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TABLE III—DEMAND FUNCTION AND PRICE ELASTICITIES FOR CAPITAL IN VARIOUS FARMS

Village	Farm size	Function	R^2	Elasticity at current rate
(*a*) *Current Technology*				
Dichaon Kalan ..	LIF	C = 783·5145—1·3180 I	0·3515	—0·0154
	HIF	C = 1083·4582—1·3923 I	0·5020	—0·0117
Nangal Thakran ..	LIF	C = 124·8487—0·1922 I	0·5893	—0·0141
	HIF	C = 731·1441—0·5393 I	0·2360	—0·0067
Gharaoli ..	LIF	C = 1834·4424—5·6541 I	0·9181	—0·0285
	HIF	C = 1777·0977—5·1081 I	0·8497	—0·0266
(*b*) *Acceptable Technology*				
Dichaon Kalan ..	LIF	C = 3805·1374—7·3602 I	0·8847	—0·0177
Nangal Thakran ..	LIF	C = 224·6029—0·1538 I	0·5892	—0·0062
Gharaoli ..	LIF	C = 2703·2270—7·3367 I	0·8393	—0·0250

I=Interest rate; R^2=Coefficient of multiple determination; C=demand of capital.

not inhibit the acquisition and use of outside funds and it is profitable to borrow even at higher than the current interest rates without detriment to the amount of borrowing. This contradiction is only superficial. Cost of credit is not the only factor influencing the use of borrowed funds, psychological and other factors, *i.e.*, the availability of credit at proper time and in the form required, are also important. Again, the failure to incorporate risk and uncertainty factors in the analysis might itself be responsible for the emergence of capital rationing problem. Why farmers do not borrow even though it apparently is profitable to do so, is a question which cannot be answered unless a more detailed analysis is undertaken.

NET PRESENT VALUE OF LOAN-FINANCED INVESTMENT FOR IRRIGATION DEVELOPMENT AND REPAYMENT CAPACITY OF FARMERS—A CASE STUDY IN PUNJAB*

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'Credit is a hangman's rope,' this old proverb has been replaced by a new one, 'credit serves as an elevator.' The dynamic outlook, of late, being

* For the inspiration behind writing this paper the author is grateful to Dr. Raj Krishna, Professor of Economics, Rajasthan University and Dr. S. A. Dave, Deputy Director, Economic Department, Reserve Bank of India. Thanks are also due to Shri B. Santra, Lecturer in Agricultural Economics, Kalyani University, for his valuable suggestions. The author alone is responsible for all possible flaws in the exposition.

pursued by the commercial banks and governmental credit institutions manifests the creditworthiness of credit granted to the farmers. Agricultural credit is no longer viewed as an instrument for causing the extinction of the farmers. On the contrary, it is visualized as an economic ladder helping in the upliftment of the wretched peasantry.

This dynamic outlook has been fostered primarily by the intensity of the society's demand for increased agricultural production and by a feeling that the desired goals cannot be achieved unless an appropriate production-oriented credit policy is pursued by the credit institutions.

The experience of high-yielding varieties of crops in India has revealed that significant increase in agricultural production cannot be brought about through the mere introduction of these varieties. The success of high-yielding varieties largely hinges on assured supply of some key inputs like fertilizer, pesticides, insecticides and irrigation water, etc. There is more or less consensus of opinion regarding the point that the green revolution in India will not succeed unless it is accompanied by White revolution. But the problem with which we are confronted is that most of the farmers in India are not in a position to develop adequate irrigation facilities within the farm by means of self-financing. This pinpoints to the necessity of providing adequate finance to the farmers by the credit institutions. There is a good sign that the commercial banks have recently stepped in the field of direct agricultural finance.

It has been suggested in the different studies conducted by the Reserve Bank of India that the financing institutions interested in providing credit for farm development should adopt an 'area approach' to any development scheme and undertake a techno-economic appraisal while adopting this approach. Of course, this does not preclude the activity of the bank or a credit institution outside the integrated project area.

