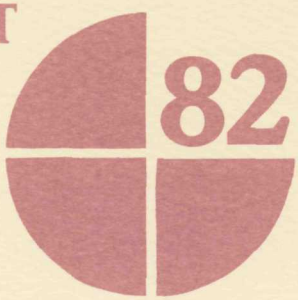
RESEARCH REPORT



AGRICULTURAL GROWTH AND STRUCTURAL CHANGES IN THE PUNJAB ECONOMY: AN INPUT-OUTPUT ANALYSIS

G. S. Bhalla
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R. K. Sharma

August 1990

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

In collaboration with the
CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT at JAWAHARLAL NEHRU UNIVERSITY

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This research report is part of IFPRI's continuous efforts to understand the relationship between technological change in agriculture and overall economic growth that expands employment and income opportunities for the poor in developing countries. The research is a collaborative effort with the Centre for the Study of Regional Development at Jawaharlal Nehru University in New Delhi.

The study documents and analyzes the structural changes that have occurred in the Punjab economy since the green revolution of the mid-1960s. With two input-output tables—one for 1969/70 and the other for 1979/80—the authors have traced the sources of structural changes and examined the changes in the intersectoral linkages and the quantum of indirect and induced income and employment generated by different sectors. Thus the study provides information and critical understanding required to develop programs that enhance the sectoral income and employment multipliers.

The study highlights changes in the relative importance of the primary, secondary, and tertiary sectors in the economy of Punjab in the wake of improvements in agricultural production technology. It also brings out significant structural changes within these sectors. For instance, within the primary sector, the relative share of crop production has declined, whereas that of animal husbandry has increased. Similarly, within manufacturing a notable change has been the emergence of machine- and metal-based industries. These changes are reflected in the operation of the economy at a higher technological level and in the increased labor productivity in most sectors.

Pointing to the large public investment in rural infrastructure that both preceded and followed the introduction of the new agricultural technology, the authors conclude that while the primary importance of agricultural development cannot be denied, its success is by no means independent of other factors.

It is notable that the agricultural breakthroughs in Punjab stimulated growth in other sectors of the economy, but not as much as had resulted from similar breakthroughs in other regions or countries, perhaps because of the large net outflow of capital from Punjab. This observation raises important issues on the role of further agricultural growth as well as the problem of interregional disparities and how best to deal with them.

Just Faaland

Washington, D.C.
August 1990

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Any errors and omissions that remain are the sole responsibility of the authors.

1

SUMMARY

This report analyzes the structural changes that have taken place in the Punjab economy as a consequence of rapid economic growth since the introduction of the new seed-fertilizer agricultural technology during the mid-1960s. The report also attempts to identify the contribution made by agriculture in the growth process of the state.

Agriculture has been a vibrant sector in the state, thanks to large investments undertaken in irrigation both before and after independence in 1947. But the introduction of seed-fertilizer technology during the mid-1960s brought about a qualitative change and led to unprecedented growth in agricultural output, particularly for wheat and rice. Because of close input, output, and consumption linkages, rapid agricultural growth was accompanied by even faster growth in the secondary (industrial) and tertiary (service) sectors. Consequently, both total and per capita incomes have increased rapidly. With the state income rising at an annual rate of 5.0 percent from 1960/61 to 1983/84, the primary (mainly agricultural) sector recorded an annual growth rate of 4.5 percent, the secondary sector grew at 5.6 percent a year, and the tertiary sector at 6.8 percent. These growth rates were significantly higher than those registered by the rest of the country.

Some of the structural changes that have taken place in the Punjab economy consequent to its rapid growth are worth noting. First, even though the primary sector continues to dominate the Punjab economy to a much greater extent than it does the country as a whole, the economy is undergoing a perceptible process of diversification. Whereas the share of the primary sector declined from 59.9 percent in 1960/61 to 50.0 percent in 1983/84, that of the secondary sector increased from 14.6 to 17.2 percent, and that of the tertiary sector from 25.4 to 32.8 percent during the same period.

Second, the new technology has resulted in phenomenal increases in wheat and rice yields. This, in turn, has made wheat and rice the dominant crops in the state, accounting for nearly 60 percent of the total gross cropped area. Modernization and adoption of new technology has necessitated an increasing use of intermediate non-agricultural inputs in the production process, thus strengthening the intersectoral linkages.

Further, because of the increasing use of intermediate inputs in agricultural production, value added as a proportion of value of output has tended to decline. Important changes have also taken place in the relative shares of factor incomes in value added in agriculture. In particular, the share of interest and depreciation as a proportion of value added has tended to grow because of increasing use of capital in the production process.

The new seed-fertilizer technology in wheat (and later in rice) was no doubt exogenous to start with. But a noteworthy achievement in Punjab was the rapid process of internalization of this technology and its successful exploitation by Punjab farmers. The most crucial element in making this possible was large public investment in irrigation and power, scientific research, extension services, roads, markets, and other rural infrastructure. Because of assured profitability of the new technology, public investments in infrastructure were supplemented by large private investments. Along with improved agriculture, important technological improvements have also taken place in some manufacturing lines because of upgraded skills, use of power, and general improvements in infrastructure.

Manufacturing continues to be dominated by agroprocessing industries, with textiles accounting for about one-fourth of total manufacturing activity in both value of output and value added. This is followed by other agriculture-based industries, particularly food processing and dairying. However, a notable change is that basic metal industries, metal products, manufacture and repair of vehicles, and bicycles and parts had by 1979/80 become fairly important manufacturing sectors in Punjab. The emergence of machine-based and metal-based industries reflects the deepening industrial structure of the state.

Because of the much higher level of agricultural output and manufacturing activity, trade and transport and other services such as public administration and banking and insurance have significantly increased their share in the state economy. The Punjab economy, which continues to be dominated by agriculture and agriculture-based industries, is showing signs of a slow and gradual transition toward a more diversified economy.

An analysis of intersectoral linkages in the Punjab economy shows that a higher use of intermediate inputs in agriculture has led to more roundabout methods of production and much larger direct and indirect increases in the demand for nonagricultural inputs and generation of significant linkages. But the total effect of direct, indirect, and induced demand on the Punjab economy is considerably reduced because of large-scale imports of intermediate inputs and consumption goods. The incremental direct and indirect output requirements from the domestic economy are notably smaller in Punjab than in India as a whole because of the high level of imports of industrial goods. The gains of the "green revolution" in Punjab are, therefore, increasingly shared with the rest of the country. This is evident from the considerable number of workers who come from outside the state during the planting and peak harvesting seasons.

A comparison of 1969/70 and 1979/80 input-output tables brings out some of the changes that have taken place in the disposal of gross domestic product (GDP) at market prices among various elements of final demand during this period. Consumption remains the most important activity, accounting for nearly 60 percent of gross domestic expenditures during both 1969/70 and 1979/80. A significant change is a marked increase in the share of gross fixed capital formation in GDP during 1979/80 compared with 1969/70. Another notable feature of the Punjab economy is that despite very large imports of industrial products as inputs for the agricultural and manufacturing sectors and for final consumption, the increasing exports of wheat, rice, and cotton and of some agroprocessing and other industries have made it a highly export-surplus economy. Whereas substantial resources were transferred to Punjab for both rehabilitation and infrastructural investment for a number of years after independence, there is evidence to suggest that considerable savings from the Punjab economy have been used for investment outside the state since it became surplus in agricultural production. A major challenge for policymakers is to create a climate that encourages the investment of these savings within Punjab, thereby accelerating the growth rate of the secondary and tertiary sectors.

An analysis of forward and backward linkages among various sectors in the Punjab economy shows that some important changes have taken place in the nature and number of these linkages. During 1969/70, only the agricultural sectors, including animal husbandry, and some agroprocessing sectors were generating high forward and backward linkages on account of income and wage income with and without import leakages. During 1979/80, many more sectors joined this group (when linkages are considered without or with import leakages), indicating that the economy was functioning at a higher technological level. The important new sectors with import leakages

are some machine-based and metal-based industries on the one hand, and trade and transport, other services, banking, and real estate on the other.

The multiplier analysis further confirms that important changes took place in the structure of the Punjab economy during 1969/70-1979/80. For example, in 1969/70, it was primarily the agriculture-based industries that recorded the highest indirect income and employment. In 1979/80, in addition to these, other industries such as basic metals, metal products, other chemicals, machine goods, electrical and nonelectrical machinery, and drugs and pharmaceuticals also began to show high indirect income and employment levels. It is also found that, since major economic activity is devoted to meeting the consumption needs of the Punjab population, those sectors that have an important place in the consumption basket have very high induced incomes.

The rapid growth and structural transformation of the Punjab economy has taken place primarily as a result of technological breakthroughs in agriculture. The Punjab experience underlines that in an agriculture-dominant, labor-surplus economy, rapid growth in agriculture has widespread effects and can become a powerful instrument for marked acceleration of the overall growth of the economy.

The Punjab experience also emphasizes that it is possible for a region within a large country to enjoy the fruits of specialization and comparative advantage in a constrained "open" economy context. Punjab was able to derive the maximum benefits of specialization in agriculture because, being a state of India, it could freely export its agricultural surpluses at favorable prices, import modern agricultural and industrial inputs from the rest of India, and attract a large number of agricultural laborers from other Indian states.

2

GROWTH OF THE PUNJAB ECONOMY SINCE 1960/61

Input-output analysis is a powerful tool for understanding the structural features of an economy and baring the underlying intersectoral linkages in it. The existence of two input-output tables for Punjab, one for 1969/70 (Alagh, Bhalla, and Kashyap 1980, 104-113) and the other for 1979/80 (Appendix 1, Table 44), should be helpful for understanding not only the structural features but also the changes that have taken place in the Punjab economy over this period. However, by its very nature, an input-output table is a snapshot of an economy at a point of time. Although a comparison of the two snapshots can certainly provide some understanding of structural changes, it fails to give any insight on the dynamics of change during this period. In order to provide a background for further analysis and to fully appreciate the nature of these changes, the pattern of sectoral growth is reviewed by examining the behavior of the net state domestic product by industry of origin between 1960/61 and 1983/84.

Overall Growth

Punjab is one of the smallest states of India, accounting for 1.65 percent of the country's area and about 2.45 percent of its population. This state bore the main brunt of the partition of India in 1947. However, within a few years after this shattering experience, Punjab was able not only to rehabilitate its economy but also to emerge as the richest state in India. By 1983/84, the per capita income in Punjab was 3,560 rupees (Rs) compared with a national average of Rs 2,288. Table 1 shows several features of the remarkable rate of growth since 1960. First, as a result of an annual growth rate of about 5 percent in net state domestic product during 1960/61-1983/84, the per capita income recorded a growth of nearly 3 percent a year and almost doubled over this period.[1] During the same period, national income and per capita income in the country as a whole grew at annual rates of nearly 3.5 and 1.3 percent, respectively.

Second, although all sectors of the Punjab economy have been growing at impressive rates, growth has been particularly high in the secondary and tertiary sectors; for example, during 1960/61-1983/84 the primary sector grew at an annual rate of 4.1 percent, while the secondary sector had a growth rate of 5.6 percent and the tertiary sector, 6.8 percent.[2] The respective growth rates of these sectors at the national level

[1] Since the Punjab was reorganized in 1966/67, time series data on state income are available only from 1966/67 onward. The Economic Adviser to the Government of Punjab has given a figure for 1960/61, but NSDP figures for 1960/61-1965/66 have not been estimated. In addition, all data up to 1969/70 are at 1960/61 constant prices and the later data are at 1970/71 constant prices. In view of this, it is difficult to obtain exact growth rates for the entire period 1960/61-1983/84. An attempt has been made to convert the 1960s figures to 1970/71 constant prices, but the limitations of this exercise are worth noting. Growth rates from 1970/71 to 1983/84 are more reliable for this reason.

[2] The three sectors of the economy are defined as follows: Primary—agriculture; animal husbandry; forestry and logging; fishing; and mining and quarrying; Secondary—manufacturing; construction; and electricity, gas, and water supply; Tertiary—transport, storage, and communications; trade, hotels, and restaurants; banking and insurance; real estate and ownership of dwellings; public administration and defense; and other services. To simplify the text, all subsectors within these categories are also referred to as sectors throughout the report.

Table 1—Net state domestic product at factor cost, by industry of origin, 1960/61-1983/84

Industry	1960/61	1969/70	1970/71	1979/80	1983/84	Growth Rate 1960/61-1983/84	Growth Rate 1970/71-1983/84
			(Rs million)[a]			(percent)	
Agriculture[b]	4,532	6,687	6,212	8,188	9,153	3.3	3.6
Livestock	744	1,672	2,131	3,352	3,830	6.9	4.6
Forestry	16	26	30	58	68	6.6	9.1
Fishery	4	5	5	8	10	4.2	5.2
Mining and quarrying	1	2	5	2	4	5.7	2.5
Subtotal: primary sector	5,297	8,392	8,382	11,607	13,065	4.1	4.9
Registered manufacturing	287	582	567	1,235	1,600	7.8	5.7
Unregistered manufacturing	355	570	582	1,028	1,287	6.7	7.8
Construction	608	896	938	889	1,258	2.4	4.5
Electricity	42	113	112	264	350	9.1	9.8
Subtotal: secondary sector	1,292	2,161	2,199	3,416	4,494	5.6	7.1
Transport and storage	321	442	503	908	1,138	6.6	6.8
Trade and hotels	1,003	1,770	1,803	2,874	4,228	6.7	7.9
Banking and insurance	125	212	231	447	737	8.1	9.8
Real estate and dwellings	215	228	230	227	360	2.0	4.1
Public administration	137	273	317	563	925	8.6	9.8
Other services	447	672	697	1,129	1,182	4.6	4.2
Subtotal: tertiary sector	2,247	3,597	3,780	6,149	8,570	6.8	7.3
Net state domestic product	8,836	14,151	14,362	21,172	26,130	4.9	5.4

Sources: Based on data from Punjab, *The Statistical Abstract of Punjab,* various issues (Chandigarh: Economic and Statistical Adviser, various years).
Note: Parts may not add to totals because of rounding.
[a] In 1970/71 prices.
[b] Refers to crop production only.

were 2.2, 4.2, and 5.0 percent. Thus, while the rate of growth in the primary sector in Punjab was nearly double that of India, growth rates in the secondary and tertiary sectors were nearly one and a half times higher. Further, although the growth of the primary sector in Punjab was substantially lower than that of the other sectors, it is quite impressive when compared with other low- and middle-income countries (see Westley 1986). The various sectors within the primary, secondary, and tertiary sectors, however, recorded varying rates of growth. For example, within the primary sector, income from agriculture grew at an annual rate of 3.3 percent and that from livestock at about 7.0 percent. Within the secondary sector, income from electricity grew at the rate of 9.1 percent and from manufacturing at slightly more than 7.0 percent.

Third, because of the differential rates of growth in the three sectors, their respective shares in the total net state domestic product underwent a significant change. During 1960/61-1983/84 the share of the primary sector, when measured in 1970/71 constant prices, declined from 59.9 percent of the state income to 50.0 percent. The share of agriculture declined from 51.3 percent to only 35.0 percent. On the other hand, during the same period the share of the secondary sector increased from 14.6 percent to 17.2 and that of the manufacturing sector from 7.3 percent to 11.0 percent. A notable shift was in the share of the tertiary sector in the net state domestic product, which rose from 25.4 percent in 1960/61 to 32.8 percent in 1983/84. The changes in the shares of different sectors are more pronounced when calculated at current prices. Despite the rapid growth of the primary, secondary, and tertiary sectors, the

primary sector continues to dominate the Punjab economy to a much greater extent than it does the country as a whole. Thus, for India during 1983/84, the primary sector accounted for only 40.9 percent of total income compared with 50.0 percent for Punjab, while the secondary and tertiary sectors' contribution to national income, at 20.6 percent and 38.5 percent, respectively, was much greater than their contribution in Punjab. Nevertheless, it is obvious that the Punjab economy is undergoing a process of sectoral diversification in terms of income generated by various sectors. This sectoral diversification in income shares has not been accompanied by a commensurate diversification of the work force. In fact, the proportion of the male work force engaged in agriculture increased substantially from 56.2 percent in 1961 to 63.6 percent in 1971. Only during 1971-81 was there a small decline in the male work force in agriculture (India, Ministry of Home Affairs 1982) to 60.0 percent in 1981.

Fourth, all three sectors have contributed to the growth of the economy. However, since a high proportion of state income has always come from the primary sector, the growth of this sector has directly and indirectly been the main engine of growth in the state. For instance, out of a total increase of Rs 17,293.3 million in state income between 1960/61 and 1983/84, Rs 7,768.6 million (as much as 44.9 percent) was provided by the primary sector.

Finally, as a consequence of the introduction of new seed-fertilizer technology during the mid-1960s, the growth rate of state income and of the primary, secondary, and tertiary sectors accelerated appreciably during 1970/71-1983/84. Since the thrust of economic development in the state has been provided by the agricultural sector, a detailed discussion of its performance is undertaken next, followed by a brief discussion of the growth of the secondary and tertiary sectors of the economy.

Growth and Transformation of Punjab Agriculture

Punjab has recorded a very high rate of growth in agriculture since the inception of planning in 1950/51.[3] It was during the 1950s that the basic institutional and economic infrastructures were created in agriculture through land reforms and massive public investments. These investments were made in development of irrigation and electric power, foundation of agricultural research and extension services, strengthening of the cooperative credit structure, and expansion of markets. Simultaneously, land reform legislation was passed and put into effect. Although land reforms were half-hearted and failed to bring about any perceptible improvement in the distribution of landownership, they did succeed in abolishing the intermediaries and reducing the incidence of tenancy, thereby facilitating consolidation of holdings. These developments during the early postindependence years laid the foundations for rapid growth and modernization of agriculture. Because of large-scale investment in irrigation and other rural infrastructure as well as changes in institutional structure, Punjab was able to record an agricultural growth rate as high as 4.6 percent during 1950/51-1964/65—long before the onset of the "green revolution." Both area expansion and yield increases contributed to this growth.

[3] During 1952/53-1964/65, Punjab led the other states in growth rates of total agricultural output and of individual crops such as wheat, rice, and cotton. This was not the case, however, in relation to growth of productivity. For example, during this period the Punjab trailed Gujarat, Madras, and Mysore in the growth of overall productivity; Gujarat, Madras, Mysore, Andhra Pradesh, and Kerala in the growth of foodgrain productivity; and Mysore, Maharashtra, and Andhra Pradesh in the growth of nonfood productivity (see India, Ministry of Food and Agriculture 1968).

The introduction of the new seed-fertilizer technology in the mid-1960s marked the beginning of a new chapter in the history of Punjab agriculture. Under the impact of technological improvements from the late 1960s, there appears to have been an unparalleled rise in agricultural production and productivity. The state is now universally acknowledged as the heartland of the green revolution. Information on area, output, and yield levels for important crops and on total agricultural output from 1950/51 to 1984/85 is given in Table 2. Figures 1 and 2 illustrate the rapid strides made by agriculture in the state. Some of the salient features are described below.

First, with adoption of the new production technology during the late 1960s there was a remarkable expansion of area under wheat and rice, while the cultivation of most other crops (for which there was a conspicuous absence of improved technology) registered a slow but persistent decline. It was the technology-price-profitability advantage of rice and wheat over other crops that was reflected in differential growth in area and output of various crops. Thus the share of wheat area in the gross cropped area, which had increased from 26.9 percent in 1950/51 to 30.6 percent in 1964/65, grew to 44.1 percent by 1984/85. Rice, which had accounted for only 2.9 percent of gross cropped area in 1950/51 and 5.0-6.0 percent in 1964/65, increased its share to 23.4 percent by 1984/85. For most other crops, cropped area declined in varying degrees after the onset of the wheat and rice revolution in the late 1960s, most significantly in the case of pulses (gram), coarse cereals, and groundnuts.

Second, as expected with improved technology, yield rates grew impressively in rice and wheat compared with most other crops. Wheat yields, which had grown by 2.0 percent a year during 1952/53-1964/65, grew by 2.6 percent a year during 1967/68-1984/85. The growth rate for rice was even more phenomenal, increasing from 1.7 percent a year in the pre-green-revolution period to 5.7 percent in the post-1967 years. Consequently, whereas yield increase had accounted for nearly 37 percent of the growth of wheat output in the pre-green-revolution period, its contribution to the growth of output increased to nearly half in the post-green-revolution years. In the case of rice, the contribution of yield to growth of output increased from nearly 20 percent to 35 percent during this period. For other crops, with the exception of sugarcane, there was hardly any increase in yield levels. However, because of the predominance of wheat and rice, the overall productivity of all crops taken together grew at an impressive rate, and yield increases emerged as the predominant source of growth of total agricultural output in Punjab.

Third, as a result of rapid growth in both area and yield, the output growth for wheat and rice since the late 1960s has been dramatic. Wheat output, which was a bare 1.0 million metric tons in 1950/51, rose to 2.4 million tons in 1964/65 but reached a level of 10.2 million tons in 1984/85.[4] The production of rice, which was hardly a popular crop in Punjab until the late 1960s, increased from 0.1 million tons in 1950/51 to 0.5 million tons in 1969/70, then rose to 5.1 million tons in 1984/85. By 1984/85, these two crops had become the predominant crops of the state and accounted for the major proportion of the total value of agricultural output. The expansion in area under wheat and rice, for which new technology was available, not only necessitated increasing purchases of modern inputs from other sectors of the domestic economy and from outside the state, but also generated increasing levels of marketable surpluses of these crops. As a result, Punjab agriculture became increasingly commercialized and interlinked with the national market.

[4] All tons in this report are metric tons.

Table 2—Area, output, yield, and growth rates of principal crops of Punjab, 1950/51-1984/85

Year	Rice			Wheat			Gram			Oilseeds			Sugarcane			Cotton			Gross Cropped Area
	Area[a]	Output[b]	Yield[c]	Area[a]	Output[b]	Yield[c]	Area[a]	Output[b]	Yield[c]	Area[a]	Output[b]	Yield[c]	Area[a]	Output[b]	Yield[c]	Area[a]	Output[b]	Yield[c]	
1950/51[d]	120	107	892	1,137	1,024	901	851	511	600	128	55	430	91	2,570	28,240	225	43	192	4,224
1960/61[d]	227	229	1,009	1,400	1,742	1,244	838	681	813	185	121	654	133	4,860	36,540	447	121	269	4,723
1964/65[d]	287	351	1,223	1,563	2,360	1,510	744	666	895	239	222	929	122	4,440	36,390	487	138	282	5,113
1967/68	314	415	1,322	1,790	3,335	1,863	530	452	853	399	314	987	137	4,800	35,070	419	132	315	5,441
1969/70	359	535	1,490	2,166	4,865	2,246	380	393	1,034	294	213	724	149	6,180	41,480	409	145	353	5,499
1979/80	1,167	3,041	2,606	2,823	7,896	2,797	236	162	686	199	157	789	77	3,930	51,040	630	205	326	6,535
1984/85	1,644	5,054	3,074	3,094	10,176	3,289	102	60	1,589	198	199	1,004	79	4,920	62,260	472	210	446	7,013
Growth rates (percent/year)																			
1952/53-1964/65[d]	6.82	8.68	1.74	3.34	5.38	1.98	2.11	1.26	−0.83	3.27	6.13	2.77	4.61	6.72	2.01	4.68	7.06	2.28	1.19
1967/68-1984/85	10.87	16.46	5.71	2.80	5.51	2.64	−7.45	−10.63	−2.96	−3.29	0.22	3.53	−4.28	−4.03	0.24	2.99	2.01	−0.96	1.72

Sources: For 1952/53-1964/65 growth rates, India, Ministry of Food and Agriculture, Directorate of Economics and Statistics, *Growth Rates in Agriculture, 1949-50 to 1964-65* (Delhi: Manager of Publications, 1968); for 1967/68-1984/85, statistical function of the type $Y = AB^t$ was fitted to time series of yearly data drawn from Punjab, *The Statistical Abstract of Punjab,* various issues (Chandigarh: Economic and Statistical Adviser, various years).

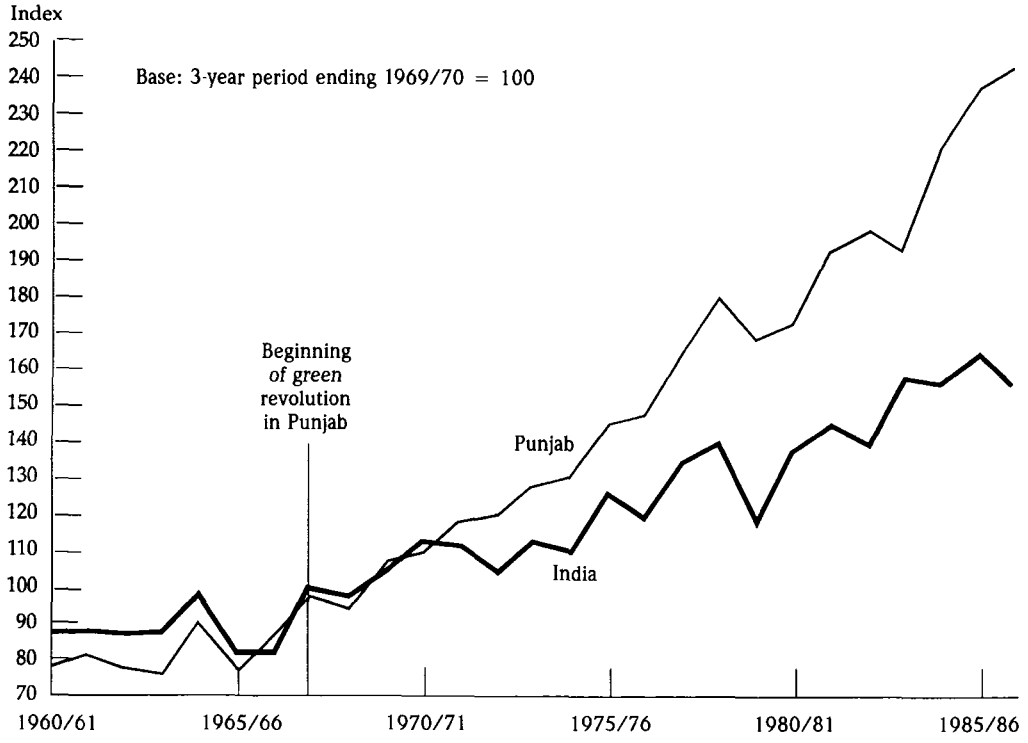
[a] In 1,000 hectares.

[b] in 1,000 metric tons.

[c] In kilograms per hectare.

[d] Refers to former Punjab that is present Punjab, Haryana, and parts of Himachal.

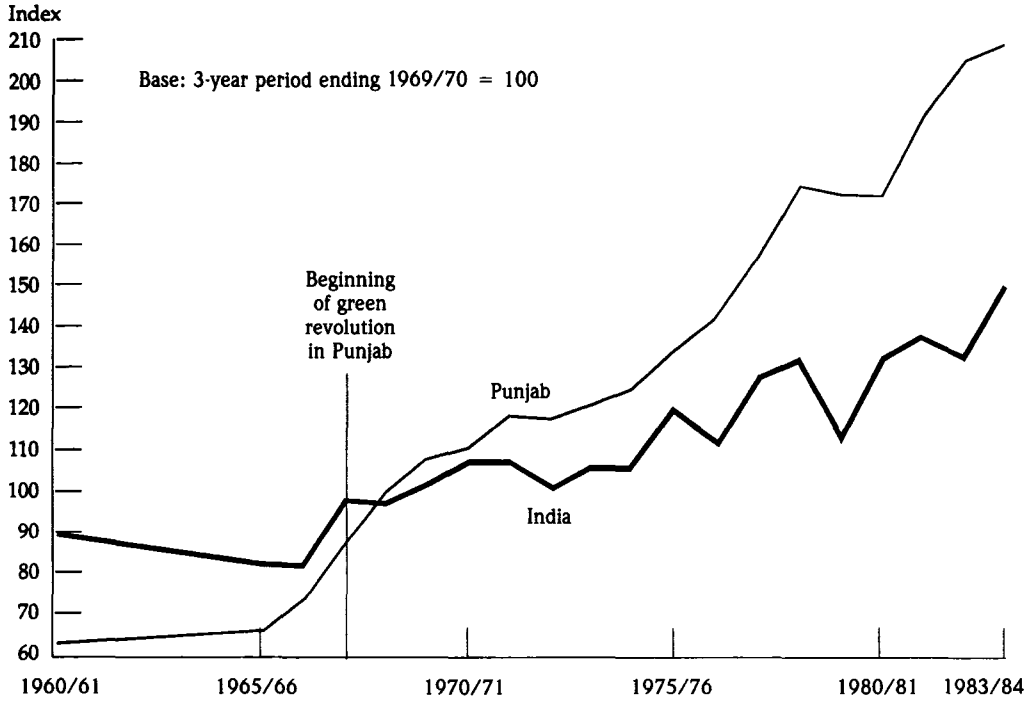
Figure 1—Index of agricultural production: India and Punjab, 1960/61-1986/87



Finally, because of the rapid rate of growth of 6.9 percent a year recorded by animal husbandry (livestock) during 1960/61-1983/84, significant diversification took place within the agricultural sector. In 1960/61, livestock accounted for only 14.1 percent of total income generated in agriculture (that is, crop production plus livestock); its share increased to 25.5 percent in 1970/71 and to 29.5 percent by 1983/84. This remarkable growth of animal husbandry was made possible by large-scale adoption of new technology for crop production in general, and for rice and wheat in particular. Since the essence of the new technology lies in the introduction of short-duration crops, it proved to be highly land-augmenting. Consequently, at the same time as the rapid expansion of area under wheat and rice, it became possible to bring a larger area under fodder cultivation. Further, with the development of irrigation, the area under green fodder increased rapidly. Per hectare productivity of green fodder also increased because of the introduction of modern seed-fertilizer technology in fodder production.

As will be discussed later, the number of bullocks per hectare of cropped area dropped significantly as a result of rapid tractorization in Punjab, resulting in a significant decline in the demand for fodder for draft animals. With the given land base, cultivators were able to sustain a larger number of milch animals in place of draft animals. The rapid increase in the number of milch animals and in milk production was made possible by development of infrastructure such as roads, transportation, veterinary services, milk-collecting booths, chilling centers, and dairies. With a rapid increase in per capita income, the consumption of milk and milk products increased sharply and

Figure 2—Index of agricultural productivity: India and Punjab, 1960/61-1983/84



Note: Productivity is per hectare of net sown area.

milk production became a fairly profitable allied agricultural activity. Milk production continues to be a part-time household activity characterized by strong production and demand linkages.

Main Determinants of Agricultural Growth

Punjab agriculture has recorded a phenomenal growth and has undergone a radical transformation since the mid-1960s. This transformation can be explained only in terms of a combination of several institutional, infrastructural, and technological factors, along with the considerable initiative shown by self-cultivating farmers in adopting the new technologies.

Institutional Factors

One of the important reasons for the agricultural transformation in Punjab has been the existence of a relatively more favorable institutional structure than is found in many other parts of the country. Under the traditional Mahalwari system of land settlement, land rights were vested primarily in the cultivating castes of the village communities. Despite dilution of the system during the British period, largely through conferment of superior land rights on a select few, self-cultivators continued to be an important component of the agrarian scene in Punjab. Partition and the consequent refugee resettlement led to the breakup of some large estates of former landlords who migrated to Pakistan and the allotment of this land to in-migrant cultivators on a

much-reduced scale. The various land reform laws, despite their limitations, resulted in the emergence of self-cultivation as the predominant mode of production. In 1953/54, in United Punjab (comprising the present Punjab, Haryana, and parts of Himachal Pradesh) about 60.0 percent of net operated area was under self-cultivation; by 1971/72 this had risen to 74.2 percent.

The Role of Infrastructure

Development of infrastructure has played a major role in the agricultural transformation of Punjab. The state enjoyed an initial advantage in irrigation development, as large-scale investments in canal irrigation had been undertaken by the colonial government during the last part of the nineteenth century and the early twentieth century. Thus, on the eve of independence in 1947, East Punjab (the present Punjab, Haryana, and parts of Himachal Pradesh) had about 33 percent of its area irrigated, compared with only 18 percent for the country as a whole (Hirashima 1978).

With the launching of planned development in 1951, the policymakers in India gave high priority to investment for the development of rural infrastructure. In Punjab the plan strategy consisted of developing agriculture—the most dominant sector—along with a network of small-scale agroprocessing, agro-input, and consumer goods industries. The policymakers were keenly aware of the importance of irrigation and other rural infrastructure such as power, credit, roads, markets, research, extension, and rural education for rapid development of agriculture and allied industries.

It is significant that Punjab was able to maintain a high level of per capita development expenditure during the entire planning period. In terms of plan outlay, the state occupied the top position during the first three plan periods (1951-66) and has since been in second place among all the major states of India. For the first three plans, this high level of expenditure was financed mainly through high levels of per capita central assistance, but it was sustained afterward through larger internal resources.

A consistent pattern of development priorities has been an important aspect of successive state plans wherein irrigation, power, agriculture, and community development together account for about 70 percent of the total plan outlay (Table 3). As a consequence, the proportion of net area irrigated increased from 49.5 percent of net area sown in 1950/51 to as much as 80.7 percent by 1980/81, compared with an increase from 17.6 percent to 27.7 percent for India as a whole. It may also be added here that the Punjab peasants have had long experience in using irrigation technology. Further, many of the immigrants came from the canal colonies of Montgomery, Lyallpur, and Sargodha after partition and brought to bear their expertise in using irrigation to augment production.

During the 1950/51-1980/81 period, the structure of irrigation changed steadily in favor of tubewells. In Punjab the net area irrigated by tubewells and wells increased from 35.8 percent in 1950/51 to 57.3 percent in 1980/81, while in India as a whole the area increased from 28.7 percent to 45.7 percent. The irrigation base of small holdings has been as good as that of the upper farm-size holdings, particularly in canal irrigation. Large-scale investments in tubewells by small farmers, combined with the widespread practice of hiring in tubewell services, have also contributed to the strength of the irrigation base in smaller holdings.

The high priority given to power in the planned development of Punjab is reflected in the per capita consumption of electricity, which increased from 5.9 kilowatt-hours in 1951 to 335.4 kilowatt-hours in 1982/83, while for India as a whole it increased from 17.8 kilowatt-hours to only 146.0 kilowatt-hours. By 1981, 100 percent of Punjab villages were electrified compared with 47.0 percent for India as a whole. By 1982/83

Table 3—Sectoral allocation of total expenditure in the five-year plans of Punjab, 1951-56 to 1980-85

Sectors	First Plan, 1951-56[a]	Second Plan, 1956-61[a]	Third Plan, 1961-66[a]	Fourth Plan, 1969-74	Fifth Plan, 1974-79[b]	Sixth Plan, 1980-85
			(percent)			
Agriculture and community development	18.10	16.70	17.21	12.00	13.17	15.25
Irrigation and power	58.60	51.70	52.79	55.43	51.18	56.38
Industries and mining	0.90	3.40	4.06	3.24	5.00	4.09
Transport and communication	5.80	7.00	5.62	14.85	9.35	5.67
Social services	8.50	16.40	18.75	13.25	20.16	17.76
Miscellaneous	8.10	4.80	1.57	1.23	1.14	0.85
Total	100.00	100.00	100.00	100.00	100.00	100.00
			(Rs million)			
Total expenditure	1,409	1,484	2,520	4,214	8,132	20,000

Sources: Based on data from Punjab, *The Statistical Abstract of Punjab,* various issues (Chandigarh: Economic and Statistical Adviser, various years); and data from the first six five-year plans of Punjab.

[a] Plan relates to former (pre-1966) Punjab.

[b] Figures for 1974/75 have not been included due to lack of data.

as much as 40.7 percent of the electricity was consumed for agricultural use in Punjab, while the national consumption for agriculture was only 18.6 percent. The availability of power in rural Punjab has made possible the electrification of thousands of pump sets and tubewells. Further, it has enabled the farmers to use power threshers, sugarcane crushers, and chaff cutters on a large scale, thus making a dent in the drudgery associated with traditional operations. The use of electric bulbs and other gadgets has also helped some farmers to visibly improve their quality of life. However, despite the great increase in power, the state has had frequent power shortages and shutdowns because supply has been unable to match demand, indicating the need for an even higher level of investment.

Another important infrastructural development is the impressive increase in the provision of cooperative credit to the cultivators. The loans disbursed in Punjab increased from Rs 7 per hectare in 1951/52 to Rs 485 in 1982/83. At the national level, the increase was only from Rs 2 to Rs 131. Another promising aspect of the cooperative credit structure in Punjab is that the per hectare disbursement of short-term cooperative loans for purchase of fertilizers is fairly equitable among farms of different sizes (Chadha 1986).

In addition to short-term cooperative credit, by 1985/86 the Primary Land Mortgage Banks were advancing loans worth about Rs 500 million a year compared with only Rs 164 million advanced during 1966/67. A major proportion of these loans is used for installation of tubewells, purchase of tractors, and land improvement. The State Land Mortgage Bank also finances the purchase of tractors and tubewells by the cultivators through large annual loans.

The availability of credit for agricultural finance in India increased rapidly after the nationalization of commercial banks in 1969, and their share in both short- and long-term credit nearly doubled during 1972-81. The expansion of commercial bank credit to agriculture was extraordinary in Punjab, increasing from Rs 470 million in 1975 to Rs 7,080 million in 1986.

Punjab has also undertaken massive programs of infrastructural development in roads, extension services, agricultural research, and education. By 1985, 98 percent of all villages in the state were linked by paved roads. The surfaced road length per 1,000 population increased from 0.56 kilometer in 1960/61 to 2.20 kilometers in 1982/83 compared with the national average of 1.07 kilometers. In 1982/83, there were 73.5 kilometers of surfaced roads per 100 square kilometers of area in Punjab compared with 22.8 kilometers for India as a whole. Between 1965 and 1983, the number of passenger vehicles in Punjab increased by nearly 150 times and goods vehicles by more than 50 times. There has also been a remarkable increase in the number of regulated markets and in storage capacity. This has greatly facilitated the smooth marketing of huge surpluses of wheat and paddy during the peak harvesting season (Punjab, Economic and Statistical Adviser, various years).

The state has also tried to develop a network of extension services for agricultural development. Several programs, such as the National Extension Programme, the Panchayati Raj[5], and the Community Development Programme, were introduced during the 1950s, and as a consequence, a hierarchy of trained agricultural extension workers was created. The Punjab Agricultural University at Ludhiana has made a signal contribution in the development of new seed varieties and has been actively involved in the extension and training programs in the state.

A great deal of investment has also been made in education and health. Punjab, once educationally backward, now figures among the leading states in educational facilities at the school and university levels as well as in engineering and medicine. The state's literacy rate has also shown a sharp rise, though it lags far behind that of Kerala (Table 4).

Table 4—Educational facilities in rural Punjab, 1966-83

Level of Education	Year	Rural Enrollment as a Share of Total Enrollment		Rural Share of Total State Expenditure on Education
		Male	Female	
			(percent)	
Primary	1966	87.24	81.58	96.73
	1977	87.50	87.58	99.62
	1983	87.05	86.02	n.a.
Middle	1966	82.84	75.67	90.54
	1977	93.34	91.16	97.67
	1983	80.63	71.75	n.a.
High and higher secondary	1966	36.69	27.57	66.44
	1977	66.57	60.96	91.11
	1983	56.76	48.29	n.a.
College	1966	18.55	12.09	n.a.
	1977	22.80	13.61	n.a.
	1983	22.01	13.80	n.a.

Sources: Based on data from Punjab, *Educational Statistics of Punjab,* Publication No. 333 (Chandigarh: Economic and Statistical Organization, n.d.), 116-119, 130-131, 146-147; and personal visits to the Directorate of Public Instruction, Chandigarh.
Note: n.a. means not available.

[5] A traditional system of self-government in Indian villages. The panchayat (village council) runs the routine affairs of the village and settles many local disputes. Soon after independence the panchayats were given many additional statutory powers in matters pertaining to local development.

Agricultural Price Policy

Another important factor in the rapid growth of agriculture in India, and particularly in Punjab, is the existence of a favorable price climate since the establishment of the Agricultural Price Commission in the mid-1960s. The commission, by its terms of reference, is expected to recommend prices for agricultural commodities that are remunerative to the cultivators and give them sufficient incentive to invest in new technology.

Most studies have shown that the minimum support prices fixed by the government on the recommendations of the commission were indeed remunerative. The establishment of the Food Corporation of India, which is required to undertake purchases of the entire market arrival of foodgrains at the minimum support prices, and the creation of market and transport infrastructure provided the assurance needed to persuade farmers to invest in new technology and thereby augment production. The Punjab farmers were the major beneficiaries of the new price policy, as they brought large surpluses of (first) wheat and (later) rice into the market and were able to obtain profitable prices for these and other commodities.

