

WHEN THE MARGINAL BECOMES MAINSTREAM: LESSONS FROM
HALF-CENTURY OF DYNAMIC SMALL-FIRM GROWTH IN LUDHIANA, INDIA.

by

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Submitted to the Department of Urban Studies and Planning
in Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY
in Economic Development
at the

Massachusetts Institute of Technology

June 1996

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ABSTRACT

In contrast to the image of inefficiency and stagnation that came to define Indian manufacturing throughout the 1970s and 1980s, Ludhiana's small-firm led industrial base has shown remarkable growth and resilience. It not only grew at rates higher than the national average throughout the post-independence period, but withstood severe downturns in nearly every decade of Punjab's post-1947 industrial history--including a decade long violent separatist movement in the 1980s. This study is an attempt to understand how, and under what conditions, these small, capital constrained firms learned to improve their performance, and over time came to dominate national markets in the key sectors in which they specialized--bicycles, sewing machines, auto-parts, simple machinery, and agricultural implements

On the face of it, this region has neither the high-technology, high wage features idealized by studies of regions like the Third Italy, nor the engineer-based, state guided economic structure exemplified by the East Asian successes. Yet, it borrows elements from both models: firms in the region combine an ability to find new, highly economical ways of producing standard goods, with an ability to constantly learn through reverse engineering, and upgrade and revise their skill-base and production processes.

This ability derives in part from ongoing interaction between three elements: (i) A skilled workforce with diverse paths of skill acquisition, and a knowledge-base built around the mechanic's practical skills, not the engineer's. (ii) State policies that historically shaped the conditions of accumulation in the region by encouraging (vocational) skill formation, indirectly generating demand for local firms early in the region's industrial history, and providing cheap and extensive physical infrastructure throughout the state--roads, rail networks, cheap power, water, serviced land and communication links. (iii) Inter-firm relations that produced, over time, institutions and arrangements that enabled local firms to conserve capital; search out new avenues of demand on an ongoing basis; get cheap and customized feedback from each other; and from a variety of sources given the extensive spread of technicians' skills in the region (e.g, from mechanics, assemblers, distributors,

government bureaucrats and users as a "class"--not only a particular user); and to constantly expose themselves to outside standards towards which they could build.

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Official Exchange Rates

<u>Year</u>	<u>Rupees per U.S. Dollar</u>
1971-71	7.44
1972-73	7.71
1973-74	7.79
1974-75	7.98
1975-76	8.65
1976-77	8.94
1977-78	8.56
1978-79	8.21
1979-80	8.08
1980-81	7.89
1981-82	8.93
1982-83	9.63
1983-84	10.31
1984-85	11.89
1985-86	12.24
1986-87	12.79
1987-88	12.97
1988-89	14.48
1989-90	16.66
1990-91	17.95
1991-92 (post-liberalization)	24.52
1992-93	26.41
1993-94 (unified rate)	31.36
1994-95	31.40

Fiscal Year: April 1 through March 31

Note: Since March 1992 a dual rate was created by the government with the free market rate applying to 60% of foreign exchange transactions. The exchange rate was reunified in March 1993 at the free market rate.

Source: IMF Statistics cited in World Bank 1994:xiii.

Figure 1.1



Map of India showing Punjab

INTRODUCTION

The literature on Punjab evokes two powerful images that are at odds with each other: first, a state ensconced in the development literature since the mid-1960s as an agricultural star performer, the hub of India's green revolution, and a model for other states to follow. Second, since the 1980s, as the site of one of India's most violent separatist struggles. The association of Punjab with its agricultural successes on the one hand, and recent political turmoil on the other, has virtually eclipsed from analysis its other key story. That Punjab has experienced quite sustained and dynamic industrial growth led by small and medium firms.

Until recently, however, the prevalent view among observers inside and outside the state has been that Punjab is industrially "backward" and "lagging" compared to industrial states such as Maharashtra, Gujarat, and Tamil Nadu (Johar and Khanna 1983, Singh M. 1990, Government of India interviews, 1992). According to this view Punjab's industry is lagging because unlike the advanced states which have some of the country's largest and most sophisticated industries, Punjab's industry is dominated by small enterprises; it has very few large firms; very few public sector parastatals; very little direct industrial investment from public or private sources outside the state, especially in core sectors such as heavy engineering, aeronautics, telecommunications or automobiles; and its industrial sector contributes less to state

income than the national average.¹

Contradicting this negative portrayal, however, is a stream of evidence that is starkly at odds with labels of backwardness. Punjab's industrial base, dominated as it is by small and medium firms, has come to exercise significant command over national markets in the sectors in which it specializes--woollen hosiery, metal based manufacturing goods such as bicycles, sewing machines, agricultural implements, auto-parts, and machinery (Pathak 1970, Pandit 1985, Dasgupta 1989, Taub and Taub 1989). Over 4/5ths of the nation's output of woollen hosiery and over 2/3rds of its bicycles and parts production comes from this region (Pandit 1985, Singh S.1990). According to some estimates, nearly 20% of the non-communist world's export of bicycle parts originates in Punjab (Dasgupta 1989:65). Equally important, Punjab's industrial base has shown impressive resilience and growth in the face of severe political instability in the state over the past decades, including the intense disruption caused by separatist violence that raged in the state throughout the 1980s, up to the early 1990s.

This evidence of resilience and sustained industrial growth is clearly at odds with the neglect in the literature of Punjab's industrial story, and the views of industrial weakness associated

¹ In 1990-91 the secondary sector in India contributed 29% to Gross Domestic Product (GDP at factor cost in current prices) compared to 23.2% by Punjab's secondary sector to Gross State Domestic Product (GSDP). Punjab's highly productive primary sector contributed 44.5% to GSDP in the same year, compared to 31% for the nation as a whole (Statistical Outline of India 1992:201, and Statistical Abstract of Punjab 1992:102-103).

with the state.² This gap between the evidence and the labels, I argue, is more because the character of Punjab's industrial success and several of the features that account for it, do not fit the standard analytical accounts of industrial success, nor the path followed by the most industrially advanced parts of India--Maharashtra, Gujarat, Bengal.

The more visible differences between Punjab and the standard industrial picture are as described by the critics cited above: the region has mostly small firms instead of the large and sophisticated corporations that lead industrial growth in other parts of India; it has little public sector investment; and its firms specialize in products that are neither traditional, nor fit into a high-tech niche; there are no traditionally wealthy industrial families or business houses that control investment, nor is there an obvious or direct flow of wealth from the agricultural sector to industry.

This study looks underneath these visible differences to build an understanding of the diverse processes by which the region's predominantly small firms accumulate capital, acquire and deploy skill, build markets, and endure through political turbulence.³ The present study, thus, centers around the lesser

² Only recently have some studies begun to regard Punjab as one of India's "newly industrializing" states (Vepa 1993).

³ Punjab's industrial trajectory is different from standard models of growth, but hardly unique. Howrah, Rajkot, Tirrupur and Coimbatore are four regions in India alone that resemble it, and the growing literature on small and medium firm led regional growth documents several comparable cases. See Tendler and Amorim 1996, Schmitz 1995, Cawthorne 1990, and the work on resurgent regions in

known story of Punjab's industrial success, and the lessons it offers about dynamism in a region dominated by small firms. Focussing on nearly seven decades of small-firm based industrial growth in Punjab, the study attempts to understand how and under what conditions small local firms managed to command a sustained foothold in national and international markets, and grow despite an environment of political instability. The illustrative case at the center of analysis is Punjab's metal-based manufacturing industry concentrated in Ludhiana district.⁴

The Case:

Four hours by road from New Delhi, and well connected to all parts of Punjab by an extensive road and rail network, Ludhiana⁵ is situated along the legendary Grand Trunk Road that linked trade centers from Calcutta in the east, to the Afghan border in the Northwest in the 16th century. Teeming with thousands of manufacturing units producing woollen hosiery and metal based

Europe and the US that inspired some of this work (Piore and Sabel 1984, Pyke et. al 1990).

⁴ The term "district" in India refers to an administrative subdivision within a state. Each district has urban and rural jurisdictions, comprising of towns, cities and villages. Punjab, with a population of 20.2 million, has 12 districts of which Ludhiana is one. Ludhiana district, with a population of 2.4 million, has one metropolis (Ludhiana city, with 1.01 million people), 9 towns, and about 984 villages. (Population figures are for 1991.)

⁵ Most of the field work for this study was carried out in Ludhiana city, the capital of Ludhiana district. The city is part of a network of industrial towns, a contiguous set of industrial agglomerations that stretch around it and which specialize in specific goods and services ranging from steel re-rolling, to bicycles, sewing machines, sports goods, surgical instruments and hand-tools.

engineering goods, Ludhiana region is Punjab's industrial core. Occupying 8% of Punjab's area, with 12% of its population, Ludhiana accounts for 21% (33,176) of Punjab's small firms, 22% (82) of its large firms, 26% of its total industrial output, and in 1991, accounted for 52% of Punjab's industrial exports (Industrial Abstract of Punjab, 1992:402, 579).⁶ With a daily factory employment of 55 workers per 1000 population, compared to 19 for Punjab and 11 for India as a whole, Ludhiana district is clearly Punjab's industrial hub. Tables 1.1 (a) and 1.1 (b) compare Punjab's main indicators with four of India's most industrialized states (Maharashtra, Gujarat, Tamil Nadu, West Bengal) and with Kerala, a state regarded as socially developed but lagging industrially, and the national average. Punjab has the highest per capita income among all states in the country and the lowest percentage of population under poverty. With a long history of land-reform (since the early nineteenth century, when the eighteenth-century ruler, Ranjit Singh, redistributed land rights to the tiller in much of central Punjab, followed by Colonial reforms in the late nineteenth century and further reforms in the 1950s), Punjab's land distribution is relatively less unequal compared to several other states, and is reflected by a low Gini coefficient of 0.24 (Sims 1988:34). The region's

⁶ If only registered firms with 10 employees or more are considered, Ludhiana has an even larger share of Punjab's industrial base. It has 33% of Punjab's registered factories and 37% of the workers employed in these factories (Statistical Abstract of Punjab 1992).

social indicators, while not as spectacular as Kerala's, are better than the national average.

Table 1.1 (a)

Area, population, density and literacy in Ludhiana district (1991)

Region	Area in Sq.Km	Population in millions	Density per sq.km	% Urban Populn.	Literacy (%)
Ludhiana (as % of Punjab)	3,857 (8%)	2.4 (12%)	629 (157%)	50%	58%

Source: Industrial Abstract of Punjab 1992:82-83

Table 1.1 (b)

Per-capita income, area, population, density, and literacy in selected states (1990-91)

State	Per capita Income in Current Rs.	% Urban Poluln.	% Populn. below Poverty#	Density per Sq. Km.	Literacy (%)
Punjab	8423.00	30%	7%	401	57%
Maharashtra	7409.00	39%	29%	256	63%
Gujarat	5404.00*	34%	18%	210	61%
West Bengal	4193.00	27%	28%	766	58%
Tamil Nadu	3894.00*	34%	33%	428	64%
Kerala	3451.00*	26%	17%	747	91%
All India Avg.	4934.00	26%	30%	267	52%

Source: Statistical Abstract of Punjab 1992:118-119, and calculated from Table 3.19 pp. 82-83.

* 1989-90 figures

1987-88 figures (Statistical Outline of India 1992:28)

Note: Goa state had higher per capita income than Punjab (Rs. 3169.00) in 1980-81. 1990-91 figures are not available. Per capita income in Rupees at current prices.

Table 1.2 (a)

Registered small-scale firms in Ludhiana and Punjab, 1991

	Ludhiana	Punjab	India*
No. of units	33,176	160,368	582,368
Employees	209,277	668,845	3,665,810
Workers/unit	6	4	6

Source: Calculated from Statistical Abstract of Punjab 1992, and data from the District Industries Center, Ludhiana, 1992.

* 1988 data.

Table 1.2 (b)

Ludhiana is Punjab's industrial hub: Distribution of registered large and small firms and their workers in Ludhiana and Punjab (1991):

	Ludhiana	(%)	Punjab	Ludhiana as % of Punjab
Total firms	33,258	100%	160,741	21%
Small firms	33,176	>99%	160,368	21%
Large firms	82	0.3%	373	22%
Employment in small	209,277	82%	668,845	31.3%
Employment in large	45,495	18%	187,311	24.3%
Industrial Exports* (Overseas)	4,537.5	--	8,663.04	52.4%

Source: Statistical Abstract of Punjab 1992:402, 403, 579.

* Value of exports in (current) millions of Rupees.

(Figures for industrial exports from Punjab to other Indian states available only in quantity terms [1009 thousand quintals by rail in 1991] and therefore not included in table).

Table 1.3

Comparative data from the Second All-India Census of small-scale registered industries in 1988.

	Ludhiana	Punjab	India
Employment/unit	7	5	6
Fixed capital per unit*	362.0	125.0	160.0
Working capital per unit*	303.0	99.0	125.0
Output/unit*	829.0	612.0	738.0

Source: Second All-India Census of Small-Scale Industrial Units, registered up to 1988. (1992). (All-India Volume:pp. T-75, T-76; Punjab Volume I:pp. 28-29).

* Output, fixed and working capital are in thousands of Rupees.

As Table 1.2 and 1.3 indicate, small firms dominate both Ludhiana and Punjab industrial structure, but Ludhiana's small firms are, on average, slightly larger, more capitalized, and generate more output per firm than do Punjab's or India's small firms taken as a whole. However, Ludhiana district is not only the urban, industrial core of a prosperous agrarian state, it simultaneously has a very dynamic agricultural base of its own as Tables 1.4 through 1.6 indicate,⁷ and has historically been one of Punjab's best performing districts.

⁷ Ludhiana is widely regarded as Punjab's best performing agricultural district. As a researcher observed, if Punjab is the state in India that is "most closely identified with the gains of the green revolution, then within Punjab, no district is more enthusiastically advanced as a model for emulation...than Ludhiana (Frankel 1971:12).

Between 1960-61 and 1967-68 (after green revolution technologies were introduced), for example, the area under irrigation in Ludhiana increased from 45% to 70%. Unlike some other parts of Punjab, this increase was due mainly to the installation of tubewells, not canals. Today, over 99.7% of the net area sown in the district (323,500 Ha.) is irrigated (Statistical Handbook of Punjab 1991:94). Similarly, between 1965-68 Ludhiana's acreage under high yielding varieties increased from a mere 170 acres to a stunning 420,000 acre., amounting to 90% of the acreage under wheat in only three years (Frankel 1971). Today, all the acreage under wheat, 99% of the area under rice, and 75%⁸ of the acreage under corn in the region is sown with high yielding varieties. During 1960-61 and 1967-8 fertilizer consumption rose 17 times, and even today per-capita fertilizer and power consumption by farmers in Ludhiana is the highest in the state and nation. Agricultural wages in the region are amongst the highest in the country (Table 1.6).⁹ And,

⁸ These are 1990-91 figures (Statistical Handbook of Punjab, 1991).

⁹ This is reflective also of the fact that minimum wages in agriculture are very high in Punjab, as are minimum wages for skilled metal and wood-workers. But this does not mean that Punjab's actual industrial wage levels are among the highest. In the industrial sector, skilled workers in states like Maharashtra, Bangalore and Tamil Nadu earn wages that are far above the minimum wage (4-6 times), while skilled production wages in Punjab are moderately over the minimum wage level (2-3 times higher). Thus while semi-skilled workers earn more in Punjab than in many other states, skilled workers earn relatively less. No wonder then, that most firm-owners say skilled labor is relatively "cheap" in Punjab compared to other regions. Among small firms however, Punjab's metal trades pay higher wages in Punjab than the national average for that sector (Second all-India census of small Industrial units

as Tables 1.4 and 1.5 show, even though Ludhiana's working population is dominated by non-agricultural workers (64%), it still leads the nation in key agricultural indicators: yields per acre of wheat and rice, area under irrigation, fertilizer use, and area under high-yielding varieties.

Table 1.4

Distribution of the working population in Punjab and Ludhiana district - 1990-91.

	Ludhiana district	Punjab
Total workers (1991)	758,043	6,036,192
% Cultivators	21%	33%
% Ag. Laborers	15%	23%
% Non-Ag. workers	64%	44%
% Industrial workers	34%	15%
% Service workers	30%	29%

Source: Calculated from the Statistical Abstract 1992:58, 402, and the Economic Survey of Punjab 1992.

in India 1992. All India and Punjab volumes, pp T-79 and T-33 respectively).

Table 1.5

Agricultural indicators for Ludhiana, and India 1990-91: Ludhiana leads the nation.

Region	Yield in Kg/Ha		% under HYV		Ferti- lizer Consp*	Net Irrigated area (%)
	Wheat	Rice	Wheat	Rice		
Ludhiana dist.	4252	3579	100%	98%	240	99.5%
India	2274	1751	86%	62%	72	34.0%

Source: Statistical Abstract of Punjab 1992:158, Statistical Handbook of Punjab 1992:80-81, 88-89, 96; Statistical Outline of India, 1992:9; and Economic Survey of India 1990-91:104

* Fertilizer consumption is of chemical fertilizer in kg. per hectare of gross cropped area (1990-91 figures).

Table 1.6

Punjab is one of India's high wage regions--agricultural wages in Punjab are highest in the nation.

Minimum wages for agricultural workers in selected states: daily rates in Rs. per day in 1989 and 1991.

State	1989	1991
Punjab	29.30 (w/meals) 33.00 (w/o meals)	33.53 (w/meals) 37.53 (w/o meals)
West Bengal	18.02	19.65 (w/meals) 22.80 (w/o meals)
Tamil Nadu	14.00	14.00
Kerala	12.00 - 15.00	12.00 - 15.00 24.00 - 32.00
Maharashtra	12.00 - 20.00	12.00 - 20.00

Source: Ministry of Labor 1991, New Delhi. (Typed Annexure)

Thus, a highly productive agricultural sector coexists side by side with Ludhiana's industrial economic profile which is dominated by non-agricultural employment in mostly small firms.

The Puzzle:

Ludhiana's industrial structure, as we noted above, is distinct from the picture of small firms in much of the development literature, and the experience of other industrialized regions in India in five key ways.

First, unlike the more industrially sophisticated states such as Maharashtra, Gujarat and Tamil Nadu, Ludhiana's industrial growth is dominated by small firms even in sectors which tend to be characterized by large and integrated firms in other regions--machine tools, auto-parts, bicycles, sewing machines and agricultural implements. Industrial surveys conducted by State and Central government agencies (for example in 1973-74, 1979-80 and 1989) have consistently shown that over 99% of Ludhiana's registered firms continue to be small in scale¹⁰--so much so that Ludhiana has been dubbed the "small

¹⁰ In India, large, small and medium firms are officially demarcated by size of capital investment rather than number of workers. In the 1970s a firm was designated small-scale in India if its fixed investment in plant and machinery did not exceed Rs. 3.5 million. Currently this limit stands at Rs. 6 million (7.5 for ancillaries). Firms with investment greater than Rs. 7.5 million are clubbed together under a composite medium/large category.

Although most small firms have 50 or less workers, the number of workers is not a defining characteristic of small firms. The Central government also allocates sole production rights of certain products to small firms (e.g., nearly all components of cycles, except rims and chain wheels, are designated as small-firm products). But this does not restrict small firms from producing

industries capital" of India (Pathak 1970; Sandhu and Singh 1983; Pandit 1985; Sukhpal Singh 1990; District Industries Center surveys 1989).¹¹ This predominance of small firms in Ludhiana is further evidenced by the fact that about 92% of the country's small woollen knitwear firms are located in Ludhiana district, and along with Delhi, over 60% of all bicycle manufacturing units in the country are located here (Pandit 1985:30).

What do these small firms actually look like? The majority of firms referred to above are not the tiny, informal, predominantly labor-intensive enterprises invoked by references to the low-end of the small scale category in the development literature. Neither are they as technically sophisticated as the small firms referred to in the industrial district literature, especially in studies of the Third Italy. A bulk of the small firms discussed here span a range that falls somewhere in between. They might start out as informal enterprises but most are typically registered; they are often small in terms of number

goods not specifically reserved for the small sector.

¹¹ In terms of production, small firms in Punjab accounted for 77% of the state's total industrial output in 1970-71 compared to only 40% in the nation. Although the relative contribution of small firms to Punjab's output has declined over the years, small firms continued to dominate total industrial output until the early 1980s. In 1980-81, for example, Punjab's small firms accounted for 52% of the state's industrial production compared with about 30% in the country as a whole (Sharma, 1980:80, and Sandhu and Singh, 1983:134). Over the 1980s, with the installation of five new thermal power plants and two large government owned railway coach and diesel engine factories in Punjab, the output of the state's large firms has exceeded that of small firms for the first time (64% in 1990-91, relative to 36% for small firms. Economic Survey of Punjab 1992-93:40).

of workers, but are quite capitalized, using a range of machinery and equipment that is for the most part locally made; a large proportion of these small firms are run by owners who are themselves skilled--in terms of having practical, technical skills, not necessarily engineering degrees--but skilled workers/owners no longer belong strictly to traditional caste, or artisanal hierarchies. Finally, even the smaller owners often have 2-3 enterprises run by various family members or partners. While each of these firms may be quite small, and is operated as a separate profit center, together the group/partnership or family has considerable market reach.

The official definition of small¹² thus obscures from view the kind of firm being discussed here. Since the cut-off limit for a small firm is Rs. 6.0-7.5 million, a firm with investment of half a million rupees is also small, and one investing Rs. 7.5 million is also small. While a large number of the smallest firms in Ludhiana have investment not exceeding a million rupees, at the upper end, it is hard to distinguish where small runs into medium, especially if one family or one set of partners owns 3-4 small firms with investment hovering at Rs. 4.0-7.5 million in each, and together employing 200-300 workers. Although the firms most visibly successful in this region are mid-sized small firms, and those close to the cut-off limit for this category, good

¹² According to the current definition, any firm with capital equipment below Rs. 6.0 million (or 7.5 million for ancillaries) is "small" in scale. (The official definition of medium scale is quite muddled because it is clubbed together with large scale).

performance is not associated with any particular end of the small or medium firm spectrum. Firms of quite varied sizes are closely linked with each other in production and contractual relationships, and their success is most often the result of precisely this interaction.¹³

Thus far we have seen that one difference between Ludhiana's industrial structure and that of other industrial states in India is its productive environment is dominated by small firms. The character of these small firms, moreover, does not fit neatly within the usual image of small firms coming off official scale categorizations of small vs. medium vs. large.

A second difference is that in sharp contrast to the marginal and dependent role of small firms portrayed in the literature on industrial modernization and in regions dominated by concentrated capital in the country, Ludhiana's small firms are the backbone of the region's industrial economy. Contrary to

¹³ Of the 117 firms I interviewed in Ludhiana between 1990-1992, 99 were officially "small" in scale, 13 were officially medium, and 5 fell in the large scale category. The largest firms had investment in hundreds of millions of rupees, and employed 800-1000 workers each. The medium sized firms had investments ranging from Rs. 8.5 million to up to 20 million, and workers ranging from 150-360. In the "small" scale category most firms had capital investment between Rs. 3.5 to 8.0 million and employed anywhere from 15-60 workers. About 20 firms within the small scale category had investment not exceeding Rs. 0.5-0.6 million and employed from 2 to 10 workers each. As noted above, most small owners owned 3-4 firms producing related products operated independently by various family members.

the view that small firms cater mainly to local demand and often lag behind larger firms in their contribution to (non-handicraft) exports, Ludhiana's firms are noted for their dynamism, and incorporation into national and export markets.¹⁴ For example, Ludhiana--which had over 33,176 registered small firms and 82 large firms in 1991--produces 95% of the nation's woollen hosiery, 85% of its sewing machine parts and over 60% of its cycles and cycle parts¹⁵ (Dasgupta 1989:63, Pandit 1985; S. Singh 1990).

This domination by Ludhiana's producers over national markets in these sectors is the result of a very different process of scaling up, compared to the more common case of a few large, leading firms dominating output and product development. In several of these sectors, Ludhiana's small metal manufacturers started out in the 1930s-1940s producing mostly components and parts, not complete items like bicycles, sewing machines or agricultural machinery. These components and parts moreover, were meant mainly for repairs, and for the spares and replacement markets, not for original equipment manufacturers.¹⁶ As more

¹⁴ I.J. Singh 1990; S. Singh 1990; Dasgupta 1989; Pandit 1985; Sandhu and Singh 1983; and Pathak 1970.

¹⁵ This figure is for the northern "cycle-producing belt" concentrated in Ludhiana, but stretching up to the fringes of Delhi.

¹⁶ The original equipment manufacturers of products such as complete bicycles and sewing machines at that time were all large and integrated firms located outside Punjab--e.g., Sen-Raleigh near Calcutta, Tube Investments (Hercules) in Madras, a BSA collaboration near Bombay, Usha and Singer sewing machines in Bengal.

and more components came to be manufactured in Ludhiana, local assemblers emerged in the 1940s and 1950s who began assembling these components into complete items like bicycles, sewing machines, diesel engines and a variety of other agricultural equipment and machinery. While some assembler-manufacturers that started out small are large firms today, several assemblers remain small.

This is in contrast to the pattern prevalent in many other states. In the bicycle industry for example, the earliest producers were four large integrated firms based in Bombay, Bengal, and Madras which in the 1940s manufactured complete bicycles, including all components in-house with the assistance of overseas collaborators such as Raleigh, BSA, Phillips, Hercules, Dunlop and others. These firms controlled most of the market share. In a striking reversal of this control, by the early 1970s Punjab's component manufacturers and assemblers had edged out all four of the largest MNC-partnered bicycle firms from the national market, forcing them to either go under, turn to the government for help, or procure parts and complete bicycles from Ludhiana's producers to survive (Singh 1990, Kumar 1989, Timberg 1984). Thus, not only did Ludhiana's small component producers overcome their local focus and out-compete large, MNC partnered producers located outside the state, but they came to control a key national market despite having started

out producing for the spares and replacement market.¹⁷

Similarly, the region is also a successful producer of agricultural machinery -- tractors,¹⁸ diesel engines and pump-sets. As with some other industries in the region, this industry also began with a local and regional focus. Punjabi farmers and agricultural R&D stations were its primary customers. Today, the reach of these firms has spread to national and international markets. Local sales¹⁹ are negligible--less than 20% of total output in the case of a bulk of the firms I interviewed in 1991-92. Thus, although firms in the region began with a local focus, they have not remained dependent solely on local demand. Many of them have successfully expanded into markets well beyond regional borders.

Even more significant is their expansion into export markets. In contrast to the widely noted finding that small firms, especially in traditional metal manufacturing sectors, have a harder time establishing themselves in export markets than

¹⁷ Supplying to the replacement market is regarded as a limiting endeavor, far from best practice, especially given the emphasis on the importance of customer-client ties in the recent literature on industrial clustering. Producing for the replacement market, according to some analysts, cannot generate the quality-enhancing learning effects that come from working closely with a technologically sophisticated buyer of original equipment. Yet others have shown how it is often an indication of a firm "withdrawing" from a particular market, a sign of difficulty and regression (Humphrey and Schmitz 1995:20).

¹⁸ In addition to several small firms, one of the nation's seven most successful tractor manufacturers is located in Punjab.

¹⁹ That is, sales to locally based final users.

do larger firms,²⁰ small firms in Ludhiana--and Punjab more generally--contribute more to exports than do large firms.²¹ For example, in 1988-89, small firms in Punjab accounted for 61% of total industrial exports in value terms compared to 39% by large firms, as Table 1.7 shows below.

Table 1.7

Export of industrial goods in Punjab: (in millions of Rupees)

	Year	Small-scale	lrg/med	total
1.	1985-86	1571.8 (64.1)	880.2 (35.9)	2452.0
2.	1986-87	1740.8 (63.3)	1008.0 (36.7)	2748.8
3.	1987-88	2339.4 (68.5)	1077.2 (31.5)	3416.6
4.	1988-89	2842.8 (61.0)	1817.2 (39.0)	4660.0

Source: District Industries Center, Ludhiana, 1991.

²⁰ See Woodfield (1994) for a further discussion of the difficulties of getting small firms to export successfully. See also Liedholm and Mead (1987).

²¹ This export behavior is not completely uncommon, of course. In the 1920s small and medium firms in Japan also accounted for a larger share of Japan's exports than did larger firms that concentrated on the domestic market (Amsden 1989:181). A similar resurgence of small firm exports from the US and some European countries was noted by the Economist in 1993.

Third, in contrast to the dependence on local input markets that one usually expects of small enterprises, small and medium firms in Ludhiana's fastest growing sectors rely almost entirely on regions outside the state for raw-materials and resources. For example, Ludhiana's hosiery industry depends on wool imported from Kashmir and Australia; the cycle and auto tyre industry depends on rubber from Kerala; and the bicycle and bicycle-parts manufacturers, machine tool makers, and the region's light engineering industry as a whole depends on Bengal, Bihar and Orissa located hundreds of miles away for iron, steel and coal.²²

Indeed, Ludhiana is an odd place for a metal industry to be concentrated in. The state has no natural advantages for the location of a metal-manufacturing industry as we saw above. Nor does it have a large local or proximate market for its metal goods to compensate for the lack of an input base--there are no major industries located in the region that would be the primary buyers of the metal products produced here. While local assemblers are an important source of demand for many small component manufacturers, a bulk of them sell their output to retailers, assemblers and merchant exporters outside the state.²³ Indeed, about 90% of the region's output of final goods

²² Dasgupta 1989; Sharma 1989; Pandit 1985; NCAER 1962, 1967; ILO 1961 cf. Pandit 1985.

²³ This differs also from the emphasis on close customer-client relations and their collective efficiency and learning effects in the recent literature on industrial clustering.

is sold outside the state (DIC, Ludhiana, 1992).²⁴ When both input and output markets are hundreds of miles away, why has this region specialized in metal manufacturing?

Fourth, despite the recent focus on the dynamism of small firms, enduring strands of the literature--both neo-marxist and Smithian--view small firms as being transitory. The expectation is that successful small firms would grow big over time by accommodating an increasingly sophisticated division of labor, and the less successful ones would eventually die out of attrition, or become vestigial. Policy makers in industrializing regions like Punjab and India seem to echo this view in lamenting the fact that over half century of robust growth among Ludhiana's small firms has not caused the region's industrial structure to change along the lines suggested above, with smaller firms growing bigger. On the contrary, manufacturing growth in Punjab over the past fifty years has hardly diminished the proportion of small firms in the state's industrial profile. Small firms were no less important in the region's industrial structure in 1990 than they were 15 years ago.²⁵

This is not to say that medium or large firms in the region are of little consequence. Rather, large firms, many of which

²⁴ This figure is for Ludhiana district's industrial output. The corresponding figure for Punjab is about 80%.

²⁵ In both periods, they constituted over 99% of all registered firms (industrial surveys conducted by the Government of India in 1972-3, 1979-80, and 1989).

were small in scale till as recently as the 1950s-60s, are an important part of the region's industrial environment, and closely tied to its small-firm base institutionally, as we will see later. Indeed, as they themselves report, their competitive strength and vitality vis-a-vis producers outside the state comes in part from the relationships they have forged with the region's small firms. Neither robust growth, nor the presence and success of these larger firms has undermined the endurance and salience of small firms in Ludhiana's industrial environment.

Fifth, and finally, in addition to their growth and integration into national and international markets, Ludhiana's small firms have shown impressive resilience in the face of several episodes of economic and political adversity. During a long period of industrial deceleration in the country between the mid-1960s and the late 1970s,²⁶ for example, Ludhiana's manufacturing fared much better than that of the nation as a whole.²⁷ Taking Punjab's rates of industrial growth as proxy for Ludhiana, manufacturing in the state registered a mean annual growth rate of 6.9% during 1966-1978 and 9.4% during 1971-78 (Johar and Kumar 1983:184) compared to the 5% mean annual growth

²⁶ There is considerable debate over the periodization and regionally differentiated impact of this deceleration. For detailed arguments see Wiener 1989, Ahluwalia 1985, and Bardhan 1984.

²⁷ Also see Table 1.8 below for a comparison of the annual growth rate of income generated by the industrial sector in Punjab and India, disaggregated by plan periods.

rate of manufacturing that prevailed nationally during 1966-1982 (Wiener 1989:134). Similarly, from 1970-71 to 1983-84 Punjab's industrial sector grew 1.67 times faster than the Indian average (Bhalla et.al. 1990).

Similarly, Ludhiana's small-firm base appears to have weathered and quite successfully bounced back from severe political "shocks" as well, in nearly every decade of its recent industrial history. The first, and worst of these shocks was the massive upheaval of partition in 1947 when Punjab was splintered into two halves between Pakistan and India, and the economic and civic base had to be virtually rebuilt on both sides. Again in 1966, the Indian Punjab was split into three provinces²⁸: Punjab, Haryana, and Himachal Pradesh. In this division, the present state of Punjab lost all of the new large-and medium-scale industrial belt that its leaders had been developing along the Delhi border since the early 1960s, to Haryana. Later, in the 1960s and early 1970s, three wars fought along Punjab's borders (with China and Pakistan) again disrupted communications, stalled production and blocked the transportation of goods and labor across the state.

Most recently, Ludhiana's productive structure, and the private and public institutions therein, seem to have weathered relatively successfully the intense political turbulence unleashed by Punjab's decade-long secessionist movement that began in the early 1980s. During 1985-90, for example--despite

²⁸ This was an administrative division along linguistic lines.

the continuing violence--Punjab's secondary sector grew at an average annual rate of 8.6% compared to 6.8% nationally (Economic Survey of Punjab, 1992) (See Table 1.8 below). And despite adverse conditions in virtually every decade of its post-colonial history, Punjab still leads the nation's twenty-two states in per capita income²⁹--a lead that it has maintained since the late 1960s.

Table 1.8

Industrial growth rates of Punjab and India: percent per annum

Period	Base	Punjab	India
1965-66 to 1968-69 (Annual Plans)	@ 1960-61 prices	6.7	2.9
1968-69 to 1973-74 (Fourth Plan)	@ 1960-61 prices	5.3	3.7
1973-74 to 1978-79 (Fifth Plan)	@ 1970-71 prices	9.95	6.9
1979-80 to 1983-84 (Sixth Plan)	@ 1970-71 prices	6.5	3.4
1985-86 to 1989-90 (Seventh Plan)	@ 1980-81 prices	8.6	6.8

Source: District Industries Center, Ludhiana, Punjab, and Economic Survey of Punjab 1992:59.

Furthermore, the experience of other violence-torn regions

²⁹ Punjab's per capita income was Rs. 9643 in 1992 at current prices, compared to the all India average of Rs. 5629 in the same year (Statistical Abstract of Punjab, 1992-1993:119). Goa (till recently a federally controlled union territory) is the only state to have surpassed Punjab's per capita income since the 1980s.

in the country, Assam and Kashmir, suggest that conditions of prolonged political uncertainty tend to cause firms to turn inward, be cut-off from outside markets, withdraw or defer investment, or hedge risk through capital flight.³⁰ Contrary to these predictions, many firms in Ludhiana--of all sizes--appear to be turning "outward," to markets outside the state and country for sales at an astonishing pace (DIC reports and personal interviews). Over the nine year period between 1980-81--when the state's political crisis began, and 1989-90, the most recent year for which figures are available, manufactured exports from Punjab to other countries increased by a striking 206%. That is, exports grew at an average annual growth rate of 23% during this period (Statistical Abstract of Punjab 1990:335, 547).

Making sense of the evidence: Unusualness of fit and similarities with other cases:

The dynamism and resilience evident in this description of Ludhiana's manufacturing performance is at odds with the image of low productivity, marginality and industrial "shallowness" associated with regions that are "bottom-heavy" -- or have many small firms with a missing middle and top tier of larger, more "modern" firms.³¹ The argument here (see Briggs for example) is

³⁰ Accounts of Latin America's unstable years document an analogous set of responses by business to instability, although the instability there is of a somewhat different nature.

³¹ Ludhiana's firm structure does include "large" small firms and medium firms, as we saw earlier in the discussion.

that although small firms provide employment, and may have desirable distributional consequences, they cannot by themselves lead a whole region into growth, because they lack enough capital, skills and access to sufficient demand to help make a whole region industrially competitive. The growth of Ludhiana's metal industry described above goes against the grain of such arguments.

Ludhiana's picture of dynamic growth is also at odds with the picture of arrested growth portrayed in the literature on Indian manufacturing throughout the 1970s and 1980s. These authors (e.g., Krueger 1974, and Lal 1983) argued that a long history of excessive intervention by India's restrictive, rent-seeking regulatory state strangled industrial productivity and penalized growth. This argument comes off a now-widely held view about the bad effects of excessive government presence in general, regardless of country. If this was the general case, why was it that industries in Ludhiana succeeded in consistently growing at rates higher than the national average despite being part of the same debilitating and restrictive policy environment?

Ludhiana in the context of other states. Punjab is not the only state with a vibrant small firm base. There are at least four others in India alone: Coimbatore in Tamil Nadu, Rajkot in Gujarat, Howrah in West Bengal, and in some ways, Bangalore in Karnataka state. In addition, there are several other cases

documented in the voluminous industrial district literature.³² But there are important differences between them. Consider, for example, the case of Bangalore, the so-called "Silicon Valley of India." Bangalore's dynamic small-firm base is of relatively recent vintage. Its origins lie in the vast public sector investments in core industries such as aeronautics, machine tools, telecommunications in the region by the government of India in the 1940s and 1950s. In the 1950s Bangalore was the hub rot of small firms, but of some of the country's largest public sector firms and science and technology institutes.³³ Its large and sophisticated R&D infrastructure has attracted engineers from all over the country, and it now boasts many of the features highlighted by researchers of the "East Asian" model of growth-- e.g., a highly educated workforce, a strong research base, strong government support, and more recently massive MNC investments. It too represents an interesting and different case to study, with its own theory-defying outcomes.

Punjab's story is different. In contrast to places like Bangalore, and Bombay, and to the image of India as having an

³² Cawthorne 1990, Kashyap 1992, Nadvi 1992, Schmitz 1995, Schmitz and Humphrey 1995, Holmstrom 1994, Kaplinsky 1994.

³³ The country's first defense related aviation company--the Hindustan Aeronautics Ltd (HAL) was located in Bangalore, as was its first telecommunications equipment manufacturing firm, Indian Telephone Industries (ITI); the government's largest machine tools manufacturer (Hindustan Machine Tools, HMT) is headquartered here since the 1940s. In addition Bangalore is host to a number of well-funded basic science institutes, such as the prestigious Indian Institute of Science, and a web of defense related R&D Centers.

excessive public sector presence, the central and state governments have invested minimally in equity ownership in Punjab's industries since it became a border state in 1947. Indeed, Punjab's share of expenditures on centrally owned industrial assets fell, from a share of 1.4% of the total central outlay in the 1970s, to only 0.74% in 1989-90, compared to 17.6% for Maharashtra in that year, and even higher for Bangalore (Handbook of Industrial Statistics 1991). Compared to public and foreign capital financing Bangalore's small-firm boom, industrial capital in Ludhiana is largely private and from within the region. It is the technician, or the mechanic, rather than the engineer, that is the back-bone of Ludhiana's industrial regime; and rather than large R&D parastatals, a combination of government business extension agencies and skilled small and medium firms have provided much of the R&D in the region. Yet the region has accumulated an impressive industrial record.

And, as we will see in this study, the state was hardly absent from Ludhiana's industrial story and history. It did not come in with direct capital investments, but it was very present in other ways, it did other things. The government built an excellent and extensive physical infrastructure--roads, railroads, serviced land, cheap electric power, water (see Tables 4.2 and 4.3 in Chapter 4); it built a tightly-linked research and development base focussed on the region's key industries--bicycles, auto-parts, machinery, sewing machines--as described later; and it built a strong industrial training base in the

state.

What lessons does this case, with its largely private, small capital base, and a history of a strong, but indirect state role have to offer other regions that are more like it and less likely to be able to count on large external inflows of capital and resources? What explains this region's industrial performance? Is Ludhiana's spectacular agricultural performance in any way linked with and/or responsible for its small-firm led industrial growth? And finally, what lessons and insights does the resilience demonstrated by small firms in this region provide regarding the conditions under which small firms are able to cope well with the pressures of uncertainty and instability?

Argument in brief:

My specific argument is that four elements are central to understanding the pattern of industrial growth in Ludhiana. (i) The key role of the state government (and in important ways, the Central government) in--directly and indirectly--shaping the region's industrial trajectory. Historically, the government indirectly transformed the skill base of a whole class of artisanal metal workers in the region through its agrarian--not industrial--policies. Subsequently, the government not only became a key source of demand for the state's firms, but its emphasis on providing extensive physical infrastructure, and industrial training raised small firm productivity and greatly

lowered production costs. (ii) A series of demand stimulating conditions early in the region's industrial history helped the region's growing small-firm base consolidate itself by providing stability, even if fortuitously, when local firms most needed it. (iii) Entrepreneur and worker relationships, shaped by the above conditions, which over time have produced a capital conserving, interdependent structure of production that has allowed even small producers to enter national and international markets. Furthermore, institutional arrangements (e.g., the crucial role of several intermediaries and brokers) emerged at several levels, which together with the conditions set by the state's credit and other policies, have enabled some agricultural surpluses to be channeled into industry in quite productive ways.³⁴ (iv) Finally, a differentiated and skilled work force, which has had quite complementary, though diverse, paths of skill acquisition and upward mobility. Understanding the structure of the region's labor market, and the distinctive worker strategies it allows for, is therefore crucial to understanding the competitiveness and adaptability of Ludhiana's firms. Enmeshed throughout, is a discussion of the ways in which the region's predominantly small firms have overcome the typical constraints that much of the development literature says hamper small-firm vitality: lack of

³⁴ It must be noted however that several authors who hold that the absence of large-scale industry in Punjab is a symptom of the state's industrial backwardness, argue that one of the reasons why industrial capital remained small and fragmented in the region was precisely because agricultural surpluses did not flow into industry in any significant way. See for example Johar and Kumar (1983) and others in Johar and Khanna (ed.) 1983.

skill, capital, credit and markets, and the state's role in indirectly making it easier for them to do so.³⁵

Themes and layout of chapters:

The next chapter (Chapter 2) traces the origins of the region's industrial networks and anchors them within the colonial government's late nineteenth century policies aimed at developing the region's agriculture--not industry. These policies were contradictory. On the one hand they resulted in increased prosperity and social mobility among agrarian groups. They offered rural artisans new career options in the military, contractual work on the government's railways, and massive irrigation works--options that helped transform and upgrade the skill-base of a whole class of artisanal workers. But on the other hand, these policies were exclusionary. They excluded non-agricultural groups from owning agricultural land, blocking them from access to a key avenue of accumulation. This exclusion transformed social institutions, broke ties of patronage between artisanal workers and their landowning clients, and pushed the newly skilled artisanal groups into industrial work. Chapter 2 details how their identity now came to be centered around skill and industrial accumulation rather than caste and ascriptive ties.

³⁵ Field work for this study was conducted in two stretches. First in the summer of 1990, and for six months between the Fall of 1991 and April 1992. I conducted over 150 interviews with firms, workers, academics, and government officials in Ludhiana, Chandigarh and Delhi.

