# Impact of Public Expenditure on Poverty in Rural India

*Using state-level data for 1970-93, a simultaneous equations model was developed to estimate the direct and indirect effects of different types of government expenditure on rural poverty and productivity growth in India. The results show that in order to reduce rural poverty, the Indian government should give highest priority to additional investments in rural roads, agricultural research and education. These types of investment not only have much larger poverty impacts per rupee spent than any other government investment, but also generate higher productivity growth. Other investments (including irrigation, soil and water conservation, health, and rural and community development) have only modest impacts on growth and poverty per additional rupee spent.*

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Poverty in rural India has declined substantially in recent decades. The percentage of the rural population living below the poverty line fluctuated between 50 and 65 per cent prior to the mid-1960s but then declined steadily to about one-third of the rural population by 1993. Much of the steady decline in poverty from the mid-1960s to the early 1980s has been attributed to agricultural growth and associated reductions in food prices [Saith 1981; Ahluwalia 1985; Srinivasan 1985; Ghose 1989; Gaiha 1989; Bell and Rich 1994]. Since then, however, the causes for the decline seem to have become more complex. The downward trend in poverty continued even when the agricultural growth rate slowed after the green revolution had run its course. Poverty also declined rapidly in states that benefited relatively little from the green revolution. Non-farm wages and employment also now play a much larger role in reducing poverty, and these are less driven by agricultural growth than before [Ravallion and Datt 1994]. Further, government spending on rural poverty and employment programmes has increased substantially in recent years, and this has directly benefited the rural poor [Sen 1997].

Although a large literature exists to explain changes in India's rural poverty, little attention has previously been paid to the role of government spending in alleviating poverty. Government expenditure has not only contributed to agricultural growth and hence indirectly to poverty alleviation, but it has directly created rural non-farm jobs and increased wages. The real significance of government development expenditure lies in the fact that it imparts a greater amount of 'trickle-down' benefits for the poor in the growth process than agricultural growth alone. Unlike agricultural growth, which often reduces poverty only by increasing mean consumption, government expenditure reduces poverty by increasing both mean income and improving the distribution of income [Sen 1997].

The primary purpose of this paper is to investigate the causes of the decline in rural poverty in India and to determine the role that government investments have played. In particular, we seek to quantify the effectiveness of different types of government expenditures in poverty alleviation. Such information can help policymakers target their investments more effectively to reduce poverty. More efficient targeting has become increasingly important in an era of macroeconomic reforms in which the government is under pressure to reduce its total budget. An econometric model is formulated and estimated using pooled cross-state, time-series (1970-93) data that permits calculation of the percentage of poor people raised above the poverty line for comparable increases in different expenditure items.

However, targeting government expenditures simply to reduce poverty is not sufficient. These expenditures also need to stimulate economic growth to help generate the resources required for future government expenditures, and hence for long-term poverty reduction. Our model is therefore formulated to measure the impact on growth as well as poverty of different items of government expenditure. The model makes it possible not only to rank different types of investment in terms of their effects on growth and poverty, but also to quantify any trade-offs or complementarities that may arise between the achievement of these two goals.

The paper is structured in four sections. Section I discusses trends in rural poverty and patterns of government expenditure in rural areas. Section II then presents our model, and Section III discuss the results of the econometric estimation and marginal returns to growth and poverty reduction of government spending. Section IV concludes the article.

## I
## Rural Poverty and Government Spending

Rural poverty, measured as the head count ratio, declined from about two-thirds of the rural population in the early 1960s to about one-third by 1993 (Figure 1). But state-level data reveal wide variations in the level of rural poverty and changes in its incidence over time (Table 1).[1]

Four states, Bihar, Madhya Pradesh, Maharashtra and Uttar Pradesh, together accounted for 55 per cent of all the rural poor in India in 1993. Bihar and Uttar Pradesh accounted for about 18 per cent each of the total poor. These states also had some of the highest incidences of poverty in 1993, with 42-68 per cent of their rural populations falling below the poverty line. On the other hand, Andhra Pradesh, Haryana, Kerala, Punjab, and West Bengal had only 25-30 per cent of their rural populations living in poverty in 1993, and together they accounted for only 16 per cent of the total poor in India.

All states except Assam and Himachal Pradesh achieved reductions in rural poverty between 1957 and 1993. The head count ratio declined the most in Kerala and Andhra Pradesh (by about 2.1 per cent per year) – we discount the figures for Jammu and Kashmir for which there are only a small number of observations (Table 1).

Most states experienced an increase in poverty after 1990. For example, in Orissa the poverty ratio increased from 27 per cent in 1990 to 40 per cent in 1993. Even in Punjab, the rural poverty ratio increased from 19 per cent to 25 per cent between 1990 and 1993. However, West Bengal, one of the states with the highest incidence of poverty in the early 1970s, had one of the lowest poverty rates in 1993.

