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FIRMS' INVESTMENT DECISIONS IN IMPERFECT CAPITAL MARKETS

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Abstract

Important features and the distribution of capital stock owned by firms in Pakistan's engineering industry are examined and related to capital markets with unequal access. Bankers' determination of a firm's credit worthiness in the 'formal' capital market is analysed. Differences in investment behaviour conditional on borrowing arrangements are then tested using a two stage switching regressions model with endogenous switching. It is concluded that firms that borrow in the 'formal' markets behave according to the flexible accelerator model of investment while non-borrowing firms plough back profits. Furthermore, the former have higher capital-output ratios and find it less difficult to adjust to their desired capital stocks compared to the latter.

Introduction

In a developing country the decision by a firm to increase its capital stock is made, typically, in a situation where sources of credit are few and amounts are rationed. It is usual to classify these sources as 'formal' and 'informal' on the basis of differences in transactions and costs of borrowing. For example, 'formal' sources such as commercial banks and specialized lending institutions differentiate amongst borrowers on the basis of their perception of the likely success of the enterprise within the framework of the government's industrial policy. Loans are offered to the selected firms at subsidized interest rates and other favourable terms. Firms that do not succeed in borrowing in the formal sector have to rely on self-generated funds or on lenders in the informal sector who are not costrained either by a ceiling on interest rates or by the industrial policy. The terms on which loans are offered and access to them in the two markets are suffiently different to think of the capital market as being 'fragmented'. We examine the impact of such 'fragmentation' on the investment decisions of firms.

It is argued (McKinnon, 1973) that governemnt intervention in the financial markets results in costly misallocation of capital. The 'favoured' firms get capital often at negative real interest rates and, as a result, tend to over capitalize which leads to exess capacity. Firms that are unable to borrow in these markets face very high real costs of investment and are often under capitalized. While this argument is not unchallenged at the macro level (e.g. Leff, 1976 and Fry, 1978), there are few micro studies that

examine the issues directly (a notable exception is Tybout, 1983). Our study attempts to test hypotheses based on McKinnon's observation using firm level evidence from Pakistan.

This evidence was collected in 1982-83 in three rounds of surveys of 119 firms manufacturing farm machinery in Pakistan. The sample constitutes 23% of the total population of 514 firms in the industry (Pakistan Agricultural Machinery Division Census, 1983). The objective of the surveys was to collect data on the economic environment in which industrialization takes place in a developing country. It yielded detailed information on the background of entrepreneurs, workings of the labor market and other variables capturing the input and output decisions of firms. Five broad categories of farm machinery are manufactured. These are tubewells, threshers, tractor attachments such as seed and fertilizer drills and fodder cutters β sugarcane crushers. Demand for this equipment increased rapidly in the 1970's due to the success of 'green revolution' technology and shortages of labour at peak periods of agricultural activity. Thus the industry is a good example of the impotance of sectoral linkages in debvelopment. Most firms in the industry are small: nearly 67% employ 10 or less workers (These are highly skilled workers and are retained throughout the year. At peak periods of manufacturing activity total work force more than doubles by hiring, in the main, unskilled workers). The largest firm in the sample employs 67 workers. A notable feature of the industry is that most firms are located in five towns in the Punjab which are Lahore, Faisalabad, Gujranwala, Daska and Mianchannu. The last two are small rural towns that are emerging as important centres of the engineering industry. (The surveys and other issues in beginning industrialization are discussed in Nabi, 1985).

The paper is organized as follows: In section 2 we present a discussion of the machines and equipment used by the firms (relating it to intersectoral

linkages hypothesis in development). This defines firms' capital stock and enables us to examine the distribution of assets across firm size. The capital market and its 'fragmentation' are discussed in section 3. This is followed by an analysis in section 4 of the bankers' perception of firms' credit worthiness and the decision to lend. Firms' investment decisions in the light of McKinnon's arguments are investigated in section 5. Additional dirct evidence regarding the impact of 'fragmentation' on capital utilization is presented in section 6. Finally, policy relevant concluding remarks are presented in section 7.

Defining Capital Stock: the machinery in use.

