RESEARCH REPORT 110

Linkages between Government Spending, Growth, and Poverty in Rural India

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Foreword

This research report on India addresses an important policy issue faced by policymakers in many developing countries: how to allocate public funds more efficiently in order to achieve both growth and poverty-reduction goals in rural areas. This research is particularly important at a time when many developing countries are undergoing substantial budget cuts as part of macroeconomic reforms and adjustment.

The econometric model employed in this research includes a broad range of government expenditure items. It traces their effects on productivity growth and poverty alleviation and ranks them, exploring the potential trade-offs and complementarities of the two goals. Of the various investments weighed, the report finds that investments in rural roads and agricultural research and development have the greatest impact, while government spending specifically targeted to poverty reduction such as rural development and employment programs have only modest effects. In the light of these results, many developing countries may want to take a second look at their policies for poverty reduction and growth.

This report is the first of several planned at IFPRI under a new program of work on public investment policies for agriculture and rural areas. Similar work is already ongoing in China and is planned for Africa. Related studies will also examine ways to improve efficiency in the supply of public goods for rural areas, both in terms of improving performance and reducing unit costs within public institutions, and in clarifying the appropriate roles of the public, private, and civil society sectors. Work is also planned on issues related to the financing of public investments in rural areas.

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Per Pinstrup-Andersen
Director General

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Summary

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 percent prior to the mid-1960s, but then declined steadily to about one-third of the rural population by the early 1990s. This steady decline in poverty was strongly associated with agricultural growth, particularly the Green Revolution, which in turn was a response to massive public investments in agriculture and rural infrastructure. Public investment in rural areas has also benefited the poor through its impact on the growth of the rural nonfarm economy, and government expenditure on rural poverty and employment programs, which have grown rapidly, has directly benefited the rural poor.

The primary purpose of this research is to investigate the causes of the decline in rural poverty in India and particularly to determine the specific role that government investments have played. The research aims to quantify the effectiveness of different types of government expenditures in contributing to poverty alleviation. Such information can assist policymakers in targeting 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.

The research uses state-level data to estimate an econometric model that permits calculation of the number of poor people raised above the poverty line for each additional million rupees spent on different expenditure items. The model is also structured to enable identification of the different channels through which different types of government expenditures affect the poor, distinguishing between direct and indirect effects. The direct effects arise in the form of benefits the poor receive from employment programs directly targeted to the rural poor. The indirect effects arise when government investments in rural infrastructure, agricultural research, health, and education of rural people stimulate agricultural and nonagricultural growth, leading to greater employment and income-earning opportunities for the poor and to cheaper food. Understanding these different effects provides useful policy insights for helping to improve the effectiveness of government expenditures in reducing poverty.

But targeting government expenditures simply to reduce poverty is not sufficient. Government expenditures also need to stimulate economic growth, to help generate

the resources required for future government expenditures. Such growth is the only way of providing a permanent solution to the poverty problem and to increase the overall welfare of rural people. The model is therefore formulated to measure the impact of different items of government expenditure on growth as well as on poverty, thus enabling the ranking of different types of investment in terms of their growth and poverty impacts, as well as quantifying any trade-offs or complementarities that may arise between the achievement of these two goals.

The results from the model show that government spending on productivity enhancing investments, such as agricultural research and development, 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 differences in their poverty and productivity effects are large.

The model has also been used to estimate the marginal returns to agricultural productivity growth and poverty reduction obtainable from additional government expenditures on different technology, infrastructure, and social investments. Additional government expenditure on roads is found to have the largest impact on poverty reduction as well as a significant impact on productivity growth. It is a dominant "win-win" strategy. Additional government spending on agricultural research and extension has the largest impact on agricultural productivity growth, and it also leads to large benefits for the rural poor. It is another "win-win" strategy. Additional government spending on education has the third largest impact on rural poverty reduction, largely as a result of the increases in nonfarm employment and rural wages that it induces.

Additional irrigation investment has the third largest impact on growth in agricultural productivity but only a small impact on rural poverty reduction, even after trickle-down benefits have been allowed for. Additional government spending on rural and community development, including Integrated Rural Development Programs, contributes to reductions in rural poverty, but its impact is smaller than expenditures on roads, agricultural R&D, and education. Additional government expenditures on soil and water conservation and health have no impact on productivity growth, and their effects on poverty through employment generation and wage increases are also small.

The results of this research have important policy implications. In order to reduce rural poverty, the Indian government should give priority to increasing its spending on rural roads and agricultural research and extension. These types of investment not only have a large impact on poverty per rupee spent, they also promote the greatest growth in agricultural productivity. Additional government spending on irrigation has a significant impact on productivity growth, but no discernible impact on poverty reduction. Government spending on power has little impact on either productivity growth or poverty. While these investments have been essential investments in the past for sustaining agricultural growth, the levels of investment stocks achieved may now be such that it may be more important to maintain those current stocks rather than to increase them further. Additional government spending on rural development is an effective way of helping the poor in

the short term, but since it has little impact on agricultural productivity, it contributes little to long-term solutions to the poverty problem.

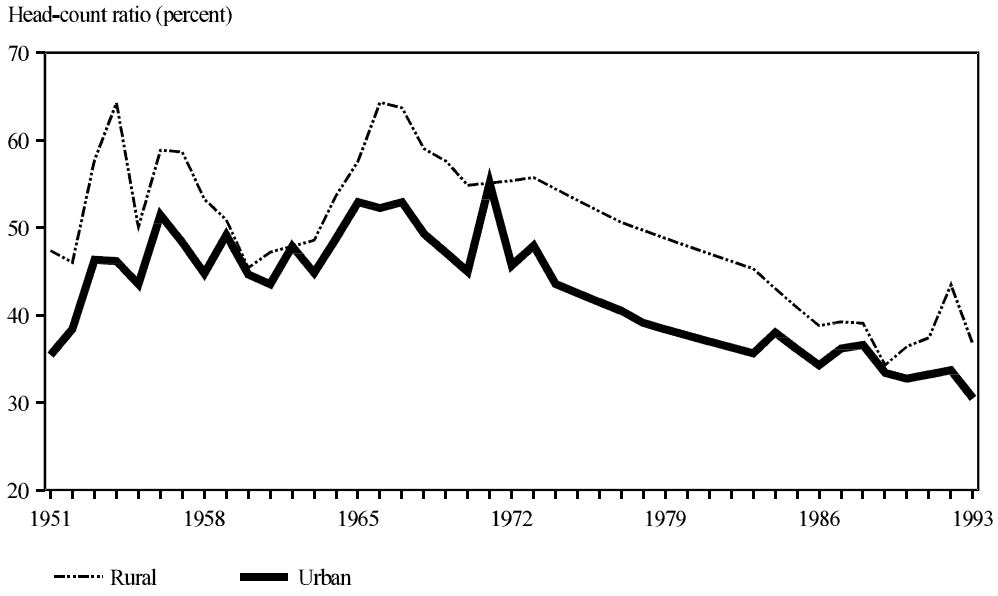
CHAPTER 1

Introduction

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 percent prior to the mid-1960s but then declined steadily. By 1990, about 34 percent of the rural population was poor (Figure 1). The percentage of poor increased again to about 40 percent of the population when policy reforms were implemented in the early 1990s, but it now seems to be declining again.

The steady decline in poverty from the mid-1960s to the early 1980s was strongly associated with agricultural growth, particularly the Green Revolution. Since then, the

Figure 1 Changes in the incidence of poverty in India, 1951 93



Source: World Bank 1997.

Note: Linear interpolation was used to estimate the missing observations for 1962, 1971, 1974–76, and 1978–82.

causes for the decline seem to have become more complex. Nonfarm wages and employment now play a much larger role in reducing poverty, and these are less driven by agricultural growth than before. Further, government spending on rural poverty and employment programs has increased substantially in recent years, and this has directly benefited the rural poor.

The primary purpose of this research is to investigate the causes of the decline in rural poverty in India and particularly to determine the role that government investments have played. Government spending can have direct and indirect effects on poverty. The direct effects are the benefits the poor receive from expenditures on employment and welfare programs such as the Integrated Rural Development Program and from various rural employment schemes that are directly targeted to the poor during drought years. The indirect effects arise when government investments in rural infrastructure, agricultural research, and the health and education of rural people stimulate agricultural and nonagricultural growth, leading to greater employment and income-earning opportunities for the poor and to cheaper food. In this report, the effectiveness of different types of government expenditures in contributing to poverty alleviation are quantified. Such information can assist policymakers in targeting 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 that permits calculation of the number of poor people raised above the poverty line for each additional million rupees spent on different expenditure items.

But targeting government expenditures simply to reduce poverty is not sufficient. Government expenditures also need to stimulate economic growth to help generate the resources required for future government expenditures. Growth is the only sure way of providing a permanent solution to the poverty problem and of increasing the overall welfare of rural people. This 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 in the achievement of these two goals.

CHAPTER 2

Context

The literature on the trends and determinants of rural poverty in India is extensive. The wide fluctuations in the incidence of rural poverty that occurred during the 1950s and early 1960s (see Figure 1) understandably led to considerable controversy about both the direction of change in rural poverty and the causal factors. Researchers obtained quite different trend results depending on the period they chose for their analysis, particularly the beginning and end points they used for comparison (Bardhan 1973; Vaidyanathan 1974; Ahluwalia 1978; Gaiha 1989; Ghose 1989; Griffin and Ghose 1979; Saith 1981). But once the incidence of rural poverty began its trend decline in the mid-1960s, a greater consensus began to emerge in the literature (Ghose 1989; Ravallion and Datt 1995; Ninan 1994).

Many studies that have tried to analyze the factors responsible for observed trends in the incidence of rural poverty in India have focused primarily on the question of whether or not agricultural growth trickles down to the poor through its indirect effects on income and employment opportunities. With few exceptions (Bardhan 1973; Griffin and Ghose 1979), most of these studies have found an inverse relationship between growth in agricultural income and the incidence of rural poverty. Some economists, inspired by the late Dharm Narain, realized that prices of commodities consumed by the rural poor are also an important factor in explaining changes in rural poverty (Saith 1981; Ahluwalia 1985; Srinivasan 1985; Ghose 1989; Gaiha 1989; Bell and Rich 1994). The role of the labor market in transmitting the benefits of technical change and government employment programs to the rural poor was only recognized recently (Ravallion and Datt 1995; Sen 1997). Despite the large literature, little attention was paid to the role of government spending in alleviating poverty.

The lack of progress in reducing rural poverty during the 1950s and 1960s is generally attributed to stagnation in the growth of per capita agricultural output (Ahluwalia 1978, 1985). However, this changed dramatically in the late 1960s with the spread of the Green Revolution, which led to a sharp increase in the rate of agricultural growth. The incidence of rural poverty declined markedly in those regions that most benefited from the Green Revolution.

Interestingly, the incidence of rural poverty has also declined in many states that did not benefit so much from the Green Revolution, particularly in the 1980s (Sen

1997; Tendulkar et al. 1990). It also continued to decline at the national level even after the agricultural growth rate slowed.

The significant feature of this later period, however, is that the agricultural wage rate, which had been stagnant until the mid-1970s, subsequently increased sharply in most parts of India, and this appears to have been a major factor in (or a significant explanation of) the decline in rural poverty (Tendulkar et al. 1990; Sen 1997; Mukherjee 1996; Ravallion and Datt 1995). While much recent research recognizes this rise in real wages, explanations vary. Some attribute this rise to yield growth in agriculture (Ravallion and Datt 1995). Others argue that the increase in the real wage rate during this period far outstripped any increase in agricultural labor productivity. In fact, after the mid-1970s, real wages went up everywhere, even in states where agricultural labor productivity had been declining for some time (Bhalla 1997). It has been argued that the increase in the real wage in agriculture arose mainly from an increase in the share of the workforce employed in nonagricultural activities (Mukherjee 1996; Sen 1997).

Since there is a weak relationship between agricultural growth and the growth of rural nonfarm activity in many parts of the country (it is much more significant in agriculturally advanced regions such as Punjab and Haryana [Hazell and Haggblade 1991]), several researchers have suggested that the reason for the expansion of rural nonfarm employment lies in an accompanying expansion in government expenditure (Sen 1997). According to these authors, government expenditure has been crucial not only in generating agricultural growth through the creation of capital assets and rural infrastructure, but it has also directly created employment in rural areas by providing jobs, particularly for the implementation of targeted employment and welfare schemes. In fact, the 1970s was marked by an important shift in state policy toward the poor and included a burst of poverty-oriented programs that sought to improve their assets, create employment, and increase their access to basic needs.

In sum, researchers seeking explanations for the decline in rural poverty after the mid-1960s have emphasized agricultural growth and price changes as the important determinants. But these factors are not sufficient to explain much of the observed changes in poverty across states and over time since the late 1970s. Growth in the rural nonfarm economy and government poverty alleviation and employment programs have also become important. Government expenditure has not only contributed to agricultural growth and hence indirectly to poverty alleviation, it has directly created rural nonfarm jobs and increased wages. Insofar as rural nonfarm employment under the wage employment scheme has been used to develop and improve the land (through land leveling, drainage, and so forth) and water resources (through the Million Well Scheme), it may also indirectly help to improve the agricultural productivity of marginal and small farmers. The real significance of government development expenditure is that more benefits are likely to trickle down to the poor in the growth process than through agricultural growth alone. Unlike agricultural growth, which often reduces poverty only by increasing mean consumption, government expenditure reduces poverty both by increasing mean income and improving the distribution of income (Sen 1997).

Another significant feature of the literature on rural poverty in India is that most of the previous studies have used a single equation approach (Ahluwalia 1978; Saith 1981; Gaiha 1989; Ravallion and Datt 1995; Datt and Ravallion 1997). There are at least two disadvantages to this approach. First, many poverty determinants such as income, production or productivity growth, prices, wages, and nonfarm employment are generated from the same economic process as rural poverty. In other words, these variables are also endogenous variables; ignoring this characteristic leads to biased estimates of the poverty effects (van de Walle 1985; Bell and Rich 1994). Second, certain economic variables 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 nonfarm employment. It is difficult to capture these different effects with a single-equation approach.

Building on previous studies of the determinants of rural poverty in India, this study develops a simultaneous equations model to estimate the various direct and indirect effects of government expenditures on productivity and poverty. Such information can be especially helpful to policymakers who wish to more efficiently target government expenditures to benefit the poor.

CHAPTER 3

Government Expenditure, Agricultural Growth, and Rural Poverty

Government Expenditure

India is a federal country, and the national constitution defines the spheres of responsibilities in the making of laws and the exercise of executive power between the central government and the Parliament, on the one hand, and the state governments and legislatures, on the other. In the field of agriculture and allied activities, predominant responsibility for legislation and the exercise of executive power lies with the state governments: the central government has exclusive responsibility only for interstate rivers and for fisheries outside territorial waters. Even expenditures on agricultural research, on which the central government spends more money than all the states put together, is spent through the states. Outlays on irrigation and flood control are largely a state responsibility.

The central government raises its revenues by levying taxes on personal income and corporate profits, and by levying customs duties, excise duties, taxes on nonagricultural wealth, estate duties on nonagricultural land, and taxes on interstate trade. The responsibility for taxes that are not assigned either to the states or the Concurrent List,[1] also rests with the central government. However, most taxes on agriculture, such as the agricultural income tax, property taxes, land revenues, and estate duties have been assigned to the states. In addition, the States may level sales taxes, registration and stamp duties, excise duties on narcotics and alcoholic beverages, income taxes on professions, and motor vehicle taxes.

Government expenditure in India is divided into nondevelopment and development spending, and the latter is further subdivided into spending on social and

[1] Areas in which jurisdiction cannot be clearly determined are entered on the Concurrent List of the Seventh Schedule. In these areas, the central government, the parliament, and the state governments and legislatures exercise concurrent jurisdiction.

economic services. Social services include health, labor, and other community services, while economic services include such sectors as agriculture, industry, trade, and transportation.

State governments are responsible for irrigation, power, agriculture, animal husbandry, dairy, soil conservation, education, health, family planning, cooperatives, rural development, forests, and more. Local functions such as public order, courts, and police are also the responsibility of the state governments.

Most expenditures on agriculture and rural areas are undertaken by the state governments. This includes expenditures financed from the states' own revenues, but even the central government's expenditure on agriculture and rural development is largely channeled through the state governments. In 1995/96, for example, direct spending by the central government on agriculture and rural development was only about 30 percent of the total, and the bulk of this was for fertilizer and other subsidies that are nonproductive. Since this report is primarily interested in productive investments, it uses only state-level expenditure data. Small omissions arise because part of total agricultural research expenditure remains within national institutions and because part of the total investment in transportation and communications does not pass through the state accounts. Allowances for these omissions are made in interpreting the results.

Total state government expenditure has grown substantially in recent decades (Table 1); in fact there was a fivefold increase in real terms between the early 1970s and the early 1990s. But the rate of increase is now slowing, growing at about 8 percent per year during the 1970s and 1980s but declining to 3.14 percent 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 percent in the 1970s to 7 percent in the 1980s to only 1 percent in the early 1990s. Within development expenditure, social services expenditure grew the least in the 1990s (only 0.42 percent per year, compared with about 9 percent in the 1970s and 1980s).

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 programs) was particularly rapid; it is the one item that continued to grow at a respectable 5.1 percent per year even during the early 1990s (Table 1).

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

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

Table 1 State government expenditure in 1960/61 prices, 1970 93

Year	Total	Development	Social services	Education[a]	Health	Welfare	Economic services	Agriculture	Irrigation	Transportation[b]	Power	Rural development[c]
						(Rs million)						
1970	19,660	12,387	6,364	4,002	1,731	268	6,023	1,889	2,582	636	1,209	411
1971	22,112	15,471	8,132	3,578	1,685	380	7,339	1,623	3,065	907	1,025	526
1972	22,899	16,786	9,029	3,759	1,813	630	7,703	2,923	3,119	1,358	1,166	708
1973	23,054	16,643	8,902	3,906	1,848	636	7,978	3,014	3,185	1,206	1,159	658
1974	18,793	16,089	7,156	3,688	1,673	501	8,933	2,716	2,738	1,129	1,345	517
1975	25,158	21,933	9,477	5,068	2,225	657	12,496	3,925	4,586	1,395	2,083	653
1976	30,608	27,105	11,563	6,018	2,693	818	15,571	4,412	4,768	1,724	2,811	711
1977	32,043	28,213	12,065	6,280	2,858	878	16,496	4,364	6,310	1,851	3,024	681
1978	38,435	35,209	14,126	7,198	3,450	1,002	21,084	5,782	7,595	2,387	3,800	1,024
1979	39,516	36,192	14,864	7,160	3,624	1,062	21,415	6,239	7,505	2,423	3,663	1,183
1980	42,110	38,215	15,846	7,589	3,810	1,123	22,369	6,665	7,263	2,691	3,675	1,418
1981	48,759	43,289	18,843	8,973	4,639	1,334	24,444	7,444	8,102	3,009	3,889	1,765
1982	56,527	49,952	22,498	10,600	5,520	1,593	27,451	8,591	8,892	3,178	4,472	2,196
1983	52,329	45,821	20,626	9,678	5,378	1,541	25,200	8,395	7,917	2,804	3,461	2,104
1984	60,754	52,075	23,263	11,035	5,894	1,717	28,790	13,048	8,473	3,082	4,230	3,146
1985	65,048	55,521	25,671	12,152	5,220	1,904	29,850	6,577	7,599	3,038	3,948	3,888
1986	72,450	61,681	28,148	13,157	4,427	2,191	33,533	5,859	9,366	3,708	4,904	5,146
1987	74,646	62,914	28,876	13,621	4,812	1,927	34,038	5,962	9,045	3,516	5,381	5,132
1988	77,435	63,484	29,886	14,784	4,941	1,950	33,598	6,162	8,725	3,458	4,930	5,216
1989	85,130	67,879	32,957	17,748	5,299	2,057	34,922	6,739	8,740	3,688	5,622	3,991
1990	91,285	72,728	34,690	18,273	5,541	2,313	38,442	7,821	8,754	4,018	6,225	5,640
1991	89,891	71,322	32,267	16,622	5,089	2,184	38,839	6,744	7,519	3,757	10,079	5,543
1992	93,817	72,837	33,789	17,741	5,349	2,293	39,047	8,209	7,963	4,087	7,099	6,177
1993	100,161	75,072	35,127	18,392	5,761	2,411	39,947	8,072	8,785	4,330	6,873	6,546
Annual growth rate (percent)												
1970–79	8.07	12.65	9.88	6.68	8.56	16.55	15.14	14.20	12.59	16.02	13.11	12.46
1980–89	8.14	6.59	8.48	9.90	3.73	6.95	5.07	0.12	2.08	3.56	4.84	12.18
1990–93	3.14	1.06	0.42	0.22	1.31	1.38	1.29	1.05	0.12	2.52	3.36	5.09
1970–93	7.34	8.15	7.71	6.86	5.37	10.03	8.57	6.52	5.47	8.69	7.85	12.79

Source: Reserve Bank of India, various years.

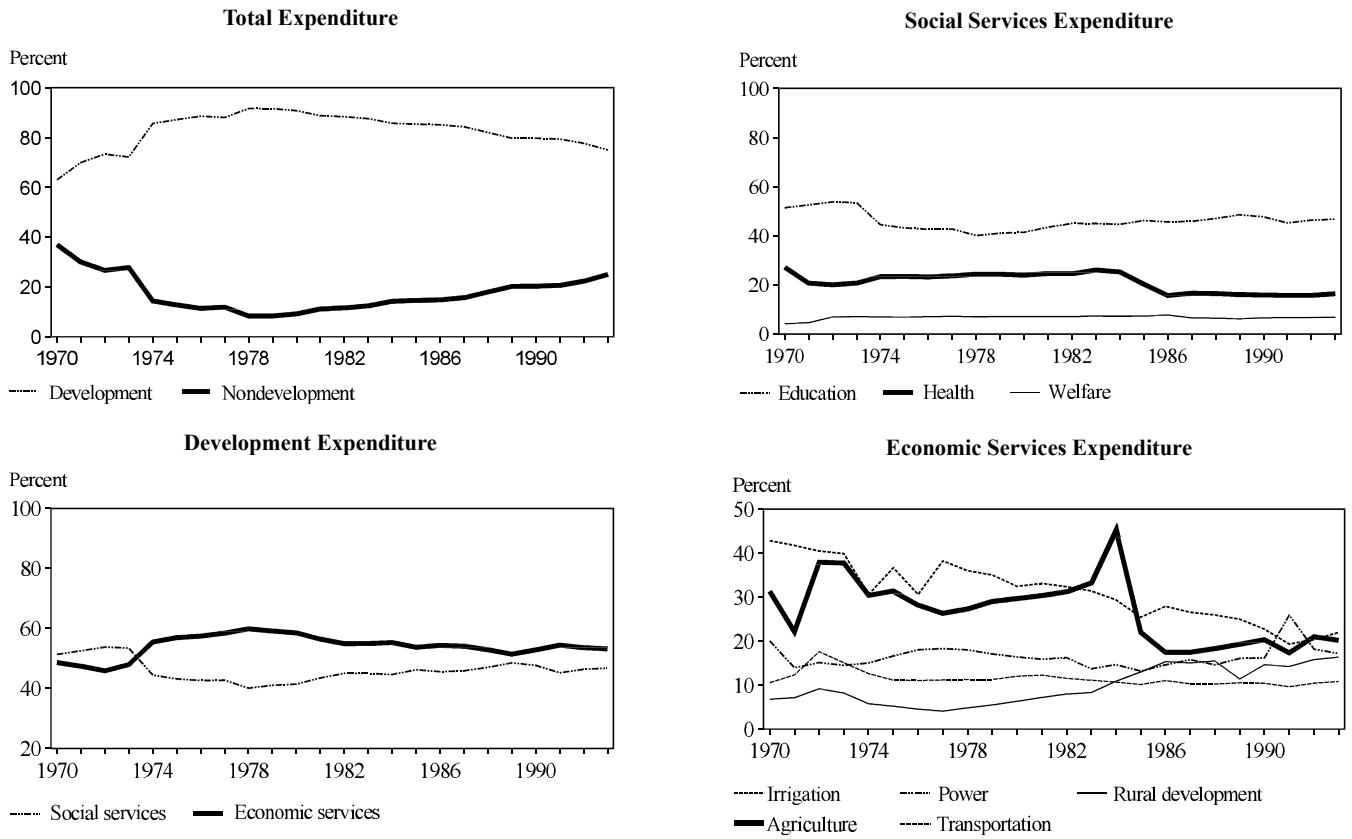
Notes: All figures in this table include both revenue and capital expenditures and are aggregated from 17 major states.