Chapter 3 traces the important role of demand-stimulating conditions early in the region's history. It shows how the particular way in which the region's larger firms organized production and dealt with these demand surges led to the mushrooming of many small firms. These firms wrested huge contracts from the government at very low bids and rather than meet the orders by increasing capacity in-house, they recruited and trained a large number of small subcontractors to produce for them. Because the government demanded that a minimum quality threshold be met, the large producers had to ensure that their small subcontractors learned to meet that quality. This aided the latter in striking out on their own in the private market later. Subsequent surges of demand, although generated by fortuitous events such as partition, and the imposition of an import substituting regime (ISI), helped these small subcontracting firms stabilize by providing them continued demand just when they most needed it.

The protection that generated this local demand, also led to the emergence of an import-competing local machinery producing sub-sector in Ludhiana. ISI programs are of course, meant to help develop just such a domestic machinery producing base accessible to all domestic firms, but the historical record shows that they don't always manage to. In most countries, especially those like India, the government's parastatals have led the way in trying to develop an import-substituting capital goods sector. As many critics have pointed out, these investments have often

ended up producing an expensive government-owned capital goods sector catering mostly to other parastatals or large private firms. Small producers can rarely afford to procure machinery from these large plants. But what was different about the way ISI policies worked out in Punjab was that they encouraged the formation of a quite sophisticated machinery producing base that catered primarily to small firms. By providing cheap, locally made customized machinery and machine tools to the region's small firms, these small capital goods producers helped lower production costs for the region's manufacturers of final goods and intermediates (e.g., consumer durables such as bicycles, sewing machines, pump-sets, agricultural implements and parts). These lower costs, and easy access to cheap machinery allowed even small producers in Ludhiana, who had few resources and little capital, to exploit more effectively the demand surges resulting from the protectionist policies of this period, and grow. In this chapter we also see that, unlike the criticism in the literature that oftentimes paints import-substitution policies with a monolithically negative brush, the Indian governments ISI policies had several direct and indirect positive outcomes, in addition to its more familiar "unproductive" aspects. Ferreting out and understanding how these positive aspects of ISI policies worked out, thus, merits careful further research in other contexts.

Chapter 4 examines the particular way in which the state and its agencies historically related to the region's small firms.

In so doing, it revisits one of the themes laid out in Chapter 2 and examines two issues: first, how the post-colonial state's agricultural policies indirectly and inadvertently influenced the growth of industry in Ludhiana. And second, how the government laid an extensive industrial training infrastructure in the region, which interacted in important ways with the less formal skill acquisition strategies of workers in the region's labor market to produce a skilled workforce at low cost. This skill base, centered around the technician's, not the engineer's skill, is a key source of shopfloor innovation among the region's small firms, and a cornerstone of their ability to raise productivity at low cost.

Chapter 5 examines the way in which the region's firms got around some of the common bottlenecks that plague small firms-- access to markets, technical know-how, credit and performance standards. It examines how firms dealt with the moving away of key sources of demand without going under. Via illustrations drawn from several examples, this chapter shows how the nature of contractual relationships between the firms themselves, and the presence of a network of intermediaries--especially sales merchants, mechanics, and technically skilled local bureaucrats-- helped local firms cope with adversity and defray the costs of seeking out and moving into new markets. The chapter also shows how local firms continually expose themselves to a variety of outside standards, and how the self-imposed pressure of comparisons with these external standards helps them

incrementally improve their own performance.

An epilogue to Chapter 5 continues the theme of how firms cope with adversity by returning to the issue of violence in Punjab during the decade of the 1980s, and examining the relationship between business and instability. The patterns emerging from a number of case examples show that firms in Ludhiana responded quite counter-intuitively to instability. Rather than holding back or deferring investment as we would typically expect, the most successful small firms actually increased investment, raised output, automated selectively, and turned to exports in a big way.

The final chapter concludes by summarizing the findings about the processes of small firm growth emerging from the Ludhiana case, and sets them in the context of views in the literature regarding credit, capital, skills, and the public sector role.

CHAPTER 2

The agrarian underpinnings of industry: mid-nineteenth century colonial investments in infrastructure and the creation of a rural middle-class

Introduction:

This chapter examines the antecedents of some of the key institutions governing the conditions of accumulation by small firms in Punjab -- namely, a rural elite, fragmented capital in both industry and agriculture, and a largely private small-producer pattern of industry built around skill controlled by a formerly lower-status social group. It explores how these institutions were shaped historically by the direct and indirect effects of the colonial government's massive mid-nineteenth century investments in infrastructure (irrigation, railways and rural roads) which commercialized Punjab's agriculture, created an export economy, produced a prosperous peasantry and a large rural middle-class by the early twentieth century.

Although these state expenditures¹ were motivated, not by concerns for industry, but by aims of developing the region's agricultural base, creating rural employment, and ensuring the loyalty of the broadbased peasantry by securing and enlarging their rights in agricultural land and private property; they did influence non-agricultural prospects by creating substantial

¹ And some of the legislation that went with them, e.g., the Punjab Land Alienation Act of 1900.

physical and social capital early in the history of Punjab's industrial growth. This "social capital" played out in two ways. (i) It provided fresh avenues of employment to those hitherto bound in relations of patronage, thus helping weaken ties of traditional hierarchy. In addition, it also offered opportunities for modest accumulation through contractorships on construction sites in the agricultural colonies, railways, and jobs in the military. (ii) The nature of these new jobs and contractorships (e.g., working with new kinds of equipment, producing new kinds of products) indirectly helped transform and upgrade the skill base of a whole class of rural artisanal workers by exposing them to new configurations of work, and placing new demands on their traditional skills.

New skills, combined with access on the part of some to modest amounts of accumulated capital, revised the identities and career paths of many non-agricultural craft workers. Consequently, when a legislation designed by the colonial government to protect the proprietary rights of its main allies (the prosperous small peasants), cut off this new class of skilled workers and small contractors from a lucrative avenue of accumulation--ownership of cultivable land--they were able to resist this exclusion by turning towards industrial work and building new, corporatist institutions around their skill. That is, those among this excluded class who had both, skill and some accumulated capital, were able to invest in manufacturing at a small scale. The colonial government's infrastructure policies

thus, although aimed at agriculture, indirectly shaped industrial identities by creating conditions that both enabled (through skill formation) and "forced" this excluded group to forge niches in industrial work.²

This argument is presented here in two parts. The first part of this chapter shows that: (i) Large parts of the Punjab that is now in India had a history of smallholder agriculture dating back to agrarian reforms by an earlier regime that tried, in the early 19th century, to minimize the threat of revolt against its rule by fragmenting landlords and their tenants through recognition of the tiller's rights to land in central Punjab. The British, on annexing Punjab in 1849, built upon this pattern of landownership. (ii) Furthermore, through massive investments in infrastructure -- canals and railroads -- they commercialized Punjab's agriculture in the late 19th century, converging it into an open, export economy with a prosperous rural base and new opportunities for accumulation, and mobility.

The second part of the chapter argues that (i) in addition to the commercialization of agriculture this openness was manifest in a second way. Work on the railways (being laid at that time across Punjab, Assam, and East Africa), and in the military (which moved troops across East Asia, Australia, Middle East and Flanders) led to considerable mobility and migration

² In other words, the social identities and career aspirations of the local population interacted with the nature of the colonial administration's policies of encouraging agriculture, building on existing trends of ownership, and encouraging self-employment in agriculture and outside it.

among workers. Service in these new departments not only allowed some savings, but became the basis for exposure to new ways of doing things, and practices outside the region. This openness, exposure to external standards and ways of doing things, together with the economy's commercial base, had a transformative impact on the skills and identities of several social groups. This transformation coalesced further with the social ferment generated in the early 1900s over some of the government's policies that sought to shore up the rights of the higher status peasantry at the exclusion of non-agriculturalists. Many of those who were left out, and who had the skill and the means, turned to industrial work and small-firm ownership.

Thus, indirectly, the government's policies that bestowed prestige, profitability, and social position to the practice of agriculture, kept the elite rural, and created the conditions for a different, lower-status non-peasant group of artisans and traders to enter into and dominate industry.

In laying out these arguments, this chapter will also show how the structure of industry in this region has been shaped and influenced by the particular way in which agricultural policies played out historically in the region.

PART I

The outcomes of the colonial state's early investments in infrastructure: mobility, exposure, and the building of an export base

1. The early phases of agricultural growth and their spillovers into industry: the late 1800s

Many analysts argue that the dynamism of small industry in Punjab can be explained in large part by the production, consumption and demand linkages generated by rising rural incomes resulting from the region's spectacular agricultural growth since the mid-1960s when local farmers widely adopted green revolution technologies (Thapar 1971, 1972, Ghosh 1977, Gosal and Kishan 1984, Bhalla et al. 1990). While the spill-over effects of agricultural prosperity in the region did have important positive impacts on small industry via demand and production linkages, the presence of these linkages (since the mid-1960s) does not in and of itself explain the particular shape and character of the region's industrial structure, as this section shows.

Looking historically at the various ways in which Punjab's agricultural practices and institutions have influenced industry, we find four themes that are at odds with the growth linkage explanations of Punjab's current pattern of industrial growth. Namely, (i) that in contrast to the salience attached to the "green revolution" period as the engine of small industrial growth in Punjab, there were several prior episodes of agricultural growth, especially in the late 19th century (1860s

through 1921), and then again in the 1950s which shaped the institutions and conditions that significantly influenced industrial investment capacities as well as local industry's choice of products and markets. (ii) Contrary to the emphasis in the growth linkage literature on incomes rising due to the transformation of agriculture, non-agricultural sources of rural income-growth were as important as agricultural sources in bringing about these increased investment capabilities and purchasing power in the late 19th, early 20th centuries. These non-agricultural sources of growth included (a) broad-based absorption of the lower classes especially from the country-side into new military careers in the colonial army, (b) manufacturing and livestock-breeding demands from the army cantonments that came to be stationed in Punjab, and (c) migration abroad, and to the newly constructed canal colonies in western Punjab for labor jobs in construction, manufacturing and trade (in addition to agriculture). (iii) Similarly, the inward-looking regional focus of much of the growth linkage literature, cannot easily capture the fact that it was not subsistence but the export nature of Punjab's canal-irrigated agricultural economy that kept an upward pressure on output and efficiency from the demand side while absorbing large amounts of labor in its double cropping cycles, that contributed to rising rural incomes in late 19th-early 20th century Punjab. (iv) Finally non-agricultural growth in jobs and incomes did not result from or follow agricultural growth as the growth linkages literature

suggests, but occurred simultaneously. Both, local agriculture and industry during this period were simultaneously fuelled by massive quasi-Keynesian investments by the public sector in infrastructure (roads, and over 2000 miles of railways), irrigation-based land settlements (26 million acres were irrigated and brought under cultivation by the early 1920s), and military recruitment (over 65% of British India's voluntary army was recruited from Punjab at the eve of WWI).

These findings--regarding the importance of inter-regional and overseas migration, remittances, and an open economy, in raising rural incomes and creating non-agricultural jobs, do not fit the standard growth linkages theory which is more inward-looking in its focus and seeks to bound the region tightly, viewing any outward flows of goods, capital and labor as leakages.

The point here is not that the growth linkage arguments do not apply, but that there are other equally salient ways in which agricultural growth and rising rural incomes influence local industry in Punjab--producing results exactly similar to the ones the growth linkages theory is interested in, of dynamic small-firm growth--but which the theory misses out or does not accommodate. In other words, although certain kinds of linkages between Punjab's agricultural successes and its small industry did occur, the timing and sequence were "wrong" and the explanation was different.

2. Canal Colonies and the fostering of an export base.

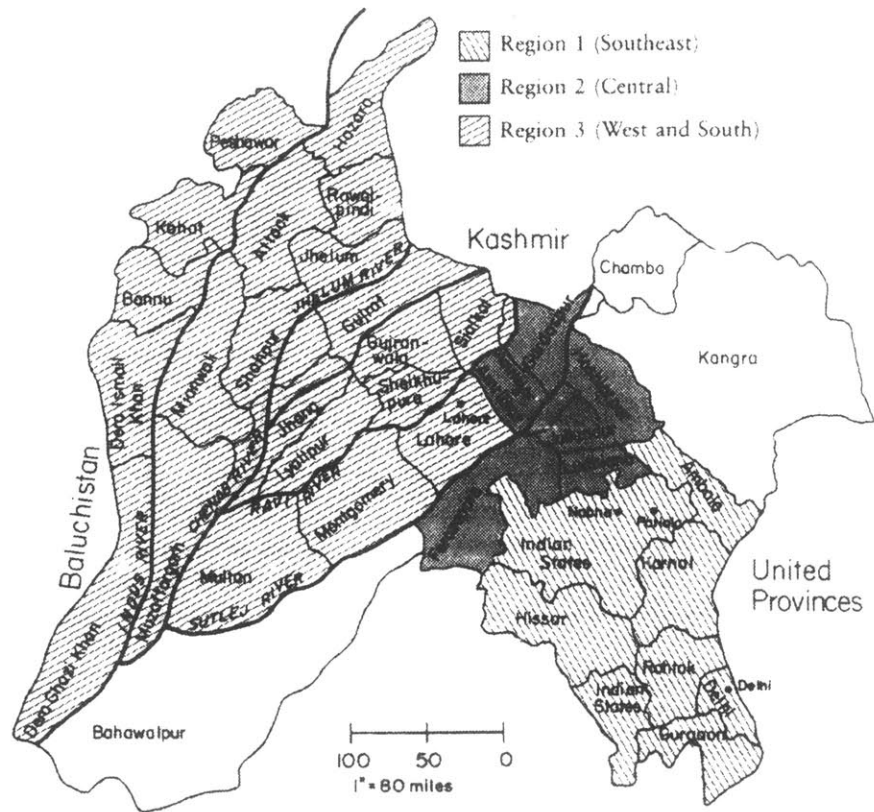
A major feature of late 19th century Punjab was the commercialization of its agriculture and its orientation towards export markets within India and abroad. The existing pattern of agricultural production as the British found it upon annexing Punjab in 1849, was highly uneven. Parts of the state-- specifically its central regions (see Fig. 2.1)³ including districts like Ludhiana, Jullunder, Sialkot, Amritsar--were productive and fertile. A large number of smallholders intensively worked the land in these regions growing wheat and gram supported partially by irrigation from underground wells and inundation canals. Some of these districts already practiced double-cropping at the time of annexation (Banerjee 1982, Kessinger 1974). The drylands of the southeast cultivated mostly millets, gram and other traditional crops without the support of much supplemental irrigation. The western region of Punjab contained vast tracts of barren wasteland.⁴

To mitigate the unevenness of agricultural output, increase agricultural productivity and revenue generation, and to reduce

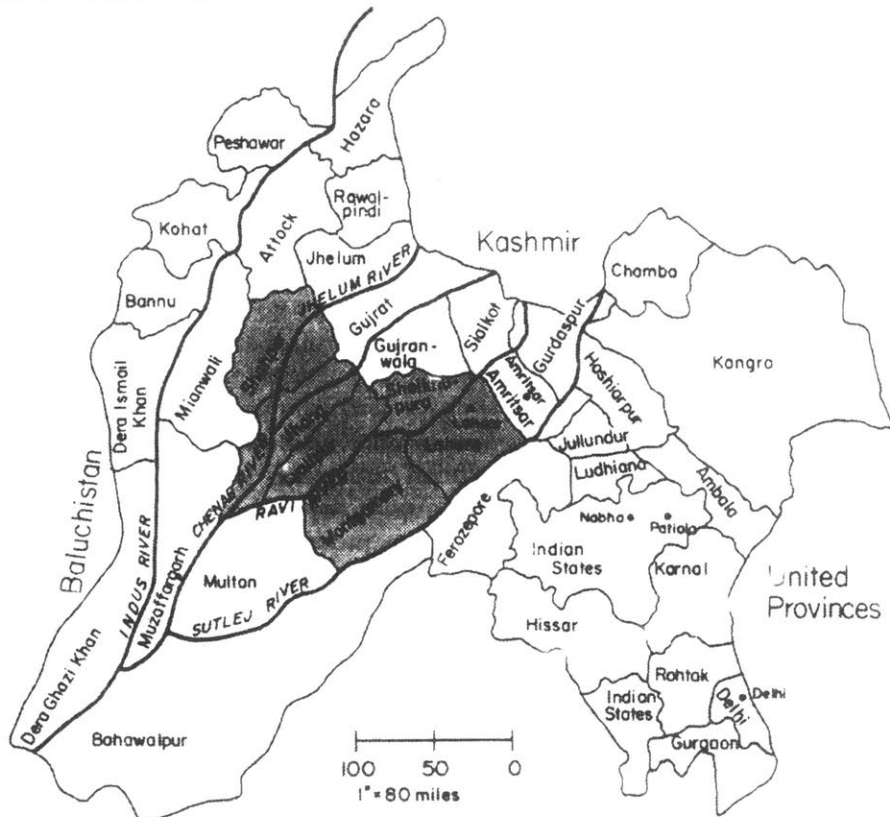
³ Source for Fig. 2.1: Fox, Richard G. 1985. Lions of the Punjab. Berkeley: Berkeley University Press.

⁴ The land-tenure systems in these regions varied as well. In contrast to the tenancy that prevailed in south Punjab, and the dominance of a handful of ruling clans who controlled vast tracts in the barren West, owner-occupied small-holdings dominated in the extensively cultivated central regions. This landownership pattern of small holders in the central regions, as we will see more fully at the end of this section, goes back to land reforms carried out in the early nineteenth century by an earlier regime.

Figure 2.1



(a) The three main regions of colonial Punjab



(b) Major canal irrigated districts of Punjab (1921)

the risk of famine, the colonial government invested massively in several infrastructure projects in Punjab starting the 1860s. The most prominent among these were the construction of major irrigation works and the "canal colonies" in west Punjab, (and the laying of an extensive railroad network throughout Punjab and the Northwest.)

The first generation of irrigation works began modestly--as public works meant to employ disbanded sikh soldiers after the British annexed Punjab in 1849. The productivity- and output-enhancing results of these modest works of refurbishing and repairing old canals--as evidenced by increased revenues--led the British to scale them up into a more serious effort of constructing new canals in the intensively cropped central Punjab (mainly the Manjha region). The first canal was opened in 1859 in the Lahore-Amritsar region; a second watered the Ferozepur-Ludhiana region in 1883, and by 1887 two and a half million acres of central Punjab were traversed by these canals and their distributories (Sims 1988, Banerjee 1982, Fox 1985).

Despite this "scaling up," the Punjab administrators, had continued to regard these early projects as remedial -- a "service" aimed at evening out the vagaries of rainfall in the most intensely cropped smallholder districts of central Punjab -- rather than as investments in the expansion of agriculture. Consequently, the British had so far committed little government capital to them, financing them instead almost entirely out of the increased land revenue that they generated (Fox 1985:48-49).

By the late 1880s the limits of this "self-financing" were clear. With rapidly rising local demand for water,⁵ the famine of 1876, and the government's growing concern over potential rural unrest in the over-cultivated, densely populated small-holder districts of central Punjab, the government launched a much more ambitious second generation of irrigation projects: Massive amounts of government funds (raised in England through sale of government bonds) were to be invested in irrigating and colonizing the barren wastes of West Punjab (Fox 1985:chapter 4).

Between the late 1880s and 1920, British and Indian engineers⁶ and local labor constructed, with quite modest technology, an irrigation system that watered 10 million acres of arid land in government owned tracts of western Punjab. (see map). By the end of the 1920s these government canals had converted twenty-six million acres of the province's soil into perennially irrigated farmland cultivated by tens of millions of people settled in nine government-planned Canal Colonies (Talbot 1988:38-40, Fox 1985:48-53, Banerji 1982: chapter 2). Between the late 1800s and the first World War, Punjab had received fully half of the colonial government's total irrigation investment in India during that period (Table 2.1).

⁵ The Sirhind canal which began irrigating the Ludhiana-Ferozepur region in 1883 was already the result of strong protests and demands from the region's sikh smallholders. They had seen the success of the Bari-Doab canal which watered the neighboring districts of Amritsar-Lahore, and also "wanted water" (Banerjee 1982).

⁶ See Tandon (1961) for an account of the involvement of Indian engineers.

Table 2.1

Percentage distribution of colonial investments in Indian irrigation: 1898-1914

Region	Up to 1897-98	During 1898-1914
Uttar Pradesh	27%	7%
Punjab	25%	50%
Madras & Orissa	13%	20%
Bombay	8%	11%
All other states	31%	12%
Total	100%	100%

Source: Khanna et. al. Studies in Punjab Economy (1983:97)

Concern for the productive smallholder from Punjab's heartland (the regime's loyal allies) had been at the center of the colonial government's agricultural scheme (Banerjee 1982, Fox 1985). The government therefore recruited thousands of these small cultivators to work the newly irrigated land. Eighty-five percent of the land grantees in the first canal colony that was settled (Lyallpur), and 75% of the second, were smallholders "carefully selected by local level officials" from among the best cultivators in central Punjab (Paustian 1930 cf. Fox 1985:58-9).⁷ Many were sikhs from districts that are now in the Indian

⁷ Most of these settlements were profitable, and the colonial government recovered more than its original investments (Fox 1985). For example, the Lower Chenab Colony, the first one settled, generated an annual return of 14.4% on initial capital investment after deducting all operating costs (Paustian 1930:145 cited in Fox 1985). But profitability and success of various groups within and across colonies varied considerably. See Banerjee (1982, chapter 2) and Fox 1985 for a discussion of the unevenness of success and

Punjab, including Ludhiana, Jullunder and their environs (Sims 1988:54-55).

Compared to the small, fragmented holdings (5-9 acres) they had farmed in their home regions, the government now allotted these recruits larger, consolidated plots of irrigated land -- 11 to 56 acres (or 0.5 to 2 "squares")⁸ -- on ten-year leases at nominal rates with an ownership option after that (Fox 1985, Banerjee 1982, Talbot 1988). Many others were drawn in on their own -- driven by pressures of debt in their home regions, extreme subdivision, or simply by the lure of the status and lucrateness that came to be associated with participating in this "new style" of agriculture.⁹ In the three decades between the 1890s when Lyallpur was opened, and 1920 when the last allotments were made, an estimated one million small cultivators had migrated westward to the canal colonies from other heavily populated parts of Punjab (Talbot 1988:40, Fox 1985, Banerjee 1982:28-29).

of the problems of salinity, water-logging and rising incidence of water-borne disease that came to plague many of these settlements later.

⁸ Each "square" was made up of 22-28 acres depending upon the colony. A bulk of the holdings were 20 acres or larger -- and this at a time when according to one estimate (Malcolm Darling), a family of five could subsist on nine acres (Darling 1930:199 cf Fox 1985:60).

⁹ The cultivator's "passion" to acquire even a few acres of land "by the canals," and the "riches" it would bring, very soon became part of popular lore, the subject of numerous local songs, stories and ballads. See Tandon 1961, and Banerjee 1982.

Even as a large but dispersed bureaucracy engineered and managed the canal systems or the "hard infrastructure", an army of irrigation officers taught the new cultivators efficient techniques of husbanding the water that was now perennially available. The farmers learned a "new sense of time...measured not by seasons or grades of sunlight, but by a rigid schedule of water allocation" (Sims 1988:55). They learned about rotation of crops, selection of seeds, alternative ways of preparing the fields, and use of simple, improved agricultural implements. Much of the wheat and cotton they produced was for export -- to other parts of India and abroad -- and the extension agents taught them to adjust their cropping pattern to meet these external demands (Banerjee 1982:202). As a result of widespread migration, this learning/information also spread to other parts of the province. For example, many of the smallholder grantees with strong links to their extended families and original holdings in the central Punjab became the chief conduits through which information and remittances flowed back to the home region (Kessinger 1974, Banerjee 1982).

Canal irrigation turned out to be cheaper, easier to use, required less time input per day, and generated a higher net return per acre compared to well irrigated or rainfed cultivation (Fox 1985, Sims 1988). All of these factors together resulted in record harvests which pushed the agricultural growth rates, and incomes, in the canal colonies far above the state average (Fox

1985).¹⁰ Whereas previously bumper harvests had often rotted in storage, this increased output was now rapidly distributed via the government's new rail network to domestic and export markets (Talbot 1988).¹¹ As surpluses increased, wheat exports rose rapidly (See Table 2.2). Wheat exports from Punjab tripled between the 1880s and World War I (Fox 1985:55), with half-a-million tons of wheat exported annually to Britain and Europe during these years (Talbot 1988:39, Banerjee 1982:51-55).¹² Already by 1906, two of Asia's largest grain markets were located in the Punjab (Sargodha in west Punjab and Jagraon near Ludhiana).¹³ By the 1920s Punjab, which comprised one-tenth of British India's area, accounted for a third of India's wheat output, and a tenth of its cotton crop (Talbot 1988:38-9).

¹⁰ Although the canal-colonies' output overshadowed that of other regions, both output, productivity and exports from the well irrigated central Punjab also grew throughout the late 1800s, early 1900s. In terms of wages and net-income the central districts closely followed the canal colonies. (Fox 1985, chapter 4).

¹¹ Agricultural growth in Punjab during this period was not hampered by lack of transportation. Starting in the 1860s, the government began laying its 4000 mile railroad network which connected Punjab to all major cities in the North and to Karachi port. Simultaneously, the Public Works Department began road construction, mainly linking the new canal colonies with major markets and towns in other parts of Punjab. (cite Sims, Talbot)

¹² In 1881-82 Punjab exported over two million cwt of wheat to England and Europe (a ten-fold increase over the amount exported in 1877-78), a trend that continued throughout the 1880s (Banerjee 1982:54).

¹³ Ludhiana District Gazetteer 1970.

Table 2.2

Wheat export from colonial Punjab during 1890-1919

Year	Average net export (in thousand maunds)
1890-94	8,126
1895-99	6,392
1900-04	15,339
1905-09	23,218
1910-14	26,370
1915-19	19,435

Source: Fox 1985:57

With rising output, product prices, and productivity, wages and net incomes in the canal colonies rose, and remained higher than the Punjab average throughout the late 19th century and upto the 1940s (Fox 1985:61-69). Wages in the canal colonies were over 20% higher than the Punjab average during this period (Fox 1985:69). High agricultural wages induced considerable migration of marginal farmers, and laborers from other parts of Punjab. In addition, agriculturally active districts outside the canal colonies, especially in the central Punjab experienced increased demand for its food-grains (including wheat) from the colonists who cultivated wheat and cotton as cash crops. For example, by 1920, nearly 65% of central Punjab's gram exports were directed towards the canal colonies (Fox 1985:75).

Moreover, unlike in some other parts of India, British policies in the Punjab did not tax away the rising rural profits. In fact "revenue demand" or tax rates fell significantly in the late 1800-early 1900s. Initially set at two-thirds in the 1860s, then at half the assessed profits, by the 1930s these rates had

fallen to a "quarter of net assets" (Talbot 1988, Banerjee 1982). Since land settlements were assessed once in twenty years, the relatively low revenue demand was arguably even more favorable to peasants: given steadily rising agricultural prices, the proportion of the produce they had to sell to pay their revenues fell over time -- to as low as 10% during the first World War (Talbot 1988:54). Those who produced for export, thus generated surpluses. By some accounts, Punjab's peasantry "ranked among the richest in Asia" in the late nineteenth - early twentieth centuries (Talbot 1988:53).

Thus, the colonial government's late nineteenth century policies aimed at commercializing Punjab's agriculture bore fruit. These policies involved on the one hand, a traditional role of the state, now much criticized -- of providing large-scale rural infrastructure -- by investing massively in canal irrigation, land-settlements, rural roads and an extensive railroad network. On the other hand it involved a strategic focus by the government to empower groups that seemed best situated to exploit these resources -- in this case the already productive smallholders of central Punjab.¹⁴ Specifically, the

¹⁴ This landownership pattern of smallholders in the central Punjab goes back to land reforms carried out by Ranjit Singh (ruler of Punjab from 1799-1839) in the early 19th century in these fertile trans-sutlej regions. Ranjit Singh's policy of vesting revenue-paying responsibilities and occupancy rights directly in the cultivator stemmed only partly from an interest in augmenting land revenues. It was also a mechanism for mitigating the risk of large landlords jeopardizing the consolidation of his rule by using their local influence and power over numerous tenants and dependents to challenge his suzerenity.

colonial government helped shape an increasingly prosperous agrarian middle-class out of these cultivators by: (i) protecting their rights in land through legislation (the land alienation bill as we will see later), (ii) making a select group of them a central part of the newly irrigated, prestigious land-settlements -- the canal colonies, (iii) and in addition to irrigation, making agriculture even more lucrative by disseminating new knowledge about seeds, implements, and cropping patterns, and by keeping the agricultural tax burden low irrespective of rising prices.

In a society where agriculture and land ownership was already privileged historically, these efforts by the colonial government in favor of this rural "elite," endowed even more status to the practice of agriculture in the late 19th century. To maintain this status, rural households continually reinvested their surplus in land (see Gazetteer 1908, Kessinger 1974, Fox 1985). Indeed, temporary migration for work abroad, or recruitment in the imperial army (as we will see below) became an added means for small cultivators to reinforce their household's

To foil such threats to Sikh rule, Ranjit Singh removed uncultivating proprietary intermediaries from between the state and the actual tillers, thereby eroding the power of traditional landowning families in the prosperous central Punjab districts (Banerjee 1982:2-5, also see Langa 1978 and Fox 1985). The British continued this policy of "leveling" the agrarian class structure, in favor of the "unfettered" small peasant proprietor (Fox 1985), and built their efforts to commercialize Punjab agriculture around them. As most goals, this goal too was realized only partially.

landed position back home.¹⁵ Despite increasing wealth, then, the social elite (mostly the cultivating jat sikhs and muslims) remained rural.¹⁶

Apart from bestowing prestige on owner-cultivation, the colonial government also instituted a set of "codes" and rules to ensure that the smaller settlers performed well, and continued cultivation instead of alienating their land to non-cultivating owners. These included strict rules about land preparation and water use, which were "forced" in some ways by the manner in

¹⁵ Kessinger (1974) who studied family histories in a central Punjab village found that "the motive of the groups to send a member overseas was to augment the position of the property group by acquiring land through resources acquired abroad." (pp. 171-2).

¹⁶ This is not to say that the rural elite was uniformly small. To the contrary, the colonial government made clear distinctions in granting land to various classes and in building disciplinary mechanisms to hold them accountable for its cultivation. Compared to the 0.5 to 2 squares granted to smallholders subject to compulsory residence on site, and owner-cultivation, "yeomen" grantees got 4-5 squares (or 111 to 139 acres), and "capitalist" grantees were given 6-20 squares (or 167 to 556 acres) (Fox 1985). No compulsory residence was stipulated in either of the latter cases, and purchase in five years was subject only to their bringing under cultivation at least half of their land by then.

These larger grants were often politically driven--e.g., as rewards for military loyalty or other forms of political patronage --or a result of government auctions of canal lands. (Auctioning as a (lucrative) means of settling the colonies became increasingly popular with the colonial government in the early 1900s). These differential policies bred a distinct set of social relations in the later colonies relative to the early settlements which comprised mainly smallholders. The larger "capitalist" and even "yeomen" grantees distanced themselves from direct cultivation, maintaining a tiered system of tenants and farm servants. These colonies were also cultivated less intensely than those controlled by smallholders, and fewer social groups shared in their prosperity. (See Fox [1985] for a Marxist interpretation of these distinctions see, and Banerjee [1982] for a closer scrutiny of the colonial administration's own records).

which canal water was released, and monitored by a large corps of canal officers. The government controlled alienation in two ways: initially by limiting the small cultivators' rights to ownership in the canal colonies--purchase was possible only after ten years of owner-cultivation as the state's tenants.¹⁷

Subsequently in 1900, by legislatively outlawing the sale of agricultural land to non-agriculturalists (traders, artisans) (we will examine the impact of this legislation on the excluded groups in a later section). It is these small but prosperous peasants, who had migrated from the central Punjab to the canal colonies, that came to dominate the parts of Punjab that came to India after partition.¹⁸

Thus large infrastructure investments that are seen as too costly and inefficient today, and large-scale land settlement, another policy that currently stands discredited as being too centralized, too unwieldy, expensive and hard to manage, shaped an agricultural boom and created wealth in the agriculturally active parts of the province. This influenced industry in two ways -- non-agricultural accumulation and employment, and the social impact of transformed skills.

¹⁷ This initial ten year period became extended for much longer leading ultimately to a massive revolt by the canal colony smallholders in 1907.

¹⁸ A bulk of the congested, smallholder dominated central Punjab (except Lahore district), and the populous Eastern districts, came to constitute the Indian Punjab after 1947.

PART II: The transformative impact of infrastructure investments:

1. New sources of non-agricultural income generation and skill acquisition

The government's investments in infrastructure that increased agricultural output and incomes, also simultaneously induced growth in non-agricultural jobs and opportunities. In contrast to the growth linkage literature which sees these non-agricultural jobs as resulting from agricultural growth, rather than happening simultaneously, these jobs and non-agri production were not built off local consumption demand generated by rising incomes. Instead, they came out of massive government investment/ programs in construction, irrigation, railways and new careers in the military. As we will see in this section, these jobs, in turn, transformed local skills by putting new pressures on artisanal workers, and exposing them to new productive environments. In so far as these new manufacturing tasks revised the skill base of traditional craftworkers and set the conditions for modest accumulation through contractorships, nineteenth century colonial investments in infrastructure inadvertently helped groom a class of skilled workers who had access to some capital, and was poised for entry into industrial work in Punjab by the early twentieth century.

(i) Opportunities in trade: As we saw above, in addition to escalation in trade, the government's colonizing of Punjab's western frontier resulted in vast movements of peasants and

traders from the densely populated central regions to the canal colonies in the west. A variety of new non-agricultural jobs in the colonies induced traders and others to migrate to West Punjab. Apart from trading in agricultural inputs, helping with storage of grain, its transportation, and cotton ginning and oil-expelling. These non-agricultural jobs also included "public sector" employment in the army's massive horse and cattle-breeding stations. Increases in available land had enabled the army to lease hundreds of acres of land for breeding horses and cattle (200,000 acres in one district alone -- Talbot 1988) in the region.

(ii) Construction and its ubiquity: Building the canal network, and the simultaneous construction of the railroad system¹⁹ induced a construction boom that lasted from the late 1800s to the early 1920s, and created a huge demand for labor of various skill levels. Apart from work on the actual construction of the canals and their main feeder lines, maintaining and operating the canals generated substantial ongoing employment. According to one observer, "there were bridges, falls, breakwaters and masonry work to be looked after, banks to be trimmed and their berms repaired, roads on the side to be kept serviceable, and many other jobs for the proper care of the canals. There was always some new construction work and remodelling, surveying and designing; and whenever the canals

¹⁹ Railroad construction in Punjab began in the 1860s.

were dry the work that could not be done otherwise had to be quickly finished before the flow began again." (Tandon 1961:44). Moreover, West Punjab's irrigation network was not only a system of canals; it was also a network of planned "colonies" where roads, houses, and other common facilities had to be built (Fox 1985, Tandon 1961). All of these tasks fuelled job growth throughout the boom years of construction from the 1860s through the 1920s, and raised workers' non-agricultural incomes.

(iii) Transformation of an artisanal skill-base: Not all of this construction and related production work was unskilled. Workers did not only labor on the canals, but the nature of the technology used in the irrigation project allowed a greater role for local craftsmen and artisans. Despite some of the complex engineering feats that west Punjab's canal systems were known for,²⁰ the technology was quite simple, and the capital equipment relatively unsophisticated (Sims 1988:75). Under the supervision of British and Indian engineers, local metalworkers frequently worked as small contractors on the rebuilding, repair, replacement or maintenance of small, local parts of the system on contract. Local craftsmen thus picked up new skills and manufacturing experience.

A small core of government-owned mechanical engineering workshops run by the Irrigation department and the Railways also

²⁰ For example the Triple Project Canal system competed in 1917. See Talbot 1988:39.

emerged during this period. These institutions became the training ground for a large number of skilled and unskilled workers. The Railway workshop in Punjab's Lahore city alone employed over 2000 men by the early 1880s, and nearly 4000 a decade later (Kerr 1991:67); The railway carriage and locomotive shops that opened in 1910 added still more. Small privately owned foundries and metalworking shops catering to these workshops emerged around them.

Just as canal irrigation became a catalyst of rural prosperity, then, the railways became a catalyst for the transformation of local skills, especially through employment in their railway workshops.²¹ The production processes in these workshops, "imported almost overnight from Britain... catapulted workers into a new work environment whose constraints and dictates were alien to their experience." (Kerr 1991:72). The railway workshops became virtual "centers of industrial education," reproducing generation after generation of skilled workers especially among the children of employees. Through on-the-job training, and the diffusion of new techniques through exposure these workshops and the Railway technical schools produced a workforce with new improved skills²² (Kerr 1991:70).

²¹ There were three such workshops in Punjab in the early 1900s.

²² Much of this learning that was indirectly spawned among local workers by the laying of the railroads, and in the workshops, was modest in nature. It exposed them to the handling of new items, new machines, working of pieces that demanded a gaining a different understanding of the use of metal and wood than what they were accustomed to. But, all design and construction of

Similarly, the Punjab Agriculture department, which co-managed the irrigation system, involved skilled local workers in the construction of the improved implements the department designed for dissemination among canal colony farmers. Many local farmers in addition turned to local mechanics and metalworkers for the repair of these implements.

Thus, whether repairing new kinds of agricultural implements, or working on the repair and maintenance of the large irrigation canals, or the construction and repair of rolling stock and equipment required to maintain 4000 miles of the railway system in Punjab, local non-agricultural workers picked up new skills and artisans learned to adapt their craft knowledge to new productive processes, new tasks and equipment and to new standards of accuracy (Kerr 1991, Saberwal 1979).

(iv) Spillovers from the lagged effects of migration.

Cultivators from central Punjab, the original home region of many of the smallholders recruited by the government to settle the early colonies, benefited from another kind of feedback. Given the uncertainty involved in the move to west Punjab in that new holdings were on government lease for ten years, and the prestige of owning agricultural land, few of the grantees who moved west sold their original holdings in central Punjab. These holdings remained under the control of the larger family or proprietary

locomotives was done in England (Lehmann n.d.).

group in the home region (Kessinger 1974, Banerjee 1982). The extended families of these settlers thus now had their feet in two places. And, they shared indirectly in the prosperity generated by the canal colonies through remittances that helped finance capital improvements such as the sinking of wells on properties in the home region, and through a flow back of information about improved implements and seed selection.

In 1947, when Punjab was divided into its Indian and Pakistani halves, this migration turned "circular." The sons and grandsons of the sikh small-grantees of the canal colonies returned to the Indian Punjab, either to their original homes or as refugees. As we will see more fully in the next chapter, the exposure of these migrants to a lifetime of practicing irrigated agriculture on relatively large holdings, not only influenced local practices, but also placed new demands on the skills of local craftsmen in the migrant's attempt to figure out how to practice irrigation in a different way -- without canals and on a much smaller scale. One of my informants, a successful small farmer in a Ludhiana suburb reported how his father's frustration at having to return to well irrigation after having farmed 60 acres of canal irrigated land in Layallpur before partition, led him to make unceasing demands on local artisans and extension officers to help him adapt some of the techniques and implements he had used on 60 acres, for use now on 18 acres in their Ludhiana village (M.S. Grewal interview, 1990).

The significance of this issue is not only that mobility and exposure to new techniques led to innovations and their spread beyond the regions where they were first introduced; equally significant are the particular kinds of pressures that these new demands brought to bear on local workers, and the outcomes of these pressures on the nature of the skill generated. Much like what happens in the case of repair, these new demands on local metal-and woodworkers by migrant farmers put pressure on them to figure out how to carry out a task that they had never before confronted or performed, and whose solution they did not know, except for having a sense of the attributes their client desired. More than anything, then, the nature of these demands, and the way they played out locally, produced a particular kind of skill among a subset of the local workforce -- the skill of the technician, the mechanic. It focussed the workers attention on process, experimenting with it from the start -- eg how to get a particular operation done, and this technician or mechanic oriented skill-base made these workers (in combination with fragmented capital) particularly suited to learning and understanding new processes through reverse engineering later.

In contrast to the emphasis in the literature on migration's "draining" effect on the home region, then, this mobility of a large number of small cultivators, and the particular nature of this mobility -- its dual roots, and the keeping open of ties to original properties -- resulted in the spread and spillover of their material gains, and exposure to new processes and ways of

practicing agriculture to a much wider base. The spread-effects of this exposure also spilt over into shaping and influencing practices of those outside agriculture -- ie the skills of the local non-agricultural craftsmen.

2. Recruitment in the army, remittances, and new chains of mobility

A large proportion of Punjab's rural, and lower class urban population shared in accumulation and mobility in a different way -- via recruitment in the army, and serving abroad. Throughout the late 19th century, till the British left India, Punjab, a region comprising less than a tenth of British India's total population size thus provided more than half of the Indian army's troops and officers. At the eve of the first world war 65% of the Imperial army of India was recruited from Punjab; in the second world war over a million Punjabi soldiers served the army accounting for more than 50% of its strength (Fox 1985:44, Talbot 1988).

This disproportionate importance of Punjab to the Imperial army, and its concern over policing Punjab's crucial border with Afghanistan, led the army to relocate its recruitment headquarters in Punjab in the early 1900s, moving away from the older recruitment centers of Bombay, Madras and Bengal (Talbot 1988).²³ The significant presence of the army in Punjab till

²³ One reason why so many troops from the Punjab were absorbed in the army is also linked with the agricultural growth discussed above. One claim is that owing to increasing agricultural

well past the second world war had substantial impact on the region's economy and structure of social mobility. First, with such broad based induction of the local population into the army--especially from rural areas--large segments of the population got to share in the benefits associated with the new defense careers--stable earnings, bonuses, allowances, pensions, and other perks.

Second, remittances from soldiers stationed throughout the country and abroad (Afghanistan, the Middle-East, S.E. Asia, East Africa, Flanders and other stations) since the late nineteenth century and especially during the two World Wars added to household income in their home regions. Since a bulk of the recruits came from agricultural households, their remittances served to both raise investments in agriculture and increase rural purchasing power (Talbot 1988, Baden Powell, Badenoch 1918). For example one study conducted in 1940 found that (in one village) although nearly 20% of this amount went to service debt, 18% of these savings were spent by the household on home construction, and 16% on cattle and purchase of agricultural equipment (Fox 1985:45).

In many instances recruitment in the army, especially for those serving abroad, became an avenue of temporary migration abroad (most frequently East Asia, Australia, East Africa).

prosperity, better incomes and consequently better diet in many parts of Punjab, few candidates from this region were rejected on medical grounds compared to those from less well off regions such as Bihar and Bengal (Talbot 1988:40-41).