Before granting credit to the farmers, the financial institutions should give more stress on the prospective repayment capacity rather than on the strict creditworthiness based on the availability of existing tangible assets of the farmers. The essentiality of considering the type and adequacy of the security offered and the current indebtedness of the loanee cannot be denied but at the same time it must be recognized that adherence to the security aspect alone would fail to infuse dynamism necessary for the development of the agricultural sector. A micro analysis of feasibility has been suggested in a number of studies carried out by the Reserve Bank of India. In these studies it has been hinted to the financial institutions to follow a simple financial feasibility criterion for evaluating the worthwhileness of a loan to be provided to the farmers. With the help of this criterion the banks or other credit institutions can judge whether a given sum of loan provided to an individual farmer would be able to pay it back within a given period. But one of the defects from which this crude criterion suffer is that it does not consider the importance of time element. In this paper an endeavour has been made to

assess the repayment potential of loans given to the farmers under different size-groups taking into consideration the importance of discounting. In short an attempt has been made here to work out the net present value (NPV) of an irrigation loan provided to the farmers belonging to different size-groups in the three districts of Punjab. The magnitude of the net present value of an investment made through borrowing gives an idea about the nature of the loan—whether it is self-liquidating or not. The magnitude of the net present value or the magnitude of difference between the gross present value and the capital cost of investment furnishes an idea about the degree of certainty of repayment of a given amount of loan out of the net cash flows generated by the investment. An endeavour has also been made to calculate the social rate of return of a loan granted for the purpose of investment for irrigation development to the farmers belonging to different size-groups in the Nabha tehsil of Patiala district, Kapurthala tehsil of Kapurthala district and Ludhiana tehsil of Ludhiana district in Punjab and to determine the rank of the size-groups in each tehsil on the basis of rate of return.

THE DATA

The relevant information necessary for the purpose of the present paper has been taken from a recent publication brought out by the Reserve Bank of India.[1] Information contained in Part II of the above said book is the outcome of a study conducted in Patiala, Kapurthala and Ludhiana tehsils in Punjab by the Economic Department, Reserve Bank of India, at the instance of the Agricultural Refinance Corporation. The Agricultural Refinance Corporation which received applications from the Punjab State Co-operative Land Mortgage Bank for refinancing loans to be provided to the farmers for the installation of tube-wells in the three tehsils specified earlier requested the Economic Department to carry out field investigations in the three scheme areas with the objectives of finding out (1) the additional benefits to cultivators belonging to different size-groups arising out of tube-well irrigation, (2) whether the farmers taking the loan would be able to repay it out of the additional benefits consequential to the emergence of irrigation facilities under the stipulated terms and conditions of the Land Mortgage Bank, and (3) whether the farmers having small sized holdings would require any special assistance to avail of the loan facilities for the installation of tube-wells.

In the Reserve Bank study additional benefits per acre and per family have been calculated by comparing two sets of cultivators—owners and non-owners of tube-wells—duly stratified according to the size of cultivated holdings and different crop-mix. The main purpose of the study conducted by the Reserve Bank of India was to give a broad idea of the increase in farm income of the cultivators consequential to the availability of tube-well irrigation.

1. Bank Credit to Farmers for Irrigation Development: Studies in Micro-Analysis of Feasibility, Reserve Bank of India, Bombay, 1969. See Part II.

The method adopted for the purpose was a comparison of the results of farm business reported during 1966-67 by the owners and non-owners of tube-wells. The implicit hypothesis of the study was that when non-owners would install tube-wells, their crop-mix, levels of farm expenditure, farm income, intensity of cultivation, farm structure and other related aspects would conform to those of owners in comparable size-groups.

A brief description of the schemes prepared by the Punjab State Co-operative Land Mortgage Bank and the three scheme areas would be helpful for realising the present analysis ventured by the author. For the sake of convenience a tehsilwise description is furnished below.

Nabha Tehsil in Patiala District

The scheme prepared for the Patiala district envisaged the construction of 600 new tube-wells in the Bhadson block of Nabha tehsil comprising 172 villages over the three-year period, 1967-68 to 1969-70. The depth of the tube-well in the tehsil is around 160 feet. On the assumption that each tube-well has the capacity of irrigating ten acres, the proposed 600 new tube-wells are expected to furnish irrigation facilities to 6,000 acres. The cost of a new tube-well with an oil engine has been assumed to be Rs. 5,500. The loans available from the Land Mortgage Bank for the construction of tube-wells carry interest rate at 7.75 per cent per annum. The period of repayment is nine years but during the first year only interest is to be recovered. On these terms the average annual repayment charge including interest from the second to the ninth year, works out at Rs. 930 in respect of a loan of Rs. 5,500. According to the Land Mortgage Bank the average value of farm land in the tehsil is Rs. 3,500 per acre. As the amount of the loan available is limited to 50 per cent of the estimated land value it becomes evident that the farmers having more than three acres of land would be eligible for the loan. During 1966-67 the net sown area in Nabha tehsil was 1.58 acres of which 39 per cent was sown more than once. The principal crops grown in the tehsil during 1966-67 were wheat, groundnut, cotton, maize and gram. As all the 172 villages in the tehsil are more or less homogeneous in character, two villages were purposively selected by the Economic Department of the Reserve Bank of India for collecting the relevant information.

