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Climate Change and Fiscal Marksmanship: Evidence From an Emerging Country, India

by

Lekha Chakraborty
Levy Economics and International Institute of Public Finance, Munich

Ajay Narayan Jha
(Former) Government of India and Finance Commission

Jitesh Yadav and Balamuraly B
(Former) National Institute of Public Finance and Policy (NIPFP)

and

Amandeep Kaur
National Institute of Public Finance and Policy (NIPFP)

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Levy Economics Institute
P.O. Box 5000
Annandale-on-Hudson, NY 12504-5000
http://www.levyinstitute.org

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ABSTRACT

According to the theory of efficient markets, economic agents use all available information to form rational expectations. The rational expectations hypothesis asserts that information is scarce, the economic system generally does not waste information, and that expectations depend specifically on the structure of the entire system. Fiscal marksmanship—the accuracy of budgetary forecasting—can be one important piece of such information that rational agents must consider in forming expectations. Against the backdrop of fiscal rules, our paper explores the budgetary forecast errors of climate change–related public spending in India. The fiscal rules stipulate that fiscal deficit–to–GDP ratio should be maintained at 3 percent. However, in the post-COVID fiscal strategy, a medium-term fiscal consolidation path of 4.5 percent fiscal deficit–to–GDP is envisioned by 2025–26. Within this fiscal consolidation framework, we analyzed the budget credibility of fiscal commitments for climate change in India. We analyzed the fiscal behavioral variables in terms of bias, variation, and randomness, and captured the systemic variations in budgetary forecast related to climate change for a period 2017–18 to 2020–21 across sectors. We identified the sectors where systematic components of forecasting errors are relatively higher than random components, where minimizing errors through altering the fiscal behavioral models is done by revising the assumptions and by applying better forecasting methods. A state-level decomposition of the public spending revealed that disaggregated fiscal space available for developmental spending constitutes around 60 percent of the total. However, identifying the specifically targeted public spending related to climate change across all states and analyzing its fiscal markmanship can further the subnational inferences.

KEYWORDS: Fiscal Marksmanship, Budget Forecast Errors, Climate Change, State Finances

JEL CODES: H30, H50, H70, Q58

1. INTRODUCTION

According to the theory of efficient markets, economic agents use all available information to form rational expectations. The rational expectations hypothesis asserts that information is scarce, the economic system generally does not waste information, and that expectations depend specifically on the structure of the entire system. Fiscal marksmanship—the accuracy of budgetary forecasting—can be one important piece that rational agents must consider in forming expectations. The significant variations between actual revenue and expenditure from the forecasted budgetary magnitudes could be an indication of fiscal policy objectives not being optimized or attained.

In this context, the role of budget estimates needs to be emphasized as a fiscal signal. This point has gained much momentum especially when expectations are based, not on what has happened in the past, but on the data relating to the future. That is, if expectations are rational rather than adaptive, it is the estimate of taxes and spending in any given budget—the ex-ante data, not the observed data, available only with a lag—that will be used by forward-looking private agents who base their decisions, in whole or in part, on fiscal variables. Against the backdrop of fiscal rules—legally mandated under the Fiscal Responsibility and Budget Management Act (FRBMA)—in India, our paper explores the budget forecast errors of climate change–related public spending in India.

The FRBMA stipulates that the fiscal deficit to GDP ratio should be maintained at 3 percent. However, in the post-covid fiscal strategy, a medium-term fiscal consolidation path of 4.5 percent fiscal deficit-GDP is envisioned for 2025–26. Within this fiscal consolidation framework, we analyze the budget credibility of fiscal commitments for climate change in India. This is particularly important against the backdrop of COP27 recently held in Egypt. The paper analyzes the fiscal behavioral variables in terms of bias, randomness, and systematic variations in budgetary forecast (forecast errors) related to climate change–related spending for a period 2017–18 to 2020–21.

