IJAZ NABI

Entrepreneurs & Markets in Early Industrialization

A CASE STUDY FROM PAKISTAN

INTERNATIONAL CENTER FOR ECONOMIC GROWTH

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Ijaz Nabi is an economist at the World Bank, where he currently specializes in the economic development of Mexico and Central America. His former posts include a Fulbright Research Fellowship at the Economic Growth Center at Yale University and a position as assistant professor of economics at the Quaid-i-Azam University in Islamabad, Pakistan. He received his Ph.D. in economics from the University of Warwick, United Kingdom. Among his many publications in the areas of finance, agriculture, industry, and labor economics, are the co-authored *The Economics of Agriculture in Pakistan: Issues and Policies* (1986), and the co-edited *Aid and Development: Transition from Agriculture to Industry and from Concessional to Commercial Flows*, to be published by the International Center for Economic Growth in 1989.

Preface

The study of entrepreneurship is a largely untold story of development in Pakistan and other countries. The Center sponsored this case study of the farm machinery industry in Pakistan to explore how a small, indigenous sector of the economy, lacking effective access to the economic institutions of the larger society, has nevertheless built a vibrant, growing industry. Small firms run by entrepreneurs have penetrated the Pakistani economy and society even more completely than the formal sector, which, dominated by large established firms, is typically the object of industrial strategies in developing countries.

We are confident that Dr. Nabi's study will make an important contribution to our understanding of the role of entrepreneurs in economic development.

Nicolás Ardito-Barletta
General Director
International Center for Economic Growth

Panama City, Panama
September 1988

Acknowledgments

This book is dedicated to the small engineers/manufacturers who are transforming rural Pakistan—and to my father who pointed them out to me.

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Ijaz Nabi

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September 1988

◆ *Chapter 1* ◆

Industrialization Issues and the Farm Machinery Industry in Pakistan

The level of industrial activity in a country is often taken as an indicator of its economic development. The reasons are straightforward. Industrial activity provides for increased flexibility in the choice of technology and in the goods produced for domestic consumption and for export. In a correct policy framework, the industrial sector is capable of rapid technological transformation to provide new investment and employment opportunities. Being located in urban areas, it is also important for its contributions to the enrichment of city cultures. Moreover, there are few examples of countries having attained high levels of development without a strong industrial base. It is little wonder, then, that for many developing countries industrialization occupies a central position in their development strategies.

There are several paths to industrialization. Until recently, the strategy in vogue was import substitution, whereby the government fostered domestic large-scale industry in an environment that was highly protected by government regulations. As a result, the import substitution industries registered impressive growth in many less developed countries. In Pakistan, for instance, the share of large-scale manufacturing in gross domestic product increased from less

than 3% in 1949/50 to nearly 12% in 1983/84. Similar high growth rates are reported for much of Latin America.

Despite this rapid growth, import-substitution industries have failed to provide adequate employment. Moreover, the inability of these infant industries to "grow up" and compete in the international market has resulted in severe trade and balance-of-payments crises. These industries have relied heavily on imported materials and machinery and, other than producing very expensive consumer goods, have had few demand or supply linkages with the rest of the economy. The resulting disenchantment with their performance has led to a search for alternative industrialization strategies.

Several alternatives exist. One is to persist with import substitution, but in a more open economic setting, with the idea of exposing the industry to international competition in order to attain greater efficiency. Another strategy, following the examples of South Korea, Hong Kong, and Taiwan, is to promote export-oriented industry in an open economy framework. Yet another alternative is to promote small-scale, labor-intensive industry that is known to use resources more efficiently than the large-scale sector. Evidence from Pakistan suggests that in the later 1970s small-scale industry was, on average, nearly nine times more labor-intensive, while value added per unit of capital was nearly twice that of the large-scale industry. Given such evidence from many countries, the promotion of small-scale industry has come to acquire great appeal as a development strategy.

Regardless of which strategy is ultimately chosen for balanced long-term growth, it is important to provide a correct policy framework that suits the economic environment in which industrialization takes place.

The objective of this book is twofold. One is to describe the economic environment in which industrialization takes place and to analyze its influence on the decisions taken by individual firms. We focus on the microeconomic behavior of the firm and of the agents that interact in its decision making. Our concern is just as much with the workings of markets, such as those for labor and capital, as with the participants in those markets—entrepreneurs, bankers, and workers. Following Hirschman (1966) we associate development with the release of entrepreneurial energy, which can overcome the hurdles of an underdeveloped economic environment. Those agents of change not only perceive new opportunities for making profits, but also create markets for inputs where none existed, experiment with new technology, and continuously expand markets for their products. All this must take place without creating

special interests and rent-generating enclaves that result from excessive government intervention. In what follows we attempt to describe this route to industrialization.

The policy framework in which industrialization takes place is equally important. The second objective of this book, therefore, is to identify the policies that consciously or unconsciously strengthen market imperfections, which, in turn, create barriers to entry and impede growth. We then suggest alternative policies that contribute to a smoother functioning of markets and promote balanced industrial development.

The Industry To Be Studied

Two broad approaches are available to study the complex process of industrialization in an underdeveloped economic environment. The first is to break it up into its component parts and study each separately, with different sets of data. Second, one can examine hypotheses concerning the components systematically by a means of detailed case study. This book presents a case study of a single industry. We chose this approach because our belief was that focusing on one industry would not only yield rich insights into the detailed issues in industrialization but also, by a judicious selection of the industry, produce valuable generalizations for policy.

The industry we chose to study was farm machinery manufacturing, which is the most important component of the engineering sector in Pakistan. There are several reasons why this industry makes an interesting case study. First, it emerged as a result of entrepreneurs seeking out profitable opportunities created by changes in other sectors of the economy. This industry is not the product of direct government intervention—not the result of tariffs, subsidies, and other import-substituting policies to promote industrialization. Therefore, the story of entrepreneurial success is both interesting and rings true. Second, demand for the industry's output is likely to continue to grow and become more sophisticated and diverse as agriculture grows. Thus the industry has to continuously upgrade machine design and production methods and therefore continue to create tensions (à la Hirschman) in the economic environment in which it operates. This makes the study of its environment particularly rewarding. Third, the industry utilizes indigenous skills, upgrading these as it grows, and thus generating important complementarities with other sectors of the economy. Fourth, this industry is a good example of sectoral linkages

and balanced growth in development. It grows directly as a result of expansion in agriculture and, in turn, contributes to increasing the productivity of agriculture, thus maximizing the multiplier effects of expansion. Finally, location is an important consideration for this industry. Firms are located in towns that serve particular farming regions, each with characteristics that influence the type of agricultural machinery demanded. Thus the industry is a good illustration of the importance of decentralization in balanced growth.[1]

The manufacturing sector in 1983/84 accounted for nearly 20% of Pakistan's gross domestic product (GDP) and 10% of its employment.[2] The importance of this industry in Pakistan's economy has been growing steadily since 1949/50, when its contribution to GDP was less than 7%. The small-scale sector's share of total manufacturing is nearly 26%, which has remained steady despite the bias in governmental policy in favor of large enterprises. The small-scale-sector employs 11% of the total labor force, compared to the large-scale sector's 3%, and 80% of the total industrial labor force in the country.

Light engineering is one of the three most important industries in the small-scale sector with 19% of value added in the sector, and 21% of its employment. The fastest-growing industry in the light engineering sector is the category known as "machinery except electrical," which increased by 27% in value added and by 19% in employment between 1969/70 and 1976/77. Farm machinery is the most important component of this industry.

Demand for farm machinery resulted from the impressive growth of Pakistan's agriculture after the introduction of new dwarf wheat and rice varieties and chemical fertilizers in the 1960s. The agricultural sector grew between 3% and 6% per year, reaching a peak in the late 1960s, and this growth generated considerable demand for agricultural machinery. The most important demand was for tubewell engines and water pumps, which ensure timely supply of water and thus facilitate the use of chemical fertilizers. During this period of rising farm incomes, other farm activities such as ploughing and threshing also started to be mechanized. By the late 1970s farmers began to complain about shortages of labor at peak periods of sowing and harvesting. As a result, there was a rapid increase in the use of tractors and tractor-driven threshers, which enabled early harvesting of the winter crop (wheat) and timely sowing of the summer crops (cotton and rice), and which contributed to an overall increase in cropping intensity. Agronomists have called this phenomena the Thresher Revolution, following the earlier Green Revolution. Demand was also created for

haulage machinery such as trolleys for marketing the increased agricultural produce.

Pakistan's modern agricultural machinery industry came into existence in response to demand for all these products. According to a census conducted by the Agricultural Machinery Division of the Ministry of Agriculture, 514 firms operated in the industry in 1983. The five broad categories of implements manufactured in the industry are (1) tubewell engines and pumps, (2) threshers, (3) trolleys, (4) tractors and tractor attachments (such as fertilizer and seed drills and various categories of ploughs), and (5) sugarcane crushers and fodder cutters. The census also reports that 80% of the firms are concentrated in a few towns of the Punjab, including Daska, Gujranawala, Faisalabad, Multan, Lahore, and Mianchannu. This location specificity and product specialization is reflected in the choice of firms in our field survey.

The Field Survey

We undertook our principal field survey between January and May 1982. The choice of firms in our sample was not based entirely on random sampling procedures. We had to consider other criteria in choosing our sample in order to capture the economic environment of the industry. Regarding size, we wanted to include very small firms, producing a few items of machinery during part of the calendar year, but also some very large firms (located in Faisalabad and Mianchannu) so that we could comment on the relationship between firm size and efficiency. To take one example of a small firm, Ismail & Co. in Multan consists of three workers, including the owner, and produces eight to ten threshers between March and May each year.

We learned during the pilot survey of the five important product groups just enumerated, so we included the product-group criterion in defining the universe of firms to study. Further, there is considerable geographic specialization in farm machinery. Firms in Faisalabad, for example, specialize in sugarcane crushers, chaff cutters, and threshers; firms in Lahore and Daska mainly produce tubewell engines and water pumps; Miaachannu firms have acquired a reputation for manufacturing threshers and other tractor-driven implements; and so on. There are also likely to be important city effects on a firm's economic performance because of the nature of

local capital and labor markets and the complementarities arising from the presence of other engineering firms.

We discovered early in the survey that firm owners were wary of outsiders bearing questionnaires. Officials from at least two government departments, excise and labor, often pose as researchers to seek information that may show the firms to be violating one byelaw or another in the eyes of the departments of industry and welfare. We learned that these officials are less concerned with the spirit of the law than with supplementing their own incomes. Under these circumstances, we had to be careful to choose firms whose owners did not suspect our motives and were willing to give reliable answers to detailed and sensitive questions regarding their economic performance. Thus we often had to approach firms through common acquaintances and other intermediaries. After establishing a comfortable relationship with one firm, we were introduced as trustworthy to others in the town. In these circumstances purely random sampling procedures would not have taken us very far.

We verified the information we received by double-checking firm responses to key variables such as the number of items produced and the number of workers employed. We did this by undertaking second visits and by confirming the reported values with neighboring firms. Firms whose responses diverged considerably on such checks were not included in the sample.

Below we present some features of the cities in which firms were selected. The discussion shows that these features are important in determining the products in which firms specialize.

Daska, which is a subdivisional headquarters, has a population of 56,000. It is located in a rice-growing region of the Punjab and serves as an important grain market. Abundant water is necessary to grow rice. After the division of water between India and Pakistan under the Indus Basin Treaty (whereby India took over control of the canals that irrigated this area), came a demand for more tubewell irrigation. The diesel engine and tubewell pump manufacturing industry in Daska arose in response to this demand.

Daska is endowed with advantages that suit the industry. The most significant advantage is location. The name Daska derives from *das kohu*, which is a measure of its distance (10 *koh*, or roughly 18 miles) from important agricultural towns such as Sialkot, Pasrur, Gujranwala, and Wazirabad—all roughly equidistant in the four directions radiating out of the city. Second, the population-land ratio in farming areas around Daska is very high and is growing. This

ensures a regular supply of low-wage labor to the town. Since rural craftsmen such as ironsmiths and carpenters are finding it hard to get work, Daska receives a steady flow of skilled workers. This partly explains the low cost and high quality of the machinery manufactured here.

The diesel engine industry appears to be declining because of increased rural electrification and the switch to tubewells powered by electric motors. These are not manufactured in Daska because the required technical know-how is not available, and because it is hard to compete with low-cost engines imported from China. However, despite the fall in demand for its traditional products, Daska continues to thrive because entrepreneurs have been quick to add new products to their mix, principally consumer durables such as washing machines. Demand for such consumer goods has arisen as a result of changing life-styles brought about by remittances from Pakistanis working in the Middle East.

Faisalabad, which is the headquarters of an administrative division of the same name, has a population of 1.09 million.[3] Until 1947, Faisalabad was an important grain center of a prosperous canal colony. Industrial activity started in the late 1950s as a result of the government's import substitution strategy. By the late 1960s, Faisalabad emerged as the third most important industrial center in the country, after Karachi and Lahore, and the main center of textiles and textile machinery manufacturing. Faisalabad has always been important in manufacturing simple tools and implements. This industry received a major boost in 1947 when members of the Muslim lohar bradri (ironsmiths' association or guild) migrated from Batala in east Punjab, which was then the most advanced center of farm machinery manufacturing in the subcontinent. Before long, Samundri Road in Faisalabad became reknowned throughout the country for the quality of its manufactured agricultural implements. As farm mechanization proceeded, Samundri Road acquired a new look and switched over to the production of motor-powered wheat threshers, sugarcane crushers, and fodder cutters, all of which are important in the mixed-crop farming of the Punjab.

Firms draw upon the large pool of skilled labor available in industrialized Faisalabad, which continues to grow because of the high rate of migration from the surrounding rural areas. The presence of textile machinery manufacturing firms results in cost-reducing complementarities. A steady demand for the products of the industry is ensured by the rapidly growing farming region around the city.

Multan is a divisional headquarters with a population of 694,000 bordering the Thar Desert. Before the introduction of canals in the area in the late nineteenth to early twentieth century, very little land was under the plough. Canals brought about a dramatic change in the region, and Multan is now one of the most prosperous and technologically advanced agricultural regions in the country. Until recently this region's demand for agricultural machinery was met by Faisalabad and Mianchannu (see below). There is a young but thriving agricultural machinery industry in the city supplying machinery to the Dera Ghazi Khan, Muzaffargarh, and Vehari districts, and even to parts of Baluchistan.

Multan is an important industrial center in the country (especially for fertilizer and textiles) and has a large and growing labor force. There are scores of farm machinery repair shops, which have contributed to establishing the farm machinery industry. The industry in Multan is concentrated along Railway, Vehari, and Azmat Wasti roads. Ten years before our survey, it announced itself to be the premier center for thresher and tractor implements industry in the country.

Mianchannu's industrialization is the result of the efforts and success of essentially one firm, Ghazi industries, named after the owner. He was a refugee from east Punjab in 1947 and belonged to the lohar bradri. He started the industry in response to a few orders for seed drills placed by a government experimental project. In time, the range and quality of his products expanded dramatically. Singlehandedly he trained a whole work force in Mianchannu. His sons and nephews worked in this firm and later opened their own firms, improving machinery design through intimate contact with farmers in the surrounding areas. Chapter 7 relates his story in detail—a case study in firm growth. At the time of our survey there were thirty-five firms manufacturing agricultural machinery in Mianchannu. The firms are located along the Grand Trunk Road connecting Lahore with Multan as it passes through the town.

Lahore is a provincial headquarters, with a population of 2.68 million. It is the second most important industrial center of Pakistan, after Karachi. Regarding agricultural machinery, Lahore's importance lies in its place as the center of a once-thriving diesel engine industry. At the peak of this industry's activity, in the late 1960s, there were nearly 2,300 firms; they were located mainly in Saric Sultan and Badami Bagh, like most of the city's foundries. The industry is currently depressed, for reasons already discussed. As in Daska, firms in Lahore have also switched over to the production

of other machinery such as cold storage compressors and washing machines. Sheikhupura road is now emerging in Lahore as an important center of the tractor implements industry because it can take advantage of complementarities with the three large tractor assembly plants that have recently started operations here.

Sialkot, a divisional headquarters with a population of 252,000, is an old-established center of small-scale industry. The farm machinery industry, which is new, is located on the outskirts of the city along the road leading to Kallowal. A few firms are located on Waszirabad road in Kotli Behram and some in the old city. Sialkot faces tough competition from the more established industry in Gujranwala and Daska.

Gujranwala, a district headquarters with a population of 597,000, is a rapidly expanding center of the engineering industry in the Punjab. Agricultural machinery firms are still few and are concentrated in Swati Gali and along the Grand Trunk Road. The main advantage in Gujranwala to firms is the easy availability of raw material and the rich complementarities with other engineering firms. For these reasons entrepreneurs here are of the view that as the industry becomes technologically more sophisticated, Gujranwala will become the most important center of the industry.

The total number of firms interviewed in each city and major product group is reported in table 1.1.

Additional Surveys

Appendices I and II contain some useful background information too detailed to be presented here. Appendix I presents a discussion of the production environment in which firms operate; it also gives some technical information on the items produced. Appendix II compares our survey with others carried out for the industry. We carried out two surveys in addition to the main field survey. The first of these were detailed case studies to obtain qualitative information regarding skill acquisition, investment decisions, and planning for growth. We also collected data on the work force to capture the supply side of the labor market (this was in January 1983). Altogether we used two sets of questionnaires, reinterviewing ten firms in five cities and addressing firm owners and the other workers. All interviews were recorded on tape in order to incorporate in our analysis the detailed views of firm owners regarding the working of input markets and government policy.

In the course of the main field survey we learned about the widespread subcontracting that was apparent in the industry. Thus we

Table 1.1
Sample of Firms, by City and Product Group

City	Tubewells	Threshers	Trolleys	Tractor Attachments	Sugarcane & Chaff Cutters	Total
Daska	16	2	—	3	—	21
Gujranwala-Sialkot	—	12	4	4	—	20
Faisalabad	—	2	—	—	18	20
Multan	1	12	5	2	—	20
Lahore	8	—	5	5	—	18
Mianchannu	—	18	—	2	—	20
Total	25	46	14	16	18	119

conducted a third survey in March-April 1984 to collect data on this relationship and other interlinkages that arise from subcontracting.

The Basic Issues To Be Investigated

In examining this industry, we consider a number of specific issues: entrepreneurship; the labor market; technology, capital markets, and investment decisions; efficiency; subcontracting; and growth.

Entrepreneurship

Although the theory of the firm has little to say about entrepreneurship in the neoclassical tradition, a number of individual writers have emphasized the role of entrepreneurs in development.[4] The important issues here include the definition of entrepreneurial talent and how it contributes to a firm's efficiency. Are the entrepreneurial features that define this talent identifiable and, if so, are they amenable to policy? Chapter 2 addresses and attempts to answer these questions. Entrepreneurial functions are identified and important features such as membership in a bradri, education, spatial mobility, and previous business experience in carrying out entrepreneurial functions are discussed.

The Labor Market

Chapter 3 considers the role of the labor market in assuring a supply of appropriately skilled manpower—a role that is crucial in industrialization, and therefore raises a number of important issues on both the demand and supply sides of the labor market. For a labor

policy that aims to upgrade skills, as in Pakistan, it is important to determine the changes in employment patterns as the industry expands. This requires examining the relationship between employment, wages, and the nature of technological change taking place in the industry. Another way to look at the performance of the labor market is to determine whether it is segmented, and then to identify the factors that cause segmentation. Appropriate measures may then be suggested to remove these factors and thus avoid bottlenecks in the supply of skilled manpower. For countries like Pakistan, in which labor turnover is high (because of both internal migration and migration to the oil-rich Middle East), it is important to study the pattern of labor mobility and any deterioration of skills or inter-industry complementarities that may arise.

Technology, Capital Market, and Investment Decisions

A major concern in the technology debate in developing countries is with its appropriateness. The issues here range from the idolized Gandhian approach, aptly sloganized by Schumacher as "Small is beautiful," to the practical problems of choosing technologies that reflect the resource endowments of particular economies. Another issue concerns the vintage of machinery and how that influences a firm's efficiency in resource use. Subsumed in this is the question of technology transfer by means of the market for used machinery. Chapter 4 considers these issues and suggests hypotheses for the efficiency tests that are carried out in chapter 5. The choice of technology involves investment in machinery, and thus depends on the workings of the capital market. The important questions, then, are: How does the government ration capital? What are the features that a government-controlled banker looks for in a firm or an entrepreneur before he decides to lend? To these we may add: Are alternative sources of credit available for potential borrowers who cannot get credit from this source? If so, is the market for capital segmented? Answers to these questions are closely linked with investment decisions. A potential investor is more likely to invest in a firm if he believes that it has a good chance of borrowing in the official, subsidized capital markets. In our discussion we suggest and then test hypotheses on these issues.

Efficiency

Why are some firms more efficient in resource use than others? Comparisons of efficiency can be made on the basis of different criteria separately, such as labor and capital productivity, or on the

basis of composite indices, such as total factor productivity. Tests may also be devised to distinguish between allocative and technical, or x-efficiency. Some of the factors that we consider in efficiency tests are entrepreneurial features, the availability of skilled manpower, access to capital markets, the nature of technology, firm location, and size of firm.

It is often argued that small firms produce more output per unit of capital than large firms, employ more labor per unit of capital, help in developing indigenous skills and technologies, enlarge the pool of entrepreneurial talent, and use underemployed resources (such as part of the family home, family labor, and hoarded capital or capital that would have financed unnecessary consumption), thus exploiting the economy's resources more efficiently than large firms. If these claims are true—and we shall verify this—industrialization strategies that favor large-scale production need to be revised.

Subcontracting

Japanese success in industrialization is often attributed to subcontracting (see, for instance, Watanabe, 1971); the reason given is that interfirm linkages, both horizontal and vertical, are established to overcome market imperfections (Lall, 1980). Such production arrangements are commonly observed in the engineering industry in many developing countries, including Pakistan. In our discussion we examine the nature of the linkages that exist under subcontracting arrangements. We investigate whether parent firms bind their vendors through credit and technology linkages, and whether such arrangements are necessary for the survival of small firms.

Growth

Our discussion of firm and industry growth is conducted at three levels. First, we identify the exogenous factors contributing to growth of the industry. Then we describe differences in individual firms' responses to these opportunities. Finally we present two case studies to illustrate the internal factors contributing to growth.

◆ *Chapter 2* ◆

The Role of Entrepreneurs in Development

In the last several decades the mainstream literature in development economics has focused its attention on large-scale enterprises to achieve industrialization. Little attention has been paid to small businesses or to the entrepreneurs who create and run them. This failure to address small businesses is all the more striking given the vital role they play in a country's transition from agriculture to industrialization.

In this chapter, through our study of entrepreneurs in Pakistan's agricultural machinery manufacturing industry, we will explore the entrepreneurial features that facilitate development in its most basic sense by discovering new, more efficient ways of using capital and labor. In considering the importance of this subject to development, it is not too great an exaggeration to say that understanding development means understanding how entrepreneurs make development happen by employing both human and physical resources in increasingly valuable ways. The role of entrepreneurs in the complex process of development will appear, in fact, throughout this book.

In exploring how entrepreneurs contribute to development, we will examine several traditional hypotheses about them—their work experience, education, concentration among certain social and ethnic groups (which pass skills down across generations), and geographic mobility. Our study invalidates several widely shared beliefs. Regarding geographic mobility, for instance, the standard

hypothesis is that geographic uprooting—caused, for instance, by voluntary or involuntary migration—releases entrepreneurial talent either to recover lost social status or to upgrade it. Our analysis shows little evidence that refugees dominate the industry, despite their substantial numbers.

It is also widely believed that education, by improving one's accessibility to technical information, contributes to entrepreneurial decision making. Our analysis shows, on the contrary, that technical education is very rare among these entrepreneurs. While a majority have been formally educated, they still believe that on-the-job training is the best form of education. It is true, as commonly believed, that some social groups pass on skills across generations, forming a pool of knowledge that allows them to be more successful as entrepreneurs compared to members of other groups. In our study, entrepreneurs belonging to the lohar bradri (a lohar is an ironsmith; a bradri is a loosely organized professional caste), who represented 60% of the entrepreneurs sampled, helped each other to acquire technical skills and thus had an advantage over other bradris. All of these issues are important in trying to untangle the complex issue of why some entrepreneurs are more successful than others in performing their complicated tasks.

Our examination of entrepreneurs and entrepreneurship has important implications for development policy. One valuable way of looking at successful development policies is in terms of policies that encourage entrepreneurs to make development happen. In considering how policymakers may encourage entrepreneurship, the question arises whether governments can use policy to actively encourage development of entrepreneurs, or whether the most they can hope to achieve is to encourage them through policies that avoid placing excessive restrictions on them. Understanding who entrepreneurs are and what they do to facilitate development will provide an essential starting point for policies that may successfully encourage both entrepreneurs and entrepreneurship, and therefore development itself.

The Theory of the Firm and the Entrepreneur

The standard textbook treatment of the role of entrepreneurs in development, based on the neoclassical theory of the firm, leaves little room for special treatment of the entrepreneur. It is assumed that under perfect competition input and output markets are com-

plete and work well, giving clear price signals to producers. The producers, in turn, carry out a cost minimization calculus to achieve production targets that maximize the firm's profits. At this point in constructing the neoclassical model, entrepreneurship could be usefully explored. However, by assuming prior knowledge of the producer's utility function and the production process, the opportunity is allowed to slip by.

In the dynamic context, one would expect the role of the entrepreneur to be more prominent since managerial decisions are required for the firm to adjust to optimal plant size and new technologies. Yet even in this dynamic context, the entrepreneur's important economic role is conjured away by assuming that barriers to entry and exit do not exist. This paradigm is convenient if the primary objective is to illustrate the analytic neatness of the firm in long-run equilibrium. However, this neatness is achieved at the expense of a rich analysis of the entrepreneur as the prime decision maker in economic activity. To quote Baumol (1968), "the prince of Denmark has been expunged from the discussion of Hamlet."

An early reference to the entrepreneur as economic man is found in Veblen's essay "Economics and Evolution." He describes him to be

> a lightening calculator of pleasures and pains, who oscillates like a homogenous globule of desire of happiness under the impulse of stimuli that shift him about the area, but leave him intact. He has neither antecedent nor consequent. He is an isolated, definitive human datum, in stable equilibrium except for the buffets of impinging forces that displace him in one direction or another. Self-imposed in elemental space, he spins symmetrically about his own spiritual axis until the parallelogram of process bears down upon him, whereupon he follows the line of the resultant. When the force of the impact is spent, he comes to rest, a self-contained globule of desire as before. . . . [He] is not a prime mover. He is not the seat of a process of living, except in the sense that he is subject to a series of permutations enforced upon him by circumstances external and alien to him." (1919: 73–74)

Given this description, it is a small wonder that the theory of the firm has little to say about the entrepreneur.

A more direct economic analysis of entrepreneurship is provided by Scitovsky (1943). He argues that undertaking entrepreneurial activity involves costs—in terms of earnings forgone—by contracting services to managers. But there are rewards also in

terms of revenues from the economic activity. The difference between the two is net income from entrepreneurship which represents rewards partly to entrepreneurial activity proper, and partly to managerial ability. An entrepreneur undertakes the venture to maximize this net income. He finds this a completely satisfying pursuit since he works not because he wishes to raise his standard of living but because he likes to work; he enjoys the power and prestige associated with being a successful entrepreneur. In an earlier century, he would have been a voyager or discoverer, the motivation being the same: the need for recognition.

The literature on the economics of imperfect competition does not shed much light on the role of the entrepreneur either. In the case of bilateral monopoly or cartels, an appeal is made to game theory to determine equilibrium. The negotiating and organizing expertise of the entrepreneur underlies the arguments, but there is little direct discussion of the entrepreneur's role. The managerial discretion models of the firm (Williamson, 1964), in which the entrepreneur maximizes sales or the number of employees rather than profits, do not come any closer to providing a theory of entrepreneurship. The models allow a wide range of objectives for the entrepreneur. However, once a particular objective is chosen the entrepreneur ceases to be important.

If entrepreneurship is an important input into economic activity, its market deserves an explanation. However, the market is difficult to analyze since psychological factors play an important role. McClelland (1961), explains entrepreneurs as being individuals who have a need for achievement and are not necessarily motivated by the desire for money. They are calculators and planners, not risk-takers—that being the domain of speculators. He argues that such achievers are not individualists and do not necessarily flourish in an environment of private enterprise. They would get just as much satisfaction out of working for a government or manipulating a committee. Clearly, the psychological factors that result in the supply of a critical number of entrepreneurs—a number that triggers off widespread economic activity—are hard to control and not very amenable to policy.

Alternatively, we may proceed by identifying the entrepreneurial functions that are demanded and then determining whether there exist entrepreneurial features that correspond to these functions. For instance, the ability to organize is an important function, and education is an entrepreneurial feature that results in better performance of that function. Policies can then be addressed to improve education

and training programs that enable potential entrepreneurs to acquire the features that contribute to profit making. In the discussion that follows, we explore these issues in more detail.

The Entrepreneurial Functions

There is a difference between entrepreneurship as such and routine management. The latter involves the coordination and execution of well-known and well-established economic activities. The markets for such managerial functions work well in most countries and rewards to services are easily determined. This, however, is not entrepreneurship.

It is entrepreneurship as defined by Schumpeter (1951) that is the subject of this chapter. Thus entrepreneurial functions involve activities where input and/or output markets are not well known and the production function used by the firm is ill-defined. In other words the entrepreneur undertakes new activities and, in this sense, is an innovator.

An important reason why the theory of the firm ignores the importance of entrepreneurial functions is that this theory contains strong assumptions regarding the environment in which the firm operates. It is assumed that firms pursue their objectives with well-defined production functions and known input and output markets. In the real world, of course, this is not true. An innovator does not know precisely how inputs will convert into output. He may be unaware of the cheapest sources of raw material and may have to discover these for himself. He may even have to think up new items of demand and thus create his own product markets. Thus an entrepreneur connects different markets, makes up for market deficiencies, completes the inputs needed for production, and creates firms (Leibenstein, 1968). His functions may include taking risks, since markets for risk-taking may be imperfect because of moral hazard (Akerlof, 1970). Further, it is the entrepreneur's directed effort that results in a firm's *x*-efficiency and guides the firm to the frontier of its production possibility.

To make the concept of entrepreneurial functions operational we shall consider some of them in the context of the market conditions in which the agricultural machinery industry exists in Pakistan. First, this industry is new and uses a relatively new technology, so that production functions are not well defined. Thus the entrepreneur has to be an innovator. Second, the industry uses skilled man-

power, which is scarce, so that the entrepreneur has to actively search for this crucial input into the production process. Third, the industry has limited access to a highly imperfect capital market, so that the entrepreneur has to find new and untapped sources of capital. Fourth, in the face of monopolistic competition, the entrepreneur has to continuously search for new types of agricultural machinery and improve the old models to increase or even retain his share in the market. Fifth, the entrepreneur has to explore and develop new marketing channels to sell his product in areas not directly under his command. Sixth, in the absence of insurance, he has to bear the entire risk of investment. Finally, he has to combine the tasks enumerated above so that his costs per unit are at least as low as those of the moderately efficient firms in the industry.

Our taxonomy of entrepreneurial functions would be of considerable value if we could associate these functions with specific entrepreneurial features. For instance, if we could say that entrepreneurs belonging to a specific social group are more likely than others to have access to capital, then we could argue that a desirable feature for achieving entrepreneurial efficiency is to belong to that group. This cannot be a sufficient condition for efficiency, since for every successful entrepreneur belonging to that social group there may be many others who did not succeed. Over time, however, a pattern does emerge and entrepreneurial functions get associated with social groups whose members have a higher probability of success compared to members of other groups. This pattern may result from the fact that specific social groups make a concerted effort to succeed in specific economic activities in order to have a secure profession.

Relating Functions to Entrepreneurial Features

It would be very useful for policymaking if we knew that entrepreneurs with certain features are more likely to perform entrepreneurial functions successfully than others. We could then concentrate on developing these features and thereby increase the pool of entrepreneurial talent. The best that the literature has to offer in this regard are case studies that attempt to classify entrepreneurs according to their social characteristics. This approach has its limitations since, as pointed out above, only the successful entrepreneurs are studied. Nevertheless, it is useful in identifying their dominant features.

Using evidence from Pakistan collected in interviews with entrepreneurs, Papanek (1967) reports that over 35% of the industrial assets in Pakistan in 1959 were owned by five communities (Malai Memon, Chinioti, Dawoodi Bohra, Khoja Isnashari, and Khoja Ismaili), which together constituted less than 0.3% of the population. Further, most of those who had set up in industry had switched over from trading. A majority of the entrepreneurs had been uprooted from areas that became part of India when the subcontinent was partitioned in 1947. Thus, Papanek's argument is that industrialization in Pakistan was undertaken by closely knit trading groups who were uprooted from India and who, in Pakistan, were provided special incentives (tax holidays, protected markets, and cheap credit) to exercise their entrepreneurial talents.

Altaf (1983) interviewed 196 Pakistani entrepreneurs, mostly Punjabis, to examine their dominant features. He reports that entrepreneurs were motivated more by the desire for independence than profit. Education played an important role in the sense that those with higher education (above ten years) expanded their businesses more rapidly compared to others. Entrepreneurs ranked previous experience in the industry as being vital for success. Considerable occupational mobility was reported. Importantly, belonging to special social groups such as a professional community or bradri was crucial in obtaining scarce capital and technical know-how. Thus Altaf's explanation of Pakistan's industrialization also emphasizes the special feature of entrepreneurs as belonging to specific social groups.

In the next section, we examine the dominant features of entrepreneurs in our sample selected from the agricultural machinery manufacturing industry of Pakistan.

Background of Entrepreneurs in Pakistan's Agricultural Machinery Manufacturing Industry

In order to examine the hypothesis that entrepreneurs constitute a special group in the population, their backgrounds need to be studied. The features that are likely to be important in distinguishing entrepreneurs from others are their origin (whether they are local or refugees), whether they belong to a bradri, their level of general and technical education, their previous experience, and whether or not there are migrant members in their households. The manner in which each of these features contributes to the performance of entrepreneurial functions will be brought out in the course of the discus-

sion. The objective of this chapter is to present a descriptive profile of entrepreneurs in the industry in order to identify their dominant features. This will be of value in subsequent discussions when entrepreneurial functions, specified in terms of investment decisions (chapter 4) and production efficiency (chapter 5), are related to these features. Detailed hypotheses regarding the relationship between the entrepreneurs' backgrounds and the performance of firms will then be presented and tested.

Origin

It is argued that individuals who become entrepreneurs are highly motivated compared to others. This motivation may result from attempts by a previously privileged group to regain social status. Their change in fortunes may have resulted from uprooting and migration. In the case of the Indian subcontinent this happened in 1947, and may to some extent explain the success of migrant entrepreneurs in Delhi, Bombay, and the newly created industrial centers of Pakistan.