[a]Expenditure on education includes spending on education, culture, and sport.

[b]Expenditure on transportation includes spending on transportation and communication.

[c]Rural development expenditure is included in agriculture expenditure for some years. Therefore, the sum of the expenditure for agriculture, irrigation, transportation, power, and rural development is not necessarily equal to total economic service expenditure.

Figure 2 Composition of state government expenditure in India, 1970 93

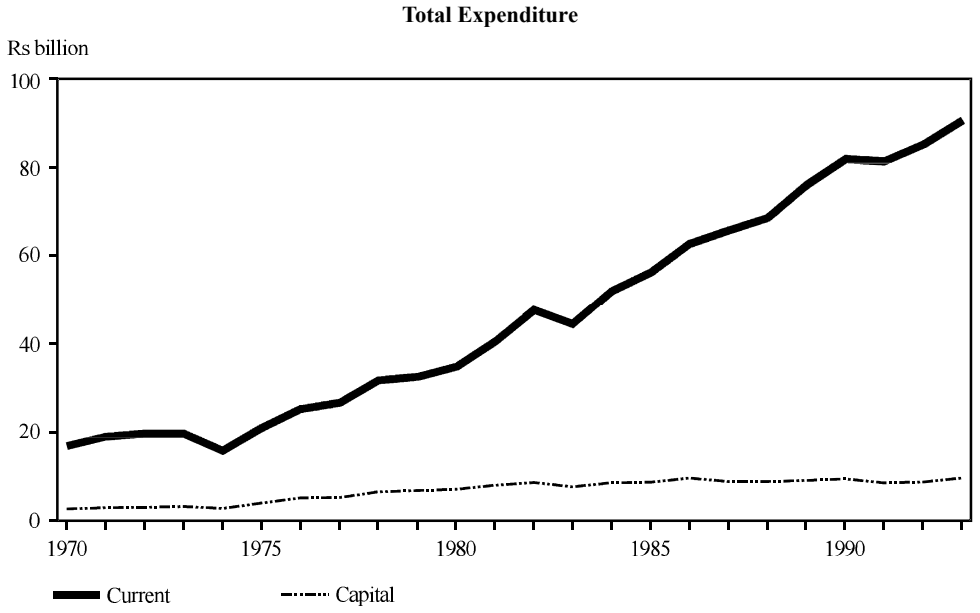


Source: Compiled from various state statistical abstracts and published government data.
Note: In 1960/61 prives.

Since 1980, agriculture's share in total state expenditure on economic services has declined from 30 percent to 20 percent, and irrigation's share has also declined.[2] In contrast, expenditure on rural development programs has expanded from 6.3 to 16.4 percent of total economic services, causing some concern that resources have been reallocated away from productivity-enhancing investments to those that have a much smaller impact on agricultural productivity and production growth.

Disaggregating government expenditure into its current and capital accounts reveals that almost all the increase in total expenditure since 1970 has been due to rapid growth in the current account (Figure 3).[3] In Figure 4, expenditures are broken

Figure 3 Total current versus capital expenditure, 1970 93



Source: Compiled from various state statistical abstracts and published government data.
Note: In 1960/61 prices.

[2] India was the largest public spender on agriculture in 1993 among all Asian countries. Its expenditures were 16 percent higher than those of the Chinese government, if measured by purchasing power parity (PPP), and 13 percent higher if measured by the official exchange rate (Fan and Pardey 1997).

[3] Under the Indian budgeting system, the government fund is made up of the revenue (or current) account and the capital account. There are receipts and expenditures under each of these two accounts. Receipts on the revenue account of a state government include tax and nontax revenues, the grants received from the central government, and the taxes devolved from the government of India. Disbursements on the revenue account include mostly recurring expenses (for example wages and salaries). The distinction between revenue and capital accounts in the budget, however, is not strictly the same as the economic distinction between recurring expenditure and fixed investment. Expenses below Rs 200,000 are generally recorded in the revenue account, even if some small capital equipment is being purchased (this is common in the case of minor irrigation). Generally speaking, if disbursements on the revenue account are less than revenue receipts, a revenue surplus results, which is available for financing capital expenditure for the year.

Figure 4 Current versus capital expenditure, by item, 1970 93

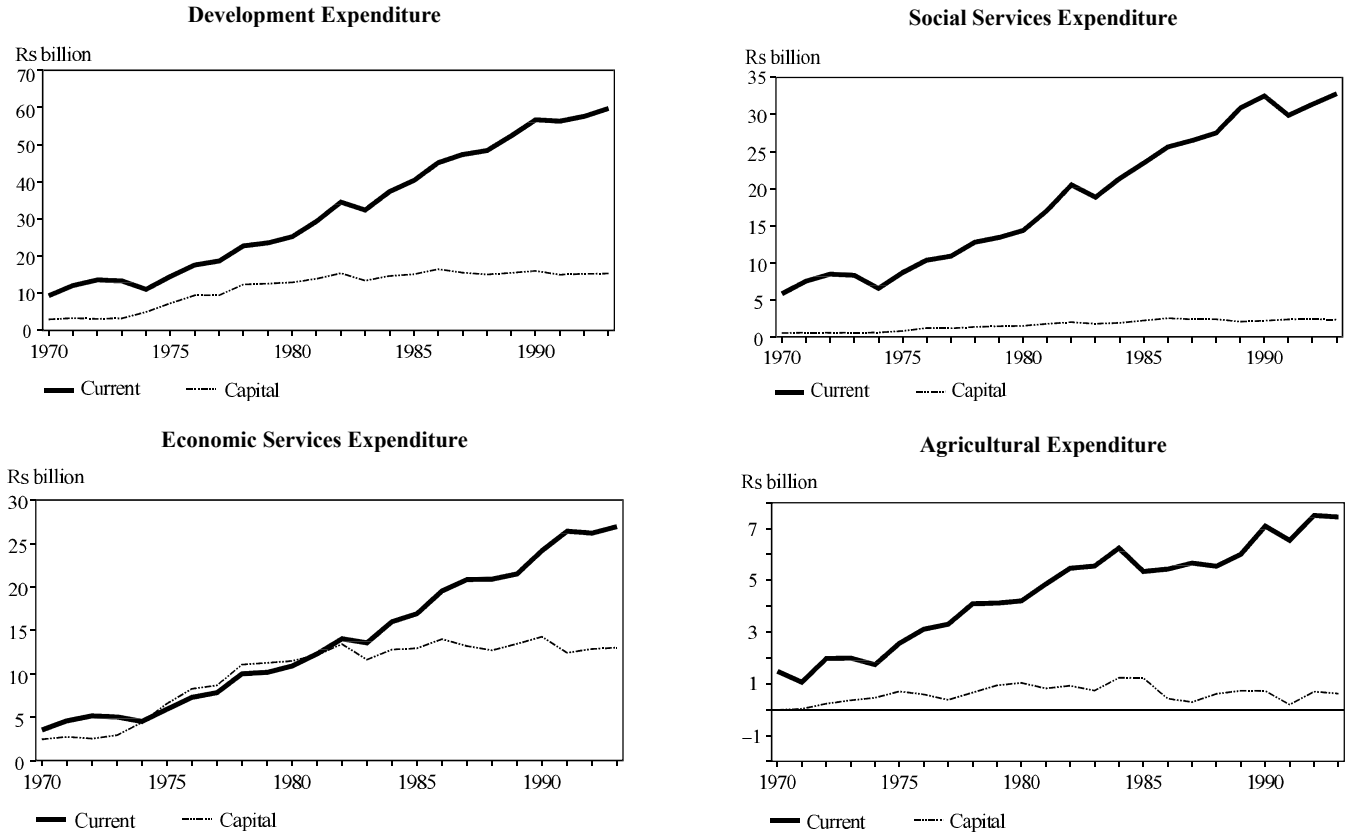


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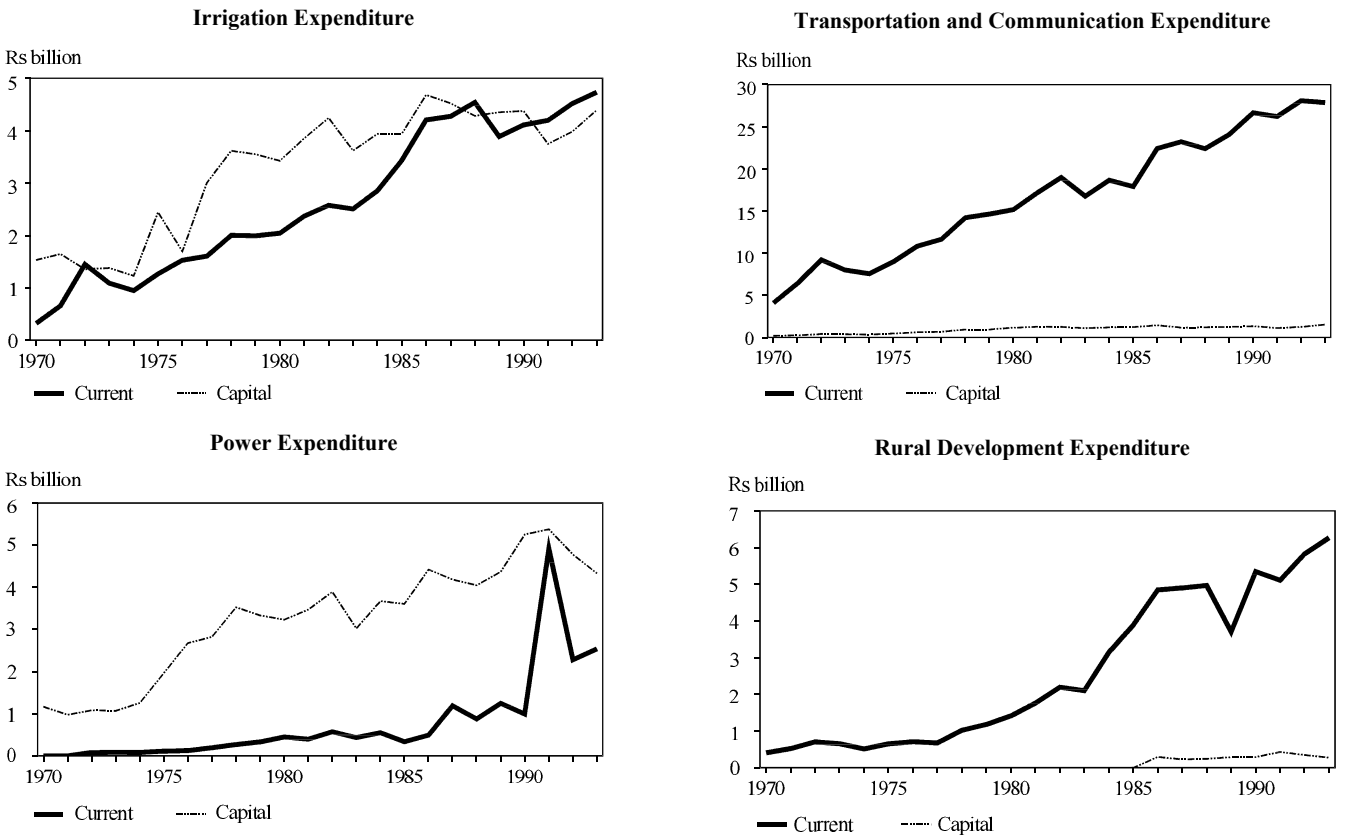
Figure 4 ***Continued***



Source: Compiled from various state statistical abstracts and published government data.
Note: In 1960/61 prices.

down into their components. Capital account expenditure has remained flat since 1970 when measured in 1960/61 prices. The majority of the expenditure on social services has also been under the current account. While expenditures from the current and capital accounts for economic services were equally important between 1970 and 1982, expenditures from the current account more than doubled between 1982 and 1993, while expenditures from the capital account remained flat.

Prior to 1987, capital account expenditure for irrigation was larger than the current account, but since 1987, the current account has become the larger. Expenditure on power was mainly from the capital account until 1990, but growth has since shifted to the current account. By 1993, more than one-third of the expenditure on power came from the current account. For agriculture, more than 95 percent of expenditure (which includes agricultural R&D, extension, and other productivity-increasing programs), has consistently been from the current account. Similarly, government expenditure for rural and community development has also been mainly from the current account. The rapid expansion of current account expenditure across all expenditure items raises questions about the efficiency of government expenditures.

The large regional variations in government expenditure that exist are illustrated by the patterns of expenditure on development activities related to agricultural growth and rural poverty reduction. Among all of the states, Maharashtra has always had the largest development expenditure, followed by Andhra Pradesh, Uttar Pradesh, and Tamil Nadu (see the Appendix, Table 7). 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 (Appendix Table 8). 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. Not surprisingly, Bihar is also the state that has the highest incidence of poverty.

Technology, Infrastructure, and Growth

The introduction of new technologies, improved infrastructure (roads and electrification), and education have all contributed to agricultural growth in India. This section analyzes these developments and provides a basis for the analysis in later sections of how these government investments have reduced rural poverty indirectly through improved agricultural productivity.

Technologies, Infrastructure, and Education

One of the most significant changes in Indian agriculture in recent decades has been the widespread adoption of high-yielding varieties (HYVs). During the Green Revolution of the 1970s, the crop area planted to HYVs for five major crops (rice, wheat, maize, sorghum, and pearl millet) increased from less than 17 percent in 1970 to 40

percent in 1980 (Table 2).[4] Even after the Green Revolution had peaked, the percentage of the crop area planted with HYVs continued to increase. It reached 52 percent of the crop area by 1990 and 55 percent by 1994.

Table 2 Technology, infrastructure, production, and productivity in agriculture, 1970 95

Year	HYVs	Irrigation	Villages electrified	Literacy rate	Road density	Production growth	Productivity growth
		(percent)			(kilometers/ 1,000 square kilometers)	(percent)	
1970	17	23	34	23	2,614	100	100
1971	19	23	36	24	2,698	99	99
1972	23	23	38	24	2,826	91	91
1973	25	25	39	25	2,941	99	99
1974	26	25	42	25	3,024	96	96
1975	29	25	45	26	3,124	110	109
1976	32	26	47	26	3,225	105	104
1977	34	26	49	27	3,520	115	113
1978	36	27	52	27	3,709	119	115
1979	37	28	55	28	3,842	119	98
1980	40	28	58	29	3,926	119	112
1981	40	29	61	29	4,076	126	118
1982	42	29	65	29	4,236	126	116
1983	41	29	68	30	4,388	142	128
1984	45	30	71	30	4,542	140	125
1985	44	30	73	31	4,707	144	128
1986	45	31	75	31	4,886	139	124
1987	48	32	78	32	5,000	144	126
1988	47	33	81	33	5,127	167	148
1989	51	33	83	34	5,258	166	140
1990	52	33	85	34	5,392	165	139
1991	54	34	86	35	5,444	166	139
1992	53	34	86	36	5,550	174	144
1993	51	34	87	37	5,622	178	146
1994	55	33	88	39	5,695	187	152
1995	n.a.	34	89	40	5,704	n.a.	n.a.
Annual growth rate (percent)							
1970–79	8.96	1.92	5.41	2.08	4.37	1.95	–0.17
1980–89	2.53	1.70	4.10	1.73	3.30	3.79	2.52
1990–95	1.49	0.15	1.04	3.08	1.13	3.17	2.29
1970–95	5.01	1.49	3.93	2.15	3.17	2.64	1.75

Source: Compiled from various state statistical abstracts and published government data.
Note: n.a. is not available.

[4] HYV (also referred to as modern varieties) are those released by the Indian national agricultural research system and the international agricultural research centers. The yields of these varieties are usually substantially higher than those of traditional varieties. The percentage of cropped areas with HYVs is calculated as the ratio of areas planted with HYVs for five major crops (rice, wheat, maize, sorghum, and pearl millet) to total cropped areas of these five crops.

While HYVs have been one of the major engines of productivity growth in Indian agriculture, there have been substantial regional differences. The richer states have generally outperformed the poorer states in HYV adoption (Appendix Table 9). In 1970, the adoption rate of HYVs in Punjab was already high at 56 percent, and it increased to 78 percent by 1979 and to more than 90 percent of the crop area by the mid-1980s. In Andhra Pradesh, where the adoption rate of HYVs was only 12 percent in 1970, more than 60 percent of the cropped area in the state was planted with HYVs by the mid-1980s, and more than 83 percent by 1995. But in states with high poverty rates, such as Bihar and Orissa, 55 percent of total crop area was still planted with traditional varieties, even in 1995. Although many factors may contribute to rural poverty, the lower rate of technology adoption in these states is definitely correlated with high rural poverty.

Irrigation, another important factor in Indian agriculture, has also increased dramatically, but with considerable regional variation. For all India, the percentage of the cropped area that is irrigated increased from 23 percent in 1970 to 33 percent in 1988 (Table 2). But the increase has been only marginal in more recent years. In the last five years, the percentage of area irrigated increased by only one percentage point. As with the adoption of HYVs, there seems to be a strong correlation between poverty and the extent of irrigation among states. In Punjab, more than 90 percent of the total cropped area was irrigated and in Haryana, almost 80 percent (Appendix Table 10). But in high-poverty states such as Assam, Maharashtra, and Orissa the irrigated area has increased very little in recent decades, and they are still the least irrigated states. Since HYVs respond well to irrigation and high rates of fertilizer use, lack of irrigation facilities in these states has hindered more widespread adoption of HYVs.

One of the greatest achievements in the development of rural India has been the rapid increase of electrification. In 1970, only 34 percent of the villages in rural India had access to electricity. But in 1995, this percentage had increased to almost 90 percent (Table 2). This rapid increase in electrification not only contributed to agricultural productivity growth by encouraging more irrigation, it also contributed to reductions in rural poverty through the generation of nonagricultural employment opportunities. Among the states, Bihar has the lowest electrification rate (Appendix Table 11). Even in 1995, more than 33 percent of the villages in that state still did not have access to electricity. Similarly, in Uttar Pradesh and West Bengal, more than 20 percent of the villages were still not electrified in 1995, whereas all of the villages in Haryana, Himachal Pradesh, Karnataka, Kerala, and Punjab have access to electricity.

For the country as a whole, the literacy rate in rural India has increased steadily from 23 percent in 1970 to 40 percent in 1995, but with great regional variation (Table 2). In Bihar and Rajasthan, more than 70 percent of the rural population was still illiterate in 1995, while more than 50 percent of the rural population had the ability to read and write in Himachal Pradesh, Kerala, and West Bengal (Appendix Table 12). Surprisingly, the literacy rate in some well-developed states such as Andhra Pradesh and Haryana remains below the national average.

Road density in rural India, measured as the length of roads in kilometers per thousand square kilometers of geographic area, increased from 2,614 in 1970 to 5,704

in 1995, a growth rate of more than 3 percent a year (Table 2). The regional data show that development of road density is highly correlated with poverty reduction (Appendix Table 13).

Production and Productivity Growth

As a result of rapid adoption of new technologies and improved rural infrastructure, agricultural production and factor productivity have both grown rapidly in India. Five major crops (rice, wheat, sorghum, pearl millet, and maize), 14 minor crops (barley, cotton, groundnut, other grain, other pulses, potato, rapeseed, mustard, sesame, sugar, tobacco, soybeans, jute, and sunflower), and 3 major livestock products (milk, meat, and chicken) are included in this measure of total production. Unlike traditional measures of production growth, which use constant output prices, the more appropriate Törnqvist-Theil index (a discrete approximation to the Divisia index is used here).[5] As Richter (1966) has shown, the Divisia index is desirable because of its invariance property: if nothing real has changed (for example, if the only input quantity changes involve movements along an unchanged isoquant), then the index itself is unchanged (Alston, Norton, and Pardey 1998). The formula for the index of aggregate production is

$$\ln YI_t = \sum_i 1/2(S_{i,t} + S_{i,t-1}) \ln(Y_{i,t} / Y_{i,t-1}), \quad (1)$$

where $\ln YI_t$ is the log of the production index at time t, $S_{i,t}$ and $S_{i,t-1}$ are output i's share in total production value at time t and t–1, respectively, and $Y_{i,t}$ and $Y_{i,t-1}$ are quantities of output i at time t and t–1, respectively. Farm prices are used to calculate the weights of each crop in the value of total production.

For all India, agricultural production grew at 2.64 percent per year between 1970 and 1995 (Table 2). In the 1970s, production growth was comparatively low, growing at an average annual rate of only 1.95 percent. During the 1980s, it grew at 3.79 percent per year, a much higher growth rate than most other countries achieved during the same period. Since 1990, production growth has slowed to only 3.17 percent per year. Agricultural production grew slowly in the high-poverty states like Assam and Bihar, but much faster in the low-poverty states like Andhra Pradesh, Karnataka, and Punjab (Appendix Table 14).

To gain richer insights into the sources and efficiency of agricultural production growth, a "total" factor productivity index was calculated. Total factor productivity (TFP) is defined as aggregate output minus aggregate inputs. Again, a Törnqvist-Theil index is used to aggregate both inputs and outputs. Specifically,

[5] Using China as an example, Fan (1997) has shown that the bias is potentially large when constant prices are used in the aggregation of output.

$$\ln TFP_t = \sum_i 1/2(S_{i,t} + S_{i,t-1})\ln(Y_{i,t} / Y_{i,t-1})$$
$$- \sum_i 1/2(W_{i,t} + W_{i,t-1})\ln(X_{i,t} / X_{i,t-1}), \quad (2)$$

where $\ln TFP_t$ is the log of the *TFP* index; $W_{i,t}$ and $W_{i,t\ 1}$ are cost shares of input *i* in total cost at time *t* and *t*–1, respectively; and $X_{i,t}$ and $X_{i,t\ 1}$ are quantities of input *i* at time *t* and *t*–1, respectively. Five inputs (labor, land, fertilizer, tractors, and buffalos) are included. Labor input is measured as the total number of male and female workers employed in agriculture at the end of each year; land is measured as gross cropped area; fertilizer input as the total amount of nitrogen, phosphate, and potassium used; tractor input as the number of four-wheel tractors; and bullock input as the number of adult bullocks. The wage rate for agricultural labor is used as the price of labor to aggregate total cost for labor: the costs of draft animals and machinery are taken directly from the production cost surveys; and the fertilizer cost is the product of total fertilizer use and fertilizer price calculated as a weighted average of the prices of nitrogen, phosphate, and potassium.[6] The land cost is measured as the residual of total revenue net of measured costs for labor, fertilizer, tractors, and bullocks.[7] Therefore, the cost share of each input is calculated by its respective cost divided by total production value.