The thirteen categories of machines used by firms in the production process are listed in table 1. Three categories of lathes are reported. Lathes play an important role in the manufacturing process since the engineering specifications are very rough so that the cast parts have to be extensively machined before assembly. Tubewell firms which undertake substatial casting report the highest use of all three types of lathes followed by sugarcane crusher/chaff cutter firms. Trolley manufacturing is simpler and the machines required are mainly drills and welding plants. Firms manufacturing tractor attachments such as seed β fertilizer drills and ploughs use the smaller lathes as well as drills and welding plants. Thresher manufacturers report use of the whole range of engineering machinery. Regarding firm size, the larger firms more frequently report the use of all machines compared to small firms except for paint spraying

machines. More small firms report these machines partly because they subcontract work from the large manufacturers (see Nabi,1985, on subcontracting in the industry).

The machinery used by firms may also be distinguished on the basis of 'traditional' or 'light' machinery and 'sophisticated' or 'heavy' machinery. The latter catogory includes machines such as powered cutting units, large furnaces (cupolas), 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, economies of scale are involved in their use. Thus it can be seen in table 1 that mainly the large firms own these machines along with a few small firms involed 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 agricutural sector. An aspect of this indegeneity is the impetus that it provides to the local engineering industry which manufactures nearly all the thirteen categories of machines listed in table 1. This can be seen in columns 3, 4 and 5 of table 2. Column 3 shows that nearly 25% of firms manufacture their own machines such as plainers and furnaces while 33% report that they manufacture their own power presses. This reflects the remarkable technical skills of the entrepreneur/manager in the industry. The machines embody sophisticated technology and can be used to manufacture a wide range of engineering equipment. Column 4 and 5 show the percentage distribution of firms (not manufacturing their own machinery) that import or purchase locally manufactured machines. Only plainers and honing β milling machines are imported in meaningfully large numbers. This evidence is indicative of the linkages that this industry forges with the engineering base in the economy

and in this manner contributing to balanced growth. The balanced growth argument can, of course, be stretched too far resulting in socially expensive import substitution which may burden consumers with unsatisfactory and obsolete technology embodied in the domestically manufactured machinery. There is little evidence to support this , at least at this stage of the engineering sophistication required of the machinery. As can be seen in the last column of table 2, nearly all the firms report that locally made macines in all categories perform as satisfactorily as imported machines.

In most industrial towns of the Punjab there is a lively market for 2nd hand engineering 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 at little initial investment in machinery. The mechanics-turned-entrepreneurs purchase the second hand machinery, repair it to satisfactory working order, and are quickly in business. Column 2 of table 2 reports incidence of use of second hand machinery in the industry. Most firms report some use of second hand machinery. Honing β milling machines, for example, are mostly purchased second hand. This enables a more widespread use of this expensive, imported machinery than would otherwise be possible.

Table 3 enables a few comments on the vintage of the machinery in use. Most machines are less than fifteen years old so that the technology which they embody is not altogether obsolete (the exception being plainers which are mostly of 1950 vintage). This is partly accounted for by the fact that most firms began their operations in the 1970's after the advent of 'green revolution' which created opportunities in the industry. The plants that they own, therefore, embody technologies of recent vintage and perform

satisfactorily for the range of agricultural machinery currently in demand. How quickly this technology becomes obsolete will be determined by government policy towards farm mechanization. If greater automation is promoted on the farm by, for example, encouraging the use of reaper-binders and combine harvestors on large farms through import and credit subsidies, the technologies are likely to be rendered obsolete much sooner.

Section 3: The Distribution of Firm assets

Our ultimate objective in this discussion is to investigate investment decisions by firms. To do so we examine changes in assets owned by the firms in our sample. One category of assets is the value of buildings and land belonging to the firms, and the other is the value of machinery installed in the plant. These enable the definition of firms' capital stock. Any additions to it that the firm makes defines investment. None of the firms reported changes in the land area that they own. A few firms report changes in the built up area but the values reported varied so much for the same square footage across firms that we are reluctant to consider these data as being reliable. The data on inventories (since changes in these would also constitute investment) is also poor. Most firm owners report no inventories saying that they purchase materials during the season when machine orders are placed. Also the finished machines are not stocked for any length of time. In most cases firms are hard pressed to meet delivery schedules of orders already placed. Thus we find that the most satisfactory definition of firms' capital stock or fixed assets is the value of machinery owned by firms.