Political Clout of Prosperous Peasantry

In Punjab, unlike many other states in India, political power has shifted decisively from the urban trading and money-lending bourgeoisie to the prosperous rural peasantry since independence. Irrespective of their political affiliation, each successive state government in Punjab has taken positive policy measures to further the interests of this section of the population. These include the rural bias in planned expenditure on infrastructure; provision of essential inputs such as water and power at highly subsidized rates; stabilization of agricultural prices; availability of cheap loans both directly and through the cooperatives; provision of inputs such as fertilizers, better seeds, and insecticides; and the organization of agricultural research and extension.

Given this infrastructure, and offered opportunities to better their lot through the adoption of new techniques, the Punjab peasants accepted the challenges by taking the necessary risks and brought about the agricultural breakthrough. The new technology was first adopted by large landholders who had the initial wherewithal and capacity to take risks, but was soon extended to peasants with smaller holdings. The profitability of the new technology prompted cultivators to make large investments in tubewells and complimentary irrigation structures in a bid to reap the technological benefits. This investment was facilitated by the availability of large amounts of subsidized institutional credit that greatly complimented the farmers' own resources.

To sum up, the Punjab has built a developed rural infrastructure over the years out of its own and central resources. In fact, the state had succeeded in creating the requisite infrastructure before full modernization commenced in the late 1960s. The availability of this well-developed infrastructural base, in conjunction with the appropriate institutional framework and a positive agricultural price policy, provides the most convincing explanation for the rapid growth of agriculture in Punjab through adoption of the new seed-fertilizer technology.

Modern Inputs and Increasing Mechanization

Along with the use of high-yielding varieties of seeds, the rapid expansion of fertilizer application since 1965/66 is a crucial ingredient of the new technology. Fertilizer use per hectare of cropped area increased from a mere 8.8 kilograms in 1965/66 to 37.6 kilograms in 1970/71 and 149.4 kilograms in 1984/85. The fertilizers are used predominantly for wheat and rice.

Another vital aspect of technological upgrading is the increasing mechanization of agricultural operations, with rapidly expanding capital stock and its changing composition over time (Table 5). The arrival of a highly productive production technology in the mid-1960s was responsible for both inspiring and facilitating the modernization and increasing mechanization of agriculture in Punjab.

The number of tractors in the state increased by more than eleven times between 1966 and 1981 compared with an increase of three and a half times during 1956-66. The number of tubewells increased by fourteen times between 1966 and 1981, while in the pre-1966 decade they increased by only five times. There was one tubewell for every 2,222 hectares of net sown area in 1951, for every 83 hectares in 1966, and for every 7 hectares in 1981. With the rapid increase in the number of tractors, the average net sown area per tractor declined from 3,125 hectares in 1951 to 356 hectares in 1966 to only 36 hectares in 1981.

The pace of mechanization in the post-1966 era has indeed been very fast, while the use of bullocks and their importance in agriculture have been rapidly declining. Between 1951 and 1966, the number of bullocks increased by about 11 percent, while in the post-1970 years the number actually declined. Over time, the wooden plow has lost ground to the iron plow, and bullock-operated cane crushers are rapidly being replaced by power-operated ones. Threshing has been almost completely mechanized, and notable inroads have also been made by combines in the harvesting operations.

As a result of these developments, not only has mechanization increased rapidly, but the capital structure in Punjab agriculture has also undergone a significant change. The state has a disproportionately high share in the distribution of capital and other modern production assets at the national level. A number of factors have been respon-

Table 5—Capital structure in Punjab agriculture, 1951-82

Item	1951[a]	1961	1966	1972	1977	1982
Bullocks (number)	1,378,100	1,455,400	1,533,500	1,669,800	1,580,800	n.a.
Net sown area per bullock (hectares)	2.6	2.6	2.5	2.5	2.6	n.a.
Plows						
Iron (number)	153,000	411,815	634,141	755,171	906,560	1,074,000
Wooden (number)	667,130	673,835	699,157	653,642	602,213	581,200
Cane crushers						
Power-operated (number)	476	1,566	3,223	9,500	16,599	29,500
Bullock-operated (number)	61,308	73,691	88,768	78,014	75,471	75,800
Tubewells						
Diesel engine (number)	1,285	6,983	25,670	249,687	304,000	447,600
Electric motor (number)	300	6,565	20,233	78,763	196,579	215,000
Net sown area per tubewell (hectares)	2,222	277	83	12	8	6
Tractors (number)	1,148	4,935	10,636	41,185	64,307	106,500
Net sown area per tractor (hectares)	3,069	760	358	99	65	40

Sources: For data through 1977, Punjab, *The Statistical Abstract of Punjab,* various issues including that for 1965 pertaining to former Punjab (Chandigarh: Economic and Statistical Adviser, various years); and for 1982 data, India, Ministry of Planning, Central Statistical Organization, *Statistical Abstract* (Delhi: Controller of Publications, 1986).

Note: n.a. means not available.

[a] For some items, the 1951 figures were not available for the present Punjab. These were derived from the figures for the old Punjab under the assumption that the ratio of the 1951 figure between the present Punjab and Haryana was the same as for the 1956 figure.

sible for the rapid mechanization of agriculture in Punjab. The spurt in tubewell installation was caused by the need to increase and regulate the flow of irrigation to permit adoption of the highly profitable new technology in wheat and rice. The drive toward mechanization was necessitated mainly by the relative scarcity of labor (due to the low man-land ratio in the state) and high wage rates, particularly during peak agricultural operations. In the post-1966 years the spurt in tractors was caused by the need for both timely completion of field crop operations and relief from the pressure on labor demand. Tractors were also increasingly used for transport purposes and soon became a status symbol, driving quite a few medium and even small farmers to purchase one regardless of the size of their holding. Large-scale investment in tubewells and other farm mechanization was facilitated partly by ready availability of subsidized institutional credit and partly through remittances from abroad.

The increasing modernization of production technology in Punjab agriculture can also be seen in the composition of material inputs. Table 6 details a number of important changes for the farm sector as a whole. While the relative share of modern inputs (for example, chemical fertilizers, diesel oil, electricity) increased dramatically, that of traditional inputs (such as organic manures, bullock feed, a part of seed cost) declined steeply over time, especially after the mid-1960s. The relative share of purchased inputs also increased sharply, from about 30 percent in 1960/61 to more than 85 percent in 1980/81. Clearly, agriculture in Punjab is increasingly linked with nonagricultural sectors for the supply of its inputs. This has created expansion possibilities for such activities, both locally and outside the state.

Changes in Factor Shares

With rapid modernization and changes in factor proportions, significant changes seem to have taken place in the shares of various factor incomes in value added through the process of agricultural production. In the absence of data on the total crop complex, the analysis of time series data undertaken here on the cost of cultivation of wheat in Punjab brings out some of these changes (Table 7). The results of trend values obtained by fitting semi-log regressions of relevant variables on time are given in Table 8. A few

Table 6—Input structure in Punjab agriculture, 1960/61-1980/81

Input	Share of Input Expenditure				
	1960/61	1965/66	1970/71	1975/76	1980/81
			(percent)		
Fertilizers	1.52	8.09	27.20	28.01	37.70
Organic manures	5.93	3.88	3.60	2.60	2.09
Diesel oil	9.24	13.99	26.53	35.93	38.73
Irrigation charges	6.62	6.50	2.71	1.57	1.03
Electricity charges	1.11	1.52	2.60	2.48	2.80
Pesticides	1.51	1.40	1.00	0.67	3.60
Repair and maintenance	5.93	4.71	4.14	2.62	2.12
Seed cost	37.44	37.75	22.00	15.85	6.33
Bullock feed	27.83	19.54	7.64	8.29	4.28
Other	2.87	2.62	2.58	1.98	1.32
Total inputs	100.00	100.00	100.00	100.00	100.00
Purchased inputs	30.00	40.00	70.00	78.00	87.00
Farm-raised inputs	70.00	60.00	30.00	22.00	13.00

Source: State Income Accounts of Punjab, consulted by author in Economic and Statistical Organization, Chandigarh.

Table 7—Value of output, factor shares in value added, and labor productivity in wheat cultivation in Punjab, 1970/71-1983/84

Year	Value of Output	Gross Value Added	Wages	Depre-ciation	Interest	Surplus	Rent	Labor Productivity[a]
				(Rs/hectare)				
1970/71	1,982.53	1,398.32	328.30	57.87	107.66	327.94	576.55	n.a.
1971/72	2,219.19	1,495.35	346.28	37.10	100.05	449.89	562.03	32.70
1972/73	1,844.93	1,162.83	276.84	28.94	90.04	194.39	574.62	32.77
1973/74	2,860.01	2,021.24	386.58	28.40	97.05	822.87	686.34	43.32
1974/75	3,420.15	2,406.75	503.11	41.31	210.66	750.50	900.67	48.97
1975/76	2,733.49	1,622.51	487.14	59.55	199.66	701.17	774.56	47.31
1976/77	2,831.41	1,660.71	467.04	55.60	200.28	219.52	718.18	49.05
1977/78	2,855.22	1,626.34	493.00	63.94	226.02	132.85	710.50	51.98
1978/79	3,399.05	2,062.16	478.17	74.80	330.89	358.12	873.15	60.85
1979/80	3,540.38	2,154.52	490.73	68.29	284.98	678.55	931.97	68.26
1980/81	3,579.38	1,934.82	478.11	57.04	320.23	139.91	939.53	80.35
1981/82	4,588.26	2,952.44	590.61	64.69	391.40	812.07	999.15	95.61
1982/83	5,093.02	3,223.05	604.26	80.59	405.06	865.74	1,267.40	103.36
1983/84	5,008.08	3,059.75	628.58	77.25	444.37	555.51	1,354.04	98.08

Source: Based on data from India, Ministry of Agriculture and Cooperation, "Comprehensive Scheme for Studying Cost of Cultivation of Principal Crops in India" (Directorate of Economics and Statistics, Delhi, various years, mimeographed).
Note: n.a. means not available.
[a]Value of output divided by numbers of workers.

Table 8—Regression results for value of output, factor shares in value added, and labor productivity in wheat cultivation in Punjab, 1970/71-1983/84

Dependent Variables	Independent Variables		R^2
	Constant	Time	
VA/VO	0.6817	−0.00488 (2.41)*	0.327
W/VA	0.2485	−0.0039 (0.871)	0.060
(D + I + S)/VA	0.3281	−0.00178 (0.257)	0.005
(D + I)/VA	0.0900	0.0236 (3.406)*	0.492
(D + I)/(VA − S)	0.1208	0.0203 (5.14)*	0.687
D/VA	0.0266	0.0015 (0.16)	0.002
R/VA	0.4096	−0.0008 (0.23)	0.004

Note: Figures in parentheses refer to t-values.
*Significant at 0.05 level.
Definitions of dependent variables:

VA = gross value added;
VO = value of output;
W = wages;
D = depreciation;
I = interest;
S = surplus; and
R = rent.

conclusions can be drawn. First, value added as a proportion of value of output has shown a declining trend that is statistically significant. This tends to confirm that, while the share of intermediate inputs in the value of output has increased, the share of value added has notably declined.

Second, as expected, the share of interest and depreciation in value added has shown an increasing trend, and the result is statistically significant.

Third, no firm conclusions can be drawn concerning the share of wages in value added. Although the regression equation has the expected negative sign, the result is statistically insignificant. Furthermore, with increased labor productivity, a corresponding increase in wage rates over time would have been expected. Nominal wage rates, when regressed on the money value of wheat output per worker (labor productivity) from 1971/72 to 1983/84, give the following equation (figure in parentheses is t-value):

$$\log(\text{wages}) = 55.04 + \underset{(5.98)}{0.51}\,(\text{labor productivity}); \qquad (1)$$

$$R^2 = 0.765.$$

The relationship between the two variables is quite significant and the value of the regression coefficient is 0.51. Accordingly, the growth rate of wages constitutes only 51 percent of the growth rate of labor productivity in the case of wheat.

Finally, there does not seem to be any significant change in the share of rent in value added. In fact, the regression coefficient has a negative sign and the value is highly insignificant.

Sharing the Gains of the Green Revolution

The above results are important in explaining the emerging changes in factor shares along with changes in the structure of production, but these do not indicate the distribution of gains of new technology among various categories of cultivators and landless labor. Unfortunately, no up-to-date secondary data or studies exist on income distribution among various sections of the peasantry in Punjab.

As far back as 1975/76, an empirical study was conducted on the impact of the green revolution on income generation and income distribution and on the standard of living of various categories of cultivator households (Bhalla and Chadha 1983). Another study on the income levels of landless labor households refers to the same year (Singh 1986). Based on these studies, some broad generalizations can be made on income distribution in Punjab.

It is generally agreed that a higher growth rate in agriculture tends to reduce rural poverty. The available data show that the state of Punjab, which has had a high agricultural growth rate over a long period, has the lowest poverty ratio among the major states of India (Table 9). The gains from the new technology seem to have trickled down to all sections of the rural population. However, since these gains are distributed more or less in proportion to the initial landholding position, and the landholding distribution is very skewed, the distribution of gains has been quite inequitable. In terms of production efficiency, the marginal and small farmers in the state, despite their limited land base, have a total crop output and farm business income per unit of area that is almost as large as those of the larger farmers. This is because their technological level is nearly as good and they make optimum use of surplus family labor. They are also able to supplement their earnings with wage and other income from nonagricultural occupations. In spite of this, many of them are still living below the poverty line. Although there is evidence to suggest that landless labor has also shared somewhat in

Table 9—Rural poverty ratio in major Indian states, 1970/71, 1977/78, and 1983/84

State	1970/71[a]	1977/78	1983/84
Andhra Pradesh	41.00	45.45	38.67
Bihar	59.00	57.82	51.35
Gujarat	43.80	43.10	27.62
Haryana	[b]	23.21	15.19
Karnataka	47.20	53.15	37.49
Kerala	62.00	47.37	26.05
Madhya Pradesh	52.90	61.63	50.30
Maharashtra	46.60	60.36	41.50
Orissa	65.00	67.89	44.76
Punjab	23.60[c]	13.21	10.87
Rajasthan	41.80	33.48	36.63
Tamil Nadu	57.30	56.26	44.08
Uttar Pradesh	40.60	49.79	46.48
West Bengal	70.10	58.31	43.84
All India	49.10	51.20	40.40

Sources: For 1970/71, Montek S. Ahluwalia, "Rural Poverty and Agricultural Performance in India," *Journal of Development Studies* 14 (3): 298-323; for 1977/78, India, Ministry of Planning, National Sample Survey Organization, *Sarvekshana,* vol. 9, no. 3 (Delhi: Controller of Publications, 1986); and for 1983/84, India Ministry of Planning, National Sample Survey Organization, *Sarvekshana,* vol. 9, no. 4 (Delhi: Controller of Publications, 1986).

[a]The 1970/71 figures are not strictly comparable with those for 1977/78 and 1983/84 because of differences in the norms used for computing poverty ratios.

[b]Included in Punjab.

[c]Includes Haryana and parts of Himachal Pradesh.

the benefits of the green revolution by obtaining higher wages from agriculture and from expanded nonagricultural occupations, many of these laborers, like the marginal and small farmers, have been unable to rise above the poverty line.

It can therefore be stated that rapid agricultural growth over a long period has made a significant dent in poverty in Punjab. However, because of the limited resource base, the gains of the small and marginal farmers and agricultural laborers have been relatively small, and many from these groups continue to hover around the poverty line. The green revolution in Punjab, as elsewhere in the country, has provided a breathing space by increasing the output and income of all sections of the peasantry and by productively absorbing the increasing labor force into agriculture. But the dynamic of the situation is such that not all increases in the rural labor force can be usefully absorbed into agriculture for all time to come. The primary focus of policymakers should be on the creation of large-scale productive employment in the manufacturing and other nonagricultural sectors through well-planned investment for diversification of the economy.

Growth of Manufacturing

Because of the very rapid growth of agriculture in Punjab, the state is universally acknowledged as the symbol of the green revolution and the most progressive agricultural state of India. However, what is often forgotten is that the growth of the manufacturing sector has always been perceptibly higher than that of agriculture. During 1960/61-1983/84, income from registered manufacturing in Punjab grew at an annual rate of 7.8 percent, while that from unregistered manufacturing increased at a rate of 6.7

percent. During this period the growth rate of income from manufacturing in India as a whole was only 4.3 percent. Because of its significantly higher growth, Punjab can no longer be considered relatively backward in industrialization. In 1961, with per capita value added in the factory sector amounting to only Rs 4, the state ranked lowest in the level of industrialization among the 14 major states of India. By 1981, per capita value added in the factory sector had increased to Rs 136 (at current prices), and the state ranked seventh in industrialization. By 1985/86, Punjab had further improved its position to fifth place (India, Ministry of Planning, various years [c]).

The nature and composition of manufacturing has undergone a notable change, especially since the advent of the green revolution in the mid-1960s. The 1960s witnessed a phase of rapid agro-industrialization, and the output of small units manufacturing agricultural tools and implements showed particularly fast growth in response to mounting demand from rapidly growing agriculture. In addition, the increase in rural income led to much higher demand for consumption goods. Consequently, many small-scale consumer goods industries came into being. The agro-industries manufacturing agricultural implements and machine tools, fertilizers, pipes and fittings, and automobile parts, and the processing industries such as cotton textiles, sugar, wheat flour, and rice-shelling grew continuously over the 1960/61-1983/84 period. Village industries such as the processing of cereals and pulses, *gur* (brown sugar), and *khandsari* (coarse sugar); oil extraction; pottery; soap; lime; fiber and leather; carpentry; and blacksmithing also showed varying degrees of growth. Another area of rapid development was repair and maintenance activities.

Over time these small-scale units developed into medium- and large-scale units in many instances. With the establishment of some new large industries such as fertilizers, electronics, and tractors in the public sector, and the expansion of the private sector in textiles and hosiery because of export demand, many consumer goods industries in the registered sector also started to grow rapidly.

Within the manufacturing sector, detailed data on output and employment are available for the registered industries only. (Under the Indian Factories Act of 1948, a registered industry is defined as any premises or precincts thereof where 10 or more workers work with the aid of power or where 20 or more workers work without power.) Table 10 gives data on the levels and growth of output and employment in selected industries of Punjab. The data on output provided by the state Economic and Statistical Organization has been deflated at constant 1970/71 prices by using appropriate indexes of prices. It is clear from the table that cotton textiles, the largest industry in the state, recorded a very high rate of growth in both output and employment during 1970/71-1982/83. Apart from catering to domestic demand from Punjab and other states, textiles in general, and hosiery goods in particular, have found a profitable export market, especially in the Soviet Union.

Besides textiles, many durable consumer goods industries such as bicycles, sewing machines, and television sets, and agro-input industries such as fertilizers, agricultural implements, and hand tools have shown remarkable growth in output and employment. The respective growth rates of employment and production given in Table 10 show that the employment elasticity with respect to output is quite high for a wide range of industries, particularly for cotton textiles, steel re-rolling, and automobile parts.

To a large extent, rapid growth and gradual modernization in manufacturing (as in agriculture) have been made possible by rapid development of the power sector, which showed a growth rate of 9.1 percent a year in net value added during 1967/68-1983/84. As noted earlier, from the beginning of planning in 1950/51, Punjab has given very

Table 10—Levels and growth of production and employment in selected industries in Punjab, 1970/71-1982/83

Industry	1970/71		1973/74		1976/77		1979/80		1980/81		1982/83		Growth Rates, 1970/71-1982/83	
	Production	Employment	Production	Employment	Production	Employment	Production	Employment	Production	Employment	Production	Employment	Production	Employment
	(Rs million)	(persons)	(Rs million)	(persons)	(Rs million)	(persons)	(Rs million)	(persons)	(Rs million)	(persons)	(Rs million)	(persons)	(percent)	
Textiles (cotton)	216	10,174	274	12,278	350	16,395	742	42,698	857	47,726	1,028	65,410	16.19	19.14
Textiles (silk, woolen, synthetic, and hosiery)	517	66,203	674	81,817	765	73,923	1,126	87,643	1,067	91,792	987	86,710	6.95	2.49
Cotton ginning and pressing	206	6,310	454	6,223	561	7,418	531	8,168	505	8,425	574	8,910	9.42	3.66
Sugar	79	4,645	71	4,653	96	5,073	78	5,052	78	5,178	220	6,210	8.82	3.23
Bicycles and parts	172	14,620	445	30,921	461	34,749	739	40,114	924	42,081	1,442	61,010	15.96	10.07
Sewing machines	40	6,907	48	7,614	69	8,187	60	8,496	64	8,735	105	12,102	7.92	4.23
Agricultural implements	216	25,535	204	26,813	313	24,258	389	31,334	423	34,375	704	48,401	10.23	4.53
Hand tools	20	1,577	42	2,701	47	3,035	82	5,636	105	6,608	149	9,370	15.38	13.74
Steel re-rollings	215	4,886	430	9,525	444	12,778	469	10,480	491	10,604	405	11,260	5.86	5.71
Water-pipe fittings	67	5,908	69	7,595	77	6,768	92	9,669	92	9,905	120	12,690	5.76	6.11
Nuts and bolts	21	2,411	38	3,056	53	4,758	93	6,924	96	7,454	113	8,690	16.71	12.25
Scientific and surgical instruments	8	2,398	11	2,948	10	1,304	9	2,040	15	2,675	23	2,860	4.38	−1.05
Fertilizers	115	3,413	202	3,964	159	3,775	524	4,810	495	4,899	1,023	5,310	18.73	3.53
Automobile parts	156	8,049	175	9,511	216	10,908	169	13,174	158	14,335	194	17,705	1.79	6.66

Sources: Based on data from Punjab, *The Statistical Abstract of Punjab,* various issues (Chandigarh: Economic and Statistical Adviser, various years). Output figures in current prices have been deflated to constant 1970/71 prices by using all-India price deflators from national account data in India, Ministry of Planning, Central Statistical Organization, *National Accounts Statistics,* various issues (Delhi: Controller of Publications, various years).

high priority to investment in power. From two-thirds to three-fourths of the total plan outlay in all the plan periods has gone to power and irrigation.

The estimates of net value added in construction have been thoroughly revised for all the years after 1970/71 by the state Economic and Statistical Organization.[6] The annual growth rate of net value added by construction was about 5.0 percent during 1970/71-1983/84.

It can be legitimately argued that given the high growth of agriculture in Punjab, the growth of manufacturing in the state has fallen considerably short of expected levels. To some extent the growth rate may appear understated when calculated for value added and not value of output. An annual growth rate of about 7 percent for value added in manufacturing (as in Table 1) may imply a growth rate of about 9-10 percent in value of output. However, even this order of manufacturing growth could not be considered consistent with the agricultural growth recorded in the state.

A few reasons can be advanced for manufacturing growth lagging behind expectations. The first is import leakages. As will be discussed in detail, Punjab's economy is linked with the rest of the country. This has enabled the state to derive a great deal of comparative advantage through specialization, both in certain crops and in some manufacturing lines. However, historically determined regional distribution of manufacturing capacities, particularly in agroprocessing and agro-input industries, often does not conform with present patterns of agricultural output.

Second, because of the extraordinary increase in output in many cases, the existing processing capacities fall far short of requirements. Sufficient investment has not been undertaken to increase processing capacities, particularly in new areas that have recently started to produce substantial marketable surpluses. Both these factors have militated against a rapid rise of manufacturing in the state. In particular, lack of sufficient investment in agroprocessing seems to have acted as a major constraint. For example, as of January 1, 1983, with a 16.2 percent share in the production of raw cotton, Punjab had only 1.7 percent of all installed spindles and 0.6 percent of all looms in India. With 21.4 percent of wheat output and a 62.0 percent share in wheat procured by the Food Corporation of India, the state had merely 5.8 percent of the roller flour mill capacity in the country. With the recent development of a new variety (COJ 64), Punjab has emerged as one of the most efficient producers of sugarcane, but with 3.4 percent of total cane output, the state had only 1.8 percent of the national capacity for cane conversion. Thus lack of investment in agroprocessing seems to be one important reason for the slower-than-expected growth rate of manufacturing.

Other reasons are perhaps sociological. It takes a long time for peasant societies to switch over to the regular rhythm and discipline of industrial culture. Also, the tensions in Punjab during the 1980s have certainly resulted in further reducing industrial investments in the state and in driving away prospective entrepreneurs.

Changes in the Tertiary Sector

From 1960/61 to 1983/84, while income from the tertiary sector as a whole recorded an annual growth rate of 6.8 percent, that from trade and transport grew at a rate of more than 6.5 percent, banking and insurance at 8.1 percent, and public

[6] The estimate of net product from construction rose from Rs 440 million in 1969/70 to Rs 960 million in 1970/71. Since these series were not carried back to the 1960s, the growth rates for 1960/61-1983/84 calculated from available data can be misleading.

administration at 8.6 percent. Growth of the tertiary sector is an essential concomitant of a growing economy. For example, the rapid growth of trade and transport is in response to marked increases in marketed agricultural surpluses, much larger activity in agroprocessing and agro-input industries, and increased flow of exports and imports.

Of particular interest in this context is the role of small market villages and towns that lie on main roads connecting larger townships. These villages and towns have gradually become hubs of economic activity, not only in trading and agroprocessing and repairs but also in the provision of social services, health, and recreation. In many cases they have emerged as tiny growth centers serving a network of peripheral villages. The rapid growth of trade, hotels and restaurants, and personal services is in response to increased consumption expenditure. Government and private expenditure on education, health, and other services is also rising rapidly. Rapid growth of public administration is primarily due to the growing role of the state in the development process as well as the excessive overstaffing characteristic of developing countries.

3

METHOD OF COMPILATION AND SOURCES OF DATA

The Punjab input-output table for the year 1969/70, which was published in a study on Punjab, Haryana, and Gujarat (Alagh, Bhalla, and Kashyap 1980), contains an elaborate account of the method of compilation of the interindustry table and the sources of data, including the sectorization scheme, the limitations of the data, and the various improvisations made by the authors. In view of this, instead of giving full details, only a brief description of the methodology used to compile the 1979/80 input-output table (Appendix 1, Table 44) and its sources of data is contained in the present report.

Compilation of Input-Output Table

The first step in the preparation of the 1979/80 input-output table was the sectorization of the economic activities in Punjab, with the main aim of having as detailed and meaningful a picture of the economy as possible within the framework of available data. In this table the state economy is divided into 39 sectors, compared with 36 sectors in the 1969/70 table. A description of the sector scheme of the 1979/80 table, along with a comparative sector scheme used in 1969/70, is given in Table 11. A detailed description of activities included in each sector is provided in Appendix 2.

Several features of the sector scheme are worth noting. First, since agriculture constitutes a major part of the economy, it has been subdivided into seven sectors containing the main crops in the state. The 1969/70 table had nine sectors for agriculture. However, since *bajra* (pearl millet) and maize have ceased to be important crops in the state, they have been combined with other agriculture and forestry in the 1979/80 table.

Second, in the 1969/70 table, separate vectors were constructed for the ordinary and improved varieties of wheat, rice, cotton, and maize, but that has not been done in the 1979/80 table, primarily because by 1979/80 almost the entire area under wheat, rice, and cotton had been brought under improved varieties.

Third, an important feature of the 1979/80 table is that trade, transport and storage, services, banking and insurance, and ownership of dwellings, which were put below the line in the earlier table, are treated as independent sectors in the structural matrix. This was done because these sectors have assumed considerable importance with the growth of the economy.

Fourth, another important feature of the 1979/80 table is that, compared with 1969/70, much better estimates have been made of exports and imports. Although the Railways Board regularly publishes data on interstate movement of commodities by rail (India, Ministry of Railways), data on interstate movement of commodities by road became available for the first time for 1978/79 as a result of a special survey conducted by the Railways India Technical and Economic Services (RITES). The unpublished data, obtained from RITES, have been updated for the present study to derive the export and import vectors for 1979/80.

Table 11—Sectoral classifications of the Punjab economy, 1979/80 and 1969/70

Sector Number, 1979/80	Description of Sector in 1979/80	Sector Number 1969/70	Sector Number 1979/80	Comparative Sector in 1969/70
1	Wheat	1	(1)	Wheat
2	Rice	2	(2)	Rice
	...	3	...	Maize
3	Cotton	4	(3)	Cotton
4	Sugarcane	5	(4)	Sugarcane
5	Gram and pulses	6	(5)	Gram and pulses
6	Oilseeds	7	(6)	Oilseeds
	...	8	...	Bajra
7	Other agriculture and forestry	9	(7)	Other agriculture
8	Animal husbandry	10	(8)	Animal husbandry
9	Dairy products and confectionery	11	(9)	Dairy products
10	Grain mill products	12	(10)	Grain mill products
11	Bakery products	...	...	...
12	Sugar	13	(11, 12)	Sugar and confectionery
13	*Other food industries*	...	...	...
14	Edible oils	14	(13, 14)	Edible oils and other foods
15	Breweries and beverages	15	(15)	Breweries and beverages
16	Ginning and textiles	16	(16)	Textiles
17	Sawmills and wooden goods	17	(16)	Cotton ginning, pressing, and other textiles
18	Paper, printing, and publishing	18	(17)	Sawmills and wooden containers
19	Rubber and leather products	19	(17)	Furniture and fixtures
	...	20	(18)	Printing and publishing
	...	21	(19)	Rubber and leather products
20	Basic chemicals, including fertilizers	22	(20)	Basic chemicals, including fertilizers
21	Drugs and pharmaceuticals	...	...	...
22	Other chemicals	...	...	...
	...	23	(21, 22)	Other chemicals
23	Glass and mineral products	24	(23)	Glass and mineral products
24	Basic metal industries	25	(24)	Basic metal industries
25	*Metal products*	26	(25)	*Metal products*
26	Machinery, except electrical	27	(26)	Machinery, except electrical
27	Electrical machinery	28	(27)	Electrical machinery
28	Railroad equipment	29	(28)	Railroad equipment
29	Motor vehicles, manufacture and repair	...	...	...
	...	30	(29)	Transport equipment
	...	31	(29)	Repair of transport equipment
30	Bicycles and parts	32	(30)	Motorcycles and bicycles
31	Scientific and surgical instruments	33	(31)	Scientific and surgical instruments
32	Sports and athletic goods	...	...	...
33	Miscellaneous industries	...	...	...
	...	34	(32, 33)	Miscellaneous industries
34	Electricity, gas, and water supply	34	(36)	Electricity
35	Construction	35	(35)	Construction
36	Trade, transport, and storage	...	...	...
37	Other services	...	...	...
38	Banking and insurance	...	...	...
39	Real estate and ownership of dwellings	...	...	...

Source: Based on extract from "National Industrial Classification—1970," reproduced in India, Ministry of Planning, Central Statistical Organization, *Annual Survey of Industries, 1980-81* (Delhi: Controller of Publications, 1983).

Fifth, as in the 1969/70 table, in order to impart greater stability to input coefficients, the flow entries for 1979/80 have been calculated at producers' prices. In the absence of detailed data at the state level, most of the "trade and transport margins" used to convert purchasers' prices into producers' prices were obtained from the 1979/80 input-output table for India (India, Planning Commission 1981). For some important sectors such as agriculture, these prices have been derived from the annual reports of the Food Corporation of India and other secondary sources. Table 12 gives producers' and purchasers' prices and trade and transport margins for various sectors. The use of all-India trade margins for Punjab assumes that the trade margins prevailing in different sectors in the state are similar to those prevailing in India as a whole—an assumption that has undoubtedly introduced some errors into the estimates.

Table 12—Sectoral trade margins: purchasers'-producers' price ratios, 1979/80

Sector Number	Sector	Price Ratio	
		Wholesale[a]	Retail Trade[b]
1	Wheat	1.0712	1.0981
2	Rice	1.0595	1.1138
3	Cotton	1.0451	n.a.[c]
4	Sugarcane	1.0718	n.a.[c]
5	Gram and pulses	1.1016	1.2132
6	Oilseeds	1.0645	n.a.[c]
7	Other agriculture and forestry	1.0645	n.a.[c]
8	Animal husbandry	1.0557	1.0889
9	Dairy products and confectionery	1.1314	1.1420
10	Grain mill products	1.0775	1.2000
11	Bakery products	1.1314	n.a.[c]
12	Sugar	1.0823	1.2980
13	Other food industries	1.0131	1.3600
14	Edible oils	1.1068	1.1600
15	Breweries and beverages	1.0764	1.2400
16	Ginning and textiles	1.0732	1.2300
17	Sawmills and wooden goods	1.1118	1.2800
18	Paper, printing, and publishing	1.1344	1.1900
19	Rubber and leather products	1.1065	1.2200
20	Basic chemicals, including fertilizers	1.0984	n.a.[c]
21	Drugs and pharmaceuticals	1.1103	1.3000
22	Other chemicals	1.0784	1.1700
23	Glass and mineral products	1.1518	1.3300
24	Basic metal industries	1.1556	1.3300
25	Metal products	1.1091	n.a.[c]
26	Machinery, except electrical	1.1153	n.a.[c]
27	Electrical machinery	1.0996	1.4700
28	Railroad equipment	1.1246	n.a.[c]
29	Motor vehicles, manufacture and repairs	1.1051	1.2700
30	Bicycles and parts	1.1315	n.a.[c]
31	Scientific and surgical instruments	1.1401	n.a.[c]
32	Sports and athletic goods	1.1401	n.a.[c]
33	Miscellaneous industries	...	1.3500

Sources: Based on data from India, Planning Commission, *A Technical Note on the Sixth Plan of India: 1980-85* (Delhi: Controller of Publications, 1981); and India, Food Corporation of India, *Annual Report,* various issues (Delhi: FCI, various years).

Note: n.a. means not available.

[a]These ratios have been used to arrive at trade and transport margins for all the sectors.

[b]These ratios have been used to arrive at trade and transport margins for the consumption sectors.

[c]The retail price indexes for these commodities are not constricted.

Sources of Data

Like the 1969/70 input-output table, the 1979/80 table has been compiled mainly on the basis of secondary data. The only source of primary data was a survey of unregistered urban industries conducted by the authors during this study to derive input-output coefficients for the unregistered small-scale units and for some unorganized activities in the tertiary sector. Most of the data for both the 1969/70 and 1979/80 tables were obtained from the Economic and Statistical Organization of the Government of Punjab, particularly from the state income section of this organization. The data provided by this organization have been supplemented from numerous other secondary sources. A brief description of the sources of data is given below by sector.

Agricultural Sectors

In the 1979/80 input-output table (Appendix 1, Table 44), agriculture is broken into seven sectors: wheat, rice, cotton, sugarcane, gram and pulses, oilseeds, and other agriculture and forestry. Detailed input vectors by crop have been prepared by using the data obtained from the Comprehensive Scheme on Cost of Cultivation of Principal Crops for Punjab compiled by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. Some of these data are published in reports of the Agricultural Prices Commission. After input coefficients for these crops were obtained, all the inputs were inflated by the estimates of outputs by crop (Punjab, Economic and Statistical Adviser, various years). The input figures by crop for major items such as cost of fertilizers, electricity charges, and cost of bullocks and implements were then aggregated and adjusted by using as control figures the data on total inputs supplied by the Economic and Statistical Adviser. Figures for value added for each included crop were similarly kept within the control figures.

Animal Husbandry

The basic information on levels of output, value added, and input costs for animal husbandry was obtained from the Punjab Economic and Statistical Adviser. Two major changes have been made for 1979/80 in calculating value added in this sector. First, unlike the method followed in the state income estimates, bullocks have been treated as a part of the animal husbandry sector and not the agricultural sectors. Second, both depreciation of bullocks and the changes in their stock have been shown in the animal husbandry sector. Depreciation of bullocks has been estimated from the data on comprehensive cost of cultivation, while data on changes in their stock were obtained from the recent publications of the government (Punjab, Economic and Statistical Organization 1980b, 1980c, 1980d).

Industrial Sectors

Of the 39 sectors in the 1979/80 Punjab input-output table, 24 pertain to industries and public utilities. In India, the registered factories are covered under the Factories Act of 1948 and are required to submit detailed returns to the government containing, among other things, information on output, inputs, value added, workers, and wages. The data for both the census and the sample sectors are published, with some time lag, in the Annual Survey of Industries. For the registered factories in Punjab, the relevant data for 1979/80 were obtained from the Economic and Statistical Adviser. These have since been published (India, Ministry of Planning 1989).

Unregistered Industrial Sectors

The state income section of the Punjab Economic and Statistical Organization prepares the value of output and value added estimates for the unorganized industries, classified according to the National Industrial Classification. Since these estimates refer only to value added and output, they cannot be used to prepare the input vectors for the unregistered industries.

With the basic aim of obtaining input vectors for the unregistered industries, a survey of 803 industrial units in 10 urban centers in Punjab was conducted by the authors during 1982/83. The results obtained from this survey have been used to arrive at the input structure for most of the industries in the unregistered sector. The separate input-output vectors prepared for the registered and unregistered industries have been combined in the 1979/80 input-output table.

An important additional source of information on rural and urban household industries was the 29th round (July 1974-June 1975) of the National Sample Survey Organization on Survey of Self-Employment in Nonagricultural Enterprises (India, Ministry of Planning 1978). Although this survey does not give details of the input structure of various household industries, it does contain useful information on the estimated number of workers wholly or partly employed in household industries, including value added and wages per worker. Nevertheless, the unavailability of reliable data on the input structure of the unregistered and household industries is a serious limitation on the industrial statistics for Punjab.

Electricity and Water Supply

Data on total output, value added, number of workers, and input structure were obtained by analyzing the Statement of Accounts for 1979/80 and the Administration Report for 1979/80 of the Punjab State Electricity Board (Punjab, Electricity Board 1980). It has been assumed that the Punjab share of hydroelectric power from Bhakra Dam is being produced within the state. Due to the unavailability of data, it was not possible to include the input vector for the water-supply undertakings in Punjab.

Other Sectors

The Punjab Economic and Statistical Organization provides separate data on value added in construction, trade, transport and storage, other services, banking and insurance, real estate and ownership of dwellings (Punjab, Economic and Statistical Adviser, various years). However, no details are available regarding their input structure. In the 1979/80 Punjab input-output table, the input structure for each of these sectors has been borrowed from the all-India input-output table for 1979/80 (India, Planning Commission 1981).

Final Demand

Household Consumption

The National Sample Survey Organization (NSSO) collects information on consumer expenditure through its various rounds. The expenditure estimates are given separately for the rural and urban population of all the states for 21 aggregate commodity groups and are also available at a disaggregated level for 321 commodities. The latest information available to the authors on consumption expenditure in Punjab pertains to calendar year 1983. This was available from the 38th round of the National Sample Survey (India, Ministry of Planning 1986b). Similar information for 1977/78 was available from the 32nd round (India, Ministry of Planning 1986a).

The task of the present study was to derive the per capita consumption expenditure and its composition for the year 1979/80. The per capita consumption figures for 1977/78 given in the 32nd round of the National Sample Survey have been extrapolated to estimate the per capita expenditure for 1979/80, while the 38th round data have been used to derive the share of consumption expenditure by commodity for 1979/80.

Several steps were involved and several adjustments became necessary to derive per capita consumption expenditure for 1979/80 from the 1977/78 estimates. The first step was to multiply the 1977/78 per capita estimated consumption expenditure of Rs 1,372.68 per month in rural households and Rs 1,256.48 per month in urban households by the 1979/80 rural and urban population estimated by the authors. A total estimated consumption expenditure amounting to more than Rs 22.7 billion was obtained for 1979/80 at per capita income levels and prices of 1977/78.

The second adjustment was made to take into account the increase in consumption as a result of the increase in real per capita income since 1977/78. At constant 1970/71 prices, between 1970/71 and 1983/84 real per capita income rose at an annual rate of 3.2 percent. Thus, assuming the income elasticity of consumption to be 0.7, total consumption for 1979/80 increased by 4.6 percent. After this adjustment, total consumption is nearly Rs 23.8 billion.

The above consumption estimates for 1979/80 were at 1977/78 prices. During 1977/78-1979/80, the consumer price index for agricultural labor rose by 12 percent and that for nonmanual employees by 11.48 percent. Inflating the 1977/78 estimates by 12 percent, an estimate of more than Rs 26.6 billion was obtained for total consumption in the state during 1979/80 at current prices.

The last adjustment was made by comparing the National Sample Survey consumption estimates with those of the Central Statistical Organization (CSO), Government of India. At the all-India level, the consumption estimates by the CSO were considerably higher than the consumption figures estimated by the NSSO. Thus, total 1977/78 consumption as estimated by the CSO was 10.2 percent higher than that estimated by the NSSO. In 1983/84 the NSSO estimates fell short of the CSO estimates by as much as 23.5 percent. Keeping in mind the gross underestimation of consumption by the NSSO, the authors inflated their figure by about 10.0 percent (9.0 percent for rural and 11.7 percent for urban households) and estimated the total consumption in Punjab during 1979/80 at about Rs 29.2 billion. This consumption level gives an average propensity to consume of 63.4 percent in relation to GDP. In the 1969/70 input-output table the estimated average propensity to consume was about 61.1 percent.