Remittances from this temporary migration led to the consolidation of family property in the home region (Kessinger 1974:171). In addition to remittances, service abroad whether through recruitment in the army, or even the railways did two other things. It brought exposure to work practices outside the province and outside India; and it provided future business contacts abroad for those returning to their home region. For example, in the case of one sewing machine producing firm I interviewed, one branch of the family had settled in the British midlands after service in the army. These emigrants maintained strong ties with the rest of the family in Ludhiana not only remitting capital to finance their Ludhiana-based sewing machine plant in the 1940s, but also as buyers of their sewing machines for sale in the UK and North Africa.

Another firm, a large producer of woollen hosiery and textiles in Ludhiana, has origins in slightly different kind of exposure. In the early 1900s, two members of this family of rural grain merchants who also ran a small hosiery contractorship, were stationed in East Asia while on service with the military (and railways). There they became exposed to Japanese hosiery machines and hosiery processes. Upon completion of their duty in East Asia, they used their accumulated savings to purchase and bring back two secondhand hosiery machines from Japan. With these machines, they set up Ludhiana's first mechanized hosiery factory in 1923. With the assistance of local metalworkers (Ramgarhias) they copied these machines to increase

their capital base; soon similar versions of the machine spread to other new hosiery firms in the market (Oswal interview 1991). This then is an early example of exposure via government service to new technology abroad thus spread among a wider group in the home region through the mechanism of reverse engineering, however rudimentary, by local craft workers.

In a similar vein, several of these rural metal workers belonging to the Ramgarhia community, became drawn into contract work for the railways or army inside and outside Punjab, repairing simple tools and machinery. Those that travelled to railway construction sites in Assam and East Africa, either returned with accumulated savings and set up small rural metal working shops; or stayed back and returned a generation later to set up businesses in Punjab. One firm in my sample, now produces auto-gears for the national market had similar origins. At the close of the 19th century this family of skilled woodworkers travelled to Kenya on contract with the Railway department, where they remained in business till after independence. With resources accumulated abroad, they financed the return to Punjab of the next generation -- for industrial apprenticeship with relatives in Ludhiana, and then business practice.

Finally, the longterm presence of the army's recruitment headquarters in Punjab had a significant impact on industrial production in the region from the demand side. Substantial, and quite stable demand originating from the army for blankets, uniforms, socks, woollen gear, small armaments and other

equipment was an important source of growth for the local woolen hosiery, knitwear, and engineering industries throughout this period (District Gazetteer of Punjab 1970, Imperial Gazetteer 1908, Talbot 1988). In particular, the large-scale demand from the government for army uniforms became a major impetus behind the setting up of "tailoring" factories devoted exclusively to the stitching of uniforms (Marenco 1976). These factories located in cities like Amritsar and Lahore relied on large numbers of industrial and domestic sewing machines imported from Japan, Switzerland, Germany and England (Marenco, Diamond interview 1992). Demand for the repair of these machines led many skilled urban workers to specialize in sewing machine repair (Diamond interview - history). War-induced shortages during the first world war led to the first instances of sewing-machine component manufacture in Punjab. One example involves the taking up of sewing machine manufacture by a Ludhiana agent for the German Durkopp sewing machine. As reported in a 1917 industrial survey of Punjab, "on the outbreak of war and on the consequent loss of his agency for Durkopp machines, [the agent] himself experimented in their manufacture, with the result that in the face of many difficulties in obtaining machinery, he has put on the market a good sewing machine selling at a moderate price" (Badenoch 1917:35).

The point here is that several sources of small-scale accumulation that existed during the late 19th century -- via the military, railways and irrigation -- converged to augment the

growth already unleashed by the colonial government's investments in irrigation and agriculture. In addition to raising rural incomes, these investments had a transformative impact on local non-agricultural skills. These investments by the state also provided continuous employment for nearly three decades of expansion upto the 1920s, and created several sources of demand that stimulated local enterprise, and brought exposure to external standards which led to learning, and a revision of local skills and industrial identities. These emerging industrial identities became further consolidated during the social ferment that emerged in the early 1920s as state investments fuelling growth slowed down. This construction of a new identity on the part of industrial workers and the transformation of social institutions associated with skill and urban accumulation, was embedded also within an upsurge of local social reform movements, induced in part by the very success of prior colonial policies, as we will see next.

III. Constructing a new industrial identity: The Punjab

Alienation of Land Bill of 1900, exclusion, and its aftermath

The prosperity produced over four decades of investment by the colonial government in massive infrastructure projects in the late 19th century, brought with it contradictions too.²⁴

²⁴ On the heels of four-five decades of prosperity from the 1860s to the 1920s, came a massive wave of social ferment in the 1920s. A number of regional social movements prevailed -- in each major communal group -- the sikhs' Singh Sabha movements, the muslims's Ahmediya movement, and the Hindus' Arya Samaj movement.

After Punjab's annexation in 1849, British investments in irrigation and transportation discussed above, were accompanied by an attempt to constitute and enforce private legal rights in land, vesting tremendous value in this asset for the first time. On the one hand the colonial government, aided by buoyant food-grain prices encouraged owner-operators to intensify food production. But on the other hand rising land values and a more rigorous drive by the government to collect taxes led to increased peasant indebtedness. Ironically, given their new legal rights in land, this indebtedness was fuelled by borrower confidence in their own worth (Fox 1985, Banerjee 1982, Siddiqui 1984). In this process, and given the prestige tied to owning agricultural land, many agriculturalists lost their land to non-farming traders, money-lenders and/or urban professionals. Between 1866 and 1874 for example, 231,000 acres of land was alienated or mortgaged on average per year in Punjab; to the

These reformist and secularizing movements within the Hindu, Sikh and Islamic communities in Punjab were in part a response to the growing influence of the British and their institutions.

The centerpiece of these reforms was an emphasis on greater control over their material conditions, upward mobility, new identities based on non-ascriptive attributes (eg skill in the case of the Ramgarhias). Each of the reforming groups emphasized education -- primary or vocational -- to partly counter the spread and popularity of schools and training institutes run by missionaries and the colonial government, and hence neutralize the appeal of some of the utilitarian policies that the British administrators were bringing into the Punjab

It is within these social movements, which interacted also with the growing "Swadeshi" (Buy Indian) sentiments expressed by the gathering Indian independence movement that the revision of identity of a skilled group (Ramgarhias) described in this section was embedded.

extent that by 1878, 7% of the province was "pledged" (Nair 1979:81,82; Siddiqui 1984:294; Khanna 1983:104). Fearing that this take-over of prestigious and valuable agricultural land by non-cultivating groups would jeopardize agricultural productivity, output, and the *raison d'être* of massive colonial investments in rural infrastructure, the government legislated the Punjab Land Alienation Bill in 1900.²⁵ Aimed at "protecting" the smallholders of the central Punjab and the canal colonies from being preyed upon by "non-agricultural" classes, this (non-retroactive) bill divided Punjab's agrarian structure into "agriculturalists" and "non-agriculturalists", legally barring the latter from owning agricultural land. Rural artisans, craft-workers, metal workers and traders were all categorized as non-agriculturalists, and thus effectively denied access to, and hence upward mobility through the purchase of agricultural land.

²⁵ Addressing the fuller controversy in the literature surrounding the issue of rural indebtedness in Punjab and British response in the form of the Land Alienation Bill is outside the scope of this paper. (See Darling 1947; Thorburn 1886; Bannerjee 1982; and Barrier 1966.) Richard G. Fox (1985), however, presents an alternative explanation about the politics behind this Bill. Pointing out that the "agriculturalists" being protected were mostly muslim petty producers from among whom the colonial government recruited its soldiers, and the bigger muslim and sikh peasants appeasing whom was politically important to the British vs. the "non-agriculturalists" who were mostly from non-farming Hindu communities, Fox argues that the Bill thus supported the colonial government's objective of maintaining "cheap recruits, loyal landlords, contented soldiers and inexpensive rural policing..." (49-50).

According to some historians (e.g., van den Dungen 1972, and Kessinger 1974), having been blocked from the land market and from access to a lucrative avenue of accumulation and social prestige, the artisan metal-workers--in particular the Ramgarhia community and more broadly the Viswakarmis-- who now had both upgraded skill and some accumulated capital, turned to urban industrial work (Saberwal 1979). They also set into motion processes of constructing for themselves a "corporate" identity based on their skills, rather than caste. They did so in three ways--first, by mobilizing the community through journals and a network of organizers to forge a common identity. The wealthier entrepreneurs served as a resource and role-models for others, encouraging them to invest in urban manufacturing, or at least build upon and diversify their rural shops if they had any. Second, by building a series of educational institutions--schools, colleges, educational banks, training and vocational centers to upgrade/preserve and pass their skills on to the next generation in a systematic way (Saberwal 1979:chapter 6,8). And third, by forming several professional associations (quasi-guilds, or quasi-craft unions) cutting across firms of different sizes, and often including skilled contract workers, to pressure the institutions of the state to grant them access to land, credit, and markets (Saberwal 1979). All of these strategies helped establish a base for further skill acquisition, dissemination, investment and the sharing of risk.

While some of the institutions set up by these groups are robust and active around Ludhiana even today, their community-based character has transformed to include other castes and classes: skilled Ramgarhias have over time collaborated with traders who lacked skills but had capital and knowledge about national and international markets. These inter-sectoral and inter-occupational alliances between firms of different sizes put in place in a previous period, have been central to the interconnectedness that characterizes Ludhiana's industrial environment today.²⁶

In sum then, a prior opportunity to acquire new skills and adapt old ones (e.g., through work on colonial infrastructure), exclusion from socio-economic mobility through landownership, as well as opportunities to accumulate small amounts of capital -- all of which were indirect outcomes of the colonial state's agricultural policies--together created conditions that pushed skilled, rural craft workers into industrial metal work. A failure to look historically at the specific ways in which people and resources have flowed between Ludhiana's rural agricultural

²⁶ Several authors show how these skilled workers (especially the Ramgarhias and Viswakarmis) are found chiefly at Ludhiana, in addition to Batala, Phagwara, Patiala and a few other centers in Punjab. Moreover, as scholars like Pathak (1970) show, metal based industries, from their inception in the mid 1800s became localized mainly around Ludhiana, pulled in by the prior growth of the hosiery industry in that region. Ludhiana's hosiery industry is believed to have originated in 1830 when a severe famine in Kashmir led large groups of displaced skilled weavers to relocate in Ludhiana; local traders apparently commercialized their skill in the mid-1890s (see for example the District Gazetteer of Punjab, Ludhiana, 1970).

and urban industrial sectors in response to state policies and other conjunctures, then, would obscure some of the early intersectoral roots of the region's contemporary industrial regime.

At the same time, the colonial government's focus on building a loyal rural elite led also to a bifurcation of career paths of the landed rural elite and the excluded artisan or merchant groups. Most of the influential rural and urban families went into public service--as magistrates, judges, educationists, city councilors--or came to control large agricultural tracts in the canal colonies. Few, if any went into industry. Industry thus remained in the hands of the skilled artisans and medium sized trader groups that had small and local capital. In the literature, and in many other parts of India, industry is usually seen as a magnet for big capital and prestige. In the Punjab case, by contrast, the colonial government's policy of developing the region's agricultural prowess for an export economy, colonization of the barren western tracts of the state, as well as the army's recruitment policies, indirectly helped industrialization by creating a skilled industrial class born out of exclusion, and thus linking industry to a subordinate, lower status group. It did so by (i) keeping the "elite" rural, by generating attractive agrarian options for landowning agriculturalists and the rural elite--investment in the canal colonies, participation in modernized, progressive agriculture protected by extending and improving the reach of

legal institutions (e.g., the Land Alienation Bill), by preferred recruitment in the army, and in upper tiers of government service; and (ii) by making industrial accumulation one of the few feasible options for the skilled non-agriculturalists, a result just the opposite of the traditional control of industrial institutions by a powerful elite.

Conclusions

This chapter traced the direct and indirect impacts of the colonial government's massive infrastructural investments in Punjab in the late 19th-early 20th centuries on agricultural accumulation as well as the shaping of non-agricultural work opportunities and transforming skill. This kind of traditional role of the state--of providing large scale infrastructure -- is criticized today for being too centralized, too costly and too cumbersome, yet, in this earlier era, it commercialized agriculture, produced an export economy, and created a wealthy rural peasantry.

These investments also generated widespread mobility among workers and cultivators. This mobility revised traditional relations and helped break and weaken established ties of patronage between workers (including artisans) and their landowning clients. Lower income agrarian households participated in a variety of these streams of accumulation--military, farming, service abroad--to seek out and enlarge their new economic base and sphere of social influence. Contrary to

the view of migration in much of the literature as a "drain" on local/regional resources, migration played a central part in the region's growing dynamism in the later 19th century. Migration brought in savings and capital through remittances. Along with these remittances came exposure to new skills, new ideas and new ways of doing things.

On the heels of this prosperity came restrictive and exclusionary legislation that excluded non-agricultural groups from purchasing cultivable land. This led to a bifurcation of the paths of the landed rural elite (most of whom were small-owner operators in the Ludhiana region) and the excluded artisans and merchant groups. Pressured by this exclusion, a whole class of skilled workers, whose skills had recently been transformed through work on the colonial government's own infrastructure investments, turned to urban industrial work. Thus, although state policies bred a fairly prosperous middle-class rural base that was connected to world economy, this rural class did not go into industry: a different non-peasant, lower status group went into industry. In the next chapter we will examine the processes and institutions that have sustained this "excluded" group in the world of industry.

CHAPTER 3

When the marginal becomes mainstream: an excluded, small-producer group in industry and its demand-induced growth

Introduction

The previous chapter showed how the colonial government's sustained investments in the region's agriculture in the 19th century, and its policy of protecting--indeed privileging--the rights of smallholders brought prestige, political power, and social status to agricultural practice, and generated broad-based wealth among the peasantry. In the central and eastern regions of undivided Punjab, dominated by smallholders, these policies and prior land reforms, virtually precluded the rise of a clearly defined elite class that could exercise disproportionate control over agrarian wealth. Rural wealth was instead spread across a large number middle-class rural households with growing incomes.

On the one hand, the lucrateness of commercial agriculture kept much of the Punjabi "elite" rural.¹ On the other hand, the

¹ Elite here refers more to social hierarchy. Jat cultivators were--and are today--at the top of Punjab's social and political hierarchy, followed by the 'warrior' castes (Khatris), the religious elite, and then the traders and artisans. Jats were mostly Sikhs, but this caste is also found among Muslims (in the Pakistani Punjab) and Hindus (in Haryana state which was a part of Punjab before 1966). The core of Punjab's political power, represented by control over the state's administration, has always been in the hands of Jat Sikhs. In addition to controlling agriculture and the state's politics, Jat sikhs are in a variety of public and academic professions, but despite their wealth, political influence and education, very few have gone into Punjab's industry. Small industry, historically controlled by the "lower" trading and artisan castes in Punjab, never seemed attractive enough for this group. Their wealth has instead gone into real

colonial government's concern for developing Punjab as the granary of British India led not only to the concentration of public investment in Punjab's agriculture, but also to policies that aggressively preserved the rights in land of the agricultural castes (e.g., Jat sikhs) at the exclusion of others. A case in point is the Land Alienation Bill of 1900 which outlawed the ownership of agricultural land by non-farming castes, thus cutting off a whole segment of rural and urban society--the non-agricultural castes--from participating in a lucrative avenue of accumulation through agriculture.

Two socially subordinate groups so excluded--rural artisans (traditional metal workers, and woodworkers), and traders and small merchants--turned to careers in industry. A bulk of the artisans that entered industry (mostly Ramgarhias--whose skills, we saw in the previous chapter, had been transformed through work on the government's railway and irrigation systems in the mid-late 1800s) took up metal manufacturing, and over time became the backbone of the region's light engineering industry. Most of the non-artisans, especially merchants, constructed for themselves elaborate distributional networks linked initially to the production and marketing of woollen hosiery, and later to metal-based consumer durables such as bicycles and sewing machines.²

estate, and transportation businesses. More recently, it is beginning to move into large agri-businesses.

² These distinctions blurred over the years as former merchants also entered into metal manufacturing in collaboration with skilled workers.

But how was it that these two subordinate groups, excluded from participating in the most prestigious and lucrative occupation at that time--commercial agriculture--and possessing only fragmented or modest capital, found success in industry? In this chapter we examine in greater detail the processes and mechanisms through which these small producers responded to and shaped their industrial environment, focusing in particular on their interaction with the state.

Part I briefly discusses the key characteristics that set Ludhiana district apart from other typical districts, as well as the ways in which it is similar to them.

Part II examines how and why small firms came to, and continue to, dominate industry in this region. A major impetus behind the emergence of a large number of small firms, we will see, was a series of demand generating episodes early in the region's industrial history. Since the second world war, a number of successive demand surges built upon each other, and although fortuitous, created conditions of stable growth just when the emergent small firms most needed it.³ The second world war was a key turning point in this regard. Although temporary, its effects proved longer lasting: instead of being followed by a demand slump and increased competition after war-induced protection ended, it was followed by new demand generated by

³ There has been much recent interest in the role of demand in its various guises, as driving industrial growth. See Saxenian (1994) for the impact of defense demand on small firm growth, and for the role of demand emanating as a result of public policy, see Tandler and Amorim 1996.

reconstruction needs following Punjab's partition in 1947, and subsequently through protective legislation, such as the import substitution regime, imposed by the government of India since the 1950s. This section emphasizes the organizational effects of the way defense demand came to be distributed in the region, in conjunction with the dynamics of capital flow from agriculture to industry.

Part III examines how this growing demand, in combination with protectionist policies, led to the emergence of a local machinery producing sector in Punjab in the 1940s-1950s. In contrast to other parts of India where firms producing base machinery were either parastatals or catered to large producers, Punjab's machinery producing firms catered mainly to the region's small firms. This sector became a source of cheap machine tools for local producers of metal-based goods such as bicycles, sewing machines agricultural implements, textile and hosiery machinery. Access to locally manufactured cheap machinery helped these firms lower production costs from the supply-side. This in turn, allowed them to exploit the demand opportunities created by the government's ISI policies more effectively.

First, a word about how the Ludhiana region compared with a typical district in the late 19th century when our story begins.

Part I: Institutional shifts in the pattern of industrial investment

In the mid-nineteenth century Ludhiana stood out from a typical Indian district⁴ in at least four ways.⁵

First, as part of the rich wheat-producing region of central Punjab, Ludhiana, in the late 19th century, was one of Punjab's better off agricultural districts. Unlike the large landholding pattern that characterized Punjab's western districts, the central Punjab region of which Ludhiana was a part, was thickly populated by smallholders who produced commercially for the market and generated a surplus. Although there was thus sufficient capital in the system, the smallholder dominated landownership pattern precluded its concentration in the hands of a small elite as in many other agriculturally prosperous regions inside and outside Punjab (Fox 1985, Bannerjee 1982, Darling 1947). From an early period therefore, there was no clearly discernable wealthy elite that had disproportionate access to or control over the region's resources, and influence over investment decisions.⁶

The colonial government's refurbishment and extension of Ludhiana's existing canal-system in the 1880s (prior to the

⁴ District is used here in the administrative sense.

⁵ The historical details in much of this section are drawn from Wall (1973) whose discussion of Ludhiana's history is based on the 1904 district gazetteer of Ludhiana.

⁶ There were influential families however, with religious or public authority.

construction of the new canal colonies in western Punjab), added to the region's rural wealth and agricultural productivity. By the turn of the century, Ludhiana had become an important grain entrepot,⁷ and a major grain market (Jagraon, just outside Ludhiana city was regarded as one of Asia's largest grain markets in the early 1900s), and remained so throughout the colonial period (District Gazetteer 1904 cf. Wall 1973, Ludhiana District Gazetteer, 1971). Ludhiana's marketing role and grain trade drew large numbers of traders into the area, and at the same time that it enhanced local revenues. In 1888, taxes on the shipment of grain that moved across the region accounted for about 75% of Ludhiana city's municipal tax revenues (District Gazetteer of Ludhiana 1907:218, cited in Wall 1973:80).

Second, along with the rising importance of grain trade, came the rise in prominence of a key rural intermediary: the grain-merchant or arhtiya. The arhtiya, based in rural society, but not of peasant stock, mainly moved grain and money across different social groups and sectors. As we will see later in this chapter, this intermediary played an important role as a financier of small enterprises in late 19th-20th century Punjab-- a role that straddled both the agricultural and the emergent industrial sector.

⁷ In part because of its location on a major highway, (the Grand Trunk road that ran from Calcutta in the East to Peshawar in the Northwest), and a railway route linking two main north Indian markets--Delhi and Lahore.

Apart from shoring up informal credit institutions such as grain merchants and the familiar money-lenders, Ludhiana's agricultural surpluses in the late 19th century also found their way into more formally organized credit societies and local banks. The proliferation of surplus-generating smallholders in the region, and the broadbased spread of modest rural wealth in the district, made these credit institutions markedly different in character from counterparts in larger centers of commerce such as Bombay, Madras and Calcutta. In the latter, most lending institutions were urban based with branches gradually spreading to rural areas. In Punjab, the progression was just the opposite. Banks, mainly mofussil or medium sized banks, originated here in rural interior towns⁸ because of the rising incomes of the peasantry, their military remittances, and profits from grain trade, and only gradually set up urban branches (Rungta 1970:113-4).

The origin of Punjab's banks in the interior had some bearing on the largely local nature of their early investment and lending patterns. In part, because these banks were relatively small, and in part because of their location in the midst of their rural clients they responded to local needs first, rather than allowing the capital to finance trade and investment in big cities outside Punjab. Many of the smaller banks did not have branches outside the state; they held modest capital which they dispensed locally in the early years of industrial growth in the

⁸ See Rungta (1970):113, 176-7

region. Thus, there was credit available through various formal and informal channels, but it was not concentrated in a few hands (G.S. Randhawa 1990, Kahlon 1991, Kular 1991, 1992 interviews).

Third, in addition to the availability of small capital through the institutions described above, Ludhiana also had a sizeable concentration of metalworkers and blacksmiths who had worked on the construction of the colonial government's railroad and irrigation networks in the late 19th century, and who subsequently took up contract jobs, and urban-based repair and production work after the Land Alienation Bill of 1900 loosened their ties to land. Like a handful of other urban centers in Punjab where similar concentrations of skilled metal- and wood-workers were taking on new production tasks and building up new specialties (e.g., sports goods in Sialkot, and cutlery in Wazirabad), Ludhiana was already an important hub of woolen hosiery production by the late 1800s. Two features distinguished Ludhiana's rising industrial presence from other regions. First, Ludhiana's woolen products were already being produced for export by the late 1800s, and second, merchants played a key role in organizing production and securing new markets for the region's artisans and skilled workers. Ludhiana's woollen knitwear industry, organized at that time around the skills of Kashmiri migrants,⁹ for example, was driven by local Punjabi traders who had commercialized the SKILL of the Kashmiri weavers by seeking

⁹ These migrants had settled in large numbers in Ludhiana after a famine in Kashmir in 1833 (Ludhiana district Gazetteer 1970, and several other sources).

out markets for the artisans' products inside and outside Punjab, and telling them what there was demand for.

Initially this network of traders helped organize the export of the region's finest woollen shawls to France and England.¹⁰ After these exports stopped in 1870 with the onset of the Franco-Prussian war, the hosiery traders turned elsewhere for demand. Most significantly, they brokered government demand. They helped local producers harness the growing demand for woollen sweaters, vests, socks, and blankets mainly from the "army, police, and other government departments"¹¹ and from the "prosperous cultivators of the canal colonies" (Latifi 1911, Ludhiana District Gazetteer 1904 cf. Wall 1973). In a pattern that has parallels even today, local sales agents helped the small artisanal producers to cut back the production of their fine woollen shawls, and switch instead to woollen sweaters, vests, socks, and blankets which are far cruder items in terms of craft, but for which there was demand.

Two issues are important to note here. It was important not only that a network of local merchants harnessed new and varied sources of demand after older ones collapsed, and succeeded in organizing the skills of the region's small, immigrant wool workers around this demand. But equally important to the wool industry's growth, was the ability and willingness on the part of

¹⁰ See Punjab, district Gazetteers, volume XV.A, Ludhiana District (1904) for a detailed account. Cited in Wall 1973:81.

¹¹ See Latifi 1911:30-31, 51.

the artisans to alter their idea and system of production to switch to newer products even if it meant lowering their standards of craftsmanship--e.g., in the above example, socks and army sweaters required a different skill and understanding of production than their older trades of knitting fine shawls and elaborate blankets. This early pattern of production not only established an institutional relationship between trader networks who could broker demand from a variety of sources, and skilled artisans; but the relationship embodied a dynamic that accomodated progressive changes in what was produced and how it was produced, and switching to new products even if they were "inferior" in craftsmanship than the older trades.

The link between distribution networks and skilled producers tightened after the colonial government's Land Alienation Bill of 1900 pushed a large number of non-agricultural artisans and traders into industry. These traders entered industry mainly as financiers of wholesale woolen yarn trade, and as financiers of small skilled producers and distributors of their products and of imports. Although this influx of traders into industry happened indirectly, as a result of legislation aimed at agriculture, the effect was to put distributors together with producers who had skills and small amounts of capital. This pattern deepened in Ludhiana when a fresh wave of traders and skilled workers from west Punjab converged on the city after partition in 1947. As one informant put it, "bechne wale (ie those skilled in sales), aur banane wale (and those skilled in production) ek hi jagah pe

baithe the (were sitting in the same market)." Both groups had modest capital, and became national players only after they combined their skills (Kular interview, 1991). Today Ludhiana is the largest wholesale "market" of wool yarn and bicycles, sewing machines (and parts) in the entire country.¹²

Over time, networks of sales agents have developed around each of the items that Ludhiana's manufacturers specialize in. Although many former traders have themselves acquired skills and entered manufacturing, a key feature that remains is a vast network of sales agents and wholesalers that exist side by side and in close interaction with the network of small producers. They help small firms market their goods cheaply and seek out new sources of demand when old ones fade. And like in the example above, a key trait of the artisanal small-owners who have succeeded in staying in business has been their ability to not rigidly hold on to old or past standards, but to move on to new requirements and be attentive to new needs, even if this meant coming down to a coarser level of workmanship as we saw in the above case, of shifting from the manufacture of fine woollen shawls to socks and vests.

Finally, the government--specifically the army, which was a major buyer of Ludhiana's goods--influenced the emerging system of collaboration between distributors and skilled producers. The army's practice of minimizing the number of intermediaries it

¹² Selling to wholesalers located in Ludhiana indirectly means selling in the national market.

dealt with in its procurement process encouraged merchants and contractors (later cooperatives) to jointly handle the purchase of raw-materials and sale of finished products (Badenoch 1917). At the same time, the government also influenced the adoption by skilled artisans of new processes. For example, when hosiery producers widely adopted knitting machines after the first World War, the government set up small training institutions to provide "instruction in the use of knitting machines intended for small capitalists who wish[ed] to open small factories on their own account" (Badenoch 1917:9). These training institutes, the army's procurement practices, and the vast rail and road network that the government began to lay in Punjab in the mid-1800 deepened the growing links between local producers, the rapidly developing sales networks run by local traders, and the access and exposure of both groups to outside markets.

By the turn of the century, thus, Ludhiana district stood out from other typical districts in three key ways. (i) It produced for export, not just for local consumption both in agriculture and industry by the late nineteenth century. (ii) It was a prosperous district, but the dominance of smallholders made it hard to isolate a clearly identifiable elite. No single group thus controlled access to the region's resources, although there was enough capital in the system. The region had a concentration

of skilled workers who, in alliance with distributors,¹³ or the region's middlemen, captured large external (export) and public sector demand which became the basis of their growth. This alliance also allowed them to find new markets and products when old markets died out. (iii) Finally, the government's provision of extensive physical infrastructure in the state, and the setting up of training institutions targeted towards upgrading traditional artisanal skills, provided Ludhiana's skilled artisans the ability and incentive to shift to the production of newer, non-traditional goods.

Part II: The demand impetus behind the mushrooming of many small firms in Ludhiana.

A second key role that the state played in shaping inter-firm relationships in the early years of Ludhiana's industrial growth was demand generation--mostly through defense contracts during the second World War. This section examines various facets of the demand impetus behind the deepening of Ludhiana's

¹³ This alliance is typically regarded, with good reason, as exploitative for the skilled producers. That exploitation is not entirely absent in Ludhiana; but the difference is that over time there has been a blurring of boundaries in that distributors are themselves becoming skilled, or at least have been training the future generations that way, and the skilled workers have learned the salience of marketing and many control vast distribution networks of their own, and/or form consortia or networks of their own to obtain some of the advantages that distributors who know the market so well have. One way they have done this since the 1970s is to make incoming skilled trainees from the family in-charge of sales for the first several years. They travel across the country, sometimes abroad, and "get to know the market" before they handle other aspects of production. These processes are discussed more fully in the next chapter.

small-firm base, and the state's role in it. Since the state's demand generating role has been so mixed in with protection--both inadvertent, as in the cutting off of imports during times of war or strife, and through deliberate policy, as in the government's import-substitution regime and tariff protection policies--we examine exactly how this combination of demand surges and protection played out within and across firms of different sizes.

1. The distribution of defense demand during WWII and its impact on the organization of production

The second world war was an important turning point for local industry in Ludhiana in several ways. During that time many skilled repair firms experimented with the production of hitherto imported components and parts whose supply was cut off by the war. But most importantly, the defense department became a major source of direct and often indirect demand for the region's goods. Episodes of regional growth fuelled by war-time defense demand are not uncommon.¹⁴ What makes Ludhiana's defense-driven industrial growth distinct is the particular way in which this demand got transmitted across firms in the region. As we will see below, the way in which defense contracts were handled by the region's larger firms is significant because of the specific relationships it helped forge, not only between

¹⁴ The role of defense demand in shaping inter-firm relationships has been salient in several quite distinct industrial environments. See Saxenian (1994) for an excellent recent statement on the silicon valley's defense related growth.

firms of different sizes, but also across sectors.

For example, as reported to me by a medium sized, Ludhiana-based machine tool producer who started out as a hosiery manufacturer in the early 1940s, the colonial government floated a massive tender for knitted socks for the army during the second World War (R.K. interview, 1990). This 20,000-socks-a-day tender (for a fixed time period) was nationwide, but the informant firm won it having underbid by a wide margin the only two other large hosiery syndicates of that time both of which were located in Bombay. In order to deliver the order on time and yet make a modest profit on the very low bid, the firm recruited dozens of households in the region as its "ancillaries." The parent firm gave its new ancillaries "advances" to purchase sock-knitting machines (which cost Rs. 20 at that time, according to the informant) and yarn which it bought against quotas from the government at bulk rates. To finance these up-front costs the firm in turn borrowed credit from arhtiyas or grain merchants who have seasonal (agrarian) surpluses to lend at interest. At the end of the defense contract there were, according to the informant firm-owner, "at least 500 new small and tiny hosiery units in Ludhiana." These units initially drew upon each other and their medium-sized "benefactor's" connections to first build an understanding of the industry, and then to produce for the market directly.¹⁵

¹⁵ See Tewari 1990 for more detail on this subsequent points in this sub-section.

One other factor crucially helped these fledgling firms stabilize, grow, and consolidate their own position in the market. This was continuing demand from several sources during the period of their initial growth. As we saw in the previous chapter, Punjab was of disproportionate importance to the imperial Indian army throughout the late 19th century up to the end of colonial rule in 1947. For example, in both the first and second World Wars, more than half the total strength (over a million people) of the imperial army was recruited from Punjab, a province that had only a tenth of British India's population (Fox 1985). By the early 1900s the army had shifted its recruitment headquarters from Bengal and Maharashtra to Punjab, where the army's presence remained entrenched till independence in 1947. This continued military presence in Punjab, including in cantonments around Ludhiana, generated sustained demand for a variety of goods that local firms produced--pullovers, knitted vests, uniforms, belts, socks and other products. This provided the new, smaller firms with a ready market just when they most needed it--early in their firm-histories when they were trying to get an independent footing in the industry.

As the hosiery industry became consolidated in Ludhiana, skilled workers engaged in the repair of hosiery machines took to the production of machine parts and eventually the whole machine, and its related tools and equipment. Foundries emerged by the

late 1930s (District Gazetteer of Ludhiana, 1970).¹⁶ As we will see later in the chapter, the significance of Ludhiana's hosiery industry lies not merely in its own expansion, but also in the way in which it stimulated the growth of the engineering and other metal based industries in the region.

2. Organizational lessons from the way war-time demand came to distributed across firms in the region

The above example illustrates several points. The first set of points concerns the nature of linkage between the region's firms and agriculture--in particular, how capital flowed from agriculture into industry. The second concerns how the search by firms for profitability in the face of low profit margins influenced the nature of inter-firm relations and subcontracting that later developed in the region.

(a) Issues of lag, and financial flows from agriculture to small industry

(i) The first point this example illustrates is the way in which agricultural surpluses flowed out to finance capital formation in industry via a key set of intermediaries who straddled both the agricultural and industrial sector. Grain brokers or arhtiyas have played a significant financier role in Ludhiana's small-firm development since 1906 when an important

¹⁶ Foundries in other parts of Punjab e.g., Lahore, Sialkot, Batala -- and even a few around Ludhiana -- had made an earlier start catering to the needs of the Railway workshops, canal construction and flour and sugar mills in the late 1800-early 1900s. See Latifi 1911, and Badenoch 1917.

grain-market was established in a suburb of Ludhiana (Jagraon). This grain market was set up to handle huge surges in agricultural production in Ludhiana district following the colonial government's aggressive efforts to boost output in light of a series of "scarcities" or near-famine conditions in the late 1800s.¹⁷ The government invested heavily in irrigation and related infrastructure -- roads, railways. As we saw in the previous chapter, these investments greatly enhanced agricultural output and led to broad-based prosperity in Punjab's agriculturally active districts.¹⁸ The arhtiya, or the rurally based grain merchant played a central role in handling this increased agrarian wealth. They coordinated sales of farmers' crops, acted as export intermediaries, and made hefty profits as brokers in moving surplus agricultural stock across the country. Many grain merchants themselves invested forward in ginning, oil-pressing and other processing mills; but a large number also lent surplus capital on interest to others who were known to them and were investing in productive units in towns and cities within their districts, as the above example showed.

Two points emerge here about the way in which linkages between agriculture and industry played out in this region, and which might also be pertinent for other settings. First, that

¹⁷ Specifically in 1860-61, 1869-70 and finally in 1877-78 (See the District Gazetteer of Ludhiana 1970:241-245).

¹⁸ Between 1898 and 1914, for instance, wheat production in Punjab increased by roughly 60% and that of cotton by 77.3% (Nair, 1979:78,128).

agriculture-industry linkages may have an important lag element that deserves greater investigation. The above example suggests that instead of the post-independence agricultural modernization in Ludhiana, which most existing studies cite as having induced the rise of small firms in this region (Johar et.al 1983, Gosal and Krishan 1984, Thapar 1972),¹⁹ it may have been this much earlier period of agricultural growth²⁰ that in part stimulated small industry, and influenced the relationship between large and small firms. And it influenced these interfirm relations not through consumption expenditure multipliers--but rather through indirect investment links²¹ financed by non-farming rural intermediaries such as the grain merchants of this region. Post-independence production and consumption links between industries such as hosiery, machine tools, cycles, and increased purchasing power and changing demand conditions in the mid-1960s, in turn, seem to have reinforced these earlier patterns, not generated them.

This leads to the second point. Rather than assuming that surpluses from an agriculturally dynamic region will necessarily flow into or influence local industry, it is more useful to

¹⁹ See Child and Kaneda (1975) for a similar argument in the case of Pakistani Punjab.

²⁰ And subsequent periods of agricultural growth as in the 1950s.

²¹ See Hart (1989a), Harris (1989), and Berry (1985) for discussions about the crucial role of investment in engendering, or not, linkages between a dynamic and modernizing agriculture and regional industry.

understand the mechanisms by which this may happen and under what conditions. For example in the case cited above it was not peasants who were themselves investing across sectors, nor the state or the banking sectors distributing rural revenues indirectly, but rather it was the non-farming grain merchant-- usually thought of as an exploitative middle-man--that proved to be the crucial broker-connection between agricultural surpluses and local industrial investment.²² But it is also important to note that a central reason why agricultural resources could flow into industry in the absence of any direct state intervention is because production was organized in such a way that the bigger firm--with the collaboration of a large number of small firms-- could successfully capture and capitalize on the region's intersectoral investment potential.²³

²² Paul London's (1970) work on the role of the rural trader in spreading the adoption of fertilizers among farmers in Punjab and U.P. is one of the few studies that examines the developmental role of the merchant in contrast to the neglect of this group by government policy and much of the literature on grounds of it being the "problem" than an agent of positive change. More recently industrial studies have begun to focus on the conditions under which traders can play a growth-enhancing role in small firm clusters (see Schmitz 1995).

²³ Contrast this situation with the case of the Muda region in Malaysia described by Hart where surpluses generated due to the irrigation scheme were concentrated more sharply in the hands of a few groups who found it more lucrative to invest their money in real estate in the capital city, or on other non-local expenditures -- like Haj travel. The region's political economy together with the Malaysian government's macro-policy created conditions which failed to retain the effects of Muda's enhanced incomes within the region.

Just the opposite seems to have occurred in Punjab. Although resources did flow out of the region, e.g., for travel abroad for employment or immigration, a considerable amount was invested locally. Given that a large number of people had small surpluses,

(ii) Second, as we saw above, it was not consumption or expenditure links resulting from rising per capita incomes that induced local industry in Ludhiana's hosiery sector, but rather, a bulk of these small firms started out producing for the government, located outside the state. The state through its defense expenditures, then, played an important but indirect role in generating the demand and thus setting the conditions for attracting investment and enabling accumulation in a number of small firms in Ludhiana during this period. Thus, although many aspects of Ludhiana's small firm growth today resemble the classic features of agriculturally induced industrial growth, a key impetus for the region's earlier growth described here actually came from outside of agriculture--from the state. In other words: (1) The theory of growth linkages gives a key role to demand that is internal to the region resulting from rising agricultural incomes, but the demand discussed here is exogenous, and from the public sector. (2) the theory emphasizes backward linkages through private sector purchases; but this is a case backward linkages through public sector purchases. (3) Finally, this demand-side influence of the public sector is often ignored because the public sector is usually thought of as providing supply-side conditions for small firm growth (subsidized credit,

it was too costly for these small investors to try bigger external markets. Furthermore, since Punjab itself was an economically growing, not a stagnant region, it proved profitable to invest locally.

investment, infrastructure).²⁴

(b) Low profit margins, nature of the product and a sustained pattern of decentralized production

(i) The mushrooming of a large number of small and tiny firms during this period occurred not merely because of defense contracts, but because of the way in which the region's large/medium firms organized production. Instead of choosing to produce the entire order of socks in-house²⁵--which on the part of the contract winning firm would mean investing in vast amounts of dedicated machinery and adding to permanent capacity--we saw that the winning firm, even though it was not small, opted to subcontract parts of the order out to many new, small firms. The impetus behind this way of organizing production was the large volume of production, and most crucially, a low bid and hence low profit margins. The low bid helped the Ludhiana firm wrest the prestigious contract from bigger, more established Bombay producers. But at that low quoted cost the firm couldn't conceivably produce the order in-house and still make a profit. Low profit margins and the pledged low end-product prices led to cost cutting strategies such as engaging smaller ancillaries. This linkage between low profit margins, low costs, low end-product prices and ancillarization (specialized contract work) is a pattern which prevails in Ludhiana up to the present day.

²⁴ For recent studies that focus on the public sector's demand-generating role on small-firm growth and attempt to correct this imbalance see Tendler and Amorim (1996).

²⁵ As the Bombay firms were proposing to do.

(ii) Finally, to understand why production in this sector continues to be organized in a highly decentralized fashion we need to look at the nature of the tasks that hosiery production involves. Although a detailed analysis of the hosiery industry is outside the scope of this section, it is important to note that in contrast to activities such as spinning which have significant economies of scale, hosiery (e.g., knitted outerwear) technology is highly divisible up and can be broken up into various stages that can be decentralized into separate, specialized firms. For example, there are firms that do only dying work, others that only knit, and yet others that embroider (see Singh 1990, Sikka 1990).²⁹ Ludhiana has both a spatially compact organization of work--where firms from several key industries are located in close proximity--and an infrastructure of brokers and intermediaries who facilitate labor exchanges, job work and subcontracting among specialized shops. Moreover, as several firm owners pointed out in interviews, no single firm then bears all the risk--of investment, changing demand and tastes, and even while labor costs are cut substantially (because of fewer workers per firm), labor management is "not cumbersome" under such arrangements--reasons that are quite consistent with the findings of many other studies of small, interconnected

²⁹ See Cawthorne (1989) for a similar break-up of the components involved in knitted hosiery in Tirrupur, Tamil Nadu, India.

In Ludhiana, the same is true for the cycle and sewing machine industry, where a variety of firms produce the separate parts, each requiring several distinct operations which in turn are done "outside" by specialized service providers.

producers.³⁰

The divisible nature of technology, especially in the hosiery, bicycles, and sewing machine parts industries, has continued to reproduce the fragmented, interconnected nature of production, as we will see in subsequent chapters. Yet, firms in Bombay and Calcutta who were in the same sectors, did not go this route. This is mainly because the origin of these larger producers in Bombay was different. Possessing the capital needed to invest in integrated operations, they started out with the production of all components and phases of work inhouse. The small producers that existed around them catered to a different, cruder segment of the market, there was thus more of a disarticulation between the big houses and the smaller sector around them. In Ludhiana by contrast, few groups had the capital to internalize all operations under one roof. Firms thus started out as component producers (in the metal trades) or specialized in specific segments of production or work processes. As more and more components came to be produced in the region, assemblers emerged, fuelling further growth through backward and forward linkages, as we see next.

³⁰ See John Harris (1981) for an analogous argument for Coimbatore's small-firm sector.

Part III: The supply Response: Import restrictions and the emergence of a cheap, local machinery-producing base in Ludhiana

The above discussion showed how a large number of small firms emerged in Ludhiana's hosiery industry at the end of the second world war as a result of the way in which the region's firms distributed the government's defense demand in order to sustain themselves on low profit margins. But demand surges created by conjunctures of war are notoriously short-lived. New entrants drawn in by war-time booms often exit as rapidly after the temporary surge in demand subsides. According to much of the literature, the smallest firms are the most vulnerable, and the first to go under. How did these new firms born during the temporary surge in production during the second world war survive? Two factors played a role--one fortuitous, and one related to the region's organization of production.

First, rather than being followed by a post-war slump, the expansion of demand during World War II,³¹ was followed, fortuitously, by a series of new demand surges. Only two years after the war ended, independence and Punjab's partition in 1947 brought an upsurge of reconstruction demand by the state

³¹ This demand which opened up during the war period of the early 1940s was selective in its impact on factory production. It did not benefit all industries equally: it raised output primarily in those industries which were important to the war effort. In Punjab these included woollen hosiery (socks and knitted outdoorwear such as pullovers, jerseys, blankets), sewing machines used for tailoring of army uniforms as well as tailoring woollen hosiery, and the spare parts of these machines which were difficult to import because of the war (see Singh 1990:72-3).

government; followed by the opening up of massive domestic demand when the government of India imposed its import substitution regime in the early 1950s.³²

Second, around the time of partition a major decentralization of production occurred in the hosiery industry with the emergence of several new tiers of traders and specialized producers (Wall 1973). Changes were also occurring in the region's metal industry. In part because of the ISI regime which curtailed imports of goods such as bicycles, machinery and other consumer durables, it became lucrative for local repair shops to take up the production of components. As more and more components of hosiery machinery, bicycles and sewing machines came to be produced in the region, assemblers emerged and absorbed more and more of the output of local parts producers.