The easier part in evaluating machinery is the head count since machines are installed in an open, accessible, part of the factory. The make, specification and vintage of machines is also easy to determine (and is presented in tables 1-3). The difficult part, however, is to assign values to machines of different vintage and specification. To do this we approached the market for second hand machinery and after detailed discussions with commission agents (who facilitate the exchange of second hand machinery), in each of the towns where firms are located, we were able to assign 1982 prices to the machines 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 is defined as changes in this measure of capital stock throughout the discussion that follows.

Table 4 presents the distribution of assets among the sampled firms. Small firms (employing 10 workers or less) constitute 66% of the sample and own 35% of the assets. Large firms (employing more than 10 workerts) constitute the remaining 34% of the sample and own 65% of the assets. Thus the value of assets per large firm (Rs 2,04,431) is nearly four times that of small firms Rs(9,56,256). The value of assets per firm is highest for sugarcane crusher/chaff cutter firms (Rs 2,33,932) followed by Thresher firms (Rs 1,34,429), Tubewell firms (Rs 1,08,270), Trolley firms (Rs 82,771) and Tractor attachment firms (Rs37,675). 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 rural towns.

Table 1:Machinery in use by product group and firm size (percentage)

Machines	All Firms	1	2	3	4	5	6	7
Lathes								
Upto 5ft	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
Plainers	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
Powered cutting units	15 (1.17)	4	26	29	0	6	5	24
Furnaces	20 (1.67)	4	13	7	83	6	8	44
Honing β 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/chaff cutters 5.Tractor attachments 6.Small firms 7.Large firms.

Figures in brackets are the average number of machines for firms that own those machines. The total number of firms in the sample is 119.

Table 2: Origin of machinery as reported by firms (percentage)

Machines	1	2	3	4	5
Lathes					
upto 5ft	40	7	2	91	98
5-8 ft	46	11	0	89	99
> 8ft	56	8	1	91	99
Shapers	41	10	3	87	98
Plainers	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
Powered cutting units	17	11	6	83	100
Furnaces	12	25	0	75	100
Honing β Milling machines	75	0	25	75	100
Power presses	19	33	0	67	100

Notes. 1.Second-hand 2.Own-made 3.Imported 4.Locally made 5.local and imported machines of same quality.

Table 3: Machinery vintage: Year of purcahase reported by firms (percantages)

Machines	Before 1950	1951-60	1961-70	1971-77	1978-82
Lathes					
upto 5ft	5	7	17	38	33
5-8 ft	11	5	7	41	36
> 8ft	12	8	13	33	34
Shapers	13	7	13	35	32
Plainers	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
Powered cutting units	6	0	6	35	53
Furnaces	21	13	8	29	29
Honing β Milling machines	0	25	0	50	25
Power presses	20	5	5	50	20

Table 4. Number of Firms and Value of Assets by Firm Size and By Product Group

Size of Firm	Tubewell Engine		Thresher Firms		Trolley Firms		Tractor Attachment		Sugarcane Crusher Chaff Cutter Firms		All Firms	
	No. of Firms	Value of Assets	No. of Firms	Value of Assets	No. of Firms	Value of Assets	No. of Firms	Value of Assets	No. of Firms	Value of Assets	No. of Firms	Value of Assets
Small (10 workers or less)	22	1530386	25	833900	13	818860	14	520800	5	740300	79	4444246
Column Percentage	88	67	54	16	93	82	88	86	22	21	66	35
Row Percentage	28	34	31	19	18	18	18	12	5	17	100	100
Large (More than 10 workers)	3	743298	21	4408866	1	174400	2	82000	13	2768688	40	8177252
Column Percentage	12	33	46	84	7	18	12	14	78	79	34	65
Row percentage	8	9	52	54	2	2	5	1	33	34	100	100
Total No. of firms	25	2273684	46	5242766	14	993260	16	602800	18	3508988	119	12621498
Row Percentage	21	18	39	42	12	8	13	5	15	28		

Section 3: The Capital Market.

In Pakistan financial intermediation by the government began in the late 1950's as part of the 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 industrial policy of the government. Most of these institutions lend to the private sector ventures which fall within the government's investment licensing policy. Thus according to the 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 farm machinery industry which only recently gained recoganition by the government as an industry with a considerable potential for growth, this policy resulted in a highly fragmented capital market which may have influenced the investment decisions of firms a la McKinnon.