TFP for India grew at an average annual rate of 1.75 percent between 1970 and 1995 (Table 2). In the 1970s, TFP showed no improvement, but it grew fast in the 1980s, at 2.52 percent per year. Since 1990, TFP growth in Indian agriculture has continued to grow but at a slower rate of 2.29 percent per year.

For the whole period 1970–94, Punjab and West Bengal had the highest growth rates in TFP, while in Assam, Gujarat, and Rajasthan, TFP improved only slightly or even declined during this period (Appendix Table 15). The correlation between productivity growth and poverty reduction is stronger than that between production growth and poverty reduction, suggesting that productivity growth may be the more important variable to use for explaining poverty.

Rural Employment and Wages

Rural employment in India has undergone several significant changes since the 1970s. Total rural employment grew very little in the 1970s and even declined in the mid-1980s (Table 3). But since 1987, total employment in rural India has been growing at almost 2 percent per year. Nonagricultural employment has grown faster than agricultural employment, and growth in nonagricultural employment has accelerated in recent years. In the 1990s, it grew at 2.59 percent per year compared with 1.17 percent per year in the 1970s, and 1.79 percent per year in the 1980s.

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[6] The cost data for draft animals and machinery were taken from the Planning Commission through Dr. Haque at the National Center for Agricultural Policy and Economics Research, New Delhi.

[7] This approach implicitly assumes that there is a perfect land rental market. If the residual is negative, the average shares of the zone where the district is located are used for aggregation.

Table 3 Rural employment and wages, 1970 93

Year	Total rural employment	Agricultural employment	Nonagricultural employment	Rural wage index	Nonagricultural employment as a share of total employment
		(thousands)		(1970 = 100)	(percent)
1970	220,755	178,812	41,943	100.00	19.00
1971	220,910	178,937	41,973	97.48	19.00
1972	221,064	178,399	42,665	91.97	19.30
1973	221,289	178,492	42,797	86.46	19.34
1974	221,444	178,529	42,915	74.23	19.38
1975	221,599	178,565	43,034	90.88	19.42
1976	221,755	178,601	43,153	105.35	19.46
1977	221,910	178,637	43,272	104.81	19.50
1978	223,684	178,839	44,845	110.25	20.05
1979	225,920	179,354	46,567	105.52	20.61
1980	228,180	179,825	48,355	101.11	21.19
1981	230,461	180,250	50,212	103.66	21.79
1982	232,766	180,626	52,140	106.20	22.40
1983	235,094	182,433	52,661	112.84	22.40
1984	230,016	176,790	53,226	122.41	23.14
1985	225,094	171,293	53,801	135.09	23.90
1986	220,277	165,895	54,381	143.00	24.69
1987	215,563	160,594	54,968	136.38	25.50
1988	219,883	164,584	55,299	147.18	25.15
1989	224,259	167,526	56,732	154.71	25.30
1990	228,721	170,519	58,203	158.35	25.45
1991	233,273	173,562	59,711	148.06	25.60
1992	237,915	176,656	61,259	158.31	25.75
1993	242,649	179,803	62,846	163.59	25.90
Annual growth rate (percent)					
1970–79	0.26	0.03	1.17	0.60	0.91
1980–89	–0.19	–0.78	1.79	4.84	1.99
1990–93	1.99	1.78	2.59	1.09	0.59
1970–93	0.41	0.02	1.77	2.16	1.36

Source: Employment figures for 1972, 1977, 1983, 1987, and 1993 are from the Government of India. The figures for the rest of the years are interpolated using the time trend.

As a percentage of total rural employment, nonagricultural employment increased from 19 percent in 1970 to 26 percent in 1993 (Table 3). The biggest increase in this share occurred in the 1980s. Government investment in roads, power, and rural development may have contributed to this rapid increase, as will be discussed later. Rural development investment is specifically targeted by the government to alleviate rural poverty by generating rural employment.

Rural wages in real terms have increased faster than both agricultural and nonagricultural employment; they grew at an average annual rate of 2.16 percent between 1970 and 1993. As with nonagricultural employment, the most rapid increase was in the 1980s when wages increased by almost 5 percent per year (Table 3 and Appendix Table 16). Again, government investment in rural infrastructure and rural development may have contributed to this rapid growth.

The level and structure of employment and wages seem to have moved together since the early 1970s, but in a peculiar manner. First, there is a clear contrast between the pre- and post-1987 situation. Agricultural employment actually declined between 1970 and 1987, while nonfarm employment grew at an increasing rate. The increase in nonfarm employment coincides with a steady increase in rural wages since the early 1970s. Thus it seems likely that rural poverty declined during 1972–87 largely due to increases in rural wages, which in turn were induced by the expansion of rural nonfarm employment.

Agricultural and nonagricultural employment rates increased in the early 1990s, while the growth in rural wage rates slowed down (Table 3). The increase in rural poverty associated with the introduction of the policy reforms may have induced workers to accept lower productivity jobs.

State-level data reveal that in poor states such as Bihar, Orissa, and Uttar Pradesh, not only is nonagricultural employment less important in total rural employment, but the growth rate is among the lowest of all the states (Appendix Table 17).

Rural Poverty

Figure 1 shows the changes in rural poverty since 1951 measured as a head-count ratio. The head-count ratio is the percentage of the rural population falling below the poverty line, defined as Rs 49 of income per month at 1973/74 prices. Rural poverty fluctuated between 50 and 65 percent in the 1950s and early 1960s, before beginning a steady decline from the mid-1960s until the late 1980s. It declined from about two-thirds to one-third of the rural population. It increased again to an average of about 40 percent in the early 1990s, at the time of implementation of the policy reforms, but declined again in 1993, the last year for which data are available.

The long downward trend in rural poverty from 1967 to 1989 coincided with several important factors. As already discussed, the rapid adoption of HYVs together with improved irrigation increased agricultural production and productivity growth sharply during this period. This change in technology was a direct result of increased government investment in agricultural research and extension, infrastructure, irrigation, and education during the 1960s, 1970s, and 1980s. The increase in government investment also improved nonagricultural employment opportunities and wages, contributing directly to further reductions in rural poverty. The stagnation in agricultural productivity growth and the increase in rural poverty observed in the early 1990s may have resulted from reduced government investment in rural areas during this period.

State-level data reveal wide variations in the level of rural poverty and change in its incidence (Appendix Table 18). The poverty ratio declined in all states except Assam between 1957 and 1993. The poverty ratios declined at relatively higher rates per year in Andhra Pradesh, Kerala, Maharashtra, Punjab, Tamil Nadu, and West Bengal, and at lower rates in Bihar, Haryana, and Rajasthan.

All states but Assam and Jammu and Kashmir achieved reductions in rural poverty between the mid-1960s and the late 1980s when farmers adopted HYVs. In the late 1980s poverty fell to below 20 percent in Haryana and Punjab, but remained close

to 50 percent in Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, and Tamil Nadu. Most states experienced an increase in poverty after 1990. For example, in Orissa, the poverty ratio increased from 27 percent in 1990 to 40 percent in 1993. Even in Punjab, the rural poverty ratio increased from 19 percent to 25 percent. However, West Bengal, one of the states with the highest incidence of poverty in the early 1970s, had one of the lowest in 1993. West Bengal also achieved the most rapid growth in TFP in agriculture since 1970.

Given the observed diversity in the rates of poverty alleviation across states, it is important to ask whether there is a relationship between the rates of change and the initial levels of poverty. Does poverty go down faster in those states that had less poverty to begin with or in those states that had higher initial poverty levels? To answer this question, correlation coefficients across the 14 states were calculated between the head-count ratios and the annual rates of change in poverty.

The correlations indicate that the relationship between the level of poverty in 1957 and the percentage change in the level of poverty during 1957–60 was negative and significant. This means that the biggest reductions in rural poverty occurred in the poorest states. But in the 1960s, the relationship was reversed. The correlation was positive (0.789) and significant, which shows that the annual rate of decline in poverty tends to be greatest in those states that had the lowest poverty ratio in 1960. In the 1970s, the correlation between the initial level of poverty and the percentage change in poverty was positive, but it was weak and insignificant (0.351). It is interesting to note that this relationship changed again during 1983–90, and poverty fell fastest in those states that had the highest poverty rates in 1983.

Another important issue is whether the decline in rural poverty was sufficient to reduce the absolute number of persons 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 percent). Most of the states experienced a net increase in the size of their poor population (Appendix Table 19). The only exceptions were Andhra Pradesh, Kerala, and Tamil Nadu. In Bihar, the number of poor people below the poverty line was about 20 million in 1960, but the number of poor had increased to 51.5 million by 1993, a growth rate of 2.89 percent 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 rate of 1.94 percent per year).

Another related feature of rural poverty in India is its continuing concentration in some regions. Two states, Bihar and Uttar Pradesh, accounted for 26 percent of the total rural poor in 1960; by 1993, their share had increased to 36.5 percent (Appendix Table 20). Conversely, Andhra Pradesh, Kerala, and Tamil Nadu have reduced their shares of poor people in the national total by almost half.

CHAPTER 4

Conceptual Framework

Most previous studies of the determinants of rural poverty in India have used a single equation approach and have tried to explain rural poverty as a function of explanatory variables like agricultural production, wages, and the price of food. The conceptual framework proposed for this analysis is a simultaneous structural equations system in which many economic variables are endogenous, and their direct and indirect interactions are explicitly considered in the model. There are at least three advantages to this approach. First, the simultaneous system allows us to endogenize many economic variables that are likely to be generated in the same economic process, therefore, reducing or even eliminating the bias resulting from the endogeneity of these variables in the empirical econometric estimation of the various effects. Second, certain economic variables such as government investments affect poverty through multiple channels. For example, government investment in roads will not only reduce rural poverty through improved agricultural productivity, it will also affect rural poverty through improved wages and nonfarm employment. The simultaneous equations system will also allow us to estimate these various direct and indirect effects. Third, it will also enable us to observe where the weak link is in the economic process of productivity growth and poverty reduction as will be shown later in the report.

A Simultaneous Equations System

The conceptual framework for the model is portrayed in Figure 5, and the formal structure of the system is given in equations 3 to 13. The variables are defined in Table 4.

$$P = f(TFP, WAGES, NAEMPLY, TT, LANDN, POP_{-1}, RAIN, T); \quad (3)$$

$$TFP = f(RDE, RDE_{-1}, ...RDE_{i}, IR, LITE, ROADS, RAIN, T); \quad (4)$$

$$WAGES = f(TFP, ROADS, LITE, HELE, HELE_{-1}, ..., HELE_{l}, T); \quad (5)$$

$$NAEMPLY = f(GERDEV, ROADS, LITE, GCSSL, PVELE, T); \quad (6)$$

Figure 5 Effects of government expenditures on rural poverty

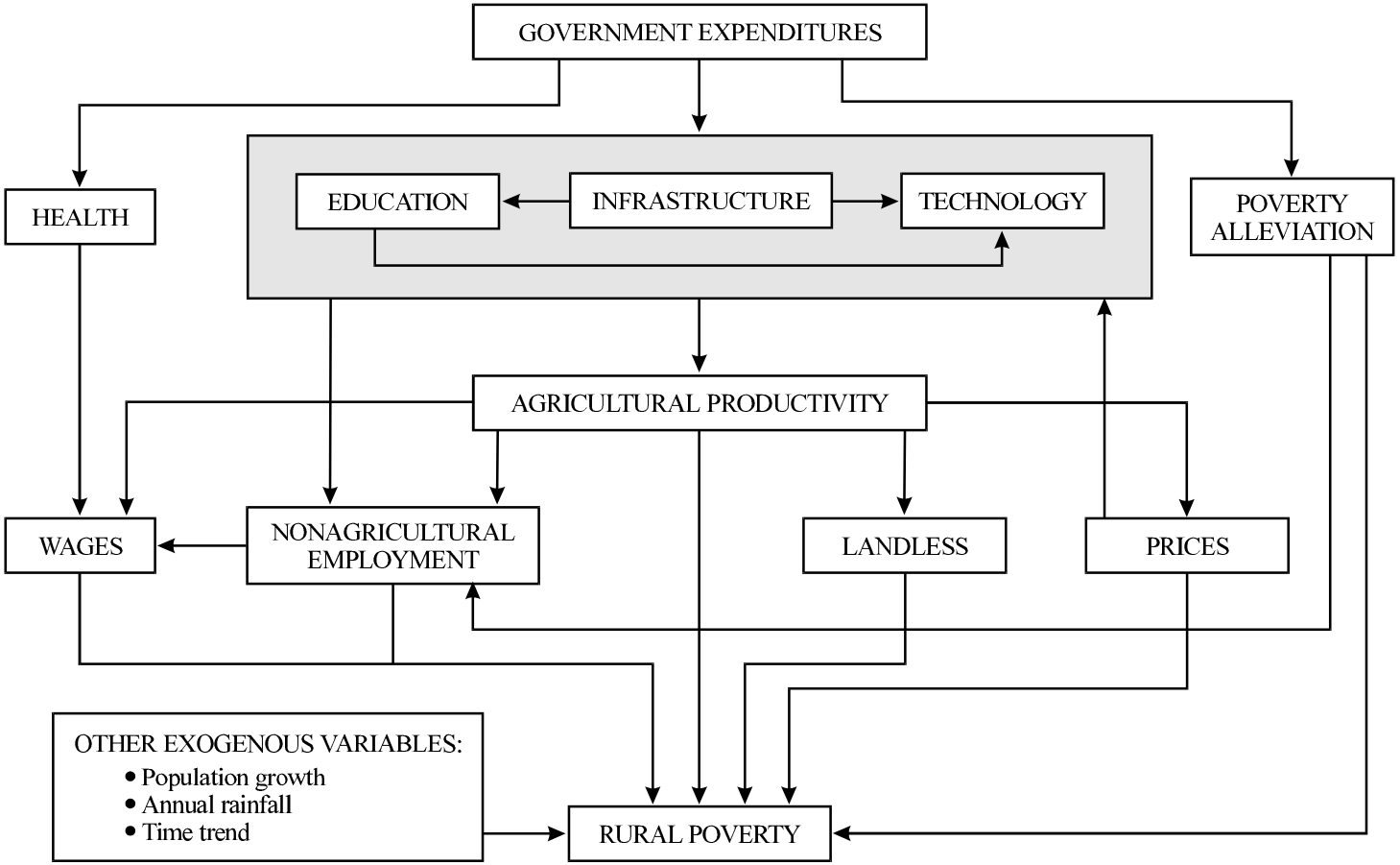

Table 4 Definition of exogenous and endogenous variables

Exogenous variables	
ATT	Moving five-year average of the terms of trade (predetermined endogenous variable)
EDE	Government spending on rural education
GCSSL	Government capital stock accumulated in soil and water conservation investment. It is the weighted average of the past government expenditure on soil and water conservation, $GCSSL_t = \Sigma_m w_m ESL_{t\ m}$, where $ESL_{t\ m}$ 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.
GERDEV	Government expenditure on rural and community development measured in stock terms using three-years lag, similar to expenditures on soil and water conservation
HELE	Government spending on medical and public health and family welfare
IRE	Government expenditure on irrigation, both from revenue and capital accounts
POP	Rural population growth
PWRE	Government revenue and capital spending on rural power
RAIN	Annual rainfall
RDE	Government spending (both revenue and capital) on agricultural R&D
ROADE	Government investment and spending on rural roads
T	Time trend
WAPI	World agricultural price index (average export price for rice, wheat, and corn)
Endogenous variables	
IR	Percentage of total cropped area that is irrigated (sum of both public and private irrigation)
LANDN	Percentage of rural households that are landless
LITE	Literacy rate of rural population
NAEMPLY	Percentage of nonagricultural employment in total rural employment
P	Rural population falling below poverty line
PRIR	Percentage of total cropped areas under private irrigation (wells, tube wells, and tanks)
PUIR	Percentage of total cropped areas under public irrigation (canal irrigation)
PVELE	Percentage of rural villages that are electrified
ROADS	Road density in rural areas
TFP	Total factor productivity growth (Tornqvist-Theil index). It is defined as aggregate output minus aggregated inputs.
TFPn	Total factor productivity growth at the national level
TT	Terms of trade, measured as agricultural prices divided by a relevant nonagricultural GNP deflator
WAGES	Wage rate of agricultural labor

$$PUIR = f(IRE, IRE_{-1}, ..., IRE_{\ j}, PVELE, ATT, T); \quad (7)$$

$$PRIR = f(PUIR, PVELE, ATT, T); \quad (8)$$

$$ROADS = f(ROADE_{-1}, ..., ROADE_{-k}, T); \quad (9)$$

$$LITE = f(EDE, EDE_{-1}, ..., EDE_{-m}, T); \quad (10)$$

$$PVELE = f(PWRE, PWRE_{-1}, ..., PWRE_{\ n}, T); \quad (11)$$

$$LANDN = f(TFP, T); \text{ and} \quad (12)$$

$$TT = f(TFP, TFPn, WAPI, T). \quad (13)$$

Equation (3) models the determinants of rural poverty (*P*).[8] They include growth in TFP in agricultural production (*TFP*), changes in agricultural wages (*WAGES*), changes in nonagricultural employment (*NAEMPLY*), changes in the terms of trade (*TT*), changes in the percentage of landless households in total households (*LANDN*), growth in rural population (*POP*), changes in annual rainfall (*RAIN*) and a time trend variable (*T*).[9] *TFP* rather than agricultural income is used in order to capture the impact on rural poverty of technology-driven shifts in the production function, rather than simply increased input use. Some economists, such as Datt and Ravallion (1997), have used output per hectare (land productivity) as a proxy for agricultural performance or to represent changes in agricultural technology. But changes in land productivity do not necessarily imply technical change because farmers can simply use more inputs on a per hectare basis to increase land productivity. Wages are the second most important source of income after agricultural production for rural residents in India. Income from wages can derive from both agricultural and nonagricultural sources. The terms of trade variable measures the impact of changes in agricultural prices relative to nonagricultural prices on rural poverty.[10] It is hypothesized that in the short run, the poor may suffer from higher agricultural prices because they are usually net buyers of foodgrains. Population growth also affects rural poverty since higher growth in population may increase 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 large. The percentage of landless households is included in the equation to measure the potential impact of access to land on rural poverty. Rainfall is included to capture the direct effects of variations in agricultural production on the poor, particularly the effects of drought. The time trend variable should capture the time-fixed effects of other variables that are not included in the equation.

Equation (4) models the determination of TFP growth in agriculture. The TFP growth index is the ratio of an aggregated output index to an aggregated input index (see equation [2]).[11] The following variables were included in the equation: current and lagged government spending on agricultural research and extension (*RDE,*

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[8] All variables without subscripts indicate observations in year t at the state level. For presentation reasons, the subscript is omitted. The variables with subscript "–1,...–*j*" indicate observations in year $t-1,\ldots,t-j$.

[9] The population growth variable is also likely to be an endogenous variable. But if this variable is corrected with certain state fixed effects such as cultural and geopolitical factors, the bias of the estimated parameters should be eliminated by the difference form of all variables in the equation, as will be discussed later in the report. In addition, lagged population growth was used instead of current population growth to reduce the potential simultaneity bias.

[10] Instead of using the inflation rate in rural areas (Saith 1981; Ahluwalia 1985; Bell and Rich 1994; Datt and Ravallion 1997), the terms of trade (agricultural prices relative to nonagricultural prices) are used. The reason is that increases in agricultural prices may have even greater impact on the rural poor than the general price index since the poor are usually net buyers of agricultural products.

[11] Another advantage of using TFP growth instead of production growth is that the TFP function has significantly fewer independent variables than the production function. The production function includes input variables like labor, land, fertilizer, machinery, and draft animals as independent variables, in addition to those variables included in the TFP function. Fewer independent variables in the TFP function help reduce potential multicollinearity problems in the estimation and help increase the reliability of the estimated coefficients.

RDE_{-1},... RDE_{i}), the percentage of irrigated cropped area in total cropped area (*IR*), the literacy rate of the rural population (*LITE*), road density (*ROADS*), annual rainfall (*RAIN*), and a time trend (*T*).[12] The first four variables should capture the productivity-enhancing effects of technologies, infrastructure, and education, while the last two variables should capture the impact of rainfall and other omitted variables on growth in TFP. In the initial estimation, an effort was made to separate out the differential impacts of public and private irrigation in the equation, but these two variables are too highly correlated (about 0.7 even when both variables are differenced). Instead, the percentage of cropped area under both private and public irrigation is used in the final specification. Government investments in soil and water conservation (*GCSSL*) were also included in earlier versions of the equation, but since the estimated coefficient was not statistically significant and its sign was very sensitive to the model specification, the variable was dropped in the final model.

Equation (5) is a wage determination function. Rural wages are determined by growth in TFP, roads, literacy, health, and the time trend.[13] The impact of improved roads on wages is often ignored in specifying wage determination equations. Ignoring this effect is likely to lead to underestimation of the impact of government spending on poverty, since wage increases induced by improved rural roads can be potentially large, benefiting workers in agricultural and nonagricultural activities. Since data on the health of the rural population are not available, current and past government expenditures on health are used as independent variables in the wage equation.

Equation (6) determines nonagricultural employment. It is modeled as a function of rural roads, electrification, and education; government expenditures on rural development programs and soil and water conservation; and a time trend. Improved roads should help farmers to set up small nonfarm businesses and to market their products. Improved roads and education also help farmers to find jobs in towns. Government programs in rural development such as the Integrated Rural Development Programs and Rural Employment Schemes are designed by the government to alleviate rural poverty and to generate nonagricultural and wage employment opportunities for rural laborers. Government spending on soil and water conservation is also often used by the government to generate wage employment for farmers, particularly in drought years.

Equation (7) models the relationship between government investment in irrigation and the percentage of the cropped area under canal irrigation. Since nearly all canal irrigation results from government investment, the cropped area under canal irrigation is used as a proxy for public irrigation. Included in the equation are variables that represent current and past government spending on irrigation (*IRE, IRE* $_{1}$,...,

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[12] The expenditure in the current year is included because some government expenditure on extension may affect current production growth. This is also true for other expenditures such as those on roads, irrigation, power, and education.

[13] Acharya and Papanek (1995) conducted a detailed study explaining agricultural wage trends in India. They argued that agricultural wages largely depend on demand for labor in agricultural production. However, they ignored the impact of increased nonfarm activities due to improvement of infrastructure and education.