The impression in official circles in Pakistan appeared to be that the agricultural machinery sector was "dominated" by "refugees" from India. The term "refugee" implied mainly East Punjabis who had migrated to West Punjab when the province was partitioned in 1947. The term "dominated" was used frequently and somewhat loosely. We interpreted it in two ways. One was that the proportion of "refugee" entrepreneurs among the manufacturers was high. Another was that the largest firms were owned by "refugees." We decided to investigate these hypotheses.

Here the origin of entrepreneurs is studied in terms of a broad migration and mobility pattern. Five categories of origin are considered. There are entrepreneurs who are refugees in the sense discussed above, and entrepreneurs who have set up firms in towns other than the ones in which they lived prior to entering the industry. In this latter context, three categories are considered: entrepreneurs who have moved from "local rural," "other urban," and "other rural" areas to the towns where they live now. These are compared with entrepreneurs who have set up firms in their hometowns (table 2.1).

Our findings are that refugees comprise only 21% of the entrepreneurs in the industry. Thus this interpretation of "domination" by refugees is not supported by our evidence. Further, most of the entrepreneurs live in towns in which they set up their firms prior to 1947. Over 18% of the entrepreneurs moved into the towns from

Table 2.1
Breakdown of Entrepreneurs and Their Firms, by Refugee or Migrant Origin
(figures in parentheses are percentages)

		Migrants				
	Refugees	Local Urban	Local Rural	Other Urban	Other Rural	Total
TOTAL	25(21)	66(55)	21(16)	2(2)	5 (4)	119
CITY						
Daska	0 (0)	14(67)	6(29)	0(0)	1 (4)	21
Faisalabad	9(45)	11(55)	0 (0)	0(0)	0 (0)	20
Multan	6(30)	13(65)	0 (0)	1(5)	0 (0)	20
Gujranwala-Sialkot	0 (0)	9(45)	8(40)	0(0)	3(15)	20
Lahore	3(17)	8(44)	5(28)	1(6)	1 (5)	18
Mianchannu	7(35)	11(55)	2(10)	0(0)	0 (0)	20
PRODUCT GROUP						
Tubewells	2 (8)	13(52)	7(28)	2(8)	1 (4)	25
Threshers	11(23)	26(56)	7(15)	0(0)	2 (4)	46
Trolleys	0 (0)	8(57)	5(36)	0(0)	1 (7)	14
Tractor Attachments	3(18)	10(63)	2(12)	0(0)	1 (6)	16
Sugarcane & Chaff Cutters	9(50)	9(50)	0 (0)	0(0)	0 (0)	18
SIZE (LABOR)						
0–5	5(11)	23(52)	13(29)	1(2)	2 (4)	44
6–10	7(20)	20(57)	5(14)	1(3)	2 (6)	35
11–20	10(35)	14(50)	3(10)	0(0)	1(35)	28
>20	3(25)	9(75)	0 (0)	0(0)	0 (0)	12
SIZE (VALUE OF OUTPUT IN RUPEES)						
Up to 100,000	3(20)	7(47)	5(33)	0(0)	0 (0)	15
100,001–500,000	3(11)	16(62)	7(27)	0(0)	0 (0)	26
500,001–1,000,000	7(29)	10(42)	4(17)	1(4)	2 (8)	24
1,000,001–5,000,000	12(28)	24(57)	1 (2)	3(7)	2 (5)	42
Above 5,000,000	1 (8)	9(75)	1 (8)	0	1 (8)	12

the surrounding rural areas. Only a small proportion (6%) came from areas other than the ones where they had set up their firms.

Among the towns in which the industry is located, the highest concentration of refugee entrepreneurs is in Faisalabad, followed by Mianchannu and Multan. In 1947 Faisalabad was a well-established center for agricultural tools; most entrepreneurs there were Sikhs or Hindus. After the partition, Muslim entrepreneurs from East Punjab (mostly from Batala) replaced the non-Muslims in Fais-

alabad. Mianchannu and Multan, on the other hand, though located in agriculturally rich areas, were not known as centers for agricultural machinery. The refugee entrepreneurs included in our sample who came from these towns were initially involved either in wholesale and retail trade as retailers of agricultural tools, ironmongers, and arhtias (grain merchants), or in cultivating small plots of land allotted to them in exchange for land owned in East Punjab. They switched to the manufacture of agricultural machinery in the late 1960s and early 1970s after the success of Green Revolution technology had created demand for agricultural machinery.

Perhaps what is implied by "domination" is that refugees own the largest firms in the industry. To comment on "domination" by refugees, we use two measures of size. In labor force terms, most firms owned by refugee entrepreneurs (40 firms, or nearly 40% of them) employ from 11 to 20 workers and lie in the medium range. Most firms owned by "local urban" entrepreneurs (43 firms, or 65% of them) lie in the smallest size category, employing less than ten workers. But if size is measured in terms of the value of output, 13, or 50% of the firms owned by refugee entrepreneurs, have output values greater than Rs 1 million. Compared to this, 35 firms in this category are owned by "local" entrepreneurs (which represent 40% of the total "local" firms). Clearly, the basis for the argument that refugee entrepreneurs dominate the industry is pretty thin. But "domination" is a notion open to many interpretations. It may, for example, be based on the number of firms that fall in the largest size category. We learned that the largest firm in terms of employment was owned by a "local" entrepreneur who employed more than 60 workers. Further, there were 11 firms owned by "local" entrepreneurs with a total output exceeding Rs 5 million in value. There was only one firm owned by a "refugee" entrepreneur in this size category.

To sum up, our evidence does not lend support to the view of domination by refugees that is held by government officials in Pakistan. Further, distinction between entrepreneurs on the basis of their origin does not appear to act as a barrier to entry in the industry.

Bradri

"Bradri" in Pakistan is a somewhat imprecise term. It is loosely related to the Hindu caste system and becomes important in the social system only with major events, such as death and marriage. Non-market exchanges between households also work more successfully within bradris. For instance, borrowing and lending capital, family

labor, and even draft animals take place more frequently and successfully within a bradri than across bradris. Among the noncultivating section of the population, bradris are frequently identified as belonging to professions such as lohar (blacksmith), tarkhan (carpenter), mochi (cobbler), and raj (mason). To what extent do bradris contribute to the "special group" view of entrepreneurship?

The main bradris engaged in the production of agricultural machinery are the lohar, Arain, Kashmiri/Butt, Jat, Rajput, and Sheikh bradris. These comprise 103 out of the 119 entrepreneurs interviewed (table 2.2). The remaining 16 entrepreneurs belong to the Syed (2), Pathan (3), Butt (2), Dhillon (2), Awan (3) bradris, plus the Khakwani, Gujjar, Bhatti, and Kharal bradris (1 entrepreneur each). Lohars comprise the largest single bradri (70 entrepreneurs, which is nearly 60% of the total). Most lohars like to classify themselves as Mughals because they were an important occupational group when India was under Mughal rule from the sixteenth to the eighteenth century. In those earlier times lohars were at the core of any war machine. Rajputs (10) and Arains (9) are the other important bradris engaged in this industry. In our sample only five entrepreneurs belong to the Sheikh bradri, which is generally considered to provide the entrepreneurial pool in Pakistan. Among the non-Punjabi bradris only the Baluch (2) and Pathan (3) ones are important. Interestingly, there are two Syed entrepreneurs in our sample, indicating that this bradri, the highest-ranking social group, may be shedding the traditional attitudes of avoiding industrial entrepreneurship.

The lohar bradri is the largest single bradri in Daska (16), Faisalabad (12), Gujranwala-Sialkot (17), and Mianchannu (12). In Multan there are 10 lohar entrepreneurs and five non-Punjabi entrepreneurs (Baluch 2, Pathans 3). In Lahore, the entrepreneurs are from a more diffused bradri background. Only three are Mughals. Arains (6) and Kashmiri Butts (4) both are more important. Other bradris such as the Jats (2), Rajputs (1), Awan (1), and Sheikhs (1) are also represented.

Although lohars are an important entrepreneurial group in our sample, the firms that they own are mainly small (measured in terms of the number of workers employed). Sixty-five out of 70 lohar entrepreneurs have firms employing 20 workers or less. Two lohar entrepreneurs employ 20 to 40 workers and three employ 40 to 60 workers. However, if we use the value of output as the measure of size, the picture changes. Most lohar entrepreneurs (44) belong to the larger size category, producing goods with an annual value greater than Rs 500,000. Each entrepreneur belonging to the Arain,

Table 2.2
Breakdown of Entrepreneurs and Their Firms, by Bradri
(figures in parentheses are percentages)

	Mughal	Arain	Kahmiri/ Butt	Jat	Rajput	Sheikh	Others	Total
TOTAL	70(59)	9 (8)	5 (4)	4 (3)	10 (8)	5 (4)	16(13)	119
CITY								
Daska	16(76)	0 (0)	0 (0)	0 (0)	4(19)	1(14)	0 (0)	21
Faisalabad	12(60)	1 (5)	0 (0)	1 (5)	4(20)	0 (0)	2(10)	20
Multan	10(50)	0 (0)	1 (5)	1 (5)	0 (0)	1 (5)	7(35)	20
Gujranwala-Sialkot	17(85)	1 (5)	0 (0)	0	0 (0)	1 (5)	1 (5)	20
Lahore	3(17)	6(33)	4(22)	2(11)	1 (6)	1 (6)	1 (6)	18
Mianchannu	12(60)	1 (5)	0 (0)	0 (0)	1 (5)	1 (5)	5(25)	20
PRODUCT GROUP								
Tubewells	13(52)	2 (8)	3(12)	1 (4)	5(20)	0 (0)	1 (4)	25
Threshers	30(65)	2 (4)	0 (0)	0 (0)	1 (2)	2 (4)	11(24)	46
Trolleys	5(36)	4(29)	1 (7)	1 (7)	0 (0)	1 (7)	2(14)	14
Tractor Attachments	12(75)	0 (0)	1 (6)	1 (6)	0 (0)	2(12)	0 (0)	16
Sugarcane & Chaff Cutters	10(56)	1 (5)	0 (0)	1 (6)	4(22)	0 (0)	2(11)	18
SIZE (LABOR)								
0–5	27(61)	5(11)	2 (5)	2 (5)	3 (7)	1 (2)	4 (9)	44
6–10	21(60)	2 (6)	1 (3)	2 (6)	4(11)	2 (6)	3 (9)	35
11–20	17(61)	1 (3)	2 (6)	0 (0)	2 (6)	1 (3)	5(18)	28
>20	5(42)	1 (8)	0 (0)	0 (0)	1 (8)	1 (8)	4(33)	12
SIZE (VALUE OF OUTPUT IN RUPEES)								
Up to 100,000	10(67)	1 (7)	0 (0)	0 (0)	1 (7)	2(14)	1 (7)	15
100,001–500,000	16(62)	2 (8)	1 (4)	0 (0)	4(15)	0 (0)	3(12)	26
500,001–1,000,000	13(54)	4(17)	0 (0)	1 (4)	2 (8)	1 (4)	3(12)	24
1,000,001–5,000,000	22(52)	1 (2)	4(10)	3 (7)	2 (4)	2 (4)	8(20)	42
Above 5,000,000	9(75)	1 (8)	0 (0)	0 (0)	1 (8)	0 (0)	1 (8)	12

Jat, or "other" bradri also produces goods with a total value exceeding Rs 5 million.

Most lohar entrepreneurs manufacture threshers and tubewell engines and pumps. This is an interesting statistical contrast, since threshers are a relatively new product for which there is a potentially very high demand and a good rate of return on investment. Tubewell engines and pumps, on the other hand, are old items that were in great demand in the early 1960s but have now been replaced by electric motors. Rajput entrepreneurs are engaged mainly in die-

sel engine manufacturing. Most Arain entrepreneurs manufacture trolleys, while the Pathan and Baluch entrepreneurs manufacture threshers.

The bradri is a strong candidate for an entrepreneurial feature that may determine a firm's entry into the industry. The lohar entrepreneurs have the advantage of long bradri experience, which has enabled them to acquire knowledge of the technology and of the input and output flows of the production function. As a close-knit group, the bradri helps fellow lohars to acquire the technical knowledge that is crucial for them to enter the industry. Most importantly, they have better access to skilled workers since they too belong, in general, to the lohar bradri (see chapter 3). In chapter 5, on production efficiency, we shall explicitly test the hypothesis that these features of lohar entrepreneurs render them more efficient than others.

Education

Entrepreneurs are innovators who find new ways of doing things, and thus break with tradition. They have an outlook that enables them to transcend the existing patterns of economic activity—an outlook that is different and more dynamic compared to that of the rest of the society. Education contributes in an important way to acquiring that outlook. As we find emphasized in the literature on human capital (see, for example, Singer, 1983), education helps people to acquire information and to make logical connections that enable them to sift the relevant from the irrelevant. Technical education, in particular, is very important when production functions are not clearly defined. In the discussion that follows, a profile of the level of general education among the entrepreneurs in our sample is presented. However, since we are concentrating on the engineering industry, the question of whether technical education is an important variable in the making of an entrepreneur is also asked. A final question posed is whether technical and general education are important in the choice of items produced by the firms and in determining plant size.

Thirty-seven entrepreneurs (31%) in our sample have had no formal schooling at all (table 2.3). More than half of the entrepreneurs in Lahore and Gujranwala-Sialkot have never been to school. Another 32 (27%) have had some formal education but without matriculating (completing 10 years of education). The highest concentration of such entrepreneurs exists in Daska. There are 29 entrepreneurs (24%) with education extending to matriculation. The highest concentration of these is in Faisalabad.

Table 2.3
Breakdown of Entrepreneurs and Their Firms, by Education
(figures in parentheses are percentages)

	No schooling	Below Matriculation	Matriculation	Intermediate	B.A.	M.A.	No Response	Total
TOTAL	37(31)	32(27)	29(24)	13(11)	1(1)	6 (5)	1(1)	119
CITY								
Daska	7(33)	11(52)	3(14)	0 (0)	0(0)	0 (0)	0(0)	21
Faisalabad	2(10)	3(15)	10(50)	5(28)	0(0)	0 (0)	0(0)	20
Multan	6(30)	4(25)	5(20)	2(10)	1(5)	2(10)	0(0)	20
Gujranwala-Sialkot	11(55)	9(45)	0 (0)	0 (0)	0(0)	0 (0)	0(0)	20
Lahore	9(50)	2(11)	2(11)	3(17)	0(0)	1 (5)	1(5)	18
Mianchannu	2(10)	3(15)	9(45)	3(15)	0(0)	3(15)	0(0)	20
PRODUCT GROUP								
Tubewells	9(36)	10(40)	2(8)	3(12)	0(0)	0 (0)	1(4)	25
Threshers	12(26)	13(26)	13(28)	4 (9)	1(2)	4 (9)	0(0)	46
Trolleys	7(50)	5(36)	1 (7)	1 (1)	0	0	0(0)	14
Tractor Attachments	8(50)	3(18)	3(18)	0 (0)	0(0)	2(12)	0(0)	16
Sugarcane & Chaff Cutters	1 (5)	2(11)	10(55)	5(28)	0(0)	0 (0)	0(0)	18
SIZE (LABOR)								
0–5	17(39)	17(39)	8(18)	1 (2)	0(0)	1 (2)	0(0)	44
6–10	11(31)	10(20)	8(23)	3 (9)	1(3)	1 (3)	1(3)	35
11–20	7(25)	4(14)	9(32)	7(25)	0(0)	1 (4)	0(0)	28
>20	2(17)	1 (8)	4(33)	2(17)	0	3(25)	0(0)	12
SIZE (VALUE OF OUTPUT IN RUPEES)								
Up to 100,000	6(40)	6(40)	2(14)	0 (0)	0(0)	1 (7)	0(0)	15
100,001–500,000	8(31)	9(35)	6(23)	2 (8)	1(4)	0 (0)	0(0)	26
500,001–1,000,000	6(25)	8(33)	6(25)	2 (8)	0	1 (4)	1(4)	24
1,000,001–5,000,000	12(29)	9(21)	12(29)	7(17)	0(0)	2 (4)	0(0)	42
Above 5,000,000	5(42)	0 (0)	3(25)	2(17)	0(0)	2(17)	0(0)	12

Education beyond matriculation would put entrepreneurs in the educated elite in Pakistan, since less than 1% of the total population Pakistan studies beyond that level. Only 13 entrepreneurs (11%) report having received education up to "intermediate" level (two years of college). Most of these entrepreneurs are located in Faisala-

bad. Seven entrepreneurs (6%) in our sample report that they received a university education. Of the three graduate entrepreneurs in Multan, two had master's degrees, in economics and law. The number of entrepreneurs with master's degrees in Mianchannu and Lahore, respectively, is three and one. Entrepreneurs with no formal schooling at all and those with education only up to matriculation own the smallest firms—up to five workers—in our sample. However, the owner of the largest firm in our sample—over 60 workers—also had no formal schooling. Those with higher education (intermediate and above) generally own larger firms; 13 out of 20 such firms employ more than 10 workers. Entrepreneurs with a master's degree are evenly spread in firm size-classes: one each in 0–5, 5–10, 10–20, 20–40 workers' size-classes and two in 40–60 workers' size-classes. Thus, given this definition of firm size, the entrepreneurs with higher education tend to have larger firms compared to the others.

The relationship between education and firm size noted above is confirmed when we define size in terms of the value of output produced. Thirty-eight percent of the entrepreneurs with no formal schooling at all own firms that produce machinery worth less than Rs 500,000 annually. Twenty-eight percent of the firms owned by entrepreneurs with education up to matriculation also fall in this size category. However, 76% of the firms in our sample are owned by entrepreneurs with higher education, and they produce goods worth more than Rs 500,000 annually. At the same time it must be noted that there are exceptions to this pattern. Thus, of the eight firms in the largest size-category producing goods worth more than Rs 5,000,000, seven are owned by entrepreneurs who either have no formal education at all or have been educated up to matriculation only.

Does education matter in the line of production chosen by the entrepreneurs? Among the 46 firms manufacturing threshers, nine are owned by entrepreneurs with higher education, 13 by entrepreneurs with education up to matriculation, and 12 by entrepreneurs with no formal schooling at all. These numbers constitute respectively, 45%, 41%, and 32% of the entrepreneurs in the three education levels.

It would be useful to know whether a background of formal technical education is an important characteristic of the entrepreneurs in our sample. To look at this issue, we divided the entrepreneurs into four categories on the basis of level of technical education acquired: no technical education at all, a certificate, a

diploma, and a university degree in technical education. Only six of the 119 entrepreneurs reported any technical education at all. Of these, one (in Multan) had a certificate in technical education, one (in Daska) had a diploma, while one each in Mianchannu and Multan and two in Faisalabad had university degrees in technical education. Such entrepreneurs own, in general, medium-sized firms (in both terms of employment and value of output). Three entrepreneurs (two with degrees and one with a certificate) produce mainly threshers and tractor-driven implements, which constitute a new and relatively more sophisticated product line. One degree-holder in Faisalabad is involved mainly in the manufacture of chaff cutters and sugarcane crushers. Thus it appears that the entrepreneurs with higher technical education are involved in the manufacture of relatively more sophisticated machinery.[1]

Clearly, access to education does not restrict entry to the industry. But it may be important in determining the firm's ability to borrow in the highly regulated capital market, and may also be important in determining a firm's growth. Education—in particular technical education—may become a barrier to entry in the future as the technology used by the industry becomes more sophisticated. As things stand now, the technology is fairly simple. Most engineering processes are undertaken without technical drawings; straightforward rules of thumb are used instead.

Previous Experience

The previous experience of entrepreneurs may be important in determining entrepreneurial performance. Experience in related industry can familiarize entrepreneurs with the production function in the industry. Experience in related trading activity results in useful marketing knowledge regarding both inputs and outputs. When capital markets are imperfect, experience in any economic activity that involves dealing with the financial market contributes to improving entrepreneurial efficiency.

Overwhelmingly, entrepreneurs in our sample reported that before entering the industry they were skilled workers who manufactured simple agricultural tools and implements such as animal-drawn ploughs and scythes. Eight respondents said that they were involved in wholesale and retail trade. Of these, six were trading in items not directly related to agriculture (mostly they were ironmongers). One entrepreneur in Multan was a retailer of agricultural implements, and the other was an arhtia in Mianchannu, trading in grain and other agricultural produce. Nine respondents were

directly involved in agricultural cultivation. Of these, five were landowners (three in Mianchannu, one each in Lahore and Multan), and four reported that they were tenant farmers before entering the industry (two in Lahore and one each in Multan and Faisalabad). Of the entrepreneurs with agricultural background, the smallest in terms of farm size had a holding of 10 acres in Multan and the largest owned 75 acres in Mianchannu.

Neither the choice of product line nor firm size appears to be closely related to the previous experience of entrepreneurs. There were a few cases of entrepreneurs who manufactured agricultural machinery in addition to their previous product lines. For example, one entrepreneur in Lahore manufactured cold storage plants before he switched over to agricultural machinery. In the summer, he went back to manufacturing cold storage equipment. In Sialkot an entrepreneur manufactured cutlery and steel crockery to mop up excess capacity in his diesel engine manufacturing unit. In both instances, the entrepreneur's previous experience helped in switching over to the new product line.

We came across only one entrepreneur (a landowner turned manufacturer in Mianchannu) who complained to us that his business was bad because he had had no previous experience in this line. We later discovered that he had earlier tried his hand at grain marketing and had failed. His neighbors complained bitterly that, not having the skills himself, he was unable to train his own workers. Instead, he "stole" the neighbors' workers by offering slightly more attractive terms.

Migration

Migration may be an important source of funds given imperfections in capital markets (Stark, 1975; Nabi, 1984). It has also been argued that in Pakistan remittances are channeled into productive uses in the form of investments in small firms (Hamid, 1983). We decided to investigate this.

The survey shows that only seven entrepreneurs, four in Mianchannu, and one each in Daska, Faisalabad, and Multan, have household members who work abroad. Five of these are in the Middle East, one in the United Kingdom, and one in the United States. Thus, on the face of it, it would seem that remittances do not play an important role in the industry. However, the role of remittances is subtle and indirect and needs careful analysis before we pass judgment on their impact on industrialization.

Perhaps remittances alone do not turn ordinary people into entrepreneurs. However, they can help to realize potential entrepreneurship by removing the capital constraint. In our pilot survey of the industry, we questioned an entrepreneur in Daska on this issue. He echoed the popular sentiment by insisting that migrants' remittances were being frittered away in wasteful consumption. However, when he was questioned closely regarding the source of his funds, we learned that he was taking short-term loans from one of his neighbors who usually has spare cash because he has two sons working in the Middle East. Later, in our main survey, we discovered that remittances play a significant role in the "committee" system, which complements the imperfect capital markets for this industry. (For details of this system, see chapter 4.) Thus, although there is little evidence of a direct link between entrepreneurship and migration, there are strong indirect linkages that help in realizing entrepreneurial potential in the industry.

Concluding Remarks

In this chapter, an attempt has been made to present a systematic analysis of entrepreneurship in economic activity. The role of the entrepreneur in organizing production has been discussed in terms of entrepreneurial functions. In particular, the background of entrepreneurs in the Pakistani agricultural machinery industry has been discussed in detail in order to determine whether they have important features that set them apart from others in the society. The manner in which these special features enable entrepreneurs to perform entrepreneurial functions has also been discussed.

We conclude that the neoclassical theory of the firm is unable to deal with entrepreneurship because of the assumption that input and output markets function well, and production functions are well-known. It is precisely because these assumptions do not hold in developing countries that the role of entrepreneurs becomes important. Their functions include identifying sources of demand for the products and supply of raw material and other inputs, organizing informal capital markets, and finding new techniques of production. Some individuals in society are better suited to performing these entrepreneurial functions than others. In a segmented society, it may be that special groups are more likely than others to become entrepreneurs.

Our analysis of the sample of entrepreneurs in the agricultural machinery industry suggests that a substantial proportion, 21%, are "refugees" who migrated to Pakistan from regions that went to India in 1947. However there is little evidence that they "dominate" the industry, as is commonly believed. Most (60%) of the entrepreneurs belong to the lohar bradri, whose members help each other in acquiring technical skills to innovate. Their commonly shared previous experience in related trades implies that they are familiar with the technological environment and thus have an advantage over other bradris. Sixty-three percent of the entrepreneurs have had formal education up to matriculation and only 11% percent beyond that level. Entrepreneurs with technical education are very rare. On-the-job training is still considered to be the best form of technical education.

An important feature of entrepreneurship is the ability to raise capital. In this regard, access to remittances from friends or relatives who have migrated abroad is important. However, access occurs through subtle channels and information on these channels is difficult to find.

To sum up, the evidence indicates that belonging to the lohar bradri may be an advantage. Having fled their countries as refugees in 1947 may have heightened the lohars' motivation to exercise entrepreneurial talent in this industry. However, the lohar bradri is a large group, and larger still was the number of refugees in 1947. Those who became successful entrepreneurs were only a subset of these refugees. Something more, it appears, was needed for success: perhaps their previous experience in related trades.

It needs to be emphasized that our comments are based upon analysis of the background of entrepreneurs who were successful. For every successful entrepreneur, there must be many more who did not succeed. A proper analysis would have to take these unsuccessful entrepreneurs into consideration as well. Only then would we avoid the problem of "selectivity bias" (for which see chapter 4). We have only indirect evidence of this bias. In our interviews with workers, we asked whether they would like to set up their own firms and, if so, what were the constraints. Many workers who belonged to the lohar bradri and were also refugees replied that their lack of access to capital prevented them from setting up their own firms. Thus it would appear that the main barrier to entry is access to capital, not membership in the lohar bradri, even though the latter influences the choice of product line.

It would be illuminating to extend our analysis to determine how important entrepreneurial background is in determining success. An attempt is made in chapter 5, where formal statistical procedures are used to examine the impact of entrepreneurial background on a firm's efficiency.

◆ *Chapter 3* ◆

The Labor Market

Crucial to the development process is the availability of a labor force that is hardworking, ambitious in acquiring skills, and flexible in adapting to changes in technology and demand patterns. In the early stages of industrialization the labor force is likely to fall short of these ideal characteristics. This creates degradation and bottlenecks in the labor market that can retard development. These factors, which contribute to the poor workings of the labor market, result in a number of problems such as unavailability of appropriate skills when required, poor geographical distribution of the labor force, and difficulties in identifying and selecting work forces suitable to the production process.

Although the problems outlined above are well-known—referred to in the development literature as rigidities in labor markets—they are seldom analyzed with the rigor that they deserve. This chapter addresses the relevant issues with detailed data on the workings of the labor market in the important engineering machinery manufacturing sector. The principle findings of this analysis show that the labor market is evolving rapidly with a fair amount of skill specialization. However, high commuting costs and familial responsibilities may affect the overall size of the labor market. Moreover, as in the case of entrepreneurs, the bradri factor is important in acquiring skills and in securing employment. We observe, furthermore, that small and large firms have different employment patterns: the former emphasizing the traditional apprenticeship patterns while the latter

combine highly skilled foremen with unskilled workers. Each contributes, in it own way, to the development process.

The chapter also addresses the important issue of the pattern of labor demand associated with the technology used in the industry. Unlike previous research on this important issue, we have provided evidence on the production processes that show that firms can easily substitute capital for labor. The implication is that as wages rise, firms switch over to capital-intensive methods, thus altering the composition of skills in the labor force. This indicates also the poor bargaining strength of workers in the industry.

The Pakistani labor market has undergone rapid change because of both internal and overseas migration. In recent years, the latter has become very important, with nearly two million workers—about 8% of the labor force—migrating to work in the oil-rich Middle East. Our analysis of mobility in the engineering industry labor market enables us to comment on several important aspects of the impact of overseas migration on the domestic labor market. An important finding in this context is that rapid labor mobility due to overseas migration may have contributed to the deterioration of skills. However, when skilled workers return from overseas with substantial savings, they have the potential of becoming entrepreneurs in their own right. We examine some of the hurdles they face in entering the industry as firm owners.

Our analysis of the labor market has several important implications for policy. First, the importance of education in developing a skilled force, which can respond to increasing sophistication in the industry, cannot be overemphasized. Sadly, public education in Pakistan at the primary level falls far short of the likely future needs of the industry. Second, our analysis points strongly to the strengthening of technical training through policies that improve apprenticeship programs in the industry and in other private and public institutions. Third, to encourage labor intensive production methods, macro policies need to be streamlined to remove subsidies that alter the price of capital. Finally, our analysis shows that bottlenecks and barriers that hinder workers—especially skilled workers who could become entrepreneurs—from entering industry should be removed in order to facilitate expansion of the industry.

The chapter is organized as follows. The first section presents the structure of the labor market faced by the agricultural implements industry, including the employment pattern of different skills, workers' profile in terms of age, education and dependency ratio, and the wage structure. The second section is concerned with explanations of inter-firm variations in employment. These explana-

tions are made, first indirectly, by analyzing a labor productivity function and, then directly, by estimating employment of different skill categories. In the third section, we present estimates of earnings function and examine hypotheses concerning human capital and labor market segmentation. The final section addresses the issues of job mobility and overseas migration.

The Structure of the Labor Market

The Employment Pattern

We begin the discussion of the labor market by examining the employment pattern in the industry. This represents the demand side of the market and shows differences in skills demanded that in turn, reflects the technology used by firms.

Altogether, 1,293 workers were employed by the 119 firms in our sample, which was nearly 11% of the workers employed in the engineering machinery industry of the Punjab's small-scale sector (Small Industries Survey, 1976/77). We report employment by the following five skill categories: "skilled workers" (which include fitters, turners, and shapermen); "semiskilled workers" (painters, welders, and helpers); "unskilled workers"; "apprentices"; and "foremen." Foremen are usually considered to be highly skilled generalists who supervise skilled workers. In most cases the owner of the firm is also the foreman. Accountants and managers (munshis) are rarely employed as a separate category. Most owners handle their own accounts and management problems. Occasionally several firms get together to share a munshi to take care of paper work arising out of dealings with banks and other government institutions, but this is not a widespread practice.

Tables 3.1 and 3.2, respectively, present the skill pattern of employment by firm size and product group. The vast majority of workers in the industry (65%) are skilled; only 10% of the labor force consists of unskilled workers. It should be remembered that the employment figures reported here are averages for the whole year. As mentioned in chapter 1, activity in the industry is seasonal, so that the number of unskilled workers employed in the industry to handle materials during peak periods increases three- to fourfold. There is no sharp difference between the small firms (employing less than 10 workers) and the large ones regarding the proportion of skilled workers to total workers employed. If we consider the employment pattern by product groups, we find that the proportion

Table 3.1

Skill Pattern of Employment, by Firm Size
(figures in parentheses are row and column percentages)

	Total Firms	Total Workers	Skilled	Semi-skilled	Un-skilled	Appren-tices	Foremen
Firm Size							
1–5	44	163	134(82)	—	—	29(18)	—
		(13)	(16)	—	—	(18)	—
6–10	35	265	168(63)	29(11)	5 (2)	59(22)	4 (2)
		(20)	(20)	(24)	(4)	(37)	(10)
11–20	28	417	282(68)	32 (7)	40(10)	40(10)	23(15)
		(32)	(53)	(26)	(25)	(25)	(59)
>20	12	448	264(59)	60(13)	79(18)	33 (7)	12 (3)
		(35)	(31)	(50)	(64)	(20)	(31)
TOTAL	119	1293	848(65)	121 (9)	124(10)	161(13)	39 (3)

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

Table 3.2

Skill Pattern of Employment, by Product Group
(figures in parentheses are row and column percentages)

	Total Firms	Total Workers	Skilled	Semi-skilled	Un-skilled	Appren-tices	Foremen
PRODUCT GROUP							
Tubewells	25	160	125(78)	8 (5)	3 (2)	23(14)	1 (1)
		(12)	(12)	(7)	(2)	(15)	(3)
Threshers	46	658	357(54)	82(13)	101(15)	92(14)	26 (4)
		(51)	(42)	(68)	(82)	(57)	(67)
Trolleys	14	76	43(57)	9(12)	2 (3)	20(26)	2 (3)
		(6)	(5)	(7)	(1)	(12)	(4)
Tractor	16	89	76(85)	—	—	8 (9)	5 (6)
Attachments		(7)	(9)	—	—	(5)	(13)
Sugarcane &	18	310	247(80)	22 (7)	18 (6)	18 (6)	5 (1)
Chaff Cutters		(24)	(29)	(18)	(15)	(11)	(13)
TOTAL	119	1293	848(65)	121 (9)	124(10)	161(13)	39 (3)

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

of skilled workers to all workers is larger in firms manufacturing tubewells, tractor attachments, and sugarcane cutters/chaff cutters compared to thresher and trolley manufacturing firms. Thresher manufacturing firms account for the bulk of employment generated in the industry. More workers are hired in all skill categories.

An interesting pattern emerges regarding the apprenticeship program in the industry. It appears that large and small firms have more or less the same (absolute) number of apprentices. This implies that apprentices are a larger proportion of the work force in small compared to large firms—a revealing aspect of firm organization. What happens is that small firms more actively encourage family members to take up apprenticeship in the firm and thus supplement the skilled work force. Large firms, on the other hand, rely more on the market to purchase the services of trained skilled workers.

Most firms that employ foremen (that is, foremen who are not also firm owners) are relatively large and are concentrated in the thresher manufacturing group of firms. This is probably because thresher manufacturing requires coordinating several production stages and therefore supervising the coordination. Also, as firm size increases, more workers are hired in the market, and supervision becomes essential to avoid shirking of work effort.

In the next section employment functions in the industry are formally estimated and the variables that explain the demand for specific skills are identified. Later in chapter 5 other labor-related features of the firm are explored in the context of choice of technology and the associated labor intensity of the production process.

A Profile of Workers

To understand the nature of the labor market faced by the industry, we focus next on some supply-side features of the market. Among the issues explored are: How important are non-market relationships among workers and between workers and employees? Are commuting costs important in limiting the size of the market? Workers' education is also profiled here.

Some demographic data are useful in this context. Table 3.3 shows that the majority of workers are between the ages of 18 and 35; this holds for all skill-categories of workers except apprentices, most of whom are between 13 and 18. Foremen tend to be slightly older than other skilled workers because experience, measured in

Table 3.3
Age Profile of Workers, by Skill-Category
(percentages)

	< 13 Years	13–17	18–24	25–34	35–49	> 50 Years
Skilled	—	9	35	34	22	—
Semiskilled	—	33	60	7	—	—
Apprentices	13	74	13	—	—	—
Foremen	—	—	20	33	35	10

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

years of service, is the most important qualification in reaching the status of foreman.

Nearly 56% of the workers are below age 25, and 44% are married (see table 3.4). However, the number of dependents, which include parents, brothers and sisters, and other members of the extended family, remains fairly large, ranging from eight for foremen to four for semiskilled workers, the mean for all workers being 4.5. Thus, even if they are single, many workers support dependents, which is likely to result in their low reservation wage, the minimum wage they are willing to accept, and restricts their mobility to look for alternative employment opportunities.