In India, fiscal arithmetic has three stages: the announcement of Budget Estimate (BE); the government's announcement of the Revised Estimate (RE) the next year, after review and revision; and finally the publication of the Actuals (actual spending) with a lag of one year or two. We analyze whether there is a correlation between BE and RE, and between BE and Actuals or a significant deviation between these three, relative to climate change–related spending.

2. REVIEW OF THE LITERATURE

The political economy of budget deficits and other macro-fiscal variables started gaining attention in the 1990s (Alesina and Perotti 1995; Blanchard 1990). However, one of the earlier discussions of fiscal forecast errors was made by Allan (1965) in the case of Britain. According to Allan, fiscal marksmanship was important during that time because the margin for error was limited given the trade-off between inflation and full employment. In such a scenario, accurate predictions of budgetary estimates were important for meeting fiscal policy targets of full employment without undesirably high inflation. Davis (1980), following up on Allan's study, used a longer time series (1951–78).

Auld (1970) has done a fiscal marksmanship exercise for Canada for the post-war period (through 1968). Auld says that if the government is to finance its long-range programs, accurate predictions are important. Morrison (1986) has done a fiscal marksmanship exercise in the United States for the years 1950–83. Cassidy, Kamlet, and Nagin (1989) analyzed the revenue forecast biases in the context of Europe. Good fiscal marksmanship can be one important piece of available information rational agents must consider in forming expectations. In this context, the role of budget estimates needs to be emphasized as what Davis (1980) refers to as a *fiscal signal*, noting that budget estimates have an important "signal effect" for outside forecasters and analysts, with particular attention, in recent years, given to the estimated borrowing requirement. If expectations are rational rather than adaptive, it is the estimate of taxes and public expenditure in any given budget—the ex-ante data, not the observed data—that will be used by forward-looking private agents who base their decisions, in whole or in part, on fiscal variables (Morrison 1986).

In the context of the eurozone, Brück and Stephan (2005) have estimated the political economy determinants of budget deficit forecast errors. Their findings show that politics, electoral cycles, and the institutional designs of governments affect the quality of fiscal forecasts. Their findings against the backdrop of the Stability and Growth Pact (SGP) suggest maligned incentives for "unobservable fiscal effort" (Beetsma and Jensen 2004) by eurozone governments (compared to other OECD governments) in reporting their budget deficits prior to elections. They explained the fiscal behavior under three cycles (i.e., an electoral forecast cycle, a partisan forecast cycle, and an institutional cycle), applying panel econometric techniques to the analysis of the forecast errors of both eurozone and non-eurozone OECD economies. Their findings suggest that the forecast errors align with election cycles in eurozone countries.

Rullán and Villalonga (2018), in the context of the SGP, have examined the relationship between fiscal rules and budgetary forecasts by analyzing the significance of political and institutional variables in the eurozone. Their findings show that the level of public sector debt is crucial in explaining budgetary forecast errors. The electoral mandate, political orientation of ruling parties, tax autonomy, and per capita revenue are the other significant determinants of forecast errors. This study took the literature forward to subnational tiers of government in 15 European countries, unlike the earlier studies in the context of the eurozone that confined their analysis to a macroeconomic perspective at the national government level. The SGP therefore creates incentives for creative budgetary deficit forecasts prior to election cycles (Strauch, Hallerberg, and Hagen 2004).

Giuriato, Cepparulo, and Barberi (2016) analyzed the quality of the fiscal forecasts of 13 eurozone countries by using annual forecasts for the period 1999–2013 against the backdrop of stability and convergence programs. They found that if fiscal rules counter the executive's monopoly on fiscal forecasting, strengthening the legislature's formal powers negatively influences the fiscal forecast accuracy. Pina and Venes (2011) analyzed the budget balance forecasts prepared by 15 European countries in their Excessive Deficit Procedure (EDP) reporting. They found that growth surprises, fiscal institutions, elections cycles, forms of fiscal governance, and numerical expenditure rules (unlike deficit and debt rules) affect the forecast errors.