IRE_j), the extent of rural electrification (the percentage of villages that have been electrified), a lagged terms-of-trade variable (ATT),[14] and a time trend.

Equation (8) models the determinants of private irrigation. It is hypothesized that canal irrigation supported by the government is often a precursor to private irrigation, because it increases the economic returns to investments in wells and pump sets (by raising the groundwater level). Private irrigation is defined as the percentage of the cropped area under wells and tube wells, which are mostly the result of farmers' private initiatives. Other determinants of private irrigation investment in equation (8) are rural electrification, the terms of trade, and the time trend.

Equations (9), (10), and (11) model the relationships between lagged government expenditures on roads, education, and rural electrification and the available stock of these variables. In equation (9), the stock of roads (measured in density form) is specified as a lagged function of government expenditures on roads ($ROADE, ROADE_1, ..., ROADE_k$) and time trend T. Similarly, the literacy rate at any point in time is a lagged function of past government spending on education ($EDU, EDU_1, ...EDU_m$) and time T (equation [10]). The percentage of villages that are electrified depends on past government spending on power ($PWRE, PWRE_1, ..., PWRE_n$) and the time event (equation [11]).

Equation (12) models the effect of productivity growth on access to land (measured as the incidence of landlessness). It has often been argued that improved productivity as a result of technological change and infrastructure improvements has worsened equity problems in rural areas. Endogenizing access to land in the model should capture these effects.

Equation (13) determines the terms of trade. Growth in TFP in the state and at the national level ($TFPn$) increases the aggregate supply of agricultural products, and therefore reduces agricultural prices. Lower prices will help the poor if they are net buyers of grains. The inclusion of national TFP growth will help to reduce any upward bias in the estimation of the poverty alleviation effects of government spending within each state, since TFP growth in other states will also contribute to lower food prices through the national market. A world price index of rice, wheat, and corn is included in the equation to capture the impact of international markets on domestic agricultural prices. Some demand-side variables were also included in an earlier version of the equation, such as population and income growth, but they were not significant and were dropped from the equation. Part of the effects of these omitted variables is captured by the time trend variable.

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[14] To test whether there is any difference in the impact of current and capital account expenditures, both a capital stock variable (using seven-years lag) and a current expenditure variable for irrigation are used in equation (7). The results reveal that capital expenditure has a significant and positive effect on the percentage of irrigation, but the current expenditure has a small, negative, but statistically insignificant impact on the percentage of irrigation. This seems to indicate that government may have overspent on the current account and underspent on the capital account. But further study is needed to clarify the exact definition of these two accounts. Similar tests could not be done for government expenditure on roads, education, agricultural R&D, rural development, welfare of scheduled castes and tribes and other backward classes, because these government expenditures are mainly from the current account.

Marginal Effects of Government Expenditures on Poverty

By differentiating equations (3) to (13), the marginal impact and elasticities of different types of government expenditures on rural poverty can be derived.

The impact of government investment in agricultural research and development in year $t\ \ i$ on poverty at year t can be derived as:

$$\begin{aligned} dP/dRDE_{\ i} &= (\partial P/\partial TFP)(\partial TFP/\partial RDE_{\ i}) \\ &+ (\partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial RDE_{\ i}) \\ &+ (\partial P/LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial RDE_{\ i}) \\ &+ (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP/\partial RDE_{\ i}). \end{aligned} \tag{14}$$

The first term on the right-hand side of equation (14) captures the impact on poverty of government investments in R&D through yield-enhancing technologies such as improved varieties and therefore TFP.[15] Increased TFP also affects poverty through changes in wages, access to land, and relative prices, which are captured in the remaining terms of the right-hand side of the equation. By aggregating the total effects of all past government expenditures over the lag period, the sum of marginal effects is obtained for any particular year.

The impact of government investment in irrigation in year $t\ \ j$ on poverty in year t is derived as[16]

$$\begin{aligned} dP/dIRE_{\ j} &= (\partial P/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial IRE_{\ j}) \\ &+ (\partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial\_IRE_{\ j}) \\ &+ (\partial P/LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial IRE_{\ j}) \\ &+ (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial IRE_{\ j}) \\ &+ (\partial P/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR)(\partial PUIR/\partial IRE_{\ j}) \\ &+ \partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR) \\ &\quad (\partial PUIR/\partial IRE_{\ j}) \\ &+ (\partial P/LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR) \\ &\quad (\partial PUIR/\partial IRE_{\ j}) \\ &+ (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR) \\ &\quad (\partial PUIR/\partial IRE_{\ j}). \end{aligned} \tag{15}$$

As with government investments in agricultural R&D, the impact of government investments in irrigation is captured through improved productivity, wages, access to land, and relative prices (terms 1 to 4 of equation [15]). But government irrigation also

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[15] The terms are separated by "+".

[16] It is assumed that both private and public irrigation have the same impact on productivity growth, which is calculated through equation (4).

affects private irrigation, which in turn also affects productivity and poverty. These indirect effects are captured in terms 5 to 8 of equation (15).

The impact of government investment in rural roads in year $t\ \ k$ on poverty in year t is derived as

$$\begin{aligned} dP/dROADE_k = {} & (\partial P/\partial TFP)(\partial TFP/\partial ROADS)(\partial ROADS/\partial ROADE_k) \\ & + (\partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial ROADS) \\ & \quad (\partial ROADS/\partial ROADE_k) \\ & + (\partial P/\partial LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial ROADS) \\ & \quad (\partial ROADS/\partial ROADE_k) \\ & + (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP/\partial ROADS) \\ & \quad (\partial ROADS/\partial ROADE_k) \\ & + (\partial P/\partial NAEMPLY)(\partial NAEMPLY/\partial ROADS)(\partial ROADS/\partial ROADE_k) \\ & + (\partial P/\partial WAGES)(\partial WAGES/\partial ROADS)(\partial ROADS/\partial ROADE_k). \end{aligned} \tag{16}$$

The first term on the right-hand side of equation (16) measures the direct effects of improved productivity on poverty attributable to a greater road density. Terms 2, 3, and 4 are the indirect effects of improved productivity through changes in wages, access to land, and prices. Term 5 captures the effects on poverty of greater nonagricultural employment opportunities. The sixth term of the equation is the impact of improved agricultural wages arising from government investment in roads.

The impact of government investment in education in year $t\ \ m$ on poverty in year t is derived as

$$\begin{aligned} dP/dEDE_m = {} & (\partial P/\partial TFP)(\partial TFP/\partial LITE)(\partial LITE/\partial EDE_m) \\ & + (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP/\partial LITE)(\partial LITE/\partial EDE_m) \\ & + (\partial P/\partial LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial LITE)(\partial LITE/\partial EDE_m) \\ & + (\partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial LITE)(\partial LITE/\partial EDE_m) \\ & + (\partial P/\partial NAEMPLY)(\partial NAEMPLY/\partial LITE)(\partial LITE/\partial EDE_m) \\ & + (\partial P/\partial WAGES)(\partial WAGES/\partial LITE)(\partial LITE/\partial EDE_m). \end{aligned} \tag{17}$$

As with government investment in roads, the first four terms of equation (17) capture the impact of government investment in education through improved agricultural productivity. Terms 5 and 6 capture the impact of government investments in education on poverty through improved nonfarm employment opportunities and changes in rural wages.

The impact of government investment in electricity in year $t\ \ n$ on rural poverty in year t is derived as follows:

$$\begin{aligned} dP/dPWRE_n = {} & (\partial P/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial PVELE)(\partial PVELE/\partial PWRE_n) \\ & + (\partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial PVELE) \\ & \quad (\partial PVELE/\partial PWRE_n) \end{aligned}$$

$$
\begin{aligned}
&+ (\partial P/(LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial PVELE)\\
&\quad (\partial PVELE/\partial PWRE_n)\\
&+ (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP/\partial IR)(\partial PUIR/\partial PVELE)\\
&\quad (\partial PVELE/\partial PWRE_n)\\
&+ (\partial P/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR)(\partial PUIR/\partial PVELE)\\
&\quad (\partial PVELE/\partial PWRE_n)\\
&+ (\partial P/\partial WAGES)(\partial WAGES/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR)\\
&\quad (\partial PUIR/\partial PVELE)(\partial PVELE/\partial PWRE_n)\\
&+ (\partial P/(LANDN)(\partial LANDN/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR)\\
&\quad (\partial PUIR/\partial PVELE)(\partial PVELE/\partial PWRE_n)\\
&+ (\partial P/\partial TT)(\partial TT/\partial TFP)(\partial TFP/\partial IR)(\partial PRIR/\partial PUIR)(\partial PUIR/\partial PVELE)\\
&\quad (\partial PVELE/\partial PWRE_n)\ (\partial P/\partial NAEMPLY)(\partial NAEMPLY/\partial PVELE)\\
&\quad (\partial PVELE/\partial PWRE_n). \qquad (18)
\end{aligned}
$$

The first 10 terms measure the effect of government investment in power through improved irrigation. The last terms capture the effect of improved electrification on poverty arising from nonagricultural employment opportunities.

The effects of government expenditures on rural and community development expenditures is derived as

$$dP/dGERDEV = (\partial P/\partial NAEMPLY)(\partial NAEMPLY/\partial GERDEV). \qquad (19)$$

This type of expenditure affects rural poverty by improving nonagricultural employment opportunities.

Government investments in health affect poverty through improved agricultural wages:

$$dP/dHELE_r = (\partial P/\partial WAGES)/(\partial WAGES/\partial HELE_r). \qquad (20)$$

Government investments in soil and water conservation affect rural poverty through improved nonfarm employment:

$$dP/dGCSSL=(\partial P/\partial NAEMPLY)(\partial NAEMPLY/\partial GCSSL). \qquad (21)$$

CHAPTER 5

Data, Model Estimation, and Results

Data Sources and Measurement

Table 4 presents the definitions of each variable used in the estimation of the model. The head-count ratio, which measures poverty as a percentage of the rural population falling below the poverty line, is used in this analysis. Rural population under the poverty line is simply the percentage of poor multiplied by the total rural population. Other measures, such as the poverty-gap index, the squared poverty-gap index, and the Sen index, are also used by many scholars to supplement the head-count ratio. There are three reasons why the poverty gap was not used as the dependent variable in the model. First, policymakers in developing countries are mostly interested in the incidence of poverty. Second, Datt and Ravallion's (1997) findings show that the signs and magnitudes of parameters in the poverty equation do not change very much, whether poverty is measured as the incidence of poverty or by a poverty-gap index. Third, using the incidence of poverty allows us to calculate the marginal impact of an additional unit of government spending on the number of poor people reduced.

The head-count ratio data used in this analysis were constructed by Gaurav Datt and are published in a World Bank (1997) publication. Datt used the poverty line originally defined by 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 it is equal to a per capita monthly expenditure of Rs 49 at all-India rural prices for October 1973–June 1974.

The measure of TFP growth has already been defined. But there have been many estimates of TFP in Indian agriculture over the years. Many argue that the cost data used in aggregating total input may affect TFP measures to a great extent. In order to test the sensitivity of the TFP measures using different approaches, the primal approach was also used. First, a production function for Indian agriculture was estimated, using the district level data. Then the production elasticities of inputs (land, labor, fertilizer, machinery, and animals) were used to construct TFP growth at the state level. The results are similar to those obtained by using the cost

shares (the dual approach). But the earlier approach is preferred because the elasticities used in the second approach do not vary by states.

The road density variable is defined as the length of road per unit of geographic area. Education is measured using the literacy rate, defined as the percentage of literate people in the total rural population more than seven years old. Public irrigation is defined as the percentage of the total cropped area under canal irrigation, and private irrigation is defined as the percentage of the total cropped area under well and tube-well irrigation. The electrification variable measures the percentage of all villages that have access to electricity. The rural wage used is the male labor rate in real terms deflated by the consumer price index for agricultural labor. These variables were aggregated from district-level data, which were obtained from the Planning Commission through the National Center for Agricultural Policy and Economics Research, New Delhi.

Nonagricultural employment is measured as the percentage of nonagricultural employment in total rural employment.[17] Data on nonagricultural employment are only reported by the National Statistics Service for every five years beginning in 1973. The data for other years were estimated by geometric interpolation.

The terms of trade variable is measured as the change in agricultural prices relative to nonagricultural prices. The landless variable is measured as the percentage of rural households classified as landless. Since the landless data are only available every 10 years from census surveys beginning in 1953, the data for intermediate years were estimated by geometric interpolation.

Government expenditure data by state were obtained from *Finances of State Governments*, various issues, published by the Reserve Bank of India.[18] All the expenditures are deflated into 1960/61 prices using a state consumer price index for agricultural labor. They include expenditures from both the current (for maintenance and operation) and the capital (investment) accounts.

Agricultural R&D expenditure includes government expenditure on agricultural research and extension. Government expenditure on irrigation includes spending on flood control. But prior to 1985, it was under the heading of minor irrigation, multipurpose river projects, and irrigation, navigation, drainage, and flood control projects in the Indian financial reporting system. Government expenditure on roads, education, power, and health in rural areas are calculated from total state level expenditures scaled down by the proportion of the total population living in rural areas. Instead of using current and past expenditures, stock variables are used to measure the impact of government spending on rural development and soil and water conservation. A three-year lag structure is used with weights of 0.4, 0.3, 0.2, and 0.1 for the current year, t 1, t 2, and t 3, respectively. These expenditures usually have immediate and short-run impacts on rural poverty.

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[17] Employment is defined as usual status, if more than half of a worker's time is engaged in a particular employment category.

[18] For more details on the definition and classification of government expenditures on agriculture, refer to the *Database and guide on government finances in Indian agriculture*, by New Concept Consulting Services (1990).

Model Estimation

Double-log functional forms are used for all the equations in the system. More flexible functional forms such as the translog or quadratic impose fewer restrictions on the estimated parameters, but when these were tried, many of the estimated coefficients were not statistically significant because of multicollinearity problems.

The model defined by equation system (3) to (13) incorporates interdependencies among government investment, technology, infrastructure, productivity growth, rural employment generation, wages, and rural poverty. However, many economists have argued that government investment may itself be an endogenous variable. Binswanger, Khandker, and Rosenzweig (1989) argued that government may allocate its investment based on agroclimatic conditions, that is, high-potential areas may receive more resources from government than areas with low potential. If this is true, government investment behavior should be modeled in the equations system as well. However, it is difficult to quantify the agroclimatic conditions needed as potential explanatory variables, which may include seasonal rainfall, temperature, soil, topology, and so forth. Annual rainfall is explicitly included in the poverty and productivity equations because it is the only agroclimatic variable available at the state level for the last several decades. For other variables, the following procedure is used to reduce or even eliminate the bias, since these variables are usually fixed over time: for example, certain cultural factors such as religion and geographic characteristics such as their topology and distance to urban and industrial centers. Let the following equation represent any equation in the simultaneous system:

$$Y = \beta X + \gamma Z + \varepsilon, \tag{22}$$

where Y is the dependent variable, X is a vector of government investment variables, Z is a vector of other independent variables, and ε is an error term. If the government allocates its investment based on agroclimatic conditions, then X is correlated with the error term ε. By ignoring this endogeneity, the estimates of β vector will be biased.

Suppose $\varepsilon = e_i + e_{it}$, where e_i is a time invariant regional fixed effect representing agroclimatic conditions and e_{it} is white noise. This fixed effect can, in principle, be predicted by government in determining its investment allocation across regions.

Taking the first difference of equation (22),

$$Y_{it} \quad Y_{i,t\ 1} = \beta(X_{it} \quad X_{i,t\ 1}) + \gamma(Z_{it} \quad Z_{i,t\ 1}) + \varepsilon_{it} \quad \varepsilon_{i,t\ 1,} \text{ or}$$

$$y = \beta x + \gamma z + \varepsilon, \tag{23}$$

where y and z are the first differences of Y and X, and $\varepsilon = e_{it} - e_{i,t-1}$. Since e_{it} is purely white noise, it is unlikely that x is correlated with ε. Therefore, any bias in the β estimates will be reduced.[19]

Based on this reasoning, all variables (except the time trend) in the analysis were first transformed into geometric annual growth rates in logarithm form, $dx = \ln(x_t/x_{t-n})/n$, 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 different time intervals between observations.[20] It also alleviates potential multicollinearity problems among many dependent variables on the right-hand side of the equations and reduces the bias due to measurement errors.[21]

Lags and Distributions of Public Investments

The lead times can be long before government investments in R&D, roads, education, power, health, and irrigation affect agricultural production, but once they kick in, the effects can last a long time. One of the thornier problems to resolve when including government investment variables in a production or productivity function concerns the choice of appropriate lag structure. Most past studies use stock variables, which are usually weighted averages of current and past government expenditures on certain investments such as R&D. But what weights and how many years lag should be used in the aggregation are currently issues of some contention in the literature.[22] Since the shape and length of these investments are largely unknown, a free-form lag structure is used in the estimation: current and past government expenditures on certain invest-

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[19] Two other approaches to correct the potential bias were tried. In the first approach, government expenditures on R&D, irrigation, roads, power, health, rural development, and soil and water conservation were estimated as functions of state GDP and fixed time and state effects, using the annual data from 1953 to 1993. The predicted value was used instead of actual government expenditures to estimate the equations system. Very little change was found in the estimated parameters.

In the second approach, seven equations were added to the system with government expenditures as functions of state GDP and lagged terms-of-trade variables (since all variables are in difference forms, fixed effects in these equations have been eliminated), and the system was reestimated. Again, the results showed little difference.

[20] For more information on how to reduce estimated biases due to endogeneity of dependent variables, omitted variables, and measurement errors using the difference procedure, refer to Hsiao 1986.

[21] F tests were conducted for all equations in the system to test whether the slopes of all variables changed between pre-1986 and post-1986. For the poverty, TFP, wages, nonagricultural employment, public irrigation, private irrigation, and education equations, the hypothesis that there have been no structural changes could not be rejected at the 95 percent significance level. However, for the equations for power, terms of trade, and landlessness, the hypothesis is rejected, which means that there have been structural shifts in the equations (the slopes of coefficients have shifted). These changes do not affect the final results fundamentally, because these changes have occurred mainly in the power, price, and landless equations, and these equations are not dominant factors in determining rural poverty. However, adding slope dummies to all variables in the system would reduce the degrees of freedom substantially.

[22] Alston, Norton, and Pardey (1998) argue that research lag may be much longer than previously thought, or even infinite. But in many developing countries, the national agricultural research systems are much younger than those in developed countries (often 30 to 50 years old), and applied research is more common. Therefore, it is certain that research lags in developed countries are much shorter than those in developing countries.

ment items such as R&D, irrigation, roads, power, and education are included in the equations for productivity (equation 4), technology (equation 7), infrastructure (equations 9 and 11), and education (equation 10). Then statistical tools are used to test and determine the appropriate length of lag for each investment expenditure.

Various procedures have been suggested for determining the appropriate lag length. The adjusted R^2 and Akaike's Information Criteria (AIC) are used by many economists (Greene 1993). In this report, the adjusted R^2 is used. Since estimating R^2 from the simultaneous system does not provide the correct information on the fitness of the estimation, the adjusted R^2 estimated from the single equation is used.[23] The optimal length is determined when the adjusted R^2 reaches its maximum. The AIC is similar in spirit to the adjusted R^2 in that it rewards goodness of fit, but it penalizes the loss of degrees of freedom. The lags determined by the adjusted R^2 approach are 13 years for R&D, 8 years for irrigation, 11 years for education, 7 years for power, 7 years for roads, and 10 years for health. These lags are considered short compared with much longer lags obtained for the United States (Pardey and Craig 1989; Alston, Norton, and Pardey 1998).

Another problem related to the estimation of lag distribution is that independent variables (for example, RDE, RDE_{-1}, RDE_{-2}, ... and RDE_i in the TFP function) are often highly correlated, making the estimated coefficients statistically insignificant. Many ways of tackling this problem have been proposed. The most popular approach 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 report, PDLs with degree 2 are used. In this case, it is only necessary to estimate three instead of i+1 parameters for the lag distribution. For more detailed information on this subject, refer to Davidson and MacKinnon 1993. Once the lengths of lags are determined, the simultaneous equation system can be estimated with the PDLs and appropriate lag length for each investment.[24]

Estimation Results

The results of the systems equation estimation are presented in Table 5. Most of the coefficients in the estimated system are statistically significant at the 5 percent confidence level (one-tail test) or better.[25]

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[23] The single-equation estimation of lag length in the technology, infrastructure, and education equations will not cause any biases of the estimated lag lengths since there are no endogenous variables in the right-hand side of the equations. For the productivity equation, the inclusion of the annual rainfall and time trend variables in addition to the use of the first difference of all variables should reduce the bias of estimated parameters due to the endogeneity of government investment in R&D.

[24] The sums of the coefficients from PDLs and free-form lag structure are not significantly different for all types of expenditure except R&D. The summed coefficient of R&D expenditure from PDLs is substantially larger than that from free-form lag structure (0.296 versus 0.091). Therefore, the estimated productivity and poverty effects from free-form lag structure are also substantially lower than those from PDL distribution.

[25] R^2 is usually lower when dependent and independent variables are transformed into the difference form. The growth rates used for both dependent and independent variables are equivalent to the difference form in logarithm. The model with traditional double-log forms at the level for all equations were also estimated for comparison purposes. Both the *t*-values and R^2s are much better than those obtained under the difference form in Table 5 (almost all coefficients are statistically significant and R^2s range from 0.70 to 0.95).

Table 5 Determinants of rural poverty in India: Simultaneous equation system

Number	Equation	R^2
(3)	$P = -0.073^* - 0.164\ TFP^* - 0.205\ WAGES^* + 0.189\ TT^* - 0.458\ NAEMPLY^* + 0.000\ LANDN - 0.849\ POP + 0.380\ RAIN$	0.117
(4)	$TFP = -0.034 + 0.296\ TRDE^* + 0.145\ IR^* + 0.231\ ROADS^* + 0.532\ LITE^* + 0.356\ RAIN^*$	0.296
(5)	$WAGES = 0.089^* + 0.111\ TFP^* + 0.316\ ROADS^* + 1.457\ LITE^* + 0.005\ THELE$	0.133
(6)	$NAEMPLY = -0.027 + 0.046\ GERDEV^* + 0.208\ ROADS^* + 0.503\ LITE^* + 0.025\ GCSSL^*$	0.022
(7)	$PUIR = -0.035 + 0.120\ TIRE^* + 0.06\ PVELE + 0.07\ ATT$	0.127
(8)	$PRIR = -0.007 + 0.926\ PUIR^* - 0.127\ ATT + 0.013\ PVELE$	0.697
(9)	$ROADS = 0.007^* + 0.315\ TROADE^*$	0.113
(10)	$LITE = 0.032^* + 0.084\ TEDE^*$	0.270
(11)	$PVELE = 0.232 + 0.072\ TPWRE^*$	0.167
(12)	$LANDN = 0.031 + 0.026\ TFP$	0.022
(13)	$TT = -0.025 - 0.176\ TFP^* - 0.563\ TFP_n^* + 0.279\ WAPI^*$	0.379

Notes: Coefficients for expenditures on R&D (*TRDE*), irrigation (*TIRE*), roads (*TROADE*), education (*TEDE*), power (*TPWRE*), and health (*THELE*) are sums of coefficients of current and lagged expenditures. Coefficients for time-trend variables are not reported.