At the same time a machinery sector grew which significantly lowered production costs for the region's small firms. These lower production costs allowed a larger number of local firms to

³² This discussion sheds light on another issue. The literature on Punjab's industrialization often cites its small-firm bias as rooted in the influx of enterprising immigrants from western Punjab upon the state's partition in 1947, many of whom started small businesses as a means of rehabilitation. But this inflow of a large number of displaced immigrants from Pakistan did not in and of itself translate into a mushrooming of "dynamic" small and medium firms in Ludhiana. Rather, it was the simultaneous opening up of massive domestic demand that fortuitously allowed these emergent firms to stabilize and grow. Import restrictions and protection were the key impetus--from the demand side--which allowed new firms to find markets for their output relatively easily.

exploit the new surges in demand. The source of lower production costs was the emergence of a cheap machinery and tools manufacturing base in Ludhiana and neighboring districts that catered specifically to small producers. I trace the key features of this process below.

(i) Exploiting demand surges in an environment of scarcities, and its influence on local skills and capabilities:

The cutting off of imports during the second WW, and the simultaneous escalation of demand from the army for woollen pullovers, sweaters, and socks was accompanied by severe shortages of woollen yarn and knitting machine parts and needles. While a few local metal workers repaired and reconditioned knitting machines and parts at that time, knitting needles and most of the yarn (wool-tops and shoddy) were imported. Given the urgency of the government's own war needs, its solution was to fix supply quotas for dyed woolen yarn and knitting needles. The defense department's purchasing agency distributed knitting machine needles, and a fixed quota of dyed yarn per fixed order of jerseys and socks -- e.g., 150 bales of yarn for 100 pullovers -- to firms that won the government's supply tenders (personal interview, Raibahadur 1992).³³ But increased competition between firms (nationwide) who were vying for these same supply

³³ In fact, it was in the inter-war period that the government first considered developing the local industrial base, and with that goal in mind, set up an industrial review committee to examine issues of tariffs and protection for local firms.

tenders from the government pulled down profit margins as we saw earlier. Ludhiana's firms coped with these low profit margins by subcontracting, as we saw in the previous section, and by increasing efficiency. One way in which firms increased efficiency (as I illustrate below) was by increasing output and reducing wastage--a pattern that characterizes the region's organization of work even today. The point to note in the illustration below is how reduction of wastage was an inadvertent effect of the search by firms of ways to increase output and shore up margins in the context of a quotas and input scarcities.

"Forced" efficiency and the broadening of skills: an example. A medium sized woollen hosiery firm that started production on a small scale in 1926³⁴ reported that in the inter-war years and during World War II, firms tried to make up for low margins by increasing output. They did so in a variety of ways. One way was to economize on the fixed quota of dyed yarn that the government gave them (150 bales of yarn for a supply order of 100 pullovers), and to use the saved yarn to produce extra pullovers which they sold at a higher premium in the local market. Since the yarn was procured only by firms that

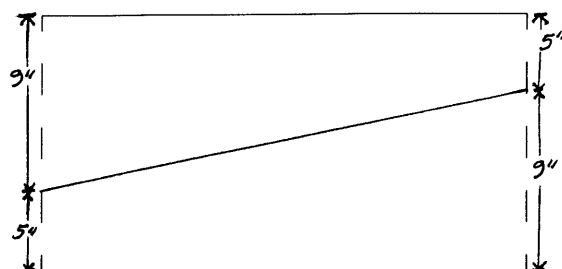
³⁴ Raibahadur (RB), personal interview 1992. Several of the firms I have used to illustrate my points are medium sized firms today (with investment upto Rs. 15-20 million and about 100-150 workers spread over one or two units) that started out as small firms. I use these firms because they have the longest history of my sample and best illustrate the process of evolution, change and continuity in some of Ludhiana's most enduring productive practices.

won tenders to supply sweaters to the army, this economizing on yarn could not come at the cost of pullover quality because the order had to meet the army's strict requirements of color, size, knit, and design.

The interviewee firm and a few of its colleagues economized instead by eliminating wastage by using new kinds adaptations to standard knitting machines which they developed together with local machinery repair and reconditioning firms. To take one example, the standard practice of producing jerseys and pullovers at that time involved knitting the body and sleeves of the garment separately on different machines and then sewing them together using industrial sewing machines. In this process, the sleeves generated the most wastage. Sleeves were knit singly on 9-inch knitting frames as rectagles that were 9-inches wide,³⁵ and as long as the sleeve needed to be. These rectangular pieces were shaped by cutting off a strip down the length so that the wrist tapered down to 4 inches during the actual stitching. A long, sleeve length knitted strip was thus invariably wasted for every sleeve. To eliminate this wastage, and put the saved yarn to better use, in the late 1930s-early 1940s the interviewee firm and a few other hosiery producers turned to local mechanics for help with modifying the standard machines. Their solution was to replace the standard, imported knitting machine's 9-inch cylinder with a 14-inch cylinder, so that the knitted sleeve-rectangle

³⁵ The width was 9 inches to accommodate the armhole.

would now yield exactly two, diagonally stacked sleeves of the exact dimensions (9" for the armhole + 5" at the wrist on each side. $9+5 = 14$).



The superfluous strip was thus fully eliminated. Hosiery firms saved on yarn, which they used to increase output to sell on the open market at a premium and shore up their margins.³⁶

Although not on par with imported machines in terms of quality and their economic life, the locally adapted machines provided adequate quality of knit despite their shorter economic life (RB interview, 1992). These modifications moreover were cheap. They were cheap not only because they were carried out by local mechanics, but also in part because the innovation was simple. It involved copying the existing design of the 9-inch cylinder to make one of a larger size that suited the knit that the hosiery firms required, and substituting it for the standard 9-inch cylinder on a regular knitting frame body.

But two other features were important. First, that there was skill in the region to attempt such modifications, and that small producers had easy access to these skilled workers and

³⁶ Some firms simply sold the extra yarn to other producers at a premium.

mechanics. Second, a key pressure on the mechanics that focussed their efforts, was the strict quality code imposed and enforced by the final customer whom the hosiery firms served--the colonial government's defense agency. Woollen pullovers and socks hardly compare with the narrow latitude for deviance from standards that armaments and other "harder" war-supplies impose on producers. But within the codes for size, design, and quality that the government's woollen gear did have, the mechanics had to be pay attention to certain demands of quality. If the hosiery suppliers wanted repeat orders, they had to supply the government the quality of goods it needed and in a time frame that the government set. That this quality threshold was relatively low, may explain why the metalworkers succeeded, or even attempted to make the modifications in the first place. But more important even in this regard was that the demand that the hosiery firms placed on the machinery manufacturers was not abstract, but highly specific: once the solution was discovered, the workers had a model (e.g. the 9-inch cylinder) to work from and did not have to begin from scratch.³⁷

Once introduced, the modification became ubiquitous across Ludhiana's hosiery firms. This adoption had broader spillovers. It also led the repair mechanics who made the modifications to eventually produce the entire knitting machine (RB interview, 1992). The process thus improved the output and earnings of the

³⁷ The "forced" innovation came from copying and modifying what existed.

small hosiery producers, broadened the skills of local mechanics, and deepened the region's productive structure through backward linkages.³⁸

(ii) Import controls, demand escalation, and the creation of a cheap, local, machinery base geared towards small firms

A similar process occurred in the growing metal-based consumer durables industry. The rising standard of living among Punjab's peasantry, as well as the location of the imperial army in Punjab raised local demand for consumer durables. According to the Punjab District Gazetteer of Punjab 1907, "the circulation of...currency [doubled] between 1891-1904; deposits in postal banks increased by [27%]...and wages rose twice as high as in [the mid 1800s];"... "[The peasantry's] increased means enabl[ed] them to travel more, eat better food, wear better clothing." And "In the towns, cheap European luxuries, such as German watches, ...shoes, bicycles find a considerable sale.." (1907:70,72). Many local households owned goods such as bicycles. Similarly, the growth of the hosiery industry and the army's presence in Punjab increased the demand for goods such as sewing machines (industrial and tailor models) for stitching uniforms, pullovers

³⁸ The solution seems an obvious one; and there is no way of knowing whether firms in other regions thought of the same thing or not--but that is less important. It is clearly a major asset to be part of a productive environment where a small firm (the hosiery producer) can turn to another local small producer (the repair mechanic) to successfully innovate at relatively little cost on an imported machine without sacrificing on the quality requirements of its final buyer (the army).

and other items (Marenco 1974 ck); as well as for repair work.

Faced with shortages during WWII in the availability of spare parts many of these repair firms took to producing replacement parts and components themselves. Shortages in the availability of nuts and bolts and other fasteners in the replacement market for auto-parts similarly drew in producers into that line of work. After partition these metal-based consumer durable industries got a further boost when several non-artisanal traders from former West Punjab, who formerly held local agencies for the distribution of sewing machines and bicycles, also entered into the production of parts and assembly of sewing machines and bicycles upon their arrival into India, in partnership with skilled local artisans.³⁹

As the firms producing metal components grew in importance, the local machine tool industry whose beginnings we partially traced above, also gathered steam. Three demand-enhancing factors influenced its growth: growing demand from the region's

³⁹ A point worth noting here concerns the role of imports in creating demand and as a means of exposure to outside standards and products. The agriculturalists and urban middle classes in this region already consumed goods from industries outside the state and country -- e.g., German bicycles, watches, British and Japanese sewing machines. As Hirschman pointed out in 1958, regions or countries "tend to develop a comparative advantage in [producing] the articles they import" because "imports fulfil the very important function of demand formation and demand reconnaissance for the country's entrepreneurs" (1958:122, 123).

Similarly, the consumption of items not locally produced, created demand for repair. In fulfilling this need, local workers learned about the nature of the product through working on its replacement and reconditioning. At the same time, this prior set of imports created a niche, and a need for the manufacture of these goods later on.

metal-based industries; massive reconstruction needs after the partition of Punjab in 1947; and protection from import-competition after the government of India embarked on an elaborate import substitution program (ISI) in the early 1950s, a few years after partition.

On the one hand, high import tariffs (on consumer goods) protected local industry from outside competition, allowing for its growth. But on the other hand, these tariffs (on some producer goods) also created severe shortages of intermediates and machinery by raising input and costs, thus constraining these firms' ability to easily exploit the opportunity for expansion.⁴⁰ The primary response to the ISI policy was the government's own. It invested in creating domestic machinery making capacity--mostly in large public sector parastatals such as Hindustan Machine Tools (HMT), although a few large private sector firms also emerged (such as Bombay-based Kirloskars). But the machinery produced by these large public and private firms met the needs mainly of other parastatals or large private firms. Their machines were of too large capacity, and too expensive for small firms to afford.⁴¹ A different kind of machine tool

⁴⁰ This strategy of protection differed from the import substitution practices that prevailed in Latin America (such as those recommended by ECLA). Following the Feldman/Mahalanobis models, the Indian government sought to cut off imports not only of consumer durables, but also of some basic machinery in order to build a basic goods (e.g., steel) and machinery building base domestically.

⁴¹ Thus, as much of the literature critical of import substitution industrialization argues, protection, in this early period seemed to benefit larger firms more than smaller ones.

industry developed in Punjab in response to the same import substitution policy: it comprised manufacturers who were themselves small in scale, and who produced for customers that were also primarily small in scale.⁴² As we saw in the previous section, a majority of these small scale machine tool producers were skilled metal workers (Ramgarhias) with roots mainly in repair, reconditioning, and contract work for the Railways or the Punjab government's irrigation department.

In Ludhiana specifically, two changes occurred after partition, that drew a bulk of the these small producers, both of machine tools and metal-based consumer goods, to spatially locate in and around its vicinity. First, as the hub of north India's hosiery industry, had an evolving industrial infrastructure, and a widespread skill base. It had trading and distribution networks, service providers and training institutions. It also had a large concentration of skilled workers, the Ramgarhias, who were involved in the metal trades, including the production of hosiery machinery, and after WWII and partition, the production of metal components for other final goods such as bicycles and sewing machines.

Second, after the partition of Punjab in 1947 Ludhiana became one of the main destinations for immigrants from Pakistan

Smaller firms relied on second hand machines.

⁴² Coimbatore was another region with a response similar to Punjab's.

-- especially those who already had their own businesses (manufacturing or trade) in former west Punjab,⁴³ or had industrial skill, and were looking for a viable place in which to restart their factories, and/or find industrial jobs. Ludhiana had a central location within Punjab, away from the troubled border; it already had a vibrant hosiery industry, and a growing light engineering base. But most importantly, these entrepreneurs and workers were drawn to this region by the new serviced industrial sites and cheap housing that the government of Punjab developed in Ludhiana for distribution in easy installments to immigrants from Pakistan and other entrepreneurs who wanted to relocate away from Punjab's violent border in the late 1940s. The government of Punjab launched this program explicitly to revive the disrupted economic base of the state by developing Ludhiana as a major industrial center within Punjab (Luthra 1948).⁴⁴ In order to help local firms rebuild the region's industry the government provided cheap serviced land in three industrial estates in Ludhiana, located the state's key industrial extension institutes, R&D centers, quality-enhancing institutions such as the Ludhiana Productivity Council, Quality Marking centers, and a key joint facilities center (the Industrial Development Institute) around these estates. It also

⁴³ Chiefly the manufacture of cycle parts and sewing machine parts.

⁴⁴ The older centers of Lahore, Sialkot, Wazirabad, Karachi had gone to Pakistan, while Amritsar--the only other major industrial center that came to the Indian Punjab (other than Ludhiana and Jullunder) was on the border and disabled by violence.

targeted skilled workers in particular, giving them modest loans, industrial sites and housing (on installments) to take up production in Ludhiana.

Industrial growth thus took off rapidly in Ludhiana in the late 1940s, and the period between 1951-1960 was the region's major phase of industrial expansion after independence (Sharma 1988, Pandit 1985). Between partition in 1947 and the mid-sixties, capital employed in Punjab increased 24 times compared to 10 times for the country as a whole; employment in factories increased 4 times in Punjab when for the country it little more than doubled; industrial output grew 10.4 times in Punjab while in the nation it grew 2.3 times; and output per person in Punjab increased 1.4 times compared to 0.6 times in the nation as a whole (Sharma 1988:79,80). Moreover, unlike the dismal record of industrial estates in most parts of India, Ludhiana's industrial estates were regarded amongst the most successful in the country (Dhar and Lydall 1961, Ford Foundation 1966). But this growing concentration of a large number of metal-based small firms in one region created bottlenecks in the procurement of base machinery. Machinery importers in Bombay and Calcutta demanded large advances and charged hefty premiums as insurance against doing business with firms located in a state reeling under the chaos of partition (Oswal interview, R.K., Bhogal). On the heels of this came the government's ISI policy in the 1950s, and hefty tariffs on imports.

These pressures that created substantial demand for cheaper

machine tools from within Punjab, encouraged several skilled artisans in Ludhiana and Batala (four hours from Ludhiana, and the home of a large number of ironworkers and foundries) to begin local manufacture of simple general purpose machines--lathes, milling machines, and hand tools--and other machinery that was in local demand. A start had already been made, as we saw in the previous section, with the manufacture and modification of specialized machines in the hosiery industry. Foundries and re-rolling mills had emerged in Ludhiana's vicinity (Khanna and Gobindgarh), workers with varied skill in metal work were widely available, manufacturers of complex sewing machine components since the 1930s had spawned workshops that carried out specialized processes, and now, with a growing local market, machinery production became profitable.

Metal workers engaged in repair and reconditioning responded to this demand for cheap, more suitable machines. Building upwards from the specific needs of their clients, and learning through reverse engineering by copying existing models, these metalworkers/mechanics began to put together machines that local firms most commonly used, and which were previously imported or purchased from distant markets.⁴⁵ Because this production was carried out and organized by repair mechanics who had craft skills, but little capital, and who worked closely with their customers, the structure of the machine tool industry took on

⁴⁵ They produced mostly simple, general purpose machine tools such as lathes, drills, power presses, grinders, shapers, milling machines, planers, small tools and hand tools.

distinctive characteristics: most producers started small, as did a bulk of their clients. They built networks around themselves which they call their "infrastructure" comprising of loosely coupled mobile teams of skilled workers, workshops that focussed on single processes such as tempering, casting, forging, and so forth, which allowed them to produce profitably while economizing on their limited capital.

In the late 1950s, less than a decade after partition, these producers broke into national markets. A national survey conducted by the Government of India in 1956 found that a single district of Punjab, Batala, alone "produced nearly half of the national output of machine tools in the private sector" (Sharma 1988:78).⁴⁶

By the 1950s then, production firms in Punjab and Ludhiana had a sizeable machinery making base at their own doorstep -- a base they could draw upon to craft tools and equipment that was much more closely tailored to their needs than any standard set of machines. Equally salient, these machines cost far less than the equipment produced by the government's parastatals and large private firms. A study comparing a workstation produced by Ludhiana firms with that prepared by firms like HMT, found for example, that the Ludhiana produced machine cost about half (55%) the price of the standard equipment for output of identical

⁴⁶ An important byproduct of this machinery base has been the development of a quite sophisticated hand-tools industry in Punjab, one of the region's premier exports today.

quality (Asian Productivity Organization 1981:52-53).^{47, 48}

As a result of the local presence of an import-saving, cheap machine tool base, production costs fell for firms in Ludhiana and Punjab that used these machines and tools to produce products such as bicycle parts, sewing machines and parts, diesel pumps and agricultural implements. This happened at the same times as demand for them increased through the introduction of the government's ISI regime and tariff protection. Thus, as domestic demand for locally produced goods increased, Ludhiana's small firms were able to capitalize on it more efficiently and economically than small firms in other parts of the country who lack access to similar resources at low cost. As we will see in the next chapter, Ludhiana's small firms lowered overheads, minimized wastage and economized on capital in a variety of ways to compete successfully by the early 1970s, not only with other small firms, but even with the large firms that produced the

⁴⁷ See the Tokyo-based Asian Productivity Organization's study of the processes used in Ludhiana to produce the bottom-bracket axle (a bicycle component requiring considerable precision) vs that used by larger firms in other parts of India (1981:Chapter 4).

⁴⁸ Despite the obvious merits of these small machine producers -- and the national demand for their products, e.g., all circular knitting machines in the country are made in Ludhiana even today -- there is still disdain among several policy-makers for these "peon-to-proprietor" small producers of Punjab. Perhaps the time it took local firms to learn to improve quality in the 1950s-1960s, their use of lower grade steel for manufacturing machine bodies, and the fact that the machines were made by skilled workers and mechanics rather than engineers, might be some reasons for the relative neglect by outside observers, until recently of these efforts.

products they came to specialize in -- bicycles and sewing machines.

Conclusions

To summarize then, this section focussed on the other side of the demand surges faced by Punjab's small firms. It argued that the very sources that created large demand which helped boost local output during this period, also put impediments in the standard path available to local firms to meet this increased demand--the path of relying on cheap imports. That is, due first to war, then the ISI regime, rising demand was accompanied by severe restrictions on imports, which blocked local access to machinery, spare parts, and other intermediates that would help firms meet growing demand for woollen hosiery (during World War II), sewing machines and bicycles.⁴⁹ These pressures, which prevented local firms early in the region's industrial history from following the standard route of relying on imports of intermediates and spare parts, opened up new opportunities for skilled workers, metal mechanics and artisans. Most of them were part of the Ramgarhia community that had been building for itself an industrial base since the Alienation of Land Bill of 1900

⁴⁹ For example, to fulfil hosiery and army uniform orders during the war, firms needed knitting machine needles, sewing machines and sewing machine maintenance (spare parts) which were all hitherto imported from UK and later, Japan and Germany. During the same period, and after partition, repair firms needed spare parts to meet the maintenance demand from bicycle owners -- hitherto imported from Germany.

excluded it from agricultural accumulation.

This dual pressure of increased demand opportunities on the one hand, and restricted imports on the other, generated a wave of import competing practices in machinery production by local metal workers and artisans, laying the basis for a shift from repair to component manufacturing.⁵⁰

Two final points need to be made here. First, the nature of these demand episodes early in the region's industrial history ensured, at another level, that there were ongoing pressures on local skilled workers to come up with new ways of doing things that would help final goods producers, who operated on slim profit margins, to cut costs. In part, because many of the small owners of the sewing-machine and bicycle component firms, as well as machine tool firms were themselves skilled workers or mechanics who had arisen from the same stock of skilled workers they employed, they were better able to converse about and respond to these demands. Moreover, for the skilled small machine tool producers, who worked with 2-3 helpers on the shopfloor to figure out how to meet the requirements of their customers, it was their own self-interest to keep revising their skills in order to make the most of demand openings. Thus the

⁵⁰ These developments on the supply side that made it cheaper for small firms to do business in this region at that time. They found cheap machine tools and cheap machinery, cheap repair services and cheap reconditioning teams. "Import competing" practices by local machinery producers thus helped lower the capital costs facing producers of consumer durables, allowing them to use existing demand more effectively.

widespread presence of skill among Ludhiana's small firm owners is not an idiosyncratic result of history, but rather, the nature of demand, the structure of supply conditions and the pressures that local producers found themselves under. These factors not only shaped those skills, but demonstrated the benefits of having access to a large pool of skilled technicians: it helped them compete with much larger competitors. It was in their interest to invest in creating institutions that would help maintain this skill and its advantages. How they did so, and what some of these institutions were, we will see in the next chapter.

Second, in contrast to the view in the literature that import controls most often benefit larger firms that are able to capture sheltered markets, the distributional impact of import restrictions and the machinery manufacturing response by small local firms in Punjab benefited the region's small manufacturers the most. This departs from the case of large public sector firms such as HMT (and private ones such as Kirloskar), that produced equipment affordable mainly by medium and large firms or by other parastatals. But, at the same time, investments by the government in parastatals like HMT indirectly played a key complementary role in the emergence of a small-firm based local machinery sector in Punjab. Parastatals like HMT provided Punjab's small firms with a standard of quality towards which to evolve. After Bangalore, the Government of India located a

branch plant of Hindustan Machine Tools in Pinjore⁵¹ in the 1950s, a few hours from Ludhiana by road. The machines produced in this plant presented local firms with a standard of quality to work towards, and a product that was more readily accessible to them to copy than imported models. Public sector plants owned by the central government therefore unwittingly provided local firms with a model around which they could grow--a role that is not usually attributed to the state.

⁵¹ This city, now in Haryana, was part of Punjab until 1966 when Punjab was split into three separate states (Punjab, Haryana and Himachal Pradesh).

CHAPTER 4

Accumulating human capital: substituting the technician's skill for meager capital and a limited natural resource base

Introduction

Earlier in the study we noted that Ludhiana is a curious place for a metal industry to be based. It has no material advantage: there are no mineral or coal deposits in the state or in its vicinity; coal, steel and iron must be carted over hundreds of miles from Bengal, Bihar and Orissa. The state of Punjab is landlocked and has no ports. Yet, despite these bottlenecks, a metal consumer durables industry dominated by small firms--just the firms that the literature argues build on local resources--has thrived in the region for the past 60-70 years. What accounts for the flourishing of a successful metal industry in this particular region?

As a partial explanation I argued in the previous chapter that the nature of skill in the region's workforce, and a sequence of demand-generating episodes early in its history were crucial in overcoming the region's lack of natural advantage. But skills and demand-escalations are hardly unique to Ludhiana. Many regions have artisanal skills--Howrah, Rajkot, Coimbatore are examples in India alone that have skills very similar to Ludhiana--and have been subjected to substantial demand. Yet, despite some success, small firms run by skilled worker-entrepreneurs in these cities do not define the industrial

character of these regions in the same way as they do Ludhiana's. Similarly, as we will see more fully in a comparative section in the next chapter, Bengal's famous metal industry at Howrah, an industry also based on small firms, metalworking skill, abundant natural resource advantages, and steady--indeed captive--government demand, declined over the same period that Ludhiana's metal industry developed a national stature. What explains the difference? What are the conditions that have allowed small firms run by skilled mechanics and former artisans, such salience in Ludhiana's industrial regime?

This chapter argues that in addition to the social structure and historical features discussed in previous chapters, a central feature of this region's productive environment is its fostering of a continually evolving human capital base centered around the technician's skill. As we saw above, many regions have skilled workers. What is different here is that more than just the presence of skill in the workforce, the process of skill acquisition in this region seems to include an ability on the part of skilled workers, artisans, and the many skilled small-owners to be open to new ways of doing work, to change and alter their skills to suit new needs, rather than hold on to highly refined, but older craft skills. We have already seen in the previous chapter how the roots of this openness to change go back to the way in which work relationships evolved between skilled artisans and locally based merchant distributors who brokered demand for them from various sources in the mid-1900s. We saw

how highly skilled weavers of fine woolen shawls were willing to come down to cruder levels of craftsmanship in order to shift to products such as woolen jerseys, pullovers, socks and belts for the army for which there was plenty of demand. Thus, even though artisans and technicians, not engineers, dominate the region's skilled workforce, their skill is hardly traditional. And, as we will see, it is constantly transforming in response to demand pressures.

A second part of the argument is that this human capital base is a result of at least two conditions: (i) An inadvertent interaction between an extensive, formal state-supported system of vocational training, and the less formal trajectories of skill acquisition by workers involving movement across the labor market, and processes such as on-the-job training on the shopfloor. (ii) And a second condition is the way in which work is organized within and between local firms, where small-owners (many of whom are themselves skilled) make constant demands on themselves and their workforce to find cheaper or more effective ways of producing standard goods using non-standard processes and through reverse engineering. Together, these conditions have provided prestige, credibility and value to the technician's craft and to vocational education.

The final part of the argument is that this human capital base differs in at least two ways from discussions about human capital in the recent literature. First, unlike the emphasis in the literature on an educated workforce centered around the

college educated skilled engineer--as in studies of East Asian industrial competitiveness (Amsden 1989, Wade 1990, World Bank 1994), the skills in Ludhiana are those of the mechanic--the mistry,¹ or "practical" engineer, located in-between the craftsman and the trained engineer. Till the 1970s, most of the region's skilled workers and small-owners were matriculates or trained through the vocational system. Thus, if measured in terms of level of schooling, literacy, and the proportion of engineers in the technically skilled workforce, Ludhiana's human capital base would appear quite mediocre. Yet, the region's manufacturing sector has consistently grown faster than the national average,² and the region's key industries (bicycles and parts, industrial sewing machines, and woollen hosiery) dominate national markets in terms of market share (60%, 85% and 95% respectively).

Second, the Ludhiana (and Punjab) case raises questions about the macro policy arguments in the recent literature about the importance of making heavy investments in education, literacy, and health as preconditions to equitable economic growth (Birdsall et. al. 1995). As we will see in this chapter, Ludhiana's case, in contrast to East Asia, does not fit these education-health first arguments. Despite mediocre social indicators and literacy rates (see Table 4.1 below), and despite

¹ A mistry is a mechanic, technician, or master craftsman--production engineer in modern parlance. A mistry most often holds a high position on the shopfloor.

² See Table 1.8 in the Introduction.

the dominance of the technician, not the engineer, in its skilled labor-force, Punjab has an innovative workforce, the highest per-capita income in the country, and only 7% of the state's population lives under the poverty line compared to 30% for the country as a whole.³ The Punjab government's focus on providing basic infrastructure⁴ throughout the state, and its emphasis on the formation of cheap and accessible technical skills allowed broad sections of the urban and rural population to build middle-class livelihoods.

In Table 4.1 below we see Punjab's economic and social indicators compared with four of India's most industrialized states (Maharashtra, Gujarat, Tamil Nadu, and West Bengal) and with Kerala, the state that leads the nation in social indicators. Punjab's social indicators--especially literacy and infant mortality--are better than the national average, but nowhere near Kerala's performance which closely resembles the literacy and public health standards achieved in the high-performing East Asian economies of which Birdsall et. al (1995) model their argument. However, Punjab's economic indicators are among the best in the nation. Although not all group and regions have equal access to this wealth, land-holdings are relatively less unequal in Punjab; the Gini coefficient for land-holdings was a modest 0.24 in the 1980s (Sims 1988), and agricultural

³ These are 1987-88 figures. See Table 4.1 for references.

⁴ Such as electricity, water, roads, rural credit societies, basic schooling.

wages are the highest in the nation as we saw in the Introductory Chapter.

Table 4.1

Per-capita income, area, population, density, and literacy in selected states (1990-91)

State	Per capita Income in Current Rs.	% Urban Population	% Population below Poverty#	Density /sq.km	Literacy (%)
Punjab	8423.00	30%	7%	401	57%
Maharashtra	7409.00	39%	29%	256	63%
Gujarat	5404.00*	34%	18%	210	61%
West Bengal	4193.00	27%	28%	766	58%
Tamil Nadu	3894.00*	34%	33%	428	64%
Kerala	3451.00*	26%	17%	747	91%
All India Avg.	4934.00	26%	30%	267	52%

Source: Statistical Abstract of Punjab 1992:118-119, and calculated from Table 3.19 pp. 82-83.

Per capita income is in Rupees at current prices

* 1989-90 figures, all the rest are 1990-91 figures.

1987-88 figures (Statistical Outline of India 1992:28)

Note: Goa state had higher per capita income than Punjab (Rs. 3169.00) in 1980-81. 1990-91 figures are not available.

Table 4.1 (cont.)

State	% Net Irrigated area (1987-88)	Infant Mortality Rate (1990)	Gross Factory Output per capita (Rs) 1987-88
Punjab	95%*	61	4,071
Maharashtra	12%	58	4,603
Gujarat	23%	72	4,245
West Bengal	23%	63	1,795
Tamil Nadu	44%	59	3,047
Kerala	14%	17	1,466
All India Avg.	33%	80	1,971

Source: Statistical Outline of India 1992:7,9,10

* 1989-90 figures

Table 4.1 (cont.)

State	Per-capita Cons. and availability of milk (1987-88) (kg/per annum)	Daily newspaper circulation per 1000 population*	Registered motor vehicles per 10,000 population*
Punjab	255**	48	556
Maharashtra	44	42	425
Gujarat	84	28	404
West Bengal	44	33	108
Tamil Nadu	61	28	209
Kerala	57	62	179
All India Avg.	64	29	206

Source: Statistical Outline of India 1992:7,9,10

* 1989-90 figures

** This figure is not a mistake.

The first part of this chapter continues the thread from the previous chapter of looking at the state's role in this region's industry. It shows how an important input in the ability of small firms in this region to thrive and build a strong human capital base, has been the Punjab government's emphasis on infrastructure provision and training. This emphasis is in contrast to the usual way in which governments in other parts of India have intervened in industry--through direct investment in public sector enterprises and equity participation in industry. The second part of the chapter focusses on technical knowledge and how local firms acquire it. It examines the networks through which the region's small firms get access to technical know-how, skill, and training, and the government's involvement in this process through its emphasis on vocational education. The third part of the chapter looks at some examples that show how small firms actually use this technical knowledge on an every-day basis to solve production problems on the shopfloor.

The government's different focus -- infrastructure and training

Part I: The state's infrastructure investments: fostering unusual agriculture-industry linkages.

Neither the state government, nor the central government invested much in Punjab's industry through asset ownership, or through the establishment of parastatals. This was a departure from the standard way in which the governments of other states in India have intervened in industry throughout the post-

independence period till recently. Since the mid-sixties the state government has had only a 2% share in the number of factories in Punjab and a 9% share in its industrial employment (Sharma 1988:80), compared to a public sector share of at least 24% in manufacturing employment alone at the all-India level (Johar et. al. 1983:167). In addition, Punjab has very few large, centrally-owned public enterprises. In the early 1990s, its share of central government industrial investments was only 0.73% of the national total, compared to 17.6% for Maharashtra for example (Punjab Economic Review 1992-3, and Handbook of Industrial Statistics 1991). But, although the Punjab government did not invest in industry through equity participation, it focussed on other things: it invested heavily in the provision of infrastructure, and encouraged skill formation through investments in technical training.

As we saw in the previous chapters, since colonial times, Punjab's respective governments have invested substantially on developing Punjab's physical infrastructure--roads, railroads, water, irrigation (through an extensive network of canals and tubewells)--mainly with the aim of developing the region's agriculture. Between 1898 when massive infrastructure projects began in Punjab, and 1914, the colonial government had invested fully half of its total infrastructure spending in Punjab (Khanna 1983:97, Sims 1988). After independence, the Punjab government continued these policies of building up Punjab's infrastructural base, mainly through investments in massive power projects (e.g.,

the Bhakra Nangal Dam) and roads, again with the view of improving Punjab's agricultural productivity (Sims 1988). Only in the mid-1980s however, when industrial actors--industrial associations made demands on the government for more power, did the state government set up a series of five small thermal power plants to increase generation capacity in response to industry's needs.

But the benefits of infrastructure such as roads, rails, power and water are "fungible" across sectors--once the infrastructure is provided, benefits accrue to a variety of local consumers. Hence the region's growing industrial sector benefited as much from the availability of cheap and ready power, water and transportation, as did the agriculturalists. The presence of this physical infrastructure--funded by both, the central and state governments--is an important factor that explains why small firms in Punjab did so well despite being in a state that lacked any natural resource advantage. Punjab's producers have long had access to cheap infrastructure, and to lots of it--more so than other states (see Table 4.2).

In 1951 only 4% of Punjab's villages were electrified; by 1966 the figure increased to 24% (Sims 1988:64). Eleven years later, by late 1977, all 12,342 villages in Punjab were electrified--nearly twenty years ahead of most other parts of the country (See Table 4.2 for the current situation). By the 1987 only three other states in India reported 100% electrification of villages: Kerala, Tamil Nadu and Haryana (Haryana, till 1966 was

a part of Punjab state) (Industrial Abstract of Punjab 1988:238). By 1992, a total of ten states reported 100% electrification. Punjab's consumers, therefore, had a head start of nearly two decades in the availability of electricity, and hence the possibilities of adopting more modern equipment.

One way in which small firms have benefited from the government's investment in fungible infrastructure is through consistently low power tariffs in Punjab.⁵ Power rates have remained low precisely because the government's investments in power were initially targeted on agriculture, and the state's powerful agrarian lobby has held them in check. As one informant reported, the Punjab administration, traditionally dominated by agrarian interests has been "locked into keeping power rates low" since the 1960s when the first dams were built. "Local officials say that they will not increase unit prices of electric power because that will raise fertilizer costs, and push up fertilizer prices;⁶ the powerful farm lobby will 'never allow that'" (J.S. Randhawa interview, 1990).⁷

⁵ Although I do not have data on comparable power rates for various states, interviewees within and outside Punjab reported that power rates are lower in Punjab than in many states. Some states, for example Andhra Pradesh and Uttar Pradesh, have over time, provided new investors with special power-rate discounts for fixed time periods as incentives to attract investment. Similarly, bulk rates vary according to users in various states.

⁶ The first fertilizer plant was located in Nangal in the 1970s, after the Bhakra-Nangal complex was completed in the decade of the 1960s.

⁷ Since Punjab's power stations are the major suppliers of power to New Delhi, the Indian capital and the seat of government, it is in the central government's own interest not to raise power

The greater political control of agriculturalists over Punjab's policies, thus indirectly wrested a benefit for small firms that the politically "subordinate" small industrial producers may not have been able to win by themselves--cheap and abundant power.

However, these spill-over benefits to industry--and especially their continuity--have had to be fought over too. Agriculturalists have always received preferential supplies of power to ensure smooth irrigation via tubewells and pumpsets.⁸ Many older firms that I interviewed reported having had to work at night during the drought years in the late 1960s-70s to make up for the diversion of power to farmers during daylight hours. Similar shortages occurred again in the early 1980s leading a few medium firms to set up units outside Punjab (Upper India Steel, interview 1991). But this time round, in the 1980s, Punjab's industrial associations heavily lobbied the industries department and the state government for better access to power. In response, the Punjab government set up a series of mini-thermal power plants throughout the state to mitigate industrial power shortages. By 1987, abundant power supply was restored to industrialists, notwithstanding times of drought. The firm cited

tariffs in Punjab and its own electricity bill.

⁸ In contrast to the cases of "urban bias" documented in the literature (see Lipton) however, ever since Punjab's farmers adopted tubewells as the preferred means of irrigation in the 1960s, power supply has traditionally been "rural biased" in Punjab.

above (Upper India) which had set up a branch plant in Andhra Pradesh in the early 1980s (despite slightly higher rates there), reported having returned to Punjab to expand operations there now that "uninterrupted supply was restored" (Upper India interview, 1991).

Today, Punjab's industrial as well as agricultural producers have the highest per capita consumption of power in the country (Table 4.3) -- even though part of this high energy use is driven by the Punjab government's post-independence policy of charging farmers ("rural consumers") a flat rate for electricity consumption.

Table 4.2

Rural electrification and percentage of villages linked with all weather roads in Ludhiana district, Punjab State, and India as of 1990-91

Region	% of villages linked w/roads*	% of village electrified
Ludhiana district	100.0%	100.0%
Punjab State	97.7%	100.0%
India	41.0%**	83.1%

Source: Statistical Handbook of Punjab, 1991 (pp. 234, 256).
Statistical Outline of India, 1992 (pp. 9).

* Indicates all-weather roads. ** 1987-88 figures.

Table 4.3

**Annual per-capita consumption of electricity: selected states
1989-90**

State	Per capita consumption of electricity (KWH) in:			
	Residential	Industry	Agriculture	Total ⁹
Punjab	74.9	266.5	276.1	639.2
Maharashtra	63.3	216.0	83.4	404.6
Gujarat	37.36	214.2	99.4	398.8
Tamil Nadu	43.1	138.9	68.3	295.4
West Bengal	27.8	81.5	NA	138.9
India	34.5	111.7	53.5	236.02

Source: Statistical Handbook of Punjab, 1991 (pp. 108-113)

Similarly, an extensive network of roads and railroads covers towns and villages throughout the state. The role of infrastructure in fostering industrial growth is the subject of much policy research today, although the connections are not well understood (World Development Report 1994, Gulyani 1996 and cites therein). The Punjab case suggests that access to cheap and well distributed physical infrastructure helps small producers compete better in several ways. Since the 1970s Punjab has been one of the nation's few states where the government had invested in servicing practically every village by at least one all-weather

⁹ Total figure includes also consumption of electricity in commercial lighting, public lighting and non-utilities.

road (see Table 4.2 above for a current statement).¹⁰ This extensive network of roads opened up new markets for Ludhiana's small firms throughout the state's interior in the early-1970s. This transportation link between small producers and markets throughout the state not only helped Ludhiana's firms capitalize on the demand for agricultural machinery and implements generated across rural Punjab during the peak years of the spread of green revolution technologies in the state in the mid 1960s-1970s, but it also had another inadvertent outcome.

A key indirect benefit to small industry of this network of roadways was the spread of the trucking industry in Punjab since the 1970s, which significantly lowered costs for small producers. This industry again, grew in response to the marketing needs of Punjab's rapidly growing agriculture. It was controlled by wealthy Jat Sikh farmers who owned fleets of trucks, but rented them out regularly since the 1970s to local firm owners to transport their goods within and outside Punjab. As one medium sized firm-owner reported, this became a highly preferred mode of transporting goods for local industrialists because it was cheaper than the railroads, and, most importantly, helped firms "turn their money around" faster. He said, compared to the

¹⁰ In many cases expatriates, settled in Canada, the U.S. or Britain added to this network. As one interviewee who was visiting from the United States reported, many come back to link "their villages" or community centers (e.g, Gurudwaras) and schools to the nearest metalled road as a sign of their new status and prestige (G. Singh, interview 1991). This interviewee, who owned a small trucking business in New York city had just funded the construction of a road linking his village school to the main road.

chronic delays in the rail-transport system due to strikes, late arrivals of trains, and over-booking, as well as the loss of goods due to theft and damage, trucks were a far quicker and safer mode of transporting their goods. Firms did not have to invest in their own trucks, the farmers were in this business. And they needed to do something productive with their vehicles in the non-harvest season. Over time, Punjab's trucking industry--servicing both industrial and agricultural producers--has evolved into one of the best developed in the country (Pahwa interview 1992, Kharbanda interview 1991, World Bank 1995).

As several firms reported, unlike trains, the trucks reached the farthest markets in the country within a week; most north-Indian markets were within a day from Ludhiana. Not only did the trucks prevent delays, damage, and delivered goods "door-to-door," but most importantly, this faster delivery meant that the customers sent their payments faster (Avon interview, 1992).¹¹ This interviewee reported that "this way, the working capital I invest comes back to me four times in one month. We produce a batch, it leaves our factory the same night. It reaches the customer's door the next morning. The customer makes the payment a few days after that. The money comes back to me, and I put it back again. Every 100,000 [rupees] I spend comes back to us four times in a month. If I relied on railways, I would be lucky if I got my money back twice in a month" (Avon (Pahwa) interview,

¹¹ Occasionally, the truckers who delivered the goods brought back draft payments.

1992). This quicker turn-over of returns meant greater liquidity and revenues--just the conditions the firm needed to reinvest and expand (Avon interview, 1992). It also lowered wastage and saved on overhead costs: "You do not have to buy bulky wooden crates. Padded plastic wrapping is enough, so you save on packaging costs. Because wooden crates are not used, there is more room on the trucks and we can pack more goods per truck. The extra weight of the crates is reduced and so transportation costs per unit are lower. There is some saving on the labor side also, you need fewer people to do the packaging. Overall, wastage is less and you save money" (Avon (Pahwa) interview 1992).¹²

The presence of cheap electricity benefited small firms in Punjab in another indirect way via agriculture. The spread of electricity, ironically, led to the rise of a diesel pump-set industry in Punjab, localized in Ludhiana. In the late 1950s-early 1960s, the rapid spread of electrification in state led the Punjab government to institute subsidies to encourage local farmers to adopt tubewells as the chief means of independent small-irrigation instead of the government digging more canals or

¹² The interviewee also made the point that it was important that they started doing this early on in their firm's history, when they were still small, capital was a constraint, and outside markets were still being forged. Lowering production costs by lowering overheads was crucial to their carving out these markets, and competing successfully against larger firms in other parts of the country. Today, twenty-five years later, the interviewee firm is one of the region's larger bicycle producers. Still, it continues to transport its goods (within India) in exactly the same way.

building large public water tanks. By the mid-1960s, tubewells had indeed become the chief source of irrigation in the Indian Punjab (Sims 1988, London 1975). Shortly after, severe power shortages in the mid-1960s, and the drought years of 1966-68 made it difficult for farmers to operate their tubewells.