The above adjustments were necessary because of the absence of direct estimates of consumption by the Punjab Economic and Statistical Organization. The limitations of the authors' consumption estimates should be kept in mind.

Government Consumption

The main source of statistics on the state government's current and capital expenditure is the Economic and Functional Classification of the Punjab Government Budget for 1979/80 (Punjab, Economic and Statistical Organization 1980a). That publication, however, does not contain a breakdown of expenditure on commodities according to the sector classification used in this study. For 1969/70, the information on the input structure of the government sector was obtained from the Controller of Stores, Government of Punjab. In the 1979/80 input-output table, distribution of current expenditure has been done according to the 1969/70 table. In addition, the details about current and capital expenditures of the municipalities and local bodies were obtained from the Economic and Functional Classification of the Municipal Budget in Punjab for 1980/81

(Punjab, Economic and Statistical Organization 1981). Since the value added in the government sector, amounting to more than Rs 2 billion, has been included in the service sector, this figure is not shown separately under government consumption.

Gross Fixed Capital Formation

The available information on gross fixed capital formation is not very comprehensive. For the registered industries, detailed data on investment, along with their breakdown into construction and machinery, are regularly collected through the Annual Survey of Industries conducted by the CSO in the Ministry of Planning. No regular data are available on gross fixed capital formation in the unregistered industrial sectors or in the agriculture, animal husbandry, or service sectors.

In 1980, for the first time, the Government of Punjab brought out three important publications on capital formation in rural households, in urban households, and by state government and local authorities (Punjab, Economic and Statistical Organization 1980b, 1980c, 1980d). These publications have helped considerably in filling the data gap and have been extensively used in this study to build estimates on capital formation in the various sectors. For example, data on capital formation in agricultural and nonagricultural enterprises and by state government and public enterprises—broken down into buildings, plants and machinery, tools, transport equipment, tubewells, land reclamation, and so forth—have been taken from these sources.

In addition, the Annual Survey of Industries has been used to obtain data on investment in various registered industries (India, Ministry of Planning 1989). Since no direct information is available on capital formation in the unregistered industrial sector, these data have been estimated from the publications on capital formation (Punjab, Economic and Statistical Organization 1980b, 1980c, 1980d).

The Economic and Statistical Organization gives independent estimates of value added in the construction sector. Whereas the input structure for the construction sector has been estimated by using the ratios in the all-India table for 1979/80 (India, Planning Commission 1981), the entire output in construction has been allocated to "gross fixed capital formation."

Changes in Stocks

The information on changes in stocks has been collected from several sources. For registered industries, it is available in the Annual Survey of Industries (India, Ministry of Planning 1989). For the government sector and the government administration as well as government departments, this information is available in the Economic and Functional Classification of the Budget (Punjab, Economic and Statistical Organization 1980a), as is information on changes in foodgrain stocks on government account. No ready information is available regarding changes in stocks in the unregistered or household industries or in agriculture. However, very detailed information on changes in stocks of rural and urban households, the state government and local authorities, and departmental enterprises has been obtained from the publications on capital formation (Punjab, Economic and Statistical Organization 1980b, 1980c, 1980d).

Exports and Imports

Detailed time series information is available on the physical quantities of exports and imports of goods hauled by railways, but no comprehensive time series data are available on the quantities exported and imported into Punjab through road transport. For 1978/79, however, Railways India Technical and Economic Services (RITES), a

subsidiary of Indian Railways, conducted a special survey to collect information on exports from and imports into various states of India. For the present study, this information, obtained from RITES, has been updated in order to derive the export and import estimates. In addition, the export and import information for wheat and rice has been obtained from the annual reports of the Food Corporation of India. It should be noted that the export and import data given by Indian Railways and by RITES are in quantities and not in value terms. Various sources have been used to obtain the prices of traded commodities and thereby derive value estimates of exports and imports. For some sectors for which export and import figures are not available from any source, the figures have been derived as residuals.

The imports into Punjab have been divided into two sets, namely, competitive and noncompetitive. All imports of commodities that are not produced within the state have been allocated to noncompetitive imports. The export-import estimates for the Punjab input-output in 1979/80 have considerably improved due to the availability of the RITES data on interstate commodity flow by road, although there is still room for improvement.

Entries Below the Line

Apart from factor payments, the other entries below the line are noncompetitive imports, repair and maintenance, work done by others, taxes, duties and subsidies, consumable stores, and depreciation. For the agricultural sector, information on these entries has been obtained from the reports of the Comprehensive Scheme of Cost of Cultivation prepared by the Economic and Statistical Adviser, Government of India. For the registered sector, this information has been taken from the Annual Survey of Industries for 1979/80 (India, Ministry of Planning). For the unregistered sector, the estimates for noncompetitive imports, repair and maintenance, and work done by others have been prepared by using a variety of sources. For example, for the 1979/80 input-output table, noncompetitive imports have been estimated as a residual, since there are intermediate inputs and components of final demand that are not being produced in the state. Again, data available for 1975-77 (in the 1982 Statistical Abstract of Punjab) on such items as output and employment in repair services for the unregistered manufacturing industrial units have been projected to derive 1979/80 estimates.

Wages

The most important entry below the line pertains to net value added and its breakdown into wages and other factor payments. In this study, only the calculation of wages is considered. Separate information on interest, rent, wages, and profits in the agricultural sector is not directly available because, in most cases, the cultivator himself provides all or part of land, capital, and labor in the process of agricultural production. The data collected under the Comprehensive Scheme of Cost of Cultivation (India, Agricultural Prices Commission, various years) have been used to estimate the share of wages in net value added by various agricultural sectors. Information from the Annual Survey of Industries (India, Ministry of Planning), which gives detailed information on factor payments for each industry in the registered sectors, has been used to estimate the wages paid in these sectors.

Wages in the unregistered and service sectors have been obtained from various sources. The National Accounts Statistics (India, Ministry of Planning, various years) provide information on compensation to employees in nine sector classifications. This information has been used to obtain the ratio of wages to net value added in each of these

sectors, and thus to derive wages. The Labor Commissioner of Punjab provides information on the average annual earnings of workers in some occupations in the unregistered sectors, and this information, as published in the Statistical Abstract of Punjab (Punjab, Economic and Statistical Adviser, various years) has also been used to calculate wages.

In addition, the results of the 29th round of the National Sample Survey of rural and urban household industries (India, Ministry of Planning 1978) have been used to calculate wages in various household industries. For the 1979/80 input-output table, the wages received in the registered, unregistered, and household industries have been combined to calculate the aggregate wages by sectors included in the table. For public administration and other services, including sanitary services, wages are derived by taking the ratio of employee compensation to value added in this sector, as given in the National Accounts Statistics. Although reliable information has been available for wages in many sectors, for the unregistered and unorganized sectors such as agriculture, forestry, animal husbandry, personal services, real estate and dwellings, trade, transport, and communications, this information is weak.

Workers

The population census of India for 1981 (India, Ministry of Home Affairs 1982) gives details about workers employed in the agriculture and manufacturing sectors at the three-digit level. This census was the main source for estimating workers by sectors. The information on total workers in agriculture was broken down into various crop sectors by using the data given in the Comprehensive Scheme of Cost of Cultivation.

For animal husbandry, the census information refers to workers engaged in animal husbandry on a full-time basis. In India, animal husbandry continues to be a part-time activity for most cultivating and noncultivating rural households. Instead of the data given by the census, the number of workers in the animal husbandry sector has been estimated on the assumption that value added per worker in this sector equals that in "other agriculture." The data on the number of workers in registered industries has been obtained directly from the Annual Survey of Industries. The census data have been used to obtain estimates of workers engaged in various sectors in the unorganized and household industries.

Person-hours

In preparing the 1979/80 Punjab input-output table, it is assumed that a worker in the agricultural sector works 261 days a year on average. Data on person-hours are directly available for the registered industrial sectors. For other sectors, days worked during a year have been estimated from various other sources such as the Statistical Abstract of Punjab and the NSSO's survey of rural and urban household industries (29th round).

4

STRUCTURAL FEATURES OF THE PUNJAB ECONOMY

This chapter briefly discusses the structural features of the Punjab economy and changes in them over time by using the input-output tables for 1969/70 (Alagh, Bhalla, and Kashyap 1980) and 1979/80 (Appendix 1, Table 44). These interindustry flow tables for Punjab present a complete production and income account of the included producing sectors along with the details of disposition of sectoral outputs for intermediate use and final demand. These tables can therefore be used to bring out the relative importance of various sectors and of changes in income and output, labor productivity, and components of final demand that occurred between 1969/70 and 1979/80.

Distribution of Sectoral Income and Output

The data on real net state domestic product (NSDP) by industry of origin for 1969/70 and 1979/80 at constant 1970/71 prices are contained in Table 1. Tables 13 and 14 give comparable data on state income and output and their sectoral distribution for both 1969/70 and 1979/80 at current prices.

It is clear from Tables 13 and 14 that although the combined share of the agriculture and animal husbandry sectors in total NSDP declined from 61.4 percent in 1969/70 to 47.2 percent in 1979/80, these sectors continue to occupy a predominant place in the Punjab economy.[7] That the state is relatively more dependent on the primary sector is obvious, since in India this sector contributed only 37.5 percent of the net national product in 1979/80. Another notable feature is that in 1979/80, with a 47.2 percent share in value added, the contribution of the primary sector to the gross value of output in Punjab was only 33.9 percent, indicating that because of less use of intermediate inputs relative to other sectors, this sector has significantly higher value added per unit of output.

The secondary sector in Punjab, which at current prices accounted for 15.9 percent of NSDP in 1969/70, increased its share to 20.8 percent in 1979/80. During the same period, the manufacturing sector's share in NSDP increased only from 11.4 percent to 13.0 percent. Despite rapid growth, it is clear that Punjab continues to be relatively less industrialized than India as a whole, since the share of manufacturing in the total net national product of India rose from 14.0 in 1969/70 to 15.9 percent in 1979/80.

The tertiary sector, which accounted for only 22.7 percent of Punjab's NSDP in 1969/70, contributed 32.0 percent of NSDP 1979/80. In India during this period the share of the tertiary sector in the total net national product increased from 30.5 percent to 36.9 percent (India, Ministry of Planning, various years[b]).

[7] The shares given in Tables 13 and 14 are taken from the two input-output tables and are at current prices. These figures are therefore not comparable to those contained in Table 1, where all data are at constant 1970/71 prices.

Table 13—Sectoral distribution of net value added and gross value of output in Punjab, 1969/70

Sector Number	Sector	Net Value Added	Distribution of Net Value Added	Share of Agriculture, Manufacturing, and Tertiary Sectors	Gross Value of Output	Distribution of Gross Value of Output	Share of Agriculture, Manufacturing, and Tertiary Sectors
		(Rs million)[a]	(percent)		(Rs million)[a]	(percent)	
1	Wheat	3,199	22.49	54.97	4,114	20.45	54.02
2	Rice	327	2.30	5.62	442	2.20	5.81
3	Maize	357	2.51	6.14	476	2.37	6.25
4	Cotton	169	1.19	2.90	244	1.21	3.20
5	Sugarcane	312	2.19	5.37	463	2.30	6.08
6	Gram and pulses	285	2.00	4.90	390	1.94	5.13
7	Oilseeds	176	1.24	3.03	251	1.25	3.29
8	Bajra	122	0.86	2.09	163	0.81	2.13
9	Other agriculture and forestry	871	6.12	14.98	1,073	5.33	14.09
	Subtotal: agriculture	5,818	40.90	100.00	7,617	37.85	100.00
10	Animal husbandry	2,918	20.51	...	3,697	18.37	...
	Subtotal: primary[b]	8,736	61.41	...	11,314	56.22	...
11	Dairy products	12	0.08	0.71	217	1.08	2.92
12	Grain mill products	56	0.39	3.41	653	3.24	8.77
13	Sugar and confectionery	13	0.09	0.80	100	0.50	1.35
14	Edible oils and other food-processing industries	98	0.69	5.99	664	3.30	8.93
15	Breweries and beverages	4	0.03	0.25	28	0.14	0.37
16	Textiles	394	2.77	24.21	1,618	8.04	21.75
17	Cotton ginning, pressing, and other textiles	24	0.17	1.49	508	2.53	6.84
18	Sawmills and wooden containers	36	0.25	2.20	131	0.65	1.76
19	Furniture and fixtures	92	0.65	5.64	272	1.35	3.66
20	Printing and publishing	13	0.09	0.81	36	0.18	0.48
21	Rubber and leather products	61	0.43	3.78	216	1.07	2.90
22	Basic chemicals, including fertilizers	93	0.65	5.69	225	1.12	3.02
23	Other chemicals	26	0.18	1.58	133	0.66	1.79
24	Glass and mineral products	94	0.66	5.75	348	1.73	4.68
25	Basic metal industries	49	0.34	3.00	370	1.84	4.97
26	Metal products	97	0.68	5.95	356	1.77	4.78
27	Machinery, except electrical	154	1.08	9.46	510	2.53	6.85
28	Electrical machinery	24	0.17	1.46	120	0.60	1.62
29	Railroad equipment	19	0.13	1.17	27	0.13	0.36
30	Transport equipment	38	0.27	2.31	122	0.61	1.65
31	Repair of transport equipment	6	0.04	0.40	16	0.08	0.22
32	Motorcycles and bicycles	45	0.33	2.76	180	0.89	2.42
33	Scientific and surgical instruments	36	0.25	2.21	58	0.29	0.79
34	Miscellaneous industries	146	1.03	8.97	530	2.63	7.12
	Subtotal: manufacturing	1,629	11.45	100.00	7,439	31.10	100.00
35	Construction	464	3.26	...	1,179	5.86	...
36	Electricity	166	1.17	...	190	0.95	...
	Subtotal: secondary	2,259	15.88	...	8,808	37.91	...
37	Trade, transport and storage	1,824	12.82	56.43	n.a.	n.a.	n.a.
38	Other services	987	6.94	30.59	n.a.	n.a.	n.a.
39	Banking and insurance	156	1.10	4.82	n.a.	n.a.	n.a.
40	Real estate	263	1.85	8.16	n.a.	n.a.	n.a.
	Subtotal: tertiary	3,230	22.71	100.00	n.a.	n.a.	n.a.
	Total	14,225	100.00	...	n.a.	n.a.	n.a.

Source: Based on Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

Notes: n.a. means not available. Parts may not add to totals because of rounding.

[a] At current prices.

[b] Because of neglible contributions, fishing and mining and quarrying have not been included in the primary sector.

Table 14—Sectoral distribution of net value added and gross value of output in Punjab, 1979/80

Sector Number	Sector	Net Value Added	Distribution of Net Value Added	Share of Agriculture, Manufacturing, and Tertiary Sectors	Gross Value of Output	Distribution of Gross Value of Output	Share of Agriculture, Manufacturing, and Tertiary Sectors
		(Rs million)[a]	(percent)		(Rs million)[a]	(percent)	
1	Wheat	5,421	12.79	37.65	9,735	11.06	44.63
2	Rice	3,574	8.43	24.82	5,189	5.90	23.79
3	Cotton	1,573	3.71	10.93	2,196	2.50	10.07
4	Sugarcane	650	1.53	4.51	813	0.92	3.73
5	Gram and pulses	365	0.86	2.53	479	0.54	2.20
6	Oilseeds	367	0.87	2.55	454	0.52	2.08
7	Other agriculture and forestry	2,448	5.78	17.01	2,944	3.35	13.50
	Subtotal: agriculture	14,398	33.97	100.00	21,810	24.78	100.00
8	Animal husbandry	5,598	13.21	...	7,976	9.06	...
	Subtotal: primary	19,996	47.18	...	29,786	33.84	...
9	Dairy products and confectionery	155	0.37	2.82	669	0.76	2.43
10	Grain mill products	157	0.37	2.85	1,874	2.13	6.82
11	Bakery products	53	0.12	0.96	156	0.18	0.57
12	Sugar	34	0.08	0.62	195	0.22	0.71
13	Other food industries	140	0.33	2.56	512	0.58	1.86
14	Edible oils	140	0.33	2.56	1,876	2.13	6.83
15	Breweries and beverages	47	0.11	0.86	285	0.32	1.04
16	Ginning and textiles	1,251	2.95	22.78	6,932	7.88	25.22
17	Sawmills and wooden goods	234	0.55	4.26	601	0.68	2.19
18	Paper, printing, and publishing	51	0.12	0.92	144	0.16	0.52
19	Rubber and leather products	233	0.55	4.25	890	1.01	3.24
20	Basic chemicals, including fertilizers	271	0.64	4.92	1,085	1.23	3.95
21	Drugs and pharmaceuticals	7	0.02	0.12	39	0.04	0.14
22	Other chemicals	36	0.09	0.66	233	0.27	0.85
23	Glass and mineral products	561	1.32	10.21	1,488	1.69	5.42
24	Basic metal industries	392	0.93	7.14	4,328	4.92	15.75
25	Metal products	280	0.66	5.09	1,377	1.57	5.01
26	Machinery, except electrical	241	0.57	4.38	1,119	1.27	4.07
27	Electrical machinery	112	0.26	2.04	536	0.61	1.95
28	Railroad equipment	28	0.07	0.51	65	0.07	0.24
29	Motor vehicles, manufacture and repair	399	0.94	7.26	1,073	1.22	3.90
30	Bicycles and parts	412	0.97	7.50	1,313	1.49	4.78
31	Scientific and surgical instruments	25	0.06	0.45	86	0.10	0.31
32	Sports and athletic goods	102	0.24	1.86	412	0.47	1.50
33	Miscellaneous industries	133	0.31	2.42	193	0.22	0.70
	Subtotal: manufacturing	5,494	12.96	100.00	27,481	31.23	100.00
34	Electricity, gas, water supply	946	2.23	...	1,657	1.88	...
35	Construction	2.393	5.65	...	6,853	7.79	...
	Subtotal: secondary	8,833	20.84	...	35,991	40.90	...
36	Trade, transport, and storage	8,649	20.41	63.83	13,841	15.73	62.28
37	Other services	3,494	8.24	25.78	6,511	7.40	29.29
38	Banking and insurance	877	2.07	6.47	1,064	1.21	4.79
39	Real estate and ownership of dwellings	530	1.25	3.92	810	0.92	3.64
	Subtotal: tertiary	13,550	31.97	100.00	22,225	25.26	100.00
	Total	42,379	100.00	...	88,002	100.00	...

Source: Based on Punjab input-output table for 1979/80 (Table 44, Appendix 1).
Note: Parts may not add to totals because of rounding.
[a]At current prices.
[b]Because of negligible contributions, fishing and mining and quarrying have not been included in the primary sector.

Some significant structural changes can be discerned within the primary, secondary, and tertiary sectors in Punjab during this period. The first important change is the rapid growth in rice and wheat output and the emergence of rice, along with wheat, as one of the two major crops in the state. Whereas the output of wheat increased by 62 percent, from 4.87 million tons in 1969/70 to 7.90 million tons in 1979/80, that of rice increased nearly six times, from 0.54 million tons to 3.04 million tons (see Table 2). Table 13 shows that in 1969/70 wheat accounted for 54.0 percent and rice for only 5.8 percent of the total value of agricultural output. In 1979/80, the contribution of wheat to the total value of agricultural output declined to 44.6 percent, while that of rice increased to 23.8 percent (Table 14). Thus these two crops together accounted for 68.4 percent of the total value of agricultural output in 1979/80. A similar picture emerges from the contribution of these crops to total value added in agriculture. Whereas wheat accounted for 55.0 percent and rice for 5.6 percent of total value added in agriculture in 1969/70, the contribution of wheat declined in 1979/80 to 37.7 percent, but that of rice increased to 24.8 percent. As discussed earlier, the cropping pattern in Punjab has become increasingly dominated by wheat and rice, and in 1979/80 these two crops accounted for about 61.0 percent of total cropped area in the state (Table 2).

Second, because of widespread adoption of the new seed-fertilizer technology, the use of intermediate inputs, in general, and that of modern inputs, in particular, increased markedly in rice and wheat between 1969/70 and 1979/80. For example, while fertilizers accounted for only 4.4 percent of the total value of wheat output in 1969/70, they contributed 14.5 percent of its value in 1979/80. Noncompetitive imports (fuels and lubricants), which constituted only 0.9 percent of the total value of wheat output in 1969/70, accounted for 13.7 percent in 1979/80. In the case of rice, the proportion of fertilizer to total output increased from 5.7 percent in 1969/70 to 12.5 percent in 1979/80, and that of fuels and lubricants increased from 1.2 percent to 8.7 percent. Consequently, during this period value added as a proportion of value of output registered a notable decline in both these crops, falling from 77.7 percent in 1969/70 to 55.7 percent in 1979/80 for wheat and from 74.0 percent to 68.9 percent for rice.

On the other hand, a perceptible decline occurred in animal draft power used in agricultural production. The expenditure on bullocks (animal husbandry sector), which constituted 7.7 percent of the value of wheat output in 1969/70, accounted for only 2.8 percent in 1979/80. For rice, a similar decline took place in the expenditure on bullocks—from 5.5 percent to 1.4 percent of its value of output during this period. The main cause of this decline is the gradual replacement of animal draft power with mechanical energy such as that of tractors. (See the 1969/70 Punjab input-output table in Alagh, Bhalla, Kashyap 1980 and the 1979/80 Punjab input-output table in Appendix 1 of this study [Table 44].)

Although industrial output recorded a large increase during 1969/70-1979/80, few significant changes occurred in the structure and composition of the manufacturing sector in Punjab. Thus the textile industry continued to be the dominant industry in the state, accounting for nearly one-fourth of the total value of manufacturing output and slightly more than one-fifth of value added in this sector in both 1969/70 and 1979/80. The food products industry, including dairy products, grain mill products, sugar, edible oil, bakery, and other foods, which together accounted for 22.3 percent of the total value of manufacturing output in 1969/70, constituted about 20.3 percent in 1979/80. However, basic metal and metal products industries emerged as major industrial sectors. Together they accounted for 20.8 percent of the total value of manufacturing output and 12.2 percent of total value added in 1979/80, compared

with a contribution of 9.8 percent to total output and 9.0 percent to total value added in manufacturing in 1969/70. Manufacture and repair of motor vehicles and manufacture of bicycles and parts also acquired more weight, together accounting for 14.8 percent of value added in the manufacturing sector in 1979/80 compared with only 0.6 percent in 1969/70.

Otherwise, the basic industrial structure of Punjab continues to consist of agriculture-based industries such as cotton textiles, grain mill products, food processing, and edible oils; some agro-input industries such as nonelectrical machinery, basic chemicals, and fertilizers; and some consumer durables such as bicycles, sewing machines, and rubber and leather products.

Taking the secondary sector as a whole, the contribution of both construction and electricity to the value added and value of output of the sector increased significantly between 1969/70 and 1979/80. The share of value added in construction[8] increased from 20.6 percent of total value added in the secondary sector in 1969/70 to 27.1 percent in 1979/80, and that of value added in electricity increased from 7.3 percent to 10.7 percent.

Since the value of total output was not estimated for the tertiary sector in 1969/70, it is not possible to delineate the changes in the distribution of value of output for that sector. However, the data on value added in the tertiary sector indicate that this sector recorded an even higher growth than the primary and the secondary sectors and consequently registered a significant increase in its share of total value added—from 22.7 percent in 1969/70 to 32.0 percent in 1979/80. While trade and transport contributed 12.8 percent to NSDP in 1969/70, its contribution increased to 20.4 percent in 1979/80. During the same period, the contribution made by sectors such as banking, insurance, real estate, public administration, and other services also increased at a rapid rate.

Output and Productivity

Tables 15 and 16 give details by sector on output and value added per worker in Punjab in 1969/70 and 1979/80. There are large intersectoral variations in output per worker, due to different technologies employed and uneven distribution of productively invested capital over the sectors. The differences in partial labor productivity measured this way give an idea of the relative efficiency of the work force in various sectors in 1969/70 and 1979/80. Since value of output and value added figures are in current prices, it is not possible to use these statistics to measure changes from 1969/70 to 1979/80.

It is, however, possible to get an idea of changes in labor productivity in real terms in the primary and the secondary sectors by using the data on state income in Table 1. During 1969/70-1979/80, per worker value added in real terms increased in both the primary and the secondary sectors. Thus, in constant prices, value added per worker increased from Rs 3,615 in 1969/70 to Rs 4,417 in 1979/80 in the primary sector and from Rs 3,634 to Rs 4,282 in the secondary sector.

Regarding intersectoral differences in labor productivity (at current prices), as shown in Tables 15 and 16, labor productivity was substantially higher in the manufacturing

[8] As noted earlier, the results for construction should be treated with caution because sectoral income estimates were thoroughly revised in 1970/71 and net value added in construction, which was only Rs 440 million in 1969/70, was raised to Rs 960 million in 1970/71.

Table 15—Sectoral distribution of workers and of output and value added per worker in Punjab, 1969/70

Sector Number	Sector	Workers	Distribution	Output per Worker	Value Added per Worker
		(persons)	(percent)	(Rs)	
1	Wheat	601,142	20.61	6,844	5,322
2	Rice	59,514	2.04	7,431	5,495
3	Maize	101,660	3.49	4,683	3,512
4	Cotton	139,318	4.78	1,752	1,213
5	Sugarcane	146,672	5.03	3,159	2,127
6	Gram and pulses	70,642	2.42	5,527	4,034
7	Oilseeds	72,520	2.49	3,456	2,427
8	Bajra	46,137	1.58	3,525	2,644
9	Other agriculture and forestry	325,292	11.15	3,299	2,678
	Subtotal: agriculture	1,526,897	53.59	(4,873)	(3,723)
10	Animal husbandry	758,629	26.01	4,873	3,846
	Subtotal: primary	2,321,526	79.60	(4,873)	(3,763)
11	Dairy products	1,403	0.05	154,984	8,553
12	Grain mill products	8,926	0.31	73,134	6,274
13	Sugar and confectionery	4,265	0.15	23,521	3,048
14	Edible oils and other food-processing industries	27,051	0.93	24,561	3,623
15	Breweries and beverages	2,114	0.07	13,151	1,892
16	Textiles	110,657	3.79	14,622	3,561
17	Cotton ginning, pressing, and other textiles	9,674	0.33	53,597	2,481
18	Sawmills and wooden containers	9,967	0.34	13,158	3,612
19	Furniture and fixtures	32,588	1.12	8,348	2,823
20	Printing and publishing	5,659	0.19	6,356	2,297
21	Rubber and leather products	25,781	0.88	8,360	2,405
22	Basic chemicals, including fertilizers	2,938	0.10	76,586	31,654
23	Other chemicals	3,838	0.13	34,628	6,774
24	Glass and mineral products	42,657	1.46	8,161	2,204
25	Basic metal industries	10,544	0.36	35,068	2,152
26	Metal products	31,599	1.08	11,255	3,070
27	Machinery, except electrical	33,396	1.15	15,266	4,611
28	Electrical machinery	4,489	0.15	26,809	5,346
29	Railroad equipment	2,853	0.10	9,367	6,660
30	Transport equipment	6,137	0.21	19,936	6,192
31	Repair of transport equipment	2,197	0.08	7,354	3,186
32	Motorcycles and bicycles	7,354	0.25	24,388	6,119
33	Scientific and surgical instruments	7,574	0.26	7,721	4,753
34	Miscellaneous industries	48,470	1.66	10,936	3,076
	Subtotal: manufacturing	442,131	15.16	(16,825)	(3,684)
35	Construction	142,335	4.88	8,285	3,260
36	Electricity	10,243	0.35	18,590	16,206
	Subtotal: secondary	594,709	20.39	(14,811)	(3,798)
	Total (primary and secondary)	2,916,235	100.00	(6,900)	(3,770)

Source: Based on Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).
Notes: Figures in parentheses are mean values. Parts may not add to totals because of rounding.

Table 16—Sectoral distribution of workers and of output and value added per worker in Punjab, 1979/80

Sector Number	Sector	Workers	Distribution	Output per Worker	Value Added per Worker
		(persons)	(percent)	(Rs)	
1	Wheat	546,440	11.80	17,814	9,921
2	Rice	560,383	12.10	9,259	6,378
3	Cotton	224,272	4.84	9,792	7,014
4	Sugarcane	70,039	1.51	11,614	9,287
5	Gram and pulses	49,703	1.07	9,629	7,344
6	Oilseeds	24,935	0.54	18,211	14,718
7	Other agriculture and forestry	305,759	6.60	9,629	6,306
	Subtotal: agriculture	1,781,531	38.47	(12,242)	(8,082)
8	Animal husbandry	828,295	17.89	9,629	6,758
	Subtotal: primary	2,609,826	56.36	(11,413)	(7,662)
9	Dairy products and confectionery	5,204	0.11	128,559	29,785
10	Grain mill products	23,913	0.52	78,367	6,565
11	Bakery products	11,337	0.24	13,732	4,675
12	Sugar	4,559	0.10	42,802	7,458
13	Other food industries	16,979	0.37	30,145	8,245
14	Edible oils	13,939	0.30	134,583	10,043
15	Breweries and beverages	2,493	0.05	114,214	18,853
16	Ginning and textiles	169,678	3.66	40,854	7,373
17	Sawmills and wooden goods	45,710	0.99	13,151	5,119
18	Paper, printing, and publishing	10,954	0.24	13,113	4,656
19	Rubber and leather products	38,397	0.83	23,185	6,068
20	Basic chemicals, including fertilizers	4,974	0.11	281,054	54,483
21	Drugs and pharmaceuticals	1,020	0.02	37,899	6,863
22	Other chemicals	4,874	0.11	47,903	7,386
23	Glass and mineral products	42,954	0.93	34,650	13,060
24	Basic metal industries	37,271	0.80	116,129	10,518
25	Metal products	52,504	1.13	26,234	5,333
26	Machinery, except electrical	26,795	0.58	41,762	8,994
27	Electrical machinery	8,060	0.17	66,475	13,896
28	Railroad equipment	2,379	0.05	27,412	11,770
29	Motor vehicles, manufacture and repair	70,679	1.53	15,179	5,645
30	Bicycles and parts	37,073	0.80	35,415	11,113
31	Scientific and surgical instruments	3,401	0.07	25,239	7,351
32	Sports and athletic goods	17,553	0.38	23,486	5,811
33	Miscellaneous industries	1,626	0.04	118,469	81,675
	Subtotal: manufacturing	654,326	14.13	(41,998)	(8,396)
34	Electricity, gas, water supply	42,784	0.92	38,736	22,111
35	Construction	100,663	2.17	67,075	23,773
	Subtotal: secondary	797,773	17.23	(45,065)	(11,072)
36	Trade, transport, and storage	546,973	11.81	25,305	15,812
37	Other services	613,024	13.24	10,621	5,700
38	Banking and insurance	37,897	0.82	28,064	23,142
39	Real estate and ownership of dwellings	25,370	0.55	31,921	20,891
	Subtotal: tertiary	1,223,264	26.42	(18,169)	(11,077)
	Total	4,630,863	100.00	(19,003)	(9,151)

Source: Based on Punjab input-output table for 1979/80 (Table 44, Appendix 1).
Notes: Figures in parentheses are mean values. Parts may not add to totals because of rounding.

sectors than in the labor-intensive agricultural sectors in both 1969/70 and 1979/80. Thus, in 1969/70 the productivity in manufacturing was about three and a half times the output of Rs 4,873 per worker in agriculture. In 1979/80 productivity in the manufacturing sectors was Rs 41,998 compared with an average productivity of Rs 12,242 per worker in agriculture. Overall productivity in the tertiary sector was higher than that in the primary sector but much lower than that in the secondary sector.

There are large variations in productivity per worker within the primary, secondary, and tertiary sectors. Within agriculture, for example, output per worker in the production of wheat, sugarcane, and oilseeds, where new technology has been adopted, is much higher than that for most other crops. In 1979/80, the highest per worker productivity among all the crops was in oilseeds, even though in 1969/70 oilseeds ranked fairly low in labor productivity. The main reason is that over this period the relative prices of oilseeds vis-à-vis other agricultural crops rose at a much higher rate.

The output per worker in animal husbandry shown in Tables 15 and 16 is quite low both for 1969/70 and 1979/80. This is primarily because reliable data on workers and person-days are not available, since animal husbandry is a part-time activity. The estimates have therefore been derived from certain assumptions, giving only a notional value of productivity to this sector.

Within manufacturing, too, there are large variations in labor productivity. In 1969/70 the highest output per worker was in manufacturing of dairy products, followed by basic chemicals, grain mill products, cotton ginning, and basic metal industries. In 1979/80, basic chemicals, including fertilizers, had the highest rank in output per worker, followed by edible oils, grain mill products, miscellaneous industries, and breweries. The lowest output per worker was in printing and publishing and bakery products. Sawmills and manufacture of motor vehicles and parts continued to have low productivity. Within the secondary sector, both construction and electricity showed a high level of labor productivity. In the tertiary sector, output per worker was very low in services but was notably above average in trade and transport, banking, and real estate and dwellings.

The intersectoral variations in labor productivity, though quite significant, are much lower when labor productivity is measured in terms of value added per worker instead of value of output per worker. Thus, within the primary sector, value added per worker ranged between Rs 1,213 and Rs 5,495 in 1969/70 and between Rs 6,306 and Rs 9,921 in 1979/80 (except for oilseeds, with nearly Rs 15,000). In the manufacturing sector, in 1969/70 the highest value added per worker was Rs 31,654 in the basic chemicals sector. Dairy products, which ranked highest in output per worker, had a value added productivity of only Rs 8,553. Value added per worker in other manufacturing sectors ranged between Rs 1,892 and Rs 6,774. In 1979/80 the highest value added per worker was in miscellaneous industries, followed by basic chemicals and dairy products. For other manufacturing sectors, value added per worker was between Rs 4,656 and Rs 18,853. The range was much higher for value of output per worker in these industries. Value added per worker was high in both construction and electricity during 1979/80.

In the tertiary sector, in 1979/80 value added per worker was quite high in trade and transport, banking, and real estate, while it was rather low in other services.

Changes in the Pattern of Final Demand

Table 17 shows how final demand was met in Punjab in 1969/70 and 1979/80 and, for comparison, in India in 1979/80. In both 1969/70 and 1979/80 a major

Table 17—Distribution of final expenditure in Punjab, 1969/70 and 1979/80, and in India, 1979/80

Item	Punjab				India	
	1969/70		1979/80		1979/80	
	Expenditure	Distribution	Expenditure	Distribution	Expenditure	Distribution
	(Rs million)	(percent)	(Rs million)	(percent)	(Rs million)	(percent)
Household consumption	8,560	61.1	29,215	63.4	742,880	73.2
Government consumption	670	4.8	2,420[a]	5.3	110,250	10.9
Gross fixed capital formation	2,150	15.3	10,461	22.7	213,070	21.2
Changes in stocks	300	2.1	1,211	2.6	48,360	4.8
Net of trade	3,355	23.9	7,739	16.8	−17,540	−1.7
Exports	6,910	49.3	37,000	80.3	83,400	8.3
Imports[b]	−3,555	−25.4	−29,261	−63.5	−100,940	−10.0
Errors	−1,015	−7.2	−4,995	−10.8	−21,600	−1.8
Gross domestic product at market prices	14,020	100.0	46,090	100.0	1,075,420	100.0

Sources: Based on Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980); Punjab input-output table for 1979/80 (Table 44, Appendix 1); and India, Ministry of Planning, *National Accounts Statistics* (Delhi: Controller of Publications, 1983).

Note: Parts may not add to totals because of rounding.

[a] In the Punjab input-output table, government expenditure is Rs 409.3 million, as it does not include value added to the government sector, which is given as Rs 2,010.4 million for 1979/80, according to the Economic and Functional Classification of the Budget. This amount has been included in value added in public administration and other services (sector 37).

[b] Includes noncompetitive imports amounting to Rs 1,305.9 million in 1969/70 and Rs 6,270.4 million in 1979/80.

part of the "domestic" expenditure net of trade was incurred for private household consumption, followed by gross fixed capital formation.

Instead of taking various components of fixed expenditure as a proportion of total final demand, it is perhaps more useful to obtain its distribution by treating GDP at market prices as the base. In 1969/70, according to the Economic and Statistical Adviser to the Punjab government, at current prices, GDP at market prices was slightly more than Rs 14.0 billion and in 1979/80 it was almost Rs 46.1 billion. According to the input-output accounting matrix, the GDP at market prices for 1979/80 is the total of net value added, depreciation, and taxes net of subsidies (Appendix 1, Table 44, last column). It works out to Rs 46.9 billion in 1979/80, indicating that there is only a very small percentage error in the authors' estimate. The GDP figures of nearly Rs 14.0 billion for 1969/70 and Rs 46.1 billion for 1979/80 given by the Economic and Statistical Adviser are used for the following discussion.

In 1979/80, 63.4 percent of the total expenditure in Punjab was on household consumption (Table 17). This percentage is much lower than the all-India average of 69.1 percent of total GDP spent on consumption. It is significant that the total gross fixed capital formation (including changes in stocks), which was 17.4 percent of GDP in 1969/70, increased to 25.3 percent of total GDP in 1979/80, comparing favorably with the all-India figure of 24.3 percent.

Exports continue to be extremely important in the economy of Punjab. This is especially true since the advent of the new technology in wheat and rice in the mid-1960s. Whereas exports constituted 49.3 percent of GDP in 1969/70, their share increased to 80.3 percent in 1979/80. The share of imports also increased from 25.4

percent to 63.5 percent, indicating an increasing linkage between the Punjab economy and the national economy.

Household Consumption

In both 1969/70 and 1979/80, household consumption was by far the most important component of final demand, accounting for nearly two-thirds of NSDP. Tables 18 and 19 show the annual per capita consumption expenditure of rural and urban households along with its composition. In nominal terms, per capita consumption expenditure in the rural and urban areas in 1969/70 was Rs 636 and Rs 695, respectively, and increased to Rs 1,744 and Rs 1,936, respectively, in 1979/80.

The composition of expenditure shows that although cereals, including grain mill products, are the most important components of consumption, their share in the total expenditure for rural households dropped from 26.9 percent in 1969/70 to 15.0 percent in 1979/80. In the consumption basket of urban household expenditure, cereals and grain mill products declined from 26.8 percent to 13.8 percent. While there was a notable fall in the proportion of expenditure on milk and dairy products by rural households, from 32.0 percent in 1969/70 to 19.5 percent in 1979/80, the expenditure on milk by urban households declined only slightly, from 19.5 percent in 1969/70 to 16.8 percent in 1979/80. It appears that the expenditure on animal husbandry products by rural households obtained from the Punjab Economic and Statistical Organization was overestimated in the state sample of the round of the National Sample Survey for 1969/70, which constituted the basis for estimates in the present study. The combined state and central sample for 1968/69 shows that rural households spent 22.2 percent—not the 32.0 percent shown in Table 18 for 1969/70—of their expenditure on dairy products compared with 19.5 percent in 1979/80 (India, Ministry of Planning 1979, 1986a, 1986b). Cereals and milk, as well as edible oils, sugar, and cloth, remained important components of consumption expenditure for both rural and urban households.

A notable change was a substantial increase in the proportion of expenditure on trade and transport, banking and insurance, other services, and real estate by rural households in 1979/80. For rural households, the share of expenditure on these tertiary activities substantially increased from 12.4 percent in 1969/70 to 22.1 percent in 1979/80.[9] During the same period, the share spent on these activities by urban households increased only marginally from 20.0 percent to 20.5 percent.

Except for the change in expenditure on the tertiary sector, the relative priorities attached to individual commodity groups in both urban and rural areas remained more or less unchanged between 1969/70 and 1979/80. The first and second priorities were expenditures on cereals and milk, followed by sugar, salt, and other food and nonfood items, indicating that the consumption pattern in both rural and urban Punjab continued to be heavily food-oriented and that there was no significant difference in the consumption basket between rural and urban households. But a perceptible decline in the proportion of expenditure on cereals indicates that, with a rise in per capita income, the consumption pattern became more diversified.

The temporal changes in the consumption pattern are shown in Table 20, which gives the distribution of monthly per capita expenditure by rural households in Punjab

[9] The 1969/70 input-output table (see Table 13) does not contain any data on banking, insurance services, and real estate. But the distribution of per capita expenditure of rural households given in the 27th round (1972/73) shows that the percentage of expenditure incurred on "services" was 12.4 percent. See India, Ministry of Planning 1979.