An important issue is whether the decline in rural poverty was sufficient to reduce the absolute number of people falling below the poverty line. At the all India level, the absolute number of poor people increased from 177 million in 1960 to 278 million in 1993, a net increase of 101 million persons (equivalent to an annual rate of increase of 1.38 per cent). Most of the states experienced a net increase in the size of their poor populations. The only exceptions were Andhra Pradesh, Kerala and Tamil Nadu. The percentage decline in the number of poor persons was particularly high in Kerala. In Bihar, the number of poor people below the poverty line was about 20 million in 1960, but it had increased to 51.5 million by 1993, a growth rate of 2.89 per cent per year. Uttar Pradesh also experienced rapid growth in the number of poor people, from 25.6 million in 1960 to 50.1 million in 1993 (equivalent to an annual growth

**Figure 1: Changes of Poverty in India**

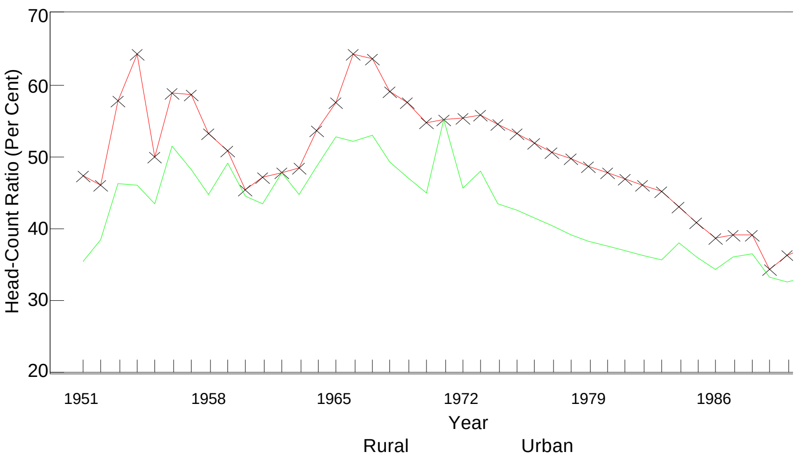



**Table 1: Changes in Incidence of Poverty by State**

| State | Incidence of Poverty (Per Cent of Poor) 1993 | Annual Growth Rate of Head Count Ratio 1957-93 | Annual Growth Rate in Number of Poor 1960-93 | State's Share of Total Poor 1993 |
|---|---|---|---|---|
| Andhra Pradesh | 29 | –2.18 | –0.70 | 5.39 |
| Assam | 49 | 0.76 | 3.26 | 3.79 |
| Bihar | 64 | –0.08 | 2.89 | 18.52 |
| Gujarat | 47 | –0.96 | 1.71 | 4.80 |
| Haryana | 28 | –0.49 | 1.92 | 1.35 |
| Himachal Pradesh | 30 | 0.51 | na | na |
| Jammu and Kashmir | 30 | –10.45 | 1.67 | 0.72 |
| Karnataka | 41 | –0.48 | 1.36 | 4.87 |
| Kerala | 31 | –2.11 | –1.14 | 2.42 |
| Madhya Pradesh | 45 | –0.90 | 1.73 | 8.95 |
| Maharashtra | 48 | –1.11 | 1.14 | 8.89 |
| Orissa | 40 | –1.32 | 0.45 | 4.23 |
| Punjab | 25 | –0.78 | 1.02 | 1.38 |
| Rajasthan | 48 | –0.18 | 1.82 | 6.32 |
| Tamil Nadu | 37 | –1.88 | –0.38 | 5.10 |
| Uttar Pradesh | 42 | –0.77 | 1.94 | 18.02 |
| West Bengal | 27 | –1.82 | 1.63 | 5.24 |
| All India | 37 | –1.30 | 1.38 | – |

*Notes*: Growth rates for Gujarat, Himachal Pradesh, Jammu and Kashmir, and Maharashtra are calculated between the first year when the data are available and 1993.
na: not available.
*Source*: World Bank 1997.

**Table 2: State Government Expenditure at 1960-61 Prices**

| | Annual Growth Rate (Per Cent) | | | |
|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-93 | 1970-93 |
| Total | 8.07 | 8.14 | 3.14 | 7.34 |
| Development | 12.65 | 6.59 | 1.06 | 8.15 |
| Social services | 9.88 | 8.48 | 0.42 | 7.71 |
| Education[a] | 6.68 | 9.90 | 0.22 | 6.86 |
| Health | 8.56 | 3.73 | 1.31 | 5.37 |
| Welfare | 16.55 | 6.95 | 1.38 | 10.03 |
| Economic services | 15.14 | 5.07 | 1.29 | 8.57 |
| Agriculture | 14.20 | 0.12 | 1.05 | 6.52 |
| Irrigation | 12.59 | 2.08 | 0.12 | 5.47 |
| Transportation[b] | 16.02 | 3.56 | 2.52 | 8.69 |
| Power | 13.11 | 4.84 | 3.36 | 7.85 |
| Rural Development[c] | 12.46 | 12.18 | 5.09 | 12.79 |

*Notes*: All figures in this table include both revenue and capital expenditures and are aggregated from 17 major states.
a Expenditure on education includes spending on education, culture and sport. Expenditure on transportation includes spending on transportation and communication.
b Rural development expenditure is included in agriculture expenditure for some years.
c Therefore, the sum of expenditure for agriculture, irrigation, transportation, power and rural development is not necessarily equal to total economic service expenditure.
*Source*: Reserve Bank of India, various years.

rate of 1.94 per cent per year). In Madhya Pradesh, the number of poor people increased from 14.13 million in 1960 to 24.90 million in 1993 (equivalent to an annual growth rate of 1.73 per cent per annum). The number of poor also increased in agriculturally advanced states like Punjab and Haryana.

Government expenditure in India is divided into non-development and development spending, and the latter is further subdivided into spending on social and economic services. Social services include health, labour, social welfare and other community services, while economic services include such sectors as agriculture, industry, trade and transportation. Most expenditures on agriculture and rural areas are undertaken by the state governments. In addition to expenditures financed from the states' own revenues, the states are also the conduits for most of the central government's expenditure on agriculture and rural development. Moreover, the lion's share of the central government's expenditure on agriculture and allied activities that is not channelled through the states is spent on fertiliser subsidies. Since these subsidies do not affect the capital stocks considered in this paper, we ignore them. Table 2 shows the trends in state government expenditures for the period 1970 to 1993.