Following strong protests by farmers, the government (i) increased agricultural prices in Punjab (despite urban dissent), (ii) and launched a "crash policy" of distributing heavily subsidized pump-sets to farmers--both by providing farmers with subsidies for the purchase of pumpsets from private dealers and also by procuring pump-sets from local producers and distributing them to the smallest farmers (Sims 1988, London 1975, J.S. Randhawa interview 1990). This sharply increased the demand for, and sales of, pumpsets: 86% of pumpsets in Punjab were purchased after the government introduced this subsidy in 1966 (London 1975:52). This period, when the government and private dealers were the main buyers of pumpsets, fuelled the rise and rapid growth of the local diesel pumpset industry, localized in Ludhiana where some firms already manufactured and assembled pumpsets. Mechanics who used to repair or assemble pumpsets from kits of parts purchased from outside the state (Gujarat mostly), took to manufacturing parts, assemblers grew, and new distribution networks emerged (London 1975:66). Subsequently, the Punjab government's subsidies to farmers for the purchase of a variety of other agricultural implements throughout the 1960s-70s led recursively to the adoption of these implements by

farmers and a further consolidation of a vibrant agricultural implements producing base in the region.

Farmers adopted the new equipment--threshers, diesel engines, pumpsets, seed-drills, tubewells--not only because more and more firms produced them locally and they could be procured "without great difficulty" (Sims 1988), or because the technology was simple. A key reason behind widespread adoption was also that local mechanics and metal workers spread throughout the region had the skills--or developed them--to fix, alter, recondition and customize these machines.¹³

This discussion of the interaction between small metal firms in Ludhiana and the spread of mechanization in Punjab's agriculture reverses a commonly held view of small-firm growth in Punjab. According to this view, Punjab's small-firm based industrial structure was fuelled by rising incomes and demand unleashed by the spread of the green-revolution in Punjab in the mid-1960s (Bhatia 1968, Sharma 1988:92).

In contrast to this view, the above discussion would suggest that rather than the green-revolution ushering in the rise of

¹³ One study of Ludhiana district (Aggarwal 1973) showed how the presence of large numbers of skilled mechanics who worked in Ludhiana but lived in its the rural hinterland (within a 25-30 mile radius) gave the small peasants access to a huge quasi-repair and reconditioning network. Although these technicians worked in factories, they were available to their peasant neighbors for advice and assistance. Farmers saved on repair costs (compared to situations where a peasant farmer from the interior has to trudge to the city for repairs), understood the equipment they were using better, and hence were able to ask for more precise modifications and customized changes (Aggarwal, 1973).

small metal based industries in Ludhiana and its vicinity, it was the opposite--that the prior presence of a core of successful metal based engineering industries facilitated the widespread adoption of the new farm technology when it was introduced in Punjab in the 1960s.¹⁴ In the process, the existing cluster of firms grew, and deepened, as did the skills of local mechanics and small manufacturers.¹⁵

Industrial estates--targeting industry directly

Aside from the indirect effects discussed above, the Punjab government also targeted industry directly. Starting in the 1950s, for example, the state government carved out several quite successful industrial estates around Ludhiana and neighboring cities. As part of a national program adopted in 1955, the idea was to provide small producers "the advantage of common services and other facilities such as a good site, electricity, water,

¹⁴ In a comparative study of farm-mechanization in the Indian and Pakistani Punjab, Gotsch (1972) shows how the access of farmers in the Indian Punjab to smaller than usual pumpsets (5 hp) and tractors (15 hp instead of 35 or 45 hp) and other equipment adapted by local artisans and metal workers to suit the special needs of particular farmers allowed even those with smaller holdings to adopt the newer technology. See also Sims (1988) for a similar study.

¹⁵ Crucial to this ability of local mechanics to deepen their skills and develop newer machines of the size and capacity that suited small local farmers was close interaction with, and exposure to the designers and engineers of the land-grant Punjab Agricultural University (PAU) established in Ludhiana with US assistance in 1962. PAU's agricultural engineers designed new implements which they got local small producers or mechanics to help build.

gas, steam, compressed air, railway siding, watch and ward.." (Official policy statement cited in Dhar and Lydall 1961:36).

Ludhiana's industrial estates, now called "focal points," are among the more successful industrial estates in the country (Dhar and Lydall 1961, Abell and Mahoney et. al. 1989). They were successful, according to some evaluations, because the government was able to harness the skills of local artisans by encouraging them to set up small factories through the provision to them of small loans to purchase factory sheds on installment. They also allotted sites to accommodate an influx of skilled workers and small producers who came to the Indian Punjab from Pakistan after partition and were looking for safe locations after the disruption of partition (Dhar and Lydall 1961, Harbans Singh interview, 1992).

As one evaluator comparing 12 industrial estates¹⁶ throughout the country in 1960 put it, "In Ludhiana estate, there is no difficulty in finding applicants for factories, even at unsubsidized rents" because there already "was a center of hosiery manufacture...and [since the war] significant growth in engineering industries like bicycles and bicycle parts, sewing machines, automobile parts, machinery and machine tools" (Dhar and Lydall 1961:42). Given the "plentitude of enterprise and skills" available in the region there was "chronic shortage" of factory space. Thus, while in Ludhiana all the sheds completed

¹⁶ Two hundred and six factories in twelve industrial estates out of a total of 483 factories operating in India's 34 functioning industrial estates in 1960 returned the evaluators' schedules.

were immediately occupied, in several other regions where "there were no entrepreneurs straining at the leash anxious to move out to better accommodations," up to 90% of the plots lay vacant several years after the industrial sheds were constructed (Dhar and Lydall 1961). The output per worker of small factories in Ludhiana's industrial estate was also among the highest in the country--more than twice that of the other estates evaluated (Dhar and Lydall 1961:56).

Such estates are still being constructed by the Punjab government, and there are eight such focal points around Ludhiana alone. In 1991, at a time when separatist violence was at its peak in Ludhiana, the region's District Industries Center received 700 applications for the 61 plots it was releasing for small units in its most recent Focal Point in Ludhiana (DIC, 1991). This overwhelming response came despite intense instability in the region, and despite reports in the media that businesses were moving out of Punjab.

Part II: Access to technical knowledge: The path of vocational training

A second, key direct investment by the Punjab government in industry was through the development of a network of vocational training institutes throughout the state that capitalized on the already entrenched practice of acquiring skill and building entrepreneurial ability through moving up systematically through the labor market (as we see below). By emphasizing vocational

training, rather than making engineering education the centerpiece of its industrial training programs, the government enabled a broad swath of the working population to gain low cost access to skills--technical skills. Even in the early 1990s, compared to 3 engineering colleges in a state of 20 million people, Punjab had 115 technical, Industrial and polytechnic institutions. Of the total number of trainees registered in technical courses throughout Punjab, less than 9% were registered in engineering courses in 1991. (Statistical Handbook of Punjab 1991:201,203). This pattern has a longer history in the region.

Unlike many other states in India, vocational education has historically occupied an important place in Punjab's industry for several reasons. Even today, the rise of engineers in the state's workforce has not diminished or entirely displaced the salience of vocational, or "practical" industrial training in industry circles. Although it is commonplace now to find a younger generation of small-factory owners formally trained as engineers, vocational education still commands respect and carries value. Many of my informants echoed the feelings expressed by successful small firm owners in the late 1960s that "the comparative advantage we hold in the metal trades will not endure unless [our] children get vocational training rather than [only] general training." (Rangnekar 1966, and Bhogal interview, 1990, J.S. interview, 1991).

First, in contrast to the pattern in states like Kerala, and Tamil Nadu where getting a graduate degree quickly and straight

off is the norm, getting to work quickly--either in your own firm (or farm) or in government, or in other firms--has been socially privileged here. "Working with one's hands" has long carried status. To some extent this idea of "working with one's hands" has derived indirect validity from the religious symbolism in Sikhism of "kirit karo, vaand chhako" -- i.e., roughly, work with your hands and share the fruits of it with the community for the common good (to reach God). According to some informants, this idea is also rooted in the highly pragmatic, urban "householder"-based interpretation of Sikhism in the late 19th-early 20th century. During this period, when social ferment swept the Punjab region (in partial response to cultural "clashes" with the growing influence of the British, and with reformist and secularizing movements within the Hindu and Islamic communities in the Punjab), the urban elite of Sikh society "read" their religion in this more pragmatic way so as to appropriate and hence neutralize some of the appeal of the utilitarian policies that the British administrators were bringing into the Punjab.¹⁷

Second, perhaps recognizing the existence of a large number of skilled workers and mechanics in the region, the state government has since the turn of the century promoted the idea of vocational education as a relatively cheap way of building a skilled workforce. This thinking was first articulated by local

¹⁷ See Kenneth Jones 1989, and Heimsath 1964, for an account of social movements in Punjab during this period.

administrators in response to the results of two detailed industrial surveys conducted by the colonial government of Punjab in 1911 and 1917, the latter with the explicit aim of understanding what kind of technical training--"industrial education"--system to develop in the province (Latifi 1911, Badenoch 1917). The primary motivation for the government at that time was the training of technicians for its ongoing irrigation works in Punjab and its railroad construction projects. The first technical institutes in the public sector were thus run by the Railway department and the Public Works Departments.

At the same time, civic groups such as the Ramgarhias (artisanal metal and wood workers), who were just then turning towards industrial entrepreneurship, were also setting up their own parochial vocational education schools to train younger members of their own community for industrial work.¹⁸ These schools, funded by the wealthier members of the Ramgarhia community who had accumulated capital in the course of contractorships in Punjab, Assam and East Africa, were initially open only to their own members. But the success of Ramgarhia entrepreneurs in Ludhiana's growing metal industry attracted non-artisanal groups to vocational education, and over time the

¹⁸ As we saw in Chapter 2, possessing only fragmented capital--skill was central to their ability to compete and grow. Led by a group of wealthy Ramgarhias the community, by the 1920s, had set up technical schools in several parts of Punjab (Saberwal 1979), as well as educational trusts and some banks near Ludhiana (Kessinger 1974, Saberwal 1979, Pandit 1985).

character of these initially communal schools has become more secular. Although major funding still comes from Ramgarhia industrialists, they now receive some support from the government.

Indeed, the visible presence of these institutions and their popularity among local workers and small entrepreneurs also served as a model for the government's own emphasis on vocational education, or at least reinforced it, in the 1930s and later after independence, in the 1940s and 1950s. In an iterative process of influence from government to community groups and back to the government, the colonial administration of Punjab also set up its own vocational training institutes by the 1930s. After independence, these institutes were supplanted by Industrial Training Institutes (ITIs) and Advanced Training Institutes (ATIs) funded by the central government.

The ITIs and ATIs are funded by the central government in states throughout the India, not in Punjab alone. The difference in Punjab is the image of credibility that the training provided by these institutes carries, not only in the eyes of the population, but also of the government.¹⁹ A second difference is that unlike other states in India where ITI trainees typically work as production workers in large companies, in Punjab most ITI graduates become entrepreneurs, and start their own small firms.

¹⁹ This is not to deny that many small firm owners regard ITI trainees as being "too white collar" compared to those that have learned by moving through the ranks.

The government of Punjab encouraged this tendency towards self-employment by promoting the spread of these institutions in smaller towns and rural districts.

This is so partly because, unlike states like West Bengal which have a huge presence of government, the public administration has been historically lean in Punjab. This translates into a smaller number of white collar job opportunities in government.²⁰ For example, in 1988, Punjab accounted for less than 1% (0.9%) of employment in total central public undertakings compared to 18% for West Bengal, 10% for Maharashtra, over 5% for Karnataka (Handbook of industrial Statistics 1989:157). Government policies have therefore implicitly reinforced what goes on anyway--job creation in the private sector--in industry and agriculture, either as workers or employers, rather than employment in government departments, and even less so in government owned industries.

The latter point is an important one. The state government hardly has any industrial employees (it has only a 9% share in industrial employment in Punjab, compared to an average of 25% at the national level in manufacturing employment alone), because it owns very little industry in Punjab. Thus, the state in this region wasn't doing what the state did elsewhere in India, namely own and run large public sector enterprises in sectors such as

²⁰ In the organized, non-farm sector however, the Punjab state government together with central, local and quasi-governmental organizations does provide a larger proportion of employment than the private sector (Punjab Plan Document, n.d. pp. 272.)

steel, aviation, heavy industry and so forth, that demanded a heavy input of sophisticated engineers or expensively trained personnel. This left room for the state to do something less costly, which also reached a larger number of people: e.g., fostering the technician's skills across broad sections of the workforce.²¹ Vocational education, thus, appears to have been a cheap and logical option in an industrial environment where "middle-class" entrepreneurs dominated, and where the typically heavy presence of the Indian state in industry was absent.

The state government's own early policies of recruiting diploma holders from these institutions rather than focussing on getting more and more engineers into the system lent patronage and respectability to these institutions as we see below. When the Punjab industries department was first established as a separate entity in the late 1950s²² the state government inducted several three/four-year engineering diploma holders,²³ and graduates from ITIs to staff its new "elite" field corps or extension cadres. The prospects of mobility seemed good to those hired compared to the older career trajectory in the state's industrial bureaucracy (Ambika, interview 1992). After half a

²¹ This is not so say that the state government discourages engineering education. There are several engineering colleges in the state, and a growing number of younger entrepreneurs are engineers. Rather, vocational education, and technician's knowledge carries validity and prestige here that it doesn't in regions where the engineer is at the center of industrial work.

²² From being a part of the urban rehabilitation and civic supplies department.

²³ As opposed to the five year engineering degree.

decade or less in the field (at 2 or 3 progressive grades), the jobs promised the recruits officers' ranking as Project officers or Functional managers in the industries department. According to a retired industry department employee who was recruited at that time, there was "excitement about industrial careers, many people wanted to join the new department. The qualifications were not difficult to get" (Gupta, Ambika Industries interview, 1992). You did not have to be an engineer.

The state government's emphasis on hiring engineering diploma holders and technical graduates from ITIs and ATIs to fill the ranks of the industries department, thus, raised the profile of these training programs in the eyes of both, those inclined towards jobs in government and those intending to go into private industry as skilled workers or owners. Initial enrollments were high--mostly from the ranks of the urban-based middle and lower-middle classes (Interview, R.P. Singh, Technical Instructor, Central Training Institute, Ludhiana, 1991).

Subsequently, as more sophisticated centers were set up with UNIDO and West German funds²⁴ as a result of the state government's lobbying the central government, a different, relatively better off layer of potential workers and owners was attracted to these Institutes--e.g., sons (few women train for industrial work; those that do are trained at a separate Women's

²⁴ For example, the Central Tool Room (CTR) set up with W. German funds in the 1980s, which offers a four-year training program; and the Bicycle and Sewing Machine R&D Center set up with UNIDO funds in the early 1980s.

Industrial Training Institute) of small or medium entrepreneurs, sons of mid-to even upper level local government bureaucrats, sons of college teachers and professors. They join these sophisticated technical diploma courses (usually of 4 years duration including one or two years of internship in local firms) either after 12 years of schooling, or after a general B.A or B.Sc degree. Meanwhile, the original Industrial Training Institutes (those not under bilateral or multilateral funding and support), are drawing rural applicants (children of agricultural workers, petty traders and others) and blue-collar urban groups.

But even today, these Industrial Training Institutes remain more "productive" in Punjab, than in other states. Although some of the larger states have a greater absolute number of training institutes, Punjab's ITIs and affiliated institutes produce the largest number of trainees per institute: In the 1980s for example, Punjab produced 169 technical trainees per institute, compared to 80 per institute in Maharashtra, 50 in Gujarat, 7 in West Bengal, and 75 in the nation as a whole. Only Kerala state comes close with 163 trainees per institute.²⁵ Vocational institutions thus remain an attractive route to skill acquisition in Punjab.

²⁵ These are 1983 figures calculated from the Government of India Handbook of Industrial Statistics 1989: Table 144, page 212.

How vocational training works in practice and its indirect

effects: For all the credibility that vocational training has been endowed with in Ludhiana, and Punjab more generally, the total number of enrollments as a proportion of total skilled workers in the labor force is surprisingly low. Evaluators of the "advanced" training institutes (CTR etc.) from New Delhi, from UNIDO, from the German mission express disappointment at the apparent and perplexing "failure" of these institutes in getting local industry to "upgrade its workforce" by hiring more CTR and Industrial Training Institute Graduates. The problem these evaluators say is that there just aren't enough big, highly capitalized firms in Punjab to absorb these graduates who obviously demand higher pay.

What these proclamations of failure neglect to see, however, are the processes that actually occur on the ground--and the changes that these institutes have unleashed both in the attitude towards skill and mobility in the local labor market and the availability of information among workers and the region's small firms.

First, unlike Maharashtra, West Bengal and some Southern states where a bulk of industrial trainees are absorbed as workers in the large /medium local firms, in Ludhiana, a bulk of the graduates of these enterprises, after a few years of moving through the labor market, start their own enterprises, and therefore are not counted in the ranks of "workers". Several of the graduates of these institutes that I interviewed, reported

that they saw attending the institutes as a particular "phase" or "episode" in their preparation for eventual entrepreneurship. Apart from those who had joined the government, many of the others gave several reasons for taking this route. They said they chose to go to these institutes because (i) they were a cheap way (in terms of time--3, sometimes 4 years and money)²⁶ to get exposed to some theory and some practice of the lines they had decided to concentrate on--e.g, tool and die making. (ii) These institutes, they said, were a way to gain focussed exposure to a variety of machines and processes (both in the Institutes and during training with the medium and large firms in the region). They were a way for trainees to gain access to a network of technicians, professionals and other personnel who they could call upon later for either assistance with technical problems, orders, or plain clarifications about government procedures and policies that applied to their chosen lines and fields.

(iii) They gain access also to a cohort who will also be in industry and with whom they can potentially consult. As one ITI alumnus who now runs a factory producing milling machines

²⁶ Typically a recruit enters an ITI after 10 or 12 years of schooling, increasingly after 12 years. So the entering age is usually 17 years. Some enter after a (3 year) bachelor's degree. After an initial two years at an ITI the recruit can spend another one or two years at an ATI (Advanced Training Institute) before the training is over. In Ludhiana a large number of recruits join the ATIs on a part-time basis--working during the day and going to the institute at night. The newer training institutes such as the Central Tool Room run a full time four year training course after 12 years of schooling. They also offer an evening school option, which stretches for more than four years.

reported, many of his batchmates now have their own firms. Some are raw-material dealers, others are machinery or spare-parts dealers. "These contacts are very useful. I turn to them if I need to get information about things I don't know much about -- where to buy certain parts or materials, who to go to, who is good, what is cheap, who can deliver at short notice; I ask them about quality differences, what to watch out for. In asking them, at least I know what I am getting" (Ramdass interview, 1991).

Similarly many other graduates reported turning to their former instructors for technical advice, or for the use of the institute's machinery after hours for a limited time period. One small firm-owner reported he had had difficulty procuring base machinery when it started out because of a severe credit crunch. He told of how he turned to the Central Training Institute from where he had graduated to make patterns for crucial spare parts that he needed, off of the institute's lathes and milling machines. The instructors allowed him to open up the machines and make copies of the parts he needed, thus saving him the large up front expense of going out and buying a new lathe and milling machine. With the help of these molds, he assembled the machines on his own shop-floor with the help of job-shop owners and could do turning and casting on contract, at less than half the cost of the machines. Assistance from these institutes thus spills over into everyday technical assistance in ways that go beyond training and instruction, ways that are harder to discern.

Second, and equally important is another indirect effect of these institutes that is even less visible: the way they have influenced skill acquisition trajectories in the labor market, and have in turn been influenced by the workings of the labor market. The labor market in the region has mimicked the kind of training that the vocational institutes impart. Building-in some of the systematic instruction provided in these institutions around a framework of learning through apprenticeship and on-the-job-training, workers in this region's labor market seem to have devised paths of skill-acquisition that provide workers with a similar rounded-ness of skills and knowledge that vocational education would. In contrast to the unevenness and random-ness of on-the-job training, there is a relative systemacity to the way in which workers in this labor market of metal manufacturing move from shop to shop that makes the skills they are gathering look more "like" the systematic learning that occurs within formal vocational settings.²⁷

This appears so, in part, also because the Institutes themselves have incorporated in their style of training (or at least in what they emphasize) the needs and skill requirements of the firms around them. This reciprocal influence between the institutes and the labor market and firms is strengthened by the

²⁷ See Taylor and Piore (1969) for an account of how this kind of systematic worker-driven training worked among tool and die makers, chefs, and printers in the United States. In each case the movement of workers from firm to firm, or the courses the chefs took had the same quality--they made related moves, or took related courses in the same field.

fact that the lines of distinction between the instructors and the region's small entrepreneurs are quite blurred. Just like the mid-level bureaucrats mentioned earlier, many locally based ITI or ATI instructors also play out a dual role as producers, running their own firms or consultancies under the name of a family member or friend. They are thus quite enmeshed in the local industrial culture and understand the practical needs of industry better than they would from a distance. Similarly, the ongoing contact between former trainees who become firm-owners, and the institutes' instructors as illustrated by the example cited above, brings back to the institute substantial feedback about what kinds of things worked and what did not.

Organizationally, the industrial training institutes in this region are no different than they are in other states; they are all centrally funded and similarly organized (the ITIs, that is, not the Central Tool Room, which is particular to Ludhiana and one of two other cities). But the particular nature of their insertion in Ludhiana's (and Punjab's) industrial environment has altered both how they work, the impact they have, and the way in which they are viewed by those on the outside--by local workers and firm owners.²⁸ They are part of an industrial milieu where

²⁸ This is not to say these institutes are not criticized or even derided by some firms or government officials. There is ample debate about them. But on balance they occupy a higher social space than do such institutes in many other parts of the country.

practical skills²⁹ are valued and where vocational education still carries respect; not dismissed as the poor man's alternative to an engineering degree that produces a blue-collar production work-force for large public and private firms. Similarly, being part of an environment where those working inside these institutes are deeply enmeshed in the everyday industrial life outside them has imbued these institutions with a relevance that cannot be deduced just from their statistical profile or standardized structure.

The region's strong focus on technician's and mechanics skills has lent significance not only to vocational training, but it has also brought into relief the importance of combining it with more informal types of training, such as on-the-job training, to serve as cheap and effective mechanisms of upskilling a workforce. This "combining" is not deliberately or consciously orchestrated by anyone. It has worked out that way. The relative systematic-ness that less formal types of training have acquired through exposure to and informational spill-overs from the public sector vocational institutions, have made on-the-job training more focussed, and a more effective avenue for acquiring more than just plant-specific skills, as we will see in the example presented in the next section. In this region, both groups of workers--those who train formally, as well as those who

²⁹ In my interviews it was commonplace to hear firm-owners describe themselves, or their fathers or older relatives as being "practical engineers" "production engineers" or "engineers through practice not training."

learn by moving from job to job--seem to be motivated by largely similar goals: of picking up technician's skills, learning the craft, and eventually starting their own enterprises. A strong focus on obtaining technician's and mechanics skills motivates both groups. Vocational education and systematic on-the-job learning, together provide these skills.

This creation of technicians (through vocational training or movement through the labor market), who eventually become small industrialists, also provides the region with an ongoing growth dynamic. More and more technicians can become small owners in part because their practical knowledge helps lower costs by allowing them to internalize some of the production skills themselves, instead of relying only on expensive labor. Those who move up the labor market to firm ownership, are also able to shape the nature of skills they demand from their workers to suit their own needs better. This eventually spills over onto the workforce as a whole.

There are, thus, several direct and indirect points of contact between these public sector programs and apprenticeship methods available in the labor market--through indirect influence, demonstration effects, or more directly through participation in both. Those who rise through the ranks, as well as those trained in ITIs often work in similar settings, though the former remain in the workforce longer (about 7-10 years) than the latter before establishing their own firms. But the combination of publicly provided training programs and more

informal systems that the government's emphasis on vocational training brings into relief and validates, provides broad sections of the local population with a public good that is available to all without taking away individual choice about how to build a career, or move through the labor market.

The following section provides an example of just such a choice, and of the systematic-ness of moving through the labor market.³⁰ Notice the tacit way in which the training institutes help spread information to workers outside the institutes about the kinds of experience / knowledge that would help build a skilled career. The example comes from the low end of the labor market, and from one of the smallest firms in my sample.

Acquiring the technician's craft by moving through the labor market: the case of S.S. Die maker

SS, seventeen years old in 1967, worked as a novice metal worker at his maternal uncle's agricultural equipment repair shop in a small rural town near Ludhiana. Low income and family responsibilities cut short his education after high school. He said he wanted to get into industrial work, but did not know how to go about it. At that time, he said, our "role models were a group of young men" from his rural town "who worked in factories

³⁰ This systematic movement, and the building of a consistent skill acquisition trajectory by moving selectively from job to job is not new or peculiar to Ludhiana's industrial environment. Several others have documented similar trajectories in situations ranging from the training of cooks, chefs and printers (Taylor and Piore 1969), to garment designers (Pyke et al for the Italian cases), and software workers (Saxenian 1994, Holmstrom 1995).

in Ludhiana," but ultimately wanted to start their own firms. They had completed their diplomas in Tool and Die making from the local Industrial Training Institute and had good jobs in Ludhiana. They earned well--"they sent money home, and when they visited, they always had money to spend." They told stories about opportunities in Ludhiana, "there is always a lot of work."

Unlike these friends, SS could not afford to take the two years to go to an ITI, he had to start earning soon, so he turned to them for advice; what was a good line to get into. They told him die-making was a good line because you can succeed with little initial investment, "if you learn how to think about design." If you know what you want you can get all processes done from "the market": casting, precision machining, planing, hardening and so on. But, because SS could not take the time to go to a training institute, they suggested he build his expertise through experience from the bottom up. First he needed to learn how all kinds of presses work. Based on their own experience at the ITI, and now in the job market, they told SS that to "learn about die-making you need to know how to operate press on which dies are used. If you understand everything about the process: how the operation for which the die is needed is carried out; how the machine works, what materials are involved, their composition, limitations, then you can learn to design. Or you will be dependent on the knowledge of the press-operator." They advised him to move to Ludhiana.

SS's colleagues helped him get a job with a registered firm

that made sewing machine parts--specifically the tension lever, which involved press work--and got many orders. In all, SS trained as a press-worker for five years: from 1967-1972 in mainly 2 firms. (i) He started out in the firm where his friends got him the job, but stayed there only for a few months because the owner made him do a lot of other work--such as transferring materials from one station to another. So as soon as he learnt some press work, he moved to another firm at a higher salary.

(ii) The second firm, Super Cycles and Allied Industries--a firm that assembled complete bicycles, but also manufactured several other parts, was his real training ground. It was a relatively large firm, he got to work on many different kinds of press-jobs, initially operating the machines, then setting them up, and eventually fixing any problems with dies that came up.

In five years he was satisfied that he had learned everything he could about press-work. He was a master. Even though SS did not go through the ITI, or a diploma program at a special tool and die making school, his trajectory through these first five years was nevertheless not arbitrary. It was systematic, and guided by the experience of his ITI-trained colleagues. He did not learn about die-design, but laid the base by learning about machines that used dies--a process that is similar to, yet different from the traditional apprenticeship. Like in an apprenticeship he built a base by gathering practical experience as he worked his way up bit by bit. But unlike an apprenticeship, SS was not tied to a single firm or "master." He

selected the firms where he would be able to learn based on the information he got from his colleagues in the labor market who had been formally trained at training institutes and had experience.

During his tenure at Super cycles SS realized also the importance of one skill that he would have learned at any training institute--being able to read drawings. He began to study in the evenings. A graduate co-worker in the factory who tutored him for a fee, taught him to read and manipulate drawings, and also prepared him for his equivalency exams.

Now that he was ready to learn how to design dies, he again turned to colleagues to find out what his next steps should be--where could he go to train as a die maker? One colleague introduced him to a well-regarded tool and die maker of Ludhiana--JS, a mechanical engineer. SS started to train with him. Just as Taylor and Piore (1969) show that individual workers bear most of the costs in this worker-driven "training", SS also bore his own training burden. He worked for JS as a factory supervisor at half the salary he was earning as a production worker at Super Cycles.

But this job was not a traditional apprenticeship. SS's employer and teacher, JS's main line of business was not tool and die making, but manufacturing agricultural machine-parts and threshers; tool and die making was only a side business. JS made them on labor rates (i.e, the customer supplied the raw-materials etc.) because he liked designing dies, not because it was his

bread and butter. Thus, SS's primary job was that of shop-floor supervisor for the agricultural equipment factory. In addition to supervising production, SS maintained the machinery, repaired the equipment and as part of his repair duties, learned about die-design. After one and half years at this firm, SS's employer and teacher--JS put him in touch with one of Ludhiana's best die-makers for a final period of training. SS spent six months at the new firm.

After seven years in the labor market, first as a press-operator, then as a supervisor, maintenance man and tool and die apprentice, SS felt confident that he had the skills to design dies, tools and could start his own firm. He took seven years to learn what a trainee who had chosen the ITI or diploma route would have learnt after two years of formal training and two or three years in the labor market.

SS's systematic movement through the labor market to learn die-design and start his own firm did not end here. Although he had explored the market, made many contacts, he felt he had not yet tested his skills at a large enough scale, and he still did not know if he could control labor. So he found a job as a die-fitter in a relatively big (though officially still a medium scale firm), registered, firm to test his abilities as a designer and to learn about controlling labor. The owner of the firm he chose, KSJ, was himself a masterful tool and die maker and had a reputation of being a demanding employer, merciless about quality

and precision. "That is why I went there."³¹ Within a few months, SS was placed in charge of the entire tool shop at KSJ's firm. "This gave me confidence; I felt I was ready now." While still an employee, SS began to look out for orders. He had already assembled a small lathe at home, and had been slowly procuring some basic equipment. Within a year he got a big order for dies from one of KSJ's former customers. With this order, and 50% of the advance payment in hand, SS left his job, rented space and started his own firm. This was 1^o years ago. Now he owns his factory space, has more machinery, and employs two workers and one apprentice.

This is not an exceptional story. The histories of a lot of former workers who accumulate skill by moving strategically through the labor market and then start their own small firms sound like this. Information to guide such workers flows into the labor market from many sources. An important source, as we saw above is the interaction of workers who are learning on the job with engineers (like JS, the mechanical engineer who SS worked for) and others who have gone through the public vocational training institutes.

Partly because the region's industrial structure is not polarized into some sophisticated firms that hire mainly engineers and others who depend mostly on less formally trained

³¹ One cannot of course join a firm of interest at will. Several former-workers who are owners today reported that they took cuts in pay (or waited for an opening) to join a firm that had a good reputation, or where you could learn.

workers, this interaction between formal and informal systems of training imparts guideposts to workers that are meaningful--even the region's largest firms accord central importance to those with experience.³² As a result, many who do not go through the formal system, nevertheless learn from it indirectly.³³ The influence, moreover is not one way--from government programs to the labor market. The nature of the local workforce has, in part, shaped what kinds of programs and skills are emphasized in these institutes--just as the past pattern of investment in the region has influenced the demand for certain types of skills-- e.g, the technician's skills--more than others.

Part III: Institutions and practices that facilitate adaptation

³² As reported to me by one of the owners of Ludhiana's largest bicycle, moped, and motor-cycle producing firm--the Hero group (which hires 1000s of workers today, but started as a small firm in the 1940s)--the owner's son, a US trained engineer, was put to training with the firm's most respected mistry (technician) before being made production manager. Indeed, the Hero group launched a whole new machine tool company built around the skills of a non-engineer technician (Atma Singh) whom they had initially hired to produce, adapt, copy, and customize machinery for their various plants. This technician today has two firms of his own, one of which exports multi-speed freewheels to several countries.

³³ What they learn has its own inner dynamic of change. With the introduction of new processes --e.g., the use of CNCs--the information available in the labor market also changes. For example, a medium sized machine tool producer in Ludhiana reported that his firm was planning to adapt and produce CNCs in their own firm. They wanted to design simpler versions of these machines that would suit local needs, and make them cheaply enough so that every Industrial Training Institute in Punjab could afford at least a few--to train the next generation of skilled workers. In the labor market as well, skilled workers talk about getting to know these machines.

and learning among small firms

How do small firms actually use these skills on a day to day basis? We will see below that the presence of skills among small owners--many of whom were workers once, their ability to understand, copy and manipulate machinery, as well as the easy access they have to a variety of services, and a wide array of skilled workers and mechanics--outside the firm, allows small firms to upgrade their production processes at a pace and a cost that most small firms not located in an environment of such industrial depth can hardly afford. The point is that this "industrial depth," or the variety of services available in this region are geared towards small producers, and often provided by other small producers, as opposed to an environment where expensive state of the art technology and services are available, but are not affordable to small producers.

(i) Reconditioning teams. One of the chief links between firms of different sizes and technology "markets" are work groups known as reconditioning teams. These groups were not set up by any agency or trade association, but evolved over time around the process of transmitting technical knowhow within the region's firms. These "floating" teams of highly skilled workers move from shop-floor to shop-floor to provide specialized services to small and large firms. Organized under "contractors" who are often themselves skilled, these workers form composite teams--of skilled fitters, machinists, specialists in milling, hydraulic machinery, electrical machinery, etc.--that recondition machines

and sometimes assist firms in adapting or modifying shop-floor equipment.

A bit like the construction industry, these teams are loosely organized as an association of independent tradesmen, rather than as a permanent firm or enterprise. The constituent members of these teams often hold other, full-time factory jobs, while still being members of such a team, affiliated with a given contractor who knows where each team member works and lives. When work comes in, the contractor is able to track down the members and assemble the team quickly. During some periods, some teams may be more fully consolidated and hold other affiliations that are only part-time; yet others may be self-employed. Although some team members may own some machinery such as lathes or other equipment, most of the time the team as a collective does not own equipment. Reminiscent of sharecropping arrangements, these floating teams use their client firm's machinery and equipment, or the services of the region's job shops, or hire out the use of equipment lying idle in firms that are going out of business, or are changing lines, or have spare capacity for other reasons.³⁴ The contractor who organizes the team is responsible for the quality of the work they do.

³⁴ One reconditioning contractor that I interviewed had leased out the fully equipped machine tool factory whose owner had suddenly passed away and the only successor, a school-going son, was too young to take up production. Instead of selling the equipment, much of which had been specially made by the deceased owner, the family had contracted it out to the reconditioning engineer on commission with the understanding that he would also train the son during the summer and winter vacations till he finished college (Prem Engineering, interview 1991).

Given the "temporary" character and floating nature of these work-groups one would expect them to be worse off relative to permanent workers--with regard to minimum wages and other benefits. But the opposite seems to be true. In contrast to the mostly non-unionized status of permanent labor on the shopfloor, these independent workgroups are fairly organized and wield considerable bargaining power vis-a-vis firm-owners as reflected in rates that are both coordinated across most teams in the region, and frequently renegotiated. Rate lists displayed prominently by most such teams coordinate rates across teams. An important source of their bargaining power comes from the fact that these groups have come to serve as key links between individual firms and the "technology market"--i.e., since they circulate between a variety of firms, they know who is selling what machines, who is looking for machines, who has the skills that some other firm is looking for, and what new machines have arrived in the government's "seconds" store for auctions. They are tied to markets outside the state as well, and are, therefore, important conduits for the spread of technological information among the region's firms of all sizes.

There is a second kind of arrangement wherein various contractors lead different "crews," each specialized in particular operations (painting, grinding, turning, milling) to firms that need extra skilled hands, or those that as yet lack--or can't afford--an adequate enough permanent skilled/semi-skilled staff, or have received bulk orders in a product line

they have only recently entered. Eventually many of these workers/ specialists open their own shops, but the institutional arrangement persists, permitting small firms to gain access to a shared pool of specialized skills that few of them can afford to permanently internalize. This lowers their production costs. To ensure that this system continues, many producers associations are talking about lobbying state government bureaucrats to provide welfare benefits to these latter groups.

(ii) Other features of Ludhiana's productive environment within which the region's skills are embedded

As mentioned earlier in this chapter, skills by themselves are not enough. What are the other features of this region's industrial environment that allow small firms that have access to skills, but not much capital, to lower production costs? I highlight six such features of Ludhiana's productive environment.

(a) An array of inter-linked networks: The scores of small, medium and a few large firms that produce bicycles, sewing machines, textile and knitting machinery, auto-parts, agricultural equipment and machine tools in three spatially contiguous industrial estates, and eight "focal points" on the fringes of Ludhiana city,³⁵ are supported by a variety of networks. These firms are highly inter-linked through chains of job-shops, layers of independent contractors, labor teams, intermediate goods producers. All kinds of production services

³⁵ As well as thinly spread throughout the city.

from electroplating, material testing, hardening, forging, casting, machining, tool and die making can be got done from specialized small firms in "the market." Raw-materials such as re-rolled steel and intermediates such as nuts and bolts of all varieties and so forth, are locally produced and available cheap, as are services of accountants, fax shops, and sundry other administrative assistance.³⁶ A variety of government institutions³⁷ engaged in R&D, human resource development, export assistance, monitoring and incentive provision to small firms, permeates this landscape.

(b) Active manufacturers associations: Operating throughout these industrial districts are over 50 remarkably active manufacturers associations organized by trade. Among other things, these associations organize buyer-seller meets collaboratively with local government agencies, pressure the state government for training, resources, and infrastructure, and monitor and maintain "market custom" among local firms. Underneath the 5-10 largest associations, this monitoring is done

³⁶ Many of the smallest firms get form letters of other bulk material typed at very low rates from typing and shorthand training colleges.

³⁷ Some of the key institutions are the (i) District Industries Center (funded by the state government), (ii) the Small Industries Services Institute (one of 16 centrally run networks of regional institutes set up in Ludhiana in 1956), (iii) Ludhiana Productivity Council (one of 47 such councils in the country set up here in 1958), (iv) Mechanical Engineering Research and Development Organization (one of 3 in nation set up in 1965), (v) Quality Marking Centers (by trades; funded by the state government funded, and first set up since 1956), (vi) Central Tool Room (UNDP/West German funded), and (vii) the Bicycle and Sewing Machine R&D Center (funded by UNIDO and operational in 1988).

by numerous loosely coupled consortiums of firms that arise from time to time in episodic fashion around producers in very specific product lines³⁸ to deal with localized problems faced by them--such as undercutting or other problems. It is similarly possible for firms to belong to a number of different sectoral or regional associations.

A common pattern also is that skilled workers who are members of reconditioning teams are often also members of particular producers associations (such as machine tools associations). Similarly, some service firms or job shops are part of quasi trade unions--e.g., turners associations, or milling workers associations. This blurring of boundaries between workers and small owners in part reflects the trajectory of skill acquisition and small firm ownership discussed in the previous section. Many technicians who are workers go on to become firm owners. This crossing of boundaries, and continuity of identity between skilled workers and small entrepreneurs who rise from the ranks, also ensures that "market custom"³⁹ is

³⁸ These episodic organizations form around and include firms that are actually facing the problem not the larger sectoral group--e.g., they would form around free-wheel producers (not all bicycle parts producers) or sewing machine crank-shaft producers (not all sewing machine parts producers).

³⁹ See Piore discussion of customary law for an analogous process among workers.

upheld--i.e., commonly understood standards of what constitutes fair work are adhered to--more or less--both by workers and owners through a loose system of "self-monitoring." To illustrate briefly, one small sewing machine assembler I interviewed reported how in the 1980s his firm had developed fixtures that would allow workers to assemble upto 5 sewing machines per day instead of the existing norm of 2-3 machines per worker. But he said, "no one adopted this system because it went against market custom," or the prevailing norm of what constituted fair work (J.S. Mechanical interview, 1992).⁴⁰

(c) Local arrangements that allow for efficient and innovative use of certain raw-materials: Other kinds of "market custom" involving informal collective agreements by firms of various sizes that may not know each other that well also exist that help small producers cut costs jointly. For example, after one of Ludhiana's major strikes in the early 1970s, a set of institutional arrangements exist in the city that allow small, medium and large producers to use scrap in highly efficient and innovative ways. In a search for ways to cut costs following a large increase in wages and piece rates after the 1972 strike, producers of various sizes decided to pass on punched/stamped metal sheets to other firms for downstream usage. For example, if a BB-cup (bicycle part) maker purchases a full length metal sheet at say Rs. 10 per length, he sells off his punched sheet to

⁴⁰ This market norm of 2-3 machines in the 1980s is a shifting anchor. In the late 1970s it was 1-2 machines per worker per day.

a washer maker or a bicycle accessory maker at a lower price, say, Rs. 6 per length. The latter producer extracts the material it needs for its parts from the left over sheet and sells it further to a firm that produces even smaller parts at an even lower price till the final pieces are sold to the local scrap dealer who then sells it to the local steel re-rolling mill. Although the first firm buys the steel sheet at market rates, the second and third users pay a lower cost.

This system of minimizing waste involves the collaboration of firms that may themselves not gain lower costs directly (such as the first firm), yet collectively it enables Ludhiana's nut and bolt, and cycle parts industry to sell some of their products at prices lower than production cost elsewhere. Some bicycle parts produced this way cost less even than what producers in other regions (Bombay or Delhi) pay just for raw-materials.

(d) Other ways of lowering production costs: The cost benefits and skills discussed above are not the only way in which Ludhiana's producers are able to produce goods (such as bicycles and sewing machines) of comparable quality to large producers elsewhere at much lower costs. They save also in their management costs by keeping overheads low. In contrast to the plush offices of firms in bigger cities, their offices are basic, often a small space partitioned off the shopfloor, with the proprietor or partner handling most of the banking, tax, procurement and sales responsibilities himself (i.e., involving a degree of self-exploitation), accepting generally low profit

margins (ranging on average from 6-10%⁴¹), and often working long hours--8-10. Additional cost saving comes through widespread lateral subcontracting among firms in the region.

I have not included "cheap labor" here because although labor costs for some tasks are low in Ludhiana, wages in the sectors that dominate Ludhiana's industrial structure--woollen hosiery, bicycles and parts, auto-parts and other transportation equipment, sewing machines and parts, machine tools, machinery and metal working--are higher than the national average (Report on the Second All-India Census of Small Industrial Units in India--All India and Punjab volumes, 1992: pp. T-79 and T-33 respectively). Similarly other researchers have found that even as far back as 1975, Ludhiana's manufacturers paid their workers three times as much as their counterparts in other industrially developed states such as Tamil Nadu (Taub and Taub 1989:110).

The story is more complex than just wages--it involves widespread occupational mobility among the local labor force. This issue is linked to several factors: the land reform of the mid-19th century that led to a relatively less unequal distribution of income; effects of the green revolution over time; easy availability of basic wage goods--food, vegetables,

⁴¹ Despite low profit margins on many of the standardized goods produced in this region, most firms in my sample, once they had established themselves, diversified into at least a few "monopoly" items--complex, expensive, high quality parts, or import competing products--that are imported but not yet produced in India on a substantial scale (such as high speed industrial sewing machines). Profit margins on these items were as high as 100%, even though volumes were initially not that large.

milk, transportation; "effectiveness" of some of the government's programs targeted towards agricultural laborers and urban-and rural based artisans; the outreach of other industrial training institutes; expatriate worker remittances; and how the changing economic structure influenced and was impacted by changes in the occupational structure.