Table 18—Per capita consumption expenditure and its distribution in Punjab, 1969/70

Sector Number	Sector	Per Capita Expenditure		Distribution	
		Rural	Urban	Rural	Urban
		(Rs)		(percent)	
1	Wheat	134.76	85.06	21.19	12.25
2	Rice	[a]	[a]	[a]	[a]
3	Maize	16.10	3.37	2.53	0.49
4	Cotton	[a]	[a]	[a]	[a]
5	Sugarcane	18.59	3.12	2.92	0.45
6	Gram and pulses	7.14	7.77	1.12	1.12
7	Oilseeds	[a]	[a]	[a]	[a]
8	Bajra	[a]	[a]	[a]	[a]
9	Other agriculture and forestry	50.46	57.59	7.93	8.29
10	Animal husbandry	203.13	135.24	31.94	19.47
11	Dairy products	0.36	0.05	0.06	0.01
12	Grain mill products	19.89	97.40	3.13	14.02
13	Sugar and confectionery	11.91	19.25	1.87	2.77
14	Edible oils and other food-processing industries	15.68	25.55	2.46	3.68
15	Breweries and beverages	12.15	10.71	1.91	1.54
16	Textiles	36.12	26.88	5.68	3.87
17	Cotton ginning, pressing, and other textiles	[a]	[a]	[a]	[a]
18	Sawmills and wooden containers	[a]	[a]	[a]	[a]
19	Furniture and fixtures	[a]	0.08	[a]	0.01
20	Printing and publishing	2.60	5.14	0.41	0.74
21	Rubber and leather products	10.65	6.86	1.67	0.99
22	Basic chemicals, including fertilizers	1.23	0.91	0.19	0.13
23	Other chemicals	26.94	27.51	4.24	3.96
24	Glass and mineral products	0.38	0.17	0.06	0.24
25	Basic metal industries	[a]	[a]	[a]	[a]
26	Metal products	0.24	0.56	0.04	0.08
27	Machinery, except electrical	0.43	0.20	0.07	0.03
28	Electrical machinery	0.82	0.89	0.13	0.13
29	Railroad equipment	[a]	[a]	[a]	[a]
30	Transport equipment	[a]	[a]	[a]	[a]
31	Repair of transport equipment	[a]	[a]	[a]	[a]
32	Motorcycles and bicycles	2.52	2.46	0.40	0.35
33	Scientific and surgical instruments	[a]	[a]	[a]	[a]
34	Miscellaneous industries	3.16	4.68	0.50	0.67
35	Construction	[a]	[a]	[a]	[a]
36	Electricity	1.54	7.83	0.24	0.67
	Subtotal	576.80	529.30	90.69	76.21
	Trade margins	37.67	125.61	5.92	18.08
	Taxes, duties, and subsidies	0.68	1.72	0.11	0.25
	Fuels and lubricants	8.00	27.30	1.26	3.93
	Other noncompetitive imports	12.91	10.66	2.03	1.54
	Total	636.06	694.59	100.00	100.00

Source: Based on Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).
Note: Parts may not add to totals because of rounding.
[a]Data are unavailable, as these commodities do not directly enter into the consumption basket.

on major commodity groups over various National Sample Survey rounds. As indicated earlier, the proportion of expenditure on foods declined rapidly after 1973/74. Within the food group, while expenditure on cereals declined, there was an increase in expenditure on noncereal foods, particularly beverages and refreshments. The percentage of expenditure on nonfoods increased substantially over time, particularly for alcoholic beverages, clothing, and other nonfood items.

Table 19—Per capita consumption expenditure and its distribution in Punjab, 1979/80

Sector Number	Sector	Per Capita Expenditure		Distribution	
		Rural	Urban	Rural	Urban
		(Rs)		(percent)	
1	Wheat	116.63	120.56	6.69	6.23
2	Rice	18.94	9.79	1.09	0.51
3	Cotton	[a]	[a]	[a]	[a]
4	Sugarcane	43.47	3.62	2.49	0.19
5	Gram and pulses	42.70	41.21	2.45	2.13
6	Oilseeds	[a]	[a]	[a]	[a]
7	Other agriculture and forestry	159.61	189.82	9.15	9.81
8	Animal husbandry	271.10	273.85	15.55	14.15
9	Dairy products and confectionery	68.12	50.43	3.91	2.61
10	Grain mill products	126.13	136.20	7.23	7.04
11	Bakery products	6.56	24.74	0.38	1.28
12	Sugar	34.73	54.47	1.99	2.81
13	Other food industries	31.37	13.01	1.80	0.67
14	Edible oils	49.38	81.82	2.83	4.23
15	Breweries and beverages	22.20	43.28	1.27	2.24
16	Ginning and textiles	119.30	92.01	6.84	4.75
17	Sawmills and wooden goods	4.17	1.86	0.24	0.10
18	Paper, printing, and publishing	13.76	22.88	0.79	1.18
19	Rubber and leather products	39.11	31.30	2.24	1.62
20	Basic chemicals, including fertilizers	1.19	[a]	0.07	[a]
21	Drugs and pharmaceuticals	67.44	81.01	3.87	4.19
22	Other chemicals	55.17	85.37	3.18	4.41
23	Glass and mineral products	1.62	0.66	0.09	0.03
24	Basic metal industries	1.64	[a]	0.09	[a]
25	Metal products	4.20	1.66	0.24	0.09
26	Machinery, except electrical	3.26	3.52	0.18	0.18
27	Electrical machinery	4.39	9.91	0.25	0.51
28	Railroad equipment	[a]	[a]	[a]	[a]
29	Motor vehicles, manufacture and repair	[a]	0.46	[a]	0.02
30	Bicycles and parts	0.65	1.28	0.04	0.07
31	Scientific and surgical instruments	[a]	[a]	[a]	[a]
32	Sports and athletic goods	0.10	0.31	0.01	0.02
33	Miscellaneous industries	8.04	2.48	0.46	0.13
34	Electricity, gas, water supply	15.66	52.27	0.90	2.70
35	Construction	1.41	5.03	0.08	0.26
36	Trade, transport, and storage	285.47	228.65	16.37	11.81
37	Other services	37.78	105.00	2.17	5.42
38	Banking and insurance	9.97	11.07	0.57	0.57
39	Real estate and ownership of dwellings	48.60	52.92	2.97	2.73
	Noncompetitive imports	28.65	101.69	1.64	5.25
	Taxes and duties	1.12	1.63	0.06	0.08
	Total	1,743.64	1,935.77	100.00	100.00

Source: Based on Punjab input-output table for 1979/80 (Table 44, Appendix 1).
Note: Parts may not add to totals because of rounding.
[a]Data are unavailable, as these commodities do not directly enter into the consumption basket.

Since detailed household schedules of expenditure are not available, it is not possible to use the available data to directly derive the consumption elasticities for various commodities. In an earlier study (Bhalla and Chadha 1983) these elasticities were derived on the basis of a survey of 1,663 rural households conducted in 1975/76. As expected, while the expenditure elasticities were high for clothing (1.8-1.9), footwear (1.5-1.6), services (1.2-1.3), milk and milk products (1.3-1.4), and beverages (1.4-1.6), they were quite low for cereals, edible oils, and other essentials. Details are given in Table 21.

Table 20—Distribution of average monthly per capita expenditure on major commodity groups in rural Punjab, 1964/65-1983

Commodity Group	1964/65		1966/67		1968/69		1973/74		1977/78		1983	
	Expenditure	Percentage	Expenditure	Percentage	Expenditure	Percentage	Expenditure	Percentage	Expenditure	Percentage	Expenditure	Percentage
	(Rs)		(Rs)		(Rs)		(Rs)		(Rs)		(Rs)	
Cereals and cereal substitutes	9.14	25.24	12.19	26.50	12.78	22.60	15.10	20.00	16.55	17.71	24.88	14.58
Pulses and pulse products	1.14	3.15	1.43	3.11	1.56	2.76	2.38	3.15	2.90	3.10	5.05	2.96
Milk and milk products	7.00	19.33	9.34	20.31	12.02	21.15	16.01	21.20	21.97	23.51	31.11	18.23
Edible oils	0.88	2.43	1.12	2.44	1.53	2.71	2.59	3.43	3.22	3.45	5.99	3.51
Meat, eggs, and fish	0.32	0.89	0.33	0.72	0.58	1.03	0.93	1.23	0.93	1.00	1.78	1.04
Fruit and vegetables	1.24	3.42	1.31	2.85	1.82	3.22	3.60	4.77	3.48	3.72	8.73	5.12
Sugar, salt, and spices	3.58	9.88	3.99	8.67	6.47	11.43	8.80	11.65	8.63	9.24	14.23	8.34
Beverages and refreshments	1.19	3.29	1.10	2.39	1.70	3.00	2.88	3.82	3.64	3.90	8.36	4.90
Total food	24.49	67.62	30.81	66.98	38.46	68.00	52.29	69.25	61.32	65.63	100.13	58.68
Betel leaf, tobacco, and alcoholic beverages	0.66	1.82	0.75	1.63	1.37	2.42	2.45	3.25	2.12	2.27	4.01	2.35
Clothing	3.29	9.08	2.38	5.17	5.03	8.89	6.75	8.94	8.62	9.23	19.86	11.64
Fuel and light	1.95	5.38	2.28	4.96	3.00	5.31	4.07	5.38	5.68	6.08	11.68	6.84
Consumer durables	0.94	2.60	0.86	1.87	1.86	3.29	1.81	2.40	2.90	3.10	4.45	2.61
Other nonfood items	4.89	13.50	8.92	19.39	6.84	12.09	8.14	10.78	12.79	13.69	30.52	17.88
Total nonfood	11.73	32.38	15.19	33.02	18.10	32.00	23.22	30.75	32.11	34.37	70.52	41.32
Total expenditure	36.22	100.00	46.00	100.00	56.56	100.00	75.51	100.00	93.43	100.00	170.65	100.00

Sources: India, Ministry of Planning, National Sample Survey Organization, *Sarvekshana* 2 (January 1979); India, Ministry of Planning, NSSO, *Sarvekshana* 9 (January 1986); India, Ministry of Planning, NSSO, *Sarvekshana* 9 (April 1986); and 1977/78 data obtained from the Office of the Economic Adviser, Government of Punjab, through the courtesy of J. S. Kapur, director of the National Sample Survey Organization.

Note: Parts may not add to totals because of rounding.

Table 21—Commodity expenditure elasticities for cultivating households in rural Punjab, 1974/75

Commodity Group	Range for Expenditure Elasticity[a] (e)	Range for Coefficient of Determination (r^2)	Saturation Limit for per Capita Expenditure[b]		Cash Spent as a Percentage of Total Expenditure
Cereals and cereal products	0.22–0.24	0.16–0.18	242.30	(195.10)	6.76
Pulses	0.49–0.56	0.14–0.18	42.95	(27.30)	79.08
Milk and milk products	1.32–1.40	0.80–0.86	705.73	(304.27)	3.50
Edible oils	0.23–0.30	0.01–0.02	n.a.	n.a.	78.83
Meat, eggs, and fish	3.02–3.31	0.44–0.49	145.17	(9.01)	83.67
Vegetables and fruit	0.52–0.61	0.15–0.20	55.70	(34.51)	78.83
Sugar and gur	0.72–0.73	0.63–0.65	144.03	(70.47)	70.66
Salt and spices	0.13–0.15	0.01–0.01	21.54	(14.75)	100.00
Beverages	1.37–1.63	0.54–0.68	165.67	(36.54)	100.00
Fuel and light	0.24–0.25	0.13–0.15	59.74	(45.69)	17.81
Clothing	1.76–1.92	0.65–0.70	566.80	(77.18)	100.00
Footwear	1.54–1.57	0.40–0.43	112.17	(18.39)	100.00
Miscellaneous goods and services	1.23–1.30	0.54–0.61	399.41	(70.88)	100.00

Sources: G. S. Bhalla and G. K. Chadha, *Green Revolution and the Small Peasant: A Study of Income Distribution among Punjab Cultivators* (New Delhi: Concept, 1983), 138-140; and G. K. Chadha, *The State and Rural Economic Transformation: The Case of Punjab, 1950-85* (New Delhi: Sage, 1986), 336.

Note: n.a. means not available.

[a] For each commodity group, expenditure elasticity has been worked out from four types of Engel functions (semilog, hyperbolic, log-linear, and log-inverse). The lowest and highest values of the elasticity thus constitute the range for (e).

[b] The saturation limit for commodity expenditure (computed mostly from log-inverse function) corresponds to an infinitely large level of total per capita expenditure; it is the value of the upper asymptote. The figures in parentheses are per capita expenditures actually incurred.

In sum, consumption expenditure continued to be the most important component of final demand in 1979/80. A rapid increase in per capita income also resulted in increased expenditure on consumption by both rural and urban households. Despite some minor differences, expenditure by both rural and urban households continued to be highly oriented toward food items, as is typical of the consumption pattern in developing countries.

Gross Fixed Capital Formation and Changes in Stocks

For 1979/80, gross fixed capital formation is estimated at almost Rs 10.5 million and changes in stocks at more than Rs 1.2 million, and the two together constitute 25.3 percent of GDP at market prices. This proportion is much higher than that in 1969/70, when only 15.3 percent of GDP was spent on capital formation and 2.1 percent on changes in stocks. In 1979/80, the proportion of income spent on gross domestic capital formation in Punjab was comparable to that in all of India.

A notable feature of the composition of gross capital formation in the state is that, compared with 54.8 percent in 1969/70, expenditure on construction accounted for as much as 65.1 percent of total gross fixed capital formation in 1979/80. On the other hand, investments in nonelectrical and electrical machinery constituted only 17.3 percent and 3.8 percent, respectively, of gross capital formation. In the country as a whole, construction constituted 53.4 percent of the total expenditure on gross fixed capital formation during 1979/80.

The much higher allocation of investment expenditure on construction in Punjab than in all of India can be explained by certain specific features of development in the

state. During the 1960s, because of exceptionally high levels of profitability in the adoption of new technology, the cultivators undertook large investments in tubewells, tractors, other agricultural machinery, farm houses, and other construction. Since the life of agricultural machinery is quite long and a great deal of investment was undertaken during the 1960s and 1970s, further investment in machinery seems to be petering out.

Further, during the late 1970s, gross fixed investment in agriculture was characterized by an unusually high component of construction. For example, a room is normally constructed along with a tubewell, and a shed accompanies the purchase of a tractor. Large investments have also been undertaken in the construction of godowns and warehouses by both the central and the state governments, by public sector agencies, and by private individuals for the storage of wheat and rice surpluses. Finally, in the socioeconomic context of Punjab, where a very high priority is accorded to residential houses, increased incomes have resulted in larger investments in residential construction.

Exports and Imports

The Punjab continues to be a highly export-surplus economy. In 1979/80 exports constituted as much as 80.3 percent of the total GDP compared with 49.3 percent in 1969/70 (Table 17). On the other hand, the share of imports also increased—to 63.5 percent of GDP in 1979/80 from only 25.4 percent in 1969/70. But despite large imports in 1979/80, the balance of trade had a net surplus of more than Rs 7.7 billion, or 16.8 percent of GDP. In 1969/70, the net surplus of the economy was almost Rs 3.4 billion, or 23.9 percent of GDP. Agricultural commodities continue to be important in the export basket; in 1979/80 they constituted 33.8 percent of all exports. Animal husbandry contributed another 6.4 percent to total exports. Within the agricultural sector, wheat and rice together accounted for 27.3 percent of total exports from the state.

During the 1970s some of the manufacturing industries also made significant contributions to exports, and some of these found an export market not only in the rest of India but in foreign countries as well. Consequently, manufactures remained important in the export market, contributing nearly 43 percent to total exports compared with about 42 percent in 1969/70. Within manufacturing, the sectors that contributed fairly large proportions to exports are basic metals and alloys (8.8 percent), other chemicals (9.9 percent), textiles (5.0 percent), bicycles (3.3 percent), and motor vehicles (1.9 percent). Large exports also took place from the tertiary sector, with trade and transport accounting for 5.9 percent and other services for 11.5 percent of total exports from Punjab.

With modernization of agriculture and industry, growth of income, and a growing interrelationship with the rest of the country, imports have also risen at a rapid rate. For example, at current prices, competitive imports amounted to more than Rs 2.2 billion and noncompetitive imports to about Rs 1.3 billion in 1969/70. The total imports into the state's economy in 1979/80 were almost Rs 23.0 billion for competitive and Rs 6.3 billion for noncompetitive imports. As is to be expected, a major proportion of imports were used up as inputs for agricultural production, followed by industrial production. For example, the largest imports were those of basic chemicals and fertilizers and other chemicals, which accounted for 29 percent of total imports into Punjab. These were followed by basic metals and alloys, electrical and nonelectrical machinery, and nonmetallic mineral products. As in 1969/70, most of the noncompetitive imports consisted of diesel oil, petrol, and other petroleum products.

A peculiar feature of the manufacturing sector in Punjab is that because of nonavailability of raw materials, except in agriculture-based industry, most of the industrial raw materials such as iron and steel, coal, diesel, and petroleum needed for basic

metals, machine tools, and durable consumer goods industries are imported from the rest of India. These raw materials are used to produce manufactured goods that are primarily exported to the rest of the country. A significant development that has resulted in considerable reduction in imports is the establishment of two large fertilizer plants in the public sector in Punjab.

Within the consumption basket, imports included drugs and pharmaceuticals (7.8 percent); other agriculture, mainly wood (5.5 percent); dairy products and confectionery (4.0 percent); edible oils (3.6 percent); sugar (2.5 percent); rubber and leather products (3.0 percent); and textiles (4.7 percent).

5

LINKAGE ANALYSIS OF THE PUNJAB ECONOMY

The Punjab input-output tables for 1969/70 (Alagh, Bhalla, and Kashyap 1980) and 1979/80 (Appendix 1, Table 44) were used in Chapter 4 to analyze the main features and changes in the structure of the Punjab economy during 1969/70-1979/80. One of the important uses of an input-output table is to lay bare the structure of production in an economy and the interdependencies between various sectors.

This chapter examines the nature and extent of sectoral interdependence in Punjab through calculation of the direct and indirect input use and output disposal of each sector. In particular, an attempt will be made to quantify the relationship between agriculture and the nonagricultural sectors of the Punjab economy.

Some notable attempts have been made to analyze the relationship between agricultural growth and industrial development by defining the major points of influence and by quantifying the various relationships between the two sectors (see Rangarajan 1982). It is beyond the scope of this report to build an econometric model with a new view to undertaking a comprehensive study of production, demand, and savings and investment types of linkages through which agriculture influences industry or vice versa. However, the input-output analysis does permit quantification of the extent of intersectoral interdependence, including backward and forward linkages.

An input-output table only quantifies the direct and indirect dependence of various sectors on one another within a general equilibrium framework without implying any causality of relationships. It appears that some of the causal hypotheses advanced by some scholars using this framework may lack much theoretical validity.

Before an in-depth analysis of the pattern of linkages is undertaken for all 39 sectors in the 1979/80 Punjab input-output table, an overview of the interrelationships among various sectors in the Punjab economy is provided by aggregating the 39 sectors into only 5 sectors. The Indian input-output table for 1979/80 (India, Planning Commission 1981) has also been condensed into 5 equivalent sectors to bring out the main differences in the structure of production in Punjab and in India as a whole. This is followed by a detailed analysis of changes in the linkage patterns in Punjab during 1969/70-1979/80. The pattern of backward and forward linkages and changes therein have been studied by use of the Rasmussen method, working out Rasmussen indices separately for 1969/70 and 1979/80 for all the disaggregated sectors contained in the Punjab input-output tables for these years.

An Overview of Agriculture-Nonagriculture Linkages

The extent of intersectoral linkages depends on the density of the input structure of various sectors in an economy. That the production structure of agriculture in Punjab is different from that in the rest of the country is brought out by a comparison of the condensed five-sector input-output flow and coefficient tables for Punjab and India for 1979/80 (Tables 22-25). Some of the differences are detailed below.

First, whereas intermediate inputs (including such inputs as noncompetitive imports) constituted 24.8 percent of the value of agricultural output in India, their share was

Table 22—Interindustrial flows and patterns of final demand in Punjab, 1979/80

Item	Agriculture and Allied Industries	Manufacturing and Allied Industries	Trade, Transport, and Storage	Banking and Insurance	Public and Other Services	Total Intermediate Use	Private Consumption		Government Consumption
							Rural	Urban	
					(Rs 1,000)[a]				
Agriculture and allied industries	2,238,900	3,790,010	60,198	0	201,771	6,290,879	7,762,995	2,794,962	25,391
Manufacturing and allied industries	3,639,381	13,406,580	837,004	12,432	1,326,917	19,222,320	8,085,507	3,482,375	180,544
Trade, transport, and storage	573,467	4,055,336	1,430,546	33,862	773,282	6,866,493	3,396,441	1,000,401	79,370
Banking and insurance	97,821	319,818	318,637	83,191	47,529	866,996	118,676	48,477	0
Public and other services	0	0	971,217	18,208	346,613	1,336,038	1,027,926	690,903	0
Total inputs	6,549,569	21,571,750	3,617,602	147,693	2,696,112	34,582,720	20,391,540	8,017,118	285,305
Noncompetitive imports	2,060,152	2,425,777	567,093	1,252	21,734	5,076,008	340,863	444,905	79,016
Repair and maintenance	189,200	557,736	0	0	0	746,936	0	0	24,684
Work done by others	0	780,782	0	0	0	780,782	0	0	0
Taxes, duties, and subsidy	232,007	466,989	414,031	4,183	245,922	1,363,132	13,298	7,077	0
Consumable stores	0	578,930	0	0	0	578,930	0	0	0
Depreciation	759,000	775,359	593,300	33,700	332,900	2,494,259	0	0	20,295
Net value added	19,995,750	8,833,328	8,649,200	876,700	4,023,800	42,378,780	0	0	0
Gross output	29,785,680	35,990,650	13,841,230	1,063,528	7,320,468	88,001,550	20,745,710	8,469,100	409,300
Workers (in number of persons)	2,609,826	797,773	546,973	37,897	638,394	4,630,863	0	0	0
Person-days (in thousands of days)	681,164	232,063	171,203	10,611	187,278	1,282,319	0	0	0
Wages	5,571,936	4,589,304	5,602,138	457,900	3,079,880	19,301,160	0	0	0

Item	Capital Formation	Change in Stocks	Exports	Imports	Final Demand	Gross Output
			(Rs 1,000)[a]			
Agriculture and allied industries	234,805	460,000	14,860,680	2,644,033	23,494,800	29,785,680
Manufacturing and allied industries	9,275,284	421,600	15,669,690	20,346,670	16,768,330	35,990,650
Trade, transport, and storage	323,838	0	2,174,683	0	6,974,733	13,841,230
Banking and insurance	0	0	29,379	0	196,532	1,063,528
Public and other services	0	0	4,265,601	0	5,984,430	7,320,468
Total inputs	9,833,927	881,600	37,000,040	22,990,700	53,418,825	88,001,550
Noncompetitive imports	0	329,600	0	0	1,194,384	6,270,392
Repair and maintenance	0	0	0	0	24,684	771,620
Work done by others	0	0	0	0	0	780,782
Taxes, duties, and subsidy	626,702	0	0	0	647,077	2,010,209
Consumable stores	0	0	0	0	0	578,930
Depreciation	0	0	0	0	20,295	2,514,554
Net value added	0	0	0	0	0	42,378,780
Gross output	10,460,630	1,211,200	37,000,040	22,990,700	55,305,265	143,306,800
Workers (in number of persons)	0	0	0	0	0	4,630,863
Person-days (in thousands of days)	0	0	0	0	0	1,282,319
Wages	0	0	0	0	0	19,301,160

Source: Based on Punjab input-output table for 1979/80 (Table 44, Appendix 1).
Note: Parts may not add to totals because of rounding.
[a] Factor cost at 1979/80 prices.

Table 23—Interindustry coefficient table, Punjab, 1979/80

Item	Agriculture and Allied Industries	Manufacturing and Allied Industries	Trade, Transport and Storage	Banking and Insurance	Public and Other Services
Agriculture and allied industries	0.0752	0.1053	0.0044	0.0000	0.0276
Manufacturing and allied industries	0.1222	0.3725	0.0605	0.0117	0.1813
Trade, transport, and storage	0.0192	0.1127	0.1033	0.0319	0.1056
Banking and insurance	0.0033	0.0089	0.0230	0.0782	0.0065
Public and other services	0.0000	0.0000	0.0702	0.0171	0.0473
Total inputs	0.2199	0.5994	0.2614	0.1389	0.3683
Noncompetitive imports	0.0692	0.0674	0.0410	0.0012	0.0030
Repair and maintenance	0.0064	0.0155	0.0000	0.0000	0.0000
Work done by others	0.0000	0.0217	0.0000	0.0000	0.0000
Taxes, duties, subsidy	0.0078	0.0130	0.0299	0.0039	0.0336
Consumable stores	0.0000	0.0161	0.0000	0.0000	0.0000
Depreciation	0.0255	0.0216	0.0429	0.0317	0.0455
Net value added	0.6713	0.2454	0.6249	0.8243	0.5497
Gross output	1.0000	1.0000	1.0000	1.0000	1.0000
Workers	0.0876	0.0222	0.0395	0.0356	0.0872
Person-days	0.0229	0.0065	0.0124	0.0100	0.0256
Wages	0.1871	0.1275	0.4047	0.4306	0.4207

Source: Derived from Table 22.
Note: Parts may not add to totals because of rounding.

as high as 28.9 percent in the case of Punjab. Hence, compared with the agricultural sector of India, that of Punjab is likely to generate a higher level of intersectoral linkages.

Second, consequent to adoption of the new technology in agriculture, the share of industrial inputs in the value of agricultural output was much greater, and that of agricultural inputs much smaller, in Punjab than in India as a whole. Industrial inputs, including noncompetitive imports of fuels and lubricants, constituted 19.1 percent of the value of agricultural output and as much as 66.2 percent of the total value of inputs used in agricultural production in the state. In the case of India, industrial inputs accounted for only 8.8 percent of the value of agricultural output and 35.4 percent of the total value of agricultural inputs.

The direct and indirect output effects of changes in final demand from various sectors in Punjab and India can be derived from the respective Leontief inverses in Tables 26-29. Because of lower agricultural input and higher input from manufacturing in agricultural production, one unit of final demand from agriculture results in considerably lower direct and indirect output from agriculture and notably higher output from manufacturing in Punjab than in India. A Rs 1.00 increase in final demand from agriculture led to a Rs 1.11 increase in agricultural output in Punjab compared with Rs 1.15 in India—the increases in manufacturing output were Rs 0.22 in Punjab and Rs 0.18 in India. The changes for other sectors are also given in Tables 26-29.

Third, both in Punjab and in India as a whole, the proportion of agricultural output used as interindustry input is much lower, and that allocated to final consumption much greater, than is the case with manufacturing. In both cases, manufacturing uses much higher amounts of intermediate inputs as a proportion of output than does agriculture. Consequently, manufacturing generates much greater forward and backward linkages than agriculture. Because of this, increases in final demand from manufacturing lead to notably higher levels of direct and indirect output in all the sectors and particularly in manufacturing. In Punjab, an increase of Rs 1.00 in final demand from manufacturing resulted in a direct and indirect output of as much as Rs 1.66 in

Table 24—Interindustrial flows and patterns of final demand in India, 1979/80

Item	Agriculture and Allied Industries	Industry and Mining	Transport, Communications, and Trade	Money, Banking, and Real Estate	Public Administration Services	Total Intermediate Use
			(Rs million)[a]			
Agriculture and allied industries	53,848	79,334	1,424	0	6,487	141,093
Industry and mining	40,441	303,852	36,727	5,028	52,454	438,501
Transport, communications, and trade	12,519	132,697	28,682	1,043	17,908	192,847
Money, banking, and real estate	3,046	13,131	7,112	2,620	1,411	27,320
Public administration services	4,312	11,954	21,679	677	10,357	48,978
Total inputs	114,164	540,967	95,623	9,368	88,617	848,739
Indirect tax	5,848	43,175	9,242	142	7,399	65,806
Gross value added	340,945	255,935	206,304	60,335	106,990	970,509
Gross output	460,958	840,075	311,170	69,845	203,006	1,885,054

Item	Private Consumption	Public Consumption	Gross Fixed Investment	Change in Stocks	Exports	Imports	Total Final Use	Gross Output
				(Rs million)[a]				
Agriculture and allied industries	314,509	2,205	1,692	−3,782	7,039	1,797	319,865	460,958
Industry and mining	210,261	24,514	176,100	30,148	47,306	86,103	402,225	840,727
Transport, communications, and trade	79,117	10,932	19,975	0	8,301	0	118,324	311,170
Money, banking, and real estate	41,707	717	0	0	100	0	42,524	69,843
Public administration services	73,447	75,708	0	0	4,780	0	153,935	202,913
Total inputs	719,040	114,076	197,767	26,366	67,526	87,900	1,036,874	1,885,611
Indirect tax	31,490	3,494	12,603	0	1,555	0	49,142	114,950
Gross value added	0	0	0	0	0	0	0	970,510
Gross output	750,530	117,570	210,370	26,366	69,080	87,900	1,086,016	2,971,071

Source: India, Planning Commission, *A Technical Note on the Sixth Plan of India, 1980-85* (New Delhi: Controller of Publications, 1981), 99.
Note: Parts may not add to totals because of rounding.
[a]Factor cost at 1979/80 prices.

manufacturing, Rs 0.19 in agriculture, and Rs 0.25 in other sectors. In the case of India, the respective output levels were Rs 1.67, Rs 0.18, and Rs 0.39.

Fourth, with changes in final demand, the direct and indirect increases in the output of various sectors are considerably reduced when import leakages are taken into account by using the modified Leontief inverse.[10] The impact of import leakages is much stronger in Punjab than in India because of Punjab's greater dependence on industrial imports for use as inputs in both agriculture and industry.

[10] Instead of inverting (I−A), one can invert the $(I + \hat{b} - A)$ matrix, where $\hat{b}$ is a diagonal matrix of b_i, defined as $b_i = M_i/X_i$, where M_i is imports into sector i and X_i is the output of sector i.

Table 25—Interindustry coefficient table, India, 1979/80

Item	Agriculture and Allied Industries	Industry and Mining	Transport, Communications, and Trade	Money, Banking, and Real Estate	Public Administration Services
Agriculture and allied industries	0.1168	0.0944	0.0046	0.0000	0.0320
Industry and mining	0.0877	0.3617	0.1180	0.0720	0.2584
Transport, communications, and trade	0.0272	0.1580	0.0922	0.0149	0.0882
Money, banking, and real estate	0.0066	0.0156	0.0229	0.0375	0.0070
Public administration services	0.0094	0.0142	0.0697	0.0097	0.0510
Total inputs	0.2477	0.6439	0.3073	0.1341	0.4365
Indirect taxes	0.0127	0.0514	0.0297	0.0020	0.0365
Gross value added	0.7396	0.3047	0.6630	0.8639	0.5270
Gross output	1.0000	1.0000	1.0000	1.0000	1.0000

Source: Derived from Table 24.
Note: Parts may not add to totals because of rounding.

Table 26—Leontief inverse for the Punjab interindustry table, without import leakages, 1979/80

Sector Inverted Matrix [I–A]	Agriculture and Allied Industries (1)	Manufacturing and Allied Industries (2)	Trade, Transport, and Storage (3)	Banking and Insurance (4)	Public and Other Services (5)
1. Agriculture and allied industries	1.1069	0.1901	0.0239	0.0046	0.0709
2. Manufacturing and allied industries	0.2219	1.6565	0.1400	0.0321	0.3373
3. Trade, transport, and storage	0.0524	0.2149	1.1445	0.0454	0.1696
4. Banking and insurance	0.0074	0.0221	0.0306	1.0865	0.0152
5. Public and other services	0.0040	0.0162	0.0849	0.0229	1.0625

Table 27—Leontief inverse for the Punjab interindustry table, with import leakages, 1979/80

Sector Inverted Matrix $[I + \hat{b} - A]$	Agriculture and Allied Industries (1)	Manufacturing and Allied Industries (2)	Trade, Transport, and Storage (3)	Banking and Insurance (4)	Public and Other Services (5)
1. Agriculture and allied industries	0.9977	0.0895	0.0147	0.0025	0.0475
2. Manufacturing and allied industries	0.1044	0.8545	0.0722	0.0166	0.1737
3. Trade, transport, and storage	0.0351	0.1107	1.1356	0.0434	0.1483
4. Banking and insurance	0.0055	0.0114	0.0297	1.0863	0.0130
5. Public and other services	0.0027	0.0084	0.0842	0.0227	1.0609

Note: $b_i = M_i/X_i$, where M_i is imports by sector i and X_i is output of sector i.

Table 28—Leontief inverse for the India interindustry table, without import leakages, 1979/80

Sector Inverted Matrix [I−A]	Agriculture and Allied Industries (1)	Manufacturing and Allied Industries (2)	Trade, Transport, and Storage (3)	Banking and Insurance (4)	Public and Other Services (5)
1. Agriculture and allied industries	1.1526	0.1821	0.0369	0.0151	0.0919
2. Manufacturing and allied industries	0.1802	1.6715	0.2589	0.1339	0.4862
3. Trade, transport, and storage	0.0679	0.3017	1.1569	0.0425	0.1923
4. Banking and insurance	0.0126	0.0359	0.0326	1.0424	0.0209
5. Public and other services	0.0192	0.0494	0.0895	0.0159	1.0763

Table 29—Leontief inverse for the India interindustry table, with import leakages, 1979/80

Sector Inverted Matrix [I + $\hat{b}$ − A]	Agriculture and Allied Industries (1)	Manufacturing and Allied Industries (2)	Trade, Transport, and Storage (3)	Banking and Insurance (4)	Public and Other Services (5)
1. Agriculture and allied industries	1.1446	0.1548	0.0326	0.0129	0.0838
2. Manufacturing and allied industries	0.1531	1.4271	0.2210	0.1143	0.4151
3. Trade, transport, and storage	0.0629	0.2575	1.1501	0.0389	0.1794
4. Banking and insurance	0.0120	0.0307	0.0318	1.0420	0.0193
5. Public and other services	0.0183	0.0421	0.0884	0.0154	1.0742

Note: $b_i = M_i/X_i$, where M_i is imports by sector i and X_i is output of sector i.

Thus, in Punjab, a Rs 1.00 increase in final demand from agriculture led to a direct and indirect output of only Rs 0.998 in agriculture, compared with Rs 1.11 when import leakages were neglected and output was reduced from Rs 0.22 to Rs 0.11 in manufacturing. For India also, the incremental outputs of various sectors were reduced, although to a much smaller degree.

In the case of Punjab, import leakages are even higher when final demand from manufacturing is increased. Thus a unit increase resulted in a direct and indirect output of only Rs 0.86 in manufacturing, compared with Rs 1.66 when import leakages were not taken into account. In the case of India, direct and indirect output in manufacturing decreased from Rs 1.67 to Rs 1.43 even after accounting for import leakages. Because of a very high degree of interdependence with the rest of the country, many of the gains of rapid development in Punjab are being shared with the rest of India.

It is clear that the extent of output leakages from the service sectors, namely, trade, transport and storage, banking and insurance, and public and other services, is only marginal. This again brings out the important role played by the tertiary sector in increasing domestic incomes.

Intersectoral linkages between agriculture and industry and among other sectors of the economy depend on the level of technology used in the various sectors. With modernization, most of the sectors, including agriculture, tend to use higher proportions of intermediate inputs, and this leads to greater interdependence of various sectors. Dependence of agriculture on industry, in particular, and on other sectors, in general,

is bound to increase with modernization of agriculture. Similarly, because of relatively high density in the input structure of various sectors, the growth of manufacturing by itself is bound to increase interdependence among them. In short, the pattern of linkages among sectors is determined by the nature of structural changes in the production pattern. It is apparent that the extent of import leakages is quite high in the case of manufacturing in Punjab. This indicates that the scope for further development of agro-input as well as agroprocessing industries merits careful examination.

Intersectoral Linkages—Disaggregated Analysis

This section will discuss the nature of inducement effects that are the outcome of interlinkages among all 39 producing sectors contained in the 1979/80 Punjab input-output table and the 36 sectors in the 1969/70 table. Expansion of an industry leads to a series of effects due to interlinkages. The first-order effects are felt by the direct input-supplying industries, which in turn affect the activities that supply inputs to the industries affected in the first round, and the process continues until it fades out. The degree of responsiveness depends upon the nature of the industry that is affected initially, as well as the extent to which the system of industries shows an integrated or a decomposable structure. The main point is that different industries have varied inducements in the economy, depending upon the strength of linkages.

One of the important objectives of all developing countries is to achieve rapid growth in their per capita incomes. Since high per capita income is associated with a rising share of industry in GDP, the acknowledged strategy for achieving this objective is to accelerate the process of industrialization. It is in this context that a great deal of debate has taken place about the criteria for choosing the optimal set of industries in the process of industrialization. One school of thought has argued that the extent of forward and backward linkages should constitute the most important basis for this choice. The industrialization process can be carried out in a number of ways.

The original suggestion of some authors (see, for example, Hirschman 1985) was to rank sectors by their potential stimuli for growth via the inducement mechanism and to select for promotion those key sectors that had the highest backward and forward linkages. This corresponds to what may be termed ex-ante linkage analysis and should be based on technology coefficients (a_{ij}) (Blumer-Thomas 1978). It is argued that the benefits of production stimuli provided by the backward and forward linkages generally represent an externality and may not be reflected in the market prices. Consequently, the social benefits of investments with high backward and forward linkages could exceed the private benefits.

Hirschman (1985) proposed developing those sectors that ranked high in terms of linkages in the developed countries. This proposal was based on the finding that there was considerable similarity in the pattern of sectoral interdependence between the developing and the advanced industrial countries (Chenery and Watanabe 1958), suggesting that there is indeed something like a fundamental structure of production (Simpson and Tsukui 1965). This approach may be applicable only if the developing countries show an interdependence pattern approximate to that found in developed countries today. For this to be so, a number of assumptions need to be made, such as (1) the commodity composition of the underdeveloped country's output has some structural resemblance to that of the country on whose input-output tables we perform the statistics; and (2) any real choice of techniques is absent.

Raj (1975) has argued that neither of these assumptions was realistic, and even with rising incomes, consumer demand in less-developed countries could fail to approx-

imate that in developed countries because of differences in such matters as tastes, distribution of income, relative prices, and historical traditions. Thus, sectoral interdependence and the path to industrialization in developing countries are not necessarily mirrored in developed countries.

Hirschman (1985) realized that there was no guarantee that the potential stimulus measured by backward and forward linkages would be translated into actual growth; the stimulus might simply be absorbed as increased imports, higher prices, or underutilized capacity unless certain conditions were met. These conditions include the existence of a minimum market size consistent with capacity expansion, availability of complementary inputs (such as credit and skilled labor), and government policies consistent with the ranking of sectors. That sectoral linkages do not necessarily provide a stimulus to growth was brought out in a major study of linkages for several countries undertaken by Panchmukhi (1975). For example, he found that the simple correlation coefficient between the size of linkages and capacity underutilization in India was significant and positive, suggesting that in the absence of a rapid increase in their domestic demand, the expansion of sectors with high linkages may simply produce spare capacity rather than growth stimulus. In another study of Central America (Blumer-Thomas 1976), it was found that the difference between potential and actual linkages over a five-year period had not narrowed, indicating that government policy and the structure of protection were not conducive to expansion of supplying industries at the expense of imports. In such cases the only alternative would be to take policy measures that increase domestic demand for the products of these sectors.

A more fundamental set of objections to linkage analysis can be considered. Industrialization is not usually considered as an objective in itself, but as a proxy for the rise in real incomes that is supposed to accompany it. If, however, real income growth per capita is considered as the main objective, then each investment needs to be evaluated in terms of its direct and indirect effects on income rather than on output. Panchmukhi (1975) made clear that output increases do not necessarily lead to increases in income, and in fact, there is an inverse relationship between a sector's output and income multiplier effects. This suggests that the selection of key sectors by reference to their input and output linkage indices may not satisfy the income generation objective. It is also possible that the sectors with high backward linkages may have a high dependence on intermediate goods, which are typically capital-intensive. In that case, linkage analysis would suggest that priority be given to sectors that, directly or indirectly, are capital-intensive. This strategy would obviously not be suitable for developing countries with limited access to capital.

Finally, there is no consideration of efficiency or comparative costs in the selection of "key" sectors chosen with reference to linkage indices. This is particularly serious in cases where much of the potential stimulus provided by expansion of a key sector is translated into growth through a deliberate policy of import substitution. Linkage analysis does not permit a distinction between the cases where (1) the stimulus is large enough to justify establishing a supplying or using industry that is efficient; and (2) the stimulus is large enough to justify establishing a supplying or using industry that is not efficient. In the first case, government policy should ensure that the stimulus is translated into growth, while in the second, it should do so only if the subsidy needed to make the activity competitive is justified by other criteria.