Firm owners in our sample identify four sources of credit. These are:

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 Pakistan Industrial Development Bank. Firms report considerable difficulty in obtaining funds from these sources since

collateral requirements are strict and scruitiny procedures require enormous paper work which many of the small firms in the industry are unable to cope with. Also repayment schedules are stringent with little possibility of rolling forward. These features reflect high effective interest rates. Nominal interest rates (between 12% and 14%) charged, however, are reported to be attractive particularly in view of an inflation rate of 16% in this period.

The informal capital market

The most widespread arrangement here is the "committee" or the "chit" system. "Committe" members usually belong to the same biradri (which helps to avoid default since few will risk biradri boycott which affects wider social interaction). Monthly instalments are pooled together and then lots are drawn to deterimine the queue for allocating the pooled sum. It is common that those in front of the queue sell their pool to those behind at a premium decided through open bidding. According to some estimates the premium, or the real rate of interest, on such transactions varies between 15% and 20%. A "committee" may last upto two years depending on the number of mambers and the size and frequency of the draws. The pooled sum can be as high as Rs100,000 depending on the town (higher figures are reported in Faisalabad, an industrial town with considerable entrepreneurial opportunities). Most entrepreneurs report that funds obtained through the committe system are used mainly as working capital since repayments have to be made frequently and the average duration of the committe is rather brief.

Other informal 'back street' arrangements operated by commision agents also exist but the sums involved are small and repayments have to be made over a short period, so that these sources are also used to finance 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 and include firm's own savings as well as borrowing from friends and relatives. The latter have become particularly important since the 1970's due to the large inflow of overseas remittances from migrants working in the gulf. (In 1982 remittances peaked at U.S. $3 billion which amounted to nearly 10% of Pakistan's gnp). 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 wholesellers 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 are also mainly for meeting working capital requirements rather than for investing in machinery. Advances on raw materials may, of course, be important for 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.

The discussion above of the capital market faced by the agricultural machinery industry indicates the nature of fragmentation in the capital market. Several sources are available involving different terms of lending. Also access to these sources is differentiated by firm and owner characteristics. 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 here are limited and, because market clearing interest rates are not allowed to prevail, they are rationed.

Credit rationing may be considered to result from the capital market in disequilibrium since interst rates, often becuase of government policy, are not allowed to clear the market so that agents operate off their offer curves. This, as McKinnon has argued, leads to allocative inefficiencies. A somewhat different view of rationing is taken by Stiglitz and Weiss (1981). They argue that rationing may come about because lenders view it as a mechanism for arriving at 'equilibrium' in their lending programs. It is argued that the interest rate 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, i.e., borrowers that undertake more risky investments are likely to bid higher interest rates and this increases the probability of default. Thus lenders may choose to keep interest rates below the market clearing rate and resort to rationing using various screening devices to lower the risk of default. 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.

Section 4: Determining a firm's credit worthiness.

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 43 firms reported suuccess 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 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 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 5 and 6.

How do these features contribute in assuring bank managers that loan applicants having them are less likely to default compared to others? Let us take product specialization. Thresher manufacturers have enjoyed high growth and profits in the recent past because farmer demand is high and is likely to continue to grow in the near future. There is considerable scope for innovation and thus for product differentiation 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 returns and thus are less likely to default. Being located in small towns like Mianchannu and Daska may contribute to succeess in borrowing because the few bank branches in these towns enjoy monopoly in lending to successful ventures and branch managers have good knowledge of the likely success of ventures. 'Lohar' biradri is a proxy for the pool of engineering skills that an entrepreneur is likely to inherit or acquire through association, which contributes to his success. Education may help in smoother transactions with

applicants and may also be a proxy for the more general ability to acquire new skills and succeed. Firms with 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(past capital stock, past profits, years in business, education, lohar dummy, thresher dummy, location dummy)

where B is a dummy variable taking value 1 for success in borrowing and 0 otherwise. Thus the ordinary least squares method is inappropriate (Maddala, 1983). Instead, we use probit which involves the maximum likelihood procedure, assuming the normal distribution for the error term.

Results

The estimates on the coefficients along with their standard errors are reported in table 7. The statistically significant variables are 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 border line of significance while entrepreneur's business experience is insignificant. We used different versions of this variable (e.g. the quadratic form and dummies

using different cut-off points) but none of these were significant. Some of the borrowers in the sample have technical education and we tried dummies based on this variable but these were also insignificant.