Kapurthala Tehsil in Kapurthala District

The scheme prepared by the Land Mortgage Bank proposed the construction of 1,000 new tube-wells in the Kapurthala tehsil. Of the total, 900 tube-wells will run on diesel and the rest on electric power. Taking all the components of costs into consideration the average expenditure for installing a new tube-well was expected to be Rs. 7,500. The loans repayable within nine years carry an interest rate of 7.75 per cent per year. In the first year only the interest component will be recovered as it is assumed that the borrowers will not get the full benefit in the first year. The annual

instalment comprising both principal and interest has been worked out to be Rs. 1,264.

Kapurthala tehsil covers 585 villages. The entire area falls into two distinct natural regions—the Dona region and the Bet region. The important crops raised in the Dona region are maize, groundnut, sugarcane and bajra in the *kharif* and wheat and berseem in the *rabi* season. In the Bet region, paddy, maize, sugarcane, *chari gowar* and bajra are grown in the *kharif* and wheat, berseem, and barley in the *rabi* season.

The sample villages from both the regions were taken for the purpose of investigation carried out by the Reserve Bank of India.

Ludhiana Tehsil

The scheme for Ludhiana tehsil proposed the construction of 1,000 tube-wells in 101 villages of the tehsil. The villages have more or less homogeneous features and are covered by Ludhiana and Mangat development blocks. The estimated cost of a tube-well with an oil engine is Rs. 5,500. The use of electric motor instead of an oil engine will cause a further reduction in total cost. But the non-assured availability of electricity to the area rules out the consideration of the cost of tube-well run on electricity. The expected coverage of each tube-well is ten acres. On this assumption the net area which may be irrigated by the proposed construction of tube-wells has been estimated at 10,000 acres. The amount of loan and the terms of repayment are the same as those in Patiala district. Wheat, groundnut and maize are the important crops grown in the tehsil. The total geographical area of the tehsil is 4.35 lakh acres of which 82 per cent has already been brought under cultivation. This precludes the possibility of bringing in considerable amount of new area under the plough.

METHODOLOGY

The net present value criterion is a classic economic method used for the appraisal of investment. At the micro level, an individual farmer will undertake an investment if the net present value of that investment is greater than zero. The higher the net present value, the greater will be the desirability of an investment. The calculation of the net present value of an investment requires the preparation of cost series on the one hand and income series on the other. In terms of notation, the net present value (NPV) can be expressed as :[2]

$$NPV = \sum_{i=1}^{n} \frac{Y_i}{(1+r)^i} - C$$

2. A. D. Merrit and Allen Sykes : The Finance and Analysis of Capital Projects, Longmans, London, 1963, p. 34.

where C refers to the initial capital cost of investment and Y_i stands for net cash flow at the end of year i where the benefit of the investment is spread over n years.

For the calculation of the net present value of a self-financed investment the above formula will serve the purpose. But when we consider the case of a loan-financed investment made by the farmers under the conditions when the repayment of principal is spread over some later years, the above formula for the calculation of the net present value requires a slight modification. An example will make it clear. Suppose a farmer borrows Rs. 100 from a bank at a particular rate of interest for investing the amount on his farm. The farmer is required to repay the loan along with interest over the next four years. In this case, we cannot consider Rs. 100 as the capital cost incurred by the farmer. The capital cost will be equal to the aggregate present value of all the instalments of principal and interest payments to be made over four years by the farmer. The present value of the capital cost incurred at a number of periods is arrived at by summing over the discounted values of principal and interest components of costs in each period. The same rate of interest is to be used to find out the present value of capital cost incurred over a number of years as is used in discounting the net cash flows of investment. Generally, the present value of future net cash flows is obtained by discounting them at the farm's cost of capital, *i.e.*, the rate of interest at which a farmer borrows.