(e) A growing group of "brokers" and intermediaries: These middlemen come in several guises, e.g., raw-material dealers, sales dealers, wholesalers and merchant exporters who provide small firms with connections into national and export markets, finance and accounts consultants who help small firms prepare project reports that are now increasingly required by most lending institutions and banks which have been mushrooming in this region since the mid-1970s, soft-ware experts and programmer-consultants who provide the hosiery industry, and in a few cases, the machine tool industry with computerized designs, wire-drawing "barons" who peddle steel and subsist on the government's quota regime structured around raw-materials marketed through government controlled monopolies--but who also indirectly finance small producers through elaborate supplier-credit networks; and a new breed of white collar service establishments who help small and tiny (first generation) firms attain access to government incentive schemes, subsidies, and loans. These service firms also help rural and urban educated-unemployed youth to apply for special government benefits. In addition to these "new" intermediaries, are the older varieties

such as grain merchants/traders--who have traditionally financed several entrepreneurs, seed merchants who lend their seasonal surplus dear to producers in need of start-up loans or working capital, and cold-storage owners who do the same.

(f) A highly differentiated, but skilled, labor market:

Finally we return to the main point made earlier in this chapter. The presence of relatively inexpensive skills. The labor market for Ludhiana's metal industries comprises of a largely skilled local workforce which is dominated by Punjabi male workers (although many women are found in the woolen hosiery industry). There is in addition, a diverse and stratified group of unskilled and semi-skilled male migrant workers from states such as Uttar Pradesh, Bihar, Rajasthan, and even Kerala; local women homeworkers; and teams of migrant (tribal) men, women and children who circulate between seasonal agricultural work on the edges of the city and temporary factory work--such as collecting steel scrap off the streets of the industrial estates for recycling.⁴² The labor force also includes factory workers, as noted above, who live in and commute from villages located in a 15-20 km radius around Ludhiana, as well as factory, service and construction industry workers who continue to be simultaneously engaged in agriculture as a secondary occupation.

⁴² Quite innovative, special gear with magnets attached to short wooden rods and a leather strap is available through the region's radio repair shops. They use magnets from used or broken speakers to put together this contraption. Although strenuous and exploitative, the steel-scarp pickers say they often earn upto Rs. 100 per day on good days.

(iii) The skilled small owner--lowering costs, competing against imports and large domestic corporations.

Central to the dynamism of Ludhiana's light engineering and metal working sector are the skilled metal-workers many of whom go on to become entrepreneurs as mentioned in the previous section. Not only are these entrepreneurs capable of working on the shop-floor, but most significantly they manufacture, or at least customize their own machinery, tools and dies. Known for their ability to replicate existing machinery, they are able to cut costs by reconditioning and adapting used machines with the help of the skilled mechanics, job-shops, and reconditioning teams mentioned earlier. They typically start out with rented or second-hand machinery, or buy one new machine, and then copy it (or get it copied by local mechanics) to produce their own at half the price of the new machine. This access to skill, and a traditionally honed understanding of production engineering, allows these artisanal entrepreneurs to start out, and successfully sustain their shops on much less capital than would be required by an entrepreneur who had to depend on hired skilled workers for similar innovation.⁴³

Moreover, because they make some of the changes to base machinery and production processes on their own shopfloor, or with the help of small, local machine tool firms and mechanics,

⁴³ See also Dasgupta 1989, Taub and Taub 1989, and Pandit 1985:146-179 for a related discussion on the skills of Ludhiana's metal-workers.

they are able to afford more machinery per rupee spent than small firms who depend mainly on second hand machines, or on new machines produced by large firms located outside the state. One producer of automobile parts reported how he worked together with a highly experienced mistry to install a whole leaf spring plant in his firm for under Rs. 3.5 million when the quotes he got from South Korea for the same plant had been over Rs.10 million. This firm had also recently completed a prototype for a parabolic spring at an expense of only Rs. 70,000 compared to the Rs. 50 million that the giant auto company Maruti-Suzuki had spent installing its parabolic spring plant near Delhi (Akal Springs interview 1991). A medium sized partner of the same firm developed a propeller-shaft unit using local machinery and expertise for Rs. 15 million compared to Rs. 70-80 million spent by their competitors outside Punjab on imported plants.

This lowering of cost of base machinery and expertise also feeds back to the customers of the region's products, lowering their final costs. In some cases this had even led to successful competition with imports. A small auto-parts firm⁴⁴ specializing in press work in Ludhiana developed a highly precision-intensive TV picture tube frame for Samtel, a collaboration between Mitsubishi and an Indian firm at a third of the price that Samtel was paying to import the part from Japan till 1990. Now Samtel plans to re-export this indigenized part

⁴⁴ The firm is officially small in scale, but is at the large end of the category. It has two plants with a total of 170 workers.

to Canada, Europe and South Korea (Moonlight interview, 1991). Similarly, Samtel's engineer present at Moonlight's factory reported that Samtel got a quotation from South Korea for the TV's inner magnetic shield for Rs. 4 million per shield. But Moonlight is now producing this part for Samtel at Rs. 0.8 million per shield--at one-fifth the cost of the imported component. Samtel is therefore no longer importing the part from Korea. "Samtel is years ahead of its competition (Uptron, JCT) and has been able to save a minimum of Rs. 10 million in imports because of the high quality import substitutes provided by Moonlight" (Gupta, Samtel interview 1991)

By virtue of their ability to routinely manipulate base machinery, these skilled entrepreneurs minimize their need to hire skilled workers up-front. Thus, they combine the advantage of low start-up costs, a low wage bill and low fixed costs, with the large-firm type ability to develop new products through reverse engineering, and improve productivity through changes to their production processes and base machinery.

This presence of cheap skills and the work-arrangements described above help to lower production costs for both the region's small and large firms. Hardly any firm in the region--large or small--produces all components of any of the region's composite final-goods (bicycles, sewing machines etc.) in-house.⁴⁵ As noted earlier, this system has allowed the region's

⁴⁵ The region's larger assemblers do wield greater market power, yet very few of the smaller component producers and/or assemblers remain tied to single customers. Once established, they

large and small firms to together undermine and eventually displace more integrated, large MNC producers elsewhere in India. Ludhiana firms produced the same goods that these larger firms produced, of comparable quality, but at virtually half the cost. The products where Ludhiana-based firms wrested a competitive edge vis-a-vis large producers are bicycles (Sen-Raleigh and TI Cycles in Bengal and Madras respectively), sewing machines (both Singer and Usha--a large Calcutta firm--have been forced to procure a bulk of their complete machines from Ludhiana), some farm implements and simple non-electrical machinery (Rao, 1989, Singh, 1990).

(iv) Overcoming everyday obstacles in production: some examples from the shopfloor

Aside from supplying to OEMs and final buyers, a bulk of the region's small firms supply to the replacement market. This means that although the products manufactured for the replacement or spares market by these producers are fairly standardized--bicycles, sewing machines, auto-parts, machine tools--the productive process is nevertheless highly variable and is constantly adapted and altered by individual or groups of producers in order to lower production costs or increase output.

A few examples will illustrate what these firms do to make

tend to diversify their large customers while simultaneously selling in the replacement market on their own brand-name. Some seek government orders, and/or try to export indirectly through trading houses.

small ongoing modifications and how they might lower production costs. (a) The piston pin is a standardized part that comes in standardized sizes, so a firm producing these pins cannot make modifications to improve the product design. But as one manufacturer of piston pins reported, they can introduce superior material, or improve their production process to achieve better quality and less wastage. So they try to minimize rejections. In the case of the reporting firm, they reduced rejections from 10% to 2-3% in a few years.

In addition, the firm made small incremental improvements on the shopfloor involving changes to fixtures and tools, or the set-up of the machine can help increase output and efficiency.⁴⁶ Often, this involves gradual, and selective automation of the production process.

For example, the piston pin manufacturer discussed above, used to grind the piston pin one face at a time, because they had a machine in which the parts were fed vertically. With the help of their mistry (mechanic, technician-foreman) they developed a machine in-house in which the two faces of the piston pin can be now ground simultaneously. Whereas earlier an operator had to mechanically reverse the sides of the pin after one face was ground, now the machine is modified so that the pin is fed into

⁴⁶ These changes are gradual and ongoing in nature. They arise from battling with problems that emerge on the shopfloor or are pointed out by outside assemblers of these parts. The solutions emerge from the experience of the mistry and the owner's technical knowledge, or through consultations with others.

it edgeways and passes through a fixture-head fitted with two grinders at both ends. Thus both faces of the pin get ground at the same time, and the part rolls off at the other end.

Similarly this firm used to chamfer the inner and outer edge of another of its item, the bush, sequentially (i.e., first the inner edge, then the outer). A mechanic friend who had a firm in another line suggested that they develop a new tool that would allow them to chamfer both edges simultaneously. The firm produced the new tool in its own tool room, with the help of its own workers and local tool and die makers.

(b) The same firm used to cut the pipe for the piston pin on a regular machine and measure it several times with calipers to get the exact dimension. Again, a mistry suggested that they develop a tool and fixture whereby the fixture would be set exactly at the distance they needed the length of the piston to be, so that the cutter tool would automatically stop when it reached precisely the desired point. With this more complex tool and fixture the firm attained more speed as well as accuracy.

At the time of interview this firm was developing a special adaptation to its turning work-station so that the final stage/operation of polishing and finishing (now done on a separate polishing machine) would be collapsed with the final turning, thus eliminating the need for the last step and extra machines. A highly skilled project manager of the District Industries Department was helping them as a consultant (after

hours) to achieve this.⁴⁷

Despite its small size and low margins, this firm has been able to increase output, reduce rejections, and gradually upgrade its production process as its finances have allowed it, and as and when it has had to resolve production problems on the shopfloor. Constant consulting with other producers, other assemblers, and mechanics helped highlight for the firm problem areas and ideas about how to solve the problems.

Conclusions

This chapter argued that in addition to the social and historical features discussed in forgoing chapters, a key reason why metal-based small industry came to be successfully concentrated in Ludhiana, a region thousands of kms away from any material input source, was (i) the nature of its accumulated human capital, and (ii) the widespread availability of cheap physical infrastructure provided by the state government. Unlike other states in India where governments assisted industry through equity participation or ownership, Punjab's government focussed, early on, on extending basic infrastructure throughout the state,

⁴⁷ Most firms work with very low margins, as does this firm. It competes by picking up odd-sized, or customized parts that other, standard firms cannot accommodate, and by responding to a shifting niche demand. I.e., large firms produce long runs of the same part for a substantial time period, say for 2-3 months. In the interim they cannot pick up any odd sized parts that someone demands. Small firms that focus on the replacement market (or the spare parts market) pick up this kind of demand.

and encouraging skill formation among workers, technicians and small owners.

Discussions about training, upgrading of worker skills, and increasing a region's human capital base have acquired increasing relevance in the recent literature on industrial growth. But the lessons about training and the state's role in it are usually portrayed as distinct from discussions of what workers do on their own in the labor market to acquire skills. Studies that look at informal sources of learning or skill enhancement usually do not feed back into the way in which public training programs are designed. Outside of the recent work on learning via exposure to practical knowledge on the shopfloor in the literature on East Asian successes (Amsden 1989) and industrial restructuring in advanced industrial economies, on-the-job training is not only ignored, but regarded as too inadequate, too weak and disorganized, to raise worker skills to levels that would make a region competitive.

Taken by itself this may be true, and indeed some formal training programs are often designed precisely to compensate for, or improve upon, the techniques and short cuts workers learn on the shopfloor. But in this way of thinking, training systems remain dichotomous, split between the formal programs that carry much greater validity than informal processes that are more ubiquitous, but remain unvalidated and marginalized. An area that deserves serious research and policy attention, therefore, is the reconciliation of these disparate tracks of human capital

accumulation, by understanding how formal training programs can combine with, and incorporate more consciously, the less formal processes of learning that are already taking place on the shopfloor and among workers in the labor market. As described in this chapter, the Ludhiana case illustrates the striking success of such a combined process. Although the particular way in which this beneficial interaction between the state's emphasis on skill formation through vocational training and workers' own skill acquisition trajectories, came about was inadvertent, and shaped by Ludhiana's idiosyncrasies and history, it nevertheless could be repeated by fostering key relationships through policies and programs. An understanding of how formal and informal processes of training and skill acquisition interact, may provide insights into building a cheaper, broad-based system of upgrading the skills of a region's workforce that is accessible to the smallest firms.

The findings about training, apprenticeship, and learning in Ludhiana (and Punjab in general) reported in this chapter, are different also from the recent emphasis in the literature on education and health leading to stronger and more equitable economic growth (Birdsall et. al. 1995). Punjab, as we saw in Table 4.1, is the country's highest GNP state; in addition to a dynamic agriculture, small and medium sized firms are the basis of its industrial growth; and only 7% of its population is below the poverty line compared to 30% for the nation as a whole. Yet the state has only mediocre health and literacy indicators that

are slightly better than the national average (Table 4.1). While the arguments about education and health leading growth may not be wrong, the Ludhiana case does not fit the model. The broad-based character of the region's accumulated human capital cannot be read off its literacy and health indicators, yet this human capital base has been crucial to the region's economic growth. There are, thus, other paths to relatively equitable growth that do not involve heavy investments in education and health first.

In the next chapter we will see how, located within this environment, local firms built relationships with each other, with state agencies, and with numerous intermediaries, that allowed them to break out of several traps that typically plague small firms: such as coping with unstable demand, getting access to markets, technical knowhow, and performance standards.

CHAPTER 5

Getting around common bottlenecks that plague small firms: unstable demand, distribution, and performance standards

Introduction

As we have seen in the preceding chapters, many of Ludhiana's small producers had repair origins. Many others, in the bicycle industry, for example, started out as component producers at low ends of the market and moved up gradually, improving product quality over time up to the point where, by the 1970s, they had wrested away market share from the country's largest multinational bicycle producers, forcing them to procure components from Ludhiana or get out of the business. This moving from low to higher ends of markets by small firms over time is not new, or unusual in and of itself. Small firms in many regions and countries start out producing at the low end; but many firms, and regions also stay stuck at the low end. In the Ludhiana case, how did a region dominated by small producers that started out manufacturing simple components, located hundreds of miles away from any input source, come to dominate national markets in the products in which they specialized, producing over 60% of India's production of bicycles and parts, over 80% of its sewing machines and parts, and 95% of the nation's woollen hosiery output (Dasgupta 1989)? What enables some firms and regions to move from low to higher ends, and not others? How exactly do they do it?

Similarly, there is overwhelming evidence in the literature that marketing is a major stumbling block for small firms. Field studies furnish vivid evidence about how lack of access to markets, or lack of 'marketing ability' strangulates small firm growth. As sales stagnate and revenue-streams shrivel up, firms are unable to reinvest in upgrading, or expanding production, and are less and less able to compete in local or outside markets. If they additionally have heavy debt liabilities to banks or private lenders, they go under (Little et. al. 1987, Liedholm and Mead 1987).

Given this scenario, I was surprised to find hardly any of the 117 firms I interviewed report that marketing was a problem for them. The common response was that "sales are no problem." Most said they typically had more demand than they could meet. This is not to say they did not face any problems with demand, but they did not regard these problems as debilitating. Why did issues of sales and marketing not present themselves as problems to these firms which they felt they couldn't get around? What explains this departure from our usual understanding of marketing as a chronic problem that plagues small firms?

This chapter focuses on these questions and asks how and why some are firms able to cope with key bottlenecks that typically plague small firms, such as getting stuck at low-ends of the market, being unable to find out how to improve quality enough to enter outside, higher quality markets; improving performance standards; dealing with problems of marketing, and coping with

the sudden loss of demand, or acquiring the ability to shift production in response to changes in demand without incurring debilitating costs. I address these questions by looking closely at one case and explaining how several small and medium producers in Ludhiana managed to get around these traps, and the conditions under which they succeeded.

Some aspects underlying the ability of these firms to cope with bottlenecks that typically hamper small firms are best illustrated by situating Ludhiana in a comparative context. The chapter therefore begins with a brief comparison between Ludhiana and Howrah's small metal manufacturing firms. Both regions had a skilled workforce and significant early demand from the government. Yet, Ludhiana's metal-working industry prospered at the same time as Howrah's metal industry declined. What explains this difference in outcome?

The first part of the chapter lays out the comparison between Ludhiana and Howrah's metal-based engineering industries. First, drawing on the themes developed in the previous chapter, it shows how the differing nature of skills in the two regions, and the different ways in which small-owners and workers got access to them imposed quite different pressures on firms that employed these skills, as well as on their diffusion and transformation. A second difference between Ludhiana and Howrah's trajectories lies in the different kinds of demand pressures faced by small firms in the two regions. Even though government demand was important to both regions it was mediated

by different kinds of intermediaries, and evoked different responses by firms in the two regions. With the Ludhiana-Howrah comparison in mind, the second part of the chapter draws on several case-examples to examine how successful firms in Ludhiana coped with the moving away of demand and the lack of assured markets. It examines the distributional networks that give Ludhiana's small firms access to national and export markets outside the region. And it shows how firms constantly put pressure on themselves to improve output and product quality by exposing and comparing themselves to a variety of outside standards.

Part I: The Ludhiana-Howrah comparison--tracing their different trajectories:¹

Ludhiana's growing success in the 1950-60s paralleled exactly Howrah's decline. Compared to Punjab, Howrah had every natural advantage: proximity to a key port, location at the heart of Bengal's iron and steel producing centers, and a century long insertion in one of India's busiest trading and manufacturing centers (Bengal). Sources of coal and other inputs are at its doorstep. For nearly a century Howrah's metal industry had sold its output to the largest and most powerful (though monopsonistic) buyer in the region--the colonial government, in particular its railway department and shipyards near Calcutta.

¹ In addition to the references cited herein, this section draws heavily on discussions with Abhijit Bannerji on the metal industry of Howrah (MIT, 1994).

Despite these comparative and natural advantages, this industry declined; it declined over the same period that Ludhiana's metal industry prospered.

The standard West Bengal story of militant unions subverting industrial growth breaks down in explaining this decline because most of Howrah's workshops that first prospered and then declined were non-union--just like the Ludhiana workshops that began to successfully compete with them. Instead, as we see below, a different kind of human capital base and a different history of work organization in Ludhiana seemed to overwhelm any clear natural advantage that Howrah had over it.

Two of the factors explaining Ludhiana and Howrah's differing futures are examined in greater detail below. (i) One factor relates to the composition and history of skill in the two regions. (ii) The other relates to the character of demand facing small firms in the two regions: the nature and source of demand, and how it came to be transmitted across firms in the two places was different.

(i) Differing character of local skills and their differing antecedents.

Both Howrah and Ludhiana have skilled metal workers. But the nature of their skills, and the way in which they were acquired is quite different. (a) Howrah's skilled workers are narrowly specialized to perform with great precision certain sets of tasks, not because production was organized along mass production lines, but because the network of small metal firms

specialized in a very small set of items, and employed processes that demanded a narrow range of skills. The region's specialty through the 40s, 50s, and upto the 70s was pipe fitting, and the production of some machines that are involved in this process (RBI 1964). Workers in this region are, say, excellent pipe fitters because they have been doing the same task for many years. But when demand for this product waned, a bulk of the firms were unable to move successfully to new and different tasks.

By contrast, most workers in Ludhiana have broader skills. The metal industry produces a variety of related goods and uses a wide range of production processes. This has created demand for a wider range of skills. As opposed to specialist pipe fitters who work on the same problems and on the same machines everyday, the pressures imposed by the way production is organized in Ludhiana has created incentives for skilled workers to learn how to deal with newer problems not previously known to them. As we have seen in earlier, the region's small firms are constantly seeking modifications to their production process, different ways of performing specialized operations (e.g., gear-hobbing) on unspecialized, general purpose machines. This demand for finding newer, cheaper or customized ways of doing things has old roots. As we saw in chapter two, even the region's farmers have long made similar demands upon local mechanics, technicians, artisans

to develop customized equipment for them.² The skilled workers most in demand are mechanics and technicians, those who can look at a machine, or task they have never seen before and figure out how to go from machine A to B, or process C to D, in a small number of steps, and to apply these skills to different kinds of unforeseen problems.³ These skills, moreover, are available to small firms without their having to fully internalize their costs, as we saw in the last chapter--through the presence of reconditioning teams, numerous job-shops owners, and component manufacturers who are themselves skilled technicians.

(b) The history of the construction of skill, and its transmission is also different in the two regions. Different kinds of social groups went into industry in the Ludhiana vs Howrah. Artisans, who over time became transformed into technicians, mechanics, and skilled owners, were historically central to the industrial system in Ludhiana. In Howrah, by contrast, labor employed in small firms was never in the networks where skills were formed naturally. Those who owned capital had little practical skill themselves. They hired cheap migrant

² For example, we saw how the farmers who returned to East Punjab after the partition of Punjab in 1947, having been exposed to irrigated farming in West Punjab's canal colonies, and to the use of improved implements, turned to local artisans to help develop equipment to suit their smaller plots and altered conditions of work.

³ Again, these kinds of general skills are not unique to Ludhiana. Most places that have an adaptable industrial base appear to have them (See Sabel 1982, Piore and Sabel 1984, as well as cases in developing countries, especially, Schmitz 1995.)

workers from Orissa and Bihar who became trained narrowly in the jobs they performed. Other than the jobs they learnt to do, they did not have an understanding of mechanical work in general, nor did they have access to institutions of apprenticeship and information in the local labor market as did workers in Ludhiana. Howrah's metal workers existed in a narrow segment outside the formal sector, whereas in Ludhiana the bulk of small producers were the region's industrial mainstream.⁴ Thus, although there were skilled workers in Howrah, as well as less skilled workers who had a lot of experience, the trajectory of neither group was able to converge in a way that technician's skills ever became easy to acquire or be widely reproduced. Those outside the loop of the small skilled elite stayed stuck in narrowly defined job-tracks, becoming good at some tasks, but unable to acquire general skills.

(c) The social structures in which the workers and small owners in the respective regions were embedded were different as well. Punjab's agricultural and non-agricultural working class already had some wealth through 18th-19th century land reforms,

⁴ It is interesting that the career trajectories of migrants in Ludhiana appears to be quite different from that of the same group in Howrah. During my field work, some U.P. and Bihari migrants who had worked in Ludhiana for four years or more reported a desire to start their own firms one day. One semi-skilled migrant worker whom I interviewed in a small firm showed me parts of used machinery that he had been buying with his savings to assemble a motor. Ultimately he said he would find parts to put together a lathe. The demonstration effect of the trajectory of local (Punjabi) workers appeared to have been the motivator. "This is what everyone does...this is how people start here" (Babu Ram at Nirmal Auto, interview 1991).

migration, extensive contract work and the colonial government's investments in public works, irrigation and infrastructure during the late 1800-early 1900s. By contrast, the petty landlords from East Bengal who became owners of small industry in Howrah were embedded in a rack-rented system of tenancy throughout the late 19th-early 20th centuries. Although they had enough to eat, and thought of themselves as belonging to the landed class, they had no significant surpluses. Moreover, because of their perceived "upper" class social status, and white collar aspirations, these former landlords had never worked with their own hands: much of the actual cultivation was done by Muslim sharecroppers (Bannerji 1994, Bose). In Punjab, by contrast, peasant status was socially acceptable, and owner-cultivation carried status. Consequently there was no radical alienation in that society from all forms of work with one's hands. Cultivators as well as artisans earned stature by working with their hands, acquiring skill in practical work. The artisanal groups who became small owners in Ludhiana, therefore, accumulated a different kind of human capital. Since these early small-owners themselves had practical technical knowledge, they did not rely solely on hired skills.

In sum then, Punjab developed an active artisan class in the late 19th-early 20th centuries that was transforming its traditional skill base and accumulating some capital through contract work on the colonial government's infrastructure projects. This group later entered industry. East-Bengal's

peasants, who later became metal-shop owners in Howrah, had enough to live on, but did not accumulate any surplus, or skills. They hired cheap unskilled or semi-skilled migrant laborers from neighboring states who remained isolated. They could never join the networks of the skilled Bengali foremen where skills were created and preserved. Thus when demand for Howrah's metal products declined, the skilled tier just moved away to new industries and jobs⁵ leaving behind the small owners and their semi-skilled migrant workforce without the ability to shift to new products.

In contrast to this isolation, in Punjab a wide range of workers could participate in the networks that taught the skills (not only in technical schools, but within firms and the labor market). Aiding this relatively democratic structure of skill transmission, moreover, was the fact that the social boundary between small firm owners and skilled workers was blurred--they belonged loosely to the same social class--of former artisans or in some cases, merchants engaged in metal trade. The policy response from the government of Punjab throughout the 1950s-60s also encouraged skilled workers to start their own enterprises, creating a large tier of middle-class entrepreneurs who had moved up the ranks of workers. Small owners who had risen from the ranks still had ties to networks of skilled workers they had been a part of, who they could turn to for technical advice without

⁵ As did the contractors who brokered the demand between Howrah's small firms and the main buyer, the government.

having to hire them. Thus, embedded in an evolving skill-base, with indirect support from the government and from a variety of other actors, small firm owners in Ludhiana (and Punjab) were better able to cope with the moving away of, or declining of an obvious source of demand than their Howrah counterparts, as we will see below.

(ii) Demand and its varieties

A second dimension of difference between Ludhiana and Howrah lies in the nature and source of demand. In particular, government demand, and the way in which it got transmitted to small producers in both places. In Howrah, the government's large railway coach factories monopsonistically bought parts from small local suppliers via contractors. The small firms who produced for the government had little direct contact with them, and hence were unable to build any relationship with their ultimate buyers. At the same time, most of them had no independent market outside of the railway department. The products they specialized in were customized to fit the particular design and requirements of the railway workshops, and could not be sold on the open market. Thus, when the government's railway workshops moved away from their location in the vicinity of Howrah's small metalshops in the 1950s-1960s, the contractors who were the chief brokers of demand between the railway workshops and the small firms, also moved their business to where government demand was, thus cutting off the small local

producers from their primary market. Some of the small producers recovered slowly by turning to other clients in the local market, but the cluster as a whole failed to survive the exodus of the government workshops. Rather than shift to new products, a large number of firm-owners became petty traders after the metal trades declined (Bannerji 1994).

In Ludhiana, by contrast, public and private demand played itself out quite differently. Government demand--especially from the defense department and the railways--was central to the initial growth of the region's small firms as we saw in the preceding chapters, but it differed from Howrah in at least two ways. (a) Its spread amongst the region's firms was more diffuse. Unlike the Howrah case, small firms in Ludhiana as a whole, were not dependent on the production of only a narrow range of parts for a single government agency like the railways or any single buyer. Different firms produced a variety of products ranging from nuts and bolts, bicycles and parts, knitting machinery, various types of industrial sewing machines (zig-zag, overlock, embroidery machines and "tailor" models)--to a variety of auto components, machinery and tools. Firms also produced woollen hosiery, pullovers, uniforms and other goods for a variety of government departments including rural development and welfare, railways and defense. Thus, public sector demand in Ludhiana came from a diverse set of agencies, and for a variety of products.

(b) But, even as government demand was important to the early growth of the metal and hosiery firms in Ludhiana, and is still an important source of demand for local firms, private demand progressively overtook government demand--the volume of output sold in the open market (local and national) has exceeded government procurement since the 1960s (DIC, Ludhiana).⁶ Unlike Howrah, local firms here did not depend solely on government orders for particular goods for their survival. Nor did they remain locked into the repeated production of a narrow set of goods; demand emerged, instead, from a variety of public and private buyers for a variety of related goods. They were thus better able to cope with the falling off, or moving away of demand from the government or other buyers.

Inadvertent benefits to industry of the government's time-bound subsidies to agriculture

Since the late 1950s-early 1960s, moreover, the government has played another kind of indirect role in stimulating local firms, namely by unintentionally creating demand for them via a series of subsidies and incentives targeted towards the buyers of goods produced by the region's firms. For example, in the early 1960s through the 1970s the government gave farmers subsidies to purchase threshers, diesel engines and pumpsets as part of its

⁶ Although Ludhiana ~~was~~ figures are not available, from my own sample of firms, the average proportion of output purchased directly by the government works out to around 35% for the sample as a whole. Some firms sold nearly all their output to government agencies, others sold less than 5% or none at all, but on average the government procured about a third of the total output of the sample firms in 1991-1992.

drive to boost agricultural productivity. This simultaneously sparked the rise of the local pump-set and diesel engine industry. Several firms that were already producing agricultural implements, or repairing pump-sets and diesel engines reported having switched to or started the production of pumps and engines during this period. Similarly in the late 1960s and 1970s state government subsidies to farmers for the purchase of capacitors to regulate the consumption of power by pumpsets led to the growth of capacitor making firms which later turned to the production of capacitors for fans, furnaces and auto-parts. The establishment by the state government (jointly with a private consortium) of a large tractor producing firm in Punjab in the early 1970s (PTL), led to the development of a chain of ancillaries and suppliers who initially produced tractor parts, and later diversified also into the production of auto-parts for large automakers outside the state. All my interviewee firms who had been affected by these subsidies reported a sharp rise in sales when the buyers of their end products got subsidies from the government. This was especially true for firms that produced items consumed by the state's farmers or agricultural sector--ranging from agricultural implements to farm accessories, capacitors, pumpsets and diesel engines.

The finding that agricultural subsidies indirectly benefited small industry is ironic not only in light of the strong criticism in the literature about subsidies to agriculture or industry, and caveats about the pitfalls of prolonged dependence

on them, but also because subsidies aimed at increasing agricultural productivity benefited small industry--an issue that is rarely raised in the literature. In contrast to the long-term or direct subsidies debated in the literature, these subsidies to industry were both inadvertent and they were time bound. Since they were administered by the agriculture department, without the aim of benefiting industry, they lasted for the time period they were intended for in agriculture. In most of these cases the subsidies were a result of the farm-lobby pressuring the state government, not firms. But the result was the creation of demand for industry. The firms responded to the opportunities presented by this subsidy-induced demand, but given their lack of control over their duration, did not assume they could count on it indefinitely (Mahajan interview, 1991). As the subsidies in the original markets dried up, they learnt to spread to newer markets, expand their sales to other provinces where farmers would use these products, or get out of a specific line and move into a related one (e.g., making capacitors for fans instead of pumpsets to which the original subsidy applied). The halting of these inadvertent incentives thus pushed these firms to seek alternative markets beyond the local region, most did not go under.⁷

⁷ In spreading to other markets, Punjab-based firms had an advantage in that agricultural mechanization spread relatively slowly to other states compared to Punjab. Thus, as Punjab's agrarian markets for new equipment became saturated, demand for these goods was just opening up in other regions.

Part II: Getting around some common bottlenecks.

(1) Coping with the moving away of demand: some examples

This does not mean that firms in Ludhiana have uniformly faced steady demand. In several cases the primary source of demand for firms--including from the government--moved away. Some managed to switch to new products, some did not. We examine three examples below that illustrate some of the key mechanisms by which firms adapted to the sudden falling off of demand. That all three examples involve the shifting away of government demand is more a reflection of the nature of my particular sample of firms and the importance of government demand in their early histories, than any comparative statement about the stability of public vs. private demand.

(i) Case One: The buyer as the anchor. One small firm⁸ that I interviewed used to supply most of its output of fasteners (bolts and rivets of sizes ranging from 10-25mm) to the government's Railways Department since the 1960s. In the early 1980s, however, the design of wagons changed, and the Railways began to sharply cut down their demand for the firm's bolts and rivets. Some of the wagon parts that used to be fastened or riveted, were now welded; with some parts being welded and some fastened, government demand for fasteners became highly erratic and uncertain. After a year of losses and tremendous fluctuation

⁸ The firm, a partnership with two principals, has two plants with less than 25 workers in each, and an annual turnover (total sales) of over Rs. 10 million.

in orders, the firm decided to look for a product that would not be so vulnerable to changes in design. Its particular solution was two-fold. (i) First, it turned towards Ludhiana-based wholesalers to tide over its sales crunch in the short run. The firm did not give up or close down its fasteners unit--rather, with the help of these wholesalers and merchant intermediaries, it gradually reoriented its fastener production away from the railways and towards private firms and the defense department.⁹ (ii) Second, and, more importantly, it diversified into the production of a different item for which demand would not fluctuate so much. The firm chose wagon paint as the new line.

Wagon paint is a completely different item than fasteners. But on closer examination it turns out not to be entirely unrelated to some aspects of the firm's previous specialty. The common thread for the firm between this product and its previous line of fasteners was the buyer. It still supplied to the same buyer, the railways. The firm's bottom line had been to retain the railways as its chief customer--a relationship it had built over long years. In its choice of an alternative, therefore, the firm looked for an item that could still be sold to the railways but would not be vulnerable to changes in wagon design. In that search it stumbled upon wagon paint. An acquaintance who had links with the paint industry's hub in Calcutta suggested that

⁹ At the time of interview in 1990, the firm was contemplating getting into the export of fasteners to the Middle-East. Sales intermediaries--wholesalers, merchant exporters and retailers were crucial to this shift.

industrial paint for railway wagons and army trucks was a good option. Since no one produced wagon paint in Punjab, "there was little competition from within the state, and the field was wide open." Moreover, "the same wagons that are riveted or welded are also painted," so demand for wagon paint would not depend upon the shape or design of wagons (Twiga Bolts interview, 1990).

In addition to allowing the firm to continue doing business with its old buyer, the Railways, entering this new line was opportune. At the time that the firm got into paint production in 1985, regional demand for wagon-paint was especially promising. The central government had recently opened a large rail-coach manufacturing factory in a district near Ludhiana (Kapurthala), and a second large parastatal, the Diesel Components Works (DCW), was simultaneously under installation in another neighboring district.¹⁰ As one of the few industrial paint producers in Punjab, the firm felt that its proximity to these new clients, and regional buyers such as the Northern Railways, would help it win tenders more easily than the traditional paint suppliers of Calcutta, located 1200 kms away. The firm also turned to the defense department for the sale of

¹⁰ The establishment of both these parastatals was being expedited at that time by the Government of India and Punjab's administration partly in response to the rising separatist unrest in Punjab in the mid-1980s. Many believed that these parastatals were part of the Indian government's attempt to provide employment ("good jobs") to Punjab's youth (especially its "educated-unemployed" in rural areas), and to address the local grievance that the Indian government had neglected Punjab's economy, especially its industry, while extracting and draining away its agricultural surpluses.

both paints (for army trucks and tanks), and fasteners. Thus, despite the jolt it received from the slump in government demand in the early 1980s, the firm ended up diversifying and expanding production, and still retaining the Railways as its main buyer. The search for this new, less volatile line of production was not arbitrary. The firm introduced an item for which there was little local competition, but it also paid attention to the demand for it, and the opportunity that had opened up locally through the establishment of new railway factories.

Two points are important to note here. First, the firm coped with fluctuating demand by maintaining stability and continuity with regard to its key buyer--the government's railway department. Rather than give up a valued customer it had developed over long years, the firm allowed its products to take the slack. It moved from one product (fasteners) to an unrelated product (paints), in order to keep its buyer constant. The firm's search for a new product was driven as much by a concern for more stable demand, as by its desire to maintain stable ties with its old customer. This response to demand instability is virtually the opposite of the response where a firm retains its specialty product but seeks new markets or new buyers for it. Although this firm also sought new markets and buyers for its line of fasteners, its major response was to retain its buyer and shift to a new product. By contrast, as we saw in the previous section, small producers in Howrah's metal industry were unable to do either--upon the moving away of demand from the Railways,

they were neither able to shift to new products, nor find new buyers for their older specialties.

Unlike Howrah, where a large number of intermediaries (contractors) brokered demand between the Railways, the government's shipyards, and Howrah's small producers, in the above example, the small producer had direct links with the Railways which they had nurtured over many years. This direct contact not only allowed for the possibility of continuity even after demand for one item got disrupted. Most importantly, direct contact allowed the producer to build an understanding of what it would take to continue its link with the Railways--e.g. regarding requirements of quality, tender procedures and other sources of demand from the same buyer. By contrast, the small producers of Howrah were left isolated after the tier that had the information and direct contact with the Railways moved away.

Second, the response illustrated in the above example, of a firm moving between products that are themselves unrelated but linked by a "common" consumer, is contrary also to the way we think about policies that pick "winners." These policies usually support particular products or sectors, based partly on the thinking that successful firms usually develop a specialization in a particular product line, which takes many years of focussed work to build. This view is often true, but there may also be different paths to success. As the above example showed, this may involve, not necessarily remaining tied to a particular product, but rather seeking out products for which there is

demand, perhaps around a stable buyer.

In this regard, the nature of the buyer is important to note. Most government buyers are routinely criticized for being "soft" on small firms, unable to discipline them with regard to quality. This is especially true in India given its strong small-firm favoring programs such as concessional procurement and reservation of products for exclusive production in the small-scale sector. In contrast to this view, we saw that the customer, in the above case, was an exacting buyer. Although a government agency, its agenda was not to assist small firms. Since it allocated demand via tenders, the Railway department did not care whether this particular firm continued to be its supplier or not. Unlike some other public programs where an agency with an explicit mandate to help small producers buys their products and tries to further market them--such as the Handicraft Board of India--in this case the decision to maintain ties with the government buyer was the firm's, not the government's. To remain a supplier, the firm had to not only win the tender, but meet the quality requirements of the Railway department, just as much as any other supplier of paints in the country. Because of this quality-requirement, the firm, by choosing to work with the Railways, was also imposing pressure on itself to rise up to a higher standard.

Therefore, unlike some procurement programs which are criticized because they fail to help their clients graduate into independent markets (Sanyal and Pradhan 1990), this relationship

carried an in-built disciplinary mechanism.¹¹ To continue to work with the Railways, the firm had to learn to be good enough to meet its quality requirement. The firm's own decision to maintain continued association with a demanding buyer forced it to improve its quality.¹²

(ii) Case Two: changing the product mix in loose relation to the demand mix of a cluster of public consumers: A medium-sized producer of machine tools who specialized in items for the defence department faced a similar dilemma of fluctuating demand in the late 1980s. Under government contract the firm had spent nearly two years in the mid-1980s developing tools and equipment

¹¹ See also Tendler and Amorim (1996) for a detailed account of a highly successful public procurement program in Brazil that dramatically enhanced small firm performance. This program was put together, inadvertently, with similar disciplinary pressures built into it. The procuring agency had no direct interest in supporting small suppliers. They only looked for good quality at low rates and hired only those small firms who could deliver it.

¹² Not all government departments are equal. Most are not as exacting as defense and the railways, and perhaps not for all products. Starting out by supplying to "tough" and stringent departments such as the railways or defense forces supplier firms to "get it right" faster or forces the pace of learning. But not all small firms can afford that pace. Because if material gets rejected, a few times consistently, then it could wipe out a small firm that has scarce capital. As with the Railways, or defense, designs are specific to the needs of these customers, so firms cannot find alternative buyers so easily if they cut back demand. Those who have resources or the capacity to hire skilled help or are skilled themselves can afford to absorb the losses. Others may find it easier to go a different route--work their way upwards slowly through building a relationship with a small retailer, and improving quality gradually or incrementally. Because that way there is more room to make mistakes--yet they can sell early, imperfect material in small quantities to seconds' markets where rates are lower. One is not necessarily better than the other, but the two paths coexist, and work in different ways.

for a component that would go into a warship being commissioned by the Navy. But after two years of development work, even before the first batch of parts could be despatched, the government indefinitely postponed the commissioning of the vessel, and halted all ongoing production related to it. The impact of this decision on the machine tool producer was to render obsolete all the machinery that it had developed, set up, and fitted specially to fulfil the Navy's orders, including a foundry. The government compensated the firm for its two years of development time, but not fully for the machines and processes it had developed. To cope with its losses, the firm reacted in two ways.

(a) First, to recover the costs of investing in a foundry, it began to take in job work from other firms to ensure that its foundry did not lie idle. Drawing upon a pattern common among firms in the city, the firm contracted the on-site management of its foundry to an outside agent¹³ rather than deploy its own staff to run it. The outside contractor hired its own labor which came to the producer's factory site daily to operate the foundry on a commission basis for the firm (R.K. interview, 1990). Even though the firm was medium-sized, it took in job-work to cut its liabilities and recover its sunk costs--taking in job-work is therefore not only something the smallest firms do.

(b) Second, the firm had contracts from other sections of the defense department, some since the past 20 years. It tried

¹³ Under loose oversight by the one of the firm's foremen.

to get them to increase their orders, at least in the short run. But most importantly, as in the previous example, it turned to a new product and a new market: in addition to seeking orders from the Railways' Diesel coach factory installed in Punjab in the 1980s, it took up the production of CNC lathes for the government's industrial training institutes. The firm's decision to diversify into CNC lathes was not entirely abrupt--in the late 1980s it had produced turning heads of CNC lathes for Hindustan Machine Tools (HMT), the government's largest machine-tool parastatal. Since then it had wanted to enter the line more fully. The disruption caused by the cancelled contract provided the "push" to make the shift. The firm planned to take up the production of "the cheapest possible" version of CNC lathes. Its intended market was still the government--specifically its industrial training institutes (ITIs). The firm's idea was to "put at least a few cheap CNC lathes in each Industrial Training Institute in Punjab (and eventually elsewhere) so that workers could be trained on them." (R.K. interview, 1990). Despite the setback from the defense contract, by early 1990 the firm had already secured Rs. 20 million in financing for the project from the Industrial Financial Corporation of India,¹⁴ as well as

¹⁴ The firm-owner emphasized the importance in this regard of hiring (a local team of) consultants to put together a "slick and convincing" proposal. Echoing the sentiment of a growing number of medium and well-established small firms, the firm said that contracting out the service saved them time and hassles. "If we had made it ourselves we might have suffered more, it might have taken longer." It was well worth paying the consultants (Rs. 150,000 in this case) to ensure that they handed in "a professional proposal" (R.K. interview, 1990).

support from its prospective clients, the Industrial Training Institutes.

As in the previous example, this line had virtually no competition in Punjab. No other firm produced such machines locally: the firm's main competition was from imports, and secondarily, from government parastatals like HMT, and large private sector firms like Kirloskar and others in South India. As in the previous example, here too the firm sought a new product--although unlike the paints example, this product was still within firm's line of machine tools--and a new buyer (the Industrial Training Institutes). But its primary relationship still remained with government agencies. The firm thus responded to loss of demand for one item by changing its product mix (within the same broad line of machine tools), in accordance with the demand mix of its various government buyers.¹⁵

¹⁵ Firms also specialize in products which, although seemingly diverse, are linked by a common production process. For example a firm producing auto-parts may specialize in all kinds of suspension items, and develop machinery to handle a range of suspension parts (e.g., leaf-spring, propeller shaft components, rolling needles in the pin of the universal joint kit as in the case of one firm), another may develop a range of sewing machine parts all of which require specialized machining and milling work, another firm may specialize in press-items. One interviewee firm specializing in press-work had developed items as varied as fan-bodies, pump-set parts, high precision T.V. picture tubes, T.V.'s inner magnetic shield, automobile silencers, even warehouse equipment and grain silos for the government's godowns (Moonlight, 1991).