An explanation for 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 1970's 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 demonstratably impressive. Banks lend to them more readily compared to those who have had long experience in this industry but have performed less impressively . Unfortunately we do not have data on business exdperience elsewhere to obtain a true measure of length of experience. (This variable may also reflect plant vintage. An alternative, firm age, but was statistically insignificant).

We may comment on the explanatory power of our credit worthiness equation by evaluating its success in matching the predicted status of a firm regarding borrowing with its observed status. To do this probit estimates of the coefficients on variables in the equation are converted into probabilities (using standard probit-probability tables) for each firm in the sample. This yields the estimated probability of a firm's success in borrowing. Taking the cut-off point to be 0.5, the results are reported in table 8. Our model of credit worthiness correctly predicts the borrowing status of firms in 83.19% of the cases.

Table 5: Characteristics of Borrowers in 'Formal' Capital Markets

	Total	Percentages
Successful Borrowers	43	- (36)
Of Whom		
Thresher manufacturers	36	86 (39)
Located in Daska and Mianchannu	26	61 (34)
'Lohars'	24	56 (59)

Note: Percentages in brackets are based on total (119) firms while others are percentages of firms that are successful in borrowing.

Table 6: Other Variables Important in Bankers' Lending Decision (Means)

	Borrowers	Non Borrowers
Education (years)	7.22	6.024
Past Capital Stock (Rs)	94,820.17	71,386.00
Past profits (Rs)	237,190.00	117,100
Years in this Business	9.32	10.276

Table 7: Probit Maximum Likelihood Estimates of Bankers' Lending Decision.

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 (dummy)	0.0705	0.0212
Product Specialization (Thresher dummy)	1.3788	0.3212
Small Industrial Town Location (dummy)	0.6124	0.3158
Constant	-1.8731	0.4172
Log Likelihood	-56.518	
N	119	

Dummy Dependent variable = 1 if banks lend, 0 otherwise.

Notes; 1. The towns are Mianchannu and Daska.

Table 8: The Credit Worthiness Models Success in Predicting Firm's Status

	Observed status	Predicted status	
		Will Borrow	Will Not Borrow
Successful firms	43	29	13
Unsuccessful firms	76	6	70

Percentage of successful and unsuccessful borrowers whose predicted status matches with their observed status = 83.19 (with cut-off point at 0.5).

Section 5: Investment Decisions

In this section we examine investment decisions in the context of the capital markets discussed in the last two sections. The total investment undertaken by firms between 1980-82 is reported in Table 9. 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. Firstly, 6 firms that were successful in borrowing from banks did not report any investment between 1980-82. This was because even though they had secured loans towards the end of 1981, they had not actually committed these at the time of interviews. 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 stocks so that their investment as a proportion of past capital stock is only 64% that of non-borrowers. 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 regarding the impact of government intervention and credit rationing on firm's 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 and therefore a non-rationed firm will undertake the investment. A rationed firm, on the other hand, if it is to invest in that activity, will be required by its owners to demonstrate somewhat higher returns (compared to the non-rationed firm) before releasing funds.

Table 9: Total Investment Undertaken by Firms Between 1980-1982 (Rs).

	Firms Investing	Mean Investment	Investment ÷ Past Capital Stock
All Firms	64	8,258.60	0.18
Bank Borrowers	43	17,229.00	0.23
Non-Borrowers	76	3,605.00	0.15
Investing Firms	64	15,857.81	0.33
Bank Borrowers	37	20,022.97	0.27
Non-Borrowers	27	10,150.00	0.42

The firm (manager) thus will 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 (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 the full discussion see Tybout, 1983).

Abstracting from uncertainty, a firm's earnings from additions to capital stock, given product and factor prices and assuming neoclassical production technology, may be written as:

$$\pi = \pi\ (t,\ k) \text{ where } \pi_k > 0 \text{ and } \pi_{kk} < 0, \tag{1}$$

where π is earnings and t is time.