Not all potential linkages can be translated into actual linkages. This suggests the need for a modified form of linkage analysis in which technological coefficients are appropriately adjusted, keeping in view the specific constraints in a country that tend to reduce the impact of growth stimuli. These constraints may be determined by

considerations such as market size, efficiency, comparative costs, and natural resources and would vary from country to country. The modified inducement stimuli, as measured by the backward or forward linkage analysis, would be a better guide to the selection of key sectors.

Although there are major theoretical and methodological obstacles posed by ex-ante linkage analysis, the same is not true of ex-post analysis in which actual, currently prevailing linkages are measured. Ex-post linkage analysis requires the use of domestic coefficients rather than technological coefficients. It is well established that the ranking of sectors in terms of ex-post and ex-ante measures can differ markedly (Blumer-Thomas 1976).

Ex-post linkage analysis measures the inducement that is offered to a sector or a group of sectors if final demand changes at the margin. It can, therefore, be used for a country at a point of time to see whether government policy is consistent with the ranking of sectors. It can also be used to isolate enclave sectors and to help promote policies for the integration of the enclave with the national economy. It can be used for a country over time to establish the change in sectoral interdependence and also for a series of countries at a given time to make international comparisons (Weisskoff 1971).

Following this critical examination of the usefulness of inducement analysis, an attempt is made below to measure the backward and forward linkages of various sectors and the changes in the Punjab economy between 1969/70 and 1979/80 by using the respective input-output tables identified at the beginning of the chapter. The specific technique used is the measurement of inducement effects by Rasmussen's method of linkage analysis.

A brief outline of the Rasmussen method of estimating linkage indices is given below. Given the Leontief inverse, the backward and forward linkages are measured by

$$U_j = \frac{1}{m} Z_j \div \frac{1}{m^2} \sum_{j=1}^{m} Z_j, \quad \text{and} \tag{1}$$

$$U_i = \frac{1}{m} Z_i \div \frac{1}{m^2} \sum_{i=1}^{m} Z_i, \tag{2}$$

where

m = number of industries;

$$Z_j = \sum_{i=1}^{m} Z_{ij}. \tag{3}$$

Given $Z = (I - A)^{-1}$, where

I = identity matrix of n dimension, and

$$A = \text{coefficient matrix} \begin{vmatrix} a_{11} \ldots a_{1i} \ldots a_{1n} \\ \vdots \\ a_{i1} \ldots a_{ii} \ldots a_{in} \\ \vdots \\ a_{n1} \ldots a_{ni} \ldots a_{nn} \end{vmatrix},$$

Z_{ij} is a typical element that shows the direct and indirect output of industry i required to meet the unit requirement of the final demand of industry j. Thus Z_j, the column total of the Leontief inverse, indicates the output requirements from the system of industries to cope with a unit increase in the final demand requirements of industry j.

Similarly, Z_i shows the row total of the Leontief inverse and indicates the output to be supplied by industry i to cope with a unit increase in the final demand for the product of each industry. It follows from the above that

$$\sum_{j=1}^{m} Z_j = \sum_{i=1}^{m} Z_i = \sum_{i=1}^{m} \sum_{j=1}^{m} Z_{ij}. \tag{4}$$

$U_j > 1$ means that industry j is heavily dependent for its inputs on the system of industries and vice versa in the case where $U_j < 1$. Similarly, $U_i > 1$ means that industry i generally will have to increase its output more than other industries for a given increase in demand and vice versa for $U_i < 1$.

Standard deviation coefficients, V_j and V_i, have also been computed for each of the linkage indices as suggested by Rasmussen:

$$V_j = \sqrt{\frac{1}{(m-1)} \sum_{i=1}^{m} \left\langle Z_{ij} - \frac{1}{m} \sum_{i=1}^{m} Z_{ij} \right\rangle^2 \div \frac{1}{m} \sum_{i=1}^{m} Z_{ij}}, \tag{5}$$

and

$$V_i = \sqrt{\frac{1}{(m-1)} \sum_{j=1}^{m} \left\langle Z_{ij} - \frac{1}{m} \sum_{j=1}^{m} Z_{ij} \right\rangle^2 \div \frac{1}{m} \sum_{j=1}^{m} Z_{ij}}. \tag{6}$$

V_j shows the extent of disparity that industry j exhibits while drawing its inputs from the system of industries, and V_i shows the extent of disparity that the system of industries displays while drawing its inputs from industry i. The smaller these indices, the more evenly distributed would be the spread effect of backward and forward linkages.

So far, only linkages based on the Z matrix have been considered, where

$$Z = (I-A)^{-1}. \tag{7}$$

These linkages, though suggestive of output expansion inducements provided by different industrial activities, may not correspond with other objectives of development such as income and employment generation. The linkage methodology, therefore, needs to be extended to capture income and employment effects. The extension procedures followed are quite straightforward. The relevant matrices are derived by weighing the output multiplier matrix by income or employment coefficients.

Consider the following equations:

$$Z = (I-A)^{-1}, \tag{8}$$

$$W = Q(I-A)^{-1}, \tag{9}$$

$$Y = V(I-A)^{-1}, \text{ and} \tag{10}$$

$$N = L(I-A)^{-1}, \tag{11}$$

where

Z = output multiplier matrix,
Q = diagonal matrix of sectoral wage-output ratio,
V = diagonal matrix of sectoral value added-output ratio, and
L = diagonal matrix of sectoral labor-output ratio.

Given W, Y, and N matrices, the U_i, U_j and V_i,V_j for each of the matrices can be computed.

So far, the measurement of linkage indices does not take into account the import leakages. Thus the indices given above provide an idea about the "potential" inducement effects of different industrial activities. To the extent that noncompetitive imports are exogenously determined in the input-output models, the inevitable leakages are already accounted for in the above exercises. It may be mentioned that actual linkages realized by a system of industries would differ from potential linkages where leakages due to competitive imports are taken into account. This has been done, and linkage indices have also been estimated after allowing for import leakages. A simple methodology is followed for allowing import leakages. Let us define

$$R = (I + \hat{b} - A)^{-1}, \tag{12}$$

where $\hat{b}$ = a diagonal matrix of import coefficients m_i, so that

$$m_i = M_i/X_i,$$

where M_i is imports into the ith sector and X_i is the output level of the ith sector.

It is apparent that, depending upon the propensity to import, equation (12) allows for the fact that some of the input requirements would be met through competitive imports. Given R matrix, W′, Y′, and N′ matrices can be estimated as follows:

$$W' = Q(I + \hat{b} - A)^{-1}, \tag{13}$$

$$Y' = V(I + \hat{b} - A)^{-1}, \text{ and} \tag{14}$$

$$N' = L(I + \hat{b} - A)^{-1}. \tag{15}$$

These matrices would now give employment and income effects after allowing for import leakages, and U_i, U_j and V_i, V_j for each of the above matrices can be similarly computed.

Estimates of Linkage Indices

Important changes took place in the structure of the Punjab economy between 1969/70 and 1979/80, as is shown by an analysis of the forward and backward linkages among various sectors in the Punjab economy derived from the detailed 1969/70 and 1979/80 input-output tables. The estimates of various linkage indices without import leakages and with import leakages are presented along with their ranks in Appendix 1, Tables 45 and 46, for the period 1969/70 and in Tables 47 and 48 for 1979/80. The detailed results, as given in these tables, have been summarized in Tables 30 and 31.

In 1969/70 not many sectors showed both high forward and high backward linkages on account of output, income, wages, and employment, with or without import leakages.

Table 30—Linkage analysis of Punjab's economy, without import leakages, 1969/70 and 1979/80

Linkage Effect	Z Matrix		W Matrix		Y Matrix		N Matrix	
	1969/70	1979/80	1969/70	1979/80	1969/70	1979/80	1969/70	1979/80
High forward linkages ($U_i>1$)	1,4,6,7, 8,16,19, 20,23,24, 34	1,4,7,8, 14,16,17, 18,19,20, 23,24,25, 34,36,38	1,3,4,5, 6,7,8,18, 23,28,29, 34,35	4,7,8,17, 18,19,25, 33,34,36, 37,38	1,2,3,4, 5,6,7,8, 20,23,28, 34	1,2,3,4, 5,6,7,8, 17,18,23, 33,34,36, 37,38	9,10,11, 12,16,17, 20,21,22, 24,34	1,2,3,4, 5,6,7,8, 17,18,19, 25,36,37
High backward linkages ($U_j>1$)	4,10,11, 12,13,14, 15,16,17, 23,24,25, 27,30,32, 33,35	9,10,11, 12,13,14, 15,16,17, 18,19,21, 22,23,24, 25,26,27, 28,29,30, 31,32,35	1,3,4,5, 6,7,8,11, 12,17,18, 23,28,29, 35	11,16,17, 18,19,28, 29,31,32, 33,35,36, 37,38	1,2,3,4, 5,6,7,8, 10,13,14, 16,17,28, 31,34	2,3,4,5, 6,7,8,9, 11,12,13, 14,17,18, 23,33,35, 36,37,38	9,10,11, 12,13,14, 16,17,20, 21,22,24, 27,30	2,3,4,5, 7,8,11, 12,13,16, 17,18,19, 29,32,37
High backward and forward linkages ($U_i + U_j>1$)	16,23,24	14,16,17, 18,19,23, 24,25	1,3,4,5, 6,7,8,18, 23,28,29, 35	17,18,19, 33,36,37, 38	1,2,3,4, 5,6,7,8, 28,34	2,3,4,5, 6,7,8,17, 18,23,33, 36,37,38	9,10,11, 12,16,17, 20,21,22, 24	2,3,4,5, 7,8,17, 18,19,37

Source: Derived from Tables 45-48, Appendix 1.

Note: Numbers correspond to sector ordering in the 1979/80 input-output table: 1. Wheat, 2. rice, 3. cotton, 4. sugarcane, 5. gram and pulses, 6. oilseeds, 7. other agriculture and forestry, 8. animal husbandry, 9. dairy products and confectionery, 10. grain mill products, 11. bakery products, 12. sugar, 13. other food industries, 14. edible oils, 15. breweries and beverages, 16. ginning and textiles, 17. sawmills and wooden goods, 18. paper, printing, and publishing, 19. rubber and leather products, 20. basic chemicals, including fertilizers, 21. drugs and pharmaceuticals, 22. other chemicals, 23. glass and mineral products, 24. basic metal industries, 25. metal products, 26. machinery, except electrical, 27. electrical machinery, 28. railroad equipment, 29. motor vehicles, manufacture and repair, 30. bicycles and parts, 31. scientific and surgical instruments, 32. sports and athletic goods, 33. miscellaneous industries, 34. electricity, gas, water supply, 35. construction, 36. trade, transport, storage, 37. other services, 38. banking and insurance, 39. real estate and ownership of dwellings.

Only the farm sectors, including animal husbandry, showed high forward and backward linkages on account of wage income and income inducements (W,Y). This was true whether or not allowance was made for import leakages. High forward and backward employment inducements were generated primarily by agroprocessing sectors both with and without import leakages. Very few sectors generated high forward and backward output inducements with or without imports.

In 1979/80 the farm sectors (sectors 1-8 in the input-output tables) continued to show high backward and forward linkages on account of income and employment inducements, with and without import leakages. This points out the important role that the agricultural sectors play in generating forward and backward income and employment linkages in Punjab.

In 1979/80, in addition to the farm sectors, many more sectors showed high forward and high backward linkages on account of output, income, wages, and employment, both without and with import leakages, than in 1969/70. This is explained by important structural changes that took place in the Punjab economy.

Table 31—Linkage analysis of Punjab's economy, with import leakages, 1969/70 and 1979/80

Linkage Effect	R Matrix		W′ Matrix		Y′ Matrix		N′ Matrix	
	1969/70	1979/80	1969/70	1979/80	1969/70	1979/80	1969/70	1979/80
High forward linkages ($U_i > 1$)	1,2,4,7, 8,16,19, 23,24,25, 30	1,2,3,4, 8,14,16, 17,19,23, 24,25,28, 30,34,36, 37,38	1,2,3,4, 5,6,7,8, 16,23,29, 34,35	1,2,3,4, 7,8,16, 17,25,28, 29,33,34, 35,36,37, 38	1,2,3,4, 5,6,7,8, 28,31,34	1,2,3,4, 6,7,8,28, 33,34,36, 37,38,39	9,10,16, 17,20,24, 27,30,34	1,2,3,4, 5,7,8,16, 17,25,29, 36,37,38
High backward linkages ($U_j > 1$)	1,2,4,5, 8,9,10, 13,14,16, 17,19,25, 27,29,30, 32,33,35	1,2,3,4, 8,10,13, 14,16,17, 23,24,25, 28,29,30, 32,35,36, 37,38	1,3,4,5, 7,8,10, 17,28,29, 31,32,33, 35	2,3,4,8, 16,17,25, 28,29,30, 32,33,35, 36,37,38	1,2,3,4, 5,7,8,10, 17,28,31, 34,35	1,2,3,4, 6,7,8,10, 16,28,29, 30,32,33, 34,35,36, 37,38,39	9,10,13, 14,16,17, 21,22,24, 27,29,30	1,2,3,4, 5,7,8,10, 11,13,16, 17,25,28, 29,30,32, 36,37
High backward and forward linkages ($U_i + U_j > 1$)	1,2,4,8, 16,19,25, 30	1,2,3,4, 8,14,16, 17,23,24, 25,28,30, 36,37,38	1,3,4,5, 7,29,35	2,3,4,8, 16,17,25, 28,29,33, 35,36,37, 38	1,2,3,4, 5,7,8,28, 31,34	1,2,3,4, 6,7,8,28, 33,34,36, 37,38,39	9,10,16, 17,24,27, 30	1,2,3,4, 5,7,8,16, 17,25,29, 36,37

Source: Derived from Tables 45-48, Appendix 1.

Note: Numbers correspond to sector ordering in the 1979/80 input-output table: 1. Wheat, 2. rice, 3. cotton, 4. sugarcane, 5. gram and pulses, 6. oilseeds, 7. other agriculture and forestry, 8. animal husbandry, 9. dairy products and confectionery, 10. grain mill products, 11. bakery products, 12. sugar, 13. other food industries, 14. edible oils, 15. breweries and beverages, 16. ginning and textiles, 17. sawmills and wooden goods, 18. paper, printing, and publishing, 19. rubber and leather products, 20. basic chemicals, including fertilizers, 21. drugs and pharmaceuticals, 22. other chemicals, 23. glass and mineral products, 24. basic metal industries, 25. metal products, 26. machinery, except electrical, 27. electrical machinery, 28. railroad equipment, 29. motor vehicles, manufacture and repair, 30. bicycles and parts, 31. scientific and surgical instruments, 32. sports and athletic goods, 33. miscellaneous industries, 34. electricity, gas, water supply, 35. construction, 36. trade, transport, storage, 37. other services, 38. banking and insurance, 39. real estate and ownership of dwellings.

The sectors that emerged in 1979/80 as important, with both high backward and high forward linkages on account of output, were edible oils, furniture and fixtures, and rubber and metal products without import leakages, and edible oils, furniture and fixtures, glass, basic metals, railroad equipment, trade, other services, and banking with import leakages. On the other hand, rubber, which fell in this category in 1969/70, no longer had these linkages in 1979/80.

Furniture, paper products, glass, miscellaneous industries and trade, other services, and banking were the new sectors that showed both high forward and high backward linkages on account of income without import leakages in 1979/80, while wheat, railroad equipment, and electricity, which fell in this category in 1969/70, were no longer in that group. In 1979/80, oilseeds, miscellaneous industries, trade and transport, other services, banking, and real estate were the new sectors with high forward and backward income linkages with import leakages. Similar results are obtained by examining the wage income and employment linkages.

Regarding high forward linkages, in 1969/70, irrespective of import leakage assumptions, wheat, sugarcane, other agriculture, and animal husbandry showed high forward linkage inducements on account of output, wage income, and income. There were few nonfarm activities in 1969/70 that had high patterns of forward linkage inducements. Only the forward linkage pattern of electricity showed high output, income, and wage income inducements with or without import leakages. Similarly, when linkages both with and without import leakages were considered, only the forward linkages of basic metal industries had high employment and output inducements. In 1979/80 the farm sectors, including animal husbandry, showed high forward linkages on all four accounts, namely, output, income, wages, and employment, both with and without import leakages. Among the nonagricultural sectors, trade, transport, and storage and services showed high forward linkages on account of employment, income, and wage income, irrespective of import leakages. Similarly, sawmills, metal alloys, trade, transport, and storage, and services had high forward employment and output inducements.

Not many sectors showed high forward linkages on various counts in both 1969/70 and 1979/80. Only electricity showed high forward linkages on output, wage income, and total income inducements in both periods, irrespective of import leakages.

High backward linkages in 1969/70 were also confined to a few sectors. When import leakages were allowed, most of the agricultural sectors, namely, wheat, maize, sugarcane, other agriculture, and animal husbandry, showed high backward linkages in terms of output, income, and wages, but only two sectors, grain mill products and furniture and fixtures, showed high backward linkages on all four counts (Z, W, Y, N in Tables 30 and 31). Without import leakages, only grain mill products, edible oils, other foods, and furniture and fixtures show high output, employment, and income inducements (Z, N, Y). In 1979/80 many farm sectors showed high backward linkages without import leakages on account of income and employment. However, only three sectors, bakery products, sawmills, and printing and publishing, showed strong backward linkages on all four counts (Z, W, Y, N) without import leakages. On the other hand, in 1979/80 many sectors—rice, cotton, sugarcane, animal husbandry, textiles, railroad equipment, motor vehicles, bicycles and parts, sports goods, trade, transport, and storage, and services—showed high backward linkages on all counts (Z, W, Y, N) with import leakages.

It is obvious that with the development that has taken place, the structure of the Punjab economy has undergone some important changes. In 1979/80 many new sectors showed high backward and high forward linkages, indicating that the economy had by then started functioning at a higher technological level than it had achieved earlier. It is significant that in 1979/80 the farm and agroprocessing sectors were the ones to show a high forward and backward linkage pattern on all counts when import leakages were taken into account. This underlines the importance of agriculture and agriculture-related activities in the state.

Also in 1979/80, in addition to the farm and agroprocessing sectors, many new manufacturing sectors such as metal and nonmetallic products, machine goods, and bicycles and parts generated high forward and backward output, income, wage income, and employment linkages, indicating a relative deepening of the industrial structure of the Punjab economy. In addition, trade and transport, other services, banking, and real estate showed a high degree of forward and backward linkages on account of output, income, wages, and employment. Most of the above services were kept outside the structural matrix in 1969/70. Nevertheless, it is clear that along with the primary sector and the agroprocessing, basic metals, and machine goods sectors, the tertiary sector played an important role in generating backward and forward linkages on account of output, income, wage incomes, and employment.

6

INCOME AND EMPLOYMENT MULTIPLIERS IN THE PUNJAB ECONOMY

In this chapter, input-output analysis is used to calculate direct and indirect sectoral income and employment generated in the economy as a result of increases in consumption, government expenditure, investment, or exports. This analysis can be used by planners to obtain an idea of the overall impact of their policy decisions regarding investment or other government expenditure on sectoral outputs, incomes, and employment.

The coefficient table in an input-output matrix gives the direct income and employment generated per unit of output in different sectors in the production process. However, because of interrelations among various sectors, any increase in final demand from a sector sets off a process of incremental production not only in that particular sector but also in many related sectors. This is because a unit of final demand from a sector can be satisfied only by producing, in the first instance, at least one extra unit of output in that sector. However, the production of an extra unit of output requires certain direct intermediate inputs. These inputs themselves have to be produced by the respective sectors by using inputs from various other sectors. In the same way, the second round inputs and then the third round inputs must be produced, and so on.

Whereas the direct income and employment per unit of output in a sector are dependent on degrees of capital and labor intensity in its production process, its indirect output requirements from various sectors are determined by the density of its input structure. In a developing economy, because of lack of modernization and use of limited intermediate inputs, the indirect effects are rather small, even though relatively high direct income and employment per unit of output are generated in the agricultural sectors. On the other hand, the manufacturing sectors, which are characterized by the use of relatively higher intermediate inputs, generate higher indirect output, though in their case direct income and employment per unit of output are generally relatively much lower. Thus there is no necessary correspondence between direct income and indirect income gains for various sectors.

In order to obtain a comprehensive picture, the relative contribution of any sector to the economy ought to be considered by taking into account not only the direct income and employment per unit of the sector's output but also the indirect income and employment generated by the sector in the production process. The Leontief inverse, premultiplied by the income and employment coefficients, is especially suited to capturing the total direct and indirect income and employment effect of a unit increase in final demand from any sector. The direct and indirect sectoral income and employment associated with the unit of final demand can be converted to those of a unit of output from the respective sectors to make them comparable with the direct income and employment per unit of output generated in each sector. For more meaningful comparisons between sectors, direct and indirect income and employment can be standardized and sectoral multipliers calculated by dividing the direct and indirect values by their respective direct income and employment.

It should, however, be noted that income and employment sectoral multipliers calculated by using the unadjusted Leontief inverse can be misleading, as import leakages are not taken into account. But it is possible to overcome this limitation through a

modification of the Leontief inverse where import coefficients are introduced within the structural matrix. The values of indirect income and employment are considerably reduced once this adjustment is made. The higher the imports by a particular sector and the higher the import content of its various inputs, the higher the extent of reduction in the indirect income generated by it.[11] (See Appendix 3 for a discussion of the methodology.)

The above methodology does not take into account rather large interindustry effects that are generated by consumption, which is a major activity in all developing economies. As an economic activity, consumption leads to increased incomes, which in turn set in motion a chain of interindustry reactions that further increase output, income, and employment and bring about a still further increase in household consumption, and so on. It is possible to capture the induced effects of consumption through an input-output table by closing the structural matrix with respect to consumption.

In the next section an attempt is made to calculate for 1979/80 the direct and indirect income generated in each sector and the direct and indirect sectoral income multipliers per unit of output after taking into account import leakages. This is followed by a calculation of direct, indirect, and induced income effects and multipliers after including consumption in the structural matrix. Similar exercises have been done for workers employed and wage incomes. Since these multipliers were also calculated in 1969/70, any changes that took place between 1969/70 and 1979/80 in the ranking of different sectors in terms of the value of different types of multipliers are also discussed.

Direct and Indirect Income Multipliers with Import Leakages

Because of the introduction of new technology and the use of much higher levels of intermediate inputs, the net value added per unit of output in the main agricultural sectors was considerably lower in 1979/80 than in 1969/70. Nevertheless, in both 1969/70 and 1979/80 direct income (net value added) generated per unit of output in Punjab was relatively much higher in the agricultural sectors and in animal husbandry. The range in 1979/80 was from 55.7 percent of the value of output in wheat to 83.1 percent in agriculture and forestry. On the other hand, net value added per unit of output in the industrial sectors was 8.4 percent of the value of output for grain mill products, 68.9 percent for miscellaneous industries,[12] and 43.3 percent for railroad equipment. In the electricity sector, value added constituted 57.1 percent of value of output in 1979/80 compared with 87.0 percent in 1969/70. In the tertiary sector also, value added as a proportion of value of output is quite high.

To standardize direct and indirect incomes and make them comparable, sectoral multipliers have been calculated by dividing the direct and indirect values by their respective direct income. As expected, the industrial sectors, in general, and more capital-intensive sectors with fewer direct and indirect imports, in particular, record much larger income gains than the agricultural sectors. In 1969/70, the highest values of income multipliers per unit of output were obtained in the agroprocessing industries

[11] As in Chapter 5, import coefficient b_i is defined here as M_i divided by X_i, that is, imports into ith sector divided by its output.

[12] Since the vector for miscellaneous industries has been constructed by aggregating numerous industries not included in the other sectors, the net value added of 0.6894 per unit of output in this case should be treated with due caution.

such as grain mill products, dairying, and cotton ginning. The other sectors, which were far behind but recorded relatively large multiplier values, were sugar and confectionery, edible oils, and sawmilling. The multiplier values were relatively much smaller for other sectors than for the agroprocessing industries (Table 32).

In 1979/80 also, the highest multipliers were obtained by the agroprocessing industries, with slightly different ranking. For example, while grain mill products ranks highest, it is followed by edible oils and sugar and, at some distance, by breweries and beverages. But it is noteworthy that industries such as chemicals, basic metals, drugs

Table 32—Direct and indirect sectoral income and multipliers in Punjab, with import leakages, 1969/70

Sector Number	Sector	Net Value Added per Unit of Output	Income Multipliers per Unit of Final Demand	Income Multipliers per Unit of Output	Indirect Income per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.777	1.15	1.11	0.09
2	Rice	0.740	1.14	1.10	0.08
3	Maize	0.751	1.14	1.13	0.09
4	Cotton	0.691	1.08	1.10	0.07
5	Sugarcane	0.674	1.31	1.18	0.12
6	Gram and pulses	0.731	1.15	1.15	0.11
7	Oilseeds	0.704	0.54	1.18	0.12
8	Bajra	0.749	1.19	1.17	0.13
9	Other agriculture and forestry	0.812	0.86	1.11	0.09
10	Animal husbandry	0.789	1.11	1.10	0.08
11	Dairy products	0.053	8.20	7.61	0.35
12	Grain mill products	0.085	9.56	9.50	0.72
13	Sugar and confectionery	0.129	1.65	3.88	0.37
14	Edible oils and other food-processing industries	0.147	2.53	2.70	0.25
15	Breweries and beverages	0.143	0.31	1.72	0.10
16	Textiles	0.244	1.60	1.15	0.04
17	Cotton ginning, pressing, and other textiles	0.047	6.73	6.90	0.28
18	Sawmills and wooden containers	0.274	2.52	2.48	0.41
19	Furniture and fixtures	0.338	1.80	1.79	0.27
20	Printing and publishing	0.366	0.68	1.17	0.06
21	Rubber and leather products	0.285	1.20	1.23	0.07
22	Basic chemicals, including fertilzers	0.412	0.92	1.40	0.17
23	Other chemicals	0.194	0.47	1.45	0.09
24	Glass and mineral products	0.269	1.13	1.04	0.01
25	Basic metal industries	0.132	0.79	1.11	0.02
26	Metal products	0.272	1.19	1.17	0.05
27	Machinery, except electrical	0.302	0.88	1.15	0.05
28	Electrical machinery	0.198	1.23	1.37	0.07
29	Railroad equipment	0.713	1.04	1.04	0.03
30	Transport equipment	0.308	1.04	1.02	0.06
31	Repair of transport equipment	0.403	1.58	1.58	0.23
32	Motorcycles and bicycles	0.251	1.42	1.20	0.05
33	Scientific and surgical instruments	0.615	1.04	1.04	0.02
34	Miscellaneous industries	0.276	1.56	1.57	0.16
35	Construction	0.394	1.34	1.34	0.13
36	Electricity	0.871	1.05	1.00	0.00

Source: Based on authors' calculations from Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

and pharmaceuticals, sports goods, and construction have also become important and have recorded a high value of multipliers. In terms of indirect income, though agroprocessing industries generate the highest income, the contribution of other industries and sectors such as other chemicals, construction, sports goods, and drugs and pharmaceuticals is also quite high (Table 33).

Table 33—Direct and indirect sectoral income and multipliers in Punjab, with import leakages, 1979/80

Sector Number	Sector	Net Value Added per Unit of Output	Income Multipliers per Unit of Final Demand	Income Multipliers per Unit of Output	Indirect Income per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.557	1.18	1.14	0.08
2	Rice	0.689	1.07	1.08	0.06
3	Cotton	0.716	0.99	1.09	0.06
4	Sugarcane	0.799	1.05	1.06	0.05
5	Gram and pulses	0.762	0.57	1.07	0.05
6	Oilseeds	0.808	0.65	1.07	0.06
7	Other agriculture and forestry	0.831	0.73	1.02	0.02
8	Animal husbandry	0.702	1.20	1.22	0.16
9	Dairy products and confectionery	0.231	1.18	2.71	0.40
10	Grain mill products	0.084	6.14	7.74	0.56
11	Bakery products	0.340	0.97	1.91	0.31
12	Sugar	0.175	1.10	4.33	0.58
13	Other food industries	0.274	1.62	2.48	0.41
14	Edible oils	0.075	4.23	4.52	0.26
15	Breweries and beverages	0.166	1.71	2.78	0.30
16	Ginning and textiles	0.181	2.68	1.80	0.14
17	Sawmills and wooden goods	0.389	1.11	1.27	0.10
18	Paper, printing, and publishing	0.353	0.27	1.35	0.13
19	Rubber and leather products	0.262	1.10	1.59	0.16
20	Basic chemicals, including fertilizers	0.249	0.53	1.46	0.11
21	Drugs and pharmaceuticals	0.171	0.05	2.32	0.23
22	Other chemicals	0.154	0.13	2.78	0.28
23	Glass and mineral products	0.377	1.19	1.23	0.09
24	Basic metal industries	0.091	2.00	2.59	0.14
25	Metal products	0.203	1.87	1.81	0.16
26	Machinery, except electrical	0.215	0.88	1.82	0.18
27	Electrical machinery	0.210	0.92	1.86	0.18
28	Railroad equipment	0.433	1.41	1.32	0.14
29	Motor vehicles, manufacture and repair	0.372	1.28	1.39	0.14
30	Bicycles and parts	0.314	1.65	1.63	0.20
31	Scientific and surgical instruments	0.288	0.37	1.58	0.17
32	Sports and athletic goods	0.247	1.97	1.99	0.24
33	Miscellaneous industries	0.689	0.79	1.13	0.09
34	Electricity, gas, and water supply	0.571	0.92	1.03	0.02
35	Construction	0.349	2.04	2.04	0.36
36	Trade, transport, and storage	0.625	1.29	1.14	0.09
37	Other services	0.537	1.37	1.28	0.15
38	Banking and insurance	0.824	1.14	1.05	0.04
39	Real estate and ownership of dwellings	0.655	1.01	1.01	0.00

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).

Direct, Indirect, and Induced Income Multipliers

As noted earlier, the introduction of consumption in the structural matrix captures the induced effects of consumption activity along with that of indirect income. The results indicate that the built-in consumption-induced effects bring about substantially higher values for direct, indirect, and induced income and their multipliers. In 1969/70 the ranking of various sectors in terms of direct, indirect, and induced income multipliers per unit of output was grain mill products, dairy products, cotton ginning, sugar, edible oils, and sawmills (Table 34).

Table 34—Direct, indirect, and induced sectoral income and multipliers in Punjab, with import leakages, 1969/70

Sector Number	Sector	Net Value Added per Unit of Output	Income Multipliers per Unit of Final Demand	Income Multipliers per Unit of Output	Indirect and Induced Income per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.777	2.13	1.62	0.48
2	Rice	0.740	2.13	2.03	0.76
3	Maize	0.751	2.13	2.04	0.78
4	Cotton	0.691	2.00	2.04	0.72
5	Sugarcane	0.674	2.43	2.13	0.76
6	Gram and pulses	0.731	2.15	2.09	0.80
7	Oilseeds	0.704	1.00	2.17	0.82
8	Bajra	0.749	2.21	2.18	0.88
9	Other agriculture and forestry	0.812	1.60	1.87	0.71
10	Animal husbandry	0.789	2.06	1.48	0.38
11	Dairy products	0.053	15.25	14.15	0.70
12	Grain mill products	0.085	17.78	16.56	1.33
13	Sugar and confectionery	0.129	3.06	7.16	0.80
14	Edible oils and other food-processing industries	0.147	4.70	4.95	0.59
15	Breweries and beverages	0.143	0.58	3.19	0.31
16	Textiles	0.244	2.98	2.07	0.26
17	Cotton ginning, pressing, and other textiles	0.047	12.52	12.73	0.56
18	Sawmills and wooden containers	0.274	4.69	4.61	0.99
19	Furniture and fixtures	0.338	3.35	3.34	0.79
20	Printing and publishing	0.366	1.27	2.17	0.43
21	Rubber and leather products	0.285	2.23	2.27	0.36
22	Basic chemicals, including fertilizers	0.412	1.71	2.58	0.65
23	Other chemicals	0.194	0.87	2.68	0.33
24	Glass and mineral products	0.269	2.09	1.92	0.25
25	Basic metal industries	0.132	1.47	2.07	0.14
26	Metal products	0.272	2.21	2.18	0.32
27	Machinery, except electrical	0.302	1.63	2.15	0.35
28	Electrical machinery	0.198	2.30	2.54	0.31
29	Railroad equipment	0.713	1.93	1.93	0.67
30	Transport equipment	0.308	1.14	1.12	0.37
31	Repair of transport equipment	0.403	2.53	2.53	0.62
32	Motorcycles and bicycles	0.251	2.64	2.22	0.31
33	Scientific and surgical instruments	0.615	1.94	1.93	0.57
34	Miscellaneous industries	0.276	2.91	2.91	0.53
35	Construction	0.394	2.49	2.49	0.59
36	Electricity	0.871	1.95	1.84	0.73

Source: Based on authors' calculations from Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

The agroprocessing industries again recorded the highest value of multipliers in 1979/80, with grain mill products ranking first, then edible oils, sugar, and breweries and beverages. Other agroprocessing industries that had a high value of multipliers are other foods, dairy products, and cotton ginning and textiles. However, as in the case of direct and indirect income multipliers, other chemicals, drugs and pharmaceuticals, basic metals, sports goods, electrical and nonelectrical machinery, bicycles, surgical instruments, and construction also ranked fairly high in direct, indirect, and induced income multipliers (Table 35).

Table 35—Direct, indirect, and induced sectoral income and multipliers in Punjab, with import leakages, 1979/80

Sector Number	Sector	Net Value Added per Unit of Output	Income Multipliers per Unit of Final Demand	Income Multipliers per Unit of Output	Indirect and Induced Income per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.557	1.90	1.71	0.39
2	Rice	0.689	1.73	1.72	0.50
3	Cotton	0.716	1.60	1.74	0.53
4	Sugarcane	0.799	1.70	1.69	0.55
5	Gram and pulses	0.762	0.93	1.70	0.54
6	Oilseeds	0.808	1.05	1.72	0.59
7	Other agriculture and forestry	0.831	1.18	1.54	0.44
8	Animal husbandry	0.702	1.94	1.71	0.50
9	Dairy products and confectionery	0.231	1.50	4.33	0.77
10	Grain mill products	0.084	9.93	12.02	0.92
11	Bakery products	0.340	1.56	3.08	0.71
12	Sugar	0.175	1.77	6.97	1.04
13	Other food industries	0.274	2.62	3.98	0.82
14	Edible oils	0.075	6.84	7.21	0.46
15	Breweries and beverages	0.166	2.76	4.47	0.58
16	Ginning and textiles	0.181	4.33	2.79	0.32
17	Sawmills and wooden goods	0.389	1.80	2.05	0.41
18	Paper, printing, and publishing	0.353	0.44	2.19	0.42
19	Rubber and leather products	0.262	1.78	2.56	0.41
20	Basic chemicals, including fertilizers	0.249	0.86	2.35	0.34
21	Drugs and pharmaceuticals	0.171	0.08	3.75	0.47
22	Other chemicals	0.154	0.21	4.49	0.54
23	Glass and mineral products	0.377	1.92	1.99	0.37
24	Basic metal industries	0.091	3.23	4.18	0.29
25	Metal products	0.203	3.03	2.91	0.39
26	Machinery, except electrical	0.215	1.42	2.94	0.42
27	Electrical machinery	0.210	1.49	3.00	0.42
28	Railroad equipment	0.433	2.28	2.13	0.49
29	Motor vehicles, manufacture and repair	0.372	2.07	2.24	0.46
30	Bicycles and parts	0.314	2.67	2.63	0.51
31	Scientific and surgical instruments	0.288	0.60	2.55	0.45
32	Sports and athletic goods	0.247	3.19	3.21	0.55
33	Miscellaneous industries	0.689	1.27	1.83	0.57
34	Electricity, gas, and water supply	0.571	1.50	1.64	0.36
35	Construction	0.349	3.30	3.30	0.81
36	Trade, transport, and storage	0.625	2.09	1.59	0.37
37	Other services	0.537	2.21	2.00	0.54
38	Banking and insurance	0.824	1.84	1.67	0.55
39	Real estate and ownership of dwellings	0.655	1.63	1.60	0.39

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).

In 1969/70 it was discovered that induced income gains were unevenly distributed among the various sectors, and substantial induced income gains were recorded only by those sectors that were relatively more important in the consumption basket. These were grain mill products, sawmills, ginning, *bajra,* and oilseeds.

The consumption-oriented sectors also showed high indirect and induced income gains in 1979/80. The ranking of various sectors in terms of induced income gains was sugar, grain mill products, other food industries, dairy products, and bakery products. Induced income gains in construction were also quite high and considerable induced incomes were generated by trade and transport, other services, banking and insurance, and real estate.

Direct and Indirect Employment Multipliers

In 1969/70 direct employment in terms of both workers and person-hours was highest in the agricultural sectors, ranging from 0.135 workers per Rs 1,000 of output in rice to 0.571 workers in cotton. In the industrial sectors, the employment intensity was much lower and ranged from 0.006 workers per Rs 1,000 of output in dairy products to 0.157 workers in printing and publishing (Table 36).

In 1979/80 also, the highest direct employment was generated in the agricultural sectors, although its intensity was relatively much lower, varying between 0.055 workers per Rs 1,000 of output in oilseeds to 0.108 workers in rice. The manufacturing sectors again recorded a much lower employment intensity, ranging from 0.007 workers per Rs 1,000 of output in edible oils to 0.076 workers in printing and publishing. As expected, services are highly labor-intensive (Table 37).

In 1969/70 the highest values of employment multipliers per unit of output were in the agroprocessing industries such as dairy products, followed by grain mill products, cotton ginning, sugar and confectionery, edible oils, and sawmills.

The agroprocessing industries also generated the highest employment multipliers in 1979/80, although the ranking was slightly different. The first position in terms of employment multipliers was once again occupied by dairy products, followed by grain mill products, edible oils, breweries, and sugar. Besides the agroprocessing industries, other sectors that had high employment multipliers were construction, basic metals, basic chemicals, and other chemicals.

Direct, Indirect, and Induced Employment Multipliers

The introduction of consumption into the structural matrix resulted in a significant increase in the value of multipliers, particularly in sectors that are important in the consumption basket. In 1969/70 dairy products ranked highest in terms of direct, indirect, and induced employment multipliers, followed by grain mill products, basic chemicals, cotton ginning, sugar, edible oils, sawmills, other chemicals, and electrical machinery (Table 38).

In 1979/80 dairy products again recorded the highest rank in terms of the direct, indirect, and induced employment multipliers. Next came miscellaneous industries, grain mill products, basic chemicals, breweries, edible oils, and construction. The ranking in terms of indirect- and induced-employment gains is also similar to that of 1969/70 (Table 39).