Distance between residence and place of work may indicate the geographic size of the labor market. Nearly 49% of the workers reside within one mile of their place of work, which implies that commuting costs may be an important determinant of the size of the labor market. Another 34% reside between one and three miles, and about 18 percent between three and five miles (table 3.4). A breakdown of commuting distance by size of town indicates that workers employed in firms located in large cities such as Lahore, Gujranwala, Faisalabad, and Multan are mainly urban residents, while those in small towns such as Mianchannu and Daska travel relatively long distances to work. Thus it appears that the geographic "catchment area" of the labor market is bigger for small towns than for large cities. This is partly because skilled workers are more thinly spread out in rural areas and belong to the traditional lohar biradri, which continues to live in and serve the dispersed rural communities.

Table 3.4
Workers' Household Description and Commuting Pattern

	Percent Married	Mean No. of Dependents	Commuting Distance (percent) (< 1 Mile)	(1–3 Miles)	(3–5 Miles)
Skilled	57%	6	49%	34%	17%
Semiskilled	27	4	53	27	20
Apprentices	12	—	38	35	27
Foremen	80	8	67	27	6

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

The bradri profile is reported in table 3.5. Nearly 39% of the workers belong to the lohar bradri (see chapter 2 for a discussion of this bradri), with the highest concentration among skilled workers. We saw earlier that many of the firm owners also belong to it. Thus we wanted to explore how important the bradri factor is in firm organization. To this end, we asked each worker three interlinked questions: (1) whether they were related to firm owners; (2) whether other relatives worked in the same firm; and (3) whether there were other relatives in the same industry. The first question enables us to comment on the view that small firms employ family labor, and can therefore avoid the supervision problems (to ensure appropriate effort) that face large firms, relying on labor contracted in the market. The evidence indicates that only 18% of all workers are related to firm owners. However, 40% of the foremen are, and

Table 3.5
Bradri Status of Workers and Kinship in Employment (percentages)

	Lohars	Related to Firm Owners	Other Relatives in Same Firm	Other Relatives in Same Occupation
Skilled	48	17	8	59
Semiskilled	20	13	2	67
Apprentices	13	20	6	63
Foremen	33	40	—	40

Note: Skilled workers are turners, fitters, and shapermen, semiskilled workers are welders, painters, and helpers.

Table 3.6
Education Levels Attained by Workers
(percentages)

	Illiterate	Up To Primary (< 5 Years)	Up To Middle (< 8 Years)	Up To Matriculation (< 10 Years)
Skilled	18	40	31	11
Semiskilled	8	50	42	—
Apprentices	17	16	50	17
Foremen	—	—	80	20

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

it is their task to supervise. Thus, to some extent, family oriented firm organization is consistent with the evidence.

Nearly 7% of the workers report that their relatives are employed in the same firm in which they work. This is too small a percentage to suggest either that being related to other employees in the firm plays an important role in strengthening the workers' bargaining position in negotiating wage contracts and working conditions, or rather that it strengthens employers, since trouble caused by one family member means that others will be affected. Nearly 60% of workers report that members of their family are employed in other firms in the same industry. Thus the bradri factor is important in the industry not only for entrepreneurs, but also for workers. It is probably quite important in diffusing skills and aiding job search.

Finally, none of the workers reported education beyond matriculation, or the first 10 years of education (table 3.6). There was also no case of any worker having received education in a government-sponsored training institute. Most (52%) of the workers had five years or less of school. Workers did report long apprenticeships and were unanimous that this was what counted in getting employment. Foremen were the best schooled of the workers having middle- and matriculation-level education. Some 16% of all workers had never attended a school at all.

The Wage Structure

Tables 3.7 and 3.8 report the wage structure in the industry and the variation in wages by workers' characteristics. These include age,

Table 3.7
Mean Monthly Wages of Workers, by Firm Size, City, and Product Group (Pak Rs)

	Skilled	Semiskilled	Apprentices	Foremen
FIRMS EMPLOYING				
< 10 workers	763.40	575.00	242.50	680.00
> 10 workers	884.22	613.20	286.61	925.16
FIRMS LOCATED IN				
Daska	831.25	632.31	316.13	878.23
Gujranwala-Sialkot	757.50	641.67	305.26	815.13
Faisalabad	867.17	529.40	268.13	916.28
Multan	822.52	612.32	288.73	897.18
Lahore	806.29	550.00	303.14	906.23
Mianchannu	725.00	586.71	343.37	918.13
FIRMS MANUFACTURING				
Threshers	752.56	662.21	312.50	937.12
Tubewells	841.67	510.00	308.41	811.12
Other Machinery	825.51	579.17	336.47	816.67

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

education, and bradri, as well as industrial characteristics such as firm size, its location, and product specialization.

The large firms, on average, pay higher wages to their workers than the small firms. There is no clear pattern regarding wages paid by firms located in large and small towns. Also, there is no obvious pattern regarding wages paid by firms differentiated by product specialization.

It appears that for skilled workers wages peak between the ages of 25 and 35. Both skilled and semiskilled workers' wages are highest for those with primary (up to five years) education. This suggests that work experience may be more important than formal schooling in determining wage levels. For all categories of workers, those belonging to the lohar bradri (which is also the bradri of most firm owners) on average earn higher wages than workers belonging to other bradris. The evidence can be used to rank workers' wages by skill categories. Foremen are the highest-paid workers, earning Rs 937.11 per month, on average, while skilled workers such as turners, fitters, and shapermen earn Rs 848.55 per month. Semiskilled workers such as welders, painters, and helpers are the next

Table 3.8
Mean Monthly Wages of Workers, by Age, Education, and Bradri (Pak Rs)

	Skilled	Semiskilled	Apprentices	Foremen
AGE:				
< 13	—	—	210.32	—
13–17	681.75	558.81	296.00	—
18–24	812.92	608.33	—	865.13
25–34	908.50	612.32	—	911.34
35–49	833.54	—	—	—
> 50 years	—	—	—	1211.67
Mean Age	28.33	19.60	16.50	30.56
(S.D.)	(7.41)	(2.01)	(1.91)	(17.41)
EDUCATION (IN YEARS)				
Illiterate	879.48	612.50	—	—
1–5	925.06	536.21	267.14	812.50
6–8	762.37	546.31	312.00	812.00
9–10	833.75	—	295.00	967.33
Mean Education	5.17	5.90	7.50	9.21
(S.D.)	(3.11)	(3.56)	(2.65)	(1.68)
BRADRI				
Lohar	850.10	587.62	286.00	1,312.11
Other	795.40	578.57	257.15	847.36
OVERALL				
Mean Wages	848.55	576.20	291.12	937.11
(S.D.)	(190.43)	(136.72)	(103.08)	(311.33)

Note: Skilled workers are turners, fitters, and shapermen; semiskilled workers are welders, painters, and helpers.

highest-paid workers, earning Rs 576.20 per month. Apprentices are paid a stipend of about Rs 300 per month.

The labor characteristics in the brief discussion above are chosen deliberately to comment on the pattern of wages as a preview of the discussion surrounding equation 3.5, where we estimate an earnings function which will allow a more rigorous statistical test of the importance of those characteristics as determinants of wage differentials across workers. We shall then present our hypotheses concerning human capital (age and experience) and labor market segmentation more explicitly.

An important issue concerning the wage structure is the frequency of wage changes, and the bargaining strength of workers

and firm owners in bringing about those changes in the absence of labor unions in the industry. The response of workers to our direct question on these issues is reported in tables 3.9 and 3.10. Most workers (55%) reported that they get an annual increase in wages of roughly 5 to 10%. A relatively small number (10%) reported that wage changes are related to productivity changes and are not necessarily annual. Foremen reported this most frequently (82%), which suggests that supervisory labor is given well-structured incentives to achieve higher productivity.

Who initiates wage changes in the absence of unions that facilitate wage bargaining? About 37% of the workers report that wage changes take place at the employer's initiative, implying that the employer may be concerned about turnover and raise wages to lower it. About 50% of the workers report that they have to ask for wage increases and persist for up to a year before the employers concede. They believe that their bargaining strength is derived mainly from the scarcity of their skills.

Interfirm Variations in Employment

Our earlier discussion of labor demand was introductory and very general. We now address a more specific issue: Is the technology used by our firms such that wage increases lead to changes in the employment pattern? We shall analyze this issue using the well-known indirect method that involves estimating labor productivity function. We comment on this issue also by directly estimating employment functions. This procedure enables us to comment on hypotheses that relate employment generation to the structure of the industry.

The Aggregate Demand: A Labor Productivity Function

In estimating the aggregate demand function, our concern is with whether the technology is used in the production process in the industry in such a manner that wage increases causes labor displacement. This has important implications for long-run labor demand and income distribution in the industry. For example, if capital and labor can easily be substituted, then an increase in wages may have a strong discouraging impact on employment. Harris and Todaro (1969) have suggested an econometric procedure for examining this issue in Kenya. They specify a labor productivity equation

Table 3.9
Frequency of Wage Increase Reported by Workers
(percentage of workers responding)

	Annual	Productivity-Related
Skilled	50	7
Semiskilled	60	13
Apprentices	73	8
Foremen	63	82
Overall (%)	55	10

$$\log V/L = \text{constant} + \log W/L + \log Q + U \tag{3.1}$$

where V/L = output per worker, W/L = wage cost per worker, Q is output, and U the error term. A positive and statistically significant coefficient on log W/L is interpreted to imply that, holding output constant, an increase in wages results in an increase in labor productivity through greater use of capital, and that this reduces employment.

Equation 3.1 was estimated for Pakistan by Ishrat Hussein (1974) using census data on manufacturing industries for the 1960s. He estimated the coefficient on log W/L to be statistically significant with a value of 0.73, and concluded that industrial wage increases in Pakistan were likely to result in reduced employment for workers. The coefficient on log of output was insignificantly different from zero, which was interpreted to imply that economies of scale did not exist in the industry. Meekal Ahmed (1975) reestimated the equation with a cleaner data set. His estimated value of the coeffi-

Table 3.10
initiative for Wage Increases
(percentage of workers responding)

	Employers Initiative without Asking	Workers' Initiative	Don't Know
Skilled	37	47	16
Semiskilled	47	49	4
Apprentices	25	62	12
Foremen	32	59	9
Overall (%)	37	50	14

cient on long W/L is similar to that of Hussein, but he found that output was positively related to productivity changes.

The results discussed above are taken from aggregate data representing firms manufacturing very different products, which leads to problems of interpretation. Our estimates of equation 3.1 for the agricultural implements industry are based on a cross section of one industry whose technology is well known to us, so that we can circumvent some of the complications of interpreting the results. The results are reproduced in table 3.11. The coefficient on the log of wage cost to total workers is statistically significant and has a positive value implying that wages and productivity are positively correlated. This is consistent with the results reported in table 3.10, where some categories of workers report that wage increases are related to productivity increases. We interpret these findings as follows. Employers are aware that wage increases result in higher productivity, so they increase wages for selected skill categories (such as foremen) to raise productivity. This makes some of the less skilled workers redundant. Thus an increase in wages may lower employment in the industry, but it raises the skill level of the work force that remains behind. Our results show that the scale effect on productivity is very small.

Employment Functions

The employment function suggested in the vast literature in this area (see, for instance, Ball and Cyr, 1966; Brechling and O'Brien, 1967; Smyth and Ireland, 1967; Karamat Ali, 1978) assumes that, in the short run, employment of workers is demand-determined. In other words, firms can hire as many workers as they like. The employment function is then specified as

$$E = f(Q,K,T) \tag{3.2}$$

where E is employment, Q is output, K is capital, and T is technology. We estimate a version of this employment function (we assume that the underlying production function is Cobb-Douglas which is discussed in detail in chapter 5). The basic employment function is specified as

$$E_i/E = \text{constant} + \beta_1 \log \text{OUTPUT} + \beta_2 \log \text{WAGE}_i + U \tag{3.3}$$

where E_i is the employment of ith skill category, and Wage is the wage of that skill category. Equation 3.3 enables us to relate employ-

Table 3.11
Ordinary Least-Squares Estimation of a Labor Productivity Function
(Dependent variable: [value added/total workers])

Variables	Coefficient Values	*F* Statistics
log WAGE COST/TOTAL WORKERS	0.044	77.49
log VALUE ADDED	1.069	54.27
Constant	−5.164	—
R^2	0.574	78.16

Note: *F*-statistics are significant at at least 5% level; $N = 119$.

ment generation to the scale of operations through OUTPUT, and the labor market through WAGE.

The employment functions that we actually estimate are extended versions of equation 3.3. In these we include two additional variables; the capital-labor ratio, CAPLAB, as a measure of capital intensity, or the technology used by the firm in the manufacturing process; and a measure of the labor turnover rate, TRNOR. The additional hypotheses that we test in the extended model are: (1) Firms using more capital-intensive methods will demand more skilled workers and fewer unskilled workers compared to other firms; and (2) Firms that have a high turnover rate for a specific skill-category will have a higher (gross) demand for those workers than will firms with a lower turnover rate.

Hypothesis 1 may be justified as follows. In the agricultural implements industry in Pakistan more capital-intensive technology means more sophisticated machinery which can be manned only by better-trained workers. The state of technology in Pakistan is not such that more sophistication implies more simplification in running it. With the addition of these two hypotheses, the equation to be estimated is

$$E_i/E = \text{constant} + \beta_1 \log \text{OUTPUT} + \beta_2 \log \text{WAGE}_i + \beta_3 \log \text{CAPLAB} + \beta_4 \log \text{TRNOR} + U \qquad (3.4)$$

We expect the signs on β_1, β_2 and β_3 to be positive and on β_4 to be negative. Equation 3.4 is estimated using the ordinary least-squares method; the results are reported in table 3.12. Output is statistically significant and negatively correlated with employment of skilled workers and apprentices, but positively correlated with employment of unskilled workers and foremen. We interpret this

Table 3.12
Ordinary Least-Squares Estimation of Employment Functions
(Dependent variable: workers in a skill-category/total workers)

	Skilled	Semi-skilled	Un-skilled	Appren-tices	Foremen
log VALUE OF OUTPUT	−0.093	−0.026	0.081	−0.074	0.041
	(3.76)*	(0.98)*	(4.03)*	(4.94)*	(3.99)*
log WAGES	−0.391	−0.256	0.009	−0.213	0.096
	(1.08)	(12.18)*	(0.007)	(4.39)*	(4.42)*
log CAPITAL – LABOR RATIO	0.287	0.098	0.020	0.133	0.011
	(96.97)*	(4.24)*	(0.33)	(31.33)*	(0.24)
Index of labor turnover	0.043	−0.009	0.040	0.022	0.043
	(0.19)	(0.001)	(0.96)	(0.32)	(5.61)*
Constant	2.351	1.356	1.378	1.388	0.101
R^2	0.551	0.453	0.354	0.511	0.669
F value	30.023	4.486	1.649	9.544	7.690

Notes: Figures in parentheses are F statistics.
*Implies significance at at least 5% level.

result to imply that, as the scale of operations become larger, firms switch over from the traditional pattern of employment, whereby apprentices are attached to skilled workers, to a pattern in which highly trained foremen supervise unskilled workers. This is consistent with our casual observations during the survey regarding differences in the employment patterns of small and large firms.

Wages are statistically significant and negatively correlated with the employment of semiskilled workers and apprentices, while they are positively correlated with the employment of foremen. They do not appear to influence the employment of skilled or unskilled workers. This result is in keeping with our earlier remarks that firm owners give incentives to foremen because they are aware that a foreman's supervisory skills are very important for achieving higher productivity. Thus wages may be a proxy for quality of supervision. Semiskilled workers and apprentices may not be viewed in the same manner, so that the normal relationship of wages being inversely related to employment holds for these categories. Employment of unskilled workers is usually seasonal, so that in periods of peak activity, their demand may be related more to work flow than to wages.

The capital-labor ratio is statistically significant and positively related to the employment of skilled and semiskilled workers and apprentices. Thus more sophisticated machinery implies greater demand for skilled workers to man it, assisted by helpers (semiskilled workers) and apprentices.

The labor turnover rate is statistically significant only for determining the employment of foremen. We interpret it to imply that foremen, when they are hired, are considered essential by firms, so that replacements are quickly sought to ensure smooth running of the factory. Other categories of workers may be relatively more expendable.

In conclusion, we note that there is a strong skill pattern in the employment decisions of firms. We have identified two broad tendencies. One is the traditional pattern, whereby skilled workers are employed along with apprentices. The other is the more modern pattern, used by firms that have large-scale operations. This requires the employment of foremen to supervise relatively less skilled workers. This difference in employment of skills has to be borne in mind while discussing the impact of wage changes on aggregate employment, as reported in studies using aggregate data (such as Ishrat Hussein, 1974; Meekal Ahmed, 1975; Karamat Ali, 1978).

An Earnings Function

We now focus directly on the workings of the labor market by addressing the following issue. Are differences in wage earnings due to quality differences, or are there imperfections that segment the market by features other than quality? If the latter is true, it has important implications for a firm's ability to hire workers suited to the technology used in the production process. Searching for appropriate labor will require special efforts and may well affect the firm's efficiency, as we shall see in chapter 5.

The Human Capital Model

The human capital model (Becker, 1974) has considerable intuitive appeal. The argument is that an individual's decision to invest in himself by acquiring education or job experience is guided by principles similar to those in any investment decision, namely, the expectation that the present value of income streams net of costs will be positive. Thus it is posited that, other things being equal, higher human capital will be associated with higher incomes. This implies

that workers endowed with greater skills command higher wages and the entrepreneur, in his hiring decisions, need look no further than the wage rate. In empirical work the model is often reduced to a single equation and human capital variables are entered as explanatory variables in their linear or quadratic form (see, for instance, Blaug, 1974; Hamdani, 1977; Nadeem-ul-Haque, 1977; Fields, 1980; Mazumdar, 1982). The variables usually chosen are age of workers, as a proxy for experience (sometimes direct job experience measured in number of years is included), and education (measured either in years or level). In the earnings function that we estimate, we include workers' actual job experience (quadratic form) and general education (years) as measures of human capital. Our objective is to explain the dispersion in earnings resulting from differences in human capital rather than to posit a causal relationship. Some of the problems with attempting to do the latter, especially with education measured in years, are: (1) education may be used as a general screening device by employers, so that better-paid jobs may be open only to those with a particular type or level of education; (2) in cross-section data, differences in earnings between the older and the more recently educated cannot be captured satisfactorily; and (3) in some societies only the better off can afford higher education, so that the direction of causality is not obvious.

Labor Market Segmentation

As Fields (1980) has argued, a precise definition of labor market segmentation is not easy. The usual way of looking at it is in terms of variables that cause differences in incomes for workers with comparable skills. The literature on labor market imperfections distinguishes between "formal and informal," "organized and unorganized," and "modern and traditional" sectors of the labor market (Manzumdar, 1982: 85). We identify characteristics of the industry that result in such dualism and then examine how these influence workers' earnings.

Our first criterion is size of firm. Along with Guisinger and Irfan (1980), we argue that firms employing more than 10 workers may be seen to belong to the "formal sector," while firms employing fewer than 10 workers belong to the "informal sector." The main distinction between the firms is in terms of organization. Small firms are typically family enterprises relying mainly on family labor that uses the old pattern of employment whereby highly skilled firm owners employ relatives as apprentices. Large firms, on the other hand, employ foremen who supervise relatively less skilled workers

and are more market-oriented regarding payments to workers. (This is like the distinction between small family farms and large commercial farms in agriculture (Sen, 1966).

Another segmenting factor in our analysis is firm location. Location segments the market in an important way when labor mobility is restricted so that firms based in different cities draw upon different "pools" of the labor force. In the context of firms in the agricultural machinery industry, we distinguish between firms based in large urban centers such as Lahore, Faisalabad, Multan, and Gujranwala-Sialkot, and those based in small rural towns such as Mianchannu and Daska. Labor markets for firms that are locationally distinct are different in the sense that the high costs of commuting and permanent migration make it difficult for workers to move from one to the other. Workers from Daska and Mianchannu often, as we shall see in the next section, have strong rural links, which impose high opportunity costs of migration. Staying on in the local markets, however, may involve foregoing a wider choice of employment opportunities in the large towns. Other labor market segmentation criteria are the ratios of employment in government to private-sector employment, of foreign to local-sector employment, and of employment in unionized to nonunionized sectors (see, for instance, Guisinger and Irfan 1975, 1970; Maxumdar, 1982). We do not include these, since all our firms are local and privately owned, and there are no labor unions.

A special feature of the agricultural implements industry is that, as we have seen, many entrepreneurs and workers belong to the lohar bradri. We have also reported several instances where both firm owners and their workers are lohars, and lohar owners often express an explicit preference for lohar workers. This may, of course, represent merely a human capital proxy, since workers belonging to the lohar bradri are supposed to be "born into the profession" and may in fact be more skilled than others in manufacturing agricultural machinery. Thus "segmentation" variables and "human capital" variables may, to some extent, overlap. The main distinction, however, is that the former are "institutional" variables and capture nonmarket influences on earnings, while "human capital" variables are more amenable to choices exercised in the market.

Tests and Results

The earnings equation that we estimate is the following.

$$\begin{aligned} \text{MONTHLY EARNINGS} = {} & \text{constant} + \gamma_1 \text{EDUCATION} \\ & + \gamma_2 \text{EXPERIENCE} + \gamma_3 (\text{Experience})^2 \\ & + \gamma_4 \text{LOHAR DV} \\ & + \gamma_5 \text{FORMAL SECTOR DV} \\ & + \gamma_6 \text{LARGE TOWN DV} + U \end{aligned} \quad (3.5)$$

The first three variables capture the human capital model; the fourth is the bradri dummy variable; and the last two dummy variables represent factors that segment the labor market. The equation is estimated in its linear form. Another version of the dependent variable that we tried was a log of monthly earnings, but it yielded poor fits. The earnings function was estimated for all workers pooled together and then separately for skilled and semiskilled workers. This enabled us to examine the importance of the human capital and market segmentation variables in explaining wages dispersion within skill-categories; the ordinary least-squares method was used for estimation. The results are reported in table 3.13. The human capital performs well in two out of three equations, that is, for all workers pooled together and for skilled workers, but not so well for semiskilled workers. Education is statistically significant in explaining wage dispersion. The concave shape hypothesized for the relationship between experience and earnings is accepted for all workers and for semiskilled workers. For skilled workers, however, there appears to be a linear relationship between earnings and job experience. Our two labor market segmentation variables also perform quite well. Employment in the formal sector and in large industrial towns results in higher wages for all workers but especially so for the skilled workers. For these workers, belonging to the lohar bradri also improves the chances of earning higher incomes.

Job Mobility

Labor mobility patterns are very important in explaining the workings of the labor market. By identifying skill categories that have a higher mobility compared to others, we can predict labor shortages and their geographical dispersion. Vehicle mobility patterns along skill hierarchies are indicative of the evolution of a sophisticated,

Table 3.13
Ordinary Least-Squares Estimation of Workers' Earning Function
(Dependent variable: earnings per month per worker)

	All Workers		Skilled		Semiskilled	
	(1)	(2)	(1)	(2)	(1)	(2)
Education	15.886	11.722	1.269	16.692	5.473	6.442
	(1.544)*	(1.967)*	(0.102)	(1.855)	(0.379)	(0.409)
Experience	36.887	27.415	35.243	19.012	16.161	37.602
	(2.873)*	(3.612)*	(2.018)*	(1.913)*	(2.904)*	(2.878)*
(Experience)^2	−0.581	−0.416	−0.422	0.042	−0.032	−0.383
	(1.864)*	(1.871)*	(0.789)	(0.081)	(1.083)	(1.963)*
Lohar DV†		91.696		65.215		206.725
		(3.013)*		(2.061)*		(1.379)
Formal sector DV†		139.379		216.232		54.893
		(1.702)*		(2.898)*		(0.660)
Large Town DV†		123.212		63.839		183.517
		(1.986)*		(3.421)*		(1.930)*
Constant	240.791	292.979	353.816	289.276	422.035	297.768
	(1.701)*	(1.986)*	(2.461)*	(2.328)*	(2.141)*	(1.358)
R^2	0.237	0.335	0.625	0.811	0.691	0.794
F	5.619	3.079	6.057	7.962	6.077	4.426
Mean Value of Dependent Variable	687.37		848.55		576.20	
(SD)	(243.19)		(190.43)		(136.72)	

Notes: (1) is the basic human capital model; (2) is the extended model, which is the human capital market segmentation model.

*Indicates that the variables are significant at least at 10% level of significance.

†Signifies "dummy variable."

skilled, labor force. Moreover, the accumulation of skills may also contribute to the development of entrepreneurial talent. These issues are important in understanding the nature of labor markets in developing countries and are addressed in this section.

In the detailed survey of workers conducted in spring 1983, questions were asked about workers' mobility within the country as well as overseas migration, about their aspirations for setting up their own small manufacturing units, and about the anticipated difficulties in doing so. Most (92%) of the workers reported that they had no plans to move away from their current jobs. Their most

commonly stated reasons were that they had invested in a house and had strong family ties in the towns where they currently resided. Those who said they would like to move were mainly skilled workers. We approached the mobility issue indirectly and asked workers whether they would like to move to a larger factory that manufactured diverse engineering machinery. Some 27% of the workers reported that they would prefer to make such a move and were actively looking for opportunities to do so. Again, it was primarily skilled workers who expressed a strong desire to move to larger firms (formal-sector firms based in large towns) manufacturing machinery similar to the machinery they were currently manufacturing. The reason they gave was the prospect of higher incomes without additional expense for learning new skills. Those who said they would like to move were usually optimistic about the prospects of finding jobs.

At the time of the survey, topping most workers' list of priorities was overseas migration, especially to the Gulf countries in the Middle East. Saudi Arabia was the favorite target country (see Nabi, 1983, for details regarding overseas migration from Pakistan). The skill categories that felt most confident about getting employment in Saudi Arabia were fitters and welders because these skills enable workers to cope with a wide range of engineering tasks. There was a remarkable awareness among workers both regarding the nature of the jobs they would be required to do in Saudi Arabia and about the general working of the labor market there. Most of those who expressed the desire to migrate said they would like to go on medium-term contracts, from three to five years. They generally felt that this duration would enable them to accumulate sufficient savings to start their own independent operations upon returning to Pakistan.

When asked about relatives in the Middle East who might facilitate migration, 38% of the workers reported that they had relatives working there. Interestingly, however, most workers were not confident that their relatives could help them in finding jobs abroad. Only 5% reported that their relatives would help pay their passage to Saudi Arabia.

Regarding changing or upgrading skills, surprisingly, the more highly skilled workers expressed the most frequent desire to upgrade their skills. (Less skilled workers seemed more content with their current skills.) This may have been related to the desire for matching skills with demand in the Gulf labor market. Until recently, new skills were acquired through apprenticeship with relatives, but this pattern is changing. In the recent past, a large number

of technical "institutes" have been established privately by entrepreneurs with business acumen to provide training for skills that are in demand in the Middle East. They charge high fees and provide only a rudimentary understanding of the skills. But they do award a certificate, which appears to help in obtaining employment in the Gulf. Most workers were not aware of the few "showpiece" training institutes set up by the government, and those who were aware of them were not keen to join them because they felt that the training took too long and often resulted in skills not in demand in the Middle East.

Nearly half the workers interviewed expressed the desire to set up their own small manufacturing units. Many were inspired by the success of their current firm owners, who had been skilled employees in large firms in the past (for an account of this see chapter 2). What was lacking, of course, was capital, and this explains why migration to the Middle East, with its lucrative jobs, was so attractive to them.

Emigration has increased the turnover rate of some of the skill categories, notably that of welders and foremen. Welders' skills can be put to many uses in the booming construction industry in the Middle East. Similarly, foremen in the Gulf can perform diverse tasks that demand a somewhat higher level of sophistication. Entrepreneurs in the industry regard this high turnover rate as a major problem. The common view is that overseas migration has been responsible for a deterioration of skills, since workers spend less time in apprenticeship. This is believed to result in poor craftmanship in the industry.

Do workers consider employment in the light engineering sector a useful stepping stone to engineering skills, preparing them to move to better job opportunities in the large urban-based firms? It does not appear so. Workers employed in the industry have fairly long tenure of service, and mobility across firms and towns is not easy because of skill specialization and the perceived high opportunity cost of family disruption. However, many workers employed in firms located in small towns reside in rural areas and belong to the lohar bradri. Many return to their rural-based families after being employed for a few years in firms manufacturing agricultural machinery. Traditionally, the lohar bradri provided special farm services for the upkeep and replacement of simple farm implements. With the spread of more sophisticated farm machines in the 1960s, the village lohars found themselves redundant. By getting employment in agricultural machinery manufacturing, they (or more usually their offspring) learn the skills of repairing the new farm

machinery. This enables them to retain their importance in the rural labor force. Indeed, there are several instances of village lohars setting up their own village-based units for manufacturing simple machinery such as tractor-driven ploughs and haulage trolleys.

Conclusion

The industrial labor market consists of diverse labor skills, demand for which varies with the structure of the industry. When wages rise, firms tend to change their employment pattern, hiring more skilled and less unskilled workers, and thus increasing the overall skill level of their work force. To maintain productivity levels, firms attempt to lower the turnover rate of their more skilled employees by raising wages. On the supply side, we have seen that workers have a varied educational background within each skill category. Education and work experience are two important human capital variables, and they are significant in explaining dispersions in workers' earnings.

We have identified two important factors segmenting the labor market: firm organization (that is, whether firms are market-oriented or family firms) and geographic location. Workers belonging to larger, market-oriented firms can expect to have higher earnings compared to those working for family firms in the informal sector. Also, workers employed in firms located in large urban centers have higher incomes than those employed in firms located in small rural towns. Further, those belonging to the lohar bradri can expect to have higher earnings than other workers. Firm owners who are lohars often prefer lohar workers. Bradri, therefore, is an important factor segmenting the labor market.

Workers have a high family dependency ratio, which restricts job mobility. Because of far higher returns, workers are more willing to migrate overseas than to move to large urban centers—both moves that involve substantial family disruption. Emigration appears to have increased labor turnover rates, which may have depreciated skills and craftmanship. A redeeming feature is that some of the remittances are being reinvested in the industry by workers who set up their own manufacturing units upon return.

Finally, there is no conclusive evidence about whether workers view employment in the light engineering industry as a means to move to better-paid jobs in the large urban industrial units. On the

contrary, after acquiring skills many return to their villages to repair the new farm machinery, thus reestablishing themselves as an important part of the rural labor force.

◆ *Chapter 4* ◆

The Capital Market and Investment Decisions

While the quality of entrepreneurship and the work force (discussed in the previous two chapters) are the prime vehicles of the development process, well-functioning capital markets provide the lubricant for a smooth transition to higher stages of development.

A well-known feature of capital markets in developing countries continues to be widespread intervention by the government. Such intervention is justified on the grounds that capital is scarce and needs to be allocated selectively. We now know, however, that the allocation procedures are often arbitrary and result in capital market segmentation, with grave consequences for the efficiency with which capital is used. Importantly, because selection criteria are unable to identify them correctly, government regulation may result in small, potentially dynamic new entrants into the industry being starved of capital. On the other hand, large and established firms may be awash with capital, so that there is overinvestment (excess capacity) in their plants. This chapter analyzes these issues in the context of the capital markets faced by the engineering industry in Pakistan.

The analysis shows that the capital market is segmented into "formal" and "informal" sectors. The formal sector consists of large commercial banks and several development institutions regulated by the government. While the interest rates charged by these formal institutions are set by law and tightly controlled by the government,

access to funds is difficult except for a small proportion of firms in the industry. On the other hand, the "informal" sources of credit are many and usually provide small loans at high cost. Such capital market segmentation is consistent with the findings of a large body of development literature. However, given the detailed data available, we can take our discussion much further by actually identifying the selection procedures used by bank managers and pointing out their strengths and weaknesses.

We find, for instance, that a firm's chances of borrowing in the formal capital market are high if it has already accumulated a large capital stock and has demonstrated success in the past through earning high profits. Chances also improve if entrepreneurs belong to social groups well known for their entrepreneurial and engineering skills. Prudent product specialization and locating firms in small towns catering to the requirements of large agricultural belts also improve the likelihood of success in borrowing in the formal capital market. Thus we find that the formal capital markets, by and large, use carefully selected proxies to identify borrowers. Nonetheless, dynamic new entrants, some of whom are correctly identified by credit arrangements in the "informal" sector, are left out.

It is recognized in the development literature that the capital market segmentation discussed above results in investment inefficiencies. However, the direct link between the two is rarely established. Another important contribution of the discussion in this chapter is that we use analytical procedures that do establish such a link. This strengthens our principal finding that firms with easy access to formal capital markets tend to over-invest and are not the most efficient users of capital.

An important policy conclusion of this chapter is that private-sector financial intermediaries are indispensable for spotting small firms with growth potential. Financial reforms that strengthen private intermediation are therefore very important for improving the economy-wide efficiency with which scarce capital is used in developing countries.

The chapter is organized as follows. First a discussion of machines and equipment used by the firms is presented. This discussion leads to a definition of a firm's capital stock and so enables us to examine the distribution of assets across firm size. Next, the capital market and its "fragmentation" are discussed. This is followed by an analysis of the bankers' perception of a firm's creditworthiness and the decision to lend. The investment decisions of the firm are then investigated, followed by additional evidence

regarding the impact of "fragmentation" on capital utilization. The final section offers suggestions for policies to improve the workings of capital markets.

Defining Capital Stock: The Machinery in Use

Our survey of firms' machinery and equipment provides very useful and detailed information that allows comments on the technology used, identifies linkages with the domestic engineering goods market and enables us to estimate the firm's aggregate capital stock. In their production process, the firms in the agricultural machinery industry use the 13 categories of machines listed in table 4.1. Three categories of lathe are reported. Lathes play an important role in the manufacturing process since engineering specifications are very rough and the cast parts have to be extensively machined before assembly. Tubewell firms that undertake substantial casting report the highest use of all three types of lathe; they are followed by firms that make sugarcane crushers and chaff cutters. Trolley manufacturing is simpler; the machines required are mainly drills and welding plants. Firms manufacturing tractor attachments such as seed and fertilizer drills or ploughs use small lathes as well as drills and welding plants. Thresher manufacturers report use of the whole range of engineering machinery. Larger firms more frequently report use of all machines than do small firms, except for paint spraying machines. More small firms report using these machines partly because they subcontract work from the large manufacturers (see chapter 6 on subcontracting in the industry.).

The machinery used by firms may also be classified as "traditional," or "light," and "sophisticated," or "heavy." The latter category includes machines such as power cutting units, large furnaces (cuploads), honing and milling machines, and power presses. What distinguishes these machines from others is that they are more expensive and require considerable expertise in handling. Also, there are economies of scale in their use. Thus it can be seen from table 4.1 that mainly large firms own these machines, along with a few small firms involved in specialized subcontracting.