Capital accumulation also imposes costs on the firm which are greater, the more rapid is capital accumulation. Thus we may write the cost of instantaneous investment at level $\dot{k} = I$ to be

$$C = C(I) \text{ where } C(0) = 0 \text{ and } C',\ C'' > 0 \tag{2}$$

Now a welfare maximizing firm takes into account (1), (2) and the discount rate of earnings, r, in arriving at its optimal investment path, I(t), which is given by the Euler condition

$$\pi_k\ (t,\ k) = r\ C'(I) - C''(I)\ \dot{I} \tag{3}$$

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

$$I(t) = \beta[k^* - k(t)] \tag{4}$$

with k^* satisfying $\pi_k (k^*) = r\, C'(0)$ and

$$\beta = -\frac{1}{2}\{r - r^2 - 2\,\pi_{kk}\,(k^*)/C''(0)\} \tag{5}$$

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 i.e. $\frac{\partial \beta}{\partial r} < 0$. This is the cost effect of rationing resulting from government intervention in the capital market.

To incorporate the liquidity effect we invoke the large body of literature on productivity changes which shows that small firms have lower capital output ratios compared to large firms. This yields larger investable surplus which is reinvested in the business. [The importance of liquidity in determining investment also appears in the context of developed countries (e.g. Meyer and Kuh, 1958; Lintner, 1967 and Hand, 1968).] Such liquidity is vital in the investment decisions of firms that are severely rationed in the official market. Thus we argue that firms with little or no access to the 'formal' capital market invest all current profits.

$$I(t) = C^{-1}\,[\pi(t)] \tag{6}$$

If the firm is severely rationed, it behaves according to (6), otherwise according to (4).

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

$$I_t = \beta(\alpha Q_t - k_{t-1}) + \delta\pi_{t-1} + U_t \qquad (7)$$

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

A Switching Regressions Model:

In order estimate the investment model of equation 7 we use a procedure which incorporates information on bank's lending decision and then examines differences in investment behaviour. This 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 behaviour of borrowing and non-borrowing firms respectively are:

$$Y_i = \beta_1 X_{1i} + U_{1i} \quad \text{iff } \gamma Z_i \geq U_i \qquad (1)$$

$$Y_i = \beta_2 X_{2i} + U_{2i} \quad \text{iff } \gamma Z_i < U_i \qquad (2)$$

U_i are assumed to be correlated with U_{1i} and U_{2i} and this is what enables the

endogenous switching in the model. We define a dummy variable I_i such that

$$I_i = \begin{cases} 1 \text{ if } \gamma Z_i \geq U_i \\ 0 \text{ otherwise} \end{cases} \tag{3}$$

(3) is the criterion function that yields regimes (1) and (2).

We normalize var $(U_1) = 1$ and that U_{ii}, U_{2i} and U_i have a trivariate normal distribution with mean zero and covariance matrix

$$\sum = \begin{matrix} \sigma_1^2 & \sigma_{12} & \sigma_{iu} \\ & \sigma_2^2 & \sigma_{2u} \\ & & 1 \end{matrix} \tag{4}$$

The likelihood function for the statistical model outlined in (1) to (4) is

$$L(\beta_1, \beta_2, \sigma_1^2, \sigma_2^2, \sigma_{1u}, \sigma_{2u})$$

$$= \left[\int_{-\infty}^{\gamma z_i} g(y_i - \beta_1 X_{1i}, U_i)\, du \right]^{I_i} \left[\iint_{\gamma z_i}^{\infty} F(y_i - \beta_2 X_{2i}, U_i) du_i \right]^{1-I_i} \tag{5}$$

where g and f are, respectively, the bivariate normal density functions of (U_{1i}, U_i) and (U_{2i}, U_i).

Maximizing (5) is cumbersome. Lee (1976) suggests a simpler alternative.

The objective is to obtain the expected values of U_{1i} and U_{2i} in (1) and (2) where:

$$E(U_{1i} | U_i \leq \gamma Z_i) = E(\sigma_{1u} U_i | U_i \leq \gamma Z_i) = -\sigma_{1u} \frac{\phi(\gamma Z)_i}{\Phi(\gamma Z)_i}$$

$$\text{and } E(U_{2i} | U_i \geq \gamma Z_i) = E(s_{2u} U_i | U_i \geq \gamma Z_i) = \sigma_{2u} \frac{\phi(\gamma Z)_i}{1 - \Phi(\gamma Z)_i}$$