**Figure 2: Government Spending**

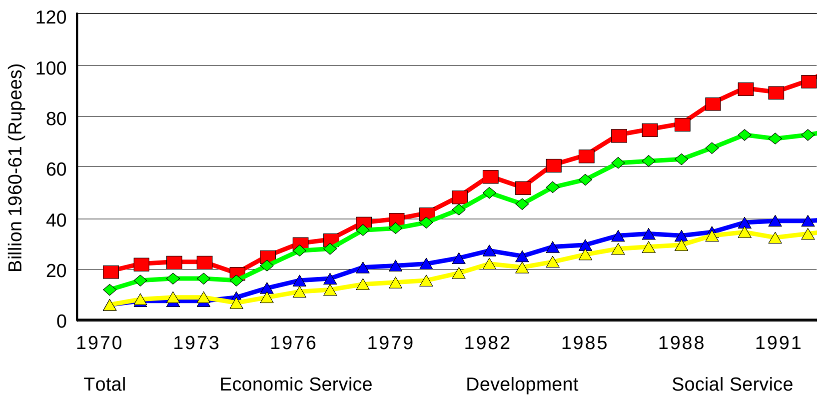
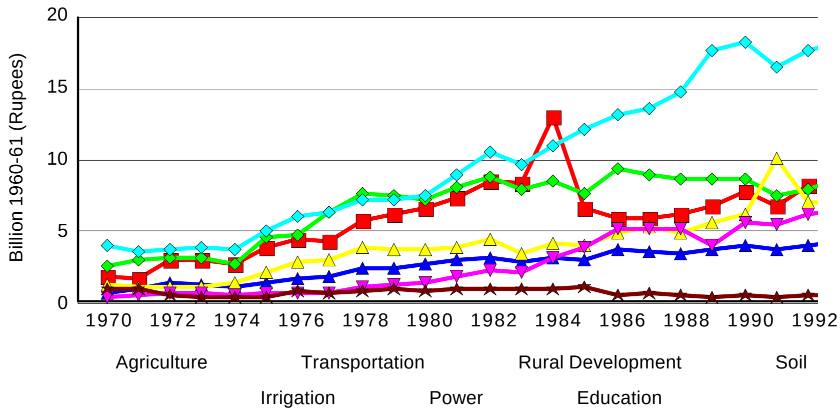



**Figure 3: Government Spending by Economic Sector**




Total state government expenditure increased fivefold in real terms over the period 1970 to 1990. But the rate of increase has slowed in recent years. After growing at about 8 per cent per year during the 1970s and 1980s, it slowed to 3.14 per cent per year in the early 1990s. Development expenditure has followed a similar pattern, though the recent drop in the rate of increase is more dramatic; from 13 per cent in the 1970s to 7 per cent in the 1980s, and to only 1 per cent in the early 1990s. Within development expenditure, expenditure on social services grew the least in the 1990s (only 0.42 per cent per year, compared with about 9 per cent in the 1970s and 1980s). Expenditure on education also grew at a low rate in the 1990s (0.22 per cent per year, compared with 7 to 8 per cent during the 1970s and the 1980s. Expenditure on irrigation also grew at a very low rate in the 1990s; only 0.12 per cent per year.

The expenditure items that grew most rapidly during the period 1970-93 were welfare and rural development. The growth in rural development expenditure (consisting of wage employment schemes and integrated rural development programmes) was particularly rapid. It is the one item that continued to grow at a respectable 5.1 per cent per year, even during the early 1990s (Table 2).

In terms of composition of state government spending, development expenditure accounted for 75 per cent of total government expenditure in 1993, and the remaining 25 per cent went to nondevelopment expenditure. Social and economic services accounted for 47 per cent and 53 per cent of total development expenditure, respectively (or 35 per cent and 40 per cent of total state government expenditure in rural areas) (Figure 2).

Among social service expenditures, education accounted for 52 per cent, health for 16 per cent and welfare of scheduled castes and tribes for 7 per cent. Among five major components of economic services, the agricultural sector accounted for 20 per cent, the irrigation sector for 22 per cent, transportation and communication for 11 per cent, the power sector for 17 per cent, and rural development programmes for 16 per cent.

Since 1980, agriculture's share in total state expenditure on economic services has declined from 30 per cent to 20 per cent, and irrigation's share has also declined. In contrast, expenditure on rural development programmes has expanded from 6.3 to 16.4 per cent of total economic services.

Large regional variations exist in government expenditure and these are illustrated by the patterns for development expenditure (Table 3). Maharashtra has always had the largest development expenditure, followed by Andhra Pradesh, Uttar Pradesh and Tamil Nadu. Among the 17 states studied here, Himachal Pradesh and Jammu and Kashmir have had the smallest development expenditures.

In per capita terms, poorer states like Assam, Bihar, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal spend much less than more advanced states like Gujarat, Haryana, Maharashtra, Punjab, and Tamil Nadu (Table 3). The difference between these two groups is substantial. For example, on a per capita basis, Maharashtra spent 3.8 times more than Bihar in 1993. Nor surprisingly, Bihar is also the state that has the highest incidence of poverty.

Development expenditures, whether expressed in aggregate or per capita, grew at a faster rate during the 1970s than in the 1980s in all states. In fact, during the 1990s, aggregate development expenditure even declined in seven states, while per capita expenditure declined in nine state (Table 3). These include Assam, Bihar, Haryana, Himachal Pradesh, Jammu and Kashmir, Orissa, Punjab, Uttar Pradesh and West Bengal.