An important feature of the agricultural machinery industry in Pakistan is that it uses indigenous engineering skills to satisfy demand generated in the agricultural sector. An aspect of this indigenous character is the impetus that it provides to the local engineering industry, which manufactures nearly all the 13 categories of

Table 4.1
Percentage of Firms Reporting Various Types of Machinery in Use, by Product Group and Firm Size

Machines	All Firms	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lathes								
Up to 5 ft.	62 (1.35)	72	46	21	28	50	41	56
5–8 ft.	71 (1.85)	96	76	21	78	50	63	85
> 8 ft.	61 (1.89)	92	65	14	94	6	49	85
Shapers	53 (1.30)	72	50	14	100	12	39	81
Planers	3 (1.25)	8	2	0	6	0	1	7
Drills	100 (2.11)	100	100	100	100	83	100	100
Grinders	47 (1.45)	40	44	36	83	33	31	54
Welding Plants	69 (2.45)	8	100	100	78	56	68	71
Paint Spraying Units	10 (1.25)	0	2	36	6	28	14	2
Power Cutting Units	15 (1.17)	4	26	29	0	6	5	24
Furnaces	20 (1.67)	4	13	7	83	6	8	44
Honing & Milling Machines	3 (1.00)	4	0	14	0	6	5	0
Power Presses	18 (1.52)	0	26	7	28	17	8	34

Notes: (1) tubewells, (2) threshers, (3) trolleys, (4) sugarcane crushers and chaff cutters, (5) tractor attachments, (6) small firms, (7) large firms. Figures in parentheses show the average number of machines for firms that own those machines. The total number of firms in the sample is 119.

machines listed in table 4.1. This can be seen in columns 3, 4, and 5 of table 4.2. Column 3 shows that nearly 25% of all firms manufacture machines such as planers and furnaces for themselves, while 33% report that they manufacture their own power presses. The situation reflects the remarkable technical skills of the entrepreneurs-manager in this industry. the machines embody sophisticated technology and can be used to manufacture a wide range of engineering equipment. Columns 4 and 5 show the percentage distribution of firms (not manufacturing their own machinery) that import or purchase locally manufactured machines. Only planers and honing and milling machines are imported in significantly large numbers. All this is evidence of the industry's strong links with the economy's engineering base, links that contribute to balanced growth in the economy. The balanced growth argument can, of course, be stretched too far. Import substitution may become socially expensive, burdening consumers with unsatisfactory and obsolete technology embodied in the domestically manufactured

Table 4.2
Percentage of Firms Reporting Various Types of Machinery in Use, by Origin of Machinery

Machines	(1)	(2)	(3)	(4)	(5)
Lathes					
Up to 5 ft.	40	7	2	91	98
5–8 ft.	46	11	0	89	99
> 8 ft.	56	8	1	91	99
Shapers	41	10	3	87	98
Planers	0	25	25	50	100
Drills	46	8	2	90	100
Grinders	25	7	0	93	100
Welding Plants	30	5	2	91	100
Paint Spraying Units	8	8	0	92	100
Power Cutting Units	17	11	6	83	100
Furnaces	12	25	0	75	100
Honing & Milling Machines	75	0	25	75	100
Power Presses	19	33	0	67	100

Notes: (1) secondhand, (2) owner-made, (3) imported, (4) locally made, (5) local and imported machines of same quality.

machinery. But there is little evidence to support this, at least for the demands made on the present generation of machines. As can be seen from the last column of table 4.2, nearly all the firms report that locally made machines in all categories perform as satisfactorily as imported ones.

In most industrial towns of the Punjab there is a lively market for secondhand machinery. This market plays an important role in beginning industrialization, since it enables the skilled workers of large firms, who wish to establish their own manufacturing units, to do so with little initial investment in machinery. These mechanics-turned-entrepreneurs purchase the secondhand machinery, put it in satisfactory working order, and are quickly in business. Column 1 of table 4.2 reports the use of secondhand machinery in the industry. Most firms report some use; honing and milling machines, for example, are mostly purchased secondhand. The practice enables a more widespread use of this expensive, imported machinery than would otherwise be possible.

Most machines are less than fifteen years old (table 4.3), so that the technology they embody is not altogether obsolete (the exception being planers, which are mostly of 1950s vintage). We can explain

Table 4.3
Percentage of Firms Reporting Various Types of Machinery in Use, by Year Machinery Purchased

Machines	Before 1950	1951–60	1961–70	1971–77	1978–82
Lathes					
Up to 5 ft.	5	7	17	38	33
5–8 ft.	11	5	7	41	36
> 8 ft.	12	8	13	33	34
Shapers	13	7	13	35	32
Planers	75	0	0	25	0
Drills	8	6	11	33	42
Grinders	4	11	9	20	71
Welding Plants	3	5	5	35	53
Paint Spraying Units	0	0	9	20	71
Power Cutting Units	6	0	6	35	53
Furnaces	21	13	8	29	29
Honing & Milling Machines	0	25	0	50	25
Power Presses	20	5	5	50	20

this partly by the fact that most firms began their operations in the 1970s at the height of the Green Revolution in agriculture which created demand for agricultural machinery. Accordingly, the production plants that the firms own, therefore, embody technologies of recent vintage and perform satisfactorily for the range of agricultural machinery currently in demand. How quickly it becomes obsolete will be determined by government policy toward farm mechanization. If greater automation is promoted on the farm by, for example, encouraging the use of reaper-binders and combine harvesters on large farms through import and credit subsidies, it is likely that these technologies will be rendered obsolete much sooner.

The Distribution of Firm Assets

To investigate investment decisions we examine changes in assets owned by the firms in our sample. The value of buildings, land, and inventories, and the value of machinery installed in the plant together define firms' capital stock. Any addition to its capital stock that a firm makes is a form of investment. None of the firms report changes in the land area that they own. A few report changes in the built-up area but the square footage values reported are varied

and unreliable. The data on inventories are also poor. Most firm owners report no inventories, saying that they purchase materials as machine orders are placed. Also, finished machines are not stocked for any significant length of time. In most cases firms are hard-pressed to meet delivery schedules for orders already placed. Thus we find that the most satisfactory definition of firms' capital stock or fixed assets is the value of the machinery they own.

The easy part in assigning values to machinery is the head count since the machines are usually installed in an open, accessible, part of the factory. The make, specification, and vintage of machines is also easy to determine (see tables 4.1 to 4.3). The difficult part is to assign comparable values to machines of different vintage and specification. To do this we approached the market for secondhand machinery. After detailed discussions with commission agents (who facilitate the exchange of such machinery), in each of the towns where firms are located, we were able to assign 1982 prices to the machinery owned by firms. Thus we are confident about the quality of data regarding firm assets or capital stock, measured as value of machinery owned. Investment, throughout the discussion that follows, is defined as changes in this measure of capital stock.

An examination of the distribution of assets among sampled firms reveals that small firms (employing 10 workers or less) constitute 66% of the sample and own 35% of the assets (table 4.4). Large firms (employing more than 10 workers) constitute the remaining 34% and own 65% of the assets. The value of assets per large firm is nearly four times that of small firms. The value of assets per firm is highest for sugarcane crusher and chaff cutter firms, followed by the values for thresher firms, tubewell firms, trolley firms, and tractor attachment firms. The low value of machinery for the last category of firms partly explains why it is easy to set up such units even in small towns.

The Capital Market

In Pakistan financial intermediation by the government began in the late 1950s as part of its policy to promote import substitution. Several specialized credit institutions such as the Investment Corporation of Pakistan, Pakistan Industrial Development Bank, Pakistan Industrial Development Corporation, and Pakistan Industrial Credit and Investment Corporation were established to engage in lending programs within the framework of a detailed government industrial policy.

Table 4.4
Characteristics of Firms That Were Successful Borrowers in "Formal" Capital Markets

	N	Percentages
SUCCESSFUL BORROWERS	43	100 (36)
Thresher Manufactureres	36	86 (39)
Located in Daska and Mianchannu	26	61 (34)
Lohars	24	56 (59)

Note: Percentages in parentheses are based on total (119) firms, while others are percentages of successful borrowers.

Most of these institutions lend to the private-sector ventures that fall within the government's investment-licensing policy. Thus, according to Pakistan Economic Survey (Ministry of Finance, 1983–84), "investment licensing aims to allocate investment funds in accordance with government priorities." In 1983–84 total loans sanctioned by these institutions were Rs 4007.12 million, which amounted to nearly 62% of the value of capital formation in the private industrial sector. In the context of the farm machinery industry, which only recently gained recognition by the government as an industry with considerable potential for growth, this policy resulted in a highly fragmented capital market, which may have influenced the firms' investment decisions. We shall investigate this issue in the discussion that follows. But first we present a discussion of the nature of the capital markets that firms face.

Firm owners in our sample identify four sources of credit: (1) the formal capital market; (2) the informal capital market; (3) self-generated funds; and (4) a variety of other sources, to be listed below.

The Formal Capital Market

This consists of commercial banks and, more recently, some of the specialized lending institutions mentioned above. The most active of these institutions is the Pakistan Industrial Development Bank. Firms report considerable difficulty in obtaining funds from these sources since collateral requirements are strict, and scrutiny procedures require enormous paperwork that many of the small firms in the industry cannot handle. Also, repayment schedules are stringent with little possibility of having them rolled forward. These features reflect high effective interest rates. The nominal interest rates charged, however,

are reported as between 12% and 14%—attractive rates, particularly in view of the prevailing inflation of about 16% in this period.

The Informal Capital Market

The most widespread arrangement here is the "committee" or "chit" system. "Committee" members usually belong to the same bradri (which is an extra reason for them not to default, since boycott by the bradri would affect their wider social interaction). Monthly installments are pooled and lots are then drawn to determine in what order a share of the pooled sum shall be allocated to each member. It is common for those at the head of the line to sell their share of the pool to those behind at a premium decided through open bidding. According to some estimates the premium, or real rate of interest, on such transactions varies from 15% to 20%. A committee may last up to two years depending on the number of members and the size and frequency of drawings. The pooled sum can be as high as Rs 100,000 in some towns; even higher figures are reported in Faisalabad, an industrial town with considerable entrepreneurial opportunities. Most entrepreneurs report that funds obtained through the committee system are used mainly as working capital since repayments have to be made frequently and the average duration of each committee is rather brief.

Other informal, "back street" arrangements operated by commission agents also exist, but the sums involved are small and repayments have to be made over a short period, so that these sources, too, are used for working capital rather than the purchase of machinery.

Self-generated Funds

This is the most frequently reported alternative to the formal capital markets for financing the purchase of machinery. Self-generated funds are defined rather broadly to include the firm's own savings as well as loans from friends and relatives. The latter have become particularly important since the 1970s due to the large inflow of overseas remittances from migrants working in the Gulf. (In 1982 remittances from all overseas Pakistanis peaked at U.S. $3 billion, which amounted to nearly 10% of Pakistan's GNP). As we say in chapter 2, direct evidence of remittances being invested in the industry is hard to obtain. However, it was frequently reported that many of the friends and relatives from whom the firms borrow have Middle East connections. Firms are reluctant to divulge information regarding the terms of such transactions. We were told that

the only condition of borrowing is to pay back the principal in a reasonable period of time.

Other Sources

Important among these are raw material wholesalers, since they defer payments on material advanced till after the manufactured machinery has been sold. Similarly, advances from customers enable firms to meet their immediate financial commitments. These arrangements, too, are mainly for meeting working capital requirements rather than for investing in machinery. Advances on raw materials may, of course, be important to those who manufacture their own machines. However, the total value of self-made machinery is a small proportion of the total value of machinery owned by firms.

Credit Rationing

The discussion above of the capital market faced by the agricultural machinery industry indicates the ways in which that market is fragmented. Several sources are available, involving different terms of lending. Access to these sources is differentiated by characteristics of firms and owners. The most desirable sources for the firms, given the loan repayment period and other terms, are those identified as belonging to the formal sector. But the funds available there are limited and, because market clearing interest rates are not allowed to prevail, they are rationed.

Credit rationing may be considered to result from disequilibrium in the capital market, since interest rates, often because of government policy, are not allowed to clear the market; agents, as a result, operate off their offer curves. This, as has often been argued (for instance, in McKinnon, 1973) leads to allocative inefficiencies. A somewhat different view of rationing is taken by Stiglitz and Weiss (1981). They argue that credit rationing may come about because lenders view it as a mechanism for arriving at "equilibrium" in their lending programs. The interest rate, they argue, is not like any other price in that it involves future returns to loans rather than exchange value at a point in time. It is this feature of interest rates that affects the lender's ability to recover loans and avoid default. For example, distinguishing borrowers by bidding up the interest rate is likely to result in adverse selection. In other words, borrowers who undertake more risky investments are likely to bid higher interest rates, which increases the probability that they will default. Thus lenders, to lower the risk of default, may choose to keep interest rates below the market clearing rate and resort to

rationing by various screening devices. In the next section an attempt is made to identify some of the screening devices used by banks to select their borrowers in the farm machinery industry.

Determining a Firm's Creditworthiness

Given that credit is rationed in the formal capital market, how do bank managers select borrowers? The case of a government credit program is analyzed by Anderson and Khambata (1985). Let us say that a_i is the cost of administering a loan of size X_i, and that i is the cost of securing loans for the program. The financial loss of a loan may be written as

$$p_i = 1 - \int_0^1 y\pi_i(y)\, dy$$

$$(1 + r)\sum_i (1 - p_i)x_i > \sum_i (1 + i + a_i)x_i \tag{4.1}$$

$$(1 - p) = \frac{\sum_i (1 - p_i)x_i}{\sum_i x_i}$$

$$a = \frac{\sum_i a_i x_i}{\sum_i x_i}$$

$$(1 + p)(1 + r) > (1 + i) + a$$

$$r > \frac{(i + a) + p}{(1 - p)} \tag{4.2}$$

$$A(r) > \frac{A(i + a)}{1 - p} \tag{4.3}$$

Anderson and Khambata note that, typically, i for term loans is about 5%. If we allow for 10% inflation, i may be considered to be around 15%. Since a is about 5%, $A(20\%) = 33\%$ for borrowings of five-year maturity. For arrears beyond six months p is estimated to be between 0.3 and 0.5. This implies a level of risk that puts annuity rates at between 50% and 70%. These rates are much too high, and programs would be hard-put to identify borrowers willing to pay them. Indeed, those who accept loans at these rates are likely to be

borrowers with very risky portfolios. Their values of p are likely to be much higher than the average values used in the program calculations of r. This is the adverse selection problem pointed out by Stiglitz and Weiss (1981). Thus, to avoid program losses due to adverse selection and default, actual interest rate ceilings are kept much lower, and managers are assigned the task of seeking out borrowers who have lower values of p than the averages noted above.

Ideally, bank managers should have access to relevant information regarding borrowers' investment portfolios and anticipated returns in order to formulate the probabilities of default realistically and then select their borrowers. Although most managers claim that that is precisely what they do, and cite the plethora of forms and feasibility studies that borrowers are required to submit with loan applications, such information, in fact, is often not available, and in any case it is treated with skepticism by most managers that we spoke with. It is said that borrowers, in feasibility studies, often exaggerate the social and private returns of their ventures, and banks often do not have either the expertise or the resources for an objective evaluation of these studies. Consequently managers seek proxies based on their perception of such indicators of likely success as firm, product, and entrepreneurial characteristics. Below we attempt to empirically identify the characteristics that enable such sorting of firms in our sample.

All 119 firms in the sample reported that they had applied for loans in the formal capital market sometime in the last five years. However, only 13 reported success in borrowing; the rest had to rely on a combination of sources such as self-generated funds and friends and relatives. A careful examination of firms that succeed in borrowing from the formal credit institutions suggests the following. The typical borrowing firm manufactures threshers and is likely to be located in a small town like Daska or Mianchannu. The owner of the firm belongs to the lohar bradri, is well-educated and, surprisingly, has had fewer years of experience in this or related business compared to the unsuccessful borrowers. The firm also has a larger value of capital stock and profits compared to others. These features of the successful firms in our sample are summarized in tables 4.4 and 4.5.

Why do bank managers think that loan applicants having these features are less likely than others to default? Let us take product specialization. Thresher manufacturers have enjoyed high growth and profits in the recent past because demand from farmers is high and is likely to continue to grow in the near future. There is considerable scope for innovation (and thus for product differentiation

Table 4.5
Other Variables Important in Bankers' Lending Decision
(mean values)

	Borrowers	Nonborrowers
Education (Years)	7.22	6.024
Past Capital Stock (Rs.)	94,820.17	71,386.00
Past Profits (Rs.)	237,190.00	117,100.00
Years in This Business	9.32	10.276

and secure markets) to suite the climatic conditions of different regions. All this indicates that thresher firms are likely to have relatively high rates of return and are less likely to default. Being located in small towns like Mianchannu and Daska may contribute to success in borrowing because the few branch banks in these towns enjoy a monopoly in lending to successful ventures, and the branch managers have a good idea of which ventures are likely to succeed. The lohar bradri is a proxy for the pool of engineering skills that an entrepreneur is likely to inherit or acquire through association, and that contributes to his success. Education may help facilitate transactions with applicants and may also be proxy for the more general ability to acquire new skills needed for success. Firms with a large initial stock of capital are more likely to succeed in borrowing because banks may regard it as indicative of success in the past. It also serves as good collateral.

To evaluate the statistical importance of these variables in determining success in borrowing, the following "credit worthiness equation" is estimated:

$$B = f(\text{Past Capital Stock, Past Profits, Years in Business, Education, Lohar DV, Thresher DV, Location DV}) \quad (4.4)$$

where B is a dummy variable taking the value of 1 for success in borrowing and of zero otherwise. It is well-known that in such situations the ordinary least-squares method is inappropriate (Maddala, 1983). Instead we use probit, which involves the maximum-likelihood procedure, assuming normal distribution for the error term.

Results

The estimates on the coefficients along with their standard errors are reported in table 4.6. The statistically significant variables are

Table 4.6
Probit Maximum Likelihood Estimates of Bankers' Lending Decision in Mianchannu and Daska

Exogenous Variables	Coefficients	Standard Errors
Past Capital Stock (Rs 1000)	0.0338	0.0181
Past Profits (Rs 1000)	0.0041	0.0021
Entrepreneur's Business Experience (Years)	−0.0169	0.0182
Lohar Entrepreneurs (DV)	0.0705	0.0212
Product Specialization (Thresher DV)	1.3788	0.3212
Small Industrial Town Location (DV)	0.6124	0.3158
Constant	−1.8731	0.4172
Log Likelihood	−56.518	

Note: DV signifies "dummy variable"; dummy dependent variable = 1 if banks lend, 0 otherwise; $N = 119$.

firm's profits, entrepreneur's education, lohar entrepreneurs, firm's product specialization (thresher manufacturers), and being based in small towns like Daska and Mianchannu. Firm's past capital stock is on the borderline of significance, while entrepreneur's business experience is not significant at all. We used different versions of this variable—for example, the quadratic form and dummy variables using different cut-off points for years of experience but none of these was significant. Some of the borrowers in the sample have technical education and we tried dummy variables based on this variable. But these, too, were not significant.

An explanation of why our results indicate that past business experience is not given much weight by lenders may be as follows. A large number of firms were established in the 1970s, when this industry's growth potential was clearly perceived. As a result, many entrepreneurs with success in other ventures (for example, crop trading in small rural towns) moved in. Thus, even though these entrepreneurs have only a few years of experience in this industry, their entrepreneurial performance elsewhere has been impressively demonstrated. Banks lend to them more readily than to those who have had long experience in this industry but have performed less impressively. Unfortunately we do not have data on business experience elsewhere to obtain a true measure of length of experience. (This variable may also reflect plant vintage. An alternative, firm age itself, was tried as an explanation but was found to be statistically insignificant.)

The explanatory power of our creditworthiness equation can be evaluated by matching the predicted success of a firm's ability to borrow in the formal credit market with the firm's observed status. To do this, probit estimates of the coefficients on variables in the equation are converted into probabilities (with the help of standard probit-probability tables) for each firm in the sample. This yields the estimated probability of a firm's success in borrowing. If we take the cutoff point to be 0.5, the results are as reported in table 4.7. Our model of creditworthiness correctly predicts the borrowing status of firms in 83.19% of the cases.

Investment Decisions

We are now ready to examine firms' investment decisions in the context of the capital markets discussed in the last two sections. The total investment undertaken by firms between 1980 and 1982 is reported in table 4.8. The first three rows in the table present averages over the entire sample of 119 firms, while the last three rows present averages for the investing firms only. Two features of the table merit comment. First, six firms that were successful in borrowing from banks did not report any investment between 1980 and 1982. This was because, even though they had secured loans toward the end of 1981, they had not actually committed them at the time they were interviewed. The second feature is that firms that are successful in borrowing invest nearly twice as much as the unsuccessful firms. But they do have considerably larger past capital stock, so that their investment as a proportion of that stock is only 64% that of nonborrowers. This suggests that the latter firms, when they have growth potential, are able to realize it by raising loans in the informal sector or by ploughing back past profits. In the discussion that follows we attend to these issues in more detail, invoking the theory of investment in imperfect capital markets.

The Theory

McKinnon's argument (1973) regarding the impact of government intervention and credit rationing on firms' investment behavior can be seen in terms of an additional constraint on firms' welfare-maximizing behavior. With subsidized interest rates, the firm perceives returns to its investment opportunities to be higher than the cost of borrowing; a nonrationed firm will therefore undertake the investment. A rationed firm, on the other hand, if it is to invest in

Table 4.7
Creditworthiness Model's Success in Predicting Firm's Status

		Predicted Status	
	Observed Status	Will Borrow	Will Not Borrow
Successful Firms	43	29	13
Unsuccessful Firms	76	6	70

Note: Percentage of successful and unsuccessful borrowers whose predicted status matches with their observed status = 83.19 (with cutoff point at 0.5).

that activity, will be required by its owners to demonstrate somewhat higher returns than the nonrationed firm before releasing funds.

The firm (or manager) will thus perceive the opportunity cost of investment to have increased. This is the cost effect of rationing. Further, a severely rationed firm—one that has no access to the formal market at all—may have to rely entirely on its own liquidity (here, self-generated funds) to undertake investment. This may be considered the liquidity effect of rationing. A formal argument incorporating the cost and liquidity effects may be developed as follows (for a full discussion see Tybout, 1983).

If we abstract from uncertainty, a firm's earnings from additions to capital stock, given product and factor prices and under the assumption of neoclassical production technology, may be written as

$$\pi = \pi(I,k) \tag{4.5}$$

where $\pi_k > 0$ and $\pi_{kk} < 0$, and where π is earnings and t is time. Thus we may write the cost of instantaneous investment at level $\dot{k} = I$ to be

$$C = C(I) \tag{4.6}$$

where $C(0) = 0$ and $C', C'' > 0$. Now a welfare maximizing firm takes into account (1), (2) and the discount rate of earnings, r, in arriving at its original investment path, $I(t)$, which is given by the Euler condition

$$\pi_k(\dot{I},k) = rC'(i) - C''(I)\dot{I} \tag{4.7}$$

Table 4.8
Total Investment Undertaken by Firms between 1980 and 1982
(Pak Rs)

	Number of Firms Investing	Mean Investment (Rs)	Investment as Proportion of Past Capital Stock
ALL FIRMS	64	8,258.60	0.18
Bank Borrowers	43	17,229.00	0.23
Nonborrowers	76	3,605.00	0.15
INVESTING FIRMS	64	15,857.81	0.33
Bank Borrowers	37	20,022.97	0.27
Nonborrowers	27	10,150.00	0.42

(Eisner and Strotz 1963, Lucas, 1967). Assuming relative prices to be constant this implies a flexible accelerator model of investment:

$$I(t) = \beta[k^* - k(t)] \tag{4.8}$$

with k^* satisfying $\pi_k(k^*) = rC'(0)$ and

$$\beta = -\frac{1}{2}\{r - \sqrt{r^2 - 2\pi_{kk}(k^*)/C''(0)}\} \tag{4.9}$$

The effect of credit rationing is that firms perceive the opportunity cost of capital to have increased, so that earnings are discounted at a higher rate. Thus rationed firms will exhibit higher marginal products of capital. Also, they will be slow to adjust their capital stock to the desired level, that is, $\partial\beta/\partial r < 0$. This is the cost effect of rationing that results from government intervention in the capital market.

To incorporate the liquidity effect we invoke the large body of literature on productivity changes. It shows that small firms have lower capital output ratios than large firms, which enables them to have a larger investable surplus that is reinvested in the business. (The importance of liquidity in determining investment also appears in the context of developed countries, see for instance, Meyer and Kuh, 1958; Lintner, 1967; and Hand, 1968.) Such liquidity is vital in the investment decisions of firms whose credit is severely rationed on the official market. Thus we argue that firms with little or no access to the formal capital market invest all current profits, so that

$$I(t) = C^{-1}[\pi(t)] \tag{4.10}$$

If the firm is severely rationed, it behaves according to equation 4.10, otherwise according to equation 4.8.

The Empirical Model

Given the theoretical framework above, empirically examining McKinnon's argument amounts to testing which of the two sets of variables, those corresponding to the flexible accelerator or the profit model, explains the behavior of firms with unequal access to the capital market. The empirical model is

$$I_t = \beta(\alpha Q_t - k_{t-1}) + \delta\pi_{t-1} + U_t \tag{4.11}$$

where Q_t is expected output, αQ_t is desired capital stock, and U_t is the error term.

Equation 4.11 is estimated for borrowers, nonborrowers, and all firms taken together. The equation is restricted to test which of the components are statistically significant in explaining investment.

It was noted earlier that not all firms in our sample undertake investment. The statistical model describing this situation is given by

$$Y = \beta X + U_i \text{ , if RHS} > 0 \text{ , otherwise } Y = 0 \tag{4.12}$$

This is the case of a censored normal regression model, and the appropriate procedure is to use Tobit maximum likelihood (Tobin, 1958; Goldberger, 1964; Maddala, 1983), as we have done.

The results are reported in table 4.9. Four null hypotheses presented in the second half of the table, are tested with likelihood ratio tests. The null hypothesis H_{01} tests the appropriateness of the model underlying equation 4.11 over the full sample of 119 firms. It is rejected at the 1% level. The null hypothesis H_{01} is also rejected at the 1% level, which implies that the model is appropriate for borrowers and nonborrowers separately. The null hypothesis H_{02}, which states that the accelerator model is irrelevant, is strongly rejected for borrowers but is rejected only at the 10% level for nonborrowers. The null hypothesis H_{03}, that profits do not matter, is accepted for borrowers but rejected at the 5% level for nonborrowers. This scheme of tests indicates that for our sample of firms the accelerator model is indeed the appropriate investment model for the borrowing firms. For the nonborrowers firms, however, past profits seem to explain investment decisions better.

Table 4.9
Tobit Maximum Likelihood Estimates on the Coefficients Determining Firms' Investment Decisions

	Borrowers	Nonborrowers
Output ($\alpha\beta$)	0.054	0.013
	(0.021)[c]	(0.057)
Past Capital (β)	−0.458	−0.215
	(0.168)[c]	(0.108)[c]
Past Profits (η)	−0.015	0.018
	(0.014)	(0.008)[c]
Constant	7,457.27	−5,441.84
	(4,402.167)[a]	(2,938.358)[a]
N	43	76

LIKELIHOOD RATIO TESTS

	Restrictions Imposed on Borrowers Only	Restrictions Imposed on Nonborrowers Only
$H_{01} = \alpha\beta = \beta = \eta = 0$	12.92[c]	9.78[c]
$H_{02} = \alpha\beta = \beta = 0$	11.36[c]	6.20[a]
$H_{03} = \eta = 0$	3.96	7.53[b]
	Constraints imposed on all firms (N = 119) simultaneously	
$H_{04} = \alpha\beta = \beta = \eta = 0$	15.70[c]	

Notes: Standard errors are in parentheses; superscript a, b, and c imply significance at 10%, 5% and 1% levels, respectively.

The value of "beta" for borrowing firms is nearly twice that of nonborrowers firms, suggesting that the former find it easier to adjust to their desired capital stock because financial backing by banks smoothes out investment transactions. Further, the values of "alpha," which are 0.109 and 0.061 for borrowing and nonborrowing firms, indicate a higher desired capital output ratio for the borrowing ones.

A Switching Regression Model

A drawback of the investment model of equation 4.11 and the previous test procedure is that it does not take into account the rich information regarding the determinants of a firm's ability to borrow from banks. A more satisfactory approach that incorporates information on the bank's lending decision, and then examines differences in investment behavior is the two-stage switching regressions

model with endogenous switching (Goldfeld and Quandt, 1973; Lee, 1978; Trost, 1977; Maddala and Nelson, 1975). The two regimes describing the investment behavior of borrowing and non-borrowing firms respectively are

$$Y_i = \beta_1 X_{1i} + U_{1i} \qquad iff\ \gamma Z_i \geq U_i \tag{4.13}$$

and

$$Y_i = \beta_2 X_{2i} + U_{2i} \qquad iff\ \gamma Z_i < U_i \tag{4.14}$$

Here, the U_i are assumed to be correlated with U_{1i} and U_{2i}, and this is what makes possible the endogenous switching in the model. We define a dummy variable I_i such that

$$I_i = 1 \text{ , if } \gamma Z_i \geq U_i \text{ , otherwise } I_i = 0 \tag{4.15}$$

Equation 4.15 is the criterion function that yields the regimes shown in equations 4.13 and 4.14.

We normalize var $(U_i) = 1$ and assume that U_{1i}, U_{2i} and U_i have a trivariate normal distribution with mean zero and covariance matrix

$$\Sigma = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1u} \\ & \sigma_2^2 & \sigma_{2u} \\ & & 1 \end{pmatrix} \tag{4.16}$$

$$L(\beta_1, \beta_2, \sigma_1^2, \sigma_2^2, \sigma_{1u}, \sigma_{2u}) = \left[\int_{-\infty}^{\gamma Z_i} g(y_i - \beta_1 X_{1i}, U_i)dU_i\right]^{I_i}\left[\int_{\gamma Z_i}^{\infty} f(y_i - \beta_2 X_{2i}, U_i)dU_i\right]^{1-I_i} \tag{4.17}$$

$$E(U_{1i} \mid U_i \leq \gamma Z_i) = E(\sigma_{1u} U_i \mid U_i \leq \gamma Z_i) = -\sigma_{1u}\frac{\varphi(\gamma Z_i)}{\Phi(\gamma Z_i)} \tag{4.18}$$

and

$$E(U_{2i} \mid U_i \geq \gamma Z_i) = E(\sigma_{2u} U_i \mid U_i \geq \gamma Z_i) = \sigma_{2u}\frac{\varphi(\gamma Z_i)}{1 - \Phi(\gamma Z_i)} \tag{4.19}$$

We define $W_{1i} = \varphi(\gamma Z_i)/\Phi(\gamma Z_i)$ and $W_{2i} = \varphi(\gamma Z_i)/[1 - \Phi(\gamma Z_i)]$ and this enables us to write equations 4.13 and 4.14 as

$$Y_i = \beta_1 X_{1i} - \sigma_{1u} W_{1i} + \varepsilon_{1i} \qquad \text{for } I_i = 1 \tag{4.20}$$

and

$$Y_i = \beta_2 X_{2i} - \sigma_{2u} W_{2i} + \varepsilon_{2i} \qquad \text{for } I_i = 0 \tag{4.21}$$

where the residuals

$$\varepsilon_{1i} = U_{1i} + \sigma_{1u} W_{1i} \tag{4.22}$$

and

$$\varepsilon_{2i} = U_{2i} + \sigma_{2u} W_{2i} \tag{4.23}$$

The two-stage procedure for estimating equations 4.20 and 4.21 is to first estimate equation 4.15 using probit maximum likelihood (which we have already done in the section on determining a firm's creditworthiness). This enables us to estimate the Mill's rations, W_{1i} and W_{2i}, involving $\emptyset$ and Φ, the distribution and density functions of the standard normal. Ordinary least-squares may then be used to estimate 4.20 and 4.21. Using this procedure we obtain the results reported in table 4.10.

The results are broadly in agreement with those of table 4.9. The coefficients on the accelerator model are statistically significant for the borrowers but not for the nonborrowers. As before, the coefficient on profits is highly significant for the nonborrowers; for the borrowers, however, it is insignificant. Also the relative values of "beta" for the two groups are similar to those of table 4.10. We have additional information regarding variables that influence firms' investment decisions. Among both borrowers and nonborrowers, thresher manufacturers invest more than others—a reflection of the growing demand for threshers in Pakistan's changing agriculture

Direct Evidence on Capital Utilization

Before concluding our discussion we present additional direct evidence on the pattern of capital utilization by firms with unequal access to the capital market. The evidence is presented in order to examine the following implications of McKinnon's argument:

Table 4.10
All Firms' Investment Decisions: Two-Stage Switching Regressions Model (dependent variable: investment, in Pak Rs)

	Borrowers ($I = 1$)	Nonborrowers ($I = 0$)
Value of Output ($\alpha\beta$)	0.039	0.017
	(0.011)[c]	(0.019)
Value of Past Capital Stock (β)	−0.368	−0.170
	(0.201)[b]	(0.213)
Profits (η)	0.021	0.093
	(0.314)	(0.014)[c]
Previous Years in Business (δ)	2,211.000	621.129
	(1,188.210)[a]	(423.540)
Entrepreneurs' Education (λ_1)	−7,342.100	638.267
	(4,387.300)[a]	(504.239)
Thresher DV (λ_2)	1,298.130	14,992.260
	(611.170)[b]	(7,522.200)
Small Town DV (λ_3)	8,719.000	23.438
	(3,719.000)[c]	(3,638.310)
Mills Ratio (σ)	12,400.000	−2,950.510
	(7,317.000)[a]	(1,141.000)
Constant	−10,502.000	−5,930.900
	(58,748)	(1,023.110)
R^2	0.432	0.191
N	43	76

Note: Standard errors are in parentheses; superscript a, b, and c imply 10%, 5%, and 1% levels of significance, respectively.

1. Firms that are successful in borrowing in the "formal" capital market will have larger capital-labor ratios than firms that are not successful (nonborrowers).
2. Borrowing firms are likely to have a larger proposition of sophisticated, imported machinery than nonborrowers firms, since lending by banks is closely tied to import licensing.
3. To the extent that there is excess capacity in plants, borrowing firms a[illegible]likely to have more of it than nonborrowing firms.

T-tests on the three statements are reported in table 4.11.

Table 4.11
T Tests for Determining Differences in Capital Utilization by Borrowing and Nonborrowing Firms

	Nonborrowers (N = 76)		Borrowers (N = 43)			
	Mean	(SD)	Mean	(SD)	T value	Prob > (T)
Capital-Labor Ratio	9,036.66	(9090.16)	12,307.04	(11,830.94)	−2.1144	0.0064
Ratio of "Sophisticated" to Total Capital	0.076	(0.141)	0.097	(0.121)	−0.6546	0.5140
Capacity Utilization Index	74.21	(18.76)	86.62	(15.30)	−3.697	0.0003

Note: T values are calculated when tests show that group variables are equal.