This modified formula of the net present value can be expressed as

$$NPV = \sum_{i=1}^{n} \frac{Y_i}{(1+r)^i} - \sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$$

where, $C_i = P_i + I_i$, P_i refers to the annual instalment towards repayment of principal and I_i to annual interest payment. If in a particular year only interest is paid, P_i becomes equal to zero and $C_i = I_i$. For the calculation of the net present value of loan-financed investment made by the farmers in the three districts mentioned above, we have to consider the cost series and benefit series which are spread over nine years. The expected life of a tube-well in the areas under consideration is roughly 20 years. This means that the benefits of investment on tube-well will accrue over 20 years. But the expected life of a pump-set is only ten years. Therefore, to get the full benefit from a tube-well a farmer has to purchase another pump-set at the end of the tenth year with a further cost of Rs. 3,200. This can be done either by self-financing or by borrowing. But while calculating the net present value of a loan-financed investment by a farmer we shall concentrate upon the cost series and benefit series of nine years only since under the stipulated terms and conditions the amount borrowed by a farmer has to be repaid within nine years. The net present value of a loan-financed investment in this case can be expressed as follows :

$$NPV = \left[\frac{Y_1}{(1+r)} + \frac{Y_2}{(1+r)^2} + \ldots\ldots + \frac{Y_9}{(1+r)^9}\right] - \left[\frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \ldots\ldots + \frac{C_9}{(1+r)^9}\right].$$

It would be a quite plausible assumption to make that in the first year the benefit of the tube-well irrigation will not be felt. The assumption of fruition lag of one year virtually means that Y_1 will be equal to zero. It should be mentioned here that Y_i's refer to the additional income per family net of all costs excepting interest and capital cost of investment.

The loan given by the bank to the farmers belonging to different size-groups can be treated as investment from the point of view of the society. Since the beneficiaries of social investment are the farmers in this case, the additional income of the farmers over nine years would be taken as the net cash flows to the society. The social rate of return under such condition can be defined as that rate which discounts the future net cash flows of an investment into equality with capital costs. Expressed in a formal way, the rate of return or yield rate of investment is the solution r to the following equation :

$$C = \sum_{i=1}^{n} \frac{Y_i}{(1+r)^i}$$

where C = capital cost of investment.

Y_i = net cash flow in the ith year.

The social rate of return on investment under different size-groups has been worked out approximately by using the method of linear interpolation. The rates of return thus arrived at can also be called marginal efficiency of social capital in alternative lines.

RESULTS AND INTERPRETATION

Table I sets out the net present values of loan-financed investment to be made by the farmers belonging to different size-groups in the three tehsil of Punjab State. The table reveals that in the Dona region of the Kapurthala district, the farmers in all the size-groups and in the Bet region of the same district the farmers in all the size-groups excepting the first one, are in a position to repay the loan of Rs. 7,500 within nine years out of the net cash flows generated due to the construction of tube-wells. They will also be able to purchase a second pump-set worth Rs. 3,200 after ten years without any recourse to further loan. Similar is the case with the farmers in all the size-groups excepting the last one in the Ludhiana district where the Land Mortgage Bank has a proposal to advance Rs. 5,500 as loan for the construction of tube-wells.

TABLE I*—NET PRESENT VALUE OF LOAN-FINANCED INVESTMENT IN PUNJAB

District	Sr. No.	Size-group (acres)	Average size of farms (acres)	Additional income per family (Rs.)	Net present value (Rs.) (nine years)
	(1)	(2)	(3)	(4)	(5)
Patiala	1.	Less than 5	2·42	—44	—5,671·68
	2.	5—10	7·10	383	—3,353·03
	3.	10—20	13·48	741	—1,417·44
	4.	20—30	25·47	1,121	637·08
Kapurthala : Dona Region	1.	Less than 5	3·21	2,006	3,472·29
	2.	5—10	6·26	2,986	8,761·82
	3.	10—20	11·75	3,772	12,750·13
Bet region	1.	Less than 5	3·09	844	—2,810·24
	2.	5—10	6·57	1,669	1,650·24
	3.	10—20	12·88	8,230	37,123·38
	4.	20—30	22·21	10,061	43,033·80
Ludhiana	1.	Less than 5	3·25	1,235	1,361·57
	2.	5—10	7·87	1,495	2,659·17
	3.	10—20	13·87	2,732	9,347·22
	4.	20—30	22·90	1,099	518·13