There have been a number of fiscal marksmanship exercises in the case of India (Kumari and Bhattacharya 1988). In one of the earlier attempts at analyzing budgetary estimates in India (for the period 1956–64), Samuel and Rangarajan (1974) undertook an analysis of two components of the state and union budgets' capital expenditure on construction and industrial development (the analysis was limited to these two because of the scope of the subject matter they were dealing with). In this study, the analysis of forecasting errors was based largely on graphs plotting the actual expenditure and the budget estimates. In their analysis, it is stated that, while in both components the central government's budget estimate was more accurate compared to the states, this difference was attributed to the difference in budgetary process's efficiency.

Asher (1978) performed a more comprehensive fiscal marksmanship exercise for India for the period 1967–76, for both the revised and budget estimates. The study showed that, during that period, both the revenues and expenditures were consistently underestimated. However, it was observed that the extent of the error on the expenditure side was larger.

Chakrabarty and Varghese (1982) have used data from 1970–80. One of the major findings of that study was that both revenues and expenditure are underestimated. Pattnaik (1990) has done a fiscal marksmanship exercise using Theil's index for the period 1951–89. The study observes that the errors in the revised estimates are lower than the errors in the budget estimates (although there are large errors in both). It stated that the errors in the estimates are largely systematic in nature for both the entire time period as well as for smaller time periods within the whole (the systematic errors were greatest for the period 1981–89).

More recent studies on fiscal marksmanship in India have a different conclusion. A study done by Nitin and Roy (2015) using data from 1990–2012 observes that the source of error in components such as tax revenue, nontax revenue, interest payments, defense revenue expenditure, and fiscal deficit were primarily due to random error (defined in their paper as being when the proportion of the random error is greater than the bias components or the error in variance). The rest of the components—such as subsidy expenditure, capital expenditure, and non-debt capital receipts—had a higher systematic error (mean error and slope error). A very interesting point made in the paper is that, while there is an attempt to have fiscal consolidation by controlling expenditure, the predictability of expenditure is quite low compared to revenue. In a similar study, Chakraborty and Sinha (2018) undertook a fiscal marksmanship exercise for the period 1990–2017 and drew a similar conclusion.

A trend that can be observed based on the empirical literature from 1951 to 1990 is that the systematic component of the error was higher, while, from 1990 to 2017, the random component is higher. It is worth noting that the above studies are based on the federal government's data. Shrestha and Chakraborty (2019) have examined the fiscal marksmanship in the context of India's states. Their study focused on Kerala and identified forecast errors with respect to tax revenue projections.

In the recent empirical literature, the fiscal forecast errors are analyzed against the backdrop of fiscal rules. The political economy of fiscal forecasts at the subnational level depends on the tax autonomy and the nature of the intergovernmental fiscal transfer mechanism. The tax autonomy is heterogeneous across states. The intergovernmental fiscal transfers may be progressive if the transfer is designed to offset the interstate fiscal disabilities.

In India, the Finance Bill 2018 has incorporated a few clauses (clauses 207–10) to amend the FRBM Act of 2003, with special emphasis on the elimination of references to "revenue balance" and using fiscal deficit as an operational parameter (Chakraborty and Chakraborty 2018). Against these policy changes, it is pertinent to analyze the impact of fiscal rules on fiscal marksmanship of macro-fiscal variables in India. Buiter and Patel (2010) have analyzed fiscal rules in India, however the effect of fiscal rules on fiscal marksmanship in the context of India has not been analyzed. As mentioned above, Nitin and Roy (2015) have analyzed the normative fiscal assessments of India's Finance Commission, and the realization of fiscal policy with regard to the central government's finances over the period 1990–2012.

The recent empirical literature on fiscal marksmanship is highly confined to the Indian national government's forecast errors (Chakraborty and Sinha 2018; Nitin and Roy 2015). There has been virtually no effort to undertake a fiscal marksmanship exercise at the state level, except by Chakraborty, Chakraborty, and Shrestha (2020). In this paper, we attempt to do a fiscal marksmanship exercise for climate change–related spending, analyzing the magnitude of the errors and subsequently examining the nature of the errors. This is done in two ways: first we check whether the errors are overestimates or underestimates, and then we check the extent of systematic and random components in these fiscal forecast errors.