* Significant at the 5 percent level.

The estimated poverty equation (equation [3]) supports the findings of many previous studies. Improvements in agricultural productivity, higher agricultural wages, and increased nonagricultural employment opportunities have all contributed significantly to reducing poverty, whereas improvements in the terms of trade for agriculture have an immediate and negative short-term impact on the rural poor (Misra and Hazell 1996).[26] Population growth, the incidence of landlessness, and annual rainfall all have insignificant direct effects on poverty.

The estimated TFP equation (equation [4]) shows that agricultural research and extension, improved roads, irrigation, and education have all contributed significantly to growth in TFP. The coefficient reported here for agricultural research and extension is the sum of the past 13 years of coefficients from the PDL distribution. The significance test is the joint *t* test of the three parameters of the PDLs.

The estimated wage equation (5) shows that TFP growth and investments in rural roads, education, and health have all contributed to increases in agricultural wages. The estimated nonagricultural employment equation (equation [6]) shows the importance of government expenditures on rural development and soil and water conservation in creating additional rural employment. Additionally, investments in roads and literacy have also been successful in promoting nonagricultural employment.

The estimated public irrigation equation (equation [7]) confirms that the percentage of the cropped area under canal irrigation is primarily a result of government investment, and that this has also been a significant catalytic force in driving private investment in well and tube-well irrigation (equation [8]). Improvements in the terms of trade seem not to have been a significant factor in encouraging either public or private investment in irrigation.

The estimated results for equations (9), (10), and (11) show that government investments in roads, education, and power have contributed to the development of roads, to increased literacy, and to the increased percentage of villages that are electrified. Most of the coefficients are statistically significant.

The estimated equation (12) for the incidence of rural landlessness shows that growth in TFP does lead to an increase in landlessness. But the coefficient is small and statistically insignificant. This may be due to the interpolation of missing observations of the landless variable. Finally, the estimated terms of trade equation (equation [13]) confirms that increases in TFP at the national and state levels do exert a downward pressure on agricultural prices, worsening the terms of trade for agriculture. It also shows that domestic agricultural prices are highly correlated with world agricultural prices.

The estimated model shows clearly that improvements in agricultural productivity not only reduce rural poverty directly by increasing income (equation [3]), but they also reduce poverty indirectly by improving wages (equation [5]) and lowering agricultural prices (equation [13]). On the other hand, improvements in agricultural pro-

[26] A variable of expenditure on rural development (measured in stock terms with a three-year lag) is also included in the road and productivity equations. The coefficients are not statistically significant in either of the equations.

ductivity contribute to worsening poverty by increasing landlessness (equation [12]), though this effect is relatively small.

Rural Poverty Elasticities and Marginal Impact

The total effects 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 percent change in government expenditure on that item. Because a double log function is used, the elasticities are obtained directly from the derivatives in equations (14) through (21). 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 total elasticities for each expenditure item are decomposed into their various direct and indirect components in Figures 6 to 13.[27]

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 incremental increases in expenditures on different items, and it provides crucial information for policymakers 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 elasticities by the ratio of the poverty or productivity variable to the relevant government expenditure item in 1993. Table 6 also shows the number of poor people

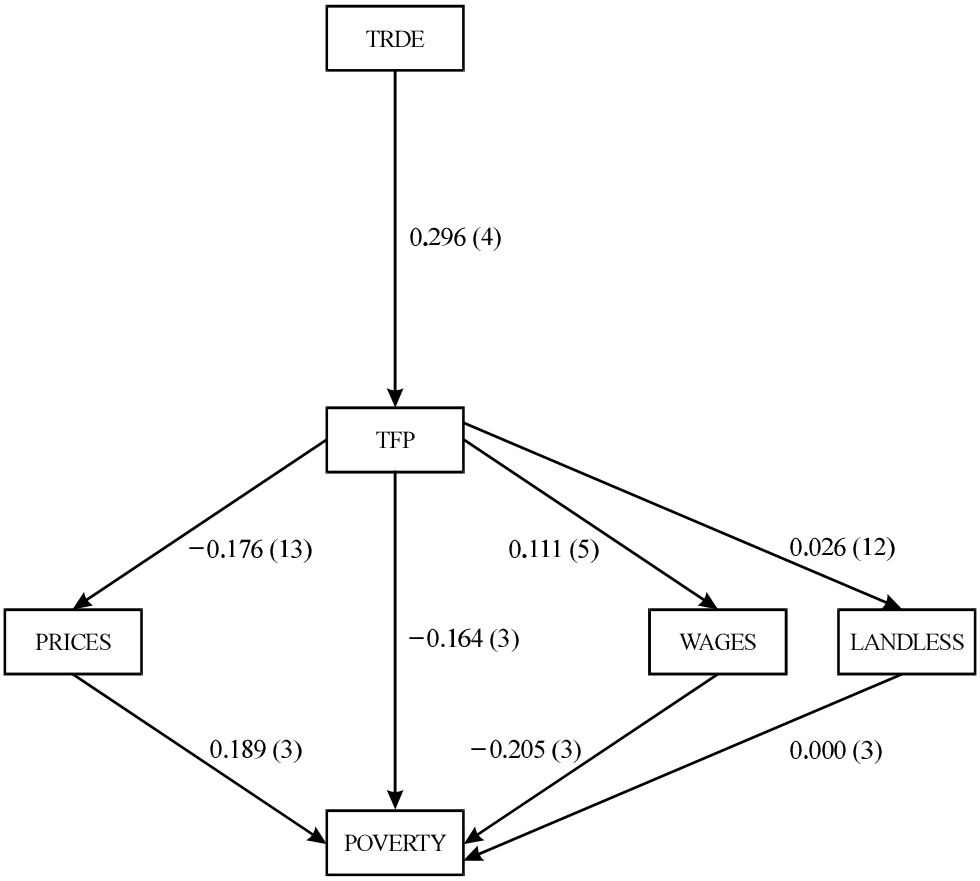
Table 6 Effects on poverty and productivity of additional government expenditures

Expenditure variable	Elasticities				Marginal impact of spending Rs 100 billion at 1993 prices				Number of poor reduced /Rs million spent	
	Poverty		TFP		Poverty		TFP			
	(percent)									
R&D	–0.065*	(2)	0.296*	(1)	–0.48*	(2)	6.98*	(1)	91.4*	(2)
Irrigation	–0.007	(5)	0.034*	(4)	–0.04	(6)	0.56*	(3)	7.4	(5)
Roads	–0.066*	(1)	0.072*	(2)	–0.87*	(1)	3.03*	(2)	165.0*	(1)
Education	–0.054*	(3)	0.045*	(3)	–0.17*	(3)	0.43*	(4)	31.7*	(3)
Power	–0.002	(6)	0.0007	(5)	–0.015	(8)	0.02	(5)	2.9	(7)
Soil and water	–0.0004	(7)	0	(6)	–0.035*	(7)	0	(6)	6.7*	(6)
Rural development	–0.019*	(4)	n.a.		–0.15*	(5)	n.a.		27.8*	(4)
Health	–0.0007	(8)	n.a.		–0.02	(4)	n.a.		4.0	(8)

Note: Numbers in parentheses are ranks. TFP is total factor productivity. n.a. is not available.
* Significant at the 5 percent level.

[27] *TRDE, TIRE, TROADE, TEDE, TPWRE*, and *THELE* in Figures 6, 7, 8, 9, 11, and 12 represent the coefficients summed over the lag period that affects the current year's production growth and poverty alleviation.

Figure 6 Effects on poverty of governmental expenditures on agricultural research and development



Total poverty effects $\frac{dP}{dTRDE} = -0.065$

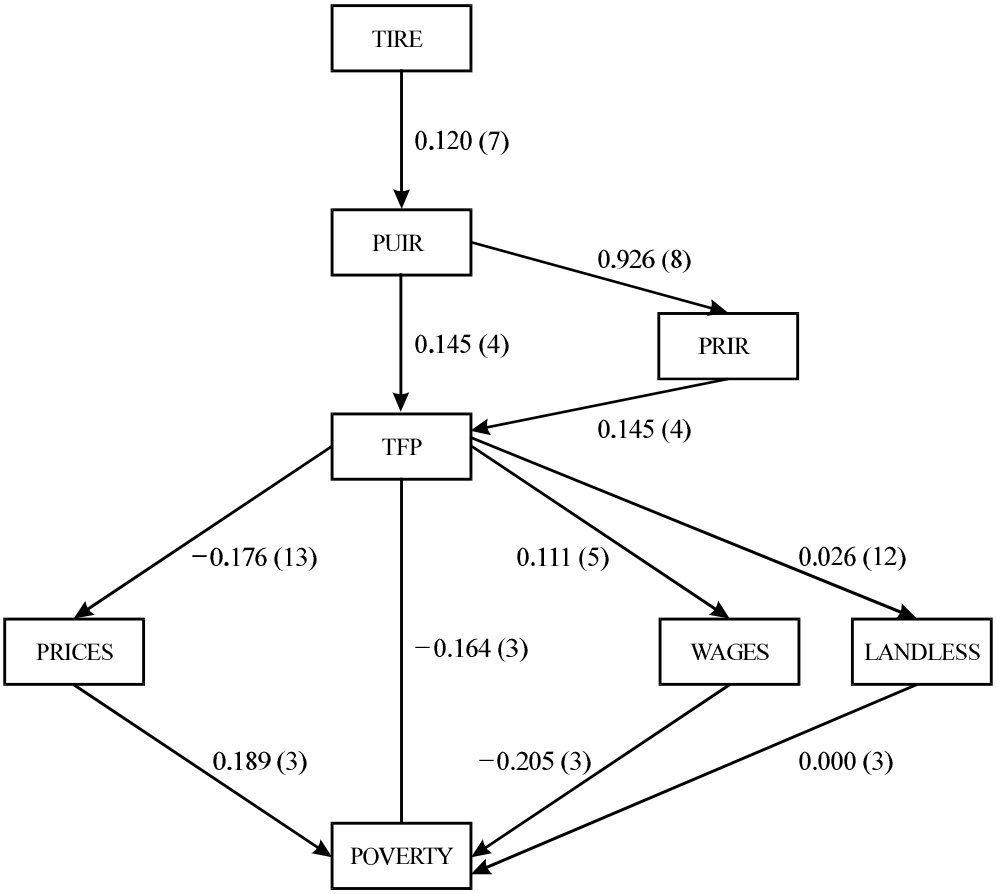
Effects on poverty (percent) per billion rupees spent = −0.48

Note: Numbers in parentheses correspond to equation numbers in Table 5.

who would be raised above the poverty line for each Rs 1 million of additional investment in an expenditure item.

An important feature of the results in Table 6 is that all the productivity-enhancing investments considered offer a "win-win" strategy for reducing poverty, while increasing agricultural productivity at the same time. There appear to be no trade-offs between these two goals. However, there are sizable differences in the productivity gains and poverty reductions obtained for incremental increases in each expenditure item.

Figure 7 Effects on poverty of governmental expenditures on irrigation



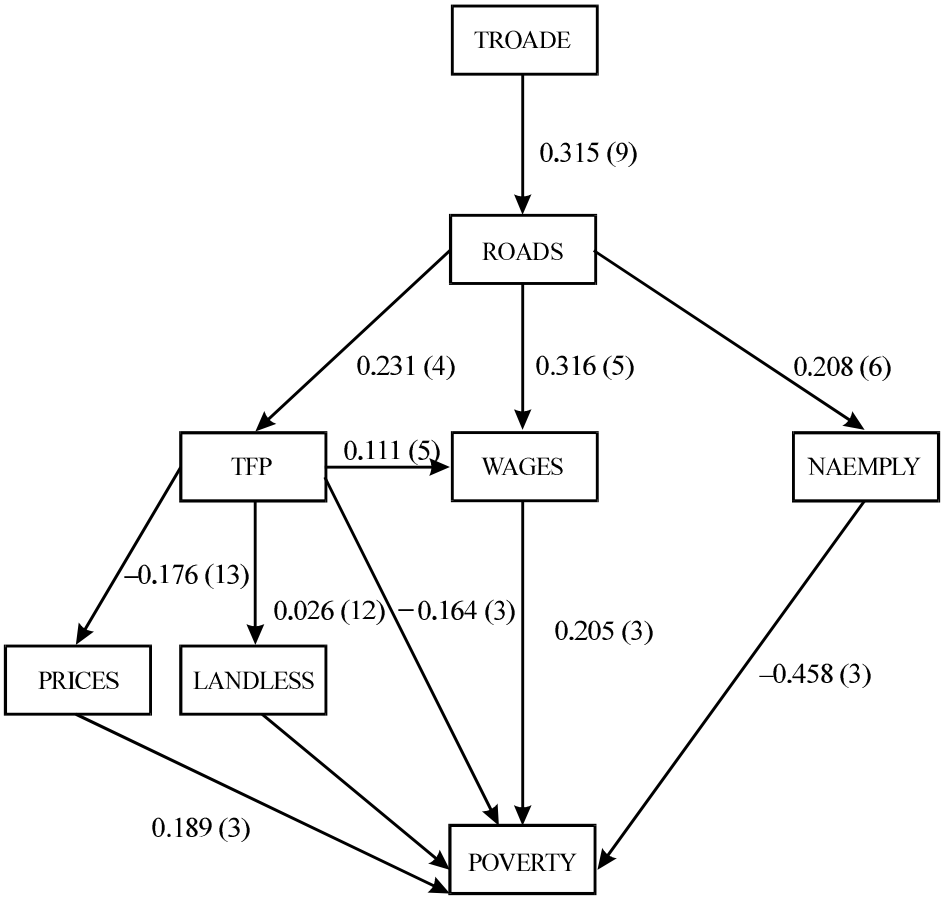
Total poverty effects $\frac{}{dTIRE}$ = 0.007

Effects on poverty (percent) per billion rupees spent = −0.04

Note: Numbers in parentheses correspond to equation numbers in Table 5.

Government expenditure on roads has by far the largest impact on rural poverty. 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 0.9 percent. Moreover, for each increase in investment in roads of Rs 1 million, 165 poor people would be lifted above the poverty line. These impacts on poverty are nearly twice as large as those of the next best poverty reducer—government investment in agricultural R&D. Investment in roads also contributes importantly to growth in TFP. An

Figure 8 Effects on poverty of governmental expenditures on roads

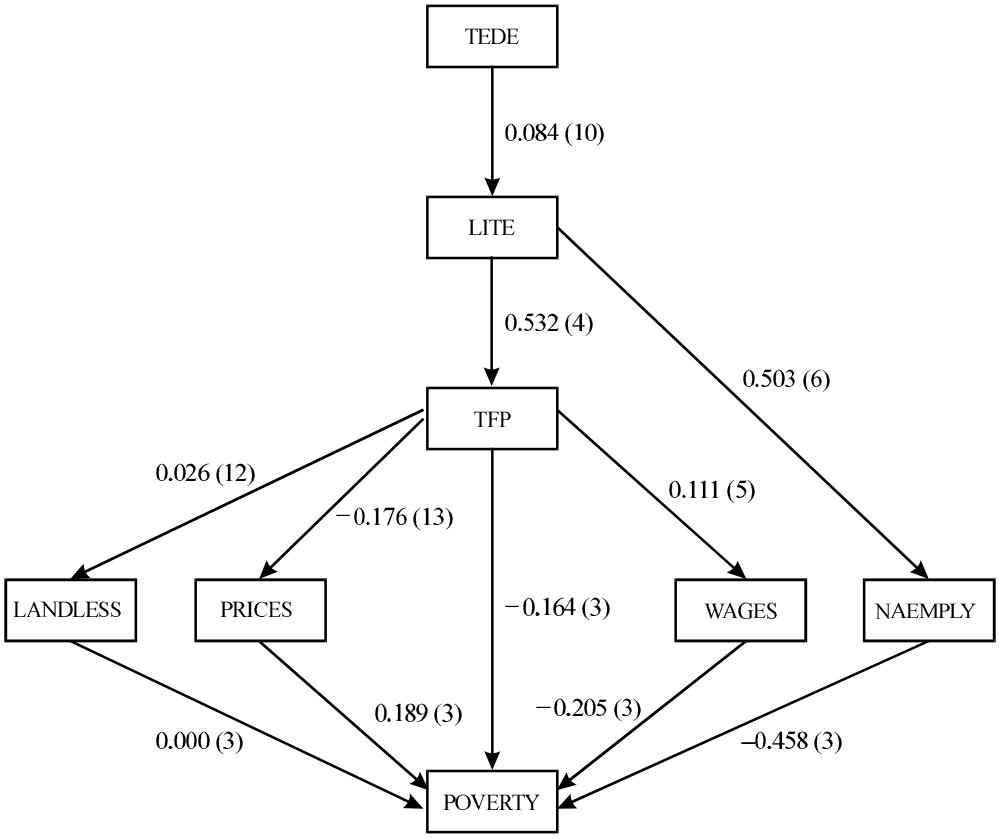


$$\frac{dP}{dTROADE} = -0.066$$

Effects on poverty (percent) per billion rupees spent = −0.87

Note: Numbers in parentheses correspond to equation numbers in Table 5.

Figure 9 Effects on poverty of governmental expenditures on education



Total poverty effects $\frac{dP}{dTEDE} = -0.054$

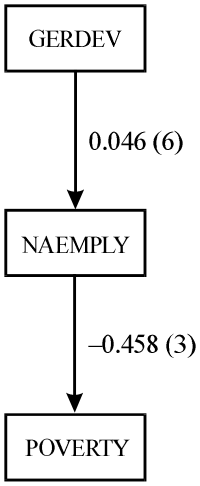
Effects on poverty (percent) per billion rupees spent = −0.17

Note: Numbers in parentheses correspond to equation numbers in Table 5.

additional Rs 100 billion invested in roads would increase TFP growth by 3 percent. This growth effect is second only to investments in agricultural R&D.

Investment in roads reduces rural poverty through productivity growth, but it also increases nonagricultural employment opportunities and leads to higher wages (Figure 8). The productivity effect accounts for 24 percent of the total impact on poverty, nonagricultural employment accounts for 55 percent, and increases in rural wages account for the remaining 31 percent. Of the total productivity effect on poverty, 75 percent arises from the direct impact of roads in increasing incomes, while the remaining 25 percent arises from lower agricultural prices (15 percent) and increased wages (10

Figure 10 Effects on poverty of governmental expenditures on rural and community development



Total poverty effects $\frac{dP}{dGERDEV} = -0.019$

Effects on poverty (percent) per billion rupees spent = −0.15

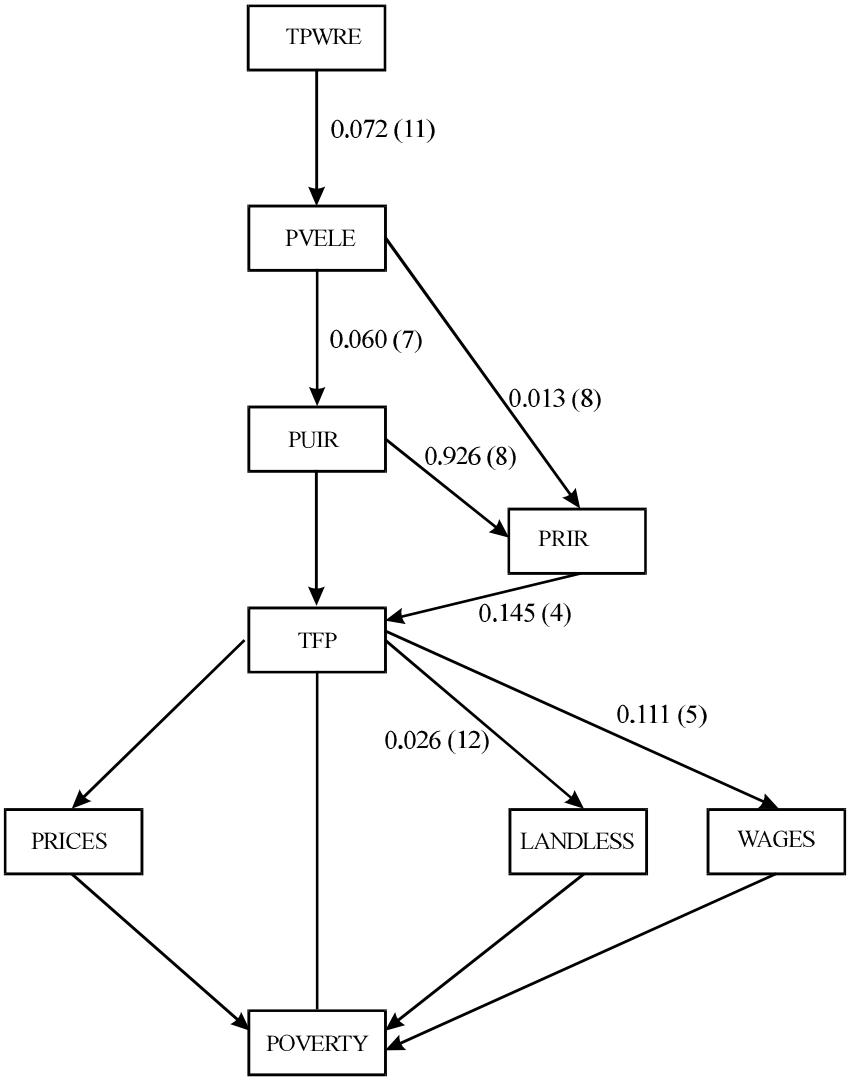
Note: Numbers in parentheses correspond to equation numbers in Table 5.

percent). An increase in the incidence of landlessness arising from the induced productivity growth has no significant impact on rural poverty.

Government investment in agricultural research and development (R&D) has the second largest effect on rural poverty, but the largest impact of any investment on growth in TFP. Another Rs 100 billion of investment in R&D would increase TFP growth by almost 7 percent and reduce the incidence of rural poverty by 0.5 percent. Moreover, another Rs 1 million spent on R&D would raise 91 poor people above the poverty line (Table 6). R&D has a smaller impact on poverty than roads because it only affects poverty through improved productivity, and it has not been particularly targeted to the poor by the government (Figure 6). If future agricultural R&D were more deliberately targeted to the poor, it might well have a greater impact on poverty (Hazell and Fan 1998).