Table 36—Direct and indirect sectoral employment and multipliers in Punjab, with import leakages, 1969/70

Sector Number	Sector	Workers per 1,000 Units of Output	Employment Multipliers per Unit of Final Demand	Employment Multipliers per Unit of Output	Indirect Employment per Unit of Output
		(persons/ Rs 1,000)			(persons/ Rs 1,000)
1	Wheat	0.146	1.16	1.13	0.02
2	Rice	0.135	1.15	1.11	0.01
3	Maize	0.214	1.12	1.10	0.02
4	Cotton	0.571	1.01	1.03	0.02
5	Sugarcane	0.317	1.21	1.10	0.03
6	Gram and pulses	0.181	1.16	1.16	0.03
7	Oilseeds	0.289	0.50	1.10	0.03
8	Bajra	0.284	1.13	1.12	0.03
9	Other agriculture and forestry	0.303	0.83	1.07	0.02
10	Animal husbandry	0.205	1.13	1.13	0.03
11	Dairy products	0.006	16.93	15.72	0.10
12	Grain mill products	0.014	12.10	12.02	0.15
13	Sugar and confectionery	0.043	2.02	4.75	0.16
14	Edible oils and other food-processing industries	0.041	3.03	3.23	0.09
15	Breweries and beverages	0.076	0.28	1.51	0.04
16	Textiles	0.068	1.57	1.13	0.01
17	Cotton ginning, pressing, and other textiles	0.019	6.43	6.60	0.11
18	Sawmills and wooden containers	0.076	2.94	2.88	0.14
19	Furniture and fixtures	0.120	1.78	1.77	0.09
20	Printing and publishing	0.157	0.60	1.03	0.01
21	Rubber and leather products	0.120	1.07	1.09	0.01
22	Basic chemicals, including fertilizers	0.013	1.35	2.06	0.01
23	Other chemicals	0.029	0.44	1.37	0.01
24	Glass and mineral products	0.123	1.09	1.01	0.00
25	Basic metal industries	0.029	0.74	1.04	0.00
26	Metal products	0.089	1.10	1.09	0.01
27	Machinery, except electrical	0.066	0.88	1.15	0.01
28	Electrical machinery	0.037	1.29	1.42	0.02
29	Railroad equipment	0.107	1.03	1.03	0.00
30	Transport equipment	0.050	1.32	1.30	0.02
31	Repair of transport equipment	0.136	1.06	1.06	0.01
32	Motorcycles and bicycles	0.041	1.52	1.28	0.01
33	Scientific and surgical instruments	0.130	1.06	1.05	0.01
34	Miscellaneous industries	0.091	1.50	1.50	0.05
35	Construction	0.121	1.44	1.44	0.05
36	Electricity	0.054	1.05	1.00	0.00

Source: Based on authors' calculations from Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

Direct and Indirect Wage Income and Multipliers

As noted earlier, the service sectors had not been included in the 1969/70 input-output table. Of the included sectors, most of the agricultural sectors had a relatively higher direct wage income per unit of output than the manufacturing sectors. On the other hand, the highest indirect wage income gains were in the industrial sectors, in general, and the agriculture-based industries, in particular. In terms of indirect wage accrual, the highest wage income gains were recorded by agroprocessing industries such as sugar and confectionery, grain mill products, sawmills, cotton ginning, dairying,

Table 37—Direct and indirect sectoral employment and multipliers in Punjab, with import leakages, 1979/80

Sector Number	Sector	Workers per 1,000 Units of Output	Employment Multipliers per Unit of Final Demand	Employment Multipliers per Unit of Output	Indirect Employment per Unit of Output
		(persons/ Rs 1,000)			(persons/ Rs 1,000)
1	Wheat	0.056	1.14	1.11	0.01
2	Rice	0.108	1.02	1.04	0.00
3	Cotton	0.102	0.96	1.06	0.01
4	Sugarcane	0.086	1.05	1.06	0.01
5	Gram and pulses	0.104	0.57	1.06	0.01
6	Oilseeds	0.055	0.68	1.13	0.01
7	Other agriculture and forestry	0.104	0.73	1.02	0.00
8	Animal husbandry	0.104	1.15	1.17	0.02
9	Dairy products and confectionery	0.008	3.26	7.51	0.05
10	Grain mill products	0.013	4.16	5.25	0.05
11	Bakery products	0.073	0.73	1.43	0.03
12	Sugar	0.023	0.91	3.61	0.06
13	Other food industries	0.033	1.55	2.38	0.05
14	Edible oils	0.007	3.56	3.81	0.02
15	Breweries and beverages	0.009	2.25	3.65	0.02
16	Ginning and textiles	0.024	2.52	1.69	0.02
17	Sawmills and wooden goods	0.076	0.99	1.12	0.01
18	Paper, printing, and publishing	0.076	0.23	1.16	0.01
19	Rubber and leather products	0.043	0.95	1.37	0.02
20	Basic chemicals, including fertilizers	0.005	0.88	2.43	0.01
21	Drugs and pharmaceuticals	0.026	0.04	1.75	0.02
22	Other chemicals	0.021	0.11	2.25	0.03
23	Glass and mineral products	0.029	1.18	1.22	0.01
24	Basic metal industries	0.009	1.96	2.54	0.01
25	Metal products	0.038	1.38	1.33	0.01
26	Machinery, except electrical	0.024	0.79	1.64	0.02
27	Electrical machinery	0.015	1.00	2.02	0.02
28	Railroad equipment	0.036	1.44	1.35	0.01
29	Motor vehicles, manufacture and repair	0.066	1.08	1.18	0.01
30	Bicycles and parts	0.028	1.71	1.68	0.02
31	Scientific and surgical instruments	0.040	0.32	1.35	0.01
32	Sports and athletic goods	0.043	1.64	1.65	0.03
33	Miscellaneous industries	0.008	1.56	2.25	0.01
34	Electricity, gas, and water supply	0.026	0.93	1.04	0.00
35	Construction	0.015	2.96	2.96	0.03
36	Trade, transport, and storage	0.040	1.45	1.28	0.01
37	Other services	0.094	1.21	1.13	0.01
38	Banking and insurance	0.036	1.21	1.11	0.00
39	Real estate and ownership of dwellings	0.031	1.02	1.02	0.01

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).

and edible oils, in that order. The value of wage income multipliers was also the highest for dairy products, followed by grain mill products, cotton ginning, sugar, and edible oils (Table 40).

In 1979/80 the highest direct wage income per unit of output was found in the tertiary sector. This was followed by construction, a few manufacturing sectors, and most of the agricultural sectors. With a few exceptions, compared with the agricultural sectors, most of the manufacturing sectors had a lower direct wage income per unit of output. On the other hand, as in 1969/70, it is the manufacturing sectors that

Table 38—Direct, indirect, and induced sectoral employment and multipliers in Punjab, with import leakages, 1969/70

Sector Number	Sector	Workers per 1,000 Units of Output	Employment Multipliers per Unit of Final Demand	Employment Multipliers per Unit of Output	Indirect and Induced Employment per 1,000 Units of Output
		(persons/ Rs 1,000)			(persons/ Rs 1,000)
1	Wheat	0.146	2.50	1.91	0.13
2	Rice	0.135	2.53	2.41	0.19
3	Maize	0.214	2.00	1.92	0.20
4	Cotton	0.571	1.29	1.32	0.18
5	Sugarcane	0.317	1.83	1.60	0.19
6	Gram and pulses	0.181	2.19	2.14	0.21
7	Oilseeds	0.289	0.79	1.72	0.21
8	Bajra	0.284	1.82	1.80	0.23
9	Other agriculture and forestry	0.303	1.34	1.57	0.17
10	Animal husbandry	0.205	2.07	1.49	0.10
11	Dairy products	0.006	31.78	29.50	0.18
12	Grain mill products	0.014	25.21	23.49	0.31
13	Sugar and confectionery	0.043	3.13	7.31	0.27
14	Edible oils and other food-processing industries	0.041	5.04	5.30	0.18
15	Breweries and beverages	0.076	0.41	2.22	0.09
16	Textiles	0.068	2.83	1.97	0.07
17	Cotton ginning, pressing, and other textiles	0.019	10.14	10.32	0.18
18	Sawmills and wooden containers	0.076	4.94	4.85	0.29
19	Furniture and fixtures	0.120	2.90	2.89	0.23
20	Printing and publishing	0.157	0.96	1.63	0.10
21	Rubber and leather products	0.120	1.70	1.73	0.09
22	Basic chemicals, including fertilizers	0.013	7.75	11.70	0.14
23	Other chemicals	0.029	1.14	3.50	0.07
24	Glass and mineral products	0.123	1.64	1.50	0.06
25	Basic metal industries	0.029	1.55	2.18	0.03
26	Metal products	0.089	1.90	1.88	0.08
27	Machinery, except electrical	0.066	1.77	2.33	0.09
28	Electrical machinery	0.037	2.73	3.02	0.08
29	Railroad equipment	0.107	2.56	2.56	0.17
30	Transport equipment	0.050	2.95	2.90	0.10
31	Repair of transport equipment	0.136	1.79	1.79	0.11
32	Motorcycles and bicycles	0.041	3.43	2.88	0.08
33	Scientific and surgical instruments	0.130	2.15	2.14	0.15
34	Miscellaneous industries	0.091	2.54	2.53	0.14
35	Construction	0.121	2.41	2.41	0.17
36	Electricity	0.054	4.79	4.51	0.19

Source: Based on authors' calculations from Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

recorded relatively much higher indirect wage income gains. Within the manufacturing sector the highest wage income gains were in grain mill products, followed by dairy products, sugar, other foods, and breweries.

Another sector that had high wage income gains is construction. In terms of the value of wage income multipliers, the ranking is breweries, dairy products, grain mill products, and edible oils among the agroprocessing industries, and basic metals, sugar, electrical machinery, other chemicals, other food industries, bicycles, and drugs and pharmaceuticals (Table 41).

Table 39—Direct, indirect, and induced sectoral employment and multipliers in Punjab, with import leakages, 1979/80

Sector Number	Sector	Workers per 1,000 Units of Output	Employment Multipliers per Unit of Final Demand	Employment Multipliers per Unit of Output	Indirect and Induced Employment per 1,000 Units of Output
		(persons/ Rs 1,000)			(persons/ Rs 1,000)
1	Wheat	0.056	1.92	1.72	0.04
2	Rice	0.108	1.48	1.48	0.05
3	Cotton	0.102	1.42	1.55	0.06
4	Sugarcane	0.086	1.70	1.69	0.06
5	Gram and pulses	0.104	0.85	1.57	0.06
6	Oilseeds	0.055	1.32	2.17	0.06
7	Other agriculture and forestry	0.104	1.11	1.45	0.05
8	Animal husbandry	0.104	1.69	1.49	0.05
9	Dairy products and confectionery	0.008	5.60	12.76	0.09
10	Grain mill products	0.013	6.85	8.29	0.09
11	Bakery products	0.073	1.03	2.02	0.07
12	Sugar	0.023	1.46	5.75	0.11
13	Other food industries	0.033	2.44	3.72	0.09
14	Edible oils	0.007	6.41	6.75	0.04
15	Breweries and beverages	0.009	4.42	7.14	0.05
16	Ginning and textiles	0.024	3.84	2.47	0.04
17	Sawmills and wooden goods	0.076	1.37	1.55	0.04
18	Paper, printing, and publishing	0.076	0.32	1.57	0.04
19	Rubber and leather products	0.043	1.40	2.01	0.04
20	Basic chemicals, including fertilizers	0.005	2.81	7.70	0.03
21	Drugs and pharmaceuticals	0.026	0.06	2.75	0.05
22	Other chemicals	0.021	0.17	3.62	0.05
23	Glass and mineral products	0.029	2.21	2.30	0.04
24	Basic metal industries	0.009	3.37	4.36	0.03
25	Metal products	0.038	2.05	1.97	0.04
26	Machinery, except electrical	0.024	1.32	2.73	0.04
27	Electrical machinery	0.015	1.85	3.74	0.04
28	Railroad equipment	0.036	2.56	2.40	0.05
29	Motor vehicles, manufacture and repair	0.066	1.56	1.70	0.05
30	Bicycles and parts	0.028	2.93	2.89	0.05
31	Scientific and surgical instruments	0.040	0.50	2.11	0.04
32	Sports and athletic goods	0.043	2.40	2.42	0.06
33	Miscellaneous industries	0.008	5.85	8.40	0.06
34	Electricity, gas, and water supply	0.026	2.30	2.52	0.04
35	Construction	0.015	6.20	6.20	0.08
36	Trade, transport, and storage	0.040	2.82	2.14	0.05
37	Other services	0.094	1.73	1.56	0.05
38	Banking and insurance	0.036	2.97	2.69	0.06
39	Real estate and ownership of dwellings	0.031	2.42	2.37	0.04

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).

Direct, Indirect, and Induced Wage Income and Multipliers

With the introduction of consumption into the structural matrix, the direct, indirect, and induced wage income multipliers recorded very high values, particularly for many of the agroprocessing industries, which are consumption-oriented. In 1969/70, the highest values for direct, indirect, and induced wage income multipliers were for grain

Table 40—Direct and indirect sectoral wage incomes and multipliers in Punjab, with import leakages, 1969/70

Sector Number	Sector	Wages per Unit of Output	Wage Multipliers per Unit of Final Demand	Wage Multipliers per Unit of Output	Indirect Wages per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.217	1.16	1.13	0.02
2	Rice	0.265	1.15	1.11	0.01
3	Maize	0.299	1.12	1.10	0.02
4	Cotton	0.266	1.01	1.03	0.02
5	Sugarcane	0.289	1.21	1.10	0.03
6	Gram and pulses	0.213	1.16	1.16	0.03
7	Oilseeds	0.213	0.50	1.10	0.03
8	Bajra	0.208	1.13	1.12	0.03
9	Other agriculture and forestry	0.285	0.83	1.07	0.02
10	Animal husbandry	0.245	1.13	1.13	0.03
11	Dairy products	0.018	16.93	15.72	0.10
12	Grain mill products	0.015	12.10	12.02	0.15
13	Sugar and confectionery	0.068	2.02	4.75	0.16
14	Edible oils and other food-processing industries	0.036	3.03	3.23	0.09
15	Breweries and beverages	0.063	0.28	1.51	0.04
16	Textiles	0.111	1.57	1.13	0.01
17	Cotton ginning, pressing, and other textiles	0.020	6.43	6.60	0.11
18	Sawmills and wooden containers	0.107	2.94	2.88	0.14
19	Furniture and fixtures	0.135	1.78	1.77	0.09
20	Printing and publishing	0.238	0.60	1.03	0.01
21	Rubber and leather products	0.104	1.07	1.09	0.01
22	Basic chemicals, including fertilizers	0.046	1.35	2.06	0.01
23	Other chemicals	0.035	0.44	1.37	0.01
24	Glass and mineral products	0.126	1.09	1.01	0.00
25	Basic metal industries	0.063	0.74	1.04	0.00
26	Metal products	0.118	1.10	1.09	0.01
27	Machinery, except electrical	0.113	0.88	1.15	0.01
28	Electrical machinery	0.061	1.29	1.42	0.02
29	Railroad equipment	0.326	1.03	1.03	0.00
30	Transport equipment	0.085	1.32	1.30	0.02
31	Repair of transport equipment	0.296	1.06	1.06	0.01
32	Motorcycles and bicycles	0.057	1.52	1.28	0.01
33	Scientific and surgical instruments	0.169	1.06	1.05	0.01
34	Miscellaneous industries	0.128	1.50	1.50	0.05
35	Construction	0.350	1.44	1.44	0.05
36	Electricity	0.137	1.05	1.00	0.00

Source: Based on authors' calculations from Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

mill products followed by dairy products, cotton ginning, edible oils, sugar, basic chemicals, sawmills, other chemicals, furniture and fixtures, and breweries (Table 42). In 1979/80 the highest value of direct, indirect and induced wage income multipliers was in the agroprocessing industries such as breweries, dairy products, grain mill products, edible oils, and sugar. Among the other manufacturing sectors, basic metals, electrical machinery, and basic chemicals also had high values (Table 43).

Table 41—Direct and indirect sectoral wage incomes and multipliers in Punjab, with import leakages, 1979/80

Sector Number	Sector	Wages per Unit of Output	Wage Multipliers per Unit of Final Demand	Wage Multipliers per Unit of Output	Indirect Wages per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.139	1.28	1.24	0.03
2	Rice	0.218	1.01	1.11	0.02
3	Cotton	0.210	1.02	1.12	0.03
4	Sugarcane	0.182	1.09	1.10	0.02
5	Gram and pulses	0.206	0.59	1.09	0.02
6	Oilseeds	0.129	0.71	1.17	0.02
7	Other agriculture and forestry	0.213	0.73	1.03	0.01
8	Animal husbandry	0.213	1.25	1.28	0.06
9	Dairy products and confectionery	0.038	2.24	5.16	0.16
10	Grain mill products	0.045	3.98	5.02	0.18
11	Bakery products	0.233	0.76	1.50	0.12
12	Sugar	0.079	0.76	2.99	0.16
13	Other food industries	0.122	1.42	2.17	0.14
14	Edible oils	0.030	3.56	3.80	0.08
15	Breweries and beverages	0.031	3.38	5.48	0.14
16	Ginning and textiles	0.101	2.34	1.57	0.06
17	Sawmills and wooden goods	0.267	1.06	1.21	0.06
18	Paper, printing, and publishing	0.281	0.25	1.26	0.07
19	Rubber and leather products	0.155	1.01	1.47	0.07
20	Basic chemicals, including fertilizers	0.051	0.75	2.07	0.06
21	Drugs and pharmaceuticals	0.090	0.05	2.12	0.10
22	Other chemicals	0.073	0.12	2.45	0.11
23	Glass and mineral products	0.108	1.45	1.51	0.06
24	Basic metal industries	0.039	2.42	3.13	0.08
25	Metal products	0.131	1.78	1.71	0.09
26	Machinery, except electrical	0.106	0.95	1.96	0.10
27	Electrical machinery	0.060	1.33	2.70	0.10
28	Railroad equipment	0.249	1.41	1.32	0.08
29	Motor vehicles, manufacture and repair	0.242	1.23	1.33	0.08
30	Bicycles and parts	0.099	2.19	2.16	0.12
31	Scientific and surgical instruments	0.156	0.38	1.61	0.10
32	Sports and athletic goods	0.150	1.89	1.90	0.13
33	Miscellaneous industries	0.296	0.78	1.12	0.04
34	Electricity, gas, and water supply	0.175	0.95	1.05	0.01
35	Construction	0.248	1.85	1.85	0.21
36	Trade, transport, and storage	0.405	1.29	1.14	0.06
37	Other services	0.457	1.26	1.18	0.08
38	Banking and insurance	0.439	1.16	1.06	0.03
39	Real estate and ownership of dwellings	0.131	1.02	1.02	0.00

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).

Conclusions on Income and Employment Multipliers

The main results of the multiplier analysis are summed up as follows. In 1969/70 the predominance of the primary sector, with traditional agriculture and rather limited interindustry linkages, indicated the relative backwardness of the Punjab economy. But with the rapid growth of agriculture and other sectors of the economy, the interindustry linkages strengthened, leading to higher generation of indirect income and employment.

Table 42—Direct, indirect, and induced sectoral wage incomes and multipliers in Punjab, with import leakages, 1969/70

Sector Number	Sector	Wages per Unit of Output	Wage Multipliers per Unit of Final Demand	Wage Multipliers per Unit of Output	Indirect and Induced Wages per Unit of a Output
		(Rs)			(Rs)
1	Wheat	0.217	2.24	1.71	0.15
2	Rice	0.265	1.97	1.88	0.23
3	Maize	0.299	1.88	1.80	0.24
4	Cotton	0.266	1.80	1.83	0.22
5	Sugarcane	0.289	2.06	1.81	0.23
6	Gram and pulses	0.213	2.22	2.17	0.25
7	Oilseeds	0.213	1.01	2.19	0.25
8	Bajra	0.208	2.35	2.32	0.28
9	Other agriculture and forestry	0.285	1.50	1.76	0.22
10	Animal husbandry	0.245	2.07	1.49	0.12
11	Dairy products	0.018	14.61	13.56	0.22
12	Grain mill products	0.015	29.75	27.71	0.40
13	Sugar and confectionery	0.068	2.20	5.14	0.28
14	Edible oils and other food-processing industries	0.036	5.77	6.07	0.18
15	Breweries and beverages	0.063	0.50	2.72	0.11
16	Textiles	0.111	2.45	1.71	0.08
17	Cotton ginning, pressing, and other textiles	0.020	9.55	9.71	0.17
18	Sawmills and wooden containers	0.107	4.07	4.00	0.32
19	Furniture and fixtures	0.135	2.90	2.90	0.26
20	Printing and publishing	0.238	0.89	1.53	0.13
21	Rubber and leather products	0.104	2.03	2.06	0.11
22	Basic chemicals, including fertilizers	0.046	3.29	4.97	0.18
23	Other chemicals	0.035	1.17	3.58	0.09
24	Glass and mineral products	0.126	1.74	1.60	0.08
25	Basic metal industries	0.063	1.18	1.66	0.04
26	Metal products	0.118	1.89	1.87	0.10
27	Machinery, except electrical	0.113	1.50	1.97	0.11
28	Electrical machinery	0.061	2.35	2.60	0.10
29	Railroad equipment	0.326	1.63	1.63	0.21
30	Transport equipment	0.085	2.42	2.38	0.12
31	Repair of transport equipment	0.296	1.45	1.45	0.13
32	Motorcycles and bicycles	0.057	3.22	2.71	0.10
33	Scientific and surgical instruments	0.169	2.07	2.06	0.18
34	Miscellaneous industries	0.128	2.31	2.30	0.17
35	Construction	0.350	1.56	1.56	0.20
36	Electricity	0.137	2.83	2.67	0.23

Source: Based on authors' calculations from Punjab input-output table for 1969/70 in Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980).

Compared with 1969/70, the indirect gains in value added, wage income, and employment are more evenly spread out among many more industries in 1979/80.

Whereas relatively high direct income and employment were generated in the agricultural sectors in 1979/80, the indirect income and employment generated by them were the lowest. On the other hand, the industrial sector in general and agroprocessing industries in particular, with low direct income and employment, showed much greater indirect income and employment gains than the agricultural sectors.

Between 1969/70 and 1979/80, a significant change seems to have taken place within the industrial sectors of Punjab. In 1969/70, it was the agriculture-based and

Table 43—Direct, indirect, and induced sectoral wage incomes and multipliers in Punjab, with import leakages, 1979/80

Sector Number	Sector	Wages per Unit of Output	Wage Multipliers per Unit of Final Demand	Wage Multipliers per Unit of Output	Indirect and Induced Wages per Unit of Output
		(Rs)			(Rs)
1	Wheat	0.139	2.48	2.23	0.17
2	Rice	0.218	1.96	1.95	0.21
3	Cotton	0.210	1.88	2.04	0.22
4	Sugarcane	0.182	2.27	2.25	0.23
5	Gram and pulses	0.206	1.13	2.07	0.22
6	Oilseeds	0.129	1.75	2.87	0.24
7	Other agriculture and forestry	0.213	1.46	1.90	0.19
8	Animal husbandry	0.213	2.26	1.99	0.21
9	Dairy products and confectionery	0.038	4.05	9.23	0.32
10	Grain mill products	0.045	6.90	8.36	0.34
11	Bakery products	0.233	1.12	2.21	0.28
12	Sugar	0.079	1.38	5.42	0.35
13	Other food industries	0.122	2.34	3.56	0.31
14	Edible oils	0.030	6.25	6.58	0.17
15	Breweries and beverages	0.031	5.74	9.28	0.25
16	Ginning and textiles	0.101	3.57	2.30	0.13
17	Sawmills and wooden goods	0.267	1.47	1.67	0.18
18	Paper, printing, and publishing	0.281	0.34	1.70	0.20
19	Rubber and leather products	0.155	1.49	2.14	0.18
20	Basic chemicals, including fertilizers	0.051	1.41	3.86	0.15
21	Drugs and pharmaceuticals	0.090	0.07	3.24	0.20
22	Other chemicals	0.073	0.19	3.95	0.22
23	Glass and mineral products	0.108	2.50	2.59	0.17
24	Basic metal industries	0.039	3.60	4.65	0.14
25	Metal products	0.131	2.52	2.42	0.19
26	Machinery, except electrical	0.106	1.40	2.90	0.20
27	Electrical machinery	0.060	2.16	4.36	0.20
28	Railroad equipment	0.249	2.03	1.90	0.22
29	Motor vehicles, manufacture and repair	0.242	1.73	1.88	0.21
30	Bicycles and parts	0.099	3.53	3.48	0.24
31	Scientific and surgical instruments	0.156	0.56	2.35	0.21
32	Sports and athletic goods	0.150	2.72	2.73	0.26
33	Miscellaneous industries	0.296	1.25	1.79	0.23
34	Electricity, gas, and water supply	0.175	1.72	1.88	0.15
35	Construction	0.248	2.59	2.58	0.39
36	Trade, transport, and storage	0.405	1.80	1.37	0.15
37	Other services	0.457	1.67	1.51	0.23
38	Banking and insurance	0.431	1.71	1.55	0.24
39	Real estate and ownership of dwellings	0.131	2.31	2.26	0.17

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).

food processing industries such as grain mill products, sawmills, sugar and confectionery, dairy products, cotton ginning, furniture, and edible oils that had the highest indirect income and employment gains. A distinguishing feature of all these sectors was that they obtained almost all of their raw materials from local sources. In 1979/80, in addition to the agroprocessing industries, some other basic and machine good industries, such as basic metals, metal products, other chemicals, electrical and nonelectrical machine goods, and drugs and pharmaceuticals, also recorded relatively higher indirect income and employment gains. It is significant that trade and transport, other services,

banking, and real estate in the tertiary sector also generated fairly high levels of indirect incomes. This suggests a gradual expansion and deepening of the industrial structure in the state.

The value of consumption multipliers in 1969/70 was 1.86, suggesting that consumption-oriented activity in the state had a substantial impact despite large imports of industrial and consumer goods. In 1979/80, the consumption multipliers had a value of 1.62, indicating that consumption-based activity continued to be highly important for the economy. The highest induced-income and employment gains were recorded by the sectors that occupy an important place in the consumption basket—primarily agriculture-based industries. However, because of direct and indirect effects, some other industries in heavy and basic areas also became important. In addition to the manufacturing sectors, construction emerged as significant in the generation of indirect as well as induced income and employment.

7

CONCLUSIONS AND POLICY IMPLICATIONS

The main conclusion of this study is that rapid agricultural transformation is a potent instrument for bringing about significant acceleration in the overall growth and transformation of a labor-surplus economy dominated by the agricultural sector. In the case of Punjab, after adoption of the new seed-fertilizer technology there was a marked increase in the growth rate of agriculture, which in turn accelerated growth in other sectors of the state economy through input, output, and consumption linkages.

The technology improvement and upgrading in agriculture and other sectors of the economy resulted in more roundabout methods of production and a higher use of intermediate inputs, thereby strengthening interindustry linkages. Further, significant increases in per capita income led to much higher demand for consumption goods, and since meeting the consumption needs of the people constitutes a major economic activity in the state, the inducement effects of consumption were also quite substantial.

In short, rapid agricultural growth, by raising the incomes of an overwhelmingly large proportion of the labor force, not only made a deep dent in rural poverty but also led to development of other sectors through forward and backward linkage effects. It should, however, be noted that the direct and indirect effects of increased economic activity in both agriculture and manufacturing in Punjab have been considerably reduced, since the state is a large importer of modern agricultural inputs such as fertilizers, insecticides, and diesel fuel; raw materials for manufacturing such as coal, pig iron, and metals; and numerous finished goods for consumption. On the other hand, Punjab has benefited immensely from the existence of an assured market for exports of agricultural surpluses and industrial products and from the easy availability of inputs such as fertilizers and diesel fuel at nationally subsidized rates.

With the rapid development of the economy, the nature and quantum of forward and backward linkages being generated in the economy has grown significantly, indicating a deepening of intersectoral relationships. A comparative analysis of the 1969/70 and 1979/80 input-output tables for Punjab shows that by 1979/80, besides the agriculture and agroprocessing sectors, many machine-based and metal-based industries as well as trade, transport, banking, real estate, and other services were generating high forward and backward linkages despite large import leakages. The multiplier analysis confirms that between 1969/70 and 1979/80, not only the farm sectors and agroprocessing industries, but sectors such as basic metals, metal products, machine goods, electrical and nonelectrical machinery, and construction as well as most tertiary services began to record high indirect and induced income and employment.

Some useful lessons in development strategy can be learned from the Punjab model of growth. The Punjab experience demonstrates that it is possible for a region within a large country to enjoy the fruits of specialization and comparative advantage through trade and integration with the rest of the country. The state was able to export large agricultural surpluses and some industrial products to the rest of India at favorable prices and also obtained various inputs for modernized agriculture and industry from the rest of the country. This enabled Punjab to exploit fully its comparative advantage in rice, wheat, and cotton production and in agroprocessing and other industries.

Although substantial resources were transferred to Punjab for both rehabilitation and infrastructural investment for many years after independence, there is evidence

to suggest that a large outflow of funds from the state has been invested in the rest of India since Punjab became highly surplus in agricultural production. Simultaneously, a large number of agricultural laborers migrated to Punjab from Bihar and other relatively less-developed states of India. Thus, in the context of an "open" regional economy, the gains of development are being shared with the rest of the economy.

Finally, Punjab was able to pioneer the green revolution and thereby transform its agriculture. Its rapid overall growth was due primarily to the state's large investments in irrigation, power, roads, communications, and other rural and urban infrastructure. These investments were financed both through large central plan transfers and through resources internally mobilized by the state. The availability of this infrastructure was mainly responsible for the adaptation of the Mexican seed-fertilizer technology to local conditions and for its rapid spread and successful exploitation by Punjab farmers. The policymakers were also able to create an appropriate institutional framework that assured the farmers of remunerative prices for all produce brought by them to the market. The ensured profitability of the new technology gave surplus farmers the enthusiasm and confidence needed to undertake fairly large private investments in irrigation, land improvements, and other farm assets, thereby further supplementing public investment in rural infrastructure. The policy lesson to be learned from the Punjab experience is that large investment in rural and urban infrastructure is a precondition for agricultural development and for rapid growth of both agriculture and other sectors of the economy.

APPENDIX 1: SUPPLEMENTARY TABLES

Table 44—Interindustry flows and patterns of final demand in Punjab, 1979/80

Sector Number	Sector	Wheat (1)	Rice (2)	Cotton (3)	Sugarcane (4)	Gram and Pulses (5)
				(Rs 1,000)		
1	Wheat	273,595	0	0	0	0
2	Rice	0	85,781	0	0	0
3	Cotton	0	0	17,938	0	0
4	Sugarcane	0	0	0	29,660	0
5	Gram and pulses	0	0	0	0	19,448
6	Oilseeds	0	0	0	0	0
7	Other agriculture and forestry	0	0	0	0	0
8	Animal husbandry	269,649	75,116	79,401	30,925	24,329
9	Dairy products and confectionery	0	0	0	0	0
10	Grain mill products	0	0	0	0	0
11	Bakery products	0	0	0	0	0
12	Sugar	0	0	0	0	0
13	Other food industries	0	0	0	0	0
14	Edible oils	0	0	0	0	0
15	Breweries and beverages	0	0	0	0	0
16	Ginning and textiles	0	0	0	0	0
17	Sawmills and wooden goods	0	0	0	0	0
18	Paper, printing, and publishing	0	0	0	0	0
19	Rubber and leather products	0	0	0	0	0
20	Basic chemicals, including fertilizers	1,406,021	650,145	214,913	35,677	1,249
21	Drugs and pharmaceuticals	0	0	0	0	0
22	Other chemicals	0	0	0	0	0
23	Glass and mineral products	0	0	0	0	0
24	Basic metal industries	0	0	0	0	0
25	Metal products	0	0	0	0	0
26	Machinery, except electrical	0	0	0	0	0
27	Electrical machinery	0	0	0	0	0
28	Railroad equipment	0	0	0	0	0
29	Motor vehicles, manufacture and repair	0	0	0	0	0
30	Bicycles and parts	0	0	0	0	0
31	Scientific and surgical instruments	0	0	0	0	0
32	Sports and athletic goods	0	0	0	0	0
33	Miscellaneous industries	0	0	0	0	0
34	Electricity, gas, and water supply	175,302	51,757	10,200	9,678	0
35	Construction	0	0	0	0	0
36	Trade, transport, and storage	291,269	117,747	39,609	6,688	4,298
37	Other services	0	0	0	0	0
38	Banking and insurance	33,335	16,790	5,101	1,266	886
39	Real estate and ownership of dwellings	0	0	0	0	0
40	Total inputs	2,449,171	997,336	367,162	113,894	50,210
41	Noncompetitive imports	1,334,025	452,875	156,385	27,041	40,316
42	Repair and maintenance	80,807	41,782	18,230	6,753	3,973
43	Work done by others	0	0	0	0	0
44	Taxes, duties, subsidy	85,968	70,420	19,610	5,217	3,264
45	Consumable stores	0	0	0	0	0
46	Depreciation	363,589	52,366	61,586	10,654	15,939
47	Net value added	5,420,991	3,573,970	1,573,118	649,892	364,902
48	Gross output	9,734,551	5,188,749	2,196,091	813,451	478,604
49	Workers (in number of persons)	546,440	560,383	224,272	70,039	49,703
50	Person-days (in thousands of days)	142,621	146,260	58,535	18,280	12,972
51	Wages	1,349,296	1,131,974	460,498	148,412	98,511

(continued)

Table 44—Continued

Sector Number	Sector	Oilseeds (6)	Other Agriculture and Forestry (7)	Animal Husbandry (8)	Dairy Products and Confectionery (9)
			(Rs 1,000)		
1	Wheat	0	0	356,830	0
2	Rice	0	0	194,374	0
3	Cotton	0	0	0	0
4	Sugarcane	0	0	20,085	0
5	Gram and pulses	0	0	129,939	412
6	Oilseeds	1,558	0	0	0
7	Other agriculture and forestry	0	82,720	490,072	1,209
8	Animal husbandry	23,225	34,255	0	210,016
9	Dairy products and confectionery	0	0	0	46,482
10	Grain mill products	0	0	0	1,201
11	Bakery products	0	0	0	110
12	Sugar	0	0	0	28,882
13	Other food industries	0	0	0	645
14	Edible oils	0	0	258,320	2,707
15	Breweries and beverages	0	0	0	0
16	Ginning and textiles	0	0	751,694	0
17	Sawmills and wooden goods	0	0	0	105
18	Paper, printing, and publishing	0	0	0	994
19	Rubber and leather products	0	0	0	0
20	Basic chemicals, including fertilizers	18,960	3,489	0	3,599
21	Drugs and pharmaceuticals	0	0	14,769	0
22	Other chemicals	0	0	0	111
23	Glass and mineral products	0	0	0	3
24	Basic metal industries	0	0	0	0
25	Metal products	0	0	0	99,102
26	Machinery, except electrical	0	0	0	0
27	Electrical machinery	0	0	0	0
28	Railroad equipment	0	0	0	0
29	Motor vehicles, manufacture and repair	0	0	0	0
30	Bicycles and parts	0	0	0	0
31	Scientific and surgical instruments	0	0	0	0
32	Sports and athletic goods	0	0	0	0
33	Miscellaneous industries	0	0	0	2
34	Electricity, gas, and water supply	2,021	5,186	0	2,066
35	Construction	0	0	0	0
36	Trade, transport, and storage	3,659	7,180	103,017	38,348
37	Other services	0	0	0	0
38	Banking and insurance	1,057	4,286	35,100	10,163
39	Real estate and ownership of dwellings	0	0	0	0
40	Total inputs	50,480	167,116	2,354,200	446,157
41	Noncompetitive imports	15,380	34,130	0	29,302
42	Repair and maintenance	3,770	33,885	0	4,451
43	Work done by others	0	0	0	1,689
44	Taxes, duties, subsidy	6,106	18,022	23,400	20,397
45	Consumable stores	0	0	0	4,513
46	Depreciation	1,138	243,380	100	7,693
47	Net value added	366,971	2,447,710	5,598,200	154,820
48	Gross output	454,093	2,944,243	7,975,900	669,022
49	Workers (in number of persons)	24,935	305,759	828,295	5,204
50	Person-days (in thousands of days)	6,508	79,803	216,185	1,325
51	Wages	58,434	626,806	1,698,005	25,695

(continued)

Table 44—Continued

Sector Number	Sector	Grain Mill Products (10)	Bakery Products (11)	Sugar (12)	Other Food Industries (13)	Edible Oils (14)
				(Rs 1,000)		
1	Wheat	1,249,251	0	0	382	0
2	Rice	58,457	0	0	0	3,482
3	Cotton	0	0	0	0	32,506
4	Sugarcane	0	0	122,405	0	0
5	Gram and pulses	67,143	0	0	0	0
6	Oilseeds	501	0	0	0	582,654
7	Other agriculture and forestry	22,069	6,553	0	128,193	2,921
8	Animal husbandry	0	5,892	1,188	74,773	0
9	Dairy products and confectionery	0	370	1,076	473	0
10	Grain mill products	0	44,802	0	10,710	2,020
11	Bakery products	0	0	0	0	0
12	Sugar	0	11,765	0	13,048	0
13	Other food industries	0	1,074	0	7,715	98
14	Edible oils	0	13,783	0	15,979	708,954
15	Breweries and beverages	0	0	0	0	0
16	Ginning and textiles	0	0	0	0	39,581
17	Sawmills and wooden goods	0	0	0	1,584	0
18	Paper, printing, and publishing	2,799	1,441	405	855	1,526
19	Rubber and leather products	0	1,585	0	618	0
20	Basic chemicals, including fertilizers	49	2,975	889	2,817	7,442
21	Drugs and pharmaceuticals	0	0	0	1,696	1,020
22	Other chemicals	0	12	0	3,384	0
23	Glass and mineral products	0	0	276	8,221	0
24	Basic metal industries	0	0	0	1,439	0
25	Metal products	0	0	0	7,675	47,121
26	Machinery, except electrical	0	0	0	0	0
27	Electrical machinery	0	0	0	0	0
28	Railroad equipment	0	0	0	0	0
29	Motor vehicles, manufacture and repair	0	0	0	0	0
30	Bicycles and parts	0	0	0	0	0
31	Scientific and surgical instruments	0	0	0	0	0
32	Sports and athletic goods	0	0	0	0	0
33	Miscellaneous industries	0	0	0	0	171
34	Electricity, gas, and water supply	10,967	941	1,234	12,184	13,988
35	Construction	0	0	0	0	0
36	Trade, transport, and storage	110,570	8,212	10,501	24,303	141,194
37	Other services	0	0	0	0	0
38	Banking and insurance	62,411	755	0	20,504	0
39	Real estate and ownership of dwellings	0	0	0	0	0
40	Total inputs	1,584,217	100,160	137,974	336,553	1,584,678
41	Noncompetitive imports	20,474	304	7,132	18,081	27,062
42	Repair and maintenance	36,244	1,228	6,036	7,102	34,232
43	Work done by others	12,027	0	581	700	10,719
44	Taxes, duties, subsidy	19,028	74	2,422	1,368	38,708
45	Consumable stores	31,121	352	2,662	3,253	21,127
46	Depreciation	14,029	651	4,217	4,346	19,042
47	Net value added	156,845	52,913	34,109	140,429	140,382
48	Gross output	1,873,985	155,682	195,133	511,832	1,875,950
49	Workers (in number of persons)	23,913	11,337	4,559	16,979	13,939
50	Person-days (in thousands of days)	5,724	2,966	992	4,633	3,036
51	Wages	83,999	36,324	15,335	62,580	56,448

(continued)

Table 44—Continued

Sector Number	Sector	Breweries and Beverages (15)	Ginning and Textiles (16)	Sawmills and Wooden Goods (17)	Paper, Printing, and Publishing (18)
			(Rs 1,000)		
1	Wheat	0	0	0	0
2	Rice	0	0	0	0
3	Cotton	0	732,467	0	0
4	Sugarcane	1,725	0	0	0
5	Gram and pulses	0	0	0	0
6	Oilseeds	0	16,330	0	0
7	Other agriculture and forestry	8,843	5,274	19,026	0
8	Animal husbandry	0	179,918	0	0
9	Dairy products and confectionery	0	0	0	0
10	Grain mill products	0	273	0	374
11	Bakery products	0	0	0	0
12	Sugar	35,005	0	0	0
13	Other food industries	14,390	10,423	0	0
14	Edible oils	0	0	0	0
15	Breweries and beverages	26,545	0	0	0
16	Ginning and textiles	0	3,346,826	3,111	815
17	Sawmills and wooden goods	218	12,920	207,786	9,846
18	Paper, printing, and publishing	7,520	17,412	2,012	42,832
19	Rubber and leather products	10,919	22,939	15,910	65
20	Basic chemicals, including fertilizers	2,695	14,015	3,601	20
21	Drugs and pharmaceuticals	0	0	0	0
22	Other chemicals	2,741	38,495	4,700	2,108
23	Glass and mineral products	31,426	0	3,076	947
24	Basic metal industries	1,346	0	27,935	11,559
25	Metal products	3,590	12,386	7,482	163
26	Machinery, except electrical	0	0	0	0
27	Electrical machinery	0	0	257	0
28	Railroad equipment	0	0	0	0
29	Motor vehicles, manufacture and repair	0	0	0	0
30	Bicycles and parts	0	0	0	0
31	Scientific and surgical instruments	0	0	0	0
32	Sports and athletic goods	0	0	0	0
33	Miscellaneous industries	173	7,527	63	1,377
34	Electricity, gas, and water supply	6,206	55,777	4,104	1,388
35	Construction	0	0	0	0
36	Trade, transport, and storage	18,632	329,445	37,173	9,975
37	Other services	0	0	0	0
38	Banking and insurance	27,420	7	2,848	968
39	Real estate and ownership of dwellings	0	0	0	0
40	Total inputs	199,394	4,802,434	339,084	82,448
41	Noncompetitive imports	12,331	78,118	1,204	892
42	Repair and maintenance	7,074	117,580	2,026	1,106
43	Work done by others	5,955	369,463	1,870	5,068
44	Taxes, duties, subsidy	4,115	147,430	12,037	1,481
45	Consumable stores	2,682	110,729	10,671	1,247
46	Depreciation	5,802	55,006	146	627
47	Net value added	47,383	1,251,349	234,077	50,768
48	Gross output	284,736	6,932,109	601,115	143,637
49	Workers (in number of persons)	2,493	169,678	45,710	10,954
50	Person-days (in thousands of days)	827	52,015	13,275	3,481
51	Wages	8,724	697,546	160,533	40,299

(continued)