* Columns 2, 3 and 4 have been prepared on the basis of information contained in Table Nos. 6·3·2, 7·3·3 and 8·3·3 of Bank Credit to Farmers for Irrigation Development, *op. cit.*

But in Patiala district loans are non-self-liquidating in all the size-groups excepting the last one where the net present value is positive even if considered in the context of first nine years within which loans are to be repaid. Net present values have been calculated here on the basis of a rate of interest of 7.75 per cent per annum which represents the cost of capital to the farmers. Positive net present value at this given rate of interest signifies that the rate of return on loan-financed investment is higher than the rate of interest charged by the bank. Thus, the higher the magnitude of the net present value at a given rate of interest, the higher would be a farmer's propensity to borrow, other things remaining the same. Since propensity signifies both ability and willingness, the prospective repayment capacity as well as the farmer's willingness to borrow would be higher when the magnitude of positive net present value is higher. It can also be said that the magnitude of the net present value serves as an index of certainty of a loan being self-liquidating in character. Thus the repayment capacity of a farmer is reflected in the net present value of a loan-financed investment.

From the point of view of the society, selection of size-groups to which loans may be advanced for the construction of tube-wells assumes vital importance. This is particularly so in a country like India where capital happens to be a scarce factor. The assessment of the relative deservedness of different size-groups can be done on the basis of marginal efficiency of loan capital. In a sense, there is no difference between the rate of return on investment and the marginal efficiency of capital. The rate of return criterion suggests that investment should be directed to that line where it yields the maximum rate of return. Similarly, advancing the loan for investment to that size-group which yields the maximum rate of return should be considered most desirable from the point of view of the society. Accordingly, an attempt has been made here to calculate the social rate of return of loans given for investment to the farmers belonging to different size-groups in the three tehsils of Punjab.

Table II presents the rates of return on investment of Rs. 5,500 in Nabha (Patiala) and Ludhiana tehsils and those of Rs. 7,500 in Kapurthala tehsil for different size-groups. A ranking of the size-groups on the basis of the rate of return has also been done in the table. The rates of return on investments from the society's point of view have been calculated by taking into consideration only the primary net tangible benefits of investment. The additional income per family can be said to represent the net tangible primary benefit of investment on tube-wells.

TABLE—II RATE OF RETURN ON INVESTMENT FOR IRRIGATION DEVELOPMENT UNDER DIFFERENT SIZE-GROUPS

	Sr. No.	Size-group (acres)	Rate of return (per cent)	Rank
Patiala	(1)	(2)	(3)	(4)
	1.	Less than 5	—*	4
	2.	5—10	—*	3
	3.	10—20	1·38	2
	4.	20—30	7·74	1
Kapurthala : Dona region				
	1.	Less than 5	16·05	3
	2.	5—10	28·00	2
	3.	10—20	33·93	1
Bet region				
	1.	Less than 5	—*	4
	2.	5—10	11·60	3
	3.	10—20	more than 50	2
	4.	20—30	more than 50	1
Ludhiana	1.	Less than 5	11·91	3
	2.	5—10	16·44	2
	3.	10—20	33·50	1
	4.	20—30	9·32	4

—*indicates negative rate of return.

It emerges from Table II that the rate of return and size of farm move in sympathy with each other. The exception is noticed in the case of Ludhiana where investment in the last size-group yields the lowest rate of return.