Regarding the average capital-labor ratio, the tests reveal that borrowing firms have, on average, higher capital per unit of labor. However, the difference between the proportion of sophisticated capital used by the two groups of firms is insignificant. This may, in part, be on account of the nature of the technology used, which may allow limited substitution between sophisticated and traditional machinery in the production process. For example, the task of furnaces for casting heavy parts cannot be done with other, less sophisticated machinery (though firms may, of course, subcontract casting). Importantly, however, as table 4.2 shows, the overall incidence of imports, even of the large sophisticated machinery, is relatively small in the industry.

The performance regarding capacity utilization is contrary to what is stated in item 3, above: borrowing firms, on average, report greater capacity utilization than nonborrowing ones. This may partly be explained in terms of our definition and measure of excess capacity. In the interviews, managers were asked how much their firms actually produced, then how much they thought could be produced by the existing plants if there were no constraints on raw materials and demand. A capacity utilization index (CUI) was then calculated as

$$CUI = \frac{\text{Actual Output}}{\text{Potential Output}} \times 100 \qquad (4.24)$$

This index may also be interpreted as reflecting the perceived firm "efficiency" of owners and/or managers. Thus higher values of the CUI indicate that they believe they are "efficient," and thus expend greater energy and are more successful in borrowing in the modern-sector capital markets.

Why don't the bank managers use the CUI as a guide in deciding who to lend to? (Note that the CUI was not included as an exogenous variable in the bank's selection function discussed in the previous section.) This is because bank managers usually do not place much faith in the owners' or managers' own perceptions of their "efficiency." In order to see whether managers' perception of their "efficiency" are a reasonable approximation of creditworthiness, we correlated firms' estimated probability of success (reported in the previous section) with the CUI. For our sample of firms the value of the correlation coefficient is 0.199, which is low.

The evidence we have reported is therefore only partially consistent with the hypotheses implied in McKinnon's view of the working of capital markets in developing countries. Borrowing firms invest more, and are more capital-intensive. However, success in borrowing is not significantly correlated with idle capacity so that, at least by this criterion of capital utilization, firms that are successful in borrowing from banks are not wasteful of capital.

Summary and Conclusions

The principal objective in this chapter was to investigate the difference in investment behavior of firms with unequal access to the capital markets. We defined capital stock in terms of the value of machinery owned by the firm, and observed that a considerably greater proportion of the equipment owned by large firms was expensive and sophisticated compared to that owned by small firms. Further, the market for secondhand machinery was fairly active and many firms manufactured their own machinery. Most firms used locally made machinery of a relatively recent vintage, namely, the 1970s. Regarding the distribution of assets, we observed that 66% of the firms employing 10 workers or less owned 35% of the assets, while 33% of the large firms employing 11 or more work-

ers owned 65% of the assets. Part of the explanation for this distribution is the unequal access to capital markets. Small firms are severely rationed in the "formal" capital market and rely on informal sources, such as the "committee" or "chit" system, or on their past profits for investment. This is because bankers in the "formal" market attach greater risk to lending to such firms.

We examined the theory of credit rationing and related it to the observed behavior of bankers in determining a firm's creditworthiness. We noted that, in the absence of complete information, bankers attached importance to such observable features of firms as past capital stock and profits, entrepreneurs' education and bradri, and product specialization.

The analysis of investment decisions of small and large firms reveals that, even though small firms are severely rationed in the "formal," subsidized, credit market, their investment performance does not appear to be seriously affected compared to that of large firms. Small firms, with potentially sound investment and growth plans, are able to obtain financing in the informal market. This may be due to informal intermediaries (who work particularly well with such firms) successfully spotting the creditworthiness of potentially profitable firms on the basis of their intimate informal contacts. Nevertheless, as we have seen, borrowing in the informal market is expensive compared to the subsidized formal market, forcing managers of small firms to demonstrate higher returns to capital than large firms in order to succeed in borrowing. This may result in some small firms being unable to borrow, even though they are as efficient in using capital as the large firms that borrow in the subsidized formal market. Moreover, the small firms, having to obtain higher yields on borrowed capital, use capital more efficiently than the large ones.

Indeed, the direct evidence on capital utilization indices—such as the capital-labor ratio—lends support to the view that the "favored" large firms, with easy access to subsidized capital, may be overcapitalized and thus may be inefficient users of scarce capital.

The analysis provided in this chapter underscores the importance of astute financial intermediation in spotting small firms with growth potential. Financial reforms that strengthen such intermediation by providing the right incentives to bank managers and by encouraging private sector intermediaries are therefore likely to contribute to improving the economy-wide returns to scarce capital in developing countries.

◆ *Chapter 5* ◆

Production: Explaining Efficiency

Why are some firms better at using their resources to produce greater output per unit of input—and therefore greater profits—compared to others? Discussion of this question is crucial to our understanding of the behavior of firms: It explains how firms allocate resources, given the nature of input markets that they face, to achieve production efficiency. It contributes to our understanding of the shortcuts and ingenuities used by firms, when they face market imperfections, to remain competitive. By providing concrete evidence and subjecting it to rigorous statistical tests, it enables us to comment on important policy-related issues of industrial location and firm size.

We can now collect important features of different factor markets discussed in the previous chapters to see how they affect efficiency. For instance, in chapter 2, entrepreneurial background was argued to be important in explaining firms' performance. In this chapter we identify entrepreneurial features that contribute to firms' production efficiency. Similarly, the evolution and choice of the skilled mix of labor discussed in chapter 3 can now be introduced directly into the firms' production functions to see how features of the labor market influence the firms' success. Moreover, attributes of machinery, identified in chapter 4, enable us to specify the technology used by the firm. We now directly examine how the choice of technology influences firms' efficiency. Imperfections in the capi-

tal market that enable some firms to acquire capital easily and more cheaply compared to others will also be incorporated into the direct analysis of production efficiency in this chapter.

There are additional important determinants of efficiency that will be analyzed is this chapter. One relates to the optimal size of the firm. It is often argued, for instance, that small firms are more efficient in production compared to the large firms, particularly in the developing countries where large firms receive government subsidies that reduce incentives to allocate resources efficiently. We construct appropriate measures of firm size to examine this hypothesis. Another determinant of efficiency is argued to be location. Firms located in towns that house related industry may enjoy externalities that result in greater efficiency. Our sample of firms located in towns with different industrial specializations enables us to draw useful conclusions about locational advantages. A useful way to organize the discussion is to group together firms by product specialization to allow for technological differences across firms. We also introduce product specialization directly into the analyses of production efficiency to comment on it as a determinant of firms' efficiency.

The chapter is organized as follows: The first section presents the broad trends of the manner in which firms use their scarce resources. It suggests hypotheses regarding firms' efficiency that are subjected to rigorous econometric analysis in the next section. In the second section, it is shown that to carry out a rigorous analysis, the appropriate procedure is to use the translog production specification. This enables us to calculate returns to the scale of firms' operations and to explore the nature of the production process in terms of input substitution possibilities. Hypotheses related to the nature of technology used by firms are also explored in this section. The detailed analysis of sectors influencing production efficiency is presented in the third section. A summary of important findings is given in the final section.

Production and Factor Proportions

We begin the discussion of the efficiency with which scarce resources are used by the firms in our sample by presenting some broad and rather simple measures of the variables in question. These are the ratios of capital to output, of capital to labor, and of output to labor. They indicate the productivity of capital and labor,

on the one hand, and the capital intensity of the technology used in the production process, on the other.

We make comparisons across firms differentiated by criteria such as product specialization, location, firm size, formal sector registration, and so forth. The objective is to identify characteristics that explain differences in firm efficiency. Policies can then be suggested for addressing these characteristics and removing the constraints that lead to inefficiency.

Product Specialization

The relative importance of product specialization in the industry can be seen by examining the mean values of a dozen important economic variables for each group (see tables 5.1a and 5.1b).

Although thresher manufacturing is the most widespread activity, it is the sugarcane crusher and chaff cutter manufacturing firms that have the highest mean values of output, wage bill, and gross profits. They also own the most machinery and employ, on average, the largest number of workers per firm (17.11). Entrepreneurs who manage or own these firms report the highest numbers of years in business. Most of these firms are based in Faisalabad. They report good business prospects, partly accounted for by the new electrically driven fodder cutters which are in great demand on the farm because they help reduce the time spent on this important chore, namely cutting fodder to feed livestock.

Child and Keneda (1975) studied the industry with data collected in 1970. They report that nearly 350 firms in the industry manufactured tubewell engines, virtually under boom conditions. This appears to have changed now. The number of firms manufacturing these engines is less than 100 while those producing other agricultural implements number almost 514 (Agricultural Machinery Location Census, 1982). Tubewell engine manufacturers that we interviewed complained of inadequate demand for diesel engines. The reasons for this are the rising costs of diesel fuel, increased electrification of rural areas (so that farmers have switched over to electric motors), and, more recently, the import of high-speed light diesel engines from China. While the demand for diesel engines was declining, the demand for other machinery, especially tractor-driven implements such as threshers, seed and fertilizer drills, and ploughs was on the increase.

Some important productivity comparisons and other factor proportions are reported in table 5.1c. Labor productivity is highest among firms manufacturing drills and ploughs, the capital-output

Table 5.1a

Mean Values of Important Economic Variables, by Product Group

	Value of Output	Raw Material & Other Intermediary Costs	Value Added	Wage Bill	Gross Profits	No. of Firms
FIRMS MANUFACTURING:						
Threshers	Rs 1,268,400	Rs 962,390	Rs 306,010	Rs 88,962	Rs 217,050	46
Tubewells	451,920	311,770	140,150	40,328	99,824	25
Trolleys	316,730	215,730	101,000	34,938	66,062	14
Drills & Ploughs	449,660	337,570	112,090	32,856	79,238	16
Sugarcane Crushers & Chaff Cutters	Rs 1,321,200	Rs 951,910	Rs 369,290	Rs 121,070	Rs 248,220	18
ALL FIRMS	Rs 881,530	Rs 651,480	Rs 230,050	Rs 695,530	Rs 160,500	119

Table 5.1b

Mean Values of Important Economic Variables, by Product Group (continued)

	Value of Machinery	Total Employment	Skilled Workers	Unskilled Workers	Skilled-Worker Wages	Years in Business
FIRMS MANUFACTURING:						
Threshers	Rs 99,009	14.022	7.769	5.978	Rs 752.56	5.478
Tubewells	89,110	6.440	5.040	1.400	841.67	10.560
Trolleys	39,515	5.385	3.384	2.000	765.37	5.385
Drills & Ploughs	29,716	5.125	4.513	0.500	695.13	7.250
Sugarcane Crushers & Chaff Cutters	Rs 194,940	17.111	13.739	3.222	Rs 740.67	22.500
ALL FIRMS	Rs 94,820	10.689	7.125	3.420	Rs 785.36	9.319

ratio is also the highest among these firms. Thus this simple criterion indicates that these firms are the most "efficient" users of capital. Indeed, as indicated by the capital-labor ratios reported in table 5.1.c, firms in this product group are also the most "efficient" in terms of employment generated per unit of capital.

Both tubewell and sugarcane crusher manufacturing firms have high capital-labor and low capital-output ratios compared to the rest of the firms, although their labor productivity is also relatively higher. These firms have been in business the longest of all firms in the industry and have acquired large stocks of capital in the form of plant machinery. Thus the evidence suggests that the older firms, which manufacture tubewells and sugarcane crushers, have large capital stocks and this results in higher labor productivity. Note that thresher manufacturing firms, which constitute the largest group in the industry, fall in the middle when compared to others with respect to productivity as well as capital-labor ratio.

Industrial Location

An important feature of the industry noted by Child and Kenada and in other studies (Directorate of Industries Survey, 1978/79; World Bank Survey, 1978) is its concentration in a few towns in the Punjab. Our survey confirms this. Most firms are located in towns such as Daska, Sialkot, Gujranwala, Faisalabad, Multan, Lahore, and Mianchannu. The reasons for the concentration frequently mentioned by entrepreneurs are historical concentration of manufacturing skills, as in Daska; concentration of manufacturers who migrated from agricultural machinery manufacturing centers in Batala (India), as in Faisalabad and Mianchannu; and access to raw material, as in Mianchannu, Gujranwala and Daska. (For a discussion of these towns' characteristics see chapter 1.)

Mean values of important economic variables and factor proportions by location for all firms are reported in tables 5.2a through 5.2c. Note that, as pointed out in chapter 1, there is some overlapping of location specificity and product specialization. Firms in Mianchannu report values of output, employment, and machinery that are considerably higher than for others. Firms in this town specialize in threshers, trolleys, and other tractor-driven implements, and to that extent reflect the high values reported in the discussion of product specialization. Firms in Gujranwala-Sialkot are next, while firms in Faisalabad and Daska report fairly low mean values of output. The evidence for Faisalabad is surprising since most sugarcane and chaff cutter firms are located there, and

Table 5.1c
Productivity and Factor Proportions, by Product Group

	Y/L	*Y/K**	*K/L*	*SKL/L*	*K/SKL*	*K/USKL*
FIRMS MANUFACTURING:						
Threshers	21,826.68	3.09	7,061.98	0.55	12,742.47	16,556.69
Tubewells	21,762.42	1.57	13,836.96	0.78	17,680.56	63,650.00
Trolleys	18,738.40	2.56	7,331.17	0.63	11,690.83	19,757.50
Drills & Ploughs	21,849.90	3.77	5,792.59	0.88	6,588.91	59,432.00
Sugarcane Crushers & Chaff Cutters	21,583.28	1.89	11,393.34	0.80	14,187.77	60,540.37
ALL FIRMS	21,520.11	2.43	8,869.97	0.67	13,298.74	27,725.15

Y/L = Value Added ÷ Number of Workers
Y/K = Value Added ÷ Value of Capital*
K/L = Value of Capital ÷ Number of Workers
SKL/L = Number of Skilled Workers ÷ Number of Workers
K/SKL = Value of Capital ÷ Number of Skilled Workers
K/USK = Value of Capital ÷ Number of Unskilled Workers

*Capital in this table and others that follow is measured as value of machinery only. Taking into account all fixed assets, including buildings and land areas, the value of capital increases substantially and the capital-output ratio falls to 0.453. We did not use this measure, however, because firms' responses to questions containing land and building values were not always reliable.

Table 5.2a
Mean Values of Important Economic Variables, by Location
(Pak Rs)

City	Value of Output	Raw Material & Other Intermediary Costs	Value Added	Wage Bill	Gross Profits	*N*
Daska	391,570	266,380	125,190	33,349	91,840	21
Gujranwala-Sialkot	1,270,500	912,890	357,610	117,100	240,510	20
Faisalabad	339,000	231,300	107,700	35,016	72,682	20
Multan	515,890	380,140	135,750	49,458	86,287	20
Lahore	501,670	359,960	141,710	39,457	102,250	18
Mianchannu	2,257,000	1,748,230	508,770	141,740	367,020	20

Table 5.2b
Mean Values of Important Economic Variables, by Location
(continued)

City	Value of Machinery	Total Employment	Skilled Workers	Unskilled Workers	Skilled-Worker Wages	Years in Business
Daska	Rs 82,400	6.143	4.667	1.476	Rs 831.25	10.524
Gujranwala-Sialkot	181,880	16.350	13.215	3.000	757.50	22.200
Faisalabad	51,905	6.800	3.250	3.550	867.17	5.750
Multan	36,135	7.050	5.810	1.150	822.52	5.150
Lahore	42,428	5.667	4.556	1.111	806.29	6.667
Mianchannu	Rs 169,560	21.850	11.120	10.100	Rs 725.00	5.300

they report high values. However, the remaining firms in Faisalabad operate on a much smaller scale, pulling down mean values for all firms in the industry.

The capital-output ratio and labor productivity of firms in Lahore are the highest, while firms in Daska and Gujranwala-Sialkot have the highest capital-labor ratios. In both these cities the capital-output ratio is very low compared to others, while labor productivity in Guiranwala-Sialkot is the second highest. Thus except for firms in Lahore, where a relatively low capital-labor ratio is accompanied by a relatively high capital-labor ratio and labor productivity, there appears to be no clear relationship between these variables. It may be that the Lahore firms perform well on these criteria because of the complementarities they enjoy with the large engineering and entrepreneurial base that exist in the city.

Table 5.2c
Productivity and Factor Proportions, by Location

City	*Y/L*	*Y/K*	*K/L*	*SKL/L*	*K/SKL*	*K/USKL*
Daska	20,379.29	1.52	13,413.64	0.76	17,644.54	55,675.68
Gujranwala-Sialkot	21,872.17	1.97	11,124.16	0.81	13,757.94	60,626.67
Faisalabad	15,838.24	2.07	7,633.09	0.48	15,970.77	14,621.13
Multan	19,255.32	3.76	5,125.53	0.82	6,219.45	31,421.74
Lahore	24,992.95	3.34	7,482.89	0.80	9,304.39	38,223.42
Mianchannu	23,284.67	3.00	7,760.18	0.51	15,248.20	16,783.12

Note: See table 5.1c for definition of variables.

Other Structural Features

In tables 5.3a and 5.3b we present firm performance classified by some additional features such as firm's registration status, entrepreneur's bradri, and—a first look—firm's size (more follows on this in the next section). Registration with the industries department of the government indicates that the firm belongs to the formal sector and so facilitates access to capital and controlled raw material. We observe that registered firms have output values nearly three times those of unregistered firms. Their figures for total employment and value of machinery values are higher than those of non-lohars. The average output value of large firms (employing more than 10 workers) is nearly six times that of small firms, while the average value of machinery and employment is four times as large.

Turning to the factor proportions and productivity measures reported in table 5.3c, we find that registered firms have higher labor productivity and a higher capital labor ratio, while unregistered firms have a higher capital-output ratio. Lohar firms report higher values of all three ratios than non-lohar firms, thus claiming both higher capital and higher labor productivity. An important hypothesis, which we shall rigorously test later (see table 5.8a) is how important the bradri is in explaining efficiency. Finally, large firms report higher capital-output ratios. In the section that follows, we examine the evidence on firm size and factor proportions in more detail.

The Size of Firm

In the literature on industrialization strategies for underdeveloped countries the size issue has occupied a central place. The virtues of small firms are claimed to be many. It is argued that they have lower capital-labor ratios than large firms and thus generate greater employment; that they have better input and output linkages with the domestic economy so that the multiplier effects of their investments are much bigger than those of large firms; that they help in developing indigenous skills and appropriate technologies and enlarge the pool of entrepreneurial talent; that by exploiting new sources of demand they help in the expansion of markets and, finally, that they use underemployed resources such as part of the family home, family labor, and hoarded capital (or capital that would have financed unnecessary consumption), and thus enable a more efficient use of the economy's resources.

Large firms' advantages, on the other hand, are seen mainly in terms of dynamic arguments. Higher capital-labor ratios in the large

Table 5.3a
Mean Values of Important Economic Variables,
by Selected Firm Characteristics
(Pak Rs)

Firms	Value of Output	Raw Material & Other Intermediary Costs	Value Added	Wage Bill	Gross Profits	*N*
Registered	1,869,600	1,415,490	454,110	138,970	315,140	21
Unregistered	669,790	487,750	182,040	54,678	127,360	98
Non-Lohar	831,720	620,790	210,930	60,034	150,900	69
Lohar	950,260	657,407	292,853	82,689	173,750	50
Small	368,950	264,080	104,870	33,534	71,312	82
Large	2,017,300	1,510,010	507,490	149,340	358,150	37

firms are said to result in a greater investible surplus and thus in economic growth. Also, large firms can supposedly afford the expenses of research and development may develop more appropriate technologies for the domestic economy, and may be more competitive in the export market than small firms. Higher labor productivity in the large firms, it is argued, implies that they can afford to pay higher wages in return for better-trained workers, and in this manner contribute to increasing the country's supply of skilled manpower. Finally, large firms are pictured as enjoying economies of scale and thus as allowing production at lower unit costs. Haroud and Nabi (1984b) have examined these arguments in detail and conclude that it may

Table 5.3b
Mean Values of Important Economic Variables,
by Selected Firm Characteristics
(continued)

Firms	Value of Machinery	Total Employment	Skilled Workers	Unskilled Workers	Skilled-Worker Wages	Years in Business
Registered	Rs 164,680	19.095	13.129	5.667	Rs 937.52	12.190
Unregistered	79,850	8.888	5.838	2.939	721.42	8.704
Non-Lohar	77,061	9.638	6.359	3.174	711.43	7.980
Lohar	119,330	12.140	8.182	3.760	854.13	10.290
Small	50,912	5.524	3.890	1.634	763.40	7.609
Large	Rs 192,130	22.135	14.295	7.378	Rs 884.22	13.108

Table 5.3c
Productivity and Factor Proportions, by Selected Firm Characteristics

Firms	Y/L	Y/K	K/L	SKL/L	K/SKL	$K/USKL$
Registered	45,005.95	2.76	16,321.11	1.30	12,542.27	29,044.09
Unregistered	20,476.94	2.28	8,982.00	0.66	13,672.95	27,159.86
Non-Lohar	21,880.71	2.74	7,993.88	0.66	12,116.51	24,309.46
Lohar	24,122.98	2.45	9,829.49	0.67	14,588.02	31,736.70
Small	18,998.19	2.06	9,223.19	0.70	13,087.92	31,234.36
Large	22,921.86	2.64	8,677.96	0.65	13,445.07	26,033.88

Note: See table 5.1c for definition of variables.

not be particularly useful to see small and large sectors of the economy as being in competition since they share many complementarities. Small firms play an important role in the initial phases of development. They both create new markets and expand existing ones, thus facilitating production in the large sector. There are also many instances of more direct complementarities, such as the classic case of Japanese subcontracting whereby small firms contract with large firms to form some production processes (see chapter 6 for similar subcontracting arrangements among the firms we are studying).

Here, we first address the important issue of an appropriate measure of firm size. Discussions of firm size in Pakistan are usually conducted in terms of number of workers employed. This reflects the concern with employment generation in industry. However, given that capital is scarce, the value of machinery and other fixed assets can also be a useful indicator of firm size. This is particularly true of an industry that employs capital-intensive techniques of production, so that large output gains, and thus the large share in total industrial production, may be obtained with relatively greater increases in capital stock and little increase in employment. In such a situation the employment criterion will show the firm to be small but the capital measure will correctly register it as being large. As a measure of size, then, the value of output or of value added reflects a concern with market concentration. If all of these measures are strongly correlated, then it is immaterial which one is chosen. In table 5.4, such correlation matrices are given for the industry as a whole and for each product group separately.

For the industry as a whole, labor, value of output, and value added appear to be strongly correlated (in most cases the value of

Table 5.4
Correlation Matrices: Indicators of Firm Size

	Total Labor	Capital Stock	Output	Value Added
ALL FIRMS				
Total Labor	1			
Value of Capital Stock	0.475	1		
Value of Output	0.920	0.321	1	
Value Added	0.961	0.396	0.966	1
THRESHERS				
Total Labor	1			
Value of Capital Stock	0.371	1		
Value of Output	0.948	0.232	1	
Value Added	0.972	0.283	0.972	1
TUBEWELLS				
Total Labor	1			
Value of Capital Stock	0.630	1		
Value of Output	0.848	0.448	1	
Value Added	0.937	0.558	0.942	1
TROLLEYS				
Total Labor	1			
Value of Capital Stock	0.208	1		
Value of Output	0.259	0.630	1	
Value Added	0.653	0.454	0.754	1
DRILLS & PLOUGHS				
Total Labor	1			
Value of Capital Stock	0.551	1		
Value of Output	0.845	0.521	1	
Value Added	0.959	0.632	0.895	1
SUGARCANE CRUSHERS & CHAFF CUTTERS				
Total Labor	1			
Value of Capital Stock	0.640	1		
Value of Output	0.795	0.795	1	
Value Added	0.914	0.914	0.935	1

the correlation coefficient is close to 1). Labor and value of capital, on the other hand, have a correlation coefficient that ranges between 0.259 and 0.795. Thus we conclude that while labor and value added are reasonable substitutes for measuring size, capital stock is not. In the discussion which follows we use both number of workers (table 5.5a) and value of capital (table 5.5b) as measures of size.

Table 5.5a
Factor Productivities and Capital-Labor Ratio, by Firm Size in Terms of Employment
(Pak Rs 1,000)

Number of Employees	Y/L	Y/K	K/L	N
0–2	20.329	4.844	13.439	7
3–5	19.440	4.802	9.572	37
6–10	18.097	4.089	8.326	35
11–15	21.908	3.582	10.194	15
16–20	20.459	3.831	8.397	12
21–30	19.513	1.877	18.491	5
31–40	26.793	6.762	4.299	3
41–50	23.221	5.452	5.293	3
51–60	30.000	6.022	4.981	1
61–70	28.147	14.500	1.941	1

Note: See table 5.1c for definition of variables.

Table 5.5b
Factor Productivities and Capital-Labor Ratio, by Firm Size in Terms of Machinery Value
(Pak Rs 1,000)

Value of Machinery	Y/L	Y/K	K/L	N
0–10	16.765	11.046	1.696	19
11–20	13.694	4.870	3.197	7
21–50	19.940	4.022	6.895	29
51–100	20.270	2.251	10.996	31
101–200	23.387	3.733	11.058	17
201–500	22.705	1.782	19.257	15
> 500	15.650	0.318	49.228	1

Note: See table 5.1c for definition of variables.

Table 5.5a shows that labor productivity increases with employment, while capital-output ratio appears to fall at first and then rises with employment. Capital-labor ratio, however, falls with employment size. Thus large firms employ more capital per unit of labor, which raises the capital output ratio and does not appear to adversely affect labor productivity.

In table 5.5b we present factor productivity and proportions by firm size, measured in terms of value of capital stock. Labor productivity over the range of capital stock moves very little, lying between Rs 1,500 and Rs 2,300 for the most part. Capital-output ratio, however, declines with size while capital-labor ratio increases. Thus firms that are large in terms of value of capital stock tend to have higher capital-labor ratios along with low capital-output ratios, but do not appear to have considerably lower labor productivity compared to small firms.

The evidence presented above shows that whether or not small firms are seen to use more labor-intensive techniques and have higher capital-output ratios depends very much on how firm size is measured. If employment size is the criterion, the evidence is weak that small firms show such trends. However, when value of capital stock is used as the measure of size, small firms reflect such factor productivity and intensities.

The Translog Production Function

In the previous discussion firm efficiency was rather loosely defined. We can make the concept of efficiency fairly rigorous by using sophisticated analytical procedures. This will enable us to isolate the impact on efficiency of several firm characteristics. To proceed with this analysis we introduce the concept of the production function, which simply expresses a mathematical relationship between inputs and firm's output. Production functions may take many forms, the most commonly used being the Cobb-Douglas production function. However, this form imposes many a priori restrictions on the relationship between inputs used by the firm. These amount to restrictions on the underlying production technology (see, for instance, Christensen, Jorgensen, and Lau, 1971; Brendt and Christensen, 1973, 1974). Avoiding this problem, we work with the more general translog production function consisting of three factors: skilled, L_s, and unskilled, L_u, labor, and capital, K. (These

variables have already been discussed in detail in chapters 3 and 4.) In this case, the production function may be written as

$$\begin{aligned}\log V = {} & a_0 + a_u \log L_u + a_s \log L_s + a_k \log K \\ & + \beta_{uu} \log (L_u)^2 + \beta_{ss} \log (L_s)^2 + \beta_{kk} \log (K)^2 \\ & + \beta_{us} (\log L_u)(\log L_s) + \beta_{uk} (\log L_u)(\log k) \\ & + \beta_{sk} (\log L_s)(\log L_k) \end{aligned} \tag{5.1}$$

where V is value added and a and β are the parameters to be estimated. Coefficients β_{uu}, β_{ss}, and β_{kk} and those on the interaction terms provide information on the curvature of the production function and the substitution possibilities between inputs. If these are statistically insignificant, the translog production function consists only of the first four terms and reduces to the Cobb-Douglas production function.

We can test whether the production function is homothetic and homogenous (i.e., displays constant return to scale). The former requires the restriction, [see original] on the translog production function, while the latter requires an additional restriction, [see original]. We test these restriction using the well-known log likelihood ration tests. The results are reported in table 5.6. The restriction of homotheticity is accepted at the 1% level of significance, as is the constant return to scale restriction. Next we test whether the translog production function collapses to the Cobb-Douglas form by imposing the restriction that all coefficients other than the first four in equation 5.1 are insignificantly different from zero. This restriction is rejected at the 1% level. The estimated parameters of the translog production function, restricted to be homothetic and displaying constant returns to scale, are reported in table 5.7. This is the basic production function that we use in our analysis of the determinants of a firm's technical efficiency.

Factors Explaining Firms' Efficiency

Two kinds of efficiency may be distinguished: allocative and technical. The former refers to whether or not firms equate marginal products with input prices, that is, to where on their production possibility frontier they lie in relation to the given input price ratio. We have dealt with this issue in a separate paper (Nabi, 1984a), where we report that firms, by and large, do maximize profits given the

Table 5.6
Test of Production Function for Homotheticity and Constant Return to Scale

Test	Unrestricted	Homo-theticity	Constant Return to Scale	Cobb-Douglas	Cobb-Douglas CRD
No. of restrictions		2	3	6	8
Chi-square critical level (.01)		9.21	11.35	16.81	11.35
Log likelihood	910.934	910.408	910.290	900.031	890.324
Log likelihood ratio	—	1.052	.288	21.806	41.22

Table 5.7
Translog Production Function
(dependent variable: log VALUE ADDED)

	Unrestricted	Restricted
Constant	7.539	6.386
	(1.488)[c]	(1.083)[c]
α_u	−0.158	−0.184
	(0.251)	(0.180)
α_s	0.889	0.478
	(0.489)[b]	(0.219)[c]
α_k	0.422	0.705
	(0.340)	(0.229)[c]
β_{uu}	0.095	0.088
	(0.025)[c]	(0.024)[c]
β_{ss}	0.036	0.015
	(0.037)	(0.032)
β_{kk}	−0.016	−0.032
	(0.019)	(0.013)[c]
β_{us}	−0.082	−0.066
	(0.038)[c]	(0.031)[c]
β_{uk}	−0.012	0.030
	(0.052)	(0.026)
β_{sk}	0.035	0.036
	(0.027)[a]	(0.019)[b]

Note: Superscripts a, b, and c indicate significance at the 10%, 5%, and 1% levels, respectively.

input price figurations they face. Here our main concern is with technical efficiency, in other words, with whether or not firms lie on the production possibility frontier of the industry. Several statistical procedures are available for examining this issue. One that has recently become popular is to examine the best practice frontier, and then estimate how far firms lie from it (see, for example, Martin and Page, 1985). A more familiar procedure is to introduce variables that may contribute to firms' technical efficiency into the production function, and then estimate coefficients on these variables. This is the procedure we shall use below, working with the restricted translog production function already reported in table 5.7. Our strategy will be to first introduce variables in groups and test whether they contribute to efficiency. This will identify the statistically significant variables, so that at the second stage we shall include only these variables from each group in the restricted translog production function in order to estimate their joint contribution to the firm's overall technical efficiency.

Entrepreneurial Features

In chapter 2, a profile of entrepreneurs was presented in terms of their bradri status, education, business experience, and other features. An attempt was made to relate entrepreneurial functions that contributed to firms' efficiency to these features. We promised in the concluding section of that chapter that the impact of some of these features on efficiency would be examined directly at a later stage. In this discussion we honor that promise. The entrepreneurial features that we examine are bradri status (that is, whether or not entrepreneurs belong to the lohar bradri), number of years of general and technical education, and years in business (included in its quadratic form). Belonging to the lohar bradri implies that the entrepreneur has potential access to industry's pool of accumulated engineering knowledge. General education may contribute to overall business acumen and years in business incorporate the hypothesis of learning by doing.

The results are reported in column 1 of table 5.8a. The likelihood ratio test indicates that the four entrepreneurial features taken together do not contribute to the firm's technical efficiency. Taking the features individually indicates, however, that business experience matters in its quadratic form. In other words, with increased experience the firm's efficiency increases, but at a decreasing rate.

Table 5.8a

Estimated Coefficients on Entrepreneurs and Firm's Labor and Machinery Characteristics Included in the Restricted Translog Production Function

Entrepreneur's Characteristics		Labor Characteristics of Firms		Machinery Characteristics of Firms	
Lohar	−0.0529	Large Firms	−0.08373	Sophisticated to Total	6008.3[c]
	(0.0387)		(0.07611)	Machine Value	(1713.2)
Education	−0.00196	Apprenticed Labor	0.2653[a]	Used Machinery to	0.15009[c]
	(0.00382)	to Total Labor	(0.1632)	Total Machine Value	(0.04637)
Technical Education	−0.08498	Skilled Labor to	0.1334	Self-made Machinery	
	(0.081967)	Total Labor	(0.1596)	to Total Machine	−0.06356
				Value	(0.08858)
Years in Business	0.0154[c]			Imported Machines to	−0.2089
	(0.0067)			Total Machine Value	(0.2587)
(Years in Business)^2	−0.00032[a]			Firm Age (Number of	0.0047[c]
	(0.00020)			Years)	(0.0021)
Log likelihood	915.170		912.229		921.433
−2 log likelihood ratio*	9.76		3.878		22.286

Note: Superscripts a, b, and c indicate significance at the 10%, 5%, and 1% levels, respectively.

*Likelihood ratio tests are carried out with reference to the restricted version of the translog production function reported in table 5.7.

Machinery Characteristics (Technology)

In chapter 4 a detailed description was given of the machinery used in the production process. Four important attributes of the machinery in use were reported. One was the importance of the secondhand market for machinery; it was discussed in terms of the incidence of such machinery in use. We reported that most firm owners and/or managers in the industry were highly skilled mechanics who manufactured their machinery themselves. The incidence of imported machinery of recent vintage was low. We also reported the value of sophisticated machinery, consisting of (for example) the large lathes (over eight feet), power cutting units, honing and milling machines, power presses, and large furnaces, compared to the value of all machinery. As argued earlier, the firm's age often reflects the vintage of machinery, and this is another important attribute. These attributes of machinery may, together or separately, reflect the plant's embodied technology and thus may contribute to its efficiency. We included all these attributes in the production function and jointly tested their impact on the firm's efficiency.

The results, reported in column 3 of table 5.8a, show the value of the likelihood ratio to be 22.286 which is greater than the tabulated critical value. Taken together, then, the five machinery characteristics do contribute to the firm's technical efficiency. When we take them individually, we find that the results for sophisticated to total machine value, used to total machine value, and vintage (firm age) are statistically significant at the 1% level, so that these characteristics do contribute positively to the firm's efficiency. (The results for total machine value are unexpected, but we shall postpone discussion until table 5.9.)

