the fixed-effects specification, as pooled and random-effects estimates are similar both qualitatively and quantitatively when the panel diagnostics suggest weak state-level effects. The contribution of the study is thus evidentiary and methodological: separating fiscal quality from fiscal quantity (on state-panel data), it demonstrates that fiscal composition (which is conceptually different from fiscal volume) does not provide for an independent and robust association with growth over this period. This is a helpful counterpoint to the literature that has been more likely to imply than control for composition effects and not harmonise the underlying fiscal series for spending volume.

Comparison with Existing Literature

In the literature, the link between public capital expenditure and growth is also ambiguous, with similar studies yielding positive, null and negative results (Table 7). This divergence is important to keep in mind when interpreting the current null finding, which, rather than challenging a consensus, now contributes to an active debate.

The findings are most similar to the recent (1990-2020) panel of Kiran and Sharma (2024), in which expenditure on development plans (capital-type) is an insignificant predictor of net state domestic product, and the basic cross-country evidence of Devarajan, Swaroop and Zou (1996) and Ghosh and Gregoriou (2008), in which the capital component of public expenditure is negatively associated with per-capita growth while current expenditure is positively. The above implies that the null result of an Indian state panel is consistent with the belief that having a higher productive component of government capital investment does not, in itself, increase short-run growth.

However, the finding is contrary to the positive Indian evidence of Marjit, Sasmal and Sasmal (2020) and Mohapatra and Giri (2016), who find significant positive growth effects of capital and development expenditure. This can be reasonably explained by two design changes. First, as the present model controls for the volume of capital expenditure, a Capital Outlay Ratio may be used as a proxy for the volume of

expenditure. Second, the present panel has rectified the unit and bifurcation mismatch and the mismatch between Andhra Pradesh and Telangana, which can inflate the apparent relationships. Also, Maitra and Hossain (2025) show that growth-enhancing capital expenditure exists, but only in the long run and only at the national level in a sectorally disaggregated sense, which is different from this annual state panel.

Importantly, none of these studies measures the capital-budget composition, such as the capital outlay share of capital expenditure, or capital level or functional heads. The present null, accordingly, is not just confirmatory but also informative: it tests a composition measure that has not been analyzed in the literature, using state-panel data, and is found not to result in an independent growth dividend.

Table 7. Comparison of the Present Null Finding with Related Studies

Study (author, year)	Setting & method	Finding / direction	Relevance to this study
Kiran & Sharma (2024)	17 Indian states, 1990-2020; GMM, FMOLS, DOLS	Capital-type (development-plan) expenditure insignificant	Closest comparator; supports the present null
Devarajan, Swaroop & Zou (1996)	43 developing countries; OLS	Capital expenditure negative; current positive	Foundational; legitimises a negative/null capital result
Ghosh & Gregoriou (2008)	15 developing countries; GMM	Capital negative; current positive	Reinforces the null under GMM
Marjit, Sasmal & Sasmal (2020)	Major Indian states; panel regression	Capital & infrastructure spending positive	Closest positive contrast; omits a spending-volume control
Mohapatra & Giri (2016)	India, national; ARDL	Development/capital expenditure positive	India composition study, but national time-series
Maitra & Hossain (2025)	India, national, 1985-2022; CVAR	Capital positive in the long run	Recent India; long-run, sectorally disaggregated

Directions are as reported by each study. The present study's result lies within the null/negative cluster.

CONCLUSION

Summary of Findings

This study investigated the predictive power of the Capital Outlay Ratio (COR) - the composition of state capital expenditure - on the growth of NSDP per capita in 28 Indian states between the years 2011-12 and 2024-25, while also accounting for the amount of capital spending, using a two-way fixed-effects panel estimator with Driscoll-Kraay standard errors. The Capital Outlay Ratio is not a statistically significant predictor of growth for the full sample or the sub-samples according to the special-category, infrastructure endowment or the GST structural break. No positive and robust association with growth is found in these

data for either the composition or the size of capital expenditure, and own tax revenue intensity is negatively associated with growth in the pre-GST period. The one clear regularity in the data is conditional convergence: poorer states grow faster from a lower base, which means that the outlay ratio is more of a measure of a state's level of development than a growth lever.

Practical Implications

In this time horizon, there is no obvious growth pay-off to the capital-outlay share, so fiscal devolution should not be linked to capital-outlay performance thresholds. The reason is not just that no effect is found, but that a high outlay share partly reflects a state being at an earlier stage of development, and growing faster from a lower base, rather than changing composition into faster growth; a criterion based on the ratio would then reward development stage as well as performance. More generally, the findings warn against using fiscal ratios at the annual level to infer growth effects, and highlight the need for simple data harmonisation, unit consistency and proper handling of state bifurcation prior to this.

Limitations and Future Research Directions

The results have three limitations that serve to further drive future research. First, the COR measure does not differentiate between capital-outlay categories, implying that they are equally growth productive, while, in fact, roads, power, irrigation, health, and education potentially have different returns; disaggregation of capital outlay by functional category could show a composition effect that is hidden in the aggregate measure. Second, capital-quality effects may not be immediate and could take a longer period to materialize, making longer-horizon or distributed-lag designs more convincing for causal inference, as well as using quasi-experimental identification strategies that leverage the staggered timing of state fiscal reform. A measure of road density was created for this study, but data are only available until 2019-20 and were thus not applied in the baseline; extension to the current road density measure is left for future studies. Third, the entire non-outlay portion of the capital budget is treated as a single category, while some of this, in particular scheduled debt repayment, is not discretionary, but rather a fiscal obligation. Two additional RBI series not used here would be necessary to separate the real allocation (outlay versus loans and advances) from mechanical repayment, which is left to future work.

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Appendix A. Comparison of Related Studies

Study (author, year)	Journal	Aim & variables	Methodology	Key findings	Direction
Kiran & Sharma (2024)	PLOS ONE	Fiscal variables and growth in 17 Indian states; NSDP, tax/non-tax revenue, development plan & non-plan expenditure	Panel GMM, FMOLS, DOLS (1990-2020)	Development-plan (capital-type) expenditure insignificant for NSDP; tax revenue and non-plan expenditure positive	Null

Devarajan, Swaroop & Zou (1996)	J. Monetary Economics	Whether capital vs current composition raises growth; expenditure shares, per-capita growth	Cross-country OLS, 43 developing countries	Capital expenditure negative, current positive; misallocation toward capital	Negative
Ghosh & Gregoriou (2008)	Oxford Economic Papers	Current vs capital spending and growth; spending shares, budget-constraint variables	Endogenous-growth model; GMM, 15 countries	Capital negative and significant; current positive	Negative
Marjit, Sasmal & Sasmal (2020)	J. Social & Economic Development	Composition of state spending and per-capita income; revenue/capital shares, infrastructure, GCF	Panel regression, major Indian states	Capital, infrastructure, GCF, services positive; revenue expenditure negative	Positive
Mohapatra & Giri (2016)	J. Economic Research	Composition of public expenditure and growth in India; development/current & sectoral heads, GFCF	ARDL bounds cointegration, national time-series	Development/capital expenditure positive; education and recurrent negative	Positive
Maitra & Hossain (2025)	J. Quantitative Economics	Sectoral growth impact of expenditure components; development, revenue, capital expenditure, sectoral income (1985-2022)	Johansen cointegration + CVAR	Long run: only capital expenditure raises sectoral and national income	Positive (long run)

Condensed from the present study's literature matrix. Directions refer to the capital/composition-to-growth relationship as reported by each study.