3. METHODOLOGY OF FISCAL MARKSMANSHIP

The data is organized from the finance accounts of various states and the Central Statistics Office (CSO). The forecast error is defined as the deviation between the predicted budget estimates (BE) or revised estimates (RE) and the actual.

The Mean Error

The mean error (ME) refers to the average difference between the forecast and the actual. The ME has been calculated by taking the average of the difference between the predicted values (of both BE and RE) and the actuals. We have divided the ME by the sum of the actuals for the reference period. The ME is a crude measure of the forecast's quality, as positive and negative errors can offset each other, thereby not giving us the exact magnitude of error. However, the ME is an indicator of possible bias in the forecast.

The Root Mean Square Error

The root mean squared error (RMSE) is a measure of the relative size of the forecast error. In this paper, to calculate the RMSE, the mean squared error (MSE) is taken over the reference period after which the square root of the MSE is calculated. While this will give us the magnitude of error, it will not give any information on the direction of the error, i.e., whether the error is positive or negative. We have taken the RMSE as a proportion of the sum of actuals of the reference period. It reflects the fact that large forecast errors are more significant than small differences.

Theil's Inequality Coefficients (U)

Theil's inequality coefficient (U) is used to analyze the measure of accuracy of the budget forecasts. Theil's inequality coefficient is based on the MSE (U_1). The forecast error of Theil (1958) is defined as:

$$\mathbf{U_1} = \frac{\sqrt{1/n\sum(P_t - A_t)^2}}{\sqrt{1/n\sum P_t^{\,2}} + \sqrt{1/n\sum A_t^{\,2}}} \qquad (1)$$

Where U_1 is the inequality coefficient, P_t is the predicted value, A_t is the actual value, and n is the number of years.

This inequality coefficient ranges from zero to one. When P_t is equal to A_t for all observations (a perfect forecast), U_1 equals zero.[1]

U_1 has been decomposed in order to indicate systematic and random sources of error. The systematic component is further divided into the proportion of the total forecast error due to bias

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[1] Theil's second equation for the inequality coefficient uses a revised measure of forecast error. Theil's (1966, 1971) revised measure of inequality is as follows:

$$\mathbf{U_2} = \frac{\sqrt{1/n\sum(P_t - A_t)^2}}{\sqrt{1/n\sum A_t^{\,2}}}$$

This measure has the advantage that the denominator does not contain P and the inequality coefficient does not depend on the forecast. In a perfect forecast, U_2 equals to zero. U_2 does not have an upper bound.

A more rigorous measure of Theil's inequality statistics is also used by incorporating the lags in the actuals and the difference of the predicted value from the lag of the actuals to capture the magnitude of error:

$$\mathbf{U_3} = \sqrt{\frac{1/n\sum[Pt - at]^2}{1/n\sum[Pt]^2 + 1/n\sum[at]^2}}$$

where $a = A_t - A_{t-1}$, $P_t = P_t - A_{t-1}$, and n= number of years and the proportion of total forecast error attributable to unequal variation. The derivation of equation (2) is given in detail in Davis (1980).

$$\mathbf{1} = \frac{(\overline{P}-\overline{A})^2}{1/n\sum(P_t-A_t)^2} + \frac{(Sp-Sa)^2}{1/n\sum(P_t-A_t)^2} + \frac{2(1-r)\,Sp.Sa}{1/n\sum(P_t-A_t)^2} \qquad (2)$$

In equation (2), *P* and *A* are mean-predicted and mean-actual changes, respectively; *Sp* and *Sa* are the standard deviations of predicted and actual values, respectively; and *r* is the coefficient of correlation between predicted and actual values.