Location

Location differences capture several important economic dimensions. For example, capital and labor markets may perform differently in small compared to large towns. Being located in towns with a large engineering base such as Lahore, Faisalabad, and Gujranwala-Sialkot may result in complementarities and other economies. Small towns such as Daska and Mianchannu that specialize in specific agricultural engineering skills (tubewell motors and pumps in the former and trailer-drawn machinery in the latter) may also give rise to complementarities. Some important general features of these towns were discussed in chapter 1, while more specific aspects of their labor and capital markets were analyzed in chapters 3 and 5. Here we attempt to examine the impact of location as a composite

feature on firms' technical efficiency by introducing five town-specific dummy variables, or "location dummies."

The joint effect of including the five location dummies is reported in column 1 of table 5.8b. The likelihood ratio test indicates that locations matter in determining efficiency. Firms located in Faisalabad, Lahore, and—surprisingly—Multan perform better than others (we postpone the discussion of the Multan dummy variable till table 5.9).

Product Specialization

Product (machinery) specialization may result for a number of reasons: region-specific cropping patterns (and therefore region-specific demand for machinery), skill specialization, complementarities with the local engineering industry, and market power. Many firms in Faisalabad, for instance, manufacture sugarcane crushers and fodder cutters because of the high demand for those two items in the Faisalabad district. Firms in Lahore specialize in the manufacture of diesel engines because access to its large foundry industry is relatively easy and a lively market for pig iron and scrap is close at hand. In Daska, diesel engine and tubewell pumps became attractive initially because of the local demand for these items. Mianchannu firms manufacture diverse tractor-driven machinery because farms in the region are relatively large and mechanization is widespread. This discussion suggests that the products specialization and location factors may overlap. (In table 5.9 we introduce both sets of dummies to isolate the impact of each group.)

Product specialization may also reflect firms' market power, since firm owners may choose to focus their entrepreneurial talents on an item in which they believe their comparative advantage lies. An advantage of such specialization may be that in time firms acquire a large proportion of the total demand for that item and thus may enjoy monopoly pricing.

In column 2 of table 5.8b we report the results of including product specialization dummies with the restricted translog production function of table 5.7. Taken jointly, such dummies are significant in explaining variations in technical efficiency (as indicated by the likelihood ratio test). Individually, however, only the dummies for the trolley and sugarcane—chaff cutter groups are statistically significant. We postpone further discussion of this until table 5.9.

Labor Characteristics

In this group we include variables that capture aspects of firms employment. We have a dummy variable for firm size measured in

Table 5.8b

Estimated Coefficients on Firm Location and Product Specialization (dummy variables included in restricted translog production function)

Location		Product Specialization	
Gujranwala-Sialkot	0.08520	Tubewells	−0.03760
	(0.07021)		(0.05503)
Faisalabad	0.10814[a]	Trolleys	0.22453[c]
	(0.06505)		(0.06779)
Multan	0.1902[c]	Drills & Ploughs	−0.03514
	(0.06505)		(0.06409)
Lahore	0.20054[c]	Sugarcane Crushers &	−0.00460[b]
	(0.06658)	Chaff Cutters	(0.00196)
Mianchannu	−0.03616		
	(0.07248)		
Log likelihood	918.502		917.544
−2 log likelihood ratio*	16.424		14.508

Notes: Superscripts a, b, and c indicate significance at the 10%, 5%, and 1% levels, respectively.

*Likelihood ratio tests are carried out with reference to the restricted translog production function reported in table 5.7.

terms of employment that equals 1 for large firms (that is employing more than 10 workers) and is zero otherwise. The proportion of apprenticed workers to total workers is included to capture the traditional pattern of labor arrangements. Another labor variable is the proportion of skilled to total workers, which reflects the skill intensity of the firm. The importance of these variables in relation to the labor market faced by the industry was discussed in chapter 3. Here we examine their ability to explain variation in value added by the firm. We expect firm size not to matter; indeed, we have shown that the industry is characterized by constant returns to scale. Firms with a higher proportion of apprentice labor may be expected to have higher value added, since such workers are likely to be better motivated (under the close supervision of skilled workers) to perform well compared to unskilled workers. Firms with a higher proportion of skilled workers are expected to perform better than others.

The results for the labor characteristics group are reported in table 5.8a column 2. Likelihood ratio tests indicate that the group of variables jointly is not statistically significant. If we take the variables individually, firms with apprenticeship programs appear to be more productive.

The Augmented Translog Production Function

We include the statistically significant variables identified in the previous discussion in the translog production function of equation 5.1. The results are reported in table 5.9.

The likelihood ratio test indicates that the augmented production function is a marked improvement over the production function of equation 5.1, thus confirming our selection of variables to explain variations in firms' value added. Taking the variables individually, we find that firms specializing in trolley manufacturing appear to be more productive than others, which may explain recent attempts by the government to tax the production of trolleys (farm machinery manufacturing as yet is exempt from taxation). The high value added by these firms may be partly demand-determined: trolley prices may be high because of scarcity. Firms located in Multan, Lahore, and Gujranwala-Sialkot appear to be more efficient than others. These results seem reasonable for the latter two cities because of the complementarities with the diverse engineering base that exists there. The relatively high efficiency of Multan firms, however, is surprising because the engineering industry in this city has only just begun. Multan has the lowest wages of all six towns, but that is probably only a small part of the higher value added by Multan firms. It is interesting that firms in Daska, Mianchannu, and Faisalabad are about equally efficient, but less so than other firms.

The learning-by-doing hypothesis is confirmed. With increasing entrepreneurial experience (measured in years) the average value added increases, but at a decreasing rate. The earlier result that firms with a larger proportion of used machinery perform better than firms using new and/or imported capital is again found here. This is probably because the secondhand machinery market deals mainly with imported machinery; despite the claim that locally manufactured and imported machinery perform equally well (see chapter 4), secondhand imported machinery seems to perform better. The variable firm age which captures plant vintage may reflect similar attributes of the machinery, that is the older the plant, the older its machinery may be. Furthermore, older plants may also have higher value added because of brand name: older, established, firms probably command higher prices for their products.

The variable capturing the impact of apprenticeship on value added turns out to be statistically insignificant. We included an additional variable in the augmented production function in order to examine the relationship between ease of borrowing and effi-

Table 5.9
Restricted Translog Production Function Coefficients
(dependent variable: log VALUE ADDED)

Constant	6.0707[c]	(continued)	
	(0.9985)		
A_u	−0.114	Trolley Manufacturing Firms	0.20033[c]
	(0.16701)		(0.06009)
A_s	−0.35323[b]	Sugarcane Crusher & Fodder	−0.1326
	(0.18341)	Cutter Manufacturing Firms	(0.1303)
A_k	0.65791[c]	Gujrawala-Sialkot DV	0.27332[b]
	(0.1876)		(0.12614)
β_{uu}	0.10384[c]	Multan DV	0.28914[c]
	(0.01975)		(0.01548)
β_{ss}	0.00003	Lahore DV	0.23872[c]
	(0.0254)		(0.05645)
β_{kk}	−0.02834[b]	Years in Business	0.01206[b]
	(0.01013)		(0.00621)
β_{uk}	0.02717[a]	(Years in Business)^2	−0.00024[a]
	(0.01664)		(0.00017)
β_{sk}	0.03396[a]	Firm Age	0.0033[a]
	(0.01901)		(0.0020)
β_{su}	−0.06113[c]	Apprenticed Labor/Total Labor	0.14503
	(0.02518		(0.12852)
		Sophisticated Machine Value/	2,183.1
		Total Machine Value	(1,687.7)
		Used Machinery/	0.17643[c]
		Total Machine Value	(0.04422)
		Bank Borrowers DV	0.15607[c]
			(0.0448)
		Log of likelihood	941.585

Note: Superscripts a, b, and c indicate significance at the 10%, 5%, and 1% levels, respectively; DV signifies "dummy variable."

ciency. This is a dummy variable taking the value of 1 for firms that succeed in borrowing from commercial banks and other specialized "official" lending institutions (see table 5.4 for the complete discussion); otherwise it takes 0. This variable is statistically significant at the 1% level, which indicates that firms that succeed in borrowing from banks are more productive. This result has interesting implications for policy (see chapter 8).

Concluding Remarks

The discussion in this chapter was about production efficiency and the factors that determine it. Labor productivity, capital-output ratio, and other important economic ratios were presented for firms differentiated by important features of the industry's structure such as firm's products specialization, location, size, bradri, and registration status. The broad pattern that emerges is for firms with high capital-output ratios to have low capital-labor ratios. Also, labor productivity is high among firms that have been in business for a long time (such a those in Lahore), partly because they have high capital-labor ratios. It is found that trolley manufacturing firms, firms based in Lahore, firms whose owners are lohars, firms employing more than 10 workers, and unregistered firms appear to use the scarce input, capital, more "efficiently" than their respective counterparts in the industrial structure.

The size issue has occupied a central position in discussions of industrial structure and performance. The evidence here is that employment and value added (or total output) are strongly correlated as indicators of size while value of capital stock is not. With respect to employment it is found that the capital-labor ratio falls and labor productivity increases with size, while the capital-output ratio is U-shaped as size increases. On the other hand, with respect to the value of capital stock, labor productivity remains constant, the capital-output ratio declines, and the capital-labor ratio increases with size. Thus different measures of size give different results regarding productivity and factor proportions.

In order to identify determinants of production efficiency in a more rigorous analytical framework, the translog production function is used because it's more flexible than the Cobb-Douglas function. Applying this production function we find that the industry is characterized by constant returns to scale. In other words, ouput increases in proportion to the increase in inputs.

Factors influencing firm's productivity were identified in terms of the firm's characteristics such as product specialization, location, machinery and equipment attributes, entrepreneurial background of the manager and/or owner, employment, organization, and access to "official" banks were included in the augmented production function. Trolley manufacturing firms and those based in Gujranwala-Sialkot, Multan, and Lahore appear to be more productive than others. Entrepreneurs' experience is important, and appears to have a concave-shaped relationship with respect to pro-

ductivity. The market for used (mainly imported) machinery is fairly active because such machinery appears to result in higher productivity. Finally, firms that can borrow from "institutional" sources of credit appear to be more productive than others. These results have important policy implications, which we take up in chapter 8. Lohar entrepreneurs do not appear to be more efficient than others despite the general impression that bradri affiliations (as posited in chapter 4) matter in the industry. This may be because some of the functions of the bradri have been picked up by other variables such as experience, bank borrowing, machinery selection, and product specialization, which are statistically significant in explaining efficiency.

◆ *Chapter 6* ◆

Subcontracting as a Production Arrangement

Subcontracting has been important in the industrial evolution of many developed countries. For example, in 1966 Japan about 310,000 enterprises (53.6% of all medium and small enterprises in manufacturing) were subcontractors and they employed 3.6 million workers, or more than one-quarter of the total manufacturing labor force (Watanabe, 1981). Subcontracting has also been important in industrialized countries such as the United States, France, and Sweden. In the United States, as recently as the 1960s, primary government contractors were legally required to contract out work to small subcontractors (United States, Small Business Administration, 1969). In France subcontractors' cooperatives were active in the early 1960s in devising schemes to help small entrepreneurs overcome problems of the prevailing recession (Levy, 1964). The success of the Swedish Association of Metalworking Industries contributed to promoting subcontracting in all four Nordic countries (Sveriges Mekanforbund, 1967). More recent examples of successful subcontracting are to be found in Taiwan and South Korea. In Pakistan the beginnings of an automotive industry in cities like Karachi and Lahore have resulted in the rapid growth of subcontracting.

In this discussion of subcontracting in manufacturing, we focus on situations where a large parent firm contracts out part of the production process to small vendors, with both parent and vendors contributing importantly to the final product. The parent firm does

not merely purchase ready-made parts and components from vendors but actually has a contract, formal or informal, with the vendor regarding work quality and delivery schedules. Such subcontracting enables us to examine the generally held view (elaborated in Hamid and Nabi, 1984) that small- and large-scale production arrangements are competing strategies in economic development. Our discussion will show that, on the contrary, subcontracting reflects important complementarities between small- and large-scale manufacturing. This suggests a special role for subcontracting in development strategies.

Our examination of subcontracting arrangements allows us to focus on several important economic issues. One is, What determines the decision of the firm regarding the number of processes it integrates to produce the final product? This is related to the question of process specialization, which will also be taken up in our discussion. Another issue concerns intersectoral linkages in the economy. The usual argument is, that for balanced growth, a development strategy that forges and exploits linkages between agriculture and industry is to be preferred to one that does not foster such linkages—one important reason being that linkages allow investment and consumption to have multiplier effects. The subcontracting arrangements that we examine in this study forge important intrasectoral linkages and thus contribute importantly to realizing balanced growth. For subcontracting to exploit such linkages successfully, communication between parent and vendor firms and thus firm location are important factors and will therefore be examined in this study.

Recent discussions of tenancy in agriculture have emphasized that, because of market imperfections, the landlord-tenant relationship often extends to credit and product markets in addition to the land market. Such market interlinkages affect tenant behavior and influence the outcome of policies aimed at increasing agricultural productivity. We find that in subcontracting arrangements parent firms often extend credit and technological know-how to vendor firms. We examine how such interlinkages in subcontracting are likely to influence both pricing decisions between parent and vendor firms and the spread of technological innovation.

An important policy conclusion of this chapter is that despite the many attractions of subcontracting, it is important not to promote it merely on ideological grounds. Its promotion should be encouraged only if it is profitable in terms of sound international cost comparison.

The study is structured as follows: In the first section we describe the sample of parent and vendor firms that were interviewed to obtain information on subcontracting. We proceed in the next to examine the following issues in detail: the nature of the contract, the reasons for subcontracting, communications between vendor and parent firms, subcontracting and the credit market, technological innovation, "tying" in subcontracting, costs and price markup, and contract enforcement. In the last section some economic implications of subcontracting are discussed and policy issues are identified.

The Data

We examine the issues just enumerated by using two sets of data. First we report the extent of subcontracting in the agricultural machinery industry on the basis of data collected in the main field survey, which was conducted in the spring of 1982. The evidence as to which processes and components are subcontracted is also taken from that survey. The evidence on contract details was collected in a subsequent survey, conducted in spring 1984. Firms were selected in Lahore, Gujranwala, Faisalabad, and Sheikhupura Districts, the four Districts of Pakistan's Punjab where subcontracting is common.

The widespread incidence of subcontracting in Faisalabad and Lahore corresponds well with experience in other countries. Both cities have a sizable industrial base; indeed, they are two of the most industrialized cities in the country. The skilled labor force is large because of the presence of a substantial engineering industry in such forms as the manufacture of textile machinery and household durables (gas cooking ranges, water heaters, washing machines, fans, and water coolers), in addition to agricultural machinery. Many of the subcontracting firms were established by skilled workers in the engineering industry who managed to save or borrow capital to start their own operations.

In the main field survey conducted in 1982, 54 firms reported that they subcontract out processes and components (that is, they are parent firms) while 40 reported that they subcontract components in (that is, they are vendor firms). In the follow-up survey we interviewed all 40 vendor firms and 31 of the parent firms. Thus we hope to discuss the subcontracting arrangements from the twin perspectives of parent and vendor firms.

The distribution of parent and vendor firms by city is given in table 6.1. The firms in Sheikhupura are in that district for administrative reasons. They are located on Sheikhupura Road on the outskirts of Lahore so that really the firms are part of Lahore's light engineering industry. In Gujranwala we interviewed four subcontracting firms. These represent only the agriculture machinery industry. Gujranwala is an important center of the light engineering sector in Pakistan and subcontracting in this sector is common. We encountered several firms that subcontract work from large Lahore firms manufacturing household durables. We did not include these firms in the sample.

Subcontracting Firms and the Processes Subcontracted

The main field survey reveals that 104 firms (out of the 119 interviewed) manufacturing agricultural machinery are involved in subcontracting. Fifty-four of these are pure parent firms while 40 are pure vendor firms. Ten firms reported that they both subcontract in as well as subcontract out, in other words that they are parent-cum-vendor firms. In table 6.2 we present evidence on variables that indicate the relative size of the firms involved in subcontracting and their key technical ratios.

It can be seen that vendor firms are smaller than parent firms while the parent-cum-vendor firms fall between the two. Also, vendor firms are more capital- and skill-intensive than parent firms.

In table 6.3 we report the processes and components subcontracted by the parent firms in the industry. Tubewell firms in our sample sell the package of diesel engines and pumps. The most important processes for these firms are casting and machining. Casting is a specialized skill and most firms do not undertake it themselves. Firms may choose to specialize in the manufacture of pump sets or diesel engines, in which case the other component is subcontracted. Twelve of the 16 tubewell firms report subcontracting either diesel engines or pumps sets. There is no sheet metal cutting activity in the tubewell industry. On the other hand, for threshers this is the most important process, requiring specialized equipment, and most firms subcontract it out. The component most frequently subcontracted out is the thresher fan.

In the sections that follow we examine subcontracting arrangements more closely, using evidence collected in the second field survey.

Table 6.1
Distribution of Subcontracting Firms in Sample, by City

City	Vendor Firms	Parent Firms	Total
Lahore	11	10	21
Sheikhupura	8	8	16
Gujranwala	2	2	4
Faisalabad	19	11	30
Total	40	31	71

Table 6.2
Mean Values of Economic Accounting Variables of Subcontracting
(Pak Rs)

	Parent Firms	Vendor Firms	Parents-cum-Vendors
Value Added	4,39,300	1,55,363	2,98,500
Value of Machinery*	2,46,613	96,765	1,06,314
Value of "Sophisticated" Machinery/Total Machinery	0.295	0.444	0.381
Total Labor	21.42	5.43	11.69
Skilled/Total Labor	0.31	0.52	0.41
Value Added/Labor	20,508	28,612	25,535
Value Added/Capital	1.78	1.605	2.807
Capital/Labor	11,513	17,820	9,094

*Total value of machinery owned by the firm, evaluated at 1982 prices (for details see chapter 4).

Table 6.3
Processes and Components Subcontracted, by Parent Firms

	Tubewell Firms	Thresher Firms
Total Firms Subcontracting	16	38
SUBCONTRACTED ACTIVITY		
Casting	14	11
Sheet Metal Cutting	0	23
Machining	8	12
Complete Components	12	14
Painting	4	6

Nature of the Contract

The interviews reveal that none of the vendor firms produces for only one parent firm. Most vendor firms subcontract from three or more parent firms. However, 70% of the vendors in our sample responded that one parent firm dominates others in the sense that between 60% and 70% of the output is manufactured for a single parent firm. Later we shall examine how this influences negotiations regarding technical innovation and prices.

The contract between vendor and parent firms is arrived at by direct negotiation. Only one vendor firm, located in Faisalabad, reported that it had subcontracted work from a firm which, in turn, had subcontracted from a parent firm. This, however, is the only vendor firm out of the 29 interviewed in Faisalabad that reported this, so that we cannot generalize regarding the tier trend in subcontracting relationships even in a city that has a large engineering industry base. Also, none of the vendor firms reported subcontracting work to secondary vendor firms. Further, only two firms (one in Lahore out of 10 interviewed and one in Sheikhupura out of eight interviewed) reported that they had obtained the contract through commission agents. Thus the classic "putting-out" or home piecework system, in which the commission agent plays an important role, does not appear to be at work in the subcontracting arrangements.

Parent firms usually have more than one subcontractor. This is partly because more than one component of the machines is subcontracted. The other reason is that firms prefer to subcontract the same component to more than one vendor to ensure bargaining strength regarding price markup over costs. The distribution by city of 31 parent firms in our sample along with the number of their vendors is reported in table 6.4, and the number of components subcontracted by parent firms in table 6.5

Table 6.5 read in conjunction with table 6.4 reveals an interesting picture. It appears that parent firms subcontract more than one component to one vendor firm. Also they subcontract more than one vendor for the same component. There seems to be little pricing advantage in subcontracting different components to the same vendor firm. This arrangement is undertaken in circumstances where the parent firm is very large compared to the vendor firm and where vendor firms have diverse engineering skills. The practice is most widespread in Lahore and its outskirts (the Sheikhupura firms), where access to firms with diverse engineering skills located in Lahore is easy.

Table 6.4
Breakdown of Parent Firms, by Number of Vendors and by City

City	(1)	(2)	(3)	(4)	(5)	(6)	Total
Lahore	2	—	5	1	1	1	10
Sheikhupura	2	2	1	—	2	1	8
Gujranwala	—	—	1	—	1	—	2
Faisalabad	3	6	2	—	—	—	11
Total	7	8	9	1	4	2	31

The importance of subcontracting in agricultural machinery manufacturing can be gauged by examining the proportion of the value of output subcontracted by the parent firm. This is reported in table 6.6. More than half the firms in our sample subcontract out between 80% of the gross value of the output they produce. Thus subcontracting arrangements constitute a significant proportion of the manufacturing activity in the industry.

Earlier we stated that most vendor firms negotiate directly with parent firms without intermediaries. This is confirmed by parent firms. Only one out of 31 firms interviewed reported secondary subcontracting. The parent firm involved here is located in Sheikhupura and manufactures relatively sophisticated agricultural machinery such as mechanical reapers—a product that lends itself to secondary subcontracting because of the large number of components involved.

Our survey reveals some interesting features regarding the choice of vendor firms by parent firms. Only one parent firm reported that it invites bids by vendors before awarding the contract. The remaining 30 firms choose their vendors through references and through personal knowledge of the vendor firm in question. Further insights into the selection procedure were

Table 6.5
Number of Components Subcontracted by Parent Firms, by City

City	(1)	(2)	(3)	(4)	(5)	(6)	Total
Lahore	—	1	1	3	3	2	10
Sheikhupura	—	—	2	1	2	3	8
Gujranwala	—	—	—	1	1	—	2
Faisalabad	—	1	2	5	1	2	11
Total	—	2	5	10	7	7	31

Table 6.6

Percentage Value of Output Subcontracted out by Parent Firms, by City

City	< 10%	10–19%	20–29%	30–39%	40–49%	50–59%	60–80%	Total
Lahore	1	—	1	2	2	3	1	10
Sheikhupura	1	2	1	2	2	—	—	8
Gujranwala	—	—	—	—	—	1	1	2
Faisalabad	2	1	—	1	2	1	4	11
Total	4	3	2	5	6	5	6	31

obtained by asking vendor firms how they obtained the contract. Their answers are reproduced in table 6.7.

Sixteen out of 40 vendor firms (40%) reported obtaining the contract from the parent firm because the owner was previously employed by it. Nineteen vendor firms (48%) reported previous employment with firms manufacturing machinery similar to that being manufactured by the parent firm and thus having the necessary expertise to manufacture the components. Only five firms reported that they had obtained the contract through relatives who worked for parent firms. It is interesting that such "nepotism" is unimportant in an industry dominated, as far as bradris are concerned, by the lohars. The relative importance, as revealed by both vendor and parent firms, of personal contacts in awarding contracts compared to bidding, may be significant in this early phase of subcontracting. As the practice becomes more widespread and the machinery manufactured becomes more sophisticated, requiring specialized and standardized engineering skills, parent firms are more likely to adopt formal bidding procedures. This is likely to happen also because with greater standardization the risk undertaken by the vendor firms in connection with the manufacturing process is likely to decline.

Typically, vendor firms are small firms with respect to both labor employed (10 workers or less) and value of machinery owned, and are considerably smaller than parent firms (see table 6.2). There are some exceptions to this. Two parent firms in Sheikhupura and Lahore report that vendor firms are larger than they in terms of both measures. The vendor firms in these two cases are large, diversified, engineering firms in Lahore that perform specialized tasks for firms in the engineering sector.

Table 6.7
Breakdown of Vendor Firms by Method of Approaching Parent Firms, by City

City	(A)	(B)	(C)	Total
Lahore	—	5	3	11
Sheikhupura	5	2	1	8
Gujranwala	1	1	—	2
Faisalabad	7	11	1	19
Total	16	19	5	40

A stands for owner of vendor firm previously employed by parent firm

B stands for owner of vendor firm previously employed by a firm manufacturing machines similar to parent firm machines

C stands for vendor firm owner's relative employed in the parent firm.

Why Subcontract?

There are several reasons why subcontracting may come to exist. As we have seen, agricultural machinery manufacturing is a good example of an industry where the production cycle is not continuous. Components can be manufactured separately and then assembled in the final stage. The parent firm that assembles the components to produce the machinery (thus assuming responsibility to the buyer for its performance) may choose to subcontract one or more for the following reasons.

1. *To save capital.* The firm may not wish to purchase machines that require specialized operations if these operations use up only a part of the machines' capacity. Under these circumstances it may be beneficial to subcontract these operations to firms specializing in that activity and performing similar operations for other engineering firms.

2. *To save labor.* Particularly worth saving here are the specialized skills required to perform operations such as those discussed above. Again, it may be feasible for a vendor firm to specialize in such operations given that it can perform them for other firms in the engineering industry.

3. *To take advantage of lower wages.* Vendor firms tend to rely on family labor and the labor market may be characterized by a dual wage structure, that is, family labor may be paid lower wages for similar tasks than labor hired in the market.

4. *To avoid problems of labor management.* Vendor firms specializing in a few operations under the close supervision of the mechanic-

owner may realize greater effort from workers who, in any case, may be related to each other, and thus may work in a congenial environment that contributes to high productivity.

5. *To save capital costs of structures and other overhead.* Vendor firms may have lower overhead costs because they are located in owners' dwellings. Subcontracting may thus lead to better utilization of the resources tied up in such dwellings and of underemployed family labor.

6. *As a buffer against business fluctuations.* When business is poor, parent firms can pass on the effects to vendor firms rather than bear all the costs of excess capacity. This is socially desirable in view of the fact that vendor firms take orders from many firms manufacturing different types of machinery; that loss of orders from one section of the industry, then, does not result in severe financial burden to the vendor firm.

In the survey we interviewed parent firms to elicit the importance of these reasons for subcontracting. In table 6.8 we reproduce their responses.

The most frequently stated reasons for subcontracting is saving on capital, followed by saving on labor. Taking advantage of vendor firms' lower wages and avoiding labor problems tie for third. Saving on costs of structures is not frequently stated as an important reason; this is surprising, given that many firms are obviously short of space—machinery, raw materials, and semifinished components clutter the shop floor. Thus it would make sense if components were subcontracted for this reason also. However, agricultural machinery manufacturing is seasonal, so that for several months in the year shop floor space appears to be adequate, and may therefore not always be perceived as a binding constraint. Only seven firms state that subcontracting is important as a buffer against business fluctuations. Several of the firms that state this reason cite the seasonal nature of the business and are aware that overhead costs are reduced as a result of subcontracting. It is worth noting also that agricultural machinery manufacturing (excluding diesel engines) is going through a period of high growth associated with the early phases of farm mechanization. Expectations regarding growth in the future are high, so that, as yet, there is a lack of awareness that this can also be an important reason for subcontracting.

The household character of vendor firms is confirmed in our survey. Except for two firms with diverse engineering skills the firms have 10 or less workers, most of whom are related to firm owners. Several of the apprentices we interviewed said that they

Table 6.8
Frequency of Stated Reasons for Subcontracting by Parent Firms, by City

City	(A)	(B)	(C)	(D)	(E)	(F)
Lahore	10	10	10	7	2	3
Sheikhupura	8	8	6	8	1	2
Gujranwala	2	2	—	2	—	—
Faisalabad	11	10	8	7	4	2
Total	31	30	24	24	7	7

Note: A: "To save capital [machinery]" D: "To avoid labor problems"
B: "To save labor" E: "To save capital [structures]"
C: "Lower wage advantage" F: "Butter against business fluctuations."

were willing to work for lower wages in their relative's firm than in someone else's because there was no "nokar-hakim" (servant-boss) relationship in the former. Also, they expected to get better training in the relative's firm; in someone else's they would be asked to do mostly unskilled work, the more advanced skills being reserved for the owner's kith and kin. Thus it appears that dual labor market features associated with the nature of firm organization may be at work and that this facilitates subcontracting.

Location of Firms

For successful subcontracting firm location is important. The firms located in Lahore and Faisalabad subcontract a larger proportion of their components than the other firms. The reason, of course, is that vendor firms are more likely to locate in towns with a large and diverse industrial base that facilitates specialization and thus allows subcontracting. All the parent firms we interviewed responded that their vendor firms were within a two-mile radius (18 firms had their vendors within a one-mile radius). Distance matters especially in the early phases of a subcontracting relationship, since close supervision of vendor firm operations may be necessary to ensure that specifications are met. Although all the parent firms we interviewed had telephone connections, only nine reported that they were connected by telephone to their vendor firms. Thus personal visits are essential. In any case, we were informed that such visits are extremely important for direct discussion on engineering specification, since drawings and written instructions are almost never used. Under these circumstances physical examination of the com-

ponents and visual impressions are what count. For all these reasons it is important to be located near vendor firms.

In Lahore many of the vendor firms are located in Sarai Sultun, an industrial enclave in Lahore City, which is adjacent to the market for scrap and pig iron. These constitute the major raw materials and a substantial proportion of the vendor firms' total cost of production. The material is bulky and has high transportation costs that can be reduced by locating near the source of supply. Another feature that attracts the firms to this location is the feeling it gives them of being in the market and of having easy access to information, whether about demand for their product, or about technological innovation. There is also considerable informal exchange of machine time and engineering advice. This location-specific character of vendor firms with their need for close supervision, makes the parent firms location-specific as well. The concentration of light engineering in Pakistan in cities like Lahore, Faisalabad, Gujranwala, Sialkot can probably be explained in this way.

Subcontracting and the Credit Market

We have already seen (in chapter 4) that the credit markets serving the light engineering sector are far from perfect. Basically, there are four broad sources of credit: government-sponsored credit institutions such as development banks and cooperatives that subsidize credit, resorting to rationing to clear the excess demand; commercial banks that charge the government fixed lending rates plus a service charge and that also ration credit; back-street capital markets that charge the market clearing interest rates but whose borrowers have a high probability of default; and, finally, friends or relatives and self-generated funds. We discussed how each of these arrangements works and how it influences investment decisions and choice of technology. Another borrowing arrangement that we discussed was suppliers' credit and advances on machine orders. In subcontracting it is this last arrangement that is most commonly observed. We recorded many instances where parent firms extended loans to vendors both for working capital and for purchasing fixed assets such as machinery. In this subsection we present the evidence on the relationship between vendor and parent firms in the credit market.

Our present discussion focuses on issues that have much in common with recent developments in the economics of agriculture in developing countries. In that literature it is argued that landlord-tenant relations are complex in that they interact in the credit, product, land, and labor-markets simultaneously. This interlocking of

markets arises from imperfections in the markets for inputs and outputs. For example, a household may find it difficult to get credit or sell family labor, so it rents land from a landowner who often also supplies credit. Another example is that of the rural middleman who "ties up" credit availability with (i.e. makes it conditional on) sale of the crop. We shall see in this subsection and those that follow that similar interlocking may also exist in the relationship between parent and vendor firms.

In table 6.9 we present the response of vendor firms to our questions about their most important sources for financing fixed investment (where fixed investment mainly covers additions to capital stock through purchase of machinery). Only two of the 40 firms we interviewed report that parent firms are the most important source for financing fixed investment. In most cases such investment is undertaken by borrowing from friends or relatives and through self-generated funds. Interestingly, informal street markets for capital are as important as parent firms in financing fixed investment. This shows that such markets may work well in that they enable relatively long-term borrowing. Unfortunately, we did not get reliable information on the terms of borrowing in these markets. From our experience in the main field survey we know that real interest rates can be as high as 30% per annum, which is more than twice the commercial bank rate. Formal credit institutions such as commercial banks and specialized government lending institutions are relatively unimportant in financing the purchase of capital stock.

In reviewing table 6.8 we stated that an important reason for subcontracting is so that parent firms can save capital. Thus it is hardly surprising that they do not lend to vendor firms to finance the purchase of machinery. To do so would tie up their capital precisely in the manner that they attempt to avoid through subcontracting. Owners of two vendor firms that had been thus financed by their parent firms were unhappy about the arrangements whereby the parent firms not only expected to jump the delivery queue but also to dictate the choice of other parent firms, particularly when rivals were involved. One of the vendors felt that his owner always "dragged him down" when his business was bad by not allowing him to seek out other customers. This is surprising, since a parent financier can always share the returns with vendors by allowing them to take orders from others.

The parent firm is an important supplier of working capital. This can be seen in table 6.10, where parent firms are listed as the most important source of borrowing by a majority of vendor firms.

Table 6.9
Most Important Sources for Financing Fixed Investments of Vendor Firms, by City

City	(A)	(B)	(C)	(D)	(E)	(F)	Total
Lahore	1	4	3	2	—	1	11
Sheikhupura	—	3	3	—	—	2	8
Gujranwala	—	—	1	—	—	1	2
Faisalabad	1	7	4	2	1	4	19
Total	2	14	11	4	1	8	40

Note: A: Parent firms
B: Friends or relatives
C: Self-generated funds
D: Commercial banks
E: Government credit banks
F: Informal street markets.

Nearly half the vendor firms interviewed report that the most important source of borrowing is the parent firm. Three vendors, one in Lahore and two in Faisalabad, report that parent firms arrange direct supplies of the raw materials needed to manufacture the components. Most vendors feel that it is best to have one's own resources (which include friends and relatives), but that if borrowing is essential, one should do so from parent firms since their terms are the best. Such borrowing does not involve the payment of interest. Also, demand is less uncertain since the parent firms are committed to buying. The advantage to parent firms of lending in this way is that it enables them to work closely with vendor firms to improve the quality of subcontracted components and to ensure that delivery schedules are met. In the next section we shall say more on this when we examine the technological relationship between parent and vendor firms.

Table 6.10
Vendor Firms' Most Important Sources of Working Capital, by City

City	(A)	(B)	(C)	(D)	(E)	(F)	Total
Lahore	6	2	2	—	—	1	11
Sheikhupura	5	2	1	—	—	—	8
Gujranwala	1	1	—	—	—	—	2
Faisalabad	7	4	3	1	—	4	19
Total	19	9	6	1	—	5	40

Note: See table 6.9 for definitions of column heads.

Subcontracting and Technology

Accounts of the Japanese subcontracting experience, and the more recent studies of subcontracting in Taiwan and Korea, suggest that this subcontracting as an industrial institution has played an important role in technological innovation. Broadly speaking, the process of technological innovation can be thought to consist of three important dimensions. One is the perceived need for the innovation, a perception that may depend on the relative prices of capital and labor and on current expectations regarding returns to the innovation. The second is the nature of the engineering skills required for innovating and whether these are easily accessible. The third is whether capital markets function well and enable the financing of innovation. Clearly, risks are associated with all three dimensions and together they may have a compound effect on the riskiness of the innovation. Subcontracting arrangements may encourage technological innovation by allowing innovating parent firms to share the risk with vendor firms by sharing their working capital. We have already seen that many parent firms lend working capital to vendor firms. At least in the case of one large parent firm (Millat Tractors, a leading innovating firm to be discussed shortly) we know that its vendors raise working capital with its assistance. In return for this assistance, which may imply a subsidy by the parent firm, vendors undertake to manufacture new components according to the parent firm's design specifications.