(iii) Case three: distributors as source of information and advances for the development of a new item. Finally, in the late 1970s a small firm (T-con) faced a declining market for power capacitors for pump-sets after the government of Punjab abruptly cut off subsidies to farmers, the firm's chief clients, for the purchase of pumpset capacitors.¹⁶ "The healthy market I had anticipated, just evaporated" (T-con 1990). In an attempt to cope with the drying up of demand, the firm-owner turned to local distributors and technician friends to find out what would be a good area to move into. One distributor suggested trying to market the power capacitors in states outside Punjab. Another distributor who had an agency for electric fans offered a longer-term solution. He suggested that the firm get into a line that needed capacitors and condensers more routinely--e.g. automobiles and electric fans, where there was always a scarcity of good capacitors in the replacement market. The distributor also offered to procure T-con's initial fan-condensers for some local manufacturers--under T-con's own brandname--and gave him a cash advance to defray the cost of the switch.¹⁷ Assured of initial

¹⁶ In the mid-1970s the government of Punjab had announced a subsidy to farmers for the compulsory purchase of capacitors which the government required them to use to save on the consumption of power on their pumpsets. Thus demand for capacitors shot up, and the firm did well. But in a few years due to poor enforcement, farmers gave up buying genuine capacitors and the government withdrew its subsidy.

¹⁷ This practice of a distributor or assembler giving small producers (or skilled technicians) advances to develop an item (copy an existing model, or modify it, or develop the tools, dies and fixtures to produce it) is common in Ludhiana. Several firms,

sales, the firm also procured some funding from the Punjab Finance Corporation. Once the firm's quality stabilized, a distributor who held an agency for a large, Calcutta-based consumer electronics company (USHA) heard of T-con's brandname, and placed the first of several orders for fan-condensers on behalf of the OEM (USHA). By the late 1980s, T-con had modernized its plant and turned from producing dry condensers and capacitors to more sophisticated oil-based condensers and capacitors. Now the firm produces a full range of electric-fan condensers, and mini-capacitors for automobiles (mainly two-wheelers) and holds a virtual monopoly in these products in Ludhiana city. At the time of interview, the firm was diversifying into other kinds of industrial capacitors--e.g., for furnaces--upon demand from local industrialists (T-con interview, 1990). The firm started out producing an item for which it had anticipated strong demand, but upon unexpected erosion of that demand, it changed its product, adapted it to fit into a new market.

Several issues emerge from the above examples. In all three examples, firms moved to new products. The shifts were not

especially those run by skilled technicians reported having been offered advances by distributors or assemblers while they were still workers, even before they had set up independently, to develop a machine, or a part, or tooling for an item for which there was demand. Extending advances (credit) by distributors for the development of an item is rarely discussed in the literature. More common are instances of suppliers credit for operating expenses.

arbitrary. The firms sought out items for which there was good demand. In two cases the move was to related products, within the same broad line,¹⁸ in one case the firm shifted to an unrelated product, but was driven by the logic of retaining a valued customer. Given that decision, it looked for an item for which demand would be less prone to fluctuations. None of the firms held on to any particular product they were producing; they moved to where there was better demand. But how did small and medium firms that were facing uncertain demand and undergoing losses, manage to successfully make the shift? (i) How did they find out where there was demand; what to produce? (ii) How did they learn how to produce these new items? (iii) How could they afford to make the shift?

I. How do small firms find out about new sources of demand?

Seeking demand on an ongoing basis.

In the Howrah example discussed at the start of this chapter, small skilled firms that had specialized in a certain line of metal goods for the Railways for nearly a century, faded away after the Railways and the contractors who brokered that demand moved away; unable to switch to new products or markets. What was different about the Ludhiana firms discussed above?

One difference is that in this region, seeking out new sources of demand, or new products for which there is demand is not a one-shot, exceptional activity that happens when a firm is

¹⁸ From a defense-item to a CNC lathe in the case of the machine tool firm, and from power capacitors to fan-condensers and a family of micro-capacitors in the other case.

facing a down turn. Rather, it is the norm. The metal industry's system of day-to-day production in this region is built around an ongoing search of demand opportunities. Many "follow" demand throughout their firm histories, seizing opportunities that open up, even if temporarily. For example, one machine tool producer that was successfully producing milling machines in the 1960s, "temporarily" diversified into the production and setting up of spinning plants in the early 1970s to catch the cresting boom for these plants among local hosiery producers after the Indian government signed a long-term contract with the Russian government for the export of woollen hosiery. All the firms selected by the Russian government were Ludhiana based, and demand for spinning plants boomed. Even before this boom died out, the firm began prospecting for other options, and responded to another opportunity that opened up, this time in the guise of a team of defense officials touring the region's engineering firms to recruit suppliers for defense products and simple armaments (R.K. interview, 1990).¹⁹ Thus, firms seek out products or markets for which there is demand not only to overcome downturns, but as an ongoing business strategy.

¹⁹ The officials had brought samples and invited tenders from those who could match the sample quality. The interviewee firm tried; its attempt passed muster, and it got recruited as a supplier--a relationship that continues till today.

Low margins, and monopoly niches. In part, this unceasing search for demand is a response to operating in an historically unstable industrial environment, where capital was scarce, and markets were never assured.²⁰ But in part, this continuous search for demand is also driven by chronically low margins and the constant pressure this puts on the profits of small producers.²¹ Therefore, one reason why small firms in this region are constantly searching for demand, is to cope with low margins.

Margins for commonly produced items in the region's bicycle and sewing machine industry are very low--between 5%-9%.²² To shore up revenues these firms have learned to find ways to offset these low margins (Swaroop Mech interview, 1991). One way in which small firms in this region cope with low margins is by seeking "monopoly niches"--or scarce items that are not made locally, that command a high premium, and allow high mark-ups.

²⁰ Whether through external disruptions such as partition, a border status, or the lack of large and stable direct public or private investment in building up key industries in the region.

²¹ Since reinvestment for the smallest firm depends critically on maintaining a steady revenue stream, stable sales are crucial to the liquidity of these firms (Mahajan interview, 1991, J.Singh 1990). But this "stability" is an artifact of the firm constantly searching out ways of increasing sales and offsetting low margins.

²² This is especially true for items where capital requirements are low, replacement demand steady, and where the production process followed by other local firms is well known and accessible to all. For example, there are at least 250 small firms producing bottom-bracket axles and cups (bicycle components) in Ludhiana city alone; and hundreds producing simple fasteners.

As one small firm producing auto-parts (for scooters) explained (as if out of a standard neoclassical text): "some items are routine, a lot of other firms also manufacture them. Competition drives their prices down. Their prices are low, but stable--almost fixed--everyone charges about the same. The margins are also very low." To compensate for these low margins, producers seek specialized items produced by very few local firms. They look for "items that are in demand but are highly specialized, or technically difficult, and which very few other producers manufacture. It is on these items that we are able to earn higher profits. The margin is often 100% or more. Firms are always looking for specialized items like this on which they can earn good profits and take out the average" i.e., raise their average profit margin to a more acceptable level (Nirmal Auto, 1991). But they do not necessarily give up on the standard items. "Standard items are safe. You know there is always demand²³ for them, so sales are not a problem" (Nirmal Auto Interview, 1991). The interviewee firm itself earned a profit margin of 7-9% on several of its products, but earned a margin of over 150% on its "niche item"--the front-hub axle of three-wheelers, a complicated item that wore out quickly, and hence required frequent repairs, but was not easily available in the replacement market. This is similar to what we saw in the examples discussed above. The machine tool producer chose a new product (CNC lathes) which hardly any local firm produced, and

²³ Mostly in the replacement market.

for which there was little local competition. The capacitor producer was also one of the few firms in Ludhiana that produced a sophisticated range of condensers and capacitors. Similarly, the bolt producing firm did not give up on the production of bolts and rivets, it reoriented its supply to the replacement market, while adding a new, more lucrative, niche line.

It is noteworthy that "niche" here doesn't refer to a new or customized item. It refers to quite standard items that are not produced locally, or are not available cheaply.²⁴ The item may be available via imports or from large manufacturers at a price affordable by only bigger firms. Thus the clientele for these niche products are generally other small and medium firms. This idea of a "niche" is different from the more complex niches discussed in the literature on industrial restructuring and flexible specialization. Firms operating in the "niche" markets discussed in the literature are usually technically sophisticated, often export-linked small producers who use state-of-the-art technology to compete in markets where consumer tastes and product designs are constantly changing. By contrast, the "niches" discussed here are relatively unsophisticated, and involve producing standard items that are not easily available,

²⁴ Examples are routine items like the front-hub axle for three wheelers discussed above, or a high-speed overlock machine that is hitherto produced only by large multinationals such as Singer or others, or automatic machinery such as machines for (bicycle) hub flanges, or a range of automatic lathes, milling machines that usually produced by large out-of-state producers or government parastatals such as HMT.

or are produced only by bigger firms and hence are inaccessible to smaller manufacturers.

The sophistication or ordinariness of the item notwithstanding, this seeking of a "niche" item, or an item that has little local competition, often amounts to competing with imports (and with large producers), even if these imported models are themselves not state of the art. For example, in the late 1970s when hosiery manufactures in India most commonly used a 3300 spm (stitches per minute) overlock machine imported from Japan, a small Ludhiana sewing machine producer introduced a modified 5500 spm self-lubricated semi-automatic overlock machine copied and modified from a 1970 Japanese model (JUKI). It was the first small Indian firm to manufacture this model locally (Akal Mechanical, 1991). This model was not only faster than the commonly used model in India, but cheaper as well.²⁵ Similarly, another Ludhiana firm "import-substituted" a 6600 spm Japanese over-lock model (hitherto produced only by Singer in India), and had plans to modify the Yamoto 711. The firm's strategy "is to go after newer models, develop a model that no-one makes in India yet, so that there is no competition" (Revo interview, 1991).

The advantage of this tendency among Ludhiana's firms of introducing items for which there is little local competition to off-set low margins in other product lines, is that it is geared

²⁵ Ludhiana's sewing machine producers association was a key player in the 1950s-1960s in the fight to get the Indian government to impose tariffs on sewing machine imports (Revo interview 1991, Rico interview, 1991. See Kumar 1989 for the chronology of tariffs on bicycles and sewing machines).

towards small producers. By introducing a line of items not previously produced by small firms, not only do these producers gain a market, but at the same time, small local consumers also get access to low-cost items that had hitherto cost a lot more. These benefits spill over into the region as a whole. It is not only the small firms that benefit from this introduction of new cheap product lines (e.g., components of bicycles, sewing machines, auto-parts, and machinery). In Ludhiana some of the largest firms procure not only components, but also machinery that is produced this way.²⁶ This finding that small producers successfully compete with imports (or import-substitute) for the benefit of other small producers as well as large firms is so contrary to the usual thinking that protection or tariffs harms small producers because it the larger producers that corner important domestic markets through tariff-induced import-substitution and that the removal of protection would free up small firms because competition would loosen the hold of large firms on national markets. In this case, Ludhiana's small industrial and hosiery sewing machine producers have come to control nearly 85% of the national market.

Access to these networks where cheap, locally made machinery

²⁶ Avon cycles, Hero Cycles, Hero-Honda, and G.S. Auto, all large firms with over 900-1000 employees reported having procured hundreds of machines from Ludhiana's small machinery producers. One firm (the Hero group) set up a whole separate machine tool firm (Rockway) around the skills of a group of Ramgarhia technicians who had equipped several of its other plants.

is produced, access to technicians, and the fact that many of the Ludhiana's small producers are themselves skilled, allows small local firms to not only seek out and enter new markets, but hedge against demand uncertainty in another way. Typically, small firm in the region "develop" tooling and fixtures for a number of items but produce only a few items at a time, and run batches on the basis of demand. As one auto-parts producer reported having developed tooling for "30-40 items" related to auto-gears (for a range of two and three wheelers) over time, but produced only 5-6 at a time "as per market demand" (Sai Auto interview, 1992).

Seeking out demand then, is not only associated with times of trouble, but it is an ongoing activity among this region's small metal-producers--a strategy key to their survival. Unlike the relatively isolated small metal firms of Howrah who found it difficult to know what to do with their specialized skills after their primary customer moved away, small firms in this region are linked to several networks of feedback. Seeking out new sources of demand is not only something they do during downturns, it is an ongoing part of how they work. As we see in the next section, firms routinely ask a variety of actors around them for feedback on what items there is demand for, what to produce. Partly because they are hooked into these circles even during times of growth, it is easier for them to find alternatives during actual times of adversity, and know who to turn to when they do need help.

II. How do firms find out about what to produce and how to produce it: Multiple sources of feedback--cheap, and easy to access. At least three sets of actors appear to be crucial to the ability of these firms to find out about and seize the opportunities of demand that open up: (a) Technicians and skilled mechanics, (b) locally based distributors, dealers and retailers. (c) And, mid-level government officials, many of whom are themselves technically skilled and serve as informal "consultants" to firms after hours.

Asking around: feedback from technicians and users:

A striking feature during field work in this region was the degree to which firms of all sizes, especially smaller firms reported turning to local technicians, skilled workers, and other colleagues for advice. This turning to skilled technicians for advice was not only formal--through consultancies, or through hired help--but most pervasively it occurred informally. Although there was a lot of hiding of one's proprietary technology or modifications from competitors, the overwhelming empirical impression in the field was one of lack of any clear boundaries between small firm-owners, skilled workers and technicians. When seeking advice or information, small-firms did not necessarily have to pay a fee or negotiate a formal contract with these groups--they interacted with them in several ways inside and outside the sphere of work and industry so that exchange of information occurred in many ways. This proximity between small-owners and technicians is not because small owners

and workers belong to the same social or ethnic group in this region, but rather because (i) technicians and skilled workers carry social status in this environment (as we saw in chapter 4), and (ii) so many of the small-owners were themselves skilled workers once. These strong ties between firms and skilled workers is hardly unique to Ludhiana. Several accounts of dynamic regions within India and in other countries describe such links,²⁷ but this easy and cheap access to technical advice is often absent in the day-to-day toil of the typical small firm. This access is a key factor underlying the ability of small producers in regions like Ludhiana to keep track of demand opportunities, to find out what to produce and how to do so.

For example, in the search for "niche" items, a scooter-mechanic, or tractor owner, or sewing machine assembler may bring a broken part to a small-firm owner acquainted to him and say this part is tricky and difficult to procure, why don't you produce it? The producer may later discover it has much wider demand than it envisaged. A clear example of how this works comes from the way in which the auto-part firm cited in the previous section (Nirmal Auto) found its "niche" item(s). This firm also started out producing "routine" items for the replacement market which were easy to manufacture and required

²⁷ For example, see accounts of Bangalore's software industry (Holmstrom 1994), the woodworkers of Sao Joao do Aruaru in Brazil's Ceara state (Tendler and Amorim 1996), small semi-conductor firms in California's "silicon valley" (Saxenian 1994), and several other regions reported in studies of European and Asian cases (Pyke et al 1990, 1992, Humphrey ed. 1995).

low capital investment--axles for two-wheelers, a long axle for three-wheelers, and the bevel gear. The firm had many competitors in these products, and margins were low (7-9%). The firm-owners began asking around for a "good [niche] item" to produce. A three-wheeler operator and motor mechanic acquainted to the interviewee's father (a former skilled mechanic, who founded the present firm in the early 1960s) was ultimately the one who suggested what they produce. The three-wheeler operator showed them a part that he had always found problematic--the front-hub axle. A complex, costly item, the front-hub axle caused operators and mechanics "a lot of headache." Because of heavy friction, owing to the part's position in the machine, its "teeth" tended to wear out rapidly requiring frequent and costly repairs, or replacement. But the item was not easily available in the spares market, so repairs cost a lot of money. Since there was a lot of replacement demand for this item, the three-wheeler operator suggested they try to produce it.

The firm-owners took it up. Being closer to the equipment and its use, the three-wheeler operator-mechanic also had advice on how to improve the part over existing models.²⁸ He suggested that they grind the inner surface between each gear tooth of the axle, in addition to the standard practice of grinding the outer surfaces. This would cut down friction, improve the axle's efficiency, and prolong its economic life.

²⁸ In many other cases the repair mechanics or assemblers serve the same purpose.

With this simple improvement over existing models, the producers have earned brand-name recognition among their buyers (wholesalers, three-wheeler operators and mechanics). They have since made further improvements, and sell the part in several cities outside Punjab. At the time of interview, their brand sold at Rs 5-6 higher than market price, and yet buyers (mainly wholesalers) queued up with advances to book orders--the firm had "more demand than we can meet." (Nirmal Auto interview, 1991).²⁹

It was, therefore, the user of the part that gave information to the firm about what niche item to produce, what item there was demand for. It was the user also, that the firm-owners turned to for ideas about where improvements could be made. But, it is important to note, the "user" discussed here does not refer to the manufacturer's particular customer or client. Rather, the firm was seeking out "users," as a class, for opinions, feedback, and ideas about what to produce, how to improve its quality, and about where demand lay. This is different from, and goes beyond the demand-driven assistance to

²⁹ As we will see more fully in the following sections, this pattern of turning to users, or repair mechanics is a common practice among small firms here--it is a cheap, ongoing process of getting feedback on one's products and processes. Some producers regularly visit the sites where machines or products similar to theirs are installed to see how workers and operators actually use them, what problems they face, what improvements can be made.

small firms emphasized in the literature where a particular producer and a particular client/user are linked in an ongoing relationship. In this case, the firm could tap into a larger pool of users, for ideas and feedback, rather than turning only to its immediate customer, or particular client with whom it had a long-standing relationship. Small firms who supply to the replacement market could especially benefit from this kind of a general relationship with users as a class. In contrast to firms that supply to an original equipment manufacturer who would have a direct stake in helping them develop their product or improve its quality, there is generally no clear or visible customer from whom suppliers to the replacement market can get feedback. It is therefore harder for these firms to improve quality and catch up with firms linked directly to OEMs. It is no wonder that the literature portrays supplying to the replacement or spares market as a second best option, a transitional step at best for firms seeking growth, and regard small firms who move from supplying OEMs to supplying as equivalent to having "dropped out of the market" (See Humphrey and Schmitz 1995). For those firms, then, building ties with general pool of users such as repair mechanics, equipment operators, technicians--is an invaluable source of direct feedback on their product.

Indirect feedback loops via retailers: Some firms in Ludhiana build these ties indirectly, via intermediaries such as retailers or dealers. A common practice among the smallest firms in the region is to turn to a few assemblers, retailers or

wholesalers very early on not only to learn what item to produce, or what there is good demand for, but to learn about the defects in their product and how to upgrade it in order to sell more freely in the open market. Firms begin by developing a relationship with one or two retailers who agree to buy small batches of their initial output at low prices (e.g, at Rs. 2-3 below market rates, given that the item is not yet upto standard). The retailer sells the item (typically a component-- of bicycles, sewing machines, or an auto-part) to small local assemblers, or to repair mechanics who can "make the component work," for a certain period of time. In return for the producer's low prices, the retailer seeks out from the assemblers or repair mechanics feedback on the item, which he passes on to the novice firm. The assemblers and mechanics thus get drawn into the feedback loop indirectly, and provide the producer with detailed feedback on the item: what is working, what is not, what needs to be improved or changed, especially with regard to tolerances, hardness, and material composition.

Crucial to this relationship is the implicit understanding that there will be incremental and progressive improvement in the quality of the manufacturer's output in a reasonable time frame. This gives the retailer confidence that the new producer "can deliver" (Iqbal interview, 1991). If the manufacturer consistently turns out poor quality goods, and does not show improvement, or doesn't incorporate the feedback the retailer gives him, the tie breaks. If the manufacturer cannot build a

good reputation with the retailer in a reasonable time period, "he fails in the market." (Iqbal interview, 1991).³⁰ This kind of "disciplining" tie between merchant traders and manufacturers is completely contrary to an older, entrenched view in the entrepreneurship literature that retailers and wholesalers will peddle anything (See London 1975), and that as long as they get cheap rates, they are unconcerned about quality. But as the above example shows, wholesalers and traders can also be agents of quality change for the smallest firms and serve as cheap and accessible sources of feedback and information.³¹ In addition to feedback on quality, as one sewing machine producer said, "when demand for one item (e.g, a sewing machine component) decreases, [the dealers] tell us to cut back on its output and produce more of another part for which demand is good" (Dalco interview, 1991).

³⁰ One small producer of a complex embroidery machine part reported how he had taken over a failing business and successfully turned it around. He succeeded where the previous owner failed because the previous owner had spent many years outside the industry and had lost his links with the technicians and mechanics who could help develop his item. Although he built a relationship with a retailer who gave him feedback, he was unable to incorporate the feedback successfully, and consistently turned out bad lots. Within a year the relationship broke. Unwilling to "get into the business of finding the mistries who could help him," the owner sold the firm and returned to his non-manufacturing business (Iqbal interview, 1991).

³¹ Although as one pump-set wholesaler said, "we sell according to what the buyer wants. If a customer comes in and says that they are willing to buy a moderate quality pump for a lower price we will sell it, but that is not the market we build towards" (Mahajan interview, 1992).

It is not just users, distributors or mechanics that provide firms with information about what to produce. As several small firms reported, they keep asking "anyone we can trust" what is a good item to produce, where the demand is. They ask mechanics, skilled workers, distributors, firms owners, government inspectors, officials of institutions such as the Central Tool Room³², the Small Industries Services Institute,³³ and the District Industries Center. One producer of piston pins, for example, said that whenever he travels by train to Delhi or other cities on business, he strikes conversations with those around him. If they are firm-owners or workers he asks them questions about problems he is struggling with. How do you resolve this? How do you do that? During my field work in 1991-91, a small-firm owner reported how he and a delegation of members from various associations had just met with the director of the Central Tool Room after his month long visit to Germany (a major financier of Ludhiana's CTR) to ask "what he had seen in plants

³² A Ludhiana based technical assistance and training center funded by Indian and German governments. All the machinery in the Tool Room is from (formerly West) Germany; the recurrent expenditure is borne by the central government. As part of a bilateral assistance program with Germany, the government of India had decided in the late 1970s to set up a Tool Room and Training Center in North India, but had not decided where. "Ludhiana's industrialists, the auto-parts association and cycle parts association, lobbied the government and convinced the central government to locate it in Ludhiana" (R.P.Sandhu, CTR training officer, interview 1992). There other four such centers in India are in Delhi, Bombay, Calcutta, and Bangalore.

³³ One of 16 such centrally funded, regional institutes in the country, the SISI provides technical assistance and runs a variety of other programs for small firms.

there, what was relevant for Ludhiana, what new ideas he had picked up."³⁴ Similarly, the general manager of Ludhiana's District Industries Center (DIC) who had spent two years in Holland on deputation also reported being "plagued by questions from firm owners" whenever he meets them casually or informally about how production is carried out there, how they deal with this problem, or that problem.

Firms not only ask and observe, but many quickly implement what they see. For example one sewing machine parts producer saw an innovative set of simple and safe-to-use grinding machines on the premises of a tap-producing firm in Delhi that he had visited during a business trip. Impressed by the machines he saw, he decided to put together a similar system in his own factory. He reproduced the system from memory, filling gaps in his own way, and thus ended up innovating further. Just as workers accumulate knowledge as they move from shop to shop, building a repository of practical knowledge, so do these many episodes of "copying" by small firms add to the local productive vocabulary.³⁵

³⁴ These visits are routine, he said. "We want to know what ideas they pick up."

³⁵ This asking and observing is not only a response to sudden adversity, or a one-time hedge against loss of demand, but an ongoing process of survival in an environment where there never were assured markets, and where firms have had to learn not to rely on only a few sources of demand.

Feedback loops and the public sector: This observing, asking and implementing, however, involves not only private actors such as mechanics and distributors, but also the government. R.K., the machine tool producer cited earlier in the chapter had started out its machine tool business with the manufacture of lathes in the 1950s. After being initially supported by a post-independence boom in the machinery industry that lasted through the 1950s, the firm faced a recession by the end of that decade. Many new small firms had begun to produce lathes, especially in Punjab, and R.K.'s profits fell. Dissatisfied with declining revenues in lathes, the firm switched to another line of machinery that still had only a few local producers in Punjab--milling machines. But why milling machines? The switch, needless to say, was not automatic or arbitrary.

A few years earlier in 1956, the firm owner had attended a national machinery exhibition organized by the government of India in New Delhi, where some foreign firms had also displayed their products. At that time, with the help of a Punjab government loan-subsidy to machinery producers, the firm-owner had bought a sample each of Czech-made milling machines, shapers and a gear-cutting machine with the expectation of copying them and selling adapted versions later.³⁶ In the early 1960s, when

³⁶ This strategy of "copying" had some history to it. This machine tool firm had spun out of a hosiery and spinning business in an "accidental" way. In the 1950s, the original hosiery firm (in business since the second world-war) had imported a second-hand spinning plant from England, along with a maintenance shop--

lathes were no longer as lucrative to produce as before, the firm asked industry officials for advice, and learned that demand for milling machines was growing. With the help of local Ramgarhia technicians, and his own skill, he went about copying the milling machine he had bought. But crucially, the firm also turned to the government for assistance--specifically, the "Colombo Plan," a new scheme that the central government had launched in the 1960s. Under this program the government, with assistance from the Ford Foundation brought in retired US and German engineers and machinery experts to provide technical assistance to local firms. The government paid the engineers' air fare, the Ford Foundation paid their fee, and the beneficiary firm paid part of their living expenses. The machine-tool producer enrolled for assistance, and got a retired American engineer under the Colombo plan to help him modify the design of the milling machine, and develop the base machinery to bring it into production.³⁷

complete with lathes and planers. The spinning plant went into production, but the firm felt the maintenance shop was under-utilized. One of the partners (the elder brother of the current owner) was skilled and interested in metal work. Along with a Ramgarhia mistry he decided to copy a lathe to see how it is made. A friend who owned a metal-working shop saw the lathe and bought it. This gave them the idea that manufacturing lathes may be a good business in its own right. The firm diversified and started a machine tool factory (R.K. interview, 1990).

³⁷ At least four firms in my sample reported using the services of such engineers. Several others report having learnt from the mechanics who worked at these firms at the time of assistance. Three of the firms are medium-sized now, the fourth still remains small. It is noteworthy that all four were active members of their respective associations (sewing machines, bicycles, and machinery making) in the 1950s-1960s--quite in keeping, it seems, with the view in the literature that active association members usually get access to government programs and benefits such as these more

Even subsequently, firms such as these frequently have turned to individual members of government institutions such as the District Industries Center, the Central Tool Room, the Bicycle R&D Center for assistance. Many learn about new ways of doing things in the course of doing "development" work for these R&D agencies--work on the prototypes these agencies develop. But, most turn to individual officials who are known to be technically skilled, or who have been abroad on deputation, for help with devising special purpose machinery, or other specialized machines after hours. Even though local firms can access the same officers for advice for free during regular working hours, they prefer to contact them personally later, and insist on paying them a fee to ensure that they get advice that is specific to their needs. Specific advice such as this requires factory visits because it is centered around the problems faced by the firm on its own shopfloor. Few standard technical assistance programs are built around site-visits, and hence are unable to accommodate specific problems. Thus firms that need concrete advice prefer to seek out skilled officials after hours, and pay for their services--a pattern that has parallels even in the region's agricultural sector.³⁸

readily than the rank and file.

³⁸ One Block Level Extension officer (industry) I interviewed, reported that since the past few years, when dairy and poultry farming became increasingly important and lucrative in Ludhiana district, livestock farmers have begun talking about paying for veterinary services. At the moment there are no privately licensed veterinary services in Punjab--all vets. are paid by the government. Yet, the practice on the ground has been

III. How firms make the switch cheaply: access to networks of skill, expertise, and distribution

In the three cases described earlier in this chapter, we saw how firms coped with the sudden moving away of demand by shifting to new products in related or unrelated lines. When most small firms are usually strapped for funds and capital, how were these firms able to invest in shifting to a new line just when they were facing loss of demand and revenues? In this section I argue that they were able to make the switch cheaply because in addition to being inserted in the feedback loops described above, these firms were also tied into networks that helped them save on costs in a variety of ways; and because they could turn to locally-based distributors to find new short-run markets.

The replacement market and the latitude it provides:

Finding markets--at least as a back-up--is easier for small firms in Ludhiana because they have the option of selling in the replacement market through a widespread network of wholesalers and dealers who supply to assemblers and to the spares and

that farmers pay the vets additional sums out of their own pocket for every visit even though the doctors are already being paid by the government for their services and for the medicine they prescribe to the farmers. The farmers still want to pay the doctor because, they say, they have high value cattle and they want to be sure of the service they get. "They want the government to let veterinary doctors charge them as if on private consultancies through village hospitals" (BLEOI interview, 1991).

repairs market nationally, via retailers.³⁹ In contrast to the intermediaries involved in the Howrah case, discussed earlier in the chapter, who brokered demand/contracts between large buyers such as the government's railway workshops and Howrah's small metal shops, the wholesales and dealers based in Ludhiana procure goods from local firms and sell them in replacement markets throughout the country.

This pattern has old roots dating back to the Punjab Land Alienation Act of 1900. As discussed in Chapter 2, after this Act barred non-agricultural artisan and trading groups from owning prestigious agricultural land, a number of them turned to industry. While artisans took up manufacturing, most merchants turned to distribution. They set up of an "all india distribution network" (Wall 1973:81). This distribution system also paralleled the "vertical disintegration of the various stages of production" of Ludhiana's woolen hosiery industry "involving several distinct groups and tiers of exchange...By 1902, "Hindu merchants obtained raw wool [through imports and domestically] and retailed it to a second class of traders, who had it spun into thread or yarn by women of all classes. Another set of merchants obtained and distributed the wool to weavers. After weavers transformed wool into wearing apparel, Punjabi wholesalers sold the articles all over India through an elaborate distribution network. An important characteristic of the India-

³⁹ Similarly, all the large light-engineering goods merchant exporters based in Bombay, Delhi and Calcutta have a strong local presence and highly active procurement offices in Ludhiana city.

wide distribution of woolen articles was that it was controlled almost exclusively by Punjabi [merchants] from Ludhiana itself" (1973:82). Subsequently, especially after the partition of Punjab in 1947 brought with it an influx of metal traders, this "far-flung" network spread to include the region's growing bicycle industry and metal goods.

As firms stabilize and grow, even the smaller firms build their own network of retail and wholesale agents across the country, and spend time maintaining them. It was surprising to hear from even quite small firms--with 15-or less workers--that they had "over 200 dealers" across the country; and that they visit their dealers (in states outside Punjab) "at least once a year to see whether they are facing procurement problems" and to get feedback on their product. "The dealers feel happy to be asked how they are doing" and the ties deepen. Two small producers of sewing machine parts, for example, said how they had just travelled to Calcutta--nearly 1200 km from Ludhiana--to attend the inauguration of their key dealer's new retail outlet there despite tight production schedules: "Large firms can maintain hundreds of dealers because they can give credit. We need goodwill" (Diamond interview 1991).⁴⁰

⁴⁰ Although having easy access to replacement markets nationally alleviates marketing problems for many small producers, this "dealer-centered" way of working also involves unevenness of demand. As a hedge against this unevenness, firms develop more than one key item--i.e., they usually develop dies and fixtures for the production of 9-10 items or more, of which they may produce only 4-5 at a given time "according to market demand" as conveyed by the dealer. Demand may fluctuate according to the orders that the dealer places. As one producer noted, this unevenness also

Just as the fasteners-wagon paint firm discussed earlier turned to the replacement market to sell its fasteners when government demand for them dried up, others use the replacement market get out from under the shadow of the local OEMs. One small bicycle parts producer (Birdi, 1992) reported how access to the replacement market helped finance his transition between buyers. In 1972 his firm was supplying most of its output to three of the region's largest OEMs--Heros, Atlas, RMI--supplying upto 2000 dozen pieces per month to each OEM. In the late 1970s however, one of the OEMs (Heros) suffered an export setback, and suddenly reduced the firm's order, complaining about quality, and wanting to reduce rates. The supplier decided to "stand on [its] own feet, and supply to a variety of markets under [its] own brandname." To do so, the firm turned to dealers in the replacement market. Whereas in mid-70s it supplied 80% of its output to 3 OEMs, after the Hero setback in the late 1970s, it began to supply 100% of its output to the replacement market under its own brand. In a few years it supplied 50% to the replacement market, and half to indirect exporters. By the early

forces small firms to train their workers carefully, "If a dealer comes and wants extra pieces of a certain part that needs specialized turning, we cannot lose the order simply because the worker who operates the lathe is absent that day" (Dalco interview, 1991).

1990s, having improved product quality in accordance with the requirements imposed by the indirect exporters,⁴¹ by the early 1990s, they were exporting more than half their output directly to East Asia, and the middle-east, and dividing the rest between indirect exports and the replacement market. (Birdi interview, 1992).

Access to networks of practical skill: A second reason why the firms cited earlier managed to switch products despite facing demand loss and adversity, is because they had access to networks of skill that allowed them to redesign their product relatively cheaply.

During my field work I had been struck by the finding that almost all the successful small firms I interviewed had tool-room of their own--whether they manufactured nuts, or bicycle parts, sewing machine parts, any auto-parts. This was surprising because tool-room are expensive to maintain. They are usually associated with larger firms who can afford to internalize expensive tool-rooms to meet their maintenance needs. Why were so many small production firms (not those specializing in machinery making) investing in tool rooms? I soon learned that these tool rooms are not for the maintenance of the various

⁴¹ Exporting indirectly through merchant exporters is a common practice among local small firms, often as a prelude to exporting directly. One firm reported how it began to export indirectly because it wanted feedback on quality. "We first sold to an indirect exporter in the 1970s to see what kind of buyers they would make, and mainly to get feedback on quality. The exporter gave extensive feedback on the product, but also made immediate payments. As a result turnover increased; and we expanded output." Later they turned to direct exports (RI Corp. interview, 1992).

machines on the firm's shopfloor, but most crucially their function is to design, manufacture, and modify tooling (dies and fixtures where needed) that converts a firm's general purpose base machinery (milling machines, lathes of various sizes, and so on) so as to perform a variety of specialized functions. It was the quality of the tooling, its precision and design that would determine the productivity of an ordinary lathe or workstation. The design of tooling was also where a firm's "proprietary knowledge" was expressed and embodied. But who runs these tool rooms? How can small firms afford skilled fitters and workers? In large part, the tool-rooms are operated by the skilled owners themselves, along with one or two technicians, or less skilled workers whom they train on the shop. But even if the owners is not skilled enough to design tooling, firm after firm reported how they had nevertheless invested in at least one highly supervisor or fitter who directed the design and maintenance work in the tool-rooms. These tool-rooms in the smaller firms are quite lean. Because firms can, and routinely do, turn to an array of specialized services available in "the market"--from tool and die makers, to firms that do casting, forging, testing, hardening, precision machining and have machines that can accommodate a range of equipment sizes--to supplement the capacities of their own tool-rooms. The proliferation of this practice--which has grown over several decades in the region--interviewees explained, is because "if you have little capital, you cannot get stuck with specialized equipment. Otherwise you

will be wiped out if demand fluctuates" (Bassi, 1991). The system of using ordinary machinery, but customizing it by using a variety of tools and fixtures allows firms to get the same base machine to perform a different task or function simply by changing its tooling. "Developing" an item therefore, at core, means developing its tooling and fixtures and modifying the machinery on which they will be used. As one small auto-parts firm described why its tool-room was so important, "tools and fixtures are key to changing design. The quality of these tools is key, and we control it."⁴² When demand changes, or if a firm needs to switch to an item with better demand, it the tooling they need to change, modify, or remake, not the base machinery. To do this cheaply, a firm needs access to skills. It is not surprising therefore that so many successful small owners in the region are themselves skilled.⁴³ It is not surprising either, that less costly technicians skills (rather than an engineer's) are so salient to the way production is organized in this region, and have been reproduced over and over for nearly a century.

⁴² But they look around as well, "we have no resistance to change. We are always looking for ways to extract the most out of the machines we have. If a technician has an idea, we are ready to go with it because we can test it out right here in our shop." (Bassi, of Moonlight. Interview 1991).

⁴³ As a skilled small machinery producer put it, "If I didn't have skill in designing this way, would not have succeeded like this. Cannot hire skill in this line and still compete (Auto-turners 1991)."

Yet, given the varied nature of the technical tasks involved in modification of this kind, these skills are constantly being modified as well. The reproduction of these skills--whether in the owner or in the workforce--therefore also involves their constant modification.

Technicians' skills are not the only source of a firm's ability to modify its production process and keep up with shifting demand. The presence of a local machine-tool industry--geared towards small producers,⁴⁴ most importantly--is another key factor behind the ability of even small local firms to switch from product to product quickly and at low cost.

As one firm-owner said firms save costs because "most firms here don't use a machine as it is supposed to always be used... If a process involves no taper turning, then you don't taper turning equipment on a machine that will do plain turning. On a machine that will do plain turning we have no threaded [section], nor so many angle adjustments or speed changes; maybe also a smaller motor. So you don't pay for those parts that you don't need" (Gopi tools, 1991). This cuts costs drastically. A medium lathe from the government's parastatal HMT costs Rs. 65,000 at minimum (in 1990). "We put ours together for Rs. 25,000. Instead of paying for items we don't need, we used the saving to modify our milling and grinding machines according to what we

⁴⁴ That is, run by and targeted towards small firms.

needed" (Gopi Tools, interview 1991).⁴⁵

This kind of customization, stripped use, and modification is not possible if a firm were to rely only on standard models available in the market, or on imports. Large machine tool producers typically do not sell a machine without its standard parts, or charge a lot more for such customization. Thus, the presence of a local machine tool industry that sells stripped down versions such as these, the presence of technicians who can make modifications routinely, and the fact that many of the small owners are themselves skilled is crucial to the ability of small firms to shift from product to product quickly, and to "develop" a variety of products. As the small tool-maker cited above put it, it is this combination of "production infrastructure" in Ludhiana that allows a small firm to lower overheads, maintain quality and compete. "You need practical and theoretical skills. An engineer can create new products and processes, but can he cut costs? The advantage here is that [Ludhiana's] workforce has skill, and even the entrepreneur has a strong functional understanding of the total process." (Gopi Tools, 1991). Even as engineers are on the rise among the region's small-owners, practical knowledge, and a "strong functional understanding"

⁴⁵ An evaluation of Ludhiana's Cycle Bottom Axle (BB axle) production technology carried out by the Asian Productivity Organization in 1981 found that the use of special fixtures in combination with a lathe-based work-station, allowed Ludhiana's small firms to produce BB axle of given quality at 50% of the cost of producing it on standard equipment (1981: 55). See Appendix-1 for a production cost comparison of the Ludhiana method with the standard procedure employed by large firms.

remains salient to the ability of small firms to compete on meager capital.⁴⁶

The owner of a small auto gear-making firm I interviewed, had set up shop in Ludhiana in the mid-80s, freshly armed with two degrees in engineering from the prestigious Indian Institute of Technology at Delhi. Surrounded by small firm-owners many of whom were not even formally trained--who had only ten years of schooling, or a non-technical BA, or at best a diploma from the local vocational training institute, or who had risen from the ranks in the labor market, he felt confident of his superior academic training, and of succeeding. He said he had felt he differed from them in many ways--from their tendency to mix so freely with their workers, to sometimes "sit and drink with them," and from their penchant for "cutting corners." He wanted to stick to the right processes and standard machinery. It came as a shock therefore, to find himself completely dominated by his skilled and semi-skilled workers by year's end, "I should have been in control, but I was the one totally dependent on them."

⁴⁶ There is an enduring debate on the importance of technical experience for owners and managers. In the 1960s the view, especially among US industrial sociologists, was that practical training was superior to pure academic understanding (Musgrave 1967). More recently, similar findings have emerged from the human resource literature concerned with productivity enhancing work-arrangements. One U.S. based study recently cited how experienced line operators: "none of [whom]...had more than a high school education" successfully solved an important problem of overcoming breaks in welds between two coils of steel that a "number of college professors and consultants" were unable to solve (Ichniowski et. al. 1993:39).

Despite his degrees, he had no practical experience, and was unable to get the job done within the limited capital he had. "I could operate all machines, but I couldn't develop the item.. or understand what was actually involved. Workers would exploit me because I didn't know much practically." For example, "if we had a 1-inch drill in the factory, and needed to bore a 2-inch hole, workers would say we can't give you accuracy till you get us a 1-3/4 inch drill. This costs Rs.900-1000 in the market. For a small lot of 200-300 pieces this was too much expense. It took me two years to learn the system, to understand how to start a job and get it done without unnecessary expense and waste." To understand "the system" he turned to the neighbors, and local technicians he had stayed aloof from earlier (Sai Auto Gears interview, 1992).

He learnt how to work backwards--to procure an original or imported part from the market and set it as a standard to work towards: measure its hardness, get its material composition tested from the government-run heat-treatment and finishing center, sit down with a group of trusted mistries or foreman and figure out the sequence of operations. And then decide what kinds of machines and fixtures would most economically yield the desired results. The standard practice for cutting gears, for example, is to use gear-shapers and gear-hobbing machines--specialized equipment that small firms like this cannot afford. So he learnt "to do what a gear-shaper or gear-hobbing machine will do, on a milling machine." This involved learning what

fixtures and tools would perform the various operations, and getting them made cheaply. Practical knowledge of the production system was central to doing business this way, where firm-owners had to find viable alternatives to using expensive specialized machinery.⁴⁷

As another engineer-small owner supplying auto-parts of some of the country's largest automakers (Maruti-Suzuki, Swaraj-Mazda) put it, most successful firms in Ludhiana have "a mixed work-culture. They have both Ramgarhia technicians, engineers, and ITI trained technicians. They each have their own importance. If an engineer designs a die, it is the Ramgarhia foreman, and the experienced workers who are able to tell, foresee practical problems in its design. They are the ones who say whether it works or not. They are the ones that provide the firm with the ability to excel. They are interested in the work, not just in getting paid for it...small firms cannot do without their expertise. As a small firm you may hire an engineer, you may even be able to afford his pay, but you can't psychologically provide him with the idea that he can develop his career opportunity here. So, he will move on. A Ramgarhia technician may move too, but he will probably move on to set up his own firm with which you can still maintain a relationship" (Technico interview, 1992).

⁴⁷ Amsden (1989), and others have noted the same importance of practical knowledge. Amsden however discusses the importance of experience in the context of putting imported technologies and machinery into operation (1989:228-9).

Turning outward and the self-imposed pressure of exposure to external standards. Apart from turning to local groups such as mechanics and merchants to learn about new markets and get feedback to upgrade themselves, a striking pattern among these firms is that they do not limit themselves to looking only inward--i.e. to resources and institutions available locally--for feedback and exposure, but in a sustained way, turn outward. As illustrated by the wagon paints example,⁴⁸ firms seem to not limit themselves to niche options available locally--they often turn outward, or go out and procure the technology they need to enter a particular line.

For example, one small electroplating firm (VPC), in operation since the mid-1940s, reported how they were approached in the 1950s by a client--Hero Cycles, currently Ludhiana's and the country's premier bicycle and motorcycle producer, which was then another small but rapidly growing firm--with a special request. Hero Cycles wanted VPC to "improve on" the standard electroplating process that was available in Ludhiana at that time. The existing system involved first applying a nickel coat on the metal surface, and then chrome-plating it. Hero wanted VPC to introduce an extra layer: it wanted "first a copper coat, then nickel, then chrome-plating." But the technology to do this was not available in Ludhiana in the 1950s. What would one expect a small firm like VPC to do under such circumstances? The

⁴⁸ Although the firm did not have experience in paints, it went all way to Calcutta to observe the production process of firms there, and to hire a skilled foreman who helped them set up.

experience of small firms in many other parts of countries like India suggests that the firm would most likely turn down the order because getting access to new know-how is costly, and it would not know where to get it. How could it afford to install it just to meet the demands of a single small customer?