The first expression on the right hand side (RHS) in equation (2) is the proportion of the total forecast error due to bias. It represents a measure of the proportion of error due to overprediction or underprediction of the average value. The second expression of the RHS in equation (2) is the proportion of total forecast error attributable to unequal variation. In other words, it measures the proportion of error due to overprediction or underprediction of the variance of the values. The third expression of the RHS in equation (2) measures the proportion of forecasting error due to random variation.

The first two sources of error are systematic; presumably they can be reduced by improved forecasting techniques, while the random component is beyond the control of the forecaster.

4. MAGNITUDE OF FORECAST ERRORS ACROSS IDENTIFIED SECTORS

The data on budget estimates, revised estimates, and actuals, starting from 2017–18 until 2020–21, for all climate adaptation–related schemes, is extracted from the Detail Demand for Grants, Union Budgets documents of the Government of India. There exists a huge variation in the expenditure incurred by various ministries towards adaptation-related programs (Chakraborty et al., forthcoming).

The values of U1, U2, and U3 for various ministries are provided in Table 1. U1 takes on a value between 0 and 1. Therefore, it can be determined from Table 1 that the magnitude of errors—in ministries such as the Ministry of Consumer Affairs, Food and Public Distribution, and the Ministry of Science and Technology—is quite significant at around 0.5. However, the Ministry of Science and Technology devotes a relatively scant budget on adaptation-related programs. In contrast, the Ministry of Consumer Affairs, Food, and Public Distribution spends significantly on adaptation-related programs. U1 for BE was reported to be lowest for the Ministry of Road Transport and Highways (0.04) as shown in Table 1.

The value of U_1 for RE was highest for the Ministry of Science and Technology (0.66) and negligible for the Ministry of Law and Justice, Ministry of Heavy Industries, and Ministry of Steel.

Table 1: Fiscal Marksmanship: Theils' Inequality Statistic (U)

Name of Ministry/Department	Theils' U (BE, Actual)			Theils' U (RE, Actual)		
	U1	U2	U3	U1	U2	U3
Ministry of Agriculture and Farmers Welfare	0.115	0.259	0.393	0.076	0.161	0.301
Department of Atomic Energy	0.098	0.197	0.732	0.022	0.044	0.123
Ministry of Ayush	0.168	0.384	1.132	0.026	0.053	0.312
Ministry of Chemicals And Fertilizers	0.174	0.315	1.129	0.017	0.035	0.085
Ministry of Coal	0.155	0.354	0.875	0.051	0.107	0.334
Ministry of Commerce and industry	0.080	0.154	0.825	0.042	0.085	0.441
Ministry of Consumer Affairs, Food and Public Distribution	0.496	0.767	0.977	0.128	0.239	0.240
Ministry of Development of North Eastern Region	0.187	0.441	0.705	0.068	0.141	0.227
Ministry of Earth Sciences	0.131	0.290	1.245	0.019	0.039	0.149
Ministry of Education	0.064	0.136	0.841	0.028	0.058	0.509
Ministry of Environment, Forests and Climate Change	0.120	0.262	1.346	0.013	0.026	0.130
Ministry of External Affairs	0.095	0.202	0.534	0.013	0.025	0.110
Ministry of Finance	0.180	0.388	0.978	0.036	0.074	0.159
Ministry of Fisheries, Animal Husbandry and Dairying	0.061	0.126	0.370	0.007	0.013	0.025
Ministry of Food Processing Industries	0.222	0.529	0.489	0.095	0.205	0.253