## II
## Conceptual Framework and Model

Most previous studies of the determinants of rural poverty in India have used a single equation approach and have tried to explain the changes in rural poverty as a function of explanatory variables like agricultural income, wages, food prices and non-farm employment. The single equation approach suffers from two major limitations. First, many of the poverty determinants on the right-hand-side of the equation are generated from the same economic process as rural poverty. As such, these variables are also endogenous to the system, and ignoring this characteristic leads to biased estimates of the poverty effects [van de Walle 1985; Bell and Rich 1994]. Second, some determinants affect poverty through multiple channels. For example, improved rural infrastructure will not only reduce rural poverty through improved agricultural productivity, it will also affect rural poverty through improved wages and non-farm employment. It is difficult to capture these different effects within a single equation approach.

To overcome these limitations, the conceptual framework used in this analysis is a simultaneous equations model in which several economic variables are specified as endogenous, and their direct and indirect interactions are explicitly considered in the structure of the model. This approach has the added advantage of helping to identify any weak links between investments and poverty reduction.

The variables are defined in Table 4, and the structure of the system is given by equations 1 to 19 in Table 5. All variables are expressed in annual growth rate form, equivalent to first differences in log form.[2]

Equation (1) models the determinants of change in rural poverty (P). These determinants include growth in total factor productivity in agriculture (TFP), changes in rural wages (WAGE) and non-agricultural employment (NAEMPLY), changes in the terms of trade (TT), changes in the percentage of landless households in total households (LANDN), one year lagged growth in the rural population ($POP_{-1}$), one year lagged GDP growth ($GDP_{-1}$) and total factor productivity (TFP).

Wages and non-agricultural employment are important sources of income for rural workers in India, and contribute to poverty reduction. Income from wages can derive

**Table 3: Development Expenditures by State, 1970-93**

| State | Total Expenditure | | | | Per Capita Expenditure | | | |
|---|---|---|---|---|---|---|---|---|
| | 1970-79 | 1980-89 | 1990-93 | 1970-93 | 1970-79 | 1980-89 | 1990-93 | 1970-93 |
| Andhra Pradesh | 13.57 | 7.98 | 3.19 | 9.08 | 11.67 | 6.12 | 1.47 | 7.25 |
| Assam | 7.05 | 8.63 | -0.57 | 6.65 | 5.10 | 6.39 | -2.53 | 4.58 |
| Bihar | 11.26 | 6.83 | -3.72 | 7.66 | 9.03 | 4.61 | -5.65 | 5.48 |
| Gujarat | 13.11 | 7.01 | 1.60 | 8.52 | 10.79 | 5.37 | 0.17 | 6.66 |
| Haryana | 13.78 | 5.42 | -0.26 | 7.41 | 11.37 | 3.20 | -2.28 | 5.17 |
| Himachal Pradesh | 24.97 | 6.62 | 1.64 | 12.49 | 22.77 | 4.57 | -0.35 | 10.39 |
| Jammu and Kashmir | 11.81 | 6.24 | -3.91 | 7.55 | 9.40 | 3.66 | -6.11 | 5.09 |
| Karnataka | 13.35 | 6.65 | 9.44 | 8.81 | 11.13 | 4.89 | 7.68 | 6.94 |
| Kerala | 10.91 | 2.41 | 1.09 | 6.14 | 9.37 | 1.91 | 0.74 | 5.25 |
| Madhya Pradesh | 13.85 | 4.74 | 3.11 | 8.77 | 11.67 | 2.61 | 1.07 | 6.64 |
| Maharashtra | 13.28 | 8.25 | 3.10 | 8.85 | 11.34 | 6.36 | 1.37 | 6.98 |
| Orissa | 10.68 | 4.84 | 0.22 | 7.89 | 8.89 | 3.09 | -1.41 | 6.13 |
| Punjab | 14.46 | 6.78 | -4.70 | 7.15 | 12.51 | 5.00 | -6.23 | 5.37 |
| Rajasthan | 11.50 | 5.71 | 6.15 | 7.98 | 8.68 | 3.23 | 3.79 | 5.40 |
| Tamil Nadu | 9.72 | 6.42 | 3.44 | 7.94 | 8.30 | 5.06 | 2.16 | 6.56 |
| Uttar Pradesh | 14.98 | 6.89 | -5.30 | 8.00 | 12.76 | 4.69 | -7.20 | 5.85 |
| West Bengal | 12.42 | 5.85 | -2.20 | 7.60 | 10.09 | 3.63 | -4.19 | 5.42 |
| All India | 12.69 | 6.59 | 1.07 | 8.17 | | | | |

*Notes*: Assam's expenditures are deflated using West Bengal's consumer price index for agricultural labour, and Himachal Pradesh and Jammu and Kashmir's expenditures are deflated by Punjab's consumer price index for labour.
na: not available.
Rural Population is used to calculate per capita expenditure.
*Source*: Calculated by the authors using data from Reserve Bank of India, various years.