VPC, however, did not refuse the order simply because it did not know how to install the extra chrome layer. Rather, it "asked around."⁴⁹ In particular, it turned to the official incharge of electroplating at the newly established government testing and finishing center in Ludhiana. The government center did not have the machines for copper-plating, but the official suggested that VPC get in touch with Cassell Fans, a large electric fan producer based in Delhi, that did have the required technology. VPC travelled to Delhi (4 hours from Ludhiana by road), and visited the plant. After consulting with technicians and operators there, he returned to Ludhiana and tried to replicate the process in his own firm with the help of local mistries and the official at the government testing and finishing center. VPC not only gave his customer, Hero Cycles, the extra copper coating that they wanted but also "extended" the technology to other firms in the market. A new process was thus

⁴⁹ Part of the reason for not passing up the opportunity perhaps was that electroplating was a growing industry in the region, and VPC's small firm was one of the oldest, best known electroplating firms in the region at that time. Also see the next footnote for more detail on this issue.

introduced in the region.⁵⁰

But the visit also generated other unexpected spill-overs. While at Cassell's, VPC had also seen a 5-station cold pressing process that "impressed him." Upon his return to Ludhiana he developed his own version of the workstation with the help of his mistries. He then developed dies required for operating the machines. The workstation was soon copied by other local firms in this line, but VPC remained a key supplier of dies to those who installed the cold-press workstation (V.P. Chopra interview).

Thus, firms with modest means can also become channels for getting access to and introducing new techniques for the benefit

⁵⁰ But why did VPC go out and get this new technique? Did it see a general benefit for its own firm in getting know-how for a more expensive form of electroplating? VPC said in this regard that the 1940s and 1950s were times of evolution and ferment in the metal industry in Ludhiana. Previously, firms (most of which were small) produced whatever they could manually. And, they could sell whatever they produced because there were scarcities--due to war initially and then, the Indian government's restrictions on imports.

But as firms produced more and became more experienced, they sought better ways of doing things. They had started from a very low threshold of quality, and there was plenty of room for improvement. Producers found that items that were made better, also got better rates (VPC interview, 1991). Demand for better techniques was increasing among local firms, and firms that provided better techniques, even if they cost more, were able to earn a much higher premium. Following Hero Cycles' use of this higher priced process on its bicycle components, several other firms also adopted the improvement, and were willing to pay the same higher price as Hero paid for it. Thus VPC did see a wider clientele for its new service than just the single client who initially asked for the service.

While the client, Hero Cycles, paid for the item and for part of the cost of the installation of the process, VPC also bore part of the installation cost.

of other small firms in the region as a whole.⁵¹ This process involves a chain of actors--customer firms, government officials, skilled mechanics or technicians, skilled small-firm owners, and directly or indirectly, large firms like Cassell in the above example. Most importantly, the introduction of new techniques does not happen at random--it is often the result of a sequence of demands placed on the supplier firm by its clients, customers, or pressures that a firm may place on itself to solve particular problems in its own production process.

Firms don't look only to larger producers in other cities for know-how, but some look to firms abroad. One medium-sized exporter of bicycle parts and hand-tools, explained how they use their travels abroad to learn from successful third-country exporters about the kinds of standards they need to meet in order to successfully enter more demanding markets. Like many medium and well-established small firms in the region, this firm also travels "extensively to markets where we do business." But, in addition, they also engage in a different kind of travel to selected places where they don't have regular business ties: "we

⁵¹ This is in contrast with the view in some strands of the literature that small firms often remain hooked into older, relatively obsolete production systems because their revenue streams and the nature of the markets they supply to prevent them from affording to constantly upgrade their systems. (The flexible specialization literature points to the opposite spectrum of small firms that supply high end markets and constantly upgrade themselves to operate close to the cutting edge technologically). While it is true, as in Ludhiana, that the machinery and procedures used by smaller firms are older and hardly at the cutting edge, the above example shows that successful small firms do keep upgrading their production systems incrementally.

make regular trips to Taiwan, South Korea, sometimes Malaysia, inward we don't have many business dealings there." They go to these countries not to sell, but "to see what kinds of standards international buyers are asking for, and what these firms are doing to meet these standards...to see how they work, and what is their set up" (Eastman interview, 1991). They not only visit the factories that manufacture components of interest to them and try to tour their shops, but they also visit repair firms--where these parts and the assemblies into which they go, are taken apart and repaired. In addition, wherever possible, they try to obtain samples of the component at various stages of its production sequence, which they show to their skilled foreman, designer, or subcontractor to extrapolate drawings from. In the same vein, they may frequently take a trusted skilled worker along who can understand the process "simply by observing the set up" and make drawings of what they saw and understood. This collage of technical know-how is then used to get small technician-suppliers in Ludhiana to develop the part locally for export through the merchant firm (Eastman interview, 1992).

In sum, as the firm-owner put it, small and medium firms like them cannot afford to travel to too many potential markets abroad to see "what sells." Instead, they travel to successful exporter countries--in this case South Korea, Taiwan, Malaysia--to see what it takes to meet international standards. Then, with the help of an ensemble of actors--skilled workers, skilled small subcontractors, and suppliers, they develop these parts locally

and try to pull themselves up to meeting the standards they saw.

Finally, another channel of exposure is through government exchange programs whereby they subsidize brief trips of selected small and medium owners to tour firms in selected countries abroad. This program was strongest in the late 1950s through the early 1970s---when most of the firms I interviewed reported having availed of it. Immediately after independence the Punjab state government took selected local producers (most of whom were small in scale) on tours of bicycle and machine tool firms that had been run by the British in different parts of India to see what imported plant and machinery looked like.

For example, as one beneficiary firm put it, the job of the Ludhiana Productivity Council (set up in the 1950s) "in the early 1960s was to take owners of small firms to tour large factories formerly owned by the British for exposure. The government used to pay half the expenses and the fare. Sen-Raleigh in Calcutta had machinery imported from outside. Many small cycle manufacturers from Punjab went to see these machines" (Birdi interview, 1992). This firm, for example traveled to Bangalore, Madras, and Calcutta on this government program. But, as the interviewee added, "few firms came forward to take advantage of this scheme because many small firms did not have enough manpower (i.e., family members who could manage the firm) to be able to leave their firms for 15 days. Firms that were able to go did better--many of the others got left behind." (Birdi interview, 1992).

This exposure and emulation, it is important to note, does not necessarily produce outcomes that bring small firms near the cutting edge.⁵² They represent, rather, an ongoing and constant source of gradual improvement through which firms are able to better their own prior performance.

Conclusions: In sum then, small firms in this region do not have an insurmountable marketing problem, and are better able to cope with the sudden moving away of demand because they turn to multiple sources for sales and feedback. These sources range from skilled technicians, assemblers, state government departments, to original equipment manufacturers (most of whom in the bicycle and sewing machine line are located in and around the Ludhiana region), to an extensive network of dealers and merchant distributors who link small producers with replacement markets nationwide (and internationally through indirect exports).⁵³ It is the combination of having easy access to the replacement market through a dense trader-wholesaler network, spatial and social proximity to OEMs, and having learnt to shift constantly to markets that have demand, that makes marketing less of a

⁵² For example many "successful" firms in Ludhiana produce machinery and products that are 15 or more years old. Cold forging techniques have been adopted by the smaller firms only recently, since the 1980s.

⁵³As several firms pointed out, these markets have different peaks and troughs of demand for the same product; so if you are hooked into a network of suppliers that has access to these differently behaving markets, you can increase supply in one or reduce supply in another as demand fluctuates without losing out on output.

problem for small firms in this region.

We saw also that firms did not remain tied to any one product, but routinely "followed demand." What remained constant in this process was ties to some preferred customers, and the small firms drawing upon a common "infrastructure" of skills and sources of feedback, information and assistance. A firm's products change, markets change, but some key customers and access to rich networks of support are the anchors that remain constant. Government demand in its various guises has been key; and replacement markets allow these firms to weave back and forth between preferred customers.

As many observers have noted, hunar (skill), and tazurba (experience) are at the heart of the region's ability to compete (Kular Cycles, interview 1990). But even more important to note is that these skills keep changing. Artisanal skills, or specific skills by themselves may die out. As they have in several regions that had strong artisanal--including among Howrah's metalworkers. But skills survived in this region because they kept getting transformed. Key institutions within which local workers were embedded--especially "demanders" as a class--forced them to be dynamic by constantly putting pressure on them to help make the most of a limited capital base.

CONCLUSIONS

The story of Ludhiana's small metal-manufacturing firms told in the preceding pages is an attempt to understand how, and under what conditions small, capital constrained firms in this region learned to improve their performance, and over time come to dominate national markets in the key sectors in which they specialized--bicycles, sewing machines, auto-parts, simple machinery, and agricultural implements. In many cases (e.g., in the case of bicycles and bicycle parts), they achieved this dominance by wresting advantage away from large multinational partnered firms located in other, more industrially sophisticated parts of India.

These firms established themselves in national markets despite being hundreds of miles away from the nearest source of coal, iron or steel,¹ and they sell a bulk of their finished goods outside the region. Thus, in contrast to the view that small firms often build off of local resources or sell to locally based customers, input as well as output markets of these firms are largely outside the state. Similarly, unlike the view that while they are repositories of employment during boom times, small firms are the first to die during downturns--these small producers have maintained their hold over national markets

¹ A vibrant steel-re-rolling industry has developed in the region, but basic raw materials comes from outside the region.

despite a long history of instability in the region,² the latest of which was a decade long period of separatist violence that crippled Punjab throughout the 1980s up to 1993. What lessons does this study then, offer about small firm growth in other regions?

On the face of it, this region has neither the high-technology, high wage features idealized by studies of regions like the third Italy, nor the engineer-based, state guided economic structure exemplified by the East Asian successes. Yet, it has elements of models and combines an ability to find new, highly economical ways of producing standard goods, with an ability to constantly learn through reverse engineering and upgrade and revise its skill-base and production processes. The core of this production structure is a knowledge-base built around the mechanic's practical skills, not the engineers--and its ongoing transformation over time in response to changing demand pressures.

A key finding of the study in this regard, has been that Ludhiana's small firms grew and did well despite adverse conditions not so much because of any inherent capabilities they had, or any unique or exceptional qualities that history endowed them with, but because they learned to deal with downturns, conflicts and adversity as disequilibria that put pressure on

² A violent partition of 1947, another in 1966 when Punjab was split into three states and lost most of its large industrial base to Haryana, three wars fought on its borders in the 1960s and early 1970s, and the long years to secessionist strife in the 1980s.

firms to find alternative strategies to get around the immediate bottleneck,³ even though this often involved settling for second-best solutions, or temporarily lowering some standards.

These inter-firm relationships, together with the government's own policies, and the nature of its responses to local demands, led to the evolution of a plurality of arrangements and institutions that helped the region's small producers economize on capital; upgrade their skills and production processes; and deal with common bottlenecks that typically hamper small firm growth--e.g., problems finding markets, coping with the sudden loss of demand, access to credit, and exposure to better production standards.

This study has argued that the ability of Ludhiana's small producers to successfully cope with adversity and find ways to get around common bottlenecks comes, in large part, from ongoing interaction between the character of the productive environment in which these firms are embedded, and the choices they themselves made. This environment has constantly changed over time as a result of strategic choices made by local firms and the region's key industrial actors (workers and producers associations, distributors, merchant exporters, reconditioning teams, skilled mistries, specialist job-shops, government agencies and locally based industrial bureaucrats), but the continuities that remain have provided local firms with at least five (advantageous) features which have persisted over the years

³ Also see Sabel (1994) for similar arguments.

even though the specific processes through which these advantages have worked have changed over time.

(i) The practice of tapping into multiple sources of demand on an ongoing basis, not only during times of adversity or downturn. These sources include demand from the government, from local assemblers, original equipment manufacturers, from direct and indirect exports, and from sales to the replacement market via merchant distributors (See Chapter 5 for details). (ii) Access to a variety of mechanisms that helped lower production costs and reduce wastage--e.g., collective arrangements to use scrap productively; a local machine tools and machinery making industry that catered primarily to the needs of small firms;

(iii) Networks of institutions and social arrangements that provided small firms with a plurality of easily accessible sources of economical and ongoing feedback that helped them learn about outside quality standards, about defects in their products and production processes, and how to upgrade the quality of their equipment and output, and rise to higher quality standards over time, and to better markets. This feedback was customized and decentralized. And networks that provided this customized and decentralized feedback, and information about new sources of demand included other firms, users, assemblers, mechanics, reconditioning teams, retailers, distributors, factors, technicians, technically skilled government bureaucrats who consulted after hours.

(iv) Widespread presence of technical skills among the region's workers and small firm-owners centered around the practical knowledge of the mechanic--not the engineer. These skills are relatively cheap--and accessible to a broader swath of production workers--compared to an environment where engineers dominate the skilled workforce. Most importantly, these skills kept getting transformed over time with changing demand pressures. Demand from clients and firms to constantly adapt things, copy through reverse engineering, or make a standard product through non-standard means put pressure on workers to not only think in open-ended ways, but forced them to keep reinventing their skills according to the demands of the task in hand or changes in technology and standards.

Close interaction between workers' informal strategies of skill acquisition and the government's formal system of providing vocational training through technical colleges, engineering diplomas was crucial to facilitating this demand-responsive/ demand-induced upgrading of a skill base that was originally rooted in repair and artisanal skills. That this formerly artisanal and traditional skill base transformed and modernized itself over time undermines arguments that heavy investments in engineering, or sophisticated technological transfers are a prerequisite to competitive industrial growth. These arguments are important, but they also assume a polarization and separation between practical skills and experience on the one hand, and formal engineering skills on the other. The Ludhiana case

demonstrates the fallacy of such a polarization. By showing how broad-based access to intermediate skills, and their demand-induced transformation, pulled a whole region of small producers up to impressive levels of growth and at least middle class livelihoods, suggests that there are alternatives to the high-technology model.

(v) Finally, the state's role was pervasive and present in influencing the region's industrial trajectory, but not always visible. Its chief, concrete manifestation was the provision of an extensive physical infrastructure in the region, the provision of a network of technical training institutions, and the endowing of status and prestige to mechanical/ practical skills through its own investments decisions and hiring practices (staffing the industry department's technical wings with graduates from industrial training institutes and holders of engineering diplomas (not necessarily degrees). But its ongoing role was one of a broker: rather than try to internalize all kinds of expertise within its ranks, it tried to put local firms together with a variety of public and private sources of assistance. The "state," for local firms, at an everyday level, is effectively a network of technically skilled officials across a network of locally-based institutions who interact together around industry's problems, irrespective of whether their institution is run by the central government (SISI), state government (DIC) or autonomous institutions funded jointly by the central government, state government, bilateral and multilateral agencies (e.g.,

Central Tool Room [run with German funding], Bicycle R&D Center [UNDP]).

These features, which allow small firms to adjust resiliently to unforeseen changes in demand or markets, are ironically mixed in with features associated with the "low" road. For example, the production system involves considerable self-exploitation on the part of both, the small-entrepreneurs as well as their workers. Workers routinely work long hours--10-14, as do the owners--10-12 hours--to raise their average returns to acceptable levels. Small owners save on overheads by handling a variety of tasks themselves--banking, letter writing, sales, purchases--by being "Peon-to-Proprietor" entrepreneurs, as they put it. They cut costs in every way--use part-time accountants if sales are sluggish; if they have to type out form-letters in bulk they get it done from local commercial colleges or from private institutions that teach typing and shorthand.

Yet, despite the need to work long hours and lower overheads in other ways, the region's smallest firms have relatively cheap and ready access a variety of services that are usually not easily available to the typical small firm: physical infrastructure, serviced industrial plots available on easy installments, a highly developed (and effective) trucking industry, a widespread network of publicly provided and privately run communication facilities--telephone, fax, and computational services--whose costs are borne partly by the government and partly externalized into the region as a whole.

We examine below briefly, the mechanisms through which the elements listed above helped firms increase productivity, raise output, lower costs and grow.

Importance of skill and the nature of its propagation:

(i) Demand-induced learning: a plurality of sources of feedback. There is compelling evidence in the literature that small firms are at their most vulnerable when they start out. Poor product quality means high rejection rates and difficulty finding demand; and revenue lost through high rejection rates can mean closure for a small, capital-constrained firm that is just starting out and needs liquidity. The problem often is that small producers may not know how to find out what they need to do to improve their product quality quickly enough, and be guided through the learning process.

Traditional technical assistance programs seek to get around this problem by offering small firms marketing assistance, or offering them technical training courses that might help them detect production problems. But this approach of offering standardized courses or assistance packages did not always work. Recent studies suggest that a more effective approach is to build customized and more focussed technical assistance processes that advise a firm according to its particular needs. These studies emphasize the importance in this regard of close supplier-client ties where a particular supplier is linked to a particular buyer--whether private or public--in an ongoing relationship of

feedback, and the buyer tries to coach the supplier through the learning process.

A striking finding of the Ludhiana study is that successful small firms learned to tap into multiple sources of feedback and demand as a matter of course, not only during troubled times. They are therefore tied into a network of feedback givers on an ongoing basis. These groups not only get to know the firm and the work it does well and are in a better position to offer suggestions and customized help on an ongoing basis, but the firm is more likely to get help during times of real adversity because it is already tied into an active and diverse support network. These same circles also become conduits for other kinds of information and advice--about new practices, opportunities such as joint exports, and production or marketing advice. These groups include skilled technicians, repair mechanics, assemblers, technically skilled government bureaucrats, R&D centers such as Ludhiana's Central Tool Room, users as a group. The turning of small local firms to these groups for feedback had two characteristics that set them apart from standard practice.

First, as we saw in Chapter 5, small firms don't just turn to their particular clients or users, but they seek out "users" as a class, for opinions and advice about what item to produce, what has good demand, and how to improve their product. For example, a small firm producing a three-wheeler gear or part may ask a general repair mechanic, or an assembler, or a three-wheeler operator acquainted with them for ways to fix certain

problems, or advice on materials and better processes that would improve the particular part. This is different from, and goes beyond, the recent emphasis in the literature on demand-driven assistance where a particular producer is linked in an ongoing relationship to a particular client from whom he gets feedback. While recent research has shown convincingly that a small firm learns fastest when it works in a close, feedback intensive relationship with a large buyer who can help bootstrap it technologically, the literature is also pointing out how only a small tier of firms can attain these "learning" relationships centered around long-term buyers. The Ludhiana case suggests that there are also other ways in which small producers can upgrade themselves that do not necessarily involve building a relationship with a particular buyer. Small firms can turn to users as a class, or to repair mechanics or assemblers as a group to accumulate the feedback that can help them improve their production processes and quality across the range of products they produce.

The second way in which this is different from standard practice is that while usually small producers can ill afford constant consultations with skilled technicians outside of the circle of their clients, or government technical assistance programs, here access to skilled mechanics and technicians is pervasive and relatively cheap. Many of the small owners are themselves former technicians, and have ties with networks of skilled workers. This is in large part because of the highly

blurred boundaries between small owners and skilled workers, on the one hand, and small entrepreneurs and mid-level government officials on the other, many of whom are skilled and run their own firms on the side under the name of family members. These technically skilled government officials were often trained in the same engineering diploma courses or technical colleges as the skilled workers and skilled small-owners and part of the same cohort. Lack of social distance or of deep class cleavages between these middle-class (skilled) workers, small entrepreneurs and mid-level bureaucrats; just as there is social proximity between a small industrialist who was once a repair mechanic (or whose father was), and another who still is a repair mechanic and an acquaintance, and can become a source of advice to the manufacturer on how to make its product or parts more efficient (as examples in chapter 5 showed). There is therefore a significant relationship between the nature of skill in the region, the premium and prestige associated with technical skills, upward mobility that has allowed many skilled workers to become small producers, and the access that such "industrialists" can maintain to skilled workers who once worked and socialized with them for ongoing and informal advice.

(ii) "Following" demand, and getting around low margins.

There is overwhelming agreement in the literature that marketing is a major stumbling block for small firms. By contrast we saw that most firms in my Ludhiana sample said marketing was not a major issue for them, at least not an issue

they couldn't get around. A key reason for this, we saw, was that small firms in this region tapped into multiple sources of demand, and kept "following" demand (i.e, finding out about newer markets, or related products for which demand was good) even in periods when demand for their current products was good. Keeping track of newer sources of demand, and hedging their risks was an ongoing strategy. Two other factors helped make marketing a less daunting task for firms in this region.

(a) One is the tendency of firm-owners (at least those who were former workers) to start out with demand in hand. Nearly 90% of firm-owners who were skilled workers before they took to production reported that they waited to build contacts and first identify demand from a committed buyer who knew what they could produce, before setting up shop. And as we saw in chapters 4 and 5, firms don't just seek out new sources of demand at the beginning of their firm histories, or during downturns, but they often "follow" demand, temporarily going into related lines of production to take advantage of opportunities that open up (as illustrated by the case of the lathe producer in chapter 5 who switched to making spinning plants to capture the short boom in the demand for these plants after seventeen of Ludhiana's hosiery firms won a large export order from the former Soviet Union in the early 1970s).

(b) Two other factors allow small firms to lower costs and minimize risk when they start out. (i) One is the practice of merchant buyers, or even OEMs, making part of the payment to

small producers in the form of advances. Merchant buyers or assemblers often extend 40-50% (but in some cases up to 70%) of total costs to small producers at the time of placing an order. This practice is by no means unique to Ludhiana--and some recent studies have reported advances as financing working capital in regions as varied as Brazil and South Africa (Tendler and Amorim 1996, Tendler 1995). What is different about the Ludhiana case, as we saw in Chapter 5, is that in this region distributors and merchant buyers extend advances to small producers not only to finance recurrent expenditures, but to also develop an item. That is, to get the producer to figure out its production process and develop the tooling to bring it into production, or to copy/modify an item for them that is so far not produced locally (Eastman Exporters was one example cited in Chapter 5).

(ii) A second feature is the presence in Ludhiana of a broad-based and deep infrastructure of specialized job-shops and firms that perform a wide range of routine as well as highly sophisticated tasks for firms. These services range from forging, casting, electroplating, testing, hardening, specialty turning and machining, painting and many others. As any visitor can see, and as local firms report, all kinds of services, processes as well as intermediate inputs (such as nuts and bolts) "are right at hand." A firm can start production from a rented shed with a bare minimum of machinery in-house, because practically every process can be got done from specialized firms in the market. Small firms, especially those that started out in

the 1960s and 1970s routinely reported having built up their capital base incremental. As product quality stabilized and output expanded and revenues increased, they invested in buying the machinery they needed, often one machine at a time, and gradually internalized some of the processes they used to get done from the outside.⁴ This ability to start with little investment not only allows very small firms, or former workers with little capital to enter into production for themselves, but having such an infrastructure to fall back on is important to the ability of small local firms to switch products relatively easily during downturns or when demand for a particular product wanes. Switching to new products does not require them to first invest in expensive re-tooling or make changes in their production processes up-front. The firm can make the changes incremental as revenues increase, and meanwhile rely on its links with specialized job shops and other service providers initially.

Demand impetuses

As we saw in chapters two and three, even historically, a series of demand generating episodes were crucial to allowing Ludhiana's small firms to establish themselves during and after the second world war. In all of these cases, the government was

⁴ More recent firms typically reported starting out with a larger equipment base, perhaps reflecting either a growing accumulation of wealth in the region, or changes in the way newer firms carry out production, requiring perhaps more specialized equipment or more precise operations.

a key source of demand for the region's metal and woollen hosiery producers. Subsequently, firms branched out into supplying the private sector and the replacement market. But government demand from a variety of departments has continued to be important.

Demand relationships with exacting departments worked best in forcing firms' pace of learning and helping improve quality. Departments with low latitudes for rejections or poor quality (e.g., railways and defense) had a built in disciplinary mechanism that enhanced performance, even though the firms won orders on the basis of tenders, rather than longer term personalized contracts.

The literature on demand-induced learning among small firms raises two issues. First, as we noted earlier, it emphasizes long-term, face to face interaction between a particular buyer and its particular supplier as facilitating the tutelage that is needed for the supplier to learn. A second factor implicitly emphasized in the development literature on industrial promotion is that government agencies are often not very good at fostering procurement-induced learning, especially among small producers. A recent study of a highly effective government procurement program in Brazil's Ceara state showed however, that if the government user agency is separated from the government agency that does the procuring, and is interested in assisting small firms, then government procurement programs can become powerful tools of learning for small suppliers because it is in the interest of the intermediary procuring agency to upgrade the

production skills of its small suppliers to ensure that they can meet the quality requirement of final buyers (Tendler and Amorim 1996). What is different about the findings of the Ludhiana case is that they suggest that proximity to the actual customer is not the only way for small firms to learn from demand induced pressures. In the Ludhiana case, firms turned to a variety of other actors who were not directly related to them through a demand relationship, for feedback on how to achieve the quality standard required of them. Similarly, as we see momentarily, many of Ludhiana's small producers who supply to the replacement market through merchant distributors or retailers, also build ties of feedback with their intermediary buyers (retailers, wholesalers and merchant distributors) and with mechanics and local technicians to find ways of improving their product despite supplying to diffuse and distant final buyers.

(c) A third reason why small firms in this region have few marketing problems is that they are embedded in a far-flung and sophisticated network of merchant distributors and wholesalers who procure spare parts and complete items from Ludhiana's small producers (of bicycles, auto-parts, sewing machines, agricultural implements and machinery) and sell them in replacement markets throughout the country as well as abroad through indirect exports. This distribution network and the replacement market provides small firms with ongoing back-up demand and allows local

firms to cope during downturns.⁵ Producers making transitions from one product to another or one buyer to another, also weave in and out of the replacement market using it as a source of interim revenues.

A feature that made this role of merchant distributors different from the picture of traders as the exploitative middleman-buyer traders emphasized in the development literature,⁶ is that it embodied substantial feedback from the merchant distributors to small suppliers on their product quality. Indeed, the smallest firms actively used this relationship with retailers/wholesalers and dealers, and its cycle of feedback to pull themselves up and improve their product quality when they started out. They reported supplying small

⁵ Many small firms sell mainly to replacement markets for much of their firm histories, but they sell to markets in several states, and even abroad via indirect exporters. They sell either through the network of dealers, or build their own networks of retail stores over time. But typically, those in the my sample who exported indirectly, eventually sought out OEM buyers, or other assemblers. Some took to exporting directly.

⁶ Although there has been some recent interest in looking at the developmental potential of intermediaries such as traders and sales agents with regard to small firm growth (e.g., Schmitz 1995), the traditional view is that the interests of traders and merchants are often contrary to those of producers, and hence detrimental to their long-term growth. The dominant view, or at least the view that informs policy, continues to be that traders and merchant-buyers typically exploit market imperfections and attempt to hoard market-power. Thus, while they sell at high mark-ups, but try to buy at low rates from small producers. And, because they can sell in different quality segments of the market, why would they care about a particular client's product quality? While much of this picture is accurate, and merchant interests are often opposed to the interests of producers, the Ludhiana case suggests instances where merchant-buyers may play a positive, quality enhancing role for small producers.

batches of output to one or two selected retailers/wholesalers at lower than market rates for a short time period. In exchange for the low rates, the distributors gave them extensive feedback on the quality of their product--feedback which they, in turn, elicited from the technicians or assemblers to whom they sold the items. Since most distributors seek to sell under their own brandname, it is in their interest to help a new supplier whose products they help market, to come up to par with market standards in a reasonable time period. As firms improve quality further, they may diversify their buyers (distributors) or sell under their own brandname.

There is growing interest in the developmental role of traders and merchants in the recent literature (See Schmitz 1995, and Piore 1996),⁷ and in the study of buyer driven commodity chains (Gerrefi 1994), but in most of these cases the trader intermediaries broker demand from large buyers abroad (e.g., the U.S. shoe chains in the Sinos Valley case studies by Schmitz), or the retailers themselves are large well-known chains (such as J.C Penny in the Mexican case studies by Piore et. al 1996). Little has been discussed about the conditions under which the replacement market--usually regarded as being a relatively

⁷ See Paul A. London's pioneering study on the role of "merchants as the promoters of rural development" (1975). Through interviews and extensive field research he shows how small merchants played a key role in financing the distribution and spread of fertilizers and irrigation equipment (such as pump-sets) among farmers in the Indian Punjab, and in Western Uttar Pradesh in the late 1960s-early 1970s. Also see Uma Lele's work on rural middlemen in India's grain markets (1968, 1971).

inferior and less quality conscious source of demand--and the merchants brokering demand from that source can play a positive, quality enhancing role in helping small firms at least come up to par with existing market standards. In the Ludhiana case we saw that this was possible with the help and presence of an ensemble of actors and feed-back givers (technicians, "users," assemblers, workers, retailers) in the environment in which local firms were inserted and whom they had easy access to.

Linkages across sectors: historical and institutional links between a dynamic agricultural sector and local industry:

Other indirect demand-generating mechanisms in Ludhiana's industrial history relate to the Punjab government's subsidies to agriculture (Chapter 4) and their impact on small industry, especially, small machine-tool producers and agricultural implements producers. Policies such as subsidies for the procurement of farm-implements and machinery are typically advocated as supply-sided subsidies to agriculture--and have often been highly criticized as such. But ironically, in this case, they unintentionally acted also as demand-sided subsidies to the machine tool industry. In this sense they were a variation on the other demand-sided impetuses discussed previously (i.e, war-induced demand from the government, demand opened up by the government's ISI policies, and the rebuilding efforts during partition). Ironically, also, it was lobbying from agriculturalists--not equipment manufacturers--that brought

about these subsidies and related policies, which indirectly stimulated industry.

(i) Importance of cheap and extensive infrastructure

Infrastructure, regarded till a few years ago as an "old" issue or one of the older, "harder" and more traditional roles of the state, is once again the subject of considerable interest today. From being criticized as being unduly subsidized, politically charged, and a burden for fiscally strapped governments in the 1980s, the infrastructure debate is revived again in the context of privatization (World Bank 1994). The Ludhiana case sheds some historical light on this question by pointing to the importance of the state's provision of extensive and cheap infrastructure throughout Punjab early in the region's industrial history and its spill-overs into private initiative.

One of the key findings of the study was that the availability of cheap and extensive infrastructure--roads, rail networks, cheap electric power, water, serviced land, and communications links-- was crucial in allowing the region's small firms to lower production costs, and compete in distant markets despite being small and constrained for capital.

Installation of this infrastructure, and access to it on the part of industry, however, did not come automatically. Indeed, much of it was not even directed towards industry originally. Historically, the Punjab government's (including the colonial government's) investments in infrastructure were targeted towards agriculture and the military. When the colonial government first

began its massive infrastructure investments in Punjab after annexing the state in 1849, it concentrated on laying a rail network that would connect the region's volatile border along Afghanistan with the center of colonial power in Delhi, and would enable the movement of troops across Punjab. The colonial government further extended its road and rail networks in Punjab to consolidate land and colonize the vast, but sparsely populated frontier regions of Western Punjab. An immediate, and short-term, goal of these infrastructure projects was to launch public works projects that would provide work/employment for the disbanded soldiers of the Sikh army whom the colonial powers had just subjugated. But a longer term and central goal in settling the frontier was to bring new land under cultivation. In this regard the colonial government invested in building one of Asia's largest irrigation canal systems--and agrarian settlements (canal colonies)--in West Punjab in the late nineteenth century.

The Railways and irrigation works had impact far beyond agriculture and defense. As we saw in Chapter 2, these new trades raised non-agricultural incomes by providing new avenues of employment and contractorships to local groups such as artisans and traders outside agriculture. Most importantly they indirectly and over time, transformed the traditional skill-base of a whole generation of artisanal metal and woodworkers formerly engaged in the manufacture of simple farm implements, through exposure to new processes and products on the state's railway projects, irrigation works and in the government's railway

workshop.

The government's focus on infrastructure continued after independence in the form of state-wide rural roads projects, construction of power plants (initially hydro projects, and later a series of small thermal power plants), and rural electrification. By the early 1970s every one of Punjab's 12,476 villages, towns and cities was electrified and connected by at least one all-weather road. Though still aimed primarily at agriculture, the benefits of these investments were fungible, across sectors and accrued to industry as much as they did to agriculturalists. In addition to their early, historical role of raising rural incomes, and transforming local artisans' skill base, infrastructure investments, especially those in roads and cheap electric power helped small local firms lower production costs and increase their marketing speed and options.

(ii) Trucking as a preferred mode of transport--speed, savings, and quicker turnover of capital

One of the more surprising findings was the preference by local firms of trucks over trains as to transport their finished goods to locations outside the state. The presence of an extensive road network had led to the growth of a robust trucking industry in Punjab since the late 1960s-early 1970s, controlled by the state's wealthy agriculturalists. The trucking industry developed initially to meet the marketing needs of agriculturalists--e.g., to expedite the transportation of

perishable produce such as fruit and vegetables, and to transport wheat, rice, other grains and export crops to other parts of India. But since harvests are seasonal, truck-owning farmers began to lease out their trucks to local firms since the 1970s. Today the region's large, small and medium producers of metal parts (not so much machinery), bicycles, sewing machines, and agricultural implements prefer this means of transport for long-distances over trains.

As we saw in Chapter 4, firms prefer using trucks because unlike the delays and pilferage and damage often involved in transporting goods by train, trucks are faster and safer; they save money because they do not need to package their goods in the heavy wooden crates mandated by the Railways. Not only do they save on the cost of these crates, but they save also on being able to pack more goods per sq. foot on the trucks. Most of all, they can turn their money around faster--they load the trucks at the end of each day, and the truckers deposit the goods at the clients doorstep by the next morning or within a few days if the destination is at the other end the country. Within a few days of delivery, the customer releases the payment: some firms are able to turn around their working capital four times a month. Unlike other states where the trucking industry is weaker and only bigger firms can afford to hire commercial trucks or maintain their own fleet, in this region the growth of a trucking industry supporting agriculture, and owned mainly by agriculturalists, has allowed even smaller firms to access it

relatively cheaply. Indeed, the presence of mechanical skills in the local workforce--and in many truck drivers--has, in turn supported the growth and maintenance of the region's trucking industry.⁸

Thus, industry's easy access to infrastructure in Punjab did not come automatically. The history of Punjab's agriculture, and the state's agricultural policies and investments, had a lot to do with the presence in Punjab, early in the region's industrial history, an extensive physical infrastructure. Subsequently local industry learned to fight for it--as evidenced by the successful battles led several of Ludhiana's industrial associations in the 1980s for more power plants, better access to power, for flyovers, storage locations, serviced land, water treatment facilities, and better maintenance of the road network.

It is true now as it has always been that infrastructure provision is a politically charged issue. It is true also that it is costly, and fiscally burdened governments can no longer treat it as a "traditional" responsibility. But the evidence suggests that cheap and extensive infrastructure is important, and its presence makes a difference to the ability of small firms to compete. It appears also that its benefits are fungible across sectors (although more research is needed to clearly understand this issue), and creating strategic disequilibria can

⁸ Gotsch (1972:191) remarked anecdotally that the high premium placed on mechanical skills in Punjab was one reason why Sikhs dominated India's transportation systems--not because they are "great drivers!".

lead to new ways of providing it. For example, having long been accustomed to the availability of infrastructure (power, roads, rail, water, transportation) local firms in Ludhiana are willing to pay to get past any bottlenecks that arise. In response, the Punjab government recently allowed private providers to extend roads, construct bridges, maintain them and levy tolls for it--without much protest from users.⁹

(iii) A different kind of "growth-linkage:" institutional and policy links

A body of theory most commonly evoked to explain Ludhiana's small-firm dominated industrial structure is the growth linkage debate (Rana cf. Sharma 1988, Gosal and Kishan 1984). According to this view, rapid agricultural growth in Punjab during the mid-1960s through the 1970s and rising rural wealth induced industrial growth in the region through increased demand for locally made consumption and production goods (bicycles, sewing machines, agricultural equipment, tractor parts, repair and replacements of components). Thus, according to this view, rising agrarian purchasing power and endogenous demand fuelled small firm growth through production and consumption linkages.

But a central feature of the Ludhiana's small firms growth that departs from the logic of the pure growth linkage argument

⁹ Another way would be for the state to prioritize investments. First bunch them up in areas where population and firm density is higher--areas that are neither urban nor rural, and then to extend to less densely settled areas.

is the export nature of Ludhiana's industrial growth, and the historical importance in Ludhiana (and Punjab) of exogenous or outside demand--from public and private sources. Even today, nearly 90% of Ludhiana's final output of sewing machines, bicycles and parts, woollen hosiery, even agricultural equipment is sold outside the state; and all of the basic inputs used by the region's metal industry (steel, iron, coal) come from outside the region. Thus an open economy has long been the basis of industrial growth in Ludhiana.

The origins of Ludhiana's small firms, moreover, especially its dominant consumer durables industries--bicycles and parts, sewing machines, (and woollen hosiery) predate the green-revolution years of high agricultural growth in the 1960s-1970s by several decades. As we saw in Chapters 2 and 3, historically, it was massive defense demand from the government during the second world war, not from agriculturalists that, caused the first real spurt of small firm growth in Ludhiana. Subsequent demand-generating episodes (rebuilding after partition, import controls, ISI) built upon this initial period of growth, allowing the small firms that had mushroomed during the war to stabilize. Indeed, it appears that the prior existence of a skilled metal working class in and around Ludhiana actually aided the spread, diffusion and rapid adoption of mechanization that was part of the green revolution technologies introduced in the 1960s. Thus, rather than rising incomes due to agrarian growth resulting from the introduction of green revolution technologies in Punjab in

the mid-1960s, inducing the rise of Ludhiana's metal industry, it was the prior existence of a small firm led metal industry that contributed to the rising agrarian incomes by aiding the adoption and adaptation of improved implements and pump-sets and other equipment that made the green revolution technologies more productive. This round of agrarian growth further boosted the growth of Ludhiana's metal-based small firms, especially its agricultural implements industry (as Deolalikar 1985 shows), rather than having caused the industry's original rise.

Rising agrarian wealth in the green revolution decades of the 1960s and 1970s did indeed boost growth rates of small local industries producing agricultural equipment, pumpsets and capacitors. But the pure growth linkage argument, while capturing some aspects of Ludhiana's small-firm based industrial growth, does not explain or account for its emergence, nor the nature of its growth. It suggests, instead, the importance of looking historically at the variety of other institutional and policy linkages between the region's industrial and agricultural sectors that shaped the conditions of accumulation, investment, and skill-formation in the region.

Three larger themes in summary

Underlying this region's pattern of small firm growth, in sum, are three larger themes that have allowed specific features in the region's production system to change while retaining some threads of continuity as institutions transformed over time.

(1) The nature of the region's labor market and human capital base. The region's base of mechanics' skills kept getting transformed in accommodating change in production needs. This was in part driven by demand--demand brought by distributors and sales agents with wide exposure, and because firms owners are themselves skilled and exposed themselves to outside standards. And in part, because many skilled workers go on to become firm owners, they carry the awareness of link between changing skills with changing demand. The nature of demand thus, affects the skill base. In designing training programs therefore, it may be useful to pay more explicit attention to the demand side--how different kinds of demand pressures impact a region's workforce, and the kinds of demand impetuses that are more likely to shape broad skills and transform them (e.g., tasks that require suppliers to adapt, modify items as they produce them--or even copy items of higher standard than they were hitherto accustomed to).

The Ludhiana case, at one level, shows the (historical) conditions under which artisans became skilled technicians in modern enterprises--both as workers and small owners--rather than remaining trapped in old trades that eventually die out of attrition. Although Ludhiana's organization of production emerged initially due to fragmented capital, relatively even distribution of income, and colonial policies that kept the elite agrarian while at the same time transforming the skill base of whole generation of artisanal workers, it reproduced itself later

due to the benefits this system afforded to both small and large producers.

(2) A second theme concerns the episodic problem solving arrangements within firms in region. These organizations arose in response to specific problems faced by a group of producers involving those most directly involved who built an alliance around the specific problem to be resolved (e.g., undercutting, or the need to revise piece rates), and after the problem was resolved, died out, to reemerge later in a different guise when a different problem presented itself. Episodic organizations emerged not only under the umbrella of a single producers association or a regional association, but in ways that cut across associations and producers groups. These highly mobile, and flexible organizations, we saw, weave in and out of traditional producers associations and are capable of carrying information around economically and pervasively. The literature has not focussed much attention on such groups partly because they are seen as transient, sporadic, not permanent, and therefore, understandably neglected as temporary. But we saw that not only are there strong elements of continuity in these organizations; but this organizational form lends itself to reinvention more easily if it operates within a more stable, overall framework of commonly understood rules and customs.

A similar structure characterized government intervention in the region. The state bureaucracy's intervention was pervasive, and through a variety of channels, some of which were outside of

government. Rather than build a comprehensive base of expertise within its ranks, the government relied on helping local firms learn on their own by exposing them to outside standards, indirectly providing them "models" towards which to build, and facilitating their linkage to a diverse set of public and private actors through buyer seller meets, brokering informal technology transfer episodes by sending small firms to visit large companies or multinationals outside the state. The Punjab government has financed such "tours" (jointly with local associations) since the 1940s and 1950s when it arranged for selected local firms to tour British plants within India. It organized similar, bilaterally funded trips of local producers to Japanese, German and Eastern European plants in the 1960s and 1970s; provided firms with access to retired American engineers for technical advice through a federally funded program supported jointly by the Ford Foundation in the 60s; and to foreign machinery in government-and bilaterally financed centers such as the Central Tool Room in Ludhiana and other R&D centers catering to the products that local firms specialize in--bicycles, sewing machines, machine tools.

The boundaries between government and industry, moreover, are very porous. Many industrial bureaucrats and mid-level officials have their own small firms under the name of family members, and play out their dual role as producers. But government action was concrete as well--it had a history of investment in infrastructure and skill formation, and invested

heavily in technical training. Although much of the infrastructure investments were initially targeted towards agriculture, their benefits were fungible, and as we noted above, benefited industry equally--e.g., cheap power, roads, and serviced land.

(3) These practices interacted with, and evolved from a social structure where extensive landreforms in the late eighteenth and nineteenth centuries, and successive agricultural policies of the colonial government had produced an economy dominated by prosperous small-holders. Peasant status was acceptable, as was the tradition of working with one's hands. But equally importantly, colonial policies which created prosperity in agriculture, also kept much of the elite that had some capital rural. Thus, a lower-status, excluded group with fragmented capital entered industry; and no single group had disproportionate control over resources or the power to influence investment decisions unilaterally. A small-firm industrial base evolved, where relatively skilled firm-owners, and workers with technicians skills put in place work arrangements that over time allowed them to economize on capital, build a plurality of institutions and networks that gave them access to technical feedback, information about new sources of demand, and exposure to outside standards, while constantly encouraging the formation of demand-response skills.

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