Ministry of Health and Family Welfare	0.096	0.178	1.102	0.013	0.026	0.110
Ministry of Heavy Industries	0.197	0.447	0.677	0.000	0.000	0.000
Ministry of Home Affairs	0.076	0.152	0.613	0.019	0.037	0.112
Ministry of Housing and Urban Affairs	0.110	0.212	0.595	0.038	0.076	0.047
Ministry of Information and Broadcasting	0.343	1.042	0.559	0.004	0.009	0.007
Ministry of Jal Shakti	0.087	0.182	1.291	0.029	0.058	0.428
Ministry of Law and Justice	0.111	0.215	0.559	0.000	0.001	0.002
Ministry of Micro, Small and Medium Enterprises	0.078	0.159	0.578	0.005	0.010	0.023
Ministry of Mines	0.222	0.471	0.533	0.214	0.443	0.507
Ministry of Minority Affairs	0.083	0.178	0.796	0.066	0.137	0.606
Ministry of New and Renewable Energy	0.223	0.544	0.948	0.054	0.114	0.287
Ministry of Panchayati Raj	0.174	0.411	0.975	0.013	0.026	0.088
Ministry of Petroleum and Natural Gas	0.127	0.275	0.571	0.021	0.043	0.090
Ministry of Power	0.123	0.256	1.022	0.081	0.158	0.493
Ministry of Railways	0.450	0.648	0.966	0.236	0.609	0.422
Ministry of Road Transport and Highways	0.038	0.074	0.352	0.016	0.033	0.131
Ministry of Rural Development	0.148	0.270	1.010	0.002	0.004	0.011
Ministry of Science and Technology	0.496	1.694	0.871	0.663	3.235	0.871
Ministry of Skill Development and Entrepreneurship	0.120	0.270	0.673	0.032	0.066	0.255
Ministry of Social Justice and Empowerment	0.065	0.128	0.527	0.008	0.016	0.051
Department of Space	0.100	0.207	0.884	0.004	0.008	0.026
Ministry of Steel	0.303	0.623	0.575	0.000	0.000	0.000
Ministry of Textiles	0.075	0.152	0.672	0.025	0.050	0.096
Ministry of Tourism	0.196	0.408	0.447	0.000	0.000	0.000
Ministry of Tribal Affairs	0.073	0.148	0.942	0.004	0.008	0.009
Ministry of Women and Child Development	0.131	0.293	1.111	0.092	0.092	0.519

Source: (Basic data), Finance Accounts (various years), Government of India

5. PARTITIONING THE BUDGET FORECAST ERRORS

Table 2 gives the results obtained after partitioning the forecast errors in budget estimates into systematic and random components. Systematic error can be improved upon, but random is beyond the forecaster's control. In the case of budget estimates, the Ministry of Science and

Technology and the Ministry of Information and Broadcasting reported the highest systematic errors, whereas the Ministry of Social Justice and Empowerment reported the lowest systematic error at around 0.07 (Table 2).

Table 2: Partitioning the Sources of Forecast Errors: Bias and Random Components

Name of Ministry	BIAS	Unequal	Random
Ministry of Agriculture and Farmers Welfare	0.63	0.33	0.04
Department of Atomic Energy	0.01	0.40	0.59
Ministry of Ayush	0.46	0.16	0.38
Ministry of Chemicals and Fertilizers	0.23	0.51	0.25
Ministry of Coal	0.61	0.09	0.30
Ministry of Commerce and industry	0.30	0.39	0.31
Ministry of Consumer Affairs, Food and Public Distribution	0.08	0.57	0.36
Ministry of Development of North Eastern Region	0.73	0.03	0.23
Ministry of Earth Sciences	0.54	0.03	0.43
Ministry of Education	0.70	0.25	0.05
Ministry of Environment, Forests and Climate Change	0.54	0.02	0.45
Ministry of External Affairs	0.50	0.01	0.49
Ministry of Finance	0.05	0.30	0.65
Ministry of Fisheries, Animal Husbandry and Dairying	0.36	0.01	0.63
Ministry of Food Processing Industries	0.44	0.09	0.47
Ministry of Health and Family Welfare	0.60	0.19	0.22
Ministry of Heavy Industries	0.44	0.02	0.54
Ministry of Home Affairs	0.00	0.22	0.78
Ministry of Housing And Urban Affairs	0.07	0.27	0.66
Ministry of Information and Broadcasting	0.49	0.50	0.00
Ministry of Jal Shakti	0.35	0.01	0.64
Ministry of Law and Justice	0.04	0.40	0.55
Ministry of Micro, Small and Medium Enterprises	0.07	0.05	0.88
Ministry of Mines	0.23	0.57	0.20
Ministry of Minority Affairs	0.61	0.01	0.38
Ministry of New and Renewable Energy	0.65	0.00	0.35
Ministry of Panchayati Raj	0.79	0.03	0.18
Ministry of Petroleum and Natural Gas	0.24	0.22	0.53