**Table 4: Definition of Exogenous and Endogenous Variables Used in Model**

| | |
|---|---|
| *Exogenous variables* | |
| $POP_{-1}$ | One year lag of rural population growth |
| WAPI | World agricultural price index (average export price for rice, wheat and maize) |
| $GDP_{-1}$ | One year lag of gross domestic product |
| ATT | Lagged five-years moving average of the terms of trade variable |
| $TFP_n$ | Total factor productivity growth at the national level |
| RAIN | Annual rainfall |
| *Endogenous variables* | |
| IRE | Government expenditure (capital and revenue) on irrigation |
| RDE | Government expenditure (capital and revenue) on agricultural R and D |
| ROADE | Government expenditure (capital and revenue) on rural roads |
| EDE | Government expenditure (capital and revenue) on rural education |
| PWRE | Government expenditure (capital and revenue) on rural power |
| GCSSL | Government capital stock accumulated in soil and water conservation investment. It is the weighted average of the past government expenditures on soil and water conservation, i e, $GCSSLt = \varphi_m w_m SOILE_{t-m}$, where $SOILE_{t-m}$ is government expenditure on soil and water conservation at time t-m. The weights are 0.4, 0.3, 0.2, and 0.1, respectively, with three years lag |
| GCSHEL | Government spending on medical and public health and family welfare measured in stock terms using three years lag similar to expenditures on soil and water conservation |
| GERDEV | Government expenditure on rural and community development measured in stock terms using three years lag similar to expenditures on soil and water conservation |
| P | Rural population falling below the poverty line |
| LITE | Literacy rate of rural population |
| ROADS | Road density in rural areas (km roads per sq $km^1$ of area) |
| IR | Percentage of total cropped area that is irrigated (sum of both public and private irrigation) |
| PUIR | Percentage of total cropped area under public irrigation (canal irrigation) |
| PRIR | Percentage of total cropped area under private irrigation (wells, tube wells, and tanks) |
| PVELE | Percentage of rural villages that are electrified |
| WAGE | Wage rate of rural labour |
| NAEMPLY | Percentage of non-agricultural employment in total rural employment |
| TFP | Total factor productivity growth (Tornqvist-Theil index) |
| LANDN | Percentage of rural households that are landless |
| TT | Terms of trade, measured as agricultural prices divided by a relevant non-agricultural GNP deflator |

from both agricultural and non-agricultural sources. The terms of trade variable measures the impact of changes in agricultural prices relative to non-agricultural prices on rural poverty. It is hypothesised that in the short run the poor may suffer from higher agricultural prices because they are usually net buyers of foodgrains. However, improvements in the terms of trade for agriculture lead to higher levels of investment and agricultural productivity, which contributes to poverty reduction in the longer-term. These longer-term impacts are captured in other equations in the model. The percentage of landless households is included in the equation to measure the potential impact of access to land on rural poverty. Population growth is likely to contribute to greater rural poverty if there is insufficient growth in rural employment. This is particularly important for a country like India where resources are limited and the population base is already large. The GDP growth variable is included to control for remaining income effects (in addition to growth in TFP, wages, and non-agricultural employment).

In order to capture the linkages between many of the independent variables, equations 2 to 13 models the determination of total factor productivity (TFP) (equation 2), the wage rate (equation 3), non-farm employment (equation 4), public irrigation

**Table 5: Estimated Model**

| | Equation | |
|---|---|---|
| (1) | P= –0.034 – 0.171 TFP – 0.185 WAGE + 0.263 TT – 0.594 NAEMPLY + 0.024 LANDN + 0.320 POP$_{-1}$ + 0.072 GDP$_{-1}$<br>(–1.32) (–2.58)* (–2.24)* (2.52)* (–3.12)* (0.43) (0.31) (0.82) | $R^2$=0 |
| (2) | TFP= –0.026 + 0.255 TRDE + 0.215 IR + 0.242 ROADS + 0.062 PVELE + 0.708 LITE + 0.012 GCSHEL + 0.022 GERDEV + 0.0015 GCSSL – 0.141 GDP$_{-1}$ + 0.272 RAIN<br>(–0.78) (1.82)* (1.83)* (2.43)* (0.60) (1.95)* (0.39) (0.63) (0.37) (–0.97) (5.47)* | $R^2$=0 |
| (3) | WAGE = –0.035 + 0.129 TFP + 0.231 ROADS + 0.062 PVELE + 0.939 LITE + 0.026 GCSHEL – 0.024 GERDEV + 0.013 GCSSL + 0.273 GDP$_{-1}$<br>(–1.39) (1.86)* (2.28)* (0.57) (2.01)* (0.83) (–0.88) (0.74) (1.32) | $R^2$=0 |
| (4) | NAEMPLY = –0.029 – 0.058 TFP + 0.190 ROADS – 0.045 PVELE + 0.710 LITE + 0.011 GCSHEL + 0.030 GERDEV – 0.003 GCSSL + 0.209 GDP$_{-1}$<br>(–2.72)* (–0.67) (2.45)* (–0.94) (3.27)* (0.24) (2.23)* (–0.37) (2.60)* | $R^2$=0 |
| (5) | PUIR = –0.021 + 0.087 TIRE + 0.067 PVELE<br>(–0.66) (4.49)* (1.05) | $R^2$=0 |
| (6) | PRIR = 0.017 + 0.918 PUIR + 0.012 PVELE<br>(2.23)* (18.61)* (0.87) | $R^2$=0 |
| (7) | ROADS = 0.088 + 0.232 TROADE<br>(4.59)* (2.83)* | $R^2$=0 |
| (8) | LITE = 0.087 + 0.067 TEDE<br>(4.59)* (6.52)* | $R^2$=0 |
| (9) | PVELE = 0.107 + 0.072 TPWRE<br>(6.34)* (2.56)* | $R^2$=0 |
| (10) | LANDN = –0.011 + 0.026 TFP + 0.511 POP$_{-1}$ – 0.142 NAEMPLY<br>(–0.89) (0.72) (1.82)* (–1.46) | $R^2$=0 |
| (11) | TT = 0.025 – 0.175 TFP – 0.792 TFPn + 0.271 WAPI<br>(2.22)* (–3.03)* (–5.54)* (8.03)* | $R^2$=0 |
| (12) | RDE = 0.107 + 0.363 GDP$_{-1}$ + 0.550 ATT<br>(2.20)* (0.82) (2.39)* | $R^2$=0 |
| (13) | ROADE = 0.224 + 0.482 GDP$_{-1}$ + 0.534 ATT<br>(5.45)* (0.31) (2.43)* | $R^2$=0 |
| (14) | IRE = 0.478 – 0.431 GDP$_{-1}$ – 0.254 ATT<br>(5.20)* (–0.53) (–0.61)* | $R^2$=0 |
| (15) | EDE = 0.123 + 0.336 GDP$_{-1}$ – 0.075 ATT<br>(5.77)* (1.79)* (–0.79)* | $R^2$=0 |
| (16) | GCSSL = –0.140 + 0.773 GDP$_{-1}$ + 0.594 ATT<br>(–3.52)* (2.31) (2.32)* | $R^2$=0 |
| (17) | PWRE = 0.133 + 1.490 GDP$_{-1}$ + 1.11 ATT<br>(1.02) (2.24)* (1.78)* | $R^2$=0 |
| (18) | GERDEV = 0.113 + 1.476 GDP$_{-1}$ + 0.677 ATT<br>(2.49)* (3.56)* (3.11)* | $R^2$=0 |
| (19) | GCSHEL = 0.177 – 0.123 GDP$_{-1}$ + 0.173 ATT<br>(5.77)* (–0.224) (0.85) | $R^2$=0 |