In the previous section we saw that 19 vendor firms reported that parent firms are the most important source for working capital. We also asked these firms about the number of innovated components they had manufactured for parent firms in the previous three years. The responses are recorded in table 6.11. It can be seen in the table that vendor firms that have borrowing arrangements with parent firms carry out innovations more frequently than vendors that do not have such arrangements. We shall now examine the technological relationship between subcontracting firms and comment on the methods by which parent firms encourage vendor firms to innovate. Parent firms need of course to explain component design to vendor firms, but technical drawings are almost never used for the purpose. Instead, the usual practice is to hand over the prototype, which may have been imported or designed by a rival firm, to the vendor with few requirements for modification. While the component is being manufactured for the first time the parent firm actively supervises the process to ensure that specifications are met. This usually requires frequent visits by skilled machinists of

Table 6.11
Number of Innovated Components Manufactured by Vendors in the Previous Three Years, by Whether or Not Parent Firms Lend Working Capital

	Total Vendors	None	One	Two	Three	Four or More
Parent Firm Lends	19	5	3	4	4	3
Parent Firm Does Not Lend	11	6	4	1	—	—

parent firms. Once the newly manufactured component is deemed satisfactory, such visits become rare.

Materials selection, too, actively involves the parent firm with the vendor, but this time throughout their relationship, since the quality of the material, as much as the vendor's craftsmanship, determines the life and quality of the component. As for equipment selection, although parent firms rarely get directly involved in it, they thoroughly investigate vendors' tools and equipment before awarding contracts. Vendors having a wide range of machining equipment have a greater chance of being selected. For vendor firms that cast components, the range of dies and furnaces is also important. Skills training, however, is not an area in which vendors are prepared to take responsibility. We observed only one parent firm with an active program of training vendor firm workers in the skills required to manufacture new components. This firm, Millat Tractors, is exceptional and not really representative of the industry. The firm is an important component of the publicly owned Automobile Corporation of Pakistan. Until 1972, when it was nationalized, it imported Massey-Ferguson Tractors in knocked-down condition and assembled them in its plant in Lahore. It had a capacity of assembling two to three thousand tractors every year. In 1980 it began a program of progressive domestic manufacturing. Starting with a domestic content of 19%, it increased the domestically produced components to 27% in 1981, 38% in 1982, and 55% in 1983. This involved 160 components in 1980 and had gone up to 410 in 1983. The firm has a large department specializing in component design, marketing, and supervision of vendor operations. It organizes frequent conferences of vendors to resolve engineering and financial problems. This firm is not included in our sample of 40 parent firms being discussed in this section.

Although all the vendor firms we interviewed expressed a keen interest in formal trade groupings to exchange information on new methods and skills, as yet no such grouping exists formally. Informal exchanges, as mentioned earlier, are common but they do not always work. Some firm owners complained bitterly of severe competition and the associated secrecy "even among people who belong to the same lohar bradri."

"Tying" in Subcontracting

In our discussion of the relationship between parent and vendor firms we saw that parent firms provide both credit for working capital and technological advice. We shall now examine whether this relationship results in the vendor firm getting "tied" to the parent firm in the sense that it is unable to perform similar tasks for other firms in the industry. If such tying is widespread, it would be likely to effect the vendor firms' ability to use capital stock (machinery) intensively, and thus one of the benefits of subcontracting would be lost.

In table 6.12 we report parent-vendor tying arrangements. Only nine vendors out of the 40 we interviewed reported tying. Tying is a verbal pledge by the vendor to the parent firm that, for a specified period, it will not perform similar work for another firm. Of the nine firms that report tying, six say that it takes place only when the parent firm introduces, or actively participates, in the development of a new component. In most cases such tying is only for one production season. Patents are nonexistent in the industry so that rival firms can, and often do, enter the market the following year by copying the newly developed models. Thus a "free-rider" problem exists for the industry and may inhibit technological innovation in it. Further evidence of this problem is supplied by the response from both parent and vendor firms that it is hard to police such tying, and that if the price is right, vendor firms are quite likely to make the innovated component available to rival firms. However, it appears that such "copying" of innovations is subject to at least one-year lag. Few parent firms, in any case, expect the innovation to be kept hidden from rivals for more than a year. This, to some extent, may explain why only small and gradual modifications are made in the designs of agricultural machinery. The other side of such loose tying arrangements is that vendor firms are relatively free of the production constraints of any particular parent firm, and thus can avoid excess capacity in their capital stock when business is bad for one such firm.

Table 6.12
Parent-Vendor Tying Arrangements, by City

City	(A)	(B)	(C)	(i)	(ii)
Lahore	11	3	2	1	1
Sheikhupura	8	2	1	1	—
Gujranwala	2	—	—	—	—
Faisalabad	19	4	3	3	—
Total	40	9	6	5	1

Note: A: Total number of firms
B: Number of vendor firms reporting tying
C: Number of firms reporting tying only when new process introduced
D: Duration of tying (i) 1 year, (ii) 2 years.

Costs and Price Mark-up in Subcontracting

We have argued that an important advantage of subcontracting is that parent firms can avoid excess capacity in the off-peak season (as well as the organizational costs of obtaining and fulfilling contracts), and thereby achieve lower production costs. However, a careful analysis is required to determine whether, in fact, the cost of producing similar components under subcontracting arrangements differs from the costs to the firm of undertaking production of all the components itself. To carry out such an analysis, detailed data on the costs of vendor firms, including the imputed value of equipment time used in the production process, should be collected and compared with similar cost data for firms that manufacture their own components. Moreover, such comparisons will not in themselves be sufficient to establish the superiority or otherwise of own production over subcontracting. There may be important externalities involved in own production that the previous analysis ignores. For example, parent firms' skilled workers and supervisory labor may become thinly spread, causing inefficiencies. Also, the shop floor may become so cluttered and congested that work flow is seriously hampered and costs escalate. All these reasons would also make subcontracting attractive.

We do not have the detailed data needed to examine the cost advantage of subcontracting as discussed above. We do, however, have information on pricing decisions in subcontracting that indicates the relative bargaining strengths of parent and vendor firms in arriving at contracted component prices, and will therefore shed some light on the decision to subcontract.

In table 6.13 we report firms' responses to our questions regarding their perception of the adequacy of prices they receive or pay for the subcontracted components. After discussions with them, we defined prices to be adequate if they were 15–20% above the cost of manufacturing components, too high if they were 20–30% above costs, and too low if they were 10–15% above costs. Thirty out of the 40 firms we interviewed replied that prices paid by parent firms were adequate, while 10 felt that prices were too low. On the other hand, 18 parent firms out of 31 interviewed replied they thought that the prices they paid were adequate, while 13 thought they were too high. Thus, more vendor firms (75%) believed that prices are adequate than did parent firms (58%). We interpret this to imply that vendor firms are more frequently satisfied with subcontracted component prices than are parent firms, who may feel that they are driven to this arrangement by the high organizational costs of undertaking production themselves.

An alternative view of pricing in subcontracting is presented in table 6.14. Here we record the response of vendor firms to our question, Are the prices you receive for the subcontracted components higher, the same, or lower than what you would receive without subcontracting (i.e. by transacting in the market for components)? The corresponding question to the parent firm was, Are the prices you pay for subcontracting components higher, the same, or lower than the imputed value of components had you manufactured them yourself? A majority (70%) of vendor firms reported that subcontracting prices were either adequate or higher, while a majority (87%) of parent firms believed that subcontracting prices were the same or lower. Vendors reporting that prices were lower under subcontracting were, in most cases, those that had a "tying" relationship with parent firms. As we have just seen, such tying is not very widespread. The conclusion that we draw from this evidence is that, by and large, vendor and parent firms are better off under subcontracting, since both feel that they could do no better under alternative arrangements.

Contract Enforcement

Success in subcontracting for the parent firm depends on ensuring that product specifications and delivery schedules are met by vendor firms. This is determined, in part, by the material and moral incentives for fulfilling contracts, such as goodwill in the industry, prompt payment on delivery, and advance payments on orders. Equally important are the penalties associated with nonfulfillment.

Table 6.13
Price-Cost Perceptions of Parent and Vendor Firms

	(A)	(B)	(C)	Total Firms
Vendor Firms	—	30 (75%)	10 (25%)	40
Parent Firms	13 (42%)	18 (58%)	—	31

Note: A: Prices too high (20%–30% above costs)
B: Prices adequate (15%–20% above costs)
C: Prices too low (10%–15% above costs).

In this regard we attempted to examine the legality of contracts in the course of the survey. We came across only one parent firm (Millat Tractors, already discussed) that had anything resembling a written contract with vendors. Even this was quite informal. The "contract" was a letter from the parent firm indicating the number of components to be supplied; there was nothing on delivery schedules and component specifications. Verbal contracts, of course, exist and are taken very seriously since, in a small business, goodwill and reputation are very important. Besides, as we have seen earlier, vendor and parent firms belong to the same lohar bradri. This is also important in contract fulfillment. Informal escape clauses exist and do come into effect when the circumstances leading to nonfulfillment are obvious—illness, or death, or bottlenecks in the supply of essential raw materials. When this happens, no legal machinery is activated. The parent firm knows of the circumstances, since personal supervision ensures close contact with vendor firms, and makes appropriate arrangements depending on whether or not it believes in the vendor's good faith. Only two parent firms in our sample reported breach of the verbal contract: the vendor firms in question had absconded with advance payments on components. In both cases the firms were new to the locality.

Table 6.14
Price Perceptions of Vendor Firms Compared to Market Prices and of Parent Firms Compared to Own Manufacture

	Higher	Same	Lower	Total Firms
Vendor Firms	4 (10%)	24 (60%)	12 (30%)	40
Parent Firms	4 (13%)	18 (58%)	9 (29%)	31

Delays in delivery of components were reported frequently, but no penalties were reported in connection with such delays except the threat that no work would be subcontracted to the vendor in the following season. This threat is rarely carried out since the average duration of the contract with vendors is between five and eight years. It is worth noting, however, that parent firms that lend credit and provide technical know-how to their vendors are more likely to succeed in contract enforcement than others. We grouped firms according to whether they provided such assistance and report their responses regarding contract fulfillment in table 6.15.

On the vendors' side, the story of subcontracting is relatively more straightforward. We came across no cases where a contract was broken prematurely. The main issue, from the vendors' perspective, is the parent firms' payment schedules. Vendor firms reporting tying arrangements are, in general, more satisfied than others regarding payment schedules. In Faisalabad two vendors reported that they had stopped working for parent firms because of exceptional delays (six months in one case and four months in the other) in payments on delivered components.

Unrecognized "federations" of agricultural machinery manufacturers—unrecognized by the government, that is—exist in all towns that we visited. Membership is open to both vendor and parent firms. However, separate groupings of vendor firms do not exist. All the vendors we interviewed expressed a keen desire to form such groups in order to exchange technical information and cooperate financially. A common perception is that such groups could ensure better working relations with parent firms particularly with regards to payment schedules. Vendors are unanimous that this is one area where the government ought to intervene and promote such groups.

Some Economic Implications of Subcontracting

Earlier studies of agricultural machinery in Pakistan by Falcon (1967) and Child and Kaneda (1975) report that large and small firms can coexist because they are producing a homogenous product. This view of the industry implies that there are no scale-related barriers to entry. The existence of widespread subcontracting arrangements that we have observed suggests, however, that there is process (or component) specialization rather than product homogeneity in the industry. This is consistent with Adam Smith's view

Table 6.15
Contract Fulfillment for Parent Firms Providing Assistance

	(A)	(B)		(C)		(D)		
		(i)	(ii)	(i)	(ii)	(i)	(ii)	(iii)
Assisting Firms	13	10	3	11	2	2	7	4
Other Parents	18	12	6	13	5	5	10	3

Note: A: Number of firms
B: Delivery schedules (i) satisfactory, (ii) unsatisfactory
C: Specification schedules (i) satisfactory, (ii) unsatisfactory
D: Average contract duration (i) 1–3 years, (ii) 3–8 years, (iii) 8 years or more.

that with expansion in the size of the market, process specialization (division of labor) follows. In a growing industry that does not require a continuous production process, large firms find it attractive to subcontract processes (or components) to small firms.

Subcontracting is also the solution implied in the classic paper by Coase (1937) on the nature of the firm. He examines the factors that discourage firms from vertically integrating until the entire production process is carried out under one organization. In the context of our discussion, when the net benefits of contracting in additional services to carry out production under one firm organization become negative, subcontracting takes place. Thus we agree with Aftab and Rahim (1983) that process specialization, which subcontracting enables, is a more satisfactory explanation for the coexistence of small and large firms in the industry than the alternative explanation grounded in the absence of scale economies, as suggested by Child and Keneda.

In our discussion of subcontracting arrangements we have focused on the interlinkages and complementarities that exist between the small vendor firms and the large parent firms. These interlinkages operate primarily in the credit market and in the exchange of technical know-how. The main complementarity, of course, is in the area of process or skill specialization. All of these are important but in many ways the most important linkage is the one forged in the credit market. It is quite certain that many of the vendor firms would be unable to continue operations, given that the credit market functions so poorly, without the credit arrangements with their parent firms. The advantage to parent firms, of course, is that it enables them to contract out processes (thus saving labor, capital, and

organizational costs) to firms that can supervise work closely and thus ensure that contract specifications and delivery schedules are met. This is important in the absence of a formal legal machinery for enforcing contracts. Subcontracting arrangements, therefore, enable small and large firms to coexist in the industrialization strategies of developing countries. Seen in this light, the debate about small and large firms as competing strategies for industrialization ignores important dimensions of the underlying issues.

The interlinkages in subcontracting arrangements imply that parent and vendor firms must be located within easy reach of one another. Historically, vendor firms in the engineering industry were located near supplies of bulky raw material to avoid transportation costs. This resulted in the concentration of such firms in specific locations where they could exchange engineering skills and information on input prices and sources of demand for their output. The pattern helps to explain why small specialized industrial towns like Daska and Mianchannu in Pakistan continue to grow.

One adverse effect of complementarities between vendor and parent firms is that they may result in "tying" and thus may inhibit the diffusion of innovations. There are at least three ways in which a carefully devised government policy may help here. One is to introduce, and vigorously police, a patent system. Another is to make more capital available to vendors from sources other than parent firms to avoid the creation of monopolies. Third, programs can be initiated that encourage research and development by selected vendor firms through financial and technical assistance. This should be followed up with frequent conventions of parent and vendor firms to exchange innovated processes (as was common in Japanese subcontracting in the first half of this century).

We have argued that subcontracting forges important intrasectoral linkages, thus enabling demand and investment expansion to have maximum multiplier effects. For this to happen it is important the expansion in demand takes place for goods that domestic engineering skills are capable of manufacturing. Thus, an import policy that makes combine harvesters cheaply available on the domestic market will result in much of the domestic engineering industry, and the subcontracting links that it forges, being bypassed.

Finally, the benefits of subcontracting must not be the only consideration in promoting import substitution. The success of Pakistan Automobile Corporation in promoting subcontracting in the manufacture of cars, trucks, and tractors must not be allowed to detract from a careful analysis of the import-substituted vehicles;

international competitiveness. For the Indian case, Watanabe (1974) has catalogued in detail the economic losses to the society of such "forced" subcontracting.

◆ *Chapter 7* ◆

Growth

Some of the factors that contribute to a firm's growth are beyond its control, such as the political climate and fiscal policies affecting investment decisions, the performance of the rest of the economy, and the workings of financial institutions. However, there are other, endogenous factors over which firms do have control, such as the entrepreneurial ability to seize profitable opportunities, managers' organizational abilities, and workers' willingness to learn new skills. In this chapter we analyze the importance of some of these factors in explaining growth in the farm machine industry.

The chapter is divided into two parts. In the first, the industry's growth is measured both in terms of existing firms' expansion in operations and of new firms entering it. Such entry is described in the first section of this part in relation to the major phases of technological change in agriculture. We find that growth and product specialization in the farm machinery industry are closely related to the demand pattern generated by growth in Pakistani agriculture. In the next section industry growth is examined in terms of changes in capital stock over time. We find the average growth performance in the industry to be very impressive. On average, firm size has increased nearly four times, with the annual growth rate being about 46%. Our analysis in the following section shows that among the factors that have contributed positively to firms' growth are judicious selection of products to specialize in and good connections with "bradris" that are known for their entrepreneurial skills. Firms that start out too big tend to grow relatively slowly. Moreover, firms using capital-intensive

technologies are found to grow faster which suggests that such firms may generate large investment surpluses. Among the exogenous factors contributing to growth are: technological change, migration, raw material availability, and linkages with the rest of the economy. Importantly, a stable political environment is found to play a subtle but important role in promoting growth.

In the second part of this chapter we reproduce detailed interviews with two firms in the industry. These will enable the reader to share more directly the firms' struggles and important turning points, with the entrepreneurs perceptions of the economic climate affecting growth. The interviews will also shed a more vivid light on many issues discussed previously in abstract terms.

Firm and Industry Growth Factors

Firm Entry

The oldest firm in our sample was established in 1945 in Daska. From that date until 1982 there are 38 years, which we have divided into eight time periods of five years each (except the last one, which is of three years).

The cumulative entry of firms into the industry by time periods in each product group is given in table 7.1. Only 15 firms were established by 1959. Of these, five produced mainly tubewells and 10 mainly sugarcane crushers and chaff cutters. The other three items, threshers, trolleys, and tractor attachments, were not being manufactured at all.

Some of the reasons for this early demand for tubewells are as follows. First, the existing canal system was insufficient to provide adequate water for the new Green Revolution technology in agriculture that had greatly increased the demand for regular irrigation. Secondly, waterlogging as a result of nearly half a century's canal irrigation in sandy, porous, soils had begun to affect vast tracts of land and was leading to a demand for tubewells for drainage. Chaff cutters and sugarcane crushers, on the other hand, have always been in demand as a result of Pakistan's mixed farming practices, which include both crop cultivation and animal husbandry.

Thirty firms in our sample reported that they had begun operations by the end of the 1960s. Of these 10 were in the tubewell group, three in the thresher group, two were manufacturing trolleys, one ploughs and drills, and 14 were in the sugarcane crusher-chaff cutter group. Firms manufacturing threshers, trolleys, and

Table 7.1
Cumulative Establishment of Firms in Each Product Group over Time Periods, 1945–1982

Time Periods	Product Groups: Tubewells	Threshers	Trolleys	Ploughs & Drills	Sugarcane Crushers & Chaff Cutters	Total Firms
1945–49	2	—	—	—	2	4
1950–54	4	—	—	—	7	11
1955–59	5	—	—	—	10	15
1960–64	8	2	2	1	14	27
1965–69	10	3	2	1	14	30
1970–74	14	7	3	4	15	43
1975–79	22	28	8	13	18	92
1980–82	25	46	14	16	18	119

drills and ploughs entered the business in response to the revised development strategy that gave agriculture high priority. Increased agricultural activity resulted in greater marketing and therefore high demand for transportation and on-farm processing equipment. Meanwhile demand for tubewells continued to grow, providing opportunities for new firms. This pattern continued to be reinforced so that, by the end of the 1970s, 92 firms in our sample were in business—a threefold increase over the previous decade.

By the mid-1970s, agricultural output was nearly double that of the previous decade. At the the same time, migration of Pakistani workers to the Middle East had started to affect rural areas, resulting in shortages of labor at peak periods, particularly at harvest. Conditions for using mechanical threshers were ideal and the light engineering sector responded quickly. As can be seen in table 7.1, there was a rapid increase in thresher manufacturing firms during this period. Of course, an official policy to subsidize the import of tractors (which provide threshers' driving power) was crucial in bringing about the so-called thresher revolution.

It appears that barriers to entry, through licensing schemes or by rationing investment funds, are not insurmountable in the industry. Firms of all sizes exist catering to specialized regional demand for agricultural machinery. After describing the industry's growth we shall take up in more detail some of the exogenous factors and policies that may have contributed to it.

Growth in Capital Stock

We may use two measures to describe the industry's growth: increase in the number of workers employed, and increase in capital stock. We use the latter measure in part because, as was discussed in chapter 4, we have fairly reliable measures of firm's capital stock and its history. Percentage growth in firm's capital stock is given as

$$G_t = \frac{K_t - K_{t-1}}{K_{t-1}} \times 100$$

where K_t and K_{t-1} are, respectively, the current and previous period average capital stocks of the firms. This measure enables us to comment on the trends in the growth of capital stock of firms in each product group for the eight periods between 1945 and 1982. Percentage growth rates for selected firms are reported in table 7.2.

Capital stock grew rapidly in the early 1950s because Muslim entrepreneurs from the Indian Punjab were establishing their firms. Growth peaked again the mid-1960s and again the mid-1970s. The average capital stocks of both small as well as large firms have been growing steadily, with small firms showing greater variation in growth than large ones. The sharpest increases in capital stocks are for the latecomers, namely, firms manufacturing trolleys, and drills and ploughs. Their growth rates peaked in the mid-to-late 1970s. By the early 1980s it appeared that the capital stock growth rates of all products groups had slowed down.

We now proceed to examine some of the factors endogenous to the firm that explain growth. To do this we define two measures of firm's growth. One is firm's growth over its lifetime, measured as change in the value of its capital stock from the date of its establishment until 1982. The other is the firm's average annual growth rate. The average values for these two measures over the entire sample are reported in table 7.3.

As the evidence shows, the firms' growth performance has been impressive. In order to identify the endogenous factors contributing to the firm's growth, we regressed the annual growth rate on firm characteristics such as product specialization, location, entrepreneur's bradri, firm's age, firm's ability to borrow, firm size in terms of employment, technology used by the firm, and initial value of capital stock. The results are reported in table 7.4.

We find that location does not influence firm growth. Product specialization, however, does. Firms manufacturing sugarcane

Table 7.2
Percentage Growth of Firm's Capital Stock (Mean Values) over Previous Five-Year Period, by Selected Firm Features

	1950–54	1955–59	1960–64	1965–69	1970–74	1975–79	1980–82
All Firms	467.74	48.98	120.23	25.12	138.04	154.88	35.48
Tubewell Firms	346.74	33.11	47.86	19.95	57.54	32.36	19.20
Thresher Firms	—	—	—	194.98	851.11	645.65	63.09
Trolley Firms	—	—	—	77.62	309.03	204.17	72.44
Drill & Plough Firms	—	—	—	575.44	23.99	147.91	61.66
Sugarcane Crusher & Chaff Cutter Firms	112.20	269.75	6.92	169.82	58.88	3.02	—
Small Firms (up to 10 Workers)	309.03	30.90	61.65	23.44	125.89	288.41	51.29
Large Firms	87.13	93.33	223.82	26.30	147.91	52.48	3.16

crushers and chaff cutters grew at a considerably higher rate compared to other firms. Both lohar bradri and firm size (in employment terms) were found to be significant in regressions in which firm age and original capital stock size were not included. With their inclusion, however, both these variables turn out to be insignificant. Not surprisingly, firms that are successful in borrowing in the modern-sector capital markets grow at a higher rate than others. Firms that start with relatively higher capital stocks grow at a much lower rate than other firms. The same is found to be true of firms that have been in business longer. We also tried dummy variables for firms established at the height of the Green Revolution in the early 1970s and those established after the military coup in 1977; our purpose was to capture investment incentives due to, respectively, expectations for demand expansion and security of invest-

Table 7.3
Percentage Growth Rates of Firms

	Mean	Standard Deviation	Number of Firms Reporting No Growth
Growth over Firm's Life	407	1,311	23
Firm Growth per Year	46	15.4	2.5

Table 7.4
Factors Influencing Firm's Growth: Ordinary Least-Squares
(dependent variable: firm's annual growth rate)

	Coefficient Value	Standard Error
Constant	2.743	0.628[c]
LOCATION DV		
Gujranwala-Sialkot	0.173	0.927
Faisalabad	−0.577	0.505
Multan	−0.018	0.483
Lahore	−0.418	0.429
Mianchannu	−0.380	0.572
PRODUCT GROUP DV		
Tubewells	0.648	0.468
Trolleys	0.459	0.413
Drills & Ploughs	0.569	0.387
Sugarcane crushers & Chaff cutters	1.954	0.877[b]
Lohar Entrepreneurs	−0.043	0.246
Large Firms (Employing More Than 10 Workers)	−0.101	0.291
Firms Sucesstully Borrowing from Banks	0.463	0.920[b]
Proportion of Original to Total Capital Stock	−2.791	0.319[c]
Firm Age	−0.087	0.149[c]
Capital-Labor Ratio	0.00022	0.00012[a]
R^2	0.539	
F value	8.011	

Note: Superscripts a, b, and c imply significance at 10%, 5%, and 1% levels, respectively; DV signifies "dummy variable."

ment (after Prime Minister Zulfikar Ali Bhutto's nationalization policies). Neither of these were statistically significant in explaining firm's growth performance. Firms' capital-labor ratio, which is a broad indicator of technology used, is statistically significant and shows that firms employing capital-intensive technologies had a better growth performance. (There may be a problem with endogeneity here, since high growth rates in capital stock could have resulted in greater capital intensity.)

Factors Influencing Industry Growth

Clearly, the advent of Green Revolution technology was a big boost to the industry. In the early stages of technological change, demand was created primarily for diesel engines and pump sets, to provide

regular irrigation for the new-yield varietals that used chemical fertilizer. This demand continued for about 15 years, allowing firms to experiment with production methods and small firms, especially, to find a niche in the industry. In recent years this demand has declined, partly on account of rural electrification, which has resulted in many farmers switching over to electric motors. This technology is considerably more capital-intensive, so that many firms have had to scale down their operations or turn to other products. The increased agricultural production accompanying technological change has also caused shortages of labor at peak periods. This had brought about the mechanization of ploughing and threshing activities and hence a new range of agricultural machinery has come into demand. Entrepreneurs are generally of the view that demand induced by farm mechanization is likely to continue growing.

Another related aspect is the migration of Pakistani workers to the Middle East. (Since 1975 nearly 2.5 million Pakistani workers have migrated abroad, mainly to the Middle East.) This, on the one hand, has resulted in shortages of labor in the rural areas and, on the other, in remittances from the migrants that have enabled farmers to switch over to mechanized cultivation, so that further demand for agricultural machinery has been created.

According to Child and Kaneda (1975), a major constraint on the industry's growth is that raw material is not reliably available. This appears to have changed now. The raw material used in the industry consists primarily of pig iron, steels of various strengths (in the form of mild steel plates), angle iron, rods, ball bearings, and nuts and bolts. Pig iron is used for casting parts and is important for firms manufacturing tubewell machinery, fodder cutters, and sugarcane crushers. It is combined in various proportions, depending on the part to be cast, with scrap purchased from the ship-breaking industry in Karachi. Until recently pig iron was imported in large quantities. With the commissioning of Pakistan Steel Mill, however, reliance on imports has decreased. Most of the entrepreneurs were quite enthusiastic about the quality of pig iron produced by the mill and described it as "soft" and easy to machine.

Raw material is, in most cases, adequately available in the towns where firms are located, although Lahore is the main market. There is no restriction on the minimum quantities purchased. Various arrangements regarding payment exist depending on the relationship between entrepreneurs and sellers. The usual practice is to pay up to half the price at the time of purchase and the remaining

half within a period of up to one month. As we saw in our discussion of capital markets, this arrangement is important given that supplies of working capital are inadequate. Thus the innovative arrangements in the raw material market appear to have smoothed out some of the problems that may have retarded growth earlier.

The nature of the political and administrative regime has an important bearing on the investment climate. Under the Bhutto government, from 1971 to 1977, there was a pervasive rhetoric of nationalization that encompassed even the very small firms. The grain trade was nationalized, which made the rhetoric all the more credible and resulted in insecurity and stagnation of investment. In the regression analysis of the previous section we attempted to examine the impact of political regime on investment by introducing dummy variables. These were statistically insignificant. However, the relationship between politics and investment is a subtle one, and may not be captured by simple regression procedures. Furthermore, it is likely that there would have been much more investment had the political climate been more encouraging. Indeed, the regime's land reform rhetoric may even have strengthened the trend to mechanize, with many landowners claiming land from their tenants to increase their self-cultivated area with the help of tractors.

An important feature of the agricultural machinery industry is its linkages with the rest of the economy, particularly the agricultural sector. The two most important linkages are through the labor and product markets. Increasing farm mechanization generates demand for labor to maintain and service farm machinery. We saw in chapter 3 that lohar biradri workers in rural areas traditionally have manufactured and serviced the usual simple farm implements, acquiring skills related to the new sophisticated machinery through employment in firms manufacturing it. In this manner the industry receives a regular flow of semiskilled workers who upgrade their skills and then return to rural areas to service the new farm machinery. The other linkage is that, with increasing farm mechanization, growth in agriculture results in the growth of the farm machinery manufacturing industry. The close interaction between farmers and manufacturers ensures that machine designs are both in keeping with local engineering capabilities and economically feasible. In this sense their interaction is a good example of institutional arrangements that result in "appropriate" technology. These two linkages may have contributed importantly in bringing about technological change and growth in both agriculture and the agricultural machinery industry.

Throughout our discussion of the structural impact on productivity performance in the industry we have emphasized the importance of location. In our regression analysis of factors influencing firms' growth, however, the dummy variable for towns are found to be statistically insignificant. Yet in conversations with firm owners and/or managers and other knowledgeable people, location was always pointed out as being important. This suggests that location may indeed matter but in indirect and subtle ways. Take, for instance, the development of the industry in Mianchannu. In the early 1950s there was only one firm located there, and it manufactured very simple implements. A series of events resulted in the firm expanding its operations to manufacture sophisticated machinery. This involved training workers, acquiring management skills, raising capital, and coming to grips with new and unforeseen technological problems almost single-handedly in a town with no engineering base. The entrepreneurial talent of the firm's owner was stretched to its limit (in the next section we reproduce a detailed interview with him). Through persistence and a remarkable ability to work hard over long periods, the firm overcame these hurdles. In 1982, Mianchannu boasted more than 30 medium-to-large firms, all of which trace their antecedents back to this firm.

These developments are reflected in the range of machinery manufactured to suite the region's farming requirements. The town has a large skilled labor force that it now exports to Faisalabad, Multan, and other cities where the industry is making a beginning. It is quite likely that the original entrepreneur would have succeeded anywhere. However, there were special features of Mianchannu that contributed to his success. It is located in the center of a prosperous agricultural district with large farms, which ensured demand. Its importance as a grain market implied that investment funds could be arranged. Its efficient administration and excellent road and rail network facilitated deliveries of raw material and transportation of finished machinery. Importantly, a steady flow of semiskilled lohar workers who could commute from surrounding rural areas provided a source of relatively cheap labor eager to learn the new skills and then return to the village to service the new farm machinery. All of these location factors contributed to industry growth and Mianchannu's reputation as a center of excellence in that industry.

Two Case Studies in Growth

In this section we present detailed interviews with two firm owners, one in Daska and the other in Mianchannu. The firm in Daska is small. In the interview with its owner we have attempted to capture an entrepreneur's concerns and struggles during the process of growth. Details regarding production and employment arrangements are retained so that the reader can experience directly many of the issues that we analyzed formally in the previous chapters. The second interview, with the Mianchannu firm, reveals a success story--the growth path of a firm which has come to be regarded as a leader in the industry. The thrust of the second interview is toward an attempt to identify the exogenous and endogenous factors that have contributed to the firm's success.

Munawar Industries

The owner, Munawar, is 41 years of age and has been educated through matriculation level.

Q. When was your firm established?

M.I. It was established in 1976, but I started work in 1968 at United Smith. That firm also made agricultural implements. In fact, at United Smith we were the founders of this industry in Daska.

Q. Did you make diesel engines?

M.I. Yes, but we later gave that up and started making other implements and spare parts for tractors because of the changing demand in the country.

Q. Why did you choose this location? Why Daska and why this locality [the ring road]?

M.I. Daska is the largest agricultural *tehsil* (county) in Sialkot District. Also tractors are in widespread use on farms here. Besides, my family has lived here for generations. The advantage of being located on [the ring road] is that farmers hesitate to go into the city because they are not very good drivers and usually do not have complete papers [for their tractors]. Also, they would rather get their work done on the outskirts of the city and avoid city hassles. The market has now developed on [the ring]. My previous employer, United Smith, which is in the city, would also like to shift here. [*He explains that he is the sole owner of the firm, which is not registered. Among his reasons*

for not registering it are the following:] For instance an inspector would come every 10 days or so to check if we have pails of sand or other types of fire extinguishers and he will also check for other things—they would compare us with the safety standards of larger firms.

Q. Are you a local of this area or a refugee?

M.I. We belong to Pasrur *tehsil* [the neighboring sub-division] but have lived here 20 years. Not many people here belong to Daska—nearly all have migrated from surrounding villages.

Q. Why did Daska become the important center for this industry? Why not Wazirabad or Sialkot or any other city?

M.I. The name "Daska" itself explains this to some extent. It originates from *daskoha*, that is, the five cities Sialkot, Gujranwala, Wazirabad, Pasrur, and Narowal are all at a distance of 10 *koh* [about 18 miles] from here. It is a very central location.

Q. You mentioned that United Smith was your first firm. Were you also the sole owner there?

M.I. No, it was a partnership. I was the manager, and the other party had contributed the capital.

Q. What was your share?

M.I. Twenty percent of the profit.

Q. Do you come from an agricultural background?

M.I. No, but ever since I started working in this industry I have visited farms to test the products out in the field and get farmers' opinions.

Q. Have any of your family been or are they presently agriculturalists?

M.I. No, our family belongs to the lohar bradri and I have inherited this occupation—my father and grandfather were also blacksmiths . . .

Q. How long have you been in this business?

M.I. I have been learning this skill since 1958. I became a skilled worker in one year—so that I have now spent nearly 22 years in the industry . . .

Q. Have any of your family members migrated abroad?

M.I. Yes, my younger brother.

Q. What country?

M.I. Kuwait.

Q. What does he do there?

M.I. He did his master's in business administration but couldn't get a job here. He worked with us for a while, got frustrated and went to Kuwait. He is a storekeeper in a company there.

Q. Does he send money?

M.I. Yes—he sends his wife Rs 1000/2000 per month, he's been there only a year and says he'll bring money with him when he comes back.

Q. I am asking because I wanted to know whether such remittances are being invested in business.

M.I. No, these people have no sense—when they come back from abroad they bring tape recorders, televisions, air conditioners—or else contribute to the price of land, bricks, and cement going up—but don't invest one *paisa* in business.

Q. What is the total value of the machinery you have?

M.I. About Rs 40,000.

Q. And the building?

M.I. This is rented. We have bought land and hope to build within six months to a year.

Q. What is the rent?

M.I. Rs 200 per month. We got it in good times! Also, the landlords have two tractors, so we help each other.

Q. Do you have any raw material in stock?

M.I. No, we have some completed machines in stock.