Ministry of Power	0.16	0.19	0.65
Ministry of Railways	0.29	0.68	0.03
Ministry of Road Transport and Highways	0.07	0.30	0.63
Ministry of Rural Development	0.29	0.64	0.07
Ministry of Science and Technology	0.89	0.11	0.00
Ministry of Skill Development and Entrepreneurship	0.93	0.01	0.06
Ministry of Social Justice And Empowerment	0.03	0.04	0.93
Department of Space	0.09	0.02	0.90
Ministry of Steel	0.07	0.15	0.78
Ministry of Textiles	0.02	0.12	0.86
Ministry of Tourism	0.25	0.30	0.45
Ministry of Tribal Affairs	0.07	0.05	0.88
Ministry of Women And Child Development	0.64	0.06	0.30

Source: (Basic data), Finance Accounts (various years), Government of India

Table 2 gives the results obtained after bifurcating the errors in revised estimates into systematic and random components. In the case of revised estimates, the Ministry of Rural Development and the Ministry of Railways reported the highest systematic errors whereas the Ministry of Tourism and the Ministry of Steel reported the lowest systematic error at around 0.07 (Table 2). For both budget and revised estimates, there is space for improvement in forecasting error since the systematic component is greater than the random component in a majority of ministries. This implies that the fiscal marksmanship may be enhanced by using more effective policy innovations to manage the tight fiscal space within the fiscal regulations.

6. SUBNATIONAL FISCAL SPACE FOR CLIMATE CHANGE COMMITMENTS

The State Action Plans (SAPs) for climate change commitments are not homogeneous, and each state in India has prepared the SAP as per the specificities of climate change–related risks and uncertainities. The estimates in the previous section, however, are confined to the Demand for Grants analysis of national budgets. Given the principle of subsidiarity, the decisions related to climate change considerations—especially adaptation—need to be taken at the level closest to the people. The meticulous analysis of all the detailed demands for grants across all states of

India scanned for the intensity of identified components of adaptation is a task beyond the scope of the present paper. However, at the aggregate level, we identified the plausible discretionary fiscal space available at the aggregate level to the state governments to undertake the climate change commitments. The classification of budgetary transactions into developmental (economic services and social services) and non-developmental (general services including interest payments, salaries, and pensions) for the purpose of identifying the plausible fiscal space for climate change commitments. At the aggregate state level, the Reserve Bank of India analysis of public expenditure across the states of India revealed that developmental spending is around 60 percent of total public expenditure (Table 3).

Table 3: State Level Development and Non-Development Expenditure as % of Aggregate Public Expenditure

Year	Development*	Non-Development*	Others**	Total (in crores)
1	2	3	4	5
2004–05	2,86,473.0	1,85,152.0	81,803.0	5,53,428.0
	(51.8)	(33.5)	(14.8)	(100.0)
2005–06	3,30,044.1	1,90,020.6	41,616.8	5,61,681.6
	(58.8)	(33.8)	(7.4)	(100.0)
2006–07	3,92,165.0	2,11,872.4	53,242.9	6,57,280.3
	(59.7)	(32.2)	(8.1)	(100.0)
2007–08	4,64,462.0	2,33,232.8	54,629.6	7,52,324.4
	(61.7)	(31.0)	(7.3)	(100.0)
2008–09	5,67,086.2	2,54,981.4	60,265.2	8,82,332.8
	(64.3)	(28.9)	(6.8)	(100.0)
2009–10	6,37,731.1	3,07,547.0	70,051.7	10,15,329.8
	(62.8)	(30.3)	(6.9)	(100.0)
2010–11	7,20,354.7	3,57,287.4	81,087.6	11,58,729.7
	(62.2)	(30.8)	(7.0)	(100.0)
2011–12	8,52,405.6	4,01,059.4	98,147.3	13,51,612.3
	(63.1)	(29.7)	(7.3)	(100.0)
2012–13	9,72,256.5	4,46,878.9	1,15,119.4	15,34,254.8
	(63.4)	(29.1)	(7.5)	(100.0)
2013–14	10,76,452.2	5,04,548.4	1,25,144.0	17,06,144.5