Table 44—Continued

Sector Number	Sector	Rubber and Leather Products (19)	Basic Chemicals, Including Fertilizers (20)	Drugs and Pharmaceuticals (21)	Other Chemicals (22)	Glass and Mineral Products (23)
				(Rs 1,000)		
1	Wheat	0	0	0	0	0
2	Rice	0	0	0	0	0
3	Cotton	0	0	91	0	0
4	Sugarcane	0	0	0	0	0
5	Gram and pulses	0	0	0	0	0
6	Oilseeds	1,468	0	0	12,054	0
7	Other agriculture and forestry	970	188	3,307	35,272	452
8	Animal husbandry	62,680	1,052	27	4,118	0
9	Dairy products and confectionery	0	0	0	9	0
10	Grain mill products	659	0	0	6,119	0
11	Bakery products	0	0	0	0	0
12	Sugar	0	0	2,151	0	0
13	Other food industries	2,318	0	0	0	0
14	Edible oils	221	1,999	0	7,340	0
15	Breweries and beverages	0	587	65	221	0
16	Ginning and textiles	29,954	0	81	407	0
17	Sawmills and wooden goods	2,159	4,948	549	516	0
18	Paper, printing, and publishing	15,915	5,086	1,749	4,470	3,321
19	Rubber and leather products	283,729	6,274	240	3,963	0
20	Basic chemicals, including fertilizers	45,202	62,514	6,499	27,040	293
21	Drugs and pharmaceuticals	0	0	4,503	0	0
22	Other chemicals	13,753	28,121	1,926	43,991	32,903
23	Glass and mineral products	0	728	2,300	9	635,756
24	Basic metal industries	14	0	364	0	84,573
25	Metal products	4,912	2,086	825	7,642	0
26	Machinery, *except electrical*	0	0	0	0	0
27	Electrical machinery	0	0	28	0	0
28	Railroad equipment	0	0	0	0	0
29	Motor vehicles, manufacture and repair	0	0	0	0	0
30	Bicycles and parts	0	0	0	0	410
31	Scientific and surgical instruments	0	0	0	0	0
32	Sports and athletic goods	0	0	0	0	0
33	Miscellaneous industries	505	282	27	141	369
34	Electricity, gas, and water supply	7,387	76,617	535	2,416	3,237
35	Construction	0	0	0	0	0
36	Trade, transport, and storage	58,997	33,113	2,906	14,319	133,470
37	Other services	0	0	0	0	0
38	Banking and insurance	6,752	51,747	770	6,504	4,521
39	Real estate and ownership of dwellings	0	0	0	0	0
40	Total inputs	537,595	275,342	28,943	176,551	899,305
41	Noncompetitive imports	84,739	205,143	1,064	7,179	12,143
42	Repair and maintenance	9,468	27,822	617	1,636	1,363
43	Work done by others	5,765	23,732	430	3,338	361
44	Taxes, duties, subsidy	6,935	20,613	282	2,064	9,338
45	Consumable stores	7,562	28,594	363	2,169	4,428
46	Depreciation	4,756	232,820	363	4,528	660
47	Net value added	233,414	270,537	6,595	36,014	560,756
48	Gross output	890,234	1,084,603	38,657	233,479	1,488,354
49	Workers (in number of persons)	38,397	4,974	1,020	4,874	42,954
50	Person-days (*in thousands of days*)	11,882	1,227	263	1,280	13,967
51	Wages	138,037	55,813	3,468	17,064	161,185

(continued)

Table 44—Continued

Sector Number	Sector	Basic Metal Industries (24)	Metal Products (25)	Machinery, Except Electrical (26)	Electrical Machinery (27)	Railroad Equipment (28)
				(Rs 1,000)		
1	Wheat	0	0	0	0	0
2	Rice	0	0	0	0	0
3	Cotton	0	0	0	0	0
4	Sugarcane	0	0	0	0	0
5	Gram and pulses	0	0	0	0	0
6	Oilseeds	0	0	0	0	0
7	Other agriculture and forestry	1,030	105	790	66	16
8	Animal husbandry	0	0	0	0	0
9	Dairy products and confectionery	295,199	0	0	0	0
10	Grain mill products	0	0	0	5	0
11	Bakery products	0	0	0	0	0
12	Sugar	423	204	66	0	0
13	Other food industries	10	0	0	0	0
14	Edible oils	0	17	0	0	0
15	Breweries and beverages	0	0	0	0	0
16	Ginning and textiles	0	43	6	0	0
17	Sawmills and wooden goods	1,399	11,748	9,114	8,213	351
18	Paper, printing and publishing	6,197	4,435	5,198	10,221	311
19	Rubber and leather products	0	3,081	3,218	706	5,159
20	Basic chemicals, including fertilizers	16,630	9,373	8,786	36,789	54
21	Drugs and pharmaceuticals	0	0	0	0	0
22	Other chemicals	1,915	3,786	900	4,449	129
23	Glass and mineral products	2,372	0	92	7,166	0
24	Basic metal industries	926,256	652,933	389,041	187,900	11,776
25	Metal products	522,160	41,298	56,982	6,670	1,857
26	Machinery, except electrical	0	930	24,424	28,981	100
27	Electrical machinery	74,263	0	7,592	0	0
28	Railroad equipment	0	0	390	0	4,188
29	Motor vehicles, manufacture and repair	0	0	0	0	0
30	Bicycles and parts	0	0	0	0	0
31	Scientific and surgical instruments	0	0	0	0	0
32	Sports and athletic goods	0	0	0	0	0
33	Miscellaneous industries	624	426	178	327	34
34	Electricity, gas, and water supply	53,509	13,834	6,779	2,936	940
35	Construction	0	0	0	0	0
36	Trade, transport, and storage	418,818	137,112	103,137	49,643	3,954
37	Other services	0	0	0	0	0
38	Banking and insurance	6,544	4,366	69,021	0	854
39	Real estate and ownership of dwellings	0	0	0	0	0
40	Total inputs	2,327,349	883,691	625,714	344,072	29,723
41	Noncompetitive imports	1,244,672	80,236	166,587	29,475	2,525
42	Repair and maintenance	54,571	28,170	16,007	8,845	54
43	Work done by others	79,018	46,711	17,324	13,260	2,573
44	Taxes, duties, subsidy	21,330	3,930	2,065	1,870	91
45	Consumable stores	156,723	47,737	31,564	15,292	145
46	Depreciation	52,519	6,739	19,178	10,679	1,838
47	Net value added	392,054	280,160	240,583	112,296	28,265
48	Gross output	4,328,236	1,377,374	1,119,022	535,789	65,214
49	Workers (in number of persons)	37,271	52,504	26,795	8,060	2,379
50	Person-days (in thousands of days)	10,654	16,022	8,252	2,450	720
51	Wages	169,210	180,015	118,772	31,974	16,250

(continued)

Table 44—Continued

Sector Number	Sector	Motor Vehicles, Manufacture and Repair (29)	Bicycles and Parts (30)	Scientific and Surgical Instruments (31)	Sports and Athletic Goods (32)	Miscellaneous Industries (33)
				(Rs 1,000)		
1	Wheat	0	0	0	0	0
2	Rice	0	0	0	0	0
3	Cotton	0	0	0	0	0
4	Sugarcane	0	0	0	0	0
5	Gram and pulses	0	0	0	0	0
6	Oilseeds	0	0	0	0	0
7	Other agriculture and forestry	364	1,328	36	426	215
8	Animal husbandry	0	0	0	1,398	12,698
9	Dairy products and confectionery	0	0	0	0	0
10	Grain mill products	0	0	0	2	0
11	Bakery products	0	0	0	0	0
12	Sugar	0	0	0	0	0
13	Other food industries	0	0	0	351	0
14	Edible oils	0	0	0	0	0
15	Breweries and beverages	0	0	0	0	0
16	Ginning and textiles	0	169	561	37,009	121
17	Sawmills and wooden goods	4,888	12,914	1,296	24,773	754
18	Paper, printing, and publishing	5,410	12,708	2,748	12,570	3,801
19	Rubber and leather products	5,856	42,696	414	115,894	550
20	Basic chemicals, including fertilizers	22,693	25,328	394	2,818	971
21	Drugs and pharmaceuticals	0	0	0	11,546	0
22	Other chemicals	4,846	18,148	41	0	79
23	Glass and mineral products	26	0	581	2,568	0
24	Basic metal industries	339,655	272,663	25,611	741	172
25	Metal products	9,325	202,731	105	0	64
26	Machinery, except electrical	0	0	0	0	0
27	Electrical machinery	1,020	0	0	0	0
28	Railroad equipment	0	0	0	0	0
29	Motor vehicles, manufacture and repair	20,924	0	267	0	0
30	Bicycles and parts	0	45,352	0	0	0
31	Scientific and surgical instruments	0	0	5,560	0	0
32	Sports and athletic goods	0	0	0	0	0
33	Miscellaneous industries	250	466	24	15,048	1,271
34	Electricity, gas, and water supply	16,852	7,863	803	1,885	3,694
35	Construction	0	0	0	0	0
36	Trade, transport, and storage	78,981	97,890	7,043	25,810	3,809
37	Other services	0	0	0	0	0
38	Banking and insurance	10,263	26,252	1,930	4,179	537
39	Real estate and ownership of dwellings	0	0	0	0	0
40	Total inputs	521,353	766,508	47,414	257,018	28,736
41	Noncompetitive imports	77,008	34,076	5,253	2,533	18,870
42	Repair and maintenance	18,529	19,097	716	10,472	1,787
43	Work done by others	13,450	29,358	2,991	16,787	703
44	Taxes, duties, subsidy	3,432	2,554	1,398	3,914	89
45	Consumable stores	27,358	37,412	2,091	18,693	9,128
46	Depreciation	12,688	12,004	1,235	897	514
47	Net value added	399,047	411,937	24,739	101,936	132,803
48	Gross output	1,072,865	1,312,946	85,837	412,250	192,630
49	Workers (in number of persons)	70,679	37,073	3,401	17,553	1,626
50	Person-days (in thousands of days)	21,950	11,844	1,043	5,395	500
51	Wages	259,321	129,755	13,420	61,732	57,104

(continued)

Table 44—Continued

Sector Number	Sector	Electricity, Gas, and Water Supply (34)	Construc-tion (35)	Trade, Transport, and Storage (36)	Other Services (37)
			(Rs 1,000)		
1	Wheat	0	0	0	46,410
2	Rice	0	0	0	75,769
3	Cotton	0	0	0	0
4	Sugarcane	0	0	0	0
5	Gram and pulses	0	0	0	5,697
6	Oilseeds	0	0	0	0
7	Other agricultureand forestry	0	116,258	13	26,614
8	Animal husbandry	0	0	60,185	47,281
9	Dairy products and confectionery	0	0	0	0
10	Grain mill products	0	0	0	0
11	Bakery products	0	0	0	8,811
12	Sugar	0	0	0	5,177
13	Other food industries	0	0	0	0
14	Edible oils	0	0	0	1,144
15	Breweries and beverages	0	0	0	280
16	Ginning and textiles	0	0	30,502	12,399
17	Sawmills and wooden goods	0	323,779	40,873	4,999
18	Paper, printing, and publishing	4,665	0	104,800	184,069
19	Rubber and leather products	0	0	177,676	14,983
20	Basic chemicals, including fer-tilizers	15	0	352	923
21	Drugs and pharmaceuticals	0	0	149	436,403
22	Other chemicals	0	51,857	643	503
23	Glass and mineral products	0	844,084	0	680
24	Basic metal industries	0	528,246	10,240	32,246
25	Metal products	0	14,149	12	85,968
26	Machinery, except electrical	0	0	25,269	11,954
27	Electrical machinery	0	454	23,322	7,659
28	Railroad equipment	0	0	56,126	0
29	Motor vehicles, manufacture and repair	0	0	101,252	14,175
30	Bicycles and parts	0	0	66,702	1,089
31	Scientific and surgical instruments	0	493	13,018	328,278
32	Sports and athletic goods	0	0	0	0
33	Miscellaneous industries	518	0	0	0
34	Electricity, gas, and water supply	62,076	44,257	186,068	174,685
35	Construction	0	0	0	0
36	Trade, transport, and storage	18,669	2,139,312	1,430,546	772,507
37	Other services	0	0	971,217	343,840
38	Banking and insurance	9,071	51,431	318,637	46,849
39	Real estate and ownership of dwellings	0	0	0	0
40	Total inputs	95,014	4,114,320	3,617,602	2,691,392
41	Noncompetitive imports	180,767	78,607	567,093	21,509
42	Repair and maintenance	141,503	0	0	0
43	Work done by others	116,909	0	0	0
44	Taxes, duties, subsidy	992	139,032	414,031	245,640
45	Consumable stores	1,314	0	0	0
46	Depreciation	174,782	127,600	593,300	58,600
47	Net value added	946,017	2,393,100	8,649,200	3,493,500
48	Gross output	1,657,298	6,852,659	13,841,230	6,510,641
49	Workers (in number of persons)	42,784	100,663	546,973	613,024
50	Person-days (in thousands of days)	11,980	24,360	171,203	178,906
51	Wages	289,600	1,699,101	5,602,138	2,973,820

(continued)

Table 44—Continued

Sector Number	Sector	Banking and Insurance (38)	Real Estate and Ownership of Dwellings (39)	Intermediate Use (40)	Rural Consumption (41)
			(Rs 1,000)		
1	Wheat	0	0	1,926,468	1,387,629
2	Rice	0	0	417,874	225,304
3	Cotton	0	0	783,002	0
4	Sugarcane	0	0	173,875	517,155
5	Gram and pulses	0	0	222,639	508,144
6	Oilseeds	0	0	614,565	0
7	Other agriculture and forestry	0	0	954,330	1,899,159
8	Animal husbandry	0	0	1,198,126	3,225,604
9	Dairy products and confectionery	0	0	343,609	810,481
10	Grain mill products	0	0	66,165	1,500,654
11	Bakery products	0	0	8,921	77,963
12	Sugar	0	0	96,721	413,219
13	Other food industries	0	0	37,024	373,118
14	Edible oils	0	0	1,010,464	587,450
15	Breweries and beverages	0	0	27,698	264,161
16	Ginning and textiles	0	0	4,253,279	1,419,506
17	Sawmills and wooden goods	0	0	685,732	49,555
18	Paper, printing, and publishing	6,688	63	472,221	163,759
19	Rubber and leather products	0	0	716,475	465,347
20	Basic chemicals, including fertilizers	0	0	2,665,230	14,118
21	Drugs and pharmaceuticals	0	0	470,086	802,406
22	Other chemicals	0	0	259,541	656,391
23	Glass and mineral products	0	0	1,540,311	19,221
24	Basic metal industries	0	0	3,504,710	19,551
25	Metal products	0	0	1,134,305	50,021
26	Machinery, except electrical	0	0	91,658	38,779
27	Electrical machinery	0	21	114,616	52,336
28	Railroad equipment	0	0	60,704	0
29	Motor vehicles, manufacture and repair	0	22	136,640	0
30	Bicycles and parts	945	6	114.504	7,593
31	Scientific and surgical instruments	0	0	347,349	0
32	Sports and athletic goods	0	0	0	1,165
33	Miscellaneous industries	0	0	29,803	95,557
34	Electricity, gas, and water supply	4,799	380	1,034,551	186,288
35	Construction	0	0	0	16,868
36	Trade, transport, and storage	33,862	775	6,866,493	3,396,441
37	Other services	18,208	2,773	1,336,038	449,653
38	Banking and insurance	83,191	680	866,996	118,676
39	Real estate and ownership of dwellings	0	0	0	578,273
40	Total inputs	147,693	4,720	34,582,720	20,391,540
41	Noncompetitive imports	1,252	225	5,076,008	340,863
42	Repair and maintenance	0	0	746,936	0
43	Work done by others	0	0	780,782	0
44	Taxes, duties, subsidy	4,183	282	1,363,132	13,298
45	Consumable stores	0	0	578,930	0
46	Depreciation	33,700	274,300	2,494,259	0
47	Net value added	876,700	530,300	42,378,780	0
48	Gross output	1,063,528	809,827	88,001,550	20,745,710
49	Workers (in number of persons)	37,897	25,370	4,630,863	0
50	Person-days (in thousands of days)	10,611	8,372	1,282,319	0
51	Wages	457,900	106,060	19,301,160	0

(continued)

Table 44—Continued

Sector Number	Sector	Urban Consumption (42)	Government Consumption (43)	Capital Formation (44)	Change in in Stocks (45)
			(Rs 1,000)		
1	Wheat	527,446	0	0	300,000
2	Rice	42,820	0	0	160,000
3	Cotton	0	0	0	0
4	Sugarcane	15,831	0	0	0
5	Gram and pulses	180,296	0	0	0
6	Oilseeds	0	0	0	0
7	Other agriculture and forestry	83,044	24,719	14,407	0
8	Animal husbandry	1,198,125	672	220,398	0
9	Dairy products and confectionery	220,604	0	0	27,100
10	Grain mill products	595,912	0	0	0
11	Bakery products	108,213	0	0	0
12	Sugar	238,334	0	0	0
13	Other food industries	56,905	0	0	0
14	Edible oils	357,951	0	0	72,000
15	Breweries and beverages	189,370	0	0	7,500
16	Ginning and textiles	402,516	17,506	0	74,350
17	Sawmills and wooden goods	8,111	642	3,464	900
18	Paper, printing, and publishing	100,134	2,962	0	1,400
19	Rubber and leather products	136,905	3,516	0	42,200
20	Basic chemicals, including fertilizers	0	4,248	0	1,600
21	Drugs and pharmaceuticals	354,399	0	0	0
22	Other chemicals	373,468	591	0	0
23	Glass and mineral products	2,871	782	0	39,600
24	Basic metal industries	0	14,989	0	0
25	Metal products	7,322	3,639	0	6,300
26	Machinery, except electrical	15,406	104,700	1,810,045	17,200
27	Electrical machinery	43,374	5,474	395,054	37,600
28	Railroad equipment	0	0	0	0
29	Motor vehicles, manufacture and repair	2,073	28	252,978	85,850
30	Bicycles and parts	5,603	0	0	0
31	Scientific and surgical instruments	0	14,443	0	0
32	Sports and athletic goods	1,366	0	0	0
33	Miscellaneous industries	10,827	7,024	0	8,000
34	Electricity, gas, and water supply	228,663	0	0	0
35	Construction	22,048	0	6,813,743	0
36	Trade, transport, and storage	1,000,401	79,370	323,838	0
37	Other services	459,349	0	0	0
38	Banking and insurance	48,477	0	0	0
39	Real estate and ownership of dwellings	231,554	0	0	0
40	Total inputs	8,017,118	285,305	9,833,927	881,600
41	Noncompetitive imports	444,905	79,016	0	329,600
42	Repair and maintenance	0	24,684	0	0
43	Work done by others	0	0	0	0
44	Taxes, duties, subsidy	7,077	0	626,702	0
45	Consumable stores	0	0	0	0
46	Depreciation	0	20,295	0	0
47	Net value added	0	0	0	0
48	Gross output	8,469,100	409,300	10,460,630	1,211,200
49	Workers (in number of persons)	0	0	0	0
50	Person-days (in thousands of days)	0	0	0	0
51	Wages	0	0	0	0

(continued)

Table 44—Continued

Sector Number	Sector	Exports (46)	Imports (47)	Final Demand (48)	Gross Output (49)
			(Rs 1,000)		
1	Wheat	5,593,841	833	7,808,083	9,734,551
2	Rice	4,491,654	148,903	4,770,875	5,188,749
3	Cotton	1,654,189	241,100	1,413,089	2,196,091
4	Sugarcane	146,124	39,534	639,576	813,451
5	Gram and pulses	0	432,475	255,965	478,604
6	Oilseeds	138,000	298,472	−160,472	454,093
7	Other agriculture and forestry	486,200	1,265,016	1,989,913	2,944,243
8	Animal husbandry	2,350,675	217,700	6,777,774	7,975,900
9	Dairy products and confectionery	188,920	921,692	325,413	669,022
10	Grain mill products	200,411	489,157	1,807,820	1,873,985
11	Bakery products	112,156	151,571	146,761	155,682
12	Sugar	23,200	576,341	98,412	195,133
13	Other food industries	324,904	280,119	474,808	511,832
14	Edible oils	685,085	837,000	865,486	1,875,950
15	Breweries and beverages	0	203,993	257,038	284,736
16	Ginning and textiles	1,848,152	1,083,200	2,678,830	6,932,109
17	Sawmills and wooden goods	143,747	291,036	−84,617	601,115
18	Paper, printing, and publishing	15,200	612,039	−328,584	143,637
19	Rubber and leather products	210,200	684,409	173,759	890,234
20	Basic chemicals, including fertilizers	364,500	1,965,093	−1,580,627	1,084,603
21	Drugs and pharmaceuticals	197,500	1,785,734	−431,429	38,657
22	Other chemicals	3,655,088	4,711,600	−26,062	233,479
23	Glass and mineral products	580,569	695,000	−51,957	1,488,354
24	Basic metal industries	3,266,686	2,477,700	823,526	4,328,236
25	Metal products	227,592	51,805	243,069	1,377,374
26	Machinery, except electrical	261,000	1,219,766	1,027,364	1,119,022
27	Electrical machinery	437,705	550,370	421,173	535,789
28	Railroad equipment	4,510	0	4,510	65,214
29	Motor vehicles, manufacture and repair	710,696	115,400	936,225	1,072,865
30	Bicycles and parts	1,213,246	28,000	1,198,442	1,312,946
31	Scientific and surgical instruments	7,328	283,283	−261,512	85,837
32	Sports and athletic goods	412,250	2,531	412,250	412,250
33	Miscellaneous industries	127,373	85,954	162,827	192,630
34	Electricity, gas, and water supply	451,669	243,873	622,747	1,657,298
35	Construction	0	0	6,852,659	6,852,659
36	Trade, transport, and storage	2,174,683	0	6,974,733	13,841,230
37	Other services	4,265,601	0	5,174,603	6,510,641
38	Banking and insurance	29,379	0	196,532	1,063,528
39	Real estate and ownership of dwellings	0	0	809,827	809,827
40	Total inputs	37,000,040	22,990,700	53,418,830	88,001,550
41	Noncompetitive imports	0	0	1,194,384	6,270,392
42	Repair and maintenance	0	0	24,684	771,620
43	Work done by others	0	0	0	780,782
44	Taxes, duties, subsidy	0	0	647,077	2,010,209
45	Consumable stores	0	0	0	578,930
46	Depreciation	0	0	20,295	2,514,554
47	Net value added	0	0	0	42,378,780
48	Gross output	37,000,040	22,990,700	55,305,270	143,306,800
49	Workers (in number of persons)	0	0	0	4,630,863
50	Person-days (in thousands of days)	0	0	0	1,282,319
51	Wages	0	0	0	19,301,160

Source: Constructed by the authors from sources described in Chapter 3.

Table 45—Linkage analysis of Punjab's economy, without import leakages, 1969/70

Sector Number	Sector	Z-Matrix				Y-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	1.17 (9)	4.20	0.83 (26)	5.19	2.08 (5)	4.20	1.45 (5)	5.31
2	Rice	0.86 (15)	5.14	0.84 (23)	5.20	1.46 (6)	5.14	1.39 (10)	5.32
3	Maize	0.72 (27)	5.94	0.83 (28)	5.16	1.24 (8)	5.94	1.40 (9)	5.25
4	Cotton	0.74 (23)	5.72	0.84 (25)	5.06	1.17 (11)	5.72	1.26 (13)	5.29
5	Sugarcane	1.24 (7)	4.16	0.94 (18)	5.08	1.92 (5)	4.16	1.46 (2)	5.04
6	Gram and pulses	0.81 (18)	5.50	0.86 (22)	5.20	1.35 (7)	5.50	1.44 (6)	5.20
7	Oilseeds	1.60 (5)	3.36	0.87 (21)	5.12	2.58 (3)	3.36	1.41 (8)	5.09
8	Bajra	0.71 (29)	6.00	0.83 (27)	5.12	1.21 (9)	6.00	1.43 (7)	5.12
9	Other agriculture and forestry	1.80 (4)	2.83	0.83 (29)	5.33	3.36 (2)	2.83	1.52 (1)	5.38
10	Animal husbandry	2.03 (2)	2.18	0.84 (24)	5.07	3.61 (1)	2.18	1.46 (4)	5.27
11	Dairy products	0.76 (20)	5.94	1.29 (5)	3.66	0.09 (33)	5.94	0.77 (23)	3.75
12	Grain mill products	0.73 (25)	5.79	1.42 (1)	3.40	0.14 (31)	5.79	1.38 (11)	3.33
13	Sugar and confectionery	0.98 (12)	4.97	1.29 (4)	4.11	0.29 (27)	4.97	0.97 (19)	3.87
14	Edible oils and other food-processing industries	0.78 (19)	5.78	1.32 (2)	3.55	0.26 (28)	5.78	1.01 (18)	2.84
15	Breweries and beverages	0.71 (28)	6.00	1.17 (8)	3.85	0.23 (29)	6.00	0.54 (33)	3.17
16	Textiles	1.14 (10)	5.18	1.11 (13)	5.29	0.64 (17)	5.18	0.68 (28)	4.87
17	Cotton ginning, pressing, and other textiles	0.89 (14)	4.74	1.32 (3)	3.86	0.10 (32)	4.74	1.08 (16)	4.50
18	Sawmills and wooden containers	0.74 (24)	5.79	1.21 (7)	4.05	0.46 (24)	5.79	1.34 (12)	3.97
19	Furniture and fixtures	0.70 (31)	5.99	1.13 (10)	3.95	0.54 (20)	5.99	1.14 (15)	3.76
20	Printing and publishing	0.70 (31)	5.99	0.80 (32)	5.23	0.59 (19)	5.99	0.71 (27)	4.98
21	Rubber and leather products	1.07 (11)	5.01	0.05 (36)	5.06	0.70 (15)	5.01	0.75 (25)	4.66
22	Basic chemicals, including fertilizers	1.27 (6)	3.40	0.92 (19)	4.72	1.20 (10)	3.40	0.98 (22)	4.40
23	Other chemicals	0.93 (13)	4.78	0.98 (17)	4.57	0.41 (25)	4.78	0.56 (32)	3.74
24	Glass and mineral products	1.95 (3)	3.95	1.25 (6)	5.92	1.20 (10)	3.95	0.79 (21)	5.79
25	Basic metal industries	2.32 (1)	2.69	1.00 (16)	5.85	0.70 (14)	2.69	0.33 (35)	5.36
26	Metal products	0.86 (16)	4.93	1.03 (15)	4.39	0.50 (21)	4.93	0.57 (31)	4.67
27	Machinery, except electrical	0.74 (22)	5.88	0.81 (31)	5.41	0.18 (30)	5.88	0.24 (36)	4.38
28	Electrical machinery	0.72 (26)	5.96	1.13 (12)	4.11	0.33 (26)	5.96	0.52 (34)	3.86
29	Railroad equipment	0.70 (32)	6.00	0.77 (33)	5.45	1.14 (12)	6.00	1.19 (14)	5.72
30	Transport equipment	0.76 (21)	5.63	0.90 (20)	4.73	0.54 (21)	5.63	0.63 (29)	4.73
31	Repair of transport equipment	0.70 (32)	6.00	0.82 (30)	5.11	0.65 (16)	6.00	0.73 (26)	5.28
32	Motorcycles and bicycles	0.83 (17)	6.00	1.14 (9)	4.48	0.48 (22)	6.00	0.62 (30)	4.60
33	Scientific and surgical instruments	0.70 (30)	6.00	0.77 (34)	5.48	0.99 (13)	6.00	1.04 (17)	5.68
34	Miscellaneous industries	0.74 (24)	5.84	1.04 (14)	4.13	0.47 (23)	5.84	0.77 (24)	3.57
35	Construction	0.70 (32)	6.00	1.13 (11)	4.00	0.63 (10)	6.00	0.96 (20)	4.10
36	Electricity	1.24 (8)	3.52	0.73 (35)	6.00	2.47 (4)	3.52	1.46 (3)	6.00

(continued)

Table 45—Continued

Sector Number	Sector	W-Matrix				N-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	1.70 (5)	4.20	1.18 (16)	5.36	0.37 (23)	4.20	0.38 (26)	4.01
2	Rice	0.15 (33)	5.14	0.24 (36)	3.67	0.30 (25)	5.14	0.44 (23)	3.97
3	Maize	1.44 (9)	5.94	1.56 (4)	5.48	0.16 (33)	5.94	0.30 (29)	3.72
4	Cotton	1.32 (11)	5.72	1.37 (8)	5.52	0.06 (35)	5.72	0.23 (32)	3.02
5	Sugarcane	2.41 (4)	4.16	1.74 (2)	5.30	0.18 (32)	4.16	0.22 (33)	3.55
6	Gram and pulses	1.16 (12)	5.50	1.24 (12)	5.17	0.21 (31)	5.50	0.25 (31)	4.66
7	Oilseeds	2.29 (3)	3.36	1.24 (11)	5.13	0.26 (28)	3.36	0.20 (34)	3.78
8	Bajra	0.99 (16)	6.00	1.18 (14)	5.05	0.12 (34)	6.00	0.16 (36)	4.41
9	Other agriculture and forestry	3.45 (1)	2.83	1.54 (5)	5.47	0.28 (26)	2.83	0.16 (35)	4.19
10	Animal husbandry	3.34 (2)	2.18	1.33 (9)	5.25	0.46 (17)	2.18	0.25 (30)	4.06
11	Dairy products	0.09 (35)	5.94	0.75 (24)	3.52	5.46 (1)	5.94	5.72 (1)	5.67
12	Grain mill products	0.07 (36)	5.79	0.95 (19)	3.84	2.47 (5)	5.79	2.70 (4)	5.29
13	Sugar and confectionery	0.45 (25)	4.97	1.23 (13)	3.96	1.08 (8)	4.97	1.05 (11)	5.10
14	Edible oils and other food-processing industries	0.19 (32)	5.78	0.87 (21)	2.78	0.89 (12)	5.78	1.25 (10)	4.15
15	Breweries and beverages	0.30 (20)	6.00	0.67 (28)	3.31	0.43 (20)	6.00	0.74 (15)	3.62
16	Textiles	0.85 (17)	5.18	0.83 (23)	5.28	0.77 (13)	5.18	0.86 (14)	4.71
17	Cotton ginning, pressing, and other textiles	0.12 (34)	4.74	0.97 (18)	4.43	2.18 (6)	4.74	1.87 (5)	5.54
18	Sawmills and wooden containers	0.53 (24)	5.79	1.41 (7)	4.00	0.45 (18)	5.79	0.55 (20)	4.75
19	Furniture and fixtures	0.63 (21)	5.99	1.24 (10)	3.82	2.71 (14)	5.99	2.98 (2)	5.46
20	Printing and publishing	1.12 (14)	5.99	1.18 (15)	5.61	0.21 (31)	5.99	0.41 (24)	3.72
21	Rubber and leather products	0.74 (19)	5.01	0.74 (25)	5.02	0.41 (21)	5.01	0.60 (17)	3.81
22	Basic chemicals, including fertilizers	0.39 (27)	3.40	0.38 (34)	3.90	4.51 (2)	3.40	2.76 (3)	5.57
23	Other chemicals	0.22 (31)	4.78	0.31 (35)	3.57	1.49 (7)	4.78	1.73 (6)	4.38
24	Glass and mineral products	1.65 (6)	3.95	1.06 (17)	5.92	0.74 (14)	3.95	0.49 (22)	5.76
25	Basic metal industries	0.99 (5)	2.69	0.43 (23)	5.71	3.79 (3)	2.69	1.61 (7)	5.91
26	Metal products	0.68 (20)	4.93	0.71 (26)	5.83	0.45 (19)	4.93	0.90 (12)	3.91
27	Machinery, except electrical	0.56 (23)	5.88	0.61 (29)	5.40	0.53 (16)	5.88	0.60 (19)	5.20
28	Electrical machinery	0.30 (30)	5.96	0.51 (31)	3.76	0.90 (11)	5.96	1.52 (8)	4.00
29	Railroad equipment	1.52 (8)	6.00	1.56 (3)	5.85	0.30 (24)	6.00	0.41 (25)	4.55
30	Transport equipment	0.43 (26)	5.63	0.54 (30)	4.52	0.70 (15)	5.63	0.90 (13)	4.49
31	Repair of transport equipment	1.39 (10)	6.00	1.46 (6)	5.70	0.24 (30)	6.00	0.37 (27)	3.94
32	Motorcycles and bicycles	0.32 (28)	6.00	0.48 (32)	4.14	0.94 (10)	6.00	0.38 (9)	4.32
33	Scientific and surgical instruments	0.80 (18)	6.00	0.85 (22)	5.60	0.25 (29)	6.00	0.32 (28)	4.77
34	Miscellaneous industries	0.63 (22)	5.84	0.92 (20)	4.03	0.37 (22)	5.84	0.60 (18)	3.68
35	Construction	1.64 (7)	6.00	2.04 (1)	4.85	0.27 (27)	6.00	0.50 (21)	3.64
36	Electricity	1.14 (13)	3.52	0.67 (27)	6.00	1.07 (9)	3.52	0.63 (16)	6.00

Source: Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980), App. 2.9, 211-215.
Note: Figures in parentheses indicate rank.

Table 46—Linkage analysis of Punjab's economy, with import leakages, 1969/70

Sector Number	Sector	R-Matrix				W'-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	1.49 (3)	4.22	1.04 (16)	5.32	2.08 (4)	4.22	1.43 (11)	5.42
2	Rice	1.09 (7)	5.14	1.04 (17)	5.36	0.19 (31)	5.14	0.27 (32)	3.87
3	Maize	0.92 (17)	5.95	1.03 (18)	5.29	1.76 (6)	5.95	1.90 (4)	5.57
4	Cotton	0.91 (18)	5.75	0.97 (24)	5.39	1.56 (8)	5.75	1.60 (6)	5.60
5	Sugarcane	1.18 (6)	5.07	1.16 (13)	5.16	2.20 (3)	5.07	2.07 (2)	5.34
6	Gram and pulses	0.97 (14)	5.55	1.03 (19)	5.25	1.33 (9)	5.55	1.43 (10)	5.21
7	Oilseeds	0.85 (25)	3.45	0.48 (33)	0.17	1.17 (12)	3.45	0.66 (23)	5.16
8	Bajra	0.91 (15)	6.00	1.06 (15)	5.16	1.21 (10)	6.00	1.44 (8)	5.09
9	Other agriculture and forestry	1.67 (2)	2.88	0.78 (27)	5.26	3.07 (2)	2.88	1.39 (12)	5.49
10	Animal husbandry	2.29 (1)	2.46	1.02 (20)	5.25	3.60 (1)	2.46	1.56 (7)	5.42
11	Dairy products	0.97 (12)	5.97	1.52 (2)	3.97	0.11 (33)	5.97	0.82 (19)	3.91
12	Grain mill products	0.93 (16)	5.82	1.76 (1)	3.52	0.09 (34)	5.82	1.09 (8)	4.05
13	Sugar and confectionery	0.43 (29)	5.32	0.59 (31)	4.18	0.19 (29)	5.32	0.53 (28)	3.99
14	Edible oils and other food-processing industries	0.85 (24)	5.90	1.22 (8)	4.12	0.20 (28)	5.90	0.61 (34)	2.53
15	Breweries and beverages	0.16 (31)	6.00	0.22 (35)	4.53	0.07 (36)	6.00	0.11 (33)	3.88
16	Textiles	0.14 (32)	5.29	1.37 (4)	5.46	1.01 (14)	5.29	0.97 (16)	5.54
17	Cotton ginning, pressing, and other textiles	1.08 (9)	4.84	1.22 (9)	4.45	0.14 (32)	4.84	0.58 (26)	3.90
18	Sawmills and wooden containers	0.94 (16)	5.81	1.38 (3)	4.27	0.65 (21)	5.81	1.44 (9)	3.94
19	Furniture and fixtures	0.90 (21)	6.00	1.27 (6)	4.36	0.78 (17)	6.00	1.32 (13)	4.04
20	Printing and publishing	0.52 (11)	6.00	0.58 (32)	5.39	0.80 (18)	6.00	0.84 (17)	5.73
21	Rubber and leather products	1.04 (28)	5.03	1.00 (22)	5.21	0.70 (20)	5.03	0.68 (22)	5.13
22	Basic chemicals, including fertilizers	0.89 (23)	3.90	0.72 (29)	4.95	0.26 (27)	3.90	0.28 (31)	4.10
23	Other chemicals	0.35 (30)	5.00	0.35 (34)	4.97	0.08 (35)	5.00	0.10 (34)	4.13
24	Glass and mineral products	1.31 (5)	4.57	0.99 (23)	5.93	1.06 (13)	4.57	0.80 (20)	5.93
25	Basic metal industries	1.47 (4)	2.78	0.65 (30)	5.87	0.60 (22)	2.78	0.27 (32)	5.74
26	Metal products	1.08 (8)	5.00	1.12 (11)	4.91	0.82 (16)	5.00	0.78 (21)	5.27
27	Machinery, except electrical	0.69 (27)	5.93	0.74 (28)	5.55	0.50 (24)	5.93	0.50 (27)	5.51
28	Electrical machinery	0.81 (26)	5.96	1.06 (14)	4.64	0.32 (26)	5.96	0.45 (30)	4.28
29	Railroad equipment	0.89 (22)	6.00	0.95 (25)	5.62	0.19 (30)	6.00	1.91 (3)	5.89
30	Transport equipment	0.97 (13)	5.63	1.07 (12)	5.12	0.53 (23)	5.63	0.60 (25)	4.88
31	Repair of transport equipment	0.89 (22)	6.00	1.01 (21)	5.29	1.71 (7)	6.00	1.78 (5)	5.75
32	Motorcycles and bicycles	1.06 (10)	6.00	1.29 (5)	4.96	0.39 (25)	6.00	0.51 (29)	4.63
33	Scientific and surgical instruments	0.90 (20)	6.00	0.95 (25)	5.65	0.98 (15)	6.00	1.03 (15)	5.72
34	Miscellaneous industries	0.91 (19)	5.87	1.21 (10)	4.12	0.75 (19)	5.87	1.03 (14)	4.20
35	Construction	0.89 (22)	6.00	1.24 (7)	4.46	1.82 (5)	6.00	2.33 (1)	6.00
36	Electricity	0.14 (33)	4.09	0.94 (26)	6.00	1.21 (11)	4.09	0.83 (18)	6.00

(continued)

Table 46—Continued

Sector Number	Sector	Z-Matrix				Y-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	2.53 (4)	4.22	1.75 (2)	5.40	0.47 (19)	4.22	0.42 (23)	4.34
2	Rice	1.77 (5)	5.14	1.66 (7)	5.43	0.37 (24)	5.14	0.47 (21)	4.28
3	Maize	1.51 (8)	5.95	1.68 (6)	5.33	0.20 (30)	5.95	0.32 (27)	4.00
4	Cotton	1.38 (11)	5.75	1.46 (10)	5.45	0.07 (36)	5.75	0.17 (33)	3.09
5	Sugarcane	1.75 (6)	5.07	1.73 (4)	5.11	0.17 (31)	5.07	0.24 (31)	3.78
6	Gram and pulses	1.55 (7)	5.55	1.65 (8)	5.24	0.25 (29)	5.55	0.28 (29)	4.85
7	Oilseeds	1.31 (12)	3.45	0.79 (22)	5.13	0.14 (34)	3.45	0.10 (36)	4.02
8	Bajra	1.49 (9)	6.00	1.74 (3)	5.15	0.15 (33)	6.00	0.20 (32)	4.51
9	Other agriculture and forestry	2.98 (2)	2.88	1.37 (12)	5.41	0.26 (28)	2.88	0.14 (34)	4.42
10	Animal husbandry	3.95 (1)	2.46	1.71 (5)	5.44	0.51 (16)	2.46	0.31 (28)	4.20
11	Dairy products	0.11 (34)	5.97	0.85 (18)	4.09	6.92 (1)	5.97	7.15 (1)	5.77
12	Grain mill products	0.17 (30)	5.82	1.60 (9)	3.49	3.13 (4)	5.82	3.38 (3)	5.39
13	Sugar and confectionery	0.12 (33)	5.32	0.42 (31)	3.92	0.46 (20)	5.32	0.47 (20)	5.20
14	Edible oils and other food-processing industries	0.28 (29)	5.90	0.73 (23)	2.70	0.97 (10)	5.90	1.28 (8)	4.47
15	Breweries and beverages	0.05 (36)	6.00	0.09 (34)	3.76	0.10 (35)	6.00	0.13 (35)	4.46
16	Textiles	0.75 (18)	5.29	0.77 (20)	5.22	0.95 (11)	5.29	1.05 (9)	4.87
17	Cotton ginning, pressing, and other textiles	0.11 (35)	4.84	0.63 (27)	4.00	2.62 (5)	4.84	2.19 (4)	5.79
18	Sawmills and wooden containers	0.56 (24)	5.81	1.36 (13)	3.89	0.87 (13)	5.81	0.66 (15)	5.06
19	Furniture and fixtures	0.67 (11)	6.00	1.19 (15)	3.94	3.45 (2)	6.00	3.64 (2)	5.68
20	Printing and publishing	0.42 (27)	6.00	0.49 (29)	5.14	0.15 (32)	6.00	0.26 (30)	3.92
21	Rubber and leather products	0.65 (21)	5.03	0.67 (25)	4.87	0.40 (22)	5.03	0.52 (18)	4.09
22	Basic chemicals, including fertilizers	0.81 (4)	3.90	0.74 (21)	4.51	3.15 (3)	3.90	2.18 (5)	5.69
23	Other chemicals	0.15 (32)	5.00	0.18 (33)	4.23	0.55 (15)	5.00	0.60 (16)	4.74
24	Glass and mineral products	0.77 (17)	4.57	0.59 (28)	5.80	0.49 (17)	4.57	0.38 (25)	5.81
25	Basic metal industries	0.43 (26)	2.78	0.21 (32)	5.39	2.37 (6)	2.78	1.09 (10)	5.93
26	Metal products	0.65 (22)	5.00	0.63 (26)	5.12	0.56 (14)	5.00	0.82 (12)	4.03
27	Machinery, except electrical	0.16 (31)	5.93	0.21 (32)	4.61	0.49 (18)	5.93	0.53 (17)	5.47
28	Electrical machinery	0.35 (28)	5.96	0.46 (30)	4.42	1.01 (9)	5.96	1.37 (7)	4.51
29	Railroad equipment	1.40 (16)	6.00	1.45 (11)	5.77	0.39 (23)	6.00	0.97 (22)	4.99
30	Transport equipment	0.66 (20)	5.63	0.73 (23)	5.04	0.89 (12)	5.63	1.00 (11)	5.02
31	Repair of transport equipment	0.79 (15)	6.00	0.88 (17)	5.34	0.30 (27)	6.00	0.42 (24)	4.41
32	Motorcycles and bicycles	0.59 (23)	6.00	0.70 (24)	5.01	1.20 (7)	6.00	1.50 (6)	4.85
33	Scientific and surgical instruments	1.21 (13)	6.00	1.26 (14)	5.77	0.32 (26)	6.00	0.37 (26)	5.21
34	Miscellaneous industries	0.55 (25)	5.87	0.85 (19)	3.86	0.46 (20)	5.87	0.66 (14)	4.09
35	Construction	0.77 (16)	6.00	1.03 (16)	4.54	0.34 (25)	6.00	0.51 (19)	4.19
36	Electricity	2.61 (3)	4.09	1.79 (1)	6.00	1.17 (8)	4.09	0.80 (13)	6.00

Source: Y. K. Alagh, G. S. Bhalla, and S. P. Kashyap, *Structural Analysis of Gujarat, Punjab, and Haryana Economies—An Input-Output Study* (New Delhi: Allied, 1980), App. 2.10, 216-220.