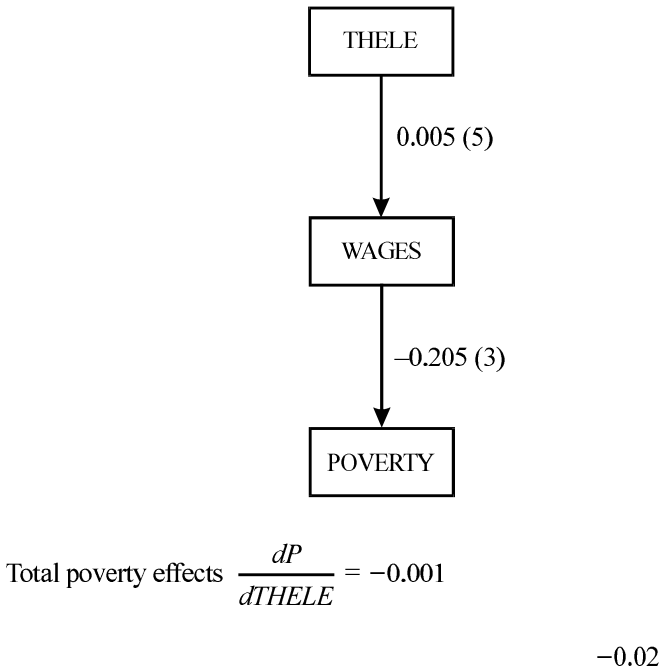
Government spending on education has the third largest impact on rural poverty reduction. An additional Rs 1 million spent on education would raise 32 poor people above the poverty line. Most of this effect arises from greater nonfarm employment opportunities and increased wages (Figure 9). Education, at least when measured as a simple literacy ratio, as it is here, has only a modest impact on growth in agriculture's TFP.

Figure 11 Effects on poverty of governmental expenditures on power



Note: Numbers in parentheses correspond to equation numbers in Table 5.

Figure 12 Effects on poverty of governmental expenditures on health



Note: Numbers in parentheses correspond to equation numbers in Table 5.

Government expenditure on rural development has the fourth largest impact on poverty reduction. Another Rs 1 million of expenditure would raise 28 poor people above the poverty line, an impact comparable to additional investment in education. But unlike other investments with similar or greater impacts on poverty, rural development expenditures have no discernible impact on TFP growth in agriculture, and hence do not provide a long-term solution to the poverty problem (Figure 10).[28]

Government expenditure on irrigation has the fifth largest impact on rural poverty reduction. Another Rs 1 million of expenditure would raise 7 poor people above the poverty line. However, public irrigation investments have the third largest impact on TFP growth; an additional Rs 100 billion would add 0.6 percent to the TFP growth rate.[29] Public irrigation affects poverty through its impact on productivity, and this impact is enhanced by its catalytic role in stimulating additional private investment in irrigation (Figure 7).

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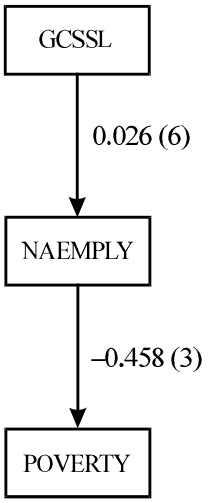
[28] Dreze, Lanjouw, and Sharma (1998) also concluded that except for the modest success of a program providing two water handpumps near the low-caste quarters, the programs have been extremely disappointing.

[29] The lesser impact of irrigation on agricultural production and productivity growth was also confirmed by Evenson, Pray, and Rosegrant (1998). They estimated that the marginal internal rate of return is only about 4 to 6 percent for irrigation, but 45 percent for extension, and 55 to 59 percent for research.

Figure 13 Effects on poverty of governmental expenditures on soil and water conservation



$$\text{Total poverty effects } \frac{dP}{dGCSSL} = -$$

Note: Numbers in parentheses correspond to equation numbers in Table 5.

Government expenditure on power has positive but small and statistically insignificant impacts on both rural poverty 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 percent greater than expenditure on roads in 1993), but current account expenditure has also increased enormously since 1990; about 90 percent of all rural villages are already electrified (Table 2). More than 90 percent of the total power effects are derived from nonfarm employment, while the remaining effect arises from productivity increases obtained through improved irrigation (Figure 11).

Additional government expenditures on soil and water conservation and health have small impacts on rural poverty, and the impact is statistically insignificant in the case of health. They also have no discernible effects on agricultural productivity growth.

CHAPTER 6

Conclusions

Using state-level data for 1970 to 1993, a simultaneous equations model is developed for this report 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 government spending on productivity-enhancing investments (especially agricultural research and extension), rural infrastructure (especially roads and education), and rural development targeted directly to the rural poor, all contribute to reductions in rural poverty, and most also contribute to growth in agricultural productivity.[30] But their effects on poverty and productivity differ greatly.

The model is also used to estimate the marginal returns to agricultural productivity growth and poverty reduction obtainable from additional government expenditures on different technology, infrastructure, and social investments. Additional government expenditure on roads is found to have the largest impact on poverty reduction as well as a significant impact on productivity growth. It is a dominant "win-win" strategy. Additional government spending on agricultural research and extension has the largest impact on agricultural productivity growth, and it also leads to large benefits for the rural poor. It is another dominant "win-win" strategy. Additional government spending on education has the third largest impact on rural poverty reduction, largely as a result of the increases in nonfarm employment and rural wages that it induces.

Additional irrigation investment has the third largest impact on growth in agricultural productivity and a smaller impact on rural poverty reduction, even allowing for

[30] The results obtained from this study differ sharply from those of Datt and Ravallion (1997), who used the aggregate state development expenditures and found insignificant correlation with rural poverty reduction. In another study, Sen (1997) found that while the aggregate state expenditures have a positive and significant impact on rural poverty, he could not obtain similar results using the individual items of government expenditures. This may be due to the different specifications of the models.

trickle-down benefits.[31] Additional government spending on rural and community development, including Integrated Rural Development Programs, contributes to reductions in rural poverty, but its impact is smaller than expenditures on roads, agricultural R&D, and education. Additional government expenditures on soil and water conservation and health have no impact on productivity growth, and their effects on poverty alleviation through employment generation and wage increases are also small.

The results of this study have important policy implications. In order to reduce rural poverty, the Indian government should give priority to increasing its spending on rural roads and agricultural research and extension. These types of investment not only have a large impact on poverty per rupee spent, but they also produce the greatest growth in agricultural productivity. Additional government spending on irrigation has substantial productivity effects, but no discernible impact on poverty reduction. The impact of government spending on power is smaller than other productivity-enhancing investments, and its poverty effect is also small. While these investments have been essential in the past for sustaining agricultural growth, the levels of investment stocks achieved may now be such that it may be more important to maintain those current stocks rather than to increase them further. Additional government spending on rural development is an effective way of helping the poor in the short term, but since it has little impact on agricultural productivity, it contributes little to long-term solutions to the poverty problem.

[31] Increased investment in irrigation played a large role in production growth during the Green Revolution; without these investments the returns to investments in roads and R&D would have been much smaller. Indeed, these higher returns are conditional on the past investments in irrigation. However, it is the marginal returns of each additional unit of investments that is measured here. Given the past investments, adding more money to irrigation may yield lower returns to productivity growth and poverty reduction than investing in roads and irrigation.

APPENDIX

Supplementary Tables

Table 7 Development expenditures, by state, 1970 93

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(1960/61 Rs million)
1970	1,083	462	795	877	344	70	276	753	612
1971	1,350	478	926	1,114	506	235	385	858	743
1972	1,347	439	963	1,226	420	269	410	1,190	720
1973	1,339	403	856	1,180	503	236	414	1,042	729
1974	1,325	426	911	1,269	528	234	418	1,023	691
1975	1,949	505	1,470	1,315	683	225	549	1,452	886
1976	2,353	593	1,662	1,821	829	267	542	1,600	1,090
1977	2,870	796	1,471	1,980	789	358	667	1,796	1,251
1978	3,347	892	2,020	2,245	1,051	500	930	2,247	1,414
1979	3,406	854	2,077	2,657	1,100	518	754	2,326	1,554
1980	3,386	975	2,402	2,901	1,100	534	818	2,242	1,742
1981	3,517	1,073	2,682	3,237	1,214	617	862	2,645	1,841
1982	4,152	1,268	3,266	4,044	1,485	683	874	3,180	1,924
1983	4,493	1,309	2,494	3,682	1,356	565	824	2,599	1,619
1984	5,057	1,566	3,159	4,081	1,486	669	967	3,096	1,727
1985	5,549	1,711	3,852	3,699	1,605	811	1,163	3,481	2,169
1986	6,332	1,793	4,009	4,759	1,700	894	1,273	3,994	2,120
1987	5,887	1,925	3,909	5,262	1,726	994	1,463	3,939	2,008
1988	6,238	1,928	4,208	5,183	1,691	998	1,288	3,613	2,039
1989	6,756	2,053	4,353	5,337	1,769	951	1,410	4,000	2,159
1990	7,282	2,068	4,864	5,482	1,795	994	1,661	4,007	2,330
1991	6,592	2,176	4,238	5,574	1,774	861	1,420	4,461	2,324
1992	6,693	1,960	4,381	6,029	1,861	851	1,327	4,386	2,300
1993	8,003	2,033	4,341	5,749	1,781	1,044	1,474	5,253	2,407
Annual growth rate (percent)									
1970–79	13.57	7.05	11.26	13.11	13.78	24.97	11.81	13.35	10.91
1980–89	7.98	8.63	6.83	7.01	5.42	6.62	6.24	6.65	2.41
1990–93	3.19	–0.57	–3.72	1.60	–0.26	1.64	–3.91	9.44	1.09
1970–93	9.08	6.65	7.66	8.52	7.41	12.49	7.55	8.81	6.14

Source: Calculated by the authors using data from Reserve Bank of India, various years.
Notes: Assam's expenditures are deflated using West Bengal's consumer price index for agricultural labor, and Himachal Pradesh and Jammu and Kashmir's expenditures are deflated by Punjab's consumer price index for labor.
n.a. is not available.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
770	1,504	443	449	709	1,155	1,252	842	12,398
1,003	1,433	564	588	913	1,450	1,821	1,146	15,513
983	1,810	610	664	935	1,528	1,956	1,331	16,803
956	2,360	623	742	866	1,467	1,885	1,040	16,639
975	1,946	521	726	763	1,105	2,057	1,157	16,076
1,366	2,541	665	976	1,185	1,541	2,991	1,602	21,900
1,866	3,242	869	1,315	1,438	1,953	3,884	1,770	27,094
1,883	3,558	987	1,026	1,420	2,245	3,447	1,744	28,287
2,252	4,522	1,235	1,216	1,834	2,591	4,382	2,716	35,392
2,475	4,622	1,104	1,515	1,890	2,662	4,396	2,415	36,325
2,842	4,649	1,414	1,360	1,793	3,239	4,292	2,647	38,336
3,099	5,335	1,588	1,617	2,224	3,728	4,998	3,145	43,421
3,441	6,305	1,860	1,856	2,402	4,260	5,493	3,598	50,091
3,376	5,878	1,262	1,838	2,379	3,715	5,585	2,818	45,792
3,644	6,575	1,555	1,868	2,252	4,244	6,748	3,451	52,145
3,713	7,262	1,716	2,275	2,437	4,427	6,265	3,562	55,697
4,104	7,997	1,978	2,073	3,112	4,542	7,392	3,770	61,843
4,372	7,887	1,940	2,888	3,713	4,878	6,534	3,825	63,148
4,375	8,342	2,090	2,487	3,162	4,735	7,182	4,077	63,634
4,313	9,488	2,164	2,455	2,955	5,672	7,819	4,417	68,070
4,860	9,654	2,524	2,542	3,466	6,043	8,656	4,852	73,080
4,568	7,873	2,387	3,716	4,021	7,896	7,490	4,028	71,397
4,978	8,842	2,516	2,307	4,188	6,945	9,123	4,095	72,782
5,327	10,580	2,540	2,201	4,146	6,689	7,351	4,539	75,457
13.85	13.28	10.68	14.46	11.50	9.72	14.98	12.42	12.69
4.74	8.25	4.84	6.78	5.71	6.42	6.89	5.85	6.59
3.11	3.10	0.22	–4.70	6.15	3.44	–5.30	–2.20	1.07
8.77	8.85	7.89	7.15	7.98	7.94	8.00	7.60	8.17

Table 8 Per capita development expenditures, by state, 1970 93

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(1960/61 Rs/person
1970	31	34	16	46	42	21	72	34	34
1971	38	34	18	57	60	69	98	38	41
1972	37	31	18	61	49	78	102	52	39
1973	36	28	16	58	57	67	101	45	39
1974	35	29	17	60	58	65	100	44	36
1975	51	34	26	61	74	62	128	61	46
1976	60	39	29	83	88	72	124	64	55
1977	72	51	25	88	81	95	149	70	62
1978	83	56	34	99	107	130	203	86	70
1979	83	53	34	115	110	133	161	88	77
1980	82	59	39	123	108	134	171	84	85
1981	84	64	43	136	117	152	176	98	89
1982	97	74	51	167	140	166	175	116	92
1983	103	76	38	149	125	135	161	93	77
1984	114	89	47	163	134	156	184	109	82
1985	123	94	56	145	141	186	215	120	103
1986	137	96	57	184	146	200	229	135	100
1987	126	101	54	200	145	218	257	131	94
1988	131	99	57	195	140	215	221	118	96
1989	139	103	58	198	143	201	236	129	101
1990	148	102	64	200	142	206	272	127	108
1991	131	105	54	201	138	175	227	139	108
1992	131	93	55	214	141	169	207	135	106
1993	154	94	54	201	133	204	225	159	111
Annual growth rate (percent)									
1970–79	11.67	5.10	9.03	10.79	11.37	22.77	9.40	11.13	9.37
1980–89	6.12	6.39	4.61	5.37	3.20	4.57	3.66	4.89	1.91
1990–93	1.47	–2.53	–5.65	0.17	–2.28	–0.35	–6.11	7.68	0.74
1970–93	7.25	4.58	5.48	6.66	5.17	10.39	5.09	6.94	5.25

Source: Calculated by the authors using data from Reserve Bank of India, various years.
Notes: Rural population is used to calculate per capita expenditure.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal
22	43	22	43	33	40	16	25
28	41	28	56	42	50	24	34
27	50	29	62	42	52	25	38
26	65	30	68	38	49	23	29
26	52	24	65	32	36	25	32
35	67	30	86	49	50	36	43
47	84	39	114	57	63	45	47
47	90	44	87	55	71	39	45
55	113	54	102	70	81	49	69
60	114	48	126	71	82	49	60
67	113	60	111	66	99	47	65
72	128	67	130	80	113	53	76
79	149	77	147	84	127	58	85
76	136	51	143	81	110	57	65
80	149	62	143	75	123	68	78
80	161	67	171	79	127	61	79
86	174	76	153	99	128	71	82
90	169	73	209	115	136	61	81
88	176	78	177	96	131	66	85
85	197	79	172	87	155	70	90
94	197	91	176	100	163	76	97
87	158	84	252	114	210	65	79
92	174	88	154	116	182	77	78
97	205	87	145	112	173	61	85
11.67	11.34	8.89	12.51	8.68	8.30	12.76	10.19
2.61	6.36	3.09	5.00	3.23	5.06	4.69	3.63
1.07	1.37	–1.41	–6.23	3.79	2.16	–7.20	–4.19
6.64	6.98	6.13	5.37	5.40	6.56	5.85	5.42

Table 9 Percentage of cropped area sown with high-yielding varieties, by state, 1970 95

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(percent)
1970	11.93	6.13	14.16	14.90	20.45	6.09	n.a.	10.38	17.50
1971	15.31	9.56	19.30	15.32	29.85	5.89	n.a.	10.62	29.06
1972	24.85	12.98	27.46	13.27	33.50	6.62	n.a.	17.45	12.79
1973	31.75	12.85	33.85	15.06	44.78	6.50	n.a.	18.24	18.45
1974	40.01	14.68	21.66	14.06	51.64	6.48	n.a.	24.00	11.15
1975	40.06	13.85	26.44	15.71	52.69	6.14	n.a.	35.74	17.39
1976	37.22	17.84	31.55	17.76	52.05	5.93	n.a.	25.14	18.05
1977	42.35	22.94	34.51	18.54	59.87	6.09	n.a.	32.42	20.50
1978	44.04	23.99	30.30	19.38	62.44	6.00	n.a.	35.10	20.12
1979	42.15	16.57	34.40	23.89	62.23	5.93	n.a.	34.11	22.15
1980	53.26	18.63	32.27	23.43	65.29	5.71	n.a.	42.94	28.71
1981	48.88	23.45	33.20	24.06	68.15	5.89	n.a.	39.14	22.59
1982	53.88	27.10	36.77	22.67	71.05	5.87	n.a.	36.71	28.04
1983	51.84	26.02	35.23	28.19	70.43	5.86	n.a.	38.35	28.65
1984	58.74	29.18	35.81	27.58	74.87	5.62	n.a.	40.53	28.19
1985	62.63	34.02	36.03	23.03	69.77	5.78	n.a.	41.23	28.73
1986	62.97	36.93	36.81	21.20	65.47	5.79	n.a.	36.05	23.26
1987	67.50	36.34	37.97	26.56	77.19	5.91	n.a.	36.68	24.43
1988	65.07	36.68	38.24	31.96	74.41	5.91	n.a.	39.95	19.88
1989	72.87	38.43	41.85	28.92	79.63	6.08	n.a.	41.00	22.82
1990	74.73	46.14	44.43	35.05	80.12	5.99	n.a.	43.00	25.61
1991	79.03	52.47	46.50	31.27	89.26	6.42	n.a.	46.20	28.70
1992	80.00	38.74	48.53	35.16	65.34	6.47	n.a.	46.76	26.22
1993	83.29	38.29	47.42	33.86	68.90	6.84	n.a.	47.48	35.10
1994	82.69	41.59	46.78	39.53	75.73	7.79	n.a.	47.93	34.21
1995	83.00	41.59	45.93	40.00	78.41	8.02	n.a.	48.00	33.35

Source: Compiled from various state statistical abstracts and published government data.
Note: n.a. is not available.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
5.08	15.21	4.10	55.81	4.83	37.00	35.99	12.42	17.07
7.44	11.27	6.38	54.67	6.04	46.00	36.41	13.53	19.24
10.26	14.95	8.66	58.10	7.48	51.58	37.52	17.38	22.83
15.25	21.08	7.36	63.85	7.52	50.30	37.84	16.68	25.23
18.18	19.31	6.79	71.78	9.97	47.37	40.13	18.52	26.40
20.97	27.38	9.87	71.55	12.39	39.87	39.98	21.12	29.05
24.29	34.35	12.14	70.98	13.37	48.50	41.48	26.30	31.60
25.49	38.35	13.93	78.48	12.48	49.48	41.96	30.76	34.40
25.94	39.40	18.47	73.28	12.70	48.91	50.95	35.83	36.24
19.05	40.67	22.53	78.71	12.53	48.07	53.56	36.83	36.95
32.37	51.35	24.23	84.21	22.79	56.77	46.35	30.59	40.45
26.93	40.17	27.31	87.79	11.50	65.33	53.92	32.80	40.12
27.83	44.14	30.06	87.00	12.18	74.81	58.57	35.35	42.61
32.49	43.87	30.34	88.74	14.06	61.84	47.25	35.46	40.50
34.94	55.55	33.02	90.98	18.15	62.17	47.71	39.86	44.56
36.82	52.01	30.64	94.56	16.96	59.37	49.59	39.75	44.31
42.63	56.50	35.58	92.35	15.60	59.15	52.17	38.60	45.62
41.19	58.82	42.61	96.94	17.95	56.92	52.96	42.82	48.46
43.25	59.25	39.68	90.79	13.25	62.55	50.51	45.34	46.82
47.26	63.25	42.57	93.55	11.85	67.00	51.00	45.01	53.39
45.83	66.09	50.66	96.75	13.47	72.51	53.28	38.79	53.36
58.57	68.71	51.85	97.31	15.54	66.95	53.29	51.06	57.29
59.24	67.86	50.78	96.40	16.77	56.63	50.70	46.86	55.83
43.60	68.60	47.01	93.27	20.48	55.44	46.94	48.02	57.48
64.01	73.47	43.92	89.45	20.59	53.75	47.90	54.91	64.49
66.00	74.00	44.99	90.00	16.63	55.00	48.00	56.94	59.20

Table 10 Percentage of cropped area irrigated, by state, 1970 95

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(percent)
1970	30.37	8.67	27.52	13.72	39.69	15.25	36.31	12.43	21.08
1971	30.93	9.36	27.11	13.67	39.81	15.25	36.52	12.52	18.74
1972	29.26	9.45	26.89	14.09	42.20	15.68	37.10	15.13	18.93
1973	28.27	9.62	28.73	14.79	46.56	17.85	38.18	12.91	18.78
1974	30.83	10.00	31.28	15.14	49.92	17.25	39.34	13.30	18.80
1975	32.00	10.11	29.94	15.99	50.47	17.30	40.01	13.93	18.82
1976	33.43	10.38	30.98	16.85	53.96	17.15	40.72	15.83	18.82
1977	33.73	10.67	32.16	17.71	54.57	17.27	41.37	15.07	18.25
1978	34.35	10.91	34.96	18.58	53.04	17.27	41.65	15.83	13.47
1979	35.45	11.30	34.95	19.25	52.77	17.37	42.39	16.06	13.69
1980	34.36	11.58	35.30	20.79	60.10	17.33	40.63	15.90	13.88
1981	34.75	11.74	34.94	21.78	61.05	17.38	40.05	16.36	14.48
1982	35.36	11.82	36.34	23.09	58.81	17.43	40.18	16.55	14.99
1983	35.62	11.50	36.41	23.29	66.35	17.42	40.29	16.55	14.99
1984	38.33	11.67	37.30	24.97	59.85	17.40	40.40	17.51	14.99
1985	37.55	12.07	37.75	23.30	63.58	17.41	40.60	18.92	15.05
1986	36.56	12.16	39.75	22.86	65.68	17.41	41.02	18.35	17.72
1987	38.27	12.17	40.43	23.12	61.82	17.42	39.33	19.76	14.85
1988	37.66	12.20	39.82	23.83	80.24	17.72	39.45	19.80	18.46
1989	38.05	12.18	39.89	26.02	62.45	17.64	42.77	23.57	17.98
1990	40.01	12.83	40.12	26.15	69.72	18.05	39.55	22.78	12.69
1991	40.41	12.30	39.98	25.69	76.10	18.46	41.50	23.05	12.22
1992	42.22	12.51	40.25	25.25	77.60	17.53	40.97	24.39	12.00
1993	41.59	12.40	39.99	27.00	75.92	17.59	34.74	24.37	12.50
1994	43.19	12.36	39.63	26.99	76.60	17.65	34.61	25.56	12.50
1995	43.51	12.73	41.56	26.90	79.59	18.99	39.55	25.90	14.06