We define $W_{1i} = \phi(\gamma Z_i)/\Phi(\gamma Z_i)$ and $W_{2i} = \Phi(\gamma Z_i)/1-\phi(\gamma Z_i)$ and this enables us to write (1) and (2) as

$$Y_i = \beta_1 X_{1i} - \sigma_{1u} W_{1i} + \varepsilon_{1i} \quad \text{for } I_i = 1 \tag{6}$$

$$Y_i = \beta_2 X_{2i} + \sigma_{2u} W_{2i} + \varepsilon_{2i} \quad \text{for } I_i = 0 \tag{7}$$

where the residuals

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

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

The two stage procedure for estimating (6) and (7) is to first estimate (3) using probit maximum likelihood (which we have already done in section 4). This enables estimation of the Mill's ratios, W_{1i} and W_{2i}, involving ϕ and Φ, the distribution and density functions, respectively, of the standard normal. Ordinary least squares may then be used to estimate (6) and (7). Using this procedure we obtain the results reported in Table 10.

The results are broadly in agreement with those of Table 10. The coefficients on the accelerator model are statistically significant for the borrowers but not for the non-borrowers. As before, the coefficient on profits is highly significant for non-borrowers but it is insignificant for the borrowers. The relative values of β for the two groups show that the borrowers find it easier to adjust to their desired capital stock. We have additional information regarding variables that influence firms' investment decisions. Both amongst borrowers and non-borrowers thresher manufacturers invest more than others which reflects the growth in demand for threshers in Pakistan's changing agriculture.

Table 10. Investment Decisions. Two stage Switching Regressions Model. Dependent Variable: Investment in Rupees. (all firms)

	Borrowers(I=1)	Borrowers(I=0)
Value of output ($\alpha\beta$)	0.039 (0.011)[c]	0.017 (0.019)
Value of Past Capital Stock(β)	-0.368 (0.201)[b]	-0.170 (0.213)
Profits (η)	0.021 (0.314)	0.093 (0.014)[c]
Previous Years in Business (δ)	2211.00 1188.21)[a]	621.129 (423.54)
Entrepreneurs' Education (λ_1)	-7342.10 (4387.3)[a]	638.267 (504.239)
Thresher Dummy (λ_2)	1298.13 611.17)[b]	14,992.26 (7522.20)
Small Town Dummy (λ_3)	8719.00 (3719.00)[c]	23.438 (3638.31)
Mills Ratio (σ)	12400.00 (7317.00)[a]	-2950.51 (1141.00)
Constant	-10502.00 (58748)	-5930.90 (1023.11)
R^2 0.432	0.191	
N	43	76

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

The results regarding the coefficients on Mill's ratios are also interesting. They indicate that borrowers invest more than average and non-borrowers less. This result brings out more clearly Mckinon's arguments concerning the impact of imperfect capital markets on investment decisions and thus justifies the two stage regression procedure that was used.

Section 7: Summary and Conclusions

The principal objective in this paper was to investigate the difference in investment behaviour of firms with unequal access to the captal markets. We defined capital stock in terms of the value of machinery owned by the firm and observed that a considerably greater proportion of equipment owned by large firms is expensive and sophisticated compared to small firms. Further, the market for 2nd hand machinery is fairly active and many firms manufacture their own machinery. Most firms use locally made machinery of a relatively recent vintage (1970's). Regarding the distribution of assets, we observed that 66% of the firms employing 10 workers or less own 35% of the assets while 33% of the large firms employing 11 or more workers own 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 behaviour of bankers in determining a firm's credit worthiness. We note that in the absence of complete information, bankers attach importance to such observable features of firms as past capital stock and profits, entrepreneurs' education and biradri and product specialization.

It appears that firms based in small rural towns are more successful in borrowing in the 'formal' market perhaps because bank branches are few and managers can easily spot firms likely to succeed.

Regarding investment decisions we hypothesized that firms that can borrow successfully in the 'formal' capital markets behave according to the standard flexible accelerator model of investment, while those unable to borrow simply invest past profits. This argument is statistically tested using a two stage switching regressions model with a criterion function that enables endogenous switching. The results show that borrowing firms invest more, have a higher capital-output ratio and find it less difficult to adjust to their desired capital stock compared to non-borrowing firms. Additionally, we find that firms that have growth potential invest more than others regardless of whether or not they have access to the 'formal' markets.

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