*Note*: Coefficients for expenditures on R and D (TRDE), irrigation (TIRE), roads (TROADE), education (TEDE), and power (TPWRE) are sums of coefficients of current and lagged expenditures.

* indicates significance at the 5 per cent level or better. The t tests for TRDE, TIRE, TROADE, TEDE and TPWRE were calculated for the linear combination of all the relevant coefficients of the lagged variables [Greene 1993: 187].

(equation 5), private irrigation (equation 6), road density (equation 7), literacy (equation 8), power (equation 9), landlessness (equation 10), terms of trade (equation 11) and other factors (Table 5). For additional details about the model, see Fan, et al (1999).

Some researchers [e g, Binswanger, et al 1989] have rightly argued that government expenditures are endogenous, being rational responses to existing levels of regional agricultural productivity and rural poverty. Without controlling for this endogeneity, the estimates of the model's parameters will be biased. Two features of our model specification may help to reduce this bias. First, annual growth rates (instead of levels) of all variables are used. This is equivalent to taking first differences in log form. If the factors driving government investment are fixed over time, then the fixed effect will be eliminated by this procedure. This approach would control, for example, the influence of agro-climatic factors on public investment decisions. More importantly, lagged instead of current government expenditures are used in the government infrastructure, technology, and education equations to capture the long lead times involved in translating actual government expenditures into productive capital stocks. The simultaneity between *current* productivity growth (or poverty reduction) and *past* government expenditures is likely to be small or even non-existent. Nevertheless, just in case any endogeneities remain, we endogenise government expenditures on various items as functions of lagged state GDP and terms of trade (ATT) variables in equations 12-19. We expect all the coefficients to be positive. It is not necessary to control for agro-climatic variables because these drop out when the variables are expressed in growth rate form. Double log functional forms were specified for all the equations in the system.

Government investments in R and D, roads, education, power, health, and irrigation can have long lead times in affecting agricultural production, as well as long term effects once they kick in. One of the thornier problems to resolve when including government investment variables in a production or productivity function concerns the choice of an appropriate lag structure. Most past studies use stock variables, which are usually weighted averages of current and past government expenditures on individual investments like R and D. But the choice of weights and the length of the lags to use remain arbitrary. We used a free form lag structure in our test procedure. Current and past values of government expenditure on different investments were first included in the equations for productivity, technology, infrastructure and education. Then statistical tools were used to test and determine the appropriate length of lag for each investment variable.

Various procedures have been suggested for determining the appropriate length of lag. We used the adjusted $R^2$ criterion, and chose the lag lengths that maximised the $R^2$ for each investment equation. This led to lags of 13 years for R and D, eight years for irrigation, 11 years for education, seven years for power, and eight years for roads.

Another problem that arises in estimating lag structures is that the independent variables (e g, RDE, $RDE_{-1}$, $RDE_{-2}$, ...$RDE_{-i}$ in the TFP function) are often highly correlated, making the estimated coefficients statistically insignificant. The most popular approach to overcome this problem is to use what are called polynomial distributed lags, or PDLs. In a PDL, the coefficients are all required to lie on a polynomial of some degree d. In this study, PDLs of degree 2 were used. In this case, it is only necessary to estimate three instead of i+1 parameters for the lag distribution. Once the lengths of the lags are determined, the simultaneous equation system with the PDLs and appropriate lag length for each investment can be estimated.

Instead of using current and past expenditures, stock variables are used to measure the impact of government spending on health, rural development and soil and water conservation. This is because these expenditures usually have relatively quick impacts on rural poverty. A three year lag structure is used with the weights of 0.4, 0.3, 0.2, and 0.1 for the current year, t–1, t–2, and t–3, respectively.