Source: Compiled from various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
8.47	8.45	16.58	74.47	14.68	45.56	38.06	20.34	23.34
8.47	8.46	16.58	74.47	14.67	45.71	38.40	21.14	23.41
9.25	9.04	10.41	76.21	14.55	45.98	39.09	19.04	23.20
9.49	8.51	18.16	76.50	16.66	47.70	39.83	21.04	24.56
9.40	9.12	17.76	76.43	15.01	48.03	40.19	22.56	24.79
9.40	9.82	18.23	76.43	15.38	47.91	40.79	23.10	25.18
9.40	10.48	18.69	76.34	15.65	47.30	41.33	23.64	25.82
9.40	11.17	19.15	76.43	15.34	47.17	40.34	24.18	26.05
10.47	11.68	18.72	80.73	18.19	46.53	42.75	24.72	27.07
11.20	11.84	19.09	82.41	19.75	45.98	43.64	25.13	27.69
10.76	11.88	19.89	86.46	23.73	46.02	43.94	25.54	28.46
11.55	12.04	19.25	84.73	21.61	47.49	45.12	25.94	28.72
11.63	12.67	19.81	85.23	20.01	44.75	44.31	26.33	28.76
11.63	11.74	21.42	85.23	22.72	42.27	45.58	26.73	29.18
11.63	11.41	23.08	84.64	22.03	42.79	47.16	27.11	29.61
11.63	11.63	25.14	89.58	22.11	42.57	49.27	27.50	30.39
13.77	11.61	26.67	90.09	21.30	47.50	51.25	27.88	31.17
15.89	12.16	27.52	90.20	24.66	43.36	53.72	28.26	32.35
15.49	11.55	28.02	90.50	28.54	42.43	57.41	28.63	33.41
17.03	13.56	29.99	91.27	21.53	43.85	56.26	28.74	33.12
16.92	14.01	30.26	91.24	23.43	45.19	55.33	29.02	33.49
20.01	12.10	23.50	93.69	24.39	44.45	56.17	31.06	33.80
18.03	11.45	21.56	92.84	25.92	46.17	56.64	31.26	33.72
18.34	11.16	19.23	93.02	27.20	46.19	56.97	33.27	33.54
18.79	11.10	17.53	93.21	28.82	46.14	57.69	31.00	33.50
18.39	11.24	16.24	93.25	30.25	46.60	58.29	31.39	33.74

Table 11 Percentage of villages electrified, by state, 1970 95

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(percent)
1970	34.31	61.44	13.49	23.82	68.13	24.90	8.66	57.84	100.00
1971	34.55	63.20	13.89	26.53	91.56	25.79	9.27	58.00	100.00
1972	39.65	64.09	14.17	30.64	91.09	29.02	9.87	58.92	100.00
1973	41.95	65.18	14.68	30.39	92.23	32.57	11.44	58.74	100.00
1974	44.56	66.10	16.30	32.04	92.43	35.53	14.89	58.92	100.00
1975	45.27	66.88	24.31	34.81	92.69	38.83	18.70	62.59	100.00
1976	49.11	67.73	25.77	35.76	92.97	40.01	22.44	65.02	100.00
1977	57.82	68.60	27.77	40.49	93.25	43.00	35.99	65.02	100.00
1978	62.19	69.51	29.73	46.50	93.79	48.40	45.06	69.38	100.00
1979	65.33	70.55	30.97	54.68	93.89	53.80	50.50	72.14	100.00
1980	68.87	71.54	30.28	63.49	94.23	58.74	55.42	75.10	100.00
1981	74.24	72.51	34.77	72.66	100.00	63.19	59.71	80.58	100.00
1982	79.42	73.64	39.02	76.98	100.00	70.10	65.13	85.57	100.00
1983	83.08	75.25	44.80	79.42	100.00	75.53	74.96	89.81	100.00
1984	86.71	76.53	49.77	83.76	100.00	81.00	77.50	92.98	100.00
1985	89.07	77.54	50.44	89.52	100.00	86.47	82.58	96.76	100.00
1986	90.93	78.98	53.28	93.08	100.00	91.80	87.37	99.65	100.00
1987	92.24	80.58	57.18	94.21	100.00	96.87	89.67	100.00	100.00
1988	94.39	82.03	60.14	96.11	100.00	100.00	91.18	100.00	100.00
1989	95.54	82.93	63.35	96.45	100.00	100.00	91.64	100.00	100.00
1990	95.53	84.31	66.14	96.75	100.00	100.00	93.24	100.00	100.00
1991	95.84	84.66	66.76	96.90	100.00	100.00	93.81	100.00	100.00
1992	95.79	84.91	67.05	97.03	100.00	100.00	94.00	100.00	100.00
1993	95.89	84.93	67.30	97.16	100.00	100.00	95.00	100.00	100.00
1994	95.91	85.21	67.57	97.16	100.00	100.00	95.11	100.00	100.00
1995	95.95	86.87	67.38	97.16	100.00	100.00	94.52	100.00	100.00

Source: Compiled from various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
11.70	29.46	7.91	50.53	63.56	54.15	25.89	8.83	33.98
11.71	32.74	11.19	56.04	63.82	58.17	26.64	9.80	36.19
14.23	35.89	16.09	57.83	63.96	62.79	27.39	10.76	37.58
15.85	39.12	17.75	61.70	63.71	66.79	28.21	16.30	39.48
16.49	42.48	21.01	70.52	64.01	70.78	28.71	24.48	41.98
18.64	45.73	26.10	79.07	64.43	74.95	29.82	26.54	44.54
20.21	49.00	29.65	87.63	64.59	79.15	31.00	27.47	46.62
21.17	52.17	33.44	98.55	64.88	83.36	31.84	30.51	49.12
24.82	55.48	37.05	98.61	64.23	87.61	33.61	32.48	51.91
29.36	58.43	40.30	99.20	64.34	91.96	34.99	34.52	54.59
34.06	63.66	43.14	99.50	65.23	95.76	36.98	36.03	57.64
38.70	70.30	45.81	99.50	64.82	97.11	40.98	40.83	61.41
44.28	72.46	45.98	99.52	64.93	97.37	43.37	47.35	64.54
49.89	75.70	48.04	99.59	65.36	97.97	47.25	51.71	67.53
55.35	78.96	50.41	99.75	64.80	98.15	50.89	53.84	70.62
60.40	80.82	51.77	99.85	65.72	98.19	55.07	56.62	73.22
64.59	81.50	54.13	99.94	66.30	98.31	58.68	59.99	75.13
69.54	88.59	57.61	100.00	66.67	98.41	61.92	63.71	77.96
75.00	90.28	60.97	100.00	67.48	98.53	64.85	67.70	80.59
80.66	92.02	63.79	100.00	70.45	99.68	67.84	72.06	82.78
84.15	92.16	65.92	100.00	75.73	99.71	69.76	76.24	84.53
87.50	92.31	70.26	100.00	78.45	99.71	71.46	77.34	85.55
89.75	92.55	74.40	100.00	79.50	99.69	73.11	78.23	86.30
91.88	92.67	78.10	100.00	81.35	99.92	74.55	78.77	87.22
94.34	92.76	80.19	100.00	82.56	99.92	76.26	79.15	88.00
94.36	93.82	86.04	100.00	83.36	99.92	77.38	78.92	89.01

Table 12 Percentage of rural population that is literate, by state, 1970 95

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(percent)
1970	19.31	27.15	16.75	27.65	24.67	32.99	14.03	23.08	55.07
1971	19.73	28.23	17.13	28.38	24.97	33.77	14.44	23.48	55.88
1972	20.19	29.56	17.25	28.89	25.38	34.27	14.86	23.97	56.90
1973	20.46	30.65	17.62	29.88	25.71	34.76	15.49	24.57	57.75
1974	21.16	31.89	18.03	30.32	26.08	35.24	16.00	25.26	58.82
1975	21.45	33.38	18.40	31.21	26.33	35.85	16.28	25.62	59.94
1976	22.02	34.76	18.68	32.03	26.72	36.32	16.71	26.26	61.06
1977	22.49	36.08	18.95	32.84	27.15	36.77	17.33	26.80	61.99
1978	23.01	37.74	19.33	33.57	27.52	37.44	17.97	27.35	63.17
1979	23.55	39.58	19.75	34.49	28.14	38.30	18.46	27.95	64.54
1980	24.03	41.46	20.14	35.20	28.47	38.69	19.11	28.67	65.72
1981	24.21	44.16	20.24	36.15	28.91	39.42	19.73	29.32	66.97
1982	24.67	44.24	20.74	36.91	28.76	40.41	20.28	29.72	68.03
1983	25.03	44.48	21.34	37.71	28.91	41.65	21.00	30.32	68.92
1984	25.38	44.45	21.57	38.50	28.91	42.63	21.56	30.71	69.66
1985	25.87	44.48	22.17	39.25	29.27	43.85	21.90	31.53	70.59
1986	26.22	44.51	22.56	40.09	29.52	44.95	22.54	31.88	71.56
1987	27.00	44.96	23.09	41.11	29.86	46.25	23.45	32.38	72.48
1988	27.48	45.00	23.47	42.03	30.19	47.56	24.09	32.92	73.48
1989	28.05	45.50	24.02	42.93	30.64	48.68	24.71	33.47	74.45
1990	28.82	45.79	24.64	43.92	31.17	50.04	25.65	34.04	75.44
1991	28.07	45.73	24.87	44.78	32.55	51.26	26.40	34.69	76.44
1992	30.14	46.27	25.55	45.76	32.54	52.66	27.16	35.38	77.45
1993	30.91	46.87	26.03	46.85	32.92	54.25	28.09	35.98	78.60
1994	32.44	48.15	27.20	49.11	34.72	57.31	29.91	37.22	80.61
1995	33.26	49.13	27.77	50.07	35.60	58.76	30.89	37.84	81.73

Source: Compiled from various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
17.26	29.78	24.61	26.70	13.07	32.56	16.36	27.92	23.38
17.49	30.77	25.26	27.24	13.61	33.00	15.86	28.07	23.64
17.61	31.76	25.62	27.92	13.87	33.60	16.55	27.87	24.19
17.99	32.91	26.37	28.83	14.17	34.24	16.70	27.83	24.68
18.23	33.99	26.65	29.47	14.69	34.60	16.87	28.16	25.18
18.67	35.17	27.30	30.31	15.10	35.15	17.03	28.28	25.68
18.99	36.46	27.72	31.27	15.66	35.92	17.38	28.82	26.29
19.39	37.56	28.43	31.79	15.90	36.23	17.62	29.07	26.75
19.77	38.99	29.17	32.95	16.50	36.91	17.90	29.70	27.44
20.13	40.48	29.72	33.82	16.94	37.56	18.30	30.25	28.12
20.47	41.96	30.44	34.78	17.44	38.02	18.55	30.70	28.74
20.99	43.61	31.01	34.93	17.93	38.49	18.28	31.30	28.61
21.56	43.29	31.47	35.75	18.50	39.21	19.50	32.03	29.27
22.30	43.06	31.67	36.31	18.92	39.74	20.20	32.99	29.82
22.92	42.84	32.33	37.29	19.54	40.26	20.95	33.97	30.32
23.64	42.68	32.77	38.20	20.07	40.99	21.71	34.84	30.92
24.22	42.30	32.86	39.07	20.71	41.63	22.62	35.86	31.45
25.06	42.22	33.36	40.06	21.44	42.40	23.45	37.01	32.14
25.69	41.85	33.90	41.02	22.06	43.14	24.49	37.90	32.74
26.50	42.35	34.55	41.74	22.65	44.03	25.56	39.26	33.53
27.36	41.34	35.05	42.89	23.42	44.50	26.71	40.63	34.21
28.30	41.20	35.46	43.97	24.19	45.54	27.43	42.07	34.58
29.08	40.63	36.04	44.96	24.92	46.49	29.38	43.61	35.67
29.88	40.43	36.61	45.92	25.71	47.15	30.88	45.59	36.63
31.86	42.58	37.83	48.27	27.35	48.81	34.52	49.96	38.84
33.41	40.52	38.51	49.32	28.40	49.80	36.55	52.50	39.81

Table 13 Road density in rural India, by state, 1970 95

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
								(kilometers/thousand square kilometers)	
1970	4,603	1,950	8,590	1,702	4,313	2,263	1,480	3,436	3,434
1971	4,658	2,033	8,735	1,755	4,654	2,407	1,506	3,761	3,527
1972	4,713	2,116	8,879	1,826	5,117	2,521	1,532	4,085	3,621
1973	4,857	2,198	8,882	1,937	5,129	2,869	1,575	4,214	3,715
1974	5,037	2,273	8,884	1,987	5,140	3,009	1,617	4,313	3,808
1975	5,216	2,348	8,899	2,016	5,152	3,049	1,660	4,567	3,902
1976	5,353	2,349	8,914	2,035	5,731	3,089	1,702	4,821	3,996
1977	5,418	2,416	9,810	2,081	6,058	3,128	1,739	4,861	4,089
1978	5,505	2,484	10,226	2,161	6,383	3,168	1,775	4,991	4,183
1979	5,656	2,520	10,642	2,207	6,383	3,208	1,848	5,108	4,277
1980	5,825	2,537	10,642	2,304	6,599	3,248	1,921	5,173	4,370
1981	5,993	2,629	10,858	2,420	6,820	3,288	1,994	5,290	4,508
1982	6,161	2,720	11,451	2,544	6,955	3,328	2,067	5,389	4,594
1983	6,262	2,820	12,043	2,687	7,043	3,368	2,135	5,488	4,680
1984	6,364	2,921	12,636	2,834	7,149	3,408	2,208	5,529	4,767
1985	6,444	3,022	13,229	2,953	7,171	3,447	2,282	5,778	4,853
1986	6,452	3,122	13,822	3,087	7,261	3,487	2,355	6,027	4,940
1987	6,564	3,219	13,822	3,263	7,215	3,527	2,428	6,081	5,066
1988	6,576	3,360	14,112	3,360	7,301	3,567	2,501	6,180	5,097
1989	6,652	3,436	14,449	3,415	7,258	3,607	2,574	6,261	5,099
1990	6,743	3,565	14,902	3,451	7,325	3,647	2,647	6,875	5,103
1991	6,802	3,662	14,488	3,490	7,419	3,687	2,720	7,044	5,217
1992	6,912	3,761	14,613	3,567	7,516	3,727	2,794	7,179	5,253
1993	6,968	3,804	14,668	3,584	7,550	3,766	2,867	7,213	5,328
1994	7,072	3,832	14,590	3,601	7,592	3,806	2,939	7,227	5,383
1995	7,072	3,832	14,700	3,604	7,624	3,844	3,013	7,236	5,437

Source: Compiled from various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
878	2,160	2,641	2,869	927	4,299	931	5,026	2,614
991	2,138	2,641	2,869	932	4,696	938	5,053	2,698
1,033	2,492	2,650	3,245	950	5,121	952	5,081	2,826
1,076	2,739	2,666	3,621	994	5,559	1,037	5,108	2,941
1,119	2,843	2,688	3,997	1,005	5,879	1,112	5,135	3,024
1,163	2,912	2,697	4,373	1,050	6,384	1,182	5,214	3,124
1,207	3,022	2,735	4,672	1,094	6,889	1,218	5,261	3,225
1,253	4,065	4,190	4,887	1,138	7,094	1,254	5,291	3,520
1,298	4,177	5,754	5,185	1,146	7,302	1,385	5,325	3,709
1,344	4,289	6,240	5,393	1,166	7,638	1,496	5,360	3,842
1,392	4,383	6,275	5,601	1,186	7,974	1,585	5,414	3,926
1,436	4,735	6,631	5,808	1,205	8,311	1,690	5,463	4,076
1,490	4,783	6,987	6,016	1,282	8,986	1,778	5,495	4,236
1,619	4,809	7,343	6,224	1,358	9,423	1,852	5,549	4,388
1,665	4,995	7,699	6,431	1,396	10,032	1,902	5,613	4,542
1,721	5,053	8,055	6,639	1,428	10,799	2,018	5,721	4,707
1,782	5,307	8,410	6,847	1,475	11,506	2,105	5,850	4,886
1,847	5,240	8,766	7,055	1,512	12,413	2,190	5,905	5,000
1,918	5,506	9,122	7,262	1,566	12,572	2,275	6,027	5,127
1,988	5,737	9,478	7,470	1,632	12,938	2,349	6,073	5,258
2,035	5,649	9,817	7,678	1,666	13,303	2,435	6,133	5,392
2,081	5,585	10,156	7,885	1,707	13,615	2,515	6,155	5,444
2,129	5,617	10,475	8,093	1,775	13,933	2,597	6,317	5,550
2,174	5,650	10,814	8,315	1,775	14,251	2,680	6,324	5,622
2,234	5,664	11,153	8,537	1,816	14,569	2,763	6,369	5,695
2,235	5,498	11,153	8,623	1,816	14,747	2,560	6,369	5,704

Table 14 Production growth in agriculture, by state, 1970 94

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(1970=100)
1970	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1971	97.40	105.34	95.48	96.20	93.57	108.80	101.82	100.83	104.78
1972	89.47	107.77	99.16	43.57	69.06	101.60	102.40	78.80	106.18
1973	110.53	105.69	79.93	76.12	69.24	102.64	105.67	101.03	105.20
1974	117.59	98.27	81.79	46.53	65.57	110.38	104.08	107.14	104.16
1975	111.41	105.78	91.98	101.28	85.42	120.33	106.21	110.41	106.37
1976	92.78	101.83	90.28	99.80	85.05	123.04	105.94	83.75	99.57
1977	110.84	99.98	94.91	94.59	89.21	119.70	110.16	111.93	101.63
1978	115.28	113.05	96.45	99.74	98.61	117.71	116.67	119.67	101.87
1979	100.71	110.62	81.20	93.59	72.26	103.72	107.41	115.04	102.56
1980	99.51	127.74	99.05	98.53	85.52	128.49	129.23	104.45	100.11
1981	124.31	126.61	95.44	114.05	86.78	115.83	131.72	111.08	98.12
1982	119.85	135.05	98.93	98.05	93.30	107.69	131.02	113.60	98.98
1983	131.84	137.15	116.31	129.54	95.79	116.48	124.53	127.23	94.80
1984	111.68	138.88	117.00	119.71	104.45	112.20	133.36	125.32	94.06
1985	118.16	151.06	121.35	66.52	122.68	129.70	151.71	117.57	89.10
1986	112.15	132.83	120.58	86.82	115.94	125.31	150.83	134.72	86.51
1987	134.25	135.08	115.77	38.48	92.78	107.08	133.51	136.66	82.66
1988	165.91	121.22	127.50	153.16	147.11	137.95	153.99	148.37	82.53
1989	156.08	125.35	126.44	125.49	103.38	167.31	156.90	140.16	86.98
1990	154.73	125.83	131.07	114.52	116.14	157.08	173.11	137.42	88.45
1991	153.60	125.19	124.77	146.47	119.59	151.88	181.76	147.41	97.62
1992	151.52	131.90	115.07	151.32	138.01	148.74	188.59	167.51	103.60
1993	162.40	110.72	133.00	117.44	139.05	138.98	211.85	180.81	109.78
1994	170.13	131.83	161.68	160.10	144.31	126.18	231.54	184.18	120.66
Annual Growth Rate (percent)									
1970–79	1.59	1.37	–0.40	–0.03	–0.16	1.83	1.73	2.02	0.21
1980–89	5.13	–0.21	2.75	2.72	2.13	2.98	2.18	3.32	–1.55
1990–94	2.40	1.17	5.39	8.74	5.58	–5.33	7.54	7.60	8.07
1970–94	2.24	1.16	2.02	1.98	1.54	0.97	3.56	2.58	0.79

Source: Calculated by the authors using various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
102.26	90.24	98.14	106.95	84.85	101.66	93.49	117.42	98.86
96.28	61.25	94.20	106.74	7 6.59	103.04	92.76	99.91	91.07
92.87	116.75	103.73	112.94	83.72	108.61	92.18	94.93	98.65
104.94	131.73	91.83	120.46	80.35	85.97	95.55	106.65	96.48
112.14	151.81	113.01	128.15	95.91	112.36	104.90	114.69	109.52
91.33	159.42	95.56	133.37	96.10	106.13	110.89	113.38	105.00
107.64	169.06	114.05	151.12	97.10	125.79	119.93	124.04	115.37
104.58	166.48	114.33	161.73	108.61	134.08	122.57	132.36	119.50
76.59	172.24	96.39	160.36	84.38	129.46	91.65	125.00	119.00
113.10	176.26	129.87	162.48	98.57	111.68	131.97	138.77	118.56
119.53	190.58	134.60	179.50	107.90	125.46	136.44	133.86	126.06
122.16	180.19	128.42	184.11	123.11	104.97	147.31	131.31	126.50
146.76	197.84	159.65	188.34	134.61	119.70	157.87	159.86	142.04
135.21	187.91	171.38	204.05	122.64	135.15	154.90	167.31	139.72
150.38	166.12	173.59	213.71	123.13	154.32	158.69	208.97	144.33
136.07	146.69	163.90	203.40	106.45	124.71	167.67	200.26	139.25
152.39	200.88	151.80	213.87	103.73	144.40	171.00	207.18	143.60
177.21	210.37	173.69	215.33	150.98	142.42	186.29	229.99	167.30
167.74	282.82	179.05	235.68	140.22	149.38	180.18	243.86	165.77
190.22	211.22	170.79	232.40	156.85	147.21	179.35	249.39	164.91
173.21	197.69	173.44	233.81	143.95	144.84	181.50	264.47	166.19
183.02	224.17	196.03	221.78	166.76	150.23	187.55	264.63	173.99
194.56	236.53	210.37	234.19	149.90	150.36	190.00	277.82	178.13
192.89	211.22	213.92	254.10	154.52	156.81	195.84	299.12	186.83
0.50	5.83	1.50	5.49	0.92	3.31	2.29	3.16	2.00
4.48	5.39	3.63	4.22	3.99	3.28	3.52	6.46	3.79
0.35	0.00	5.79	2.26	–0.37	1.59	2.22	4.65	3.17
2.78	3.16	3.22	3.96	1.83	1.89	2.84	4.67	2.64

Table 15 Total factor productivity growth in Indian agriculture, by state, 1970 94

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(1970=100)
1970	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1971	98.22	107.20	95.71	93.84	95.56	108.51	101.26	97.04	104.78
1972	92.03	105.74	98.93	46.92	74.34	100.89	101.52	7 7.69	106.18
1973	114.52	101.11	82.44	83.53	81.22	109.52	104.17	100.41	105.20
1974	119.75	93.06	90.63	49.38	78.54	117.69	102.01	102.92	104.16
1975	118.05	96.86	101.32	98.76	107.49	129.92	103.66	104.43	106.37
1976	94.57	90.72	98.97	96.24	109.29	130.85	102.78	79.11	99.57
1977	112.21	86.66	103.24	89.43	115.95	126.97	106.29	113.28	101.63
1978	113.01	97.00	104.01	91.48	130.53	123.03	110.84	110.61	101.87
1979	94.16	95.10	87.19	83.94	95.74	107.26	102.13	103.31	102.56
1980	96.77	109.86	109.78	85.85	116.29	130.41	121.34	92.30	100.11
1981	117.34	108.16	101.55	99.17	114.67	116.46	123.30	100.53	98.12
1982	106.69	114.97	106.66	82.39	120.63	107.28	121.71	97.57	98.98
1983	117.41	114.03	127.52	109.59	121.21	114.94	114.22	107.41	94.80
1984	95.85	115.44	129.18	99.08	132.45	109.56	121.55	104.31	94.06
1985	102.14	128.14	133.32	54.80	153.36	125.21	138.47	94.74	89.10
1986	100.29	112.92	131.08	72.22	143.44	119.53	136.45	108.39	86.51
1987	121.52	114.37	124.75	36.11	113.28	101.50	120.89	107.50	82.66
1988	142.77	101.94	135.43	72.22	193.67	131.01	136.93	116.26	82.53
1989	127.49	104.24	131.79	53.11	125.35	157.03	144.38	107.38	86.98
1990	125.08	106.63	136.62	49.28	140.42	146.64	146.70	103.49	88.45
1991	121.16	103.57	129.67	62.78	137.89	140.40	161.13	109.24	97.62
1992	119.97	108.72	119.94	64.18	156.95	132.67	165.55	123.32	103.60
1993	127.27	91.09	137.71	49.86	158.78	123.62	160.11	130.69	109.78
1994	133.27	107.64	165.39	67.59	160.27	111.85	174.47	132.16	120.66
Annual growth rate (percent)									
1970–79	1.37	–0.34	0.44	–0.98	3.00	2.33	1.15	1.13	0.21
1980–89	3.11	–0.58	2.05	–5.20	0.84	2.09	1.95	1.69	–1.55
1990–94	1.60	0.24	4.89	8.22	3.36	–6.55	4.43	6.31	8.07
1970–94	1.20	0.31	2.12	–1.62	1.98	0.47	2.35	1.17	0.79