Q. How many?

M.I. One or two as samples. One is a thresher which was made for an exhibition and received a President's Award. And another thresher was made on an order from Saudi Arabia, for a self-drive machine that would not have to be attached to a tractor I made the design myself—and used a Chinese engine.

Q. What would be the value of these two threshers?

M.I. About Rs 36,000.

Q. How many threshers did you make last year?

M.I. About 20.

Q. In the last five years, have you made any machinery that was completely new to your experience? That you had not made before?

M.I. We used to make only cultivators. Threshers, border blades, and land levelers are new developments.

Q. Do you make on order?

M.I. All our machinery is made on order from farmers . . .

Q. Is there any item which was important before but not anymore?

M.I. Nobody buys the old-type threshers anymore. In fact, we sold some as scrap last year. It uses more horsepower and is less productive. The old type does 12 mounds [of wheat] per hour, the new thresher does 30 mounds an hour.

Q. Of the three labor categories—skilled, semiskilled, and unskilled, how many skilled workers do you have and what are their salaries?

M.I. Four. They are paid Rs 450-500 per month.

Q. That would be your semiskilled labor. What about skilled?

M.I. They are skilled. We trained them ourselves . . .

Q. And unskilled labor?

M.I. Don't have any. We have two apprentices. Give them about Rs 100 per month. They are young [unfortunate] boys who have not been able to get an education.

Q. So that in all there are four semiskilled and two apprentices.

M.I. Yes, I'm the eldest.

Q. What do the others do?

M.I. They supervise the workers. I only give them the designs and do the overall management. They are trained mechanics.

Q. Do you give them a share of the profits or do they get a salary?

M.I. We are a joint family—I give them about Rs 100 pocket money.

Q. Is that all?

M.I. I bear all their families expenses, we live together.

Q. And you have a third relative—is he a nephew?

M.I. He is also my real brother, he's not well at the moment. He is an electrician.

Q. How long have your apprentices been with you?

M.I. They change after about a year. When they ask for more payment, we get new boys.

Q. So obviously a labor union is out of the question? And you wouldn't waste any time due to strikes.

M.I. Y·

Q. D you have any contact with the Agricultural Machinery Division of the Agriculture Department whose representatives are here accompanying me in this interview?

M.I. We should have, but we don't.

Q. Why do you feel you should?

M.I. Because they have been formally trained and educated in this field and should be able to help us and advise us in machine design. But that doesn't happen, probably because they don't have a regular office here—after all if they come for two or three hours they can't come to all the firms.

Q. Is it that they go only to larger firms?

M.I. No, that is not it.

Q. Speak plainly. They won't mind.

M.I. No—no—we will be happy to receive them whenever they come. For instance the new reaper they have designed—do you like it? We saw it in Muirdke and liked it—and there is a great demand for it. In fact we had requested them to give us the design.

Q. Do you get loans from the ADB [Agriculture Development Bank]?

M.I. Only farmers get loans from them here in Daska. We learned that a firm got a loan from them in Gujranwala, so we presume loans are available for industry also.

Q. What would you use the loan for?

M.I. To buy raw material. It costs less to buy in bulk. And it would be easier to maintain standards.

Q. Are there any machines you would like to make but you cannot due to nonavailability of credit?

M.I. We would like to make a reaper. Every farmer who comes to us asks for the reaper.

Q. Why?

M.I. Rural labor is either migrating abroad or to the cities and so there are not enough men to work on farms during the wheat harvest. The government keeps saying we should become self-sufficient in food and we should start exporting, but in fact we cannot even handle the present level of output.

Q. Are the farmers finding it difficult because they cannot get labor at all or is it because labor demands high wages?

M.I. There are two aspects. Output is increasing and there is a shortage of seasonal labor. No man with a regular job wants to go to work on the farm for just 15 days or a month.

Q. If any of your workers wanted to take leave during the harvesting season to work in the fields, would you let him?

M.I. Very reluctantly, because that is our busy season too. In any case they have become delicate sitting under fans and would rather not do strenuous work like cutting wheat in the heat of May!

Q. Is a reaper good for rice too?

M.I. Yes, but the real advantage is for wheat.

Q. Rice planting by hand is a very tedious job. Isn't there a demand for rice-planting machines?

M.I. Yes—there is a need for it, but the imported machines have never been successful.

Q. Why?

M.I. Mainly because in the countries where these machines are used the land has been properly leveled, whereas our land is not level and so it is easier to plant by hand.

Q. So there has to be a demand for land levelers first.

M.I. Yes.

Q. How many days in a year are wasted due to electricity shutdowns?

M.I. The last two years have been all right. Before that we wasted quite a few days. Now they shut down on Sundays, when we are also closed.

Q. Now I would like to ask a few questions from one of your apprentices.

M.I. There is one who first learnt his skill here and . . .

Q. I'd like to talk to someone who has come from some other job.

M.I. Yes, there is a young boy . . .

Interview with Apprentice Mohammed Rafique.

Q. How old are you?

M.R. About 13 years old.

Q. How long have you been working here?

M.R. About two months.

Q. What do you do?

M.R. Welding.

Q. How much are you paid?

M.R. Around Rs 100.

Q. What did you do before you came here?

M.R. Also worked as a welder, in a place about half a mile from here.

Q. Is this job more skilled compared to the previous one?

M.R. This one requires more skill.

ANOTHER WORKER Didn't they make grills there?

M.R. Yes.

THE OTHER WORKER Threshers and agricultural machinery are more complicated, more work is involved as compared to making iron grills.

Q. If you wanted to leave this job and work elsewhere, what sort of work would you do?

M.R. After I've learned welding here?

Q. Yes.

M.R. I would work as a welder.

Q. How far would you go?

M.R. I could find work anywhere in Daska.

Q. How much more would you be paid?

M.R. Once I've learned the skill here?

Q. Yes.

M.R. When they raise my wages here I'll know what to expect elsewhere.

Q. If and when you look for another job, how will you find it? Will you ask a relative or ask around yourself?

M.R. Ask around myself.

Ghazi Industries

Location: Mianchannu

Ghazi Industries is a leading large-scale firm in the industry. We spoke to the managing director in his air-conditioned office. He began by narrating the story of his firm

G.I. Our elders migrated from India and set up a small workshop here. They were mainly carpenters but here they concentrated on working with iron [as blacksmiths]. They used to supply small parts of agricultural machinery to the district councils and also did repair work. Then the deputy commissioner of Multan, at that time Malik Karamdad, told my father, "Ghazi Sahab, you do a lot of work for us, why don't you make a complete set of three implements each—a bullock-drawn plough, a leveler and a rice sheller—and supply them to the union councils." He gave an order of 10 sets and offered to give advance payment for five. So that is how they started production—with that advance for five sets. Since they were used to working hard, the 10 sets were completed quickly and worked very successfully. After that we made around 100 sets for the union council.

Q. Where was this first workshop located?

G.I. Very near—where we store the wood now.

Q. How many workers did your family employ at that time?

G.I. My elder brother, my father, another relative, and they also had one hired laborer. We got the initial encouragement when the first order was placed. For those 100 sets for the union councils we received a profit of Rs 200/500 for each set, which was good in those days. Then we invested in the manufacture of other bullock-drawn implements—wheat and rice drills to begin with. In 1963 we made the thresher—its price was fixed at Rs 2,500.

Q. So your main break came in 1963 when you started a new phase.

G.I. A totally new phase.

Q. What year was this workshop first started?

G.I. 1960. When they came onto iron work and agricultural implements.

Q. In 1963 how many other implements were you making when you started making the thresher?

G.I. All bullock-drawn implements—the "Pakistani plough," wheat drill, rice drill, "bar narrow," "mold board plough"—nearly all the implements that are tractor drawn now were made in one form or the other as bullock-drawn implements.

Q. How were these implements sold?

G.I. Some implements were bought by the Agriculture Department and introduced to farmers and some were bought directly by farmers. We did not have a showroom. In 1963 when we made a thresher—we fixed its price at Rs 2,500—we used our own sources of finance, and it was very successful. In the first year, we made two, in the next year 18, then around 35 to 50 threshers each year, increasing to nearly a hundred each year. Last year we made 300. Our capacity allows 500 threshers to be manufactured each year.

Q. When you invested for the first time in threshers was it all with your own finances?

G.I. We used to ask the customer for a 50% advance.

Q. What is the source of finance now?

G.I. Since we work on a large scale we get bank loans.

Q. What about the Agricultural Development Bank?

G.I. The ADB gives loans to farmers and landlords. They give loans against land, in the form of supply orders to manufacturers of agricultural machinery. When farms receive the machinery, payment is made directly to manufacturers. This is to make sure that the loan is used to purchase machinery and is not wasted.

Q. Do you feel that if you had had technical education it would have been better for the firm?

G.I. Yes—it would have been much better. Mianchannu is a small place, it does not have a college or a university. Besides, when we started there was a shortage of manpower and my elder brothers could not be sent away to study. I being younger was able to get an education, but was not properly guided about subjects—we didn't have science classes in schools and I did my matric in arts subjects.

Q. What about the next generation?

G.I. We would like them to specialize in engineering or business, take up a specific line instead of a general arts education.

Q. Why would you emphasize engineering?

G.I. Because it would become easier for us [in the firm]—we [now] have to consult engineers to understand complicated drawings—we would be able to develop a machine in weeks that presently takes us months if we could comprehend engineering drawings.

Q. Considering the rapid expansion your firm is experiencing the day is not far when your research and development section—which you mentioned—will become a very important part of your firm.

G.I. We are trying to get a qualified engineer to work with us until one of our own relatives gets trained as an engineer.

Q. Will you be able to get someone from this area?

G.I. We will try—maybe AMRI [Agricultural Machinery Research Institute] in Multan will cooperate. They help us quite a lot and guide us regarding machinery.

Q. Your machinery can be used only with a certain horsepower. This limits it to tractors with at least that horsepower.

G.I. We recommend 25 horsepower, and in Pakistan tractors are mainly 25 HP and above. We could also modify the machinery if the need arose.

Q. What are the important variables that come to your mind in measuring the success of an entrepreneur?

G.I. I would judge by how his product is received in the market. We think it is important to have a trial period of one year before placing a product in the market, so that the product maintains a good reputation among farmers.

Q. You must be interacting with farmers all the time and they must be evaluating your products and giving their recommendations.

G.I. Yes and this is a very good source of feedback for our improvement. For instance, sometimes we put a machine in the market and a farmer will come to us and say "All right, so it is well that you have copied the imported model," but then they go on to tell us how it does not suit local soil and other conditions.

We then try and modify the design. In Pakistan the land quality is varied—for instance in the Pindi or Sargoda or Khushab areas they sow wheat ten inches in the ground—and we make the drill bits longer for them as compared to those for Multan area, where wheat is sown around eight inches deep.

Q. You said you started operating in 1960. Where was that?

G.I. Here in Mianchannu.

Q. What size was your workshop?

G.I. One room and a courtyard. Of course, now that we are sitting on the national highway, we are our own free advertisement. Whether farmers actually buy it or not, many come to see our machinery.

Q. How many firms are there in Mianchannu?

G.I. Around 30. Out of which 10 are quite large, the rest are small firms and repair shops. All of these came up in the last four years—since 1978.

Q. What is the reason?

G.I. Tractors started being imported in large numbers—the demand for implements went up, we got a lot of orders. Other firms also saw opportunity for making profits and joined this line.

Q. What was the impact on labor?

G.I. New firms manage with minimum skilled labor. They start work with just one technical man and three semiskilled workers. You could say that in all these new firms the foreman is about the level of our ordinary skilled worker.

Q. What does the foreman do?

G.I. He is the chief technician. The man who is trained in all the operations and does the overall supervision. He knows the sizes of parts and can handle all the skills.

Q. Do skilled workers come from outside Mianchannu?

G.I. When we started it was a problem to find skilled labor and we had to find workers from Faisalabad, Gujranwala and Lahore. We had 15 or 20 men working for us and they stayed four or five years and got trained. There weren't many other firms.

Q. Where did they go after working with you?

G.I. Various industries in Mianchannu—some went back to their own villages and set up their own workshops. They found it

easier to repair our threshers that went there, since they themselves had made them.

Q. Have you kept contact with your previous workers?

G.I. Not much.

Q. I ask because they could also be a sales channel for you.

G.I. Now they are interested in selling their own product.

Q. If your machinery were standardized, you could subcontract to other firms to make parts.

G.I. We do that to some extent. That way different firms can specialize in specific parts and quality control is easier.

Q. Do you subcontract with your old workers who have set up their own firms?

G.I. No, because they use obsolete machinery and the work is shoddy.

Q. You were mentioning earlier that of the skilled workers mostly welders migrated abroad? Why is that?

G.I. The training period is not too long, and since it is mainly construction work in the Middle East there is a demand for welders and fitters.

Q. So there is a shortage of welders and fitters?

G.I. Yes. As compared to turners for example.

Q. If the government wanted to do something about this short supply what plan would you suggest to them?

G.I. So far government training institutes have not been very successful. It would be better if they sent workers to private firms for training.

Q. How many could you train?

G.I. We train on average ten workers per year—up to 15 during the busy season. We could train 20 to 25 workers every season (a full season is three months) for welding and fitting.

Q. What sort of incentive would you want in order to be involved in such a scheme?

G.I. There should be some sort of a written bond. The workers should stay for at least two years with us.

Q. You would not want a subsidy to pay for training?

G.I. No—only a surety that they stay for at least a period of two years—if they go away too soon, the work gets affected—not that we would mind if they stayed their whole lives.

Q. What happens to workers who come only for the season? Are they mainly semiskilled?

G.I. Yes—they go to other industries—for instance ginning factories and repair workshops.

Q. What percentage return?

G.I. About 40%.

Q. Do some workers also go away to work on farms during the harvesting season?

G.I. Yes, but they prefer to work in an industry where they are better paid, also get paid for overtime, get all the regular facilities of a government department like leave, medical allowance, etc., whereas they work the whole day on the farm. Mostly those who have their own farms might go.

Q. Have you ever thought of leaving Mianchannu and setting up your firm somewhere else?

G.I. The market is developed here. Labor is cheaper compared to other cities, for instance Lahore and Multan. Land is cheaper—we can expand more easily. Besides our family is established here. The whole world knows we are here, Ghazi Industries and Mianchannu go together.

Q. Have you ever thought of Khanewal? It's very close to Mianchannu [twenty miles]. It is an important railway junction, and besides natural gas is available.

G.I. We have a small foundry—not much use for gas. The biggest advantage in Mianchannu is that it has become an established market for agricultural implements in all of Pakistan. Everybody knows us here, we are better known being located in Mianchannu than bigger businessmen would be known in Lahore or Karachi. Personal contacts are important in small places, especially when one deals with illiterate farmers.

Q. If Khanewal became a district in four to five years it might be an advantage.

G.I. Not to industrialists—maybe to politicians.

Conclusions

A few pioneering firms have been in business since 1945. However, the major phase of firm growth in the industry took place in the first half of the 1970s as a result of the Green Revolution in agriculture and the consequent farm mechanization. Threshers, trolleys, and various ploughs and drills began to be manufactured in large numbers around this time and gave rise to what is known as the Thresher Revolution.

The same trend is reflected by the growth in capital stock, with small firms experiencing a greater variation; this suggests they enter and exit the industry more frequently than large firms. The average rate of growth of capital stock per firm between 1945 and 1982 is 407%, or 46% per year. Of the 119 firms, 23 report no growth in capital stock at all. On the average, tubewell manufacturing firms, those successful in borrowing from banks, and the more capital-intensive firms report higher annual growth, while firms that start off big and older firms report lower annual growth than other firms.

Other factors influencing growth are overseas migration, which both creates labor scarcities and results in remittances that enable the purchase of farm machinery. Government policies regarding investment and firm location may also make a difference. Because of the industry's linkages with agriculture the sector's agricultural growth performance has a direct bearing on the industry's. The importance of these factors is confirmed by the detailed interviews reported in the second part of the chapter.

◆ *Chapter 8* ◆

Entrepreneurship, Regulations, and Industrial Development: Some Policy Implications

Industrial strategies in developing countries focus mainly on large firms. To this end, governments manipulate their economies to direct resources toward large firms at the expense of other sectors of the economy. But there is growing evidence that such strategies have had little success. This micro study of the farm machinery industry in Pakistan reveals what increasing numbers of countries have come to find: that balanced industrial growth, well-integrated with the rest of the economy, happens as a result of work and cooperation by individual entrepreneurs trying to better their lot throughout the society. The government can help by providing a stable macro-economic environment and by ensuring that special interests do not monopolize scarce resources.

This study, which has focused on the single case study of the agricultural machinery industry in Pakistan, highlights the central role played by individual entrepreneurs in making development happen. They do this by taking risks in moving capital and labor to increasingly valuable uses, always seeking to improve their products in response to an ongoing dialogue they have with the farmers who are their customers.

Their success in building this industry is all the more impressive in light of the fact that not only do they get no special help from the government, but, on the contrary, are often actually hampered by government interventions in the economy. This is especially true of government regulations that create market biases against small enterprises. Perhaps the best example of these biases is the credit policy that results in allocating scarce credit to larger enterprises, causing smaller businesses to be cut out of formal credit markets.

Although we considered how government policy might be able positively to encourage entrepreneurship and increase the pool of entrepreneurial talent, the characteristics associated with entrepreneurs are too individual and eccentric to be encouraged by such policy. The most important policy contribution, we concluded instead, relates to improving the overall economic environment, especially by bringing the returns to investment into line with the risks associated with investing in new, innovative enterprises. To the extent that government policy contributes to this environment and permits returns that are necessary to encourage risktaking, it will encourage potential entrepreneurs, who belong to different social groups, to exercise their entrepreneurial talent.

Apart from the impact of economic incentives on entrepreneurship, it is the absence of widespread technical training that perhaps accounts for the importance of kinship or bradri in the industry. We observed a concentration of entrepreneurs among the *lohar bradri*, who pass their skills as ironsmiths from one generation to the next. Culture, therefore, appears to play a role in beginning industrialization, especially where access to specialized skills depends on membership in a closely knit social group. Since non-lohar firms abound, however, this cultural barrier is not very strict. Moreover, as technology and product mix become more sophisticated, the entrepreneur who is a combination of manager and skilled worker will give way to the pure risk-taking entrepreneur who hires managerial and technical expertise. Therefore, although the bradri may be a barrier in the early stages of industrialization, it should become weaker over time. The transition of industry from dependence on entrepreneurial talent limited to certain social groups to a society-wide entrepreneurial pool is occurring slowly in this industry, and reflects similar trends in other industries in Pakistan.

Employment Problems

The prominence of lohar entrepreneurs leads, in turn, to a preference for lohar workers, who are believed to inherit the group's pool of technical knowledge. We found that in most skill categories lohar workers are better paid and appear to have more responsible jobs than those in other groups. Entrepreneurs look for properly trained workers, or at least those with the ability to learn on the job. Educated workers, especially those with technical training, would almost certainly be hired regardless of their *bradri* background. But the absence of technical training tends to favor the lohars, who pass on skills informally within the group. To broaden employment opportunities, therefore, it would be valuable to expand technical training in the educational system to serve local industry's needs better than the existing showpiece government institutes are now doing. Private-sector technical schools and apprenticeship programs have in fact been much more successful than government schools in preparing their graduates for employment in the Middle East market.

Our study reveals one additional source of impediment to the workings of the labor market: misuse of bureaucratic power by the lower functionaries in the labor welfare department. The problem arises because of arbitrary and selective implementation of labor laws regulating work conditions. The laws are well-intentioned and aim to provide protection against unsafe, poorly lit, and badly ventilated working conditions. However, government functionaries implement the laws selectively and mainly against the small entrepreneurs. The objective is less to enforce the law, since the large firms go unchecked, than to extract graft from the small firms struggling for survival. This particular intervention by the government and the manner in which it is implemented is widely resented in the industry. In fact it may be counter-productive, since it has the effect of encouraging a more capital-intensive technology mix or lower output, either of which would reduce employment.

One serious problem of discrimination against the relatively low paid workers occurs as a result of government policies that encourage substitution to excessively capital-intensive technology. The problem occurs when the government maintains an overvalued exchange rate, thus encouraging rapid and widespread importation of automated, labor-displacing, machinery. There is at present a lively market for secondhand machinery in most towns where the farm machinery industry is concentrated. The ability to use secondhand machinery eases the burden of firm entry into the industry, particularly for

worker-entrepreneurs who can service and repair the machinery themselves. Although this machinery is not obsolete (most of it is less than fifteen years old), it can be made "obsolete" by indirect subsidies (through the overvalued exchange rate) to import more capital-intensive technology, which is beyond the existing capabilities of worker-entrepreneurs and their equipment. Similarly, subsidies that encourage the import and use of sophisticated farm machinery, such as combine harvesters, are likely to do serious damage to the industry. The analysis presented in the study shows that the entrepreneurs in the industry do not as yet possess the technological sophistication required to manufacture such machinery.

Policy Problems in Capital Markets

Besides these problems in the labor markets, serious policy problems also exist in the artificially limited capital markets in many developing countries. Part of the problem with undeveloped capital markets is the extreme scarcity, if not complete unavailability, of risk capital (or venture capital) to invest in small but high-risk enterprises. There is as yet little evidence that remittances from Pakistanis working overseas are being invested in the agricultural machinery industry on any significant scale. This limitation is aggravated by legal ceilings on interest in the capital market so that bankers resort to credit rationing and adopt lending strategies that discourage risk-taking investments. In chapter 4, we saw that a firm's probability of success in borrowing depends on "visible" criteria: past accumulation of capital and past profits; whether or not entrepreneurs belong to the more successful lohar bradri; profit potential; and firm location (because location will often determine whether a firm is known to bank managers). By these standards, capital tends to be allocated to large, well-established firms; small, new, innovative firms are rationed out of the formal market and forced to go to the much smaller informal market. As long as returns are limited and capital remains in short supply, this problem will almost certainly continue. The current situation might be improved by rewarding bank managers for lending to new *potentially* successful firms and by penalizing them for lending to ventures that either have low profitability or actually generate losses. Increasing bank managers' accountability might improve the allocation of capital.

The problem of policy effects on entrepreneurship, especially on the willingness to take risks in innovating machine design, is extremely serious. By and large, the designs used by the industry in

manufacturing farm machinery are copies of older models imported from industrially advanced countries and the technologically advanced Indian Punjab. In the 1965 border war with India, following the capture of a farming area in the Sialkot sector near Daska, local manufacturers visited the farms and copied the thresher designs. The same was true for the single-piston Rustin tubewell engine, which was copied from a British prototype of the 1920s; there has been little innovation in it.

There are three principal reasons why so little experimentation goes on with engineering design. Part of the problem is lack of technical training. But a more fundamental reason, again, comes from the lack of incentives for risk taking due both to the legislated limits on returns to investment already mentioned, and—just as important—to the absence of an efficiently policed patent system.

The lack of technical training explains why most worker-entrepreneurs cannot read simple technical drawings; they rely instead on homegrown rules of thumb and experience in manufacturing. This incapacity leaves the industry especially vulnerable to foreign competition, such as occurred, for instance, when lighter and more efficient Chinese diesel engines were first imported in the 1970s. The industry lacked the technical skills to compete, and many firms had either to switch products or close down. Large firms with more skilled workers, are generally more able to experiment and innovate than small ones.

The government has tried to substitute for the inefficient capital market by providing assistance through the Agricultural Machinery division in helping finance innovation and paying costs of prototypes. The division also helps in acquiring orders for successful machines. Through this cooperation a new generation of reaper-binders was successfully developed. In the absence of efficient capital markets and without adequate technical training programs, government support of the costs of research and development of basic designs may be valuable in the beginning stages of industrialization. At the same time, the overriding priority should be to increase incentives for risk taking, including establishment of a strong patent system that would effectively ensure that entrepreneurs are adequately rewarded for assuming the risks associated with innovation.

Broad Effects on Development

It is often argued that investment in many developing countries has low domestic multiplier effects because production machinery, technology, and raw materials must all be imported. Our study shows the contrary. Most of the 13 broad categories of production machinery used in the farm machinery industry, ranging from simple lathes to complex cutting, honing, and shaping machines, are domestically manufactured, often by the worker-managers themselves. The industry thus forges important linkages with the domestic engineering industry, which its growth is likely to benefit. Conversely, factors that constrain development of the local heavy engineering, foundry, and forging sectors are likely to retard growth of the light engineering industry. Investment and renewal programs in the heavy engineering sector must keep pace with developments in downstream industries.

A well-known hypothesis regarding small-scale industry in developing countries is that workers use it as a halfway house to acquire skills and search for jobs while they move from traditional agricultural occupations to employment in the large-scale sector. While our evidence on occupational mobility (presented in chapter 3) provides partial support for this hypothesis, we have much stronger evidence that, after acquiring new skills in the industry, workers return to their agricultural occupations better equipped to maintain and repair new farm machinery. This trend, which we believe is healthy, is contrary to the widely held belief that industrialization in developing countries sets in motion a one-way stream of workers from farm to city. When industry is properly linked to the domestic agricultural sector, it can directly contribute to upgrading skills in the economy-wide labor market.

The concern about urban concentration has also been mitigated by the growing mobility of workers through what has come to be known as the Suzuki Revolution, after the automobile manufacturers. The advent of inexpensive automobiles in the 1970's has facilitated cheap and frequent commuting, which has greatly increased the availability of labor for firms located in small towns. Workers can continue to live with their families in rural areas, and towns are not burdened with having to provide social services to immigrating households. Workers benefit as they avoid disrupting their family life and also because of the low costs of rural living. The multiplier effects in rural areas of incomes earned in urban areas may also be substantial.

Until recently, government policy toward the industry has been one of benign neglect. The industry has benefited from restrictions on imports of farm machinery put in place not so much to promote this industry as to conserve foreign exchange and safeguard employment in rural areas. It has enjoyed some direct benefits, principally through tax holidays. On the other hand, as we have seen, the industry has been hurt by government allocation of capital to large-scale firms; it has fallen far short of its potential for innovation because of an ineffective patent law that fails to protect property rights in the fruits of innovation. Finally, the industry has recently come to be threatened by direct government subsidies to import heavy farm machinery, in the form of combine harvesters and sophisticated reaper-binders.

This profile of the farm machinery industry shows how entrepreneurs go about the real business of development. The longer one looks at their extraordinary record—at the depth of their linkages with other parts of Pakistan's rural economy—the healthier this venture in industrial development appears. In important ways, one may think that the most advantageous condition affecting the industry is its substantial removal from governmental attempts to directly influence any part of its development. Indirect interventions in labor and capital markets, to benefit the large-scale sector, however, work to the disadvantage of entrepreneurs like the ones who are the subject of this book. Retarding such entrepreneurs means retarding development.

Successful policy should not assist entrepreneurs directly, but it should do everything it can to remove impediments to them. That is the great challenge to policymakers in developing countries everywhere.

◆ *Appendix I* ◆

The Production Environment and the Machinery Manufactured

The physical design and layout of firms manufacturing farm machinery are remarkable both for their simplicity and for their similarity across firms of different sizes and product groups. Typically, the factory constitutes four broadly designated areas. The factory front—the space between the road and the factory's built-up area—is used for displaying the finished machinery. A small front room is the office where factory records are kept and where visitors and prospective customers are entertained. Adjoining the office, and usually to its rear, is the factory store for the hardware used in production. A gate connects the shop front to the work area at the back of the office. The work area is normally unpaved, walled in, and only partially roofed. The roofed area, however, is paved and this is where machines such as lathes, scrapers, and drills are installed. The open space is used as a production assembly area at peak activity which occurs from February to May and from October to December. The work space is not clearly marked as such, so that at peak periods it appears somewhat chaotic to the visitor. There are two variations on this basic layout. Firms that undertake their own casting use a small (rearmost) section of the workyard for this purpose. This is where a cupola, or small underground casting furnace, is installed. Occasionally, machines may be installed in a large

hall and the office may be located on the floor above the work area. Differences in firm size result in scaling up or down of this basic factory design. These firms are engaged in the manufacture of the five broad categories of machinery already listed in chapter 1.

Threshers

Three categories of thresher are manufactured by firms in our sample: maize, rice, and wheat threshers. The last is the most popular and is intended to meet the great increase in demand since the early 1970s. The wheat thresher currently manufactured is a very simple machine. Its main body consists of a large drum which is mounted on two wheels for transportation. Inside the drum is an iron rod to which are welded cast iron blades, or beaters. Wheat ears are fed into the drum from an opening in the top and are propelled along the main body by the beaters. This loosens the grain, which is then panned in a tray where a fan blows out the chaff and the clean grain falls out through a small opening in the drum. The thresher usually takes its power from a tractor. In some rare cases threshers have their own electric motors, which are purchased from the electric components industry. Variations in this basic design are achieved by changing the number of beaters, which range from 12 to 24. The weight of a 24-beater thresher is about 1.2 tons. In Sialkot, Daska, and Gujranwala farmers holdings are typically small, so that smaller threshers are in greater demand. Firms located in these towns specialize in small threshers.

The important processes in thresher manufacturing are casting of parts, metal sheet cutting, machining of parts, drilling, welding, assembly, and painting. Most thresher manufacturing firms get their casting and sheet metal cutting done by firms that specialize in these processes. Thresher prices vary from Rs 9,000 to Rs 21,000 depending on the number of beaters and the weight of the thresher.

Tubewells

These consist of two components: diesel engines (with capacity ranging from 15 to 70 horsepower) and centrifugal pumps (from 1 to 3 cusecs). The slow-speed diesel engines manufactured are slightly modified versions of the simple Rustin engine designed in England in the 1920s. The manufacturing process consists mainly of casting in cupolas and crucibles, and involves little engineering

sophistication; crude design specifications are carried out with rules of thumb and improvisation. The engine's main merit is its simplicity of design, which facilitates maintenance in the village.

Production of the diesel engine involves the following stages: pattern making, casting of the main body and components, machining, crankshaft forging, precision operations such as the manufacture of the piston and fuel injection systems, assembly, testing and finishing. Most firms do not undertake all the processes themselves. As we state in chapter 6, there is considerable specialization in processes. Consequently, firms can subcontract, so that both small and large firms can coexist in the industry.

Trolleys

Trolleys are usually made on order; often the farmer lays down the specifications himself in keeping with the size of his tractors and his anticipated haulage load. The specifications include such items as the number of wheels (which can be two, four, or six), the type of axle, and the thickness of the sheet metal used for the container section. The colorful floral designs on trolleys are also in keeping with individual farmer's tastes.

The most popular trolley design consists of two wheels with a single axle. The width is about 6.5 feet, the height 2 feet, the length 11 feet, and the load-carrying capacity about 10,000 kg. The important components in trolley manufacturing are axles (which are secondhand cast-offs of Bedford and Dodge trucks), bearings (imported from China), wheels (secondhand), suspension (of the leaf-spring or woodenblock type), and the hitch (which may be welded to the chassis, attached with a bolt, or composed of split pin and castle nut). The main load-carrying body may be flat, with or without walls or canopy.

Sugarcane Crushers and Fodder Cutters

We group these two together because they involve similar technology and are often jointly manufactured by firms located in Faisalabad, which is an important sugarcane-growing district. Firms here started manufacturing sugarcane crushers in the 1950s and then fodder cutters as a by-product in the 1960s.

The sugarcane crusher consists of two heavy cylinders that crush the cane as they draw it inwards. The cylinders are rotated

by gears attached to a shaft that is rotated by some power source (a tractor, electric motor, or bullocks). Sap from the crushed cane flows out through a pipe welded to the pan on which the cylinders rotate. The components consist of ball bearings (imported from China), gears and cylinders (cast by the firms themselves), and pipes (purchased from the local ship-breaking industry).

Fodder cutters consist of a driving shaft attached to gears that rotate a wheel. Inside the wheel are attached two blades that cut the fodder as it is fed in. Increasingly, fodder cutters are being sold as complete units with an attached electric motor purchased from the electric components industry.

Other Tractor Attachments

This group of products consists of tractor-driven implements such as seed and fertilizer drills and various categories of ploughs. These items are now virtually standardized, with parts available in the wholesale markets of Lahore and Faisalabad. Simple tools such as drilling machines, perhaps a lathe, and a welding plant are all that are needed to assemble the components. Often very small firms, even the village lohars, can assemble these on order from local farmers. The simple design facilitates repair within the village.

◆ *Appendix II* ◆

Some Comparisons with Other Data Sources

In our sample 70% of the firms are unregistered, compared to 85% reported in the 1977–78 Pakistan Small Industries Corporation Survey. Some 45% of the firms are sole proprietorships, 33% are partnerships, and 18% are family businesses. They are mostly small firms: 66% of them employ up to 10 workers and 90% up to 20 workers. In table A.2 we report values of a few important variables for the firms in our sample and compare these with the findings of three other surveys of agricultural machinery. These are: (1) the Pakistan Small Industries Corporation (PSIC) Survey, 1977–78; (2) the PSIC Census of Manufacturing, 1975–76; and (3) the Directorate of Industries Survey, 1978–79.

It can be seen from table A.2 that our output and employment values are higher than for the first two data sources but lower compared to the third. Thus the information provided to us by the firms on these important variables (where misreporting is most likely) seems reasonable. This makes us confident about the reliability of our data. Of course, our survey has the advantage that data were collected on a host of variables (nearly 700 in all) describing firms' decisions, while the official surveys listed above are restricted to a few broad statistics of performance.

Table A.2
Some Comparisons with Other Data Sources

	PSIC Survey 1977–78	PSIC Census 1975–76	Directorate of Industries Survey 1978–79	Our Survey 1982
Output/Labor	19,624.36	14,250.46	38,481.27	82,470.76
Output/Raw Material Cost	1.49	1.56	1.63	1.35
Raw Material Cost/Labor	13,137.93	84,811.63	23,638.05	60,948.64
Output/Total Firms	139,486.94	592,012.62	714,763.51	881,530.38
Workers per Firm	7.10	4.46	18.57	10.69
Total Firms	306	109	148	119

Notes

Chapter 1

1. Another reason for studying this industry is that we can compare our findings with those of Child and Kaneda, 1976, which is based on data collected in 1969. This will enable an evaluation of changes that have taken place in the intervening thirteen years (our data were collected in 1982).

2. Pakistan's GDP in 1983/84 at 1959/60 prices was Rs 6,414 million; its total labor force was about 27 million (Pakistan Economic Survey, 1983/84).

3. Pakistan consists of four provinces; N.W.F.P., Baluchistan, Punjab, and Sind. Each province is divided administratively into divisions that comprise several districts. Furthermore, each district is divided into sub-divisions. Headquarters refers to the capital city at a given administrative level.

4. Some examples are Hirschman, 1966; Watanabe, 1977; Anderson, 1982; on Pakistan see Papanek, 1967; Altaf, 1983.

Chapter 2

1. One of our respondents in the pilot survey had acquired advanced technical education at a British university, and along with agricultural machinery manufactured parts for Pakistani air force jets. He is the classic outlier, so we did not include him in our final sample.

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