**Table 6: Poverty and Productivity Effects of Additional Government Expenditure**

| Expenditure Variable | Elasticities t value | | Marginal Impact of 100 Billion Rupees at 1993 Prices | | | |
|---|---|---|---|---|---|---|
| | Poverty | TFP | Poverty | | TFP | |
| | | | (Per Cent Point) | Rank | (Per Cent Point) | Rank |
| R and D | -0.060 (-2.06)* | 0.255 (1.82)* | -0.45 | 2 | 6.01 | 1 |
| Irrigation | -0.009 (-1.96)* | 0.036 (2.23)* | -0.05 | 7 | 0.61 | 4 |
| Road | -0.050 (-2.55)* | 0.057 (2.69)* | -0.65 | 1 | 2.37 | 2 |
| Education | -0.053 (-3.64)* | 0.047 (2.63)* | -0.22 | 3 | 0.62 | 3 |
| Power | -0.003 (-1.64) | 0.004 (0.64) | -0.003 | 8 | 0.12 | 8 |
| Soil and water | -0.001 (-1.52) | 0.0015 (0.37) | -0.12 | 5 | 0.43 | 6 |
| Rural development | -0.019 (-3.68)* | 0.022 (0.63) | -0.13 | 4 | 0.49 | 5 |
| Health | -0.001 (-1.13) | 0.012 (0.39) | -0.09 | 6 | 0.38 | 7 |

*Notes*: Numbers in parentheses are ranks.

* Indicated significance at the 10 per cent level.

The t values are estimated using a procedure proposed by Greene (1993: 221). A linear Taylor series approximation to the nonlinear restriction is used, using the large sample properties of the estimates.

## III
## Results

The model was estimated using a full information maximum likelihood (FIML) technique for the period 1970-93 for 14 states. The years 1971, 1974-76, 1978-82, and 1984-85 were deleted because of missing values. A total of 154 observations were used in the final estimation. The results are presented in Table 5.

The estimated poverty equation (1) supports the findings of many previous studies and shows that improvements in agricultural productivity, wages and non-farm employment contribute significantly to reducing rural poverty, while improvement in the terms of trade for agriculture significantly increase rural poverty in the short run. An increase in the incidence of landlessness is associated with increased poverty, but the relationship is not statistically significant. Increases in agricultural productivity not only contribute to reductions in rural poverty directly by increasing income (equation 1), but they also reduce poverty indirectly by improving wages (equation 3) and lowering agricultural prices (equation 11). On the other hand, improvements in agricultural productivity contribute to worsening poverty by increasing landlessness (equation 10), though this effect is relatively small and insignificant. Rural population growth significantly increases the percentage of landless rural households. Higher wages, which help to reduce poverty in rural areas, are themselves determined by the education level of the population and by the availability of roads. Similarly, non-farm employment is determined by education, road density and government programmes for rural development. Thus, higher levels of education and improved road networks help to reduce rural poverty by improving wages and non-farm employment. Agricultural productivity on the other hand, has a positive impact on wages, but has weak linkages with rural non-farm employment. Agricultural productivity, which helps to reduce poverty, is itself determined by agricultural research and extension, improved irrigation, roads and education. Increased public irrigation, particularly canal irrigation, significantly helps to increase private irrigation, confirming the complementarity between public and private irrigation (equation 6).

The coefficients in Table 5 show the direct impact of each right-hand-side variable in an equation on the left-hand-side endogenous variable. However, by totally differentiating the entire system of equations, we can estimate the marginal impact of each government investment variable on productivity growth and rural poverty reduction after allowing for all relevant direct and indirect effects.

The marginal impacts of different types of government spending on rural poverty and agricultural productivity are shown in Table 6. Two impact measures are presented. The first measure is the elasticity of each item of government spending, and this gives the percentage change in poverty or productivity corresponding to a 1 per cent change in government expenditure on that item. Since all expenditures are measured in rupees, these elasticities provide a measure of the relative growth and poverty reducing benefits that arise from additional expenditures on different items, where the increases are proportional to existing levels of expenditure.

The second measure is the marginal return measured in poverty and productivity units for an additional Rs 100 billion of government expenditure. This measure is directly useful for comparing the relative benefits of equal sized increases in expenditures on different items, and it provides crucial information for policy-makers in setting future priorities for government expenditure in order to further increase productivity and reduce rural poverty. The marginal returns were calculated by multiplying the relevant elasticities by the ratio of the poverty or productivity variable to the relevant government expenditure item in 1993.

An important result in Table 6 is that there are sizeable differences in the productivity gains and poverty reductions obtained from incremental increases in each expenditure item. Government expenditures on roads and R and D have far larger impacts on productivity growth and rural poverty reduction than any other investments. Roads expenditure has a bigger impact on poverty than R and D (45 per cent larger), but R and D has the biggest growth impact (154 per cent larger). If the government were to increase its investment in roads by Rs 100 billion (at 1993 constant prices), the incidence of rural poverty would be reduced by 0.65 per cent. This compares with a 0.45 per cent decline in rural poverty if an additional Rs 100 billion were invested in R and D.

Investment in roads reduces rural poverty through productivity growth, but also through increased non-agricultural employment opportunities and higher wages. Because the marginal impact is calculated as a total derivative of the equations system, it can be decomposed into its various direct and indirect components [Fan et al 1999]. The productivity effect accounts for 31 per cent of the total impact on poverty, non-agricultural employment for 49 per cent, and the remaining 20 per cent is accounted for by increases in rural wages. Of the total productivity effect on poverty, 75 per cent arises from the direct impact of roads in increasing incomes, and the remaining 25 per cent arises from lower agricultural prices (17 per cent) and increased wages (8 per cent). One reason that R and D investments have a smaller impact on poverty is that they work entirely through improved productivity; there is no direct expenditure benefit for the poor.