Source: Calculated by the authors using various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
101.51	88.53	97.67	105.48	83.99	100.19	93.61	119.45	98.51
94.34	60.15	92.53	103.05	75.04	99.34	92.25	101.21	90.70
90.84	116.95	102.61	106.92	82.90	109.30	91.23	95.35	99.38
103.98	120.48	86.49	113.13	74.96	86.46	95.00	106.51	95.59
111.57	137.16	106.70	123.74	91.69	114.83	104.51	113.45	109.28
90.15	141.92	89.65	126.55	90.89	106.68	109.32	111.41	103.74
105.16	147.31	106.07	141.37	90.09	125.55	112.48	120.80	112.82
99.59	142.08	105.97	147.68	101.42	130.02	116.57	127.11	114.82
72.34	145.11	88.12	142.50	77.55	123.99	85.13	118.16	98.48
108.39	146.35	120.51	142.16	88.95	106.69	121.98	131.45	112.08
111.68	156.57	122.34	154.75	98.09	127.82	124.72	122.34	117.71
112.05	147.96	115.13	156.04	109.62	101.22	132.42	119.16	115.85
132.76	159.90	142.02	157.25	118.61	118.36	138.39	144.82	128.48
120.09	148.19	151.51	167.57	107.56	131.31	135.34	150.38	124.83
130.03	130.43	150.99	174.27	108.43	148.78	137.69	187.19	128.07
113.43	115.78	140.71	164.27	92.03	120.37	148.55	179.37	123.85
124.68	157.54	130.20	171.62	89.15	140.75	145.97	183.90	126.23
143.30	158.60	154.80	173.25	154.01	136.24	158.48	203.64	148.25
132.92	210.08	152.03	188.69	114.50	143.37	150.27	211.95	140.18
149.17	150.64	147.79	184.41	130.71	138.83	148.46	217.13	138.64
134.40	141.52	173.87	183.25	115.03	135.49	147.55	227.14	138.75
140.42	161.02	196.51	172.41	129.74	137.75	149.90	225.91	144.11
149.19	167.91	210.58	187.73	113.27	136.13	150.26	236.36	146.10
145.79	149.46	196.70	207.48	118.72	138.82	151.85	251.96	151.80
–0.05	3.98	0.65	4.43	0.16	2.96	1.72	2.70	1.55
2.29	4.10	2.62	3.20	2.84	3.34	2.34	5.45	2.52
–0.57	–0.20	7.41	2.99	–2.38	–0.00	0.57	3.79	2.29
1.58	1.69	2.86	3.09	0.72	1.38	1.76	3.93	1.75

Table 16 Changes in rural wages, by state, 1970 93

Year	Andhra Pradesh	Bihar	Gujarat	Haryana	Karnataka	Kerala
						(Rs/day in 1960/61 prices)
1970	1.74	1.21	1.77	3.42	1.24	2.05
1971	1.49	1.18	2.00	3.32	1.28	2.33
1972	1.39	1.08	1.66	2.97	1.22	2.22
1973	1.31	1.16	1.41	2.71	1.19	2.14
1974	1.16	1.05	1.17	2.55	0.99	1.78
1975	1.38	1.46	1.62	2.79	1.23	2.03
1976	1.53	1.78	2.20	2.87	1.51	2.33
1977	1.51	1.53	2.02	3.14	1.67	2.40
1978	1.78	1.53	2.14	3.32	1.70	2.45
1979	1.76	1.43	1.99	3.18	1.59	2.58
1980	1.71	1.37	1.90	2.84	1.42	2.83
1981	1.99	1.61	2.16	3.27	1.52	3.26
1982	2.27	1.85	2.43	3.69	1.61	3.69
1983	1.15	0.90	1.36	2.17	0.95	1.36
1984	2.29	1.87	2.69	3.42	1.35	2.83
1985	2.51	2.02	2.89	3.38	1.47	3.11
1986	2.79	2.07	2.78	3.66	1.62	3.05
1987	2.60	2.02	2.39	3.48	1.80	3.28
1988	2.52	2.05	2.56	3.35	2.05	3.74
1989	3.00	2.08	2.48	3.76	2.27	3.87
1990	2.89	2.21	2.29	4.00	2.36	3.75
1991	2.45	1.96	2.10	4.17	1.72	3.82
1992	2.50	1.90	2.31	4.34	1.53	4.27
1993	2.56	2.07	2.21	4.16	1.92	4.18
Annual growth rate (percent)						
1970–79	0.17	1.83	1.30	–0.82	2.81	2.58
1980–89	6.45	4.73	3.01	3.16	5.34	3.54
1990–93	–4.01	–2.13	–1.20	1.35	–6.68	3.68
1970–93	1.70	2.35	0.97	0.86	1.92	3.14

Sources: Compiled by the authors using various state statistical abstracts and published government data.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Natu	Uttar Pradesh	West Bengal
1.05	1.45	1.00	3.55	2.13	1.47	1.38	1.45
1.08	1.00	1.01	3.34	2.21	1.53	1.36	1.57
1.01	1.07	0.97	3.00	2.00	1.43	1.29	1.68
0.95	1.14	0.93	2.74	1.87	1.35	1.25	1.77
0.81	0.95	0.76	2.60	1.52	1.08	1.11	1.56
1.09	0.98	0.91	2.97	1.93	1.35	1.78	1.93
1.26	1.10	1.26	3.28	2.52	1.33	1.88	2.00
1.19	1.15	1.20	3.13	2.43	1.31	1.49	2.17
1.25	1.30	1.24	3.19	2.39	1.47	1.63	2.20
1.13	1.27	1.12	3.05	2.27	1.56	1.54	2.11
1.08	1.16	1.09	2.80	2.24	1.52	1.36	2.02
1.30	1.34	1.23	2.96	2.46	1.63	1.54	2.14
1.53	1.53	1.37	3.12	2.68	1.74	1.72	2.25
0.80	0.81	0.72	2.09	1.61	0.83	1.02	1.38
1.57	1.82	1.45	3.21	2.41	1.72	1.96	2.04
1.61	2.45	1.47	3.35	2.86	1.91	1.97	2.79
1.84	2.59	1.43	3.65	3.47	1.86	2.18	2.91
1.77	2.64	1.35	2.99	3.27	1.75	1.96	2.98
1.74	2.51	1.57	3.76	3.77	1.90	1.96	3.22
1.84	2.43	1.80	3.83	3.52	1.98	2.41	3.23
2.00	2.53	1.82	3.94	3.52	2.23	2.45	3.16
1.88	2.07	1.78	4.02	3.42	2.39	2.32	3.01
2.11	2.32	1.97	4.38	3.31	2.64	2.65	3.40
3.10	2.66	2.04	4.22	2.73	2.83	2.35	3.24
0.79	–1.42	1.29	–1.67	0.69	0.63	1.28	4.26
6.15	8.63	5.76	3.55	5.14	2.97	6.57	5.34
15.78	1.68	3.88	2.30	–8.10	8.26	–1.27	0.77
4.82	2.67	3.15	0.75	1.09	2.89	2.36	3.56

Table 17 Rural employment, by state, 1972 94

State	1972 73	1977 78	1983 84	1987 88	1993 94	Annual growth rate
			(thousands)			(percent)
Total employment						
Andhra Pradesh	22,686	23,292	24,992	22,685	27,594	0.94
Bihar	22,170	23,668	24,675	21,662	25,990	0.76
Gujarat	10,648	10,626	12,020	10,633	11,692	0.45
Haryana	4,090	3,671	3,776	3,368	3,460	–0.79
Karnataka	13,569	14,559	14,095	12,792	14,836	0.43
Kerala	7,681	8,809	7,202	6,724	7,052	–0.41
Madhya Pradesh	21,724	20,361	23,716	21,029	23,411	0.36
Maharashtra	21,191	21,778	23,738	21,328	23,926	0.58
Orissa	10,683	10,266	10,938	9,908	10,977	0.13
Punjab	5,148	4,499	4,488	4,349	4,549	–0.59
Rajasthan	14,728	13,206	14,600	13,911	15,128	0.13
Tamil Nadu	17,811	17,426	18,132	17,117	18,864	0.27
Uttar Pradesh	35,689	35,045	37,364	35,645	38,628	0.38
West Bengal	13,246	14,704	15,357	14,410	16,544	1.06
All India	221,064	221,910	235,094	215,563	242,649	0.44
Agricultural employment						
Andhra Pradesh	17,831	18,704	18,594	16,810	20,861	0.75
Bihar	18,224	19,668	20,061	17,330	21,311	0.75
Gujarat	8,933	8,969	9,483	7,294	8,313	–0.34
Haryana	3,276	2,845	2,726	2,388	2,107	–2.08
Karnataka	11,561	12,113	11,501	10,183	11,691	0.05
Kerala	4,278	5,215	4,163	3,645	3,752	–0.62
Madhya Pradesh	19,638	18,162	20,680	17,937	20,415	0.18
Maharashtra	17,461	17,509	18,896	16,167	18,016	0.15
Orissa	8,717	8,715	8,553	7,421	8,639	–0.04
Punjab	4,087	3,500	3,479	2,992	3,098	–1.31
Rajasthan	12,431	10,895	11,826	9,070	10,529	–0.79
Tamil Nadu	13,430	12,878	12,493	11,160	12,073	–0.51
Uttar Pradesh	29,229	28,106	29,405	28,124	29,473	0.04
West Bengal	10,319	11,425	11,226	10,404	10,704	0.17
All India	179,417	178,704	183,087	160,925	180,981	0.04

(continued)

Table 17 ***Continued***

State	1972 73	1977 78	1983 84	1987 88	1993 94	Annual growth rate
			(thousands)			(percent)
Nonagricultural employment						
Andhra Pradesh	4,855	4,589	6,398	5,875	6,733	1.57
Bihar	3,946	4,000	4,614	4,332	4,678	0.81
Gujarat	1,714	1,658	2,536	3,339	3,379	3.28
Haryana	814	826	1,050	980	1,353	2.45
Karnataka	2,008	2,446	2,593	2,610	3,145	2.16
Kerala	3,403	3,594	3,039	3,080	3,300	–0.15
Madhya Pradesh	2,085	2,199	3,036	3,091	2,997	1.74
Maharashtra	3,730	4,268	4,843	5,161	5,910	2.22
Orissa	1,966	1,550	2,384	2,487	2,338	0.83
Punjab	1,060	999	1,010	1,357	1,451	1.50
Rajasthan	2,298	2,311	2,774	4,841	4,599	3.36
Tamil Nadu	4,382	4,548	5,639	5,957	6,791	2.11
Uttar Pradesh	6,460	6,939	7,959	7,521	9,155	1.67
West Bengal	2,927	3,279	4,131	4,006	5,840	3.34
All India	41,648	43,206	52,006	54,638	61,669	1.89

Source: Compiled from various state statistical abstracts and published government data.

Table 18 Changes in the incidence of poverty, by state, head count ratio, 1951 93

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
1951	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1952	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1953	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1954	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1955	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1956	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1957	64	37	65	n.a.	33	n.a.	n.a.	49	67
1958	67	39	66	65	28	n.a.	n.a.	54	69
1959	64	43	62	56	33	n.a.	n.a.	58	71
1960	64	32	47	50	32	n.a.	37	47	69
1961	59	43	57	57	31	n.a.	40	45	59
1962	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1963	60	36	55	60	34	n.a.	35	58	63
1964	55	35	60	69	36	n.a.	37	63	69
1965	62	45	68	68	38	n.a.	33	73	80
1966	63	62	80	69	39	n.a.	42	68	77
1967	63	55	77	65	44	n.a.	30	67	74
1968	61	63	68	58	32	n.a.	24	60	74
1969	57	49	66	66	36	n.a.	27	46	78
1970	57	51	67	61	31	n.a.	21	59	73
1971	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1972	64	58	69	61	26	n.a.	34	57	67
1973	56	56	70	58	34	27	52	61	62
1974	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1975	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1976	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1977	48	64	66	55	28	33	43	54	53
1978	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1979	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1981	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1982	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1983	38	46	70	39	21	17	28	45	44
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1985	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1986	34	44	56	43	25	n.a.	31	46	40
1987	34	43	59	43	16	16	31	43	35
1988	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1989	32	42	59	37	16	n.a.	21	54	39
1990	37	42	58	43	21	n.a.	43	43	34
1991	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1992	42	57	67	47	20	n.a.	n.a.	57	34
1993	29	49	64	47	28	30	30	41	31
Annual growth rate (percent)									
1957–93	–2.18	0.76	–0.08	–0.96	–0.49	0.51	–10.45	–0.48	–2.11

Source: World Bank 1997.

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. n.a. is not available.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	47
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	46
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	58
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	64
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	50
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	59
63	n.a.	65	33	51	73	55	53	59
56	71	56	28	49	66	51	48	53
52	58	62	33	40	71	38	50	51
51	60	62	32	57	65	41	32	45
48	58	47	31	56	57	34	50	47
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	48
45	58	58	34	50	54	49	56	49
50	72	61	36	56	65	57	57	54
57	71	60	38	55	67	51	64	58
68	76	63	39	63	71	59	68	64
71	72	63	44	60	66	65	76	64
66	69	70	32	67	68	50	70	59
64	69	66	36	69	70	54	60	59
62	62	65	32	65	63	45	63	55
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	55
65	81	67	25	63	59	56	61	55
66	65	59	35	59	59	56	63	56
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
65	79	63	25	54	58	45	56	51
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
53	55	57	22	49	55	45	49	45
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
54	54	45	23	46	45	36	34	39
48	52	48	20	50	48	41	35	39
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	39
45	46	39	14	40	42	31	26	34
48	43	27	19	39	42	37	39	36
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	37
56	61	37	18	51	47	47	28	43
45	48	40	25	48	37	42	27	37
–0.90	–1.11	–1.32	–0.78	–0.18	–1.88	–0.77	–1.82	–1.30

Table 19 Population under poverty line, by state, 1960 93

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(million)
1960	18,921	3,660	20,135	7,649	2,011	n.a.	1,160	8,687	9,851
1961	17,696	4,958	24,613	8,948	2,025	n.a.	1,279	8,324	8,684
1962	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1963	18,668	4,375	24,495	9,823	2,314	n.a.	1,155	11,199	9,694
1964	17,511	4,291	27,285	11,538	2,532	n.a.	1,235	12,432	10,875
1965	20,070	5,582	31,355	11,596	2,769	n.a.	1,141	14,619	12,776
1966	20,713	7,897	37,863	12,149	2,862	n.a.	1,478	13,883	12,669
1967	21,192	7,131	37,083	11,649	3,366	n.a.	1,078	13,989	12,408
1968	20,856	8,286	33,065	10,688	2,533	n.a.	867	12,741	12,621
1969	19,829	6,615	32,900	12,355	2,860	n.a.	1,011	10,061	13,669
1970	20,065	6,937	34,128	11,785	2,559	n.a.	819	13,022	12,990
1971	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1972	23,385	8,280	36,493	12,274	2,249	n.a.	1,377	13,010	12,310
1973	20,868	8,106	37,504	11,909	3,020	n.a.	2,146	14,023	11,638
1974	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1975	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1976	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1977	19,044	10,004	39,040	12,473	2,691	n.a.	1,921	13,821	10,582
1978	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1979	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1981	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1982	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1983	16,538	7,934	45,924	9,676	2,229	n.a.	1,444	12,510	9,148
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1985	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1986	15,651	8,276	39,704	11,028	2,929	n.a.	1,705	13,619	8,401
1987	15,946	8,205	42,043	11,267	1,925	n.a.	1,752	13,047	7,370
1988	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1989	15,442	8,321	43,791	9,974	1,945	n.a.	1,255	16,873	8,320
1990	18,196	8,591	44,479	11,811	2,601	n.a.	2,617	13,460	7,260
1991	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1992	21,320	11,941	53,473	13,180	2,650	n.a.	2,500	18,525	7,387
1993	15,003	10,539	51,551	13,365	3,762	n.a.	2,002	13,548	6,744
Annual growth rate (percent)									
1960–93	–0.70	3.26	2.89	1.71	1.92	n.a.	1.67	1.36	–1.14

Source: Calculated by the authors from World Bank 1997.
Note: n.a. is not available.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
14,126	17,031	10,147	2,742	9,698	16,082	26,586	8,539	177,022
13,660	16,901	7,861	2,738	9,650	14,342	22,811	13,560	178,050
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
13,482	17,401	10,119	3,074	9,027	13,911	33,726	15,761	198,224
15,248	22,107	10,910	3,336	10,319	16,973	39,353	16,383	222,327
17,782	22,169	10,875	3,616	10,433	17,762	35,708	19,097	237,350
21,510	24,194	11,623	3,705	12,224	19,163	42,318	20,602	264,853
23,069	23,679	11,955	4,320	11,892	17,990	46,941	23,574	271,314
21,798	23,093	13,516	3,223	13,631	18,855	37,040	22,156	254,968
21,701	23,337	12,982	3,608	14,285	19,734	40,171	19,593	254,713
21,718	21,499	12,953	3,279	13,855	18,205	34,300	20,864	248,977
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
23,509	29,117	13,889	2,722	14,157	17,469	43,775	20,971	274,988
24,413	23,638	12,369	3,822	13,622	17,729	44,788	22,405	272,001
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
25,991	31,123	14,128	2,994	13,799	18,398	39,577	21,762	277,347
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
23,647	23,611	13,976	2,764	14,334	18,627	43,647	21,217	267,226
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
25,930	24,720	11,701	3,079	14,419	15,831	37,865	15,766	250,626
23,268	24,400	12,665	2,759	16,269	17,308	44,129	16,460	258,812
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
22,671	21,972	10,798	2,018	13,690	15,412	34,605	12,886	239,973
24,780	21,133	7,546	2,687	13,475	15,617	41,827	19,645	255,725
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
30,187	30,799	10,508	2,714	18,422	17,778	55,131	14,738	311,252
24,898	24,729	11,764	3,836	17,584	14,175	50,132	14,570	278,203
1.73	1.14	0.45	1.02	1.82	–0.38	1.94	1.63	1.38

Table 20 Concentration of poor people, by state, 1960 93

Year	Andhra Pradesh	Assam	Bihar	Gujarat	Haryana	Himachal Pradesh	Jammu and Kashmir	Karnataka	Kerala
									(percent)
1960	10.7	2.1	11.4	4.3	1.1	0.0	0.7	4.9	5.6
1961	9.9	2.8	13.8	5.0	1.1	0.0	0.7	4.7	4.9
1962	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1963	9.4	2.2	12.4	5.0	1.2	0.0	0.6	5.6	4.9
1964	7.9	1.9	12.3	5.2	1.1	0.0	0.6	5.6	4.9
1965	8.5	2.4	13.2	4.9	1.2	0.0	0.5	6.2	5.4
1966	7.8	3.0	14.3	4.6	1.1	0.0	0.6	5.2	4.8
1967	7.8	2.6	13.7	4.3	1.2	0.0	0.4	5.2	4.6
1968	8.2	3.2	13.0	4.2	1.0	0.0	0.3	5.0	4.9
1969	7.8	2.6	12.9	4.9	1.1	0.0	0.4	4.0	5.4
1970	8.1	2.8	13.7	4.7	1.0	0.0	0.3	5.2	5.2
1971	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1972	8.5	3.0	13.3	4.5	0.8	0.0	0.5	4.7	4.5
1973	7.7	3.0	13.8	4.4	1.1	0.0	0.8	5.2	4.3
1974	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1975	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1976	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1977	6.9	3.6	14.1	4.5	1.0	0.0	0.7	5.0	3.8
1978	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1979	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1981	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1982	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1983	6.2	3.0	17.2	3.6	0.8	0.0	0.5	4.7	3.4
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1985	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1986	6.2	3.3	15.8	4.4	1.2	0.0	0.7	5.4	3.4
1987	6.2	3.2	16.2	4.4	0.7	0.0	0.7	5.0	2.8
1988	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1989	6.4	3.5	18.2	4.2	0.8	0.0	0.5	7.0	3.5
1990	7.1	3.4	17.4	4.6	1.0	0.0	1.0	5.3	2.8
1991	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1992	6.8	3.8	17.2	4.2	0.9	0.0	0.8	6.0	2.4
1993	5.4	3.8	18.5	4.8	1.4	0.0	0.7	4.9	2.4
Annual growth rate (percent)									
1960–93	–2.05	1.85	1.49	0.32	0.53	n.a.	0.29	–0.02	–2.49

Source: Calculated by the authors from World Bank 1997.

Madhya Pradesh	Maharashtra	Orissa	Punjab	Rajasthan	Tamil Nadu	Uttar Pradesh	West Bengal	All India
8.0	9.6	5.7	1.5	5.5	9.1	15.0	4.8	100
7.7	9.5	4.4	1.5	5.4	8.1	12.8	7.6	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
6.8	8.8	5.1	1.6	4.6	7.0	17.0	8.0	100
6.9	9.9	4.9	1.5	4.6	7.6	17.7	7.4	100
7.5	9.3	4.6	1.5	4.4	7.5	15.0	8.0	100
8.1	9.1	4.4	1.4	4.6	7.2	16.0	7.8	100
8.5	8.7	4.4	1.6	4.4	6.6	17.3	8.7	100
8.5	9.1	5.3	1.3	5.3	7.4	14.5	8.7	100
8.5	9.2	5.1	1.4	5.6	7.7	15.8	7.7	100
8.7	8.6	5.2	1.3	5.6	7.3	13.8	8.4	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
8.5	10.6	5.1	1.0	5.1	6.4	15.9	7.6	100
9.0	8.7	4.5	1.4	5.0	6.5	16.5	8.2	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
9.4	11.2	5.1	1.1	5.0	6.6	14.3	7.8	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
8.8	8.8	5.2	1.0	5.4	7.0	16.3	7.9	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
10.3	9.9	4.7	1.2	5.8	6.3	15.1	6.3	100
9.0	9.4	4.9	1.1	6.3	6.7	17.1	6.4	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
9.4	9.2	4.5	0.8	5.7	6.4	14.4	5.4	100
9.7	8.3	3.0	1.1	5.3	6.1	16.4	7.7	100
n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
9.7	9.9	3.4	0.9	5.9	5.7	17.7	4.7	100
8.9	8.9	4.2	1.4	6.3	5.1	18.0	5.2	100
0.35	–0.24	–0.92	–0.35	0.43	–1.74	0.55	0.25	0.00

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