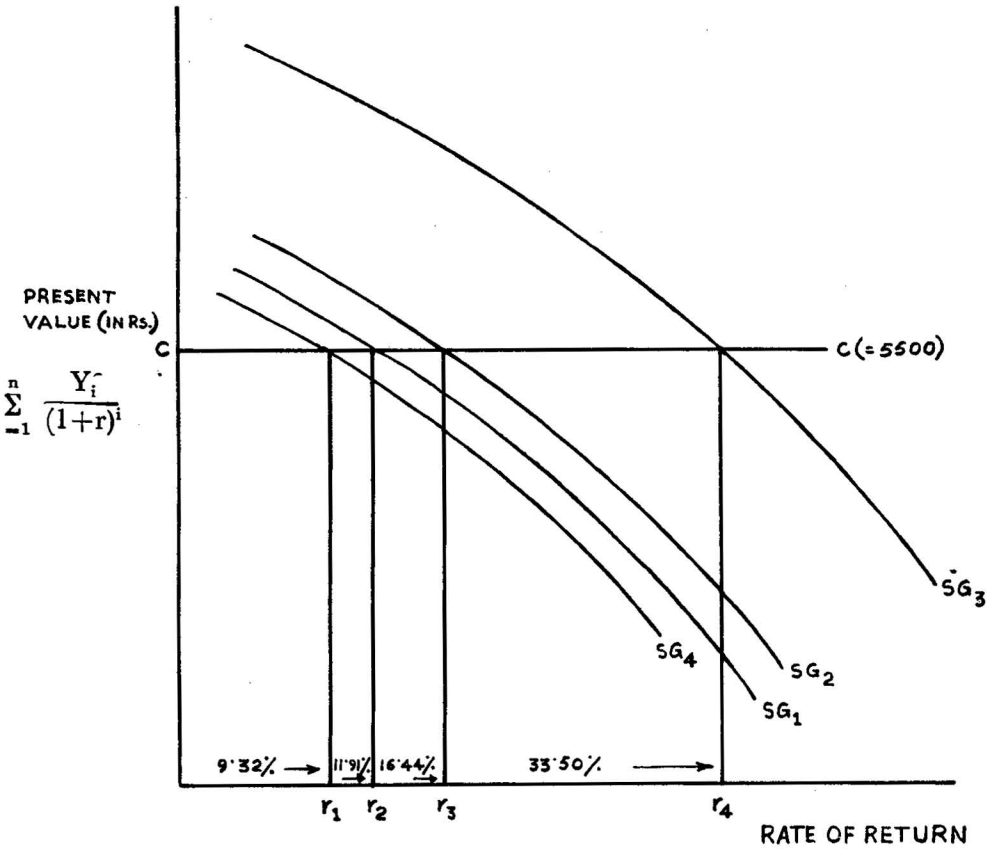

Figure 1—Determination of Rate of Return on Investment in Ludhiana Tehsil

In Figure 1 an attempt has been made to show how the rate of return is determined at the point of intersection between the horizontal line CC representing capital cost of investment and the gross present value curve of different size-groups.

The figure has been drawn only for the Ludhiana tehsil. Relevant figures for other regions have not been drawn simply to avoid unnecessary duplications.

From the above discussion, it should not be concluded that loans should be given only to the farmers belonging to that size-group which exhibits the highest rate of return on investment. The selection of the size-groups to which

loans will be advanced will also depend upon the amount of loan proposed to be advanced to the farmers in a particular region and the value judgment of the society or the bank.

REGIONAL ANALYSIS OF INSTITUTIONAL FINANCE FOR AGRICULTURE

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From just 3 per cent share of the co-operatives in agricultural financing in 1952 to 15 per cent share in 1962 and about 30-35 per cent share in 1967-68 represents a substantial progress of institutional finance in agriculture during the first two decades of planning. In 1962 the total amount lent to agriculturists by the co-operatives stood at Rs. 160 crores which jumped to Rs. 487 crores in 1967-68, a spectacular rise unprecedented in the past in India and for that matter in many under-developed countries.

Commercial banks had not entered the field of agricultural finance, their total lending being a meagre 0.9 per cent of the total agricultural finance in 1952. But in 1968 the banks entered this field in a big way and their lendings rose to Rs. 188.4 crores in June, 1969 and to Rs. 378.5 crores as on March, 1971. As a matter of fact, in the past two years the banks have achieved a far more rapid progress than even the co-operatives. Thus, institutional finance has come to play a crucial role as against operating just on the fringe upto 1952.

The progress of institutional finance so far leads to two major observations. A part of the progress, and a very important one at that, has led to substitution of private lending agencies of all descriptions by the institutional agencies. This phenomenon overrides shifts among private agencies regarding their relative importance, *e.g.*, farmer lenders having gained and the professional moneylenders having lost the ground, both in a substantial way. Secondly, with the receding importance of private agencies the public agencies have come to bear the major brunt of the developmental finance. In any forward looking analysis, the second observation regarding the developmental role of the institutional finance would matter significantly.

A few questions arise if we assign the developmental role of the institutional finance a central place in our analysis : (*i*) Do the two major public

* I am indebted to Kum. S. D. Sawant, Department of Economics, University of Bombay, Bombay for statistical help.