Government spending on education ranks third in its marginal impact on both rural poverty and agricultural productivity. An additional investment of 100 billion rupees in education reduces poverty by 0.65 per cent. Most of this effect arises from increased non-farm employment opportunities and higher wages. Government expenditures on rural development and soil and water conservation have the fourth and fifth largest impacts on poverty reduction, respectively, and an extra one billion rupees of either investment would reduce poverty by about 0.13 per cent. However, these types of expenditure have no statistically significant productivity impacts. In fact, for many regions, these types of investments were mainly used by the government to alleviate poverty, particularly during drought years. More attention should be given in future investments of this kind to improving the productive capacity of soil and water resources and to the development of rural infrastructures like roads.

Government expenditure on health ranks sixth in terms of its impact on poverty; each 100 billion rupee increase in expenditure on health reduces poverty by 0.09 per cent. Irrigation expenditure ranks seventh in terms of its impact on rural poverty, but ranks rather higher (fourth) in terms of its impact on productivity growth. But the impact of irrigation on productivity is still lower than investments in road, R and D and education. This low marginal return for irrigation has been confirmed by other studies as well [e g, Binswanger et al 1989; Evenson et al 1999], and must be seen within a regional context. A similar but disaggregated analysis by agro-climatic regions shows that irrigation investments have their highest impact on productivity growth and poverty in rainfed rather than irrigated areas [Fan and Hazell 2000]. Moreover, canal irrigation has its biggest productivity and poverty impacts in high potential rainfed areas, while private irrigation has its biggest impacts in low potential rainfed regions [Fan and Hazell 2000: 1463]. In highly irrigated regions such as Punjab, Haryana and western Uttar Pradesh (which accounts for much of the irrigated land in India,) an additional increase in irrigation expenditure is likely to yield low marginal returns [Fan and Hazell 2000; Fan et al 2000].

Government expenditure on power has a positive but negligible impact on both rural poverty reduction and productivity growth. This may be because the government has already invested heavily in rural electrification and the marginal returns from additional investments are now low. Not only is the size of power expenditure relatively large in the government's budget (50 per cent greater than road expenditure in 1993), but current (operational) expenditure has also increased enormously since 1990.

## IV
## Conclusions

Using state-level data for 1970 to 1993, this study has investigated the causes of the decline in rural poverty in India, paying particular attention to the role of public investment in rural areas. The results show that government spending on productivity enhancing investments, such as agricultural R and D and irrigation, rural infrastructure (including roads and electricity), and rural development targeted directly to the rural poor, have all contributed to reductions in rural poverty, and most have also contributed to growth in agricultural productivity. But their marginal poverty and productivity effects differ greatly today.

Additional government expenditures on roads, R and D and education have by far the largest impacts on rural poverty reduction and growth in agricultural productivity. Additional irrigation investment has only modest impacts on growth in agricultural productivity and a much lower impact on rural poverty reduction, even after allowing for trickle down benefits. However, this result only holds in the aggregate, whereas a more spatially disaggregated analysis shows that irrigation investments have much more favourable impacts in rainfed areas.

Additional government spending on soil and water conservation, and on rural and community development, including the Integrated Rural Development Programme, have smaller impacts on poverty than additional expenditures on roads, agricultural R and D and education. Additional government investment in the health of rural people has no discernible impact on productivity growth, and its effect on poverty alleviation through wage increases is also small.

The results of this study have important policy implications. Increased spending on rural roads, education and agricultural R and D can contribute the most to further rounds of poverty reduction. These types of investments not only have a much larger poverty impact per rupee spent than any other investment, but they also generate higher agricultural productivity growth. R and D investments have a larger growth impact than roads and education, but their poverty reducing impact is smaller. This trade-off between growth and poverty reduction could be reduced if R and D were targeted more specifically on the problems of poor producers in the farm and rural non-farm sectors. Additional irrigation investments contribute considerably less to growth and poverty alleviation than roads, R and D and education at the all-India level, but as Fan and Hazell (2000) have shown in a spatially disaggregated analysis, they do much better in rainfed areas.

Additional government expenditure on rural development is an effective way of helping the poor in the short term, particularly during periods of drought and economic recession, but their impact on productivity growth is small. There may be scope for improving their design so that their productivity impacts can be strengthened, particularly through the construction of infrastructure in marginal areas.

There was a drastic reduction in the government spending on roads, education, R and D and irrigation in the early 1990s. Given the importance of these investments for poverty alleviation and productivity growth, these trends urgently need to be reversed. EPW

## Notes

1 The head count ratio data used in this paper were constructed by Gaurav Datt and published by the World Bank [World Bank 1997]. Datt used the poverty line originally defined by the Planning Commission and more recently endorsed by the Planning Commission, which is based on a nutritional norm of 2,400 calories per person per day. It is defined as the level of average per capita total expenditure at which this norm is typically attained and is equal to a per capita monthly expenditure of Rs 49 at all-India rural prices for October 1973-June 1974.

2 All variables without subscripts are taken to be observations for year $t$ at the state level. For presentation purposes, we omit the relevant subscripts. Variables with subscript "–1,…–j" indicate observations in year $t-1,\dots t-j$. All variables in our analysis were first transformed into geometric annual growth rates in logarithm form, i e, $dx=ln(x_t/x_{t-n})/n$, where $x_t$ and $x_{t-n}$ represent the observations on $x$ at time $t$ and $t-n$, respectively, and $n$ is the number of years between two periods when data are available. If $n$=1, then $dx$ is simply a first difference in logarithms. This transformation avoids the problem of having different time intervals between observations. It also alleviates potential multicollinearity problems among many dependent variables on the right-hand-side of the equations.

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