Note: Figures in parentheses indicate rank.

Table 47—Linkage analysis of Punjab's economy, without import leakages, 1979/80

Sector Number	Sector	Z-Matrix						Y-Matrix					
		U_i		V_i	U_j		V_j	U_i		V_i	U_j		V_j
1	Wheat	1.15	(11)	3.66	0.74	(29)	4.82	1.59	(7)	3.66	0.96	(25)	5.09
2	Rice	0.63	(26)	5.55	0.69	(30)	5.06	1.07	(14)	5.55	1.09	(17)	5.48
3	Cotton	0.75	(23)	4.71	0.68	(31)	5.12	1.33	(9)	4.71	1.12	(14)	5.51
4	Sugarcane	1.07	(14)	3.87	0.65	(34)	5.45	2.13	(5)	3.87	1.23	(3)	5.74
5	Gram and pulses	0.63	(27)	5.72	0.63	(36)	5.70	1.18	(11)	5.72	1.17	(7)	5.81
6	Oilseeds	0.96	(17)	3.98	0.64	(35)	5.41	1.92	(6)	3.98	1,.21	(4)	5.70
7	Other agriculture and forestry	1.13	(12)	3.23	0.59	(37)	6.00	2.32	(3)	3.23	1.20	(5)	6.10
8	Animal husbandry	1.34	(8)	2.66	0.84	(26)	4.16	2.34	(2)	2.66	1.27	(2)	4.76
9	Dairy products and confectionery	0.83	(19)	4.45	1.20	(11)	3.24	0.48	(26)	4.45	1.04	(19)	2.83
10	Grain mill products	0.75	(22)	4.71	1.17	(15)	3.51	0.16	(39)	4.71	0.96	(24)	3.47
11	Bakery products	0.55	(36)	6.23	1.24	(8)	2.87	0.47	(27)	6.23	1.13	(12)	2.70
12	Sugar	0.76	(21)	4.55	1.03	(24)	3.94	0.33	(33)	4.55	1.10	(16)	4.22
13	Other food industries	0.60	(31)	5.80	1.08	(21)	3.32	0.41	(30)	5.80	1.13	(10)	2.74
14	Edible oils	1.12	(13)	4.93	1.43	(1)	4.00	0.21	(38)	4.93	1.02	(20)	3.54
15	Breweries and beverages	0.61	(29)	6.21	1.25	(5)	3.06	0.25	(37)	6.21	0.50	(21)	2.04
16	Ginning and textiles	1.59	(3)	4.19	1.37	(2)	4.88	0.71	(21)	4.19	0.93	(29)	3.49
17	Sawmills and wooden goods	1.19	(9)	4.42	1.16	(16)	4.54	1.15	(12)	4.42	1.13	(11)	4.53
18	Paper, printing, and publishing	1.15	(10)	4.23	1.18	(14)	4.17	1.01	(16)	4.23	1.06	(18)	4.13
19	Rubber and leather products	1.35	(6)	3.84	1.19	(12)	4.24	0.88	(19)	3.84	0.95	(27)	3.58
20	Basic chemicals, including fertilizers	1.50	(4)	2.47	0.75	(28)	4.89	0.93	(17)	2.47	0.58	(38)	4.01
21	Drugs and pharmaceuticals	0.71	(24)	5.49	1.27	(3)	3.09	0.30	(36)	5.49	0.94	(28)	2.10
22	Other chemicals	0.92	(18)	4.59	1.25	(7)	3.43	0.35	(31)	4.59	0.96	(23)	2.31
23	Glass and mineral products	1.35	(7)	4.48	1.25	(4)	4.79	1.26	(10)	4.48	1.18	(6)	4.79
24	Basic metal industries	3.21	(1)	1.86	1.14	(18)	4.27	0.72	(20)	1.86	0.53	(39)	2.76
25	Metal products	1.39	(5)	2.83	1.24	(9)	3.63	0.70	(22)	2.83	0.70	(36)	3.21
26	Machinery, except electrical	0.61	(30)	5.80	1.15	(17)	3.44	0.32	(34)	5.80	0.68	(37)	3.11
27	Electrical machinery	0.62	(28)	5.61	1.22	(10)	3.18	0.32	(35)	5.61	0.73	(35)	2.81
28	Railroad equipment	0.60	(32)	6.11	1.03	(23)	3.67	0.65	(23)	6.11	0.96	(26)	4.14
29	Motor vehicles, manufacture and repair	0.59	(34)	5.97	1.05	(22)	3.61	0.54	(24)	5.97	0.84	(32)	3.92
30	Bicycles and parts	0.59	(35)	6.07	1.19	(13)	3.24	0.46	(28)	6.07	0.87	(31)	3.32
31	Scientific and surgical instruments	0.64	(25)	5.78	1.13	(19)	3.49	0.45	(29)	5.78	0.81	(34)	3.38
32	Sports and athletic goods	0.55	(38)	6.24	1.25	(6)	2.96	0.34	(32)	6.24	0.96	(22)	2.45
33	Miscellaneous industries	0.59	(33)	5.83	0.68	(32)	5.10	1.01	(15)	5.83	1.11	(15)	5.33
34	Electricity, gas, and water supply	1.03	(16)	3.39	0.59	(38)	6.07	1.46	(8)	3.39	0.83	(33)	6.06
35	Construction	0.55	(38)	6.24	1.12	(20)	3.30	0.48	(25)	6.24	1.12	(13)	3.25
36	Trade, transport, and storage	2.97	(2)	1.32	0.78	(27)	5.01	4.61	(1)	1.32	1.14	(9)	5.30
37	Other services	0.82	(20)	4.43	0.95	(25)	3.88	1.10	(13)	4.43	1.15	(8)	4.27
38	Banking and insurance	1.06	(15)	3.48	0.65	(33)	5.70	2.17	(4)	3.48	1.29	(1)	5.90
39	Real estate and ownership of dwellings	0.55	(38)	6.24	0.56	(39)	6.19	0.89	(18)	6.24	0.90	(30)	6.20

(continued)

Table 47—Continued

Sector Number	Sector	W-Matrix				N-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	0.93 (14)	3.66	0.61 (36)	4.65	1.52 (11)	3.66	0.86 (24)	5.43
2	Rice	0.80 (20)	5.55	0.83 (24)	5.35	1.59 (9)	5.55	1.49 (7)	5.93
3	Cotton	0.91 (15)	4.71	0.79 (26)	5.34	1.79 (8)	4.71	1.43 (8)	5.81
4	Sugarcane	1.14 (9)	3.87	0.69 (33)	5.50	2.17 (4)	3.87	1.24 (11)	5.80
5	Gram and pulses	0.75 (21)	5.72	0.76 (29)	5.66	1.53 (10)	5.72	1.50 (6)	5.84
6	Oilseeds	0.71 (24)	3.98	0.50 (37)	5.17	1.23 (14)	3.98	0.82 (25)	5.46
7	Other agriculture and forestry	1.39 (7)	3.23	0.72 (32)	6.04	2.75 (3)	3.23	1.41 (9)	6.13
8	Animal husbandry	1.66 (6)	2.66	0.94 (19)	4.56	3.27 (1)	2.66	1.68 (3)	5.04
9	Dairy products and confectionery	0.19 (38)	4.45	0.79 (27)	2.43	0.15 (37)	4.45	0.94 (19)	3.17
10	Grain mill products	0.20 (36)	4.71	0.78 (28)	2.84	0.23 (32)	4.71	0.92 (20)	3.51
11	Bakery products	0.75 (22)	6.23	1.31 (7)	3.59	0.94 (15)	6.23	1.58 (5)	3.73
12	Sugar	0.35 (33)	4.55	0.80 (25)	3.56	0.42 (28)	4.55	1.15 (14)	4.22
13	Other food industries	0.43 (28)	5.80	1.00 (15)	2.80	0.47 (25)	5.80	1.24 (13)	2.95
14	Edible oils	0.20 (37)	4.93	0.73 (31)	2.72	0.20 (34)	4.93	0.79 (29)	3.08
15	Breweries and beverages	0.11 (39)	6.21	0.87 (22)	1.97	0.13 (38)	6.21	0.77 (30)	1.64
16	Ginning and textiles	0.93 (13)	4.19	1.04 (14)	3.88	0.92 (16)	4.19	1.11 (16)	3.74
17	Sawmills and wooden goods	1.84 (5)	4.42	1.67 (4)	4.90	2.12 (5)	4.42	1.79 (1)	5.23
18	Paper, printing, and publishing	1.88 (4)	4.23	1.76 (2)	4.57	2.06 (6)	4.23	1.77 (2)	4.97
19	Rubber and leather products	1.22 (8)	3.84	1.19 (11)	3.90	1.37 (12)	3.84	1.24 (12)	4.16
20	Basic chemicals, including fertilizers	0.45 (27)	2.47	0.41 (39)	3.02	0.16 (36)	2.47	0.20 (39)	2.29
21	Drugs and pharmaceuticals	0.37 (32)	5.49	1.00 (16)	2.38	0.44 (27)	5.49	1.00 (17)	2.60
22	Other chemicals	0.39 (30)	4.59	0.79 (20)	2.42	0.45 (26)	4.59	1.00 (18)	2.70
23	Glass and mineral products	0.85 (17)	4.48	0.99 (17)	4.10	0.91 (17)	4.48	0.87 (22)	4.68
24	Basic metal industries	0.73 (23)	1.86	0.62 (34)	3.02	0.65 (20)	1.86	0.48 (35)	2.63
25	Metal products	1.05 (10)	2.83	0.95 (18)	3.53	1.24 (13)	2.83	0.86 (23)	4.09
26	Machinery, except electrical	0.37 (31)	5.80	0.83 (23)	3.15	0.34 (31)	5.80	0.65 (32)	3.21
27	Electrical machinery	0.21 (35)	5.61	0.74 (30)	2.67	0.22 (33)	5.61	0.58 (33)	2.42
28	Railroad equipment	0.87 (16)	6.11	1.27 (9)	4.24	0.51 (24)	6.11	0.81 (26)	3.88
29	Motor vehicles, manufacture and repair	0.83 (18)	5.97	1.19 (10)	4.22	0.91 (18)	5.97	1.13 (15)	4.77
30	Bicycles and parts	0.34 (34)	6.07	0.88 (21)	2.81	0.39 (30)	6.07	0.79 (27)	3.12
31	Scientific and surgical instruments	0.58 (25)	5.78	1.05 (13)	3.41	0.59 (22)	5.78	0.90 (21)	3.81
32	Sports and athletic goods	0.48 (26)	6.24	1.27 (8)	2.65	0.55 (23)	6.24	1.27 (10)	2.92
33	Miscellaneous industries	1.02 (12)	5.83	1.12 (12)	5.32	0.12 (39)	5.83	0.30 (38)	2.98
34	Electricity, gas, and water supply	1.05 (11)	3.39	0.62 (35)	5.89	0.63 (21)	3.39	0.36 (37)	5.93
35	Construction	0.80 (19)	6.24	1.63 (5)	3.60	0.19 (35)	6.24	0.71 (31)	2.55
36	Trade, transport, and storage	6.99 (1)	1.32	1.72 (3)	5.34	2.76 (2)	1.32	0.79 (28)	4.63
37	Other services	2.18 (3)	4.43	2.02 (1)	4.83	1.82 (7)	4.43	1.64 (4)	4.92
38	Banking and insurance	2.66 (2)	3.48	1.61 (6)	5.81	0.89 (19)	3.48	0.57 (34)	5.46
39	Real estate and ownership of dwellings	0.42 (29)	6.24	0.43 (38)	6.10	0.40 (29)	6.24	0.41 (36)	6.13

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).
Note: Figures in parentheses indicate rank.

Table 48—Linkage analysis of Punjab's economy, with import leakages, 1979/80

Sector Number	Sector	R-Matrix				Y'-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	1.72 (4)	4.10	1.17 (13)	5.38	2.15 (4)	4.10	1.44 (10)	5.46
2	Rice	1.06 (14)	5.74	1.09 (16)	5.59	1.63 (8)	5.74	1.62 (5)	5.77
3	Cotton	1.10 (12)	5.13	1.00 (81)	5.56	1.76 (7)	5.13	1.56 (8)	5.74
4	Sugarcane	1.16 (11)	5.28	1.06 (17)	5.70	2.08 (5)	5.28	1.86 (3)	5.85
5	Gram and pulses	0.56 (30)	5.88	0.57 (33)	5.76	0.96 (16)	5.88	0.96 (23)	5.84
6	Oilseeds	0.80 (25)	4.83	0.66 (32)	5.65	1.44 (12)	4.83	1.16 (15)	5.81
7	Other agriculture and forestry	0.98 (20)	4.48	0.72 (31)	6.08	1.83 (6)	4.48	1.33 (12)	6.13
8	Animal husbandry	1.64 (5)	3.66	1.32 (10)	4.59	2.58 (3)	3.66	1.86 (2)	5.08
9	Dairy products and confectionery	0.50 (33)	5.37	0.76 (29)	3.63	0.26 (29)	5.37	0.60 (30)	3.13
10	Grain mill products	0.91 (24)	5.39	1.55 (6)	3.76	0.17 (35)	5.40	1.13 (17)	3.76
11	Bakery products	0.50 (32)	6.23	0.90 (25)	3.55	0.38 (27)	6.23	0.72 (26)	3.36
12	Sugar	0.29 (35)	5.40	0.44 (34)	4.09	0.11 (37)	5.40	0.42 (32)	4.29
13	Other food industries	0.67 (27)	5.99	1.06 (19)	3.82	0.41 (26)	5.99	0.98 (22)	2.97
14	Edible oils	1.04 (17)	5.54	1.31 (11)	4.45	0.17 (34)	5.54	0.70 (27)	3.21
15	Breweries and beverages	0.61 (29)	6.24	0.94 (23)	4.01	0.23 (32)	6.24	0.63 (29)	2.65
16	Ginning and textiles	1.93 (3)	4.74	1.79 (1)	5.11	0.78 (18)	4.74	1.07 (19)	3.72
17	Sawmills and wooden goods	1.04 (15)	5.19	1.06 (18)	5.07	0.91 (17)	5.19	0.96 (24)	4.94
18	Paper, printing, and publishing	0.24 (37)	5.05	0.26 (37)	4.81	0.19 (33)	5.05	0.21 (37)	4.64
19	Rubber and leather products	1.04 (16)	4.20	0.89 (26)	4.78	0.61 (23)	4.20	0.64 (28)	4.00
20	Basic chemicals, including fertilizers	0.65 (28)	3.46	0.42 (35)	5.28	0.36 (28)	3.46	0.29 (35)	4.36
21	Drugs and pharmaceuticals	0.02 (39)	5.55	0.03 (39)	4.28	0.01 (39)	5.55	0.02 (39)	2.92
22	Other chemicals	0.05 (38)	5.49	0.07 (38)	4.14	0.02 (38)	5.49	0.05 (38)	2.66
23	Glass and mineral products	1.16 (10)	5.10	1.12 (15)	5.27	0.98 (15)	5.10	0.99 (21)	5.11
24	Basic metal industries	2.29 (2)	2.38	1.02 (20)	4.67	0.47 (25)	2.38	0.40 (34)	3.19
25	Metal products	1.64 (6)	3.92	1.61 (4)	4.17	0.75 (21)	3.92	0.84 (25)	3.79
26	Machinery, except electrical	0.49 (34)	6.00	0.76 (30)	4.04	0.24 (31)	6.00	0.42 (33)	3.70
27	Electrical machinery	0.51 (31)	5.94	0.79 (28)	3.99	0.24 (30)	5.94	0.42 (31)	3.62
28	Railroad equipment	1.07 (13)	6.16	1.50 (7)	4.41	1.04 (14)	6.16	1.35 (11)	4.74
29	Motor vehicles, manufacture and repair	0.93 (23)	6.07	1.35 (8)	4.30	0.78 (19)	6.07	1.05 (20)	4.55
30	Bicycles and parts	1.02 (18)	6.13	1.65 (3)	3.89	0.71 (22)	6.13	1.14 (16)	3.94
31	Scientific and surgical instruments	0.25 (36)	5.83	0.35 (36)	4.22	0.16 (36)	5.83	0.24 (36)	4.06
32	Sports and athletic goods	0.98 (22)	6.24	1.60 (5)	3.88	0.54 (24)	6.24	1.08 (18)	3.25
33	Miscellaneous industries	0.71 (26)	5.97	0.79 (27)	5.41	1.10 (13)	5.97	1.20 (13)	5.51
34	Electricity, gas, and water supply	1.25 (9)	4.40	0.91 (24)	6.11	1.60 (9)	4.40	1.16 (14)	6.09
35	Construction	0.98 (21)	6.24	1.68 (2)	3.85	0.77 (20)	6.24	1.57 (7)	3.63
36	Trade, transport, and storage	3.43 (1)	2.06	1.31 (12)	5.32	4.81 (1)	2.06	1.78 (4)	5.46
37	Other services	1.32 (8)	4.94	1.34 (9)	4.89	1.59 (10)	4.94	1.62 (6)	4.90
38	Banking and insurance	1.48 (7)	4.48	1.15 (14)	5.82	2.73 (2)	4.48	2.07 (1)	5.95
39	Real estate and ownership of dwellings	0.98 (19)	6.24	0.99 (22)	6.20	1.45 (11)	6.24	1.45 (9)	6.20

(continued)

Table 48—Continued

Sector Number	Sector	W′-Matrix				N′-Matrix			
		U_i	V_i	U_j	V_j	U_i	V_i	U_j	V_j
1	Wheat	1.24 (4)	4.10	0.91 (19)	5.04	2.10 (8)	4.10	1.40 (10)	5.62
2	Rice	1.20 (8)	5.74	1.23 (10)	5.62	2.48 (4)	5.74	2.36 (3)	6.02
3	Cotton	1.20 (7)	5.13	1.09 (15)	5.58	2.43 (5)	5.13	2.10 (4)	5.90
4	Sugarcane	1.10 (5)	5.28	1.02 (16)	5.65	2.16 (7)	5.28	1.93 (5)	5.86
5	Gram and pulses	0.60 (16)	5.88	0.62 (26)	5.71	1.26 (12)	5.88	1.27 (12)	5.87
6	Oilseeds	0.53 (12)	4.83	0.47 (31)	5.36	0.95 (16)	4.83	0.80 (23)	5.55
7	Other agriculture and forestry	1.09 (6)	4.48	0.80 (24)	6.08	2.22 (6)	4.48	1.61 (6)	6.15
8	Animal husbandry	1.82 (3)	3.66	1.37 (9)	4.89	3.70 (1)	3.66	2.55 (1)	5.30
9	Dairy products and confectionery	0.10 (29)	5.37	0.44 (32)	2.66	0.08 (36)	5.37	0.54 (27)	3.52
10	Grain mill products	0.21 (35)	5.39	0.92 (17)	3.04	0.25 (29)	5.39	1.13 (14)	3.75
11	Bakery products	0.61 (27)	6.23	0.91 (18)	4.17	0.79 (19)	6.23	1.13 (15)	4.36
12	Sugar	0.12 (37)	5.40	0.46 (29)	3.64	0.15 (33)	5.40	0.46 (29)	4.26
13	Other food industries	0.43 (26)	5.99	0.89 (20)	3.10	0.48 (24)	5.99	1.10 (18)	3.17
14	Edible oils	0.16 (34)	5.54	0.55 (27)	2.85	0.17 (31)	5.54	0.57 (26)	2.85
15	Breweries and beverages	0.10 (32)	6.24	0.53 (28)	2.49	0.12 (35)	6.24	0.42 (30)	2.08
16	Ginning and textiles	1.01 (18)	4.74	1.21 (11)	4.09	1.03 (14)	4.74	1.32 (11)	3.95
17	Sawmills and wooden goods	1.45 (17)	5.19	1.45 (7)	5.19	1.71 (9)	5.19	1.60 (7)	5.55
18	Paper, printing, and publishing	0.36 (33)	5.05	0.37 (34)	4.96	0.40 (26)	5.05	0.38 (32)	5.39
19	Rubber and leather products	0.84 (23)	4.20	0.81 (22)	4.32	0.97 (15)	4.20	0.87 (22)	4.58
20	Basic chemicals, including fertilizers	0.17 (28)	3.46	0.20 (37)	3.38	0.06 (37)	3.46	0.09 (37)	2.95
21	Drugs and pharmaceuticals	0.01 (39)	5.55	0.02 (39)	3.21	0.01 (39)	5.55	0.02 (39)	3.64
22	Other chemicals	0.02 (38)	5.49	0.04 (38)	2.86	0.02 (38)	5.49	0.05 (38)	3.11
23	Glass and mineral products	0.66 (15)	5.10	0.80 (23)	4.42	0.73 (20)	5.10	0.72 (24)	5.14
24	Basic metal industries	0.47 (25)	2.38	0.48 (30)	3.31	0.43 (25)	2.38	0.36 (33)	3.05
25	Metal products	1.12 (21)	3.92	1.19 (12)	3.98	1.35 (10)	3.92	1.12 (16)	4.72
26	Machinery, except electrical	0.27 (31)	6.00	0.52 (29)	3.61	0.26 (28)	6.00	0.41 (31)	3.90
27	Electrical machinery	0.16 (30)	5.94	0.41 (33)	3.23	0.17 (32)	5.94	0.32 (34)	3.29
28	Railroad equipment	1.39 (14)	6.15	1.80 (5)	4.77	0.84 (18)	6.16	1.12 (17)	4.63
29	Motor vehicles, manufacture and repair	1.17 (19)	6.07	1.52 (6)	4.73	1.33 (11)	6.07	1.52 (8)	5.30
30	Bicycles and parts	0.52 (22)	6.13	1.11 (14)	3.28	0.62 (23)	6.13	1.03 (19)	3.81
31	Scientific and surgical instruments	0.20 (36)	5.83	0.30 (36)	4.03	0.21 (30)	5.83	0.27 (36)	4.63
32	Sports and athletic goods	0.76 (24)	6.24	1.45 (8)	3.42	0.90 (17)	6.24	1.49 (9)	3.84
33	Miscellaneous industries	1.10 (13)	5.97	1.19 (13)	5.56	0.13 (34)	5.97	0.28 (35)	3.48
34	Electricity, gas, and water supply	1.14 (9)	4.40	0.85 (21)	5.94	0.70 (21)	4.40	0.51 (28)	6.02
35	Construction	1.27 (20)	6.24	2.36 (4)	3.90	0.31 (37)	6.24	0.93 (20)	2.99
36	Trade, transport, and storage	7.24 (1)	2.06	2.68 (2)	5.47	2.94 (2)	2.06	1.22 (13)	4.92
37	Other services	3.15 (10)	4.94	2.95 (1)	5.31	2.70 (3)	4.94	2.42 (2)	5.52
38	Banking and insurance	3.32 (2)	4.48	2.55 (3)	5.87	1.14 (13)	4.48	0.92 (21)	5.61
39	Real estate and ownership of dwellings	0.67 (11)	6.24	0.69 (25)	6.10	0.67 (22)	6.24	0.68 (25)	6.14

Source: Based on author's calculations from Punjab input-output table for 1979/80 (Table 44, Appendix 1).
Note: Figures in parentheses indicate ranks.

APPENDIX 2: DESCRIPTION OF SECTORS IN THE PUNJAB ECONOMY, 1979/80

Sector Number	Description[13]
1	Wheat
2	Rice
3	Cotton
4	Sugarcane
5	Gram and pulses
6	Oilseeds
7	Other agriculture and forestry—*Jowar,* maize, *bajra,* barley, potatoes, chilies, green fodder, jute, vegetables, fruits. Planting, replanting, and conservation of forests; gathering of uncultivated materials; charcoal-burning carried out in the forests; felling and rough cutting of trees; hewing or rough shaping of poles, blocks, and so forth; transportation of logs to the permanent lines of transport.
8	Animal husbandry—Breeding and rearing of animals and poultry, including veterinary services; production of milk and milk products; slaughtering, preparing, and dressing of meat; production of raw hides and skins, eggs, and raw wool; hunting and trapping.
9	Dairy products and confectionery—Manufacture of dairy products (201), sugar confectionery, cocoa and chocolates (including sweetmeats).
10	Grain mill products—Manufacture of grain mill products (204).
11	Bakery products—Manufacture of bakery products (205).
12	Sugar—Manufacture and refining of sugar (206); production of indigenous sugar, *gur, khandsari,* and so forth (207).
13	Other food industries (see edible oils)—Manufacture of other food products, for example, slaughtering, preparing, and preserving of meat (200); canning and preserving of fruits and vegetables (202); production of common salt (208); manufacture of ice (215); manufacture of starch (217); manufacture of prepared animal feeds (218); manufacture of food products not elsewhere classified (219); manufacture of chewing tobacco, *zarda,* and snuff (228).
14	Edible oils (14 contains other foods and edible oils)—Manufacture of hydrogenated oils, *vanaspati ghee,* and so forth (210); manufacture of other edible oils and fats (211).

[13] Figures within parentheses indicate industry codes according to the National Industrial Classification, 1970.

Sector Number	Description
15	Breweries and beverages—Distilling, rectifying, and blending of spirits (220); wine industries (221); malt liquors and malt (222); production of country liquor and toddy (223); soft drinks and carbonated water (224).
16	Ginning and textiles—Manufacture of cotton textiles (230-239); manufacture of wool, silk, and synthetic fiber textiles (240-249); manufacture of textile products (including wearing apparel other than footwear) (260-269).
17	Sawmills and wooden goods—Manufacture of wood products, furniture, and fixtures (270-279).
18	Paper, printing, and publishing—Manufacture of paper and paper products, and printing, publishing, and allied industries (280-289); manufacture of stationery articles (387).
19	Rubber and leather products—Manufacture of leather and fur products, except repair (290-299); manufacture of rubber, plastic, petroleum, and coal products (300-307).
20	Basic chemicals, including fertilizers—Manufacture of basic industrial organic and inorganic chemicals (310); manufacture of fertilizers and pesticides (311).
21	Drugs and pharmaceuticals—Manufacture of drugs and medicines (313).
22	Other chemicals—Manufacture of paints and varnishes (312); manufacture of perfumes (314); manufacture of inedible oils (315); manufacture of turpentine, synthetic resins, plastic materials, and synthetic fibers such as nylon and terylene, except glass (316); manufacture of matches (317); manufacture of chemical products not elsewhere classified (319).
23	Glass and mineral products—Manufacture of nonmetallic mineral products (320-329); mining.
24	Basic metal industries—Basic metal and alloy industries (330-339).
25	Metal products—Manufacture of metal products and parts, except machinery and transport equipment (340-349).
26	Machinery, except electrical—Manufacture of machine tools and parts, except electrical machinery (350-359).
27	Electrical machinery—Manufacture of electrical machinery, apparatus, appliances, and supplies and parts (360-369).
28	Railroad equipment—Manufacture of locomotive parts (371); manufacture of railway wagons and coaches and parts (372).
29	Motor vehicles, manufacture and repair—Manufacture of motor vehicles and parts (374); manufacture of motorcycles, scooters, and parts (375); manufacture of transport equipment not elsewhere classified (379); repair of motor vehicles (373).

Sector Number	Description
30	Bicycles and parts—Manufacture of bicycles, cycle-rickshaws, and parts (376).
31	Scientific and surgical instruments—Manufacture of medical, surgical, and scientific equipment (380); manufacture of photographic and optical goods (381).
32	Sports and athletic goods—Manufacture of sports and athletic goods (385).
33	Miscellaneous industries—Other manufacturing industries, watches and clocks (382); manufacture of jewelry and related articles (383); manufacture of musical instruments (386); manufacture of miscellaneous products not elsewhere classified, such as costume jewelry, costume novelties, feather plumes, artificial flowers, brooms, brushes, lampshades, tobacco pipes, cigarette holders, ivory goods, badges, wigs, and similar articles (389).
34	Electricity, gas, and water supply—Generation and transmission of electric energy (400); distribution of electric energy to household, industrial, commercial, and other users (401); distribution of gas (410); water supply collection and purification, and distribution of water (420).
35	Construction—Construction, repair, and demolition of buildings, highways, streets and culverts, sewers and water mains, railway roadbeds, railroad subways, elevated highways, bridges, viaducts, drainage projects, and all other types of heavy construction; land draining and reclamation; waterways, water wells, airports and air strips, athletic fields, tennis courts, parking areas, communication systems such as telegraph and telephone lines, and all other construction. Also includes construction, repair, and demolition work undertaken as an ancillary activity by the state and for the use of an enterprise classified as any other industry. Thus the scope of this industry covers all own-account construction activities in addition to construction activities carried out by special trade contractors such as carpenters, plumbers, plasterers, and electricians (50-51).
36	Trade, transport, and storage—The activities considered in this sector are wholesale and retail trading (60, 61, 62, 63, 64, 65, 66, 67, 68), auctioneering, hiring out of durable goods and other allied activities: transport by railways; communication services rendered by the post and telegraph department; transport by other means, namely, mechanized and non-mechanized road transport, unorganized water transport, air transport, and services incidental to transport such as packing, carting, and travel agencies (70); operation of storage facilities (74).
37	Other services—Service sector includes education, research services, and libraries; medical and other health services; religious and other community services; legal services; business services; recreation and entertainment services; laundry, cleaning and dyeing, barbers and beauty shops, and other personal services; and services/activities not elsewhere classified, such as hotels, boarding houses, eating houses, cafes, and restaurants.

Sector Number	Description
38	Banking and insurance—Banking and insurance including commercial banks (scheduled and nonscheduled banks); banking department of Reserve Bank of India; post office savings bank accounts, cumulative time-deposit accounts, and national savings certificates; nonbanking financial services (except insurance and credit societies) that include the activities of stock exchanges, loan, investment, hire purchase and chit fund companies, and other nonbanking financial institutions, cooperative credit societies, life insurance (other than postal life insurance), postal life insurance, nonlife insurance such as fire insurance, and so forth.
39	Real estate and ownership of dwellings—Real estate and ownership of dwellings covers the activities of the persons engaged in the real estate sector and rental income originating from the residential dwellings.

APPENDIX 3: METHODOLOGY FOR CALCULATING MULTIPLIERS

Methodology

The basic equational system used in this model is the following:

Let there be n sectors, each producing a domestic output X.

The ith sector disposes of its output and imports to various sectors and to final demand, then

$$X_{i1} + X_{i2} + X_{i3} \ldots\ldots\ldots + X_{in} + f_i = X_i + M_i,$$

where f_i is the domestic final demand (that is, consumption, capital formation, government expenditures, and exports) and M_i is the imports of commodity i.

That is,

$$X_{i1} + X_{i2} + X_{i3} + \ldots. + X_{in} + f_1 - M_i = X_i,$$

or

$$\sum_{j=1}^{n} X_{ij} + f_i - M_i = X_i,$$

where X_{ij} is that part of output of sector i that goes as input into sector j.

Define

$$a_{ij} = \frac{X_{ij}}{X_j} \text{ and } b_i \frac{M_i}{X_i}.$$

The equation system

$$\begin{array}{l}
X_{11} + X_{12} + \ldots\ldots\ldots X_{1n} + f_1 - M_1 = X_1 \\
\vdots \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\
X_{i1} + X_{i2} + \ldots\ldots\ldots X_{in} + f_i - M_i = X_i \\
\vdots \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\
X_{n1} + X_{n2} + \ldots\ldots\ldots X_{nn} + f_n - M_n = X_n
\end{array}$$

now becomes

$$\begin{array}{l}
a_{11}X_1 + a_{12}X_2 + \ldots\ldots\ldots a_{1n}X_n + f_1 - b_1X_1 = X_1 \\
\vdots \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\
a_{i1}X_1 + a_{i2}X_2 + \ldots\ldots\ldots a_{in}X_n + f_i - b_iX_i = X_i \\
\vdots \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\
a_{n1}X_1 + a_{n2}X_2 + \ldots\ldots\ldots a_{nn}X_2 + f_n - b_nX_n = X_n.
\end{array}$$

Transporting and collecting terms:

$$
\begin{aligned}
&(1 + b_1 - a_{11})X_1 - a_{12}X_2 \ldots\ldots\ldots\ldots - a_{1i}X_i \ldots\ldots - a_{1n}X_n = f_1 \\
&\qquad\vdots \\
&- a_{21}X_1 + (1 + b_2 - a_{22})X_2 \ldots - a_{2i}X_i \ldots\ldots - a_{2n}X_n = f_2 \\
&\qquad\vdots \\
&- a_{i1}X_i - a_{i2}X_2 \ldots\ldots + (1 + b_i a_{ii})X_i \ldots\ldots - a_{in}X_n = f_i \\
&\qquad\vdots \\
&- a_{n1}X_1 - a_{n2}X_2 \ldots\ldots - a_{ni}X_i \ldots\ldots + (1 + b_n - a_{nn})X_n = f_n ,
\end{aligned}
$$

or, using matrix notation,

$$
\begin{aligned}
(I + \hat{b} - A)X &= F, \quad \text{or} \\
(I + \hat{b} - A)^{-1}F &= X,
\end{aligned}
$$

where I is the unit matrix of dimension n, $\hat{b}$ is the diagonal matrix with elements b_i, A is the coefficient matrix,

$$
A = \begin{vmatrix}
a_{11}\, a_{12} \ldots\ldots a_{1i} \ldots\ldots a_{1n} \\
a_{21}\, a_{22} \ldots\ldots a_{2i} \ldots\ldots a_{2n} \\
\vdots \\
a_{i1}\, a_{i2} \ldots\ldots a_{ii} \ldots\ldots a_{in} \\
\vdots \\
a_{n1}\, a_{n2} \ldots\ldots a_{ni} \ldots\ldots a_{nn}
\end{vmatrix} ,
$$

and F is a column vector of final demands, so that

$$
F = \begin{vmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{vmatrix} .
$$

Let

$$
(1 + \hat{b} - A)^{-1} = \begin{vmatrix}
A_{11} A_{12} \ldots\ldots\ldots A_{1n} \\
A_{21} A_{22} \ldots\ldots\ldots A_{2n} \\
\vdots \\
A_{n1} A_{n2} \ldots\ldots\ldots A_{nn}
\end{vmatrix} .
$$

The levels of direct and indirect output in the various sectors associated with a unit of final demand in any sector are represented by the relevant vector. Thus, one unit of final demand from sector 1 will lead to the following production levels:

$$\begin{vmatrix} A_{11}A_{12}\ldots\ldots\ldots A_{1n} \\ A_{21}A_{22}\ldots\ldots\ldots A_{2n} \\ \vdots \\ A_{n1}A_{n2}\ldots\ldots\ldots A_{nn} \end{vmatrix} \quad \begin{vmatrix} 1 \\ 0 \\ \\ 0 \end{vmatrix} = \begin{vmatrix} A_{11} \\ A_{21} \\ \vdots \\ A_{n1} \end{vmatrix}.$$

Let

$$V = (v_1\, v_2 \ldots . v_i \ldots . v_n), \tag{1a}$$

where $v_1, v_2 \ldots . v_n$ represent value added per unit of output in the respective sectors.

Therefore, the direct and indirect income generated by one unit of final demand in sector 1 will be

$$\left| V_1 V_2 \ldots . V_i \ldots . V_n \right| \quad \begin{vmatrix} A_{11} \\ A_{21} \\ \vdots \\ A_{n1} \end{vmatrix} = \left| V_1 A_{11} + \ldots + V_n A_{n1} \right|.$$

Similarly, the direct and indirect income generated by one unit of final demand in sector i will be

$$V_1 A_{1i} + V_2 A_{2i} \ldots\ldots\ldots V_n A_{ni}. \tag{2a}$$

Direct and indirect sectoral income multipliers per unit of final demand are given by dividing (2a) by the respective element in (1a).

Since one unit of final demand in sector i gives A_{ii} units of output in that sector, $1/A_{ii}$ units of final demand would yield one unit of output in sector i. Hence, direct and indirect income generated per unit of output in sector i would be given by

$$\frac{1}{A_{ii}} \left| V_1 A_{1i} + V_2 A_{2i} \ldots\ldots\ldots + V_n A_{ni} \right|. \tag{3a}$$

The direct and indirect sectoral income multipliers per unit of output are given by dividing each element of (3a) by the corresponding element in (1a). Direct and indirect sectoral wage income and employment multipliers are obtained similarly.

Direct and Indirect Consumption Multipliers and Induced Incomes

To derive consumption multipliers, the Punjab table was closed with respect to consumption and wage and nonwage income. The closing of the model was done on

the assumption that a certain proportion of net value added in each sector is devoted to consumption. This proportion is derived from the average propensity to consume, which worked out at 0.7171 in 1969/70 and 0.6894 in 1979/80. The augmented column was the coefficient vector for total consumption and the augmented row was obtained by multiplying the net value added by the average propensity to consume.

The $(n + 1, n + 1)$ term of the inverted $(I + \hat{b} - A)$ matrix gives the consumption multiplier.

The respective elements in the last row in the inverted matrix give direct, indirect, and induced income generated per unit of final demand in that sector. Let these be denoted by

$$V_1' V_2' \ldots\ldots\ldots V_n'. \tag{4a}$$

The direct, indirect, and induced sectoral income multipliers per unit of final demand are obtained by dividing the elements of (4a) by their respective direct income given in (1a). Further dividing these elements by the diagonal output levels yields direct, indirect, and induced sectoral incomes per unit of output. These are

$$\frac{V_1'}{A_{11}'} \quad \frac{V_2'}{A_{22}'} \quad \ldots\ldots\ldots \quad \frac{V_n'}{A_{nn}'}, \tag{5a}$$

where $A_{11}', A_{22}' \ldots . A_{ii}' \ldots . A_{nn}'$ are diagonal elements in the inverted augmented matrix. Direct, indirect, and induced sectoral income multipliers per unit of output are obtained by dividing each element of (5a) by the direct sectoral income given in the corresponding element in (1a).

The direct, indirect, and induced sectoral wage income and employment multipliers are obtained similarly.

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