	(63.1)	(29.6)	(7.3)	(100.0)
2014–15	13,25,989.2	5,66,467.4	1,33,326.0	20,25,782.5
	(65.5)	(28.0)	(6.6)	(100.0)
2015–16	15,84,006.2	6,29,349.3	1,46,873.2	23,60,228.7
	(67.1)	(26.7)	(6.2)	(100.0)
2016–17	18,31,163.8	7,10,365.1	1,66,686.4	27,08,215.3
	(67.6)	(26.2)	(6.2)	(100.0)
2017–18	18,77,392.3	8,25,774.0	2,21,432.9	29,24,599.2
	(64.2)	(28.2)	(7.6)	(100.0)
2018–19	21,00,801.6	9,44,483.7	2,92,428.1	33,37,713.3
	(62.9)	(28.3)	(8.8)	(100.0)
2019–20	21,63,340.6	10,05,162.7	3,26,499.3	34,95,002.6
	(61.9)	(28.8)	(9.3)	(100.0)
2020–21	22,64,470.7	10,63,162.2	3,69,859.4	36,97,492.3
	(61.2)	(28.8)	(10.0)	(100.0)
2021–22 (BE)	29,11,369.4	12,87,938.2	4,23,804.2	46,23,111.7
	(63.0)	(27.9)	(9.2)	(100.0)
2021–22 (RE)	29,22,422.8	12,40,854.3	4,33,289.0	45,96,566.0
	(63.6)	(27.0)	(9.4)	(100.0)
2022–23 (BE)	32,34,504.4	14,18,957.3	4,79,783.6	51,33,245.2
	(63.0)	(27.6)	(9.3)	(100.0)

Note: RE : Revised Estimates. BE: Budget Estimates.*: Includes expenditure on revenue and capital account and loans and advances extended by state government and UTs.** : Includes Grants-in-Aid and Contributions (Compensation and Assignments to Local Bodies), Discharge of Internal Debt and Repayment of Loans to the Centre. Figures in parentheses are percentage to total. Data from 2017–18 onwards include Delhi and Puducherry also.
Source: RBI and Budget documents of the State governments (various years)

Following an open-ended approach, the public expenditure for climate change, specifically adaptation-related spending can be identified based on (i) crop improvement and research; (ii) drought proofing and flood control; (iii) forest conservation; (iv) poverty alleviation and livelihood preservation; (v) rural education and infrastructure; (vi) health; (vii) risk financing; and (viii) disaster management across all states of India. This identification is the crucial prelude to a subnational, fiscal marksmanship analysis of climate commitments by all the state governments. State-specific mapping of adaptation-related fiscal space and its marksmanship is an area of future research.

7. CONCLUSION

The paper conducts the ministry-wise fiscal marksmanship analysis for climate change spending. The sources of errors, disaggregated into biasedness, unequal variation, and random components are analysed across sectors. In the sectors where the systematic components of forecasting errors are relatively higher, the errors can be reduced by using better forecasting methods. A state-level decomposition of the fiscal marksmanship estimates to understand the sources of errors—systemic or random bias—is an area of future research, which would be conducted only after sorting out the intertemporal comparability issues in the detailed demand for grants across sectors. In this paper, the analysis is confined to identifying only the fiscal space for developmental spending and it is revealed that the discretionary fiscal space available for plausible climate change commitments in the developmental spending category constitutes around 60 percent of total spending. Identifying the specifically targeted public spending related to climate change across all states and analyzing its fiscal marksmanship can further the subnational inferences, which is an area of future research.

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