PRODUCTION FUNCTION ANALYSIS AS A METHOD OF MEASURING CREDIT IMPACT

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1. Introduction

Many economists have attributed the low productivity of agriculture in developing countries to the low level of technology adopted and lack of sufficient capital to fund investments in more advanced production methods. The importance of external funds for transforming agriculture, has been emphasised by many economists and policy makers (Khan, R. 1987).

It is a widely held view that due to low incomes, the savings capacity of rural people in most developing countries is insufficient to finance farm investment in new technology. Therefore external capital is required in order to facilitate technological change and the modernisation of agriculture. In this regard institutional credit is often seem as an appropriate vehicle for promoting agricultural developmen in these countries (Von Pischke and Adams 1980). "Credit is often a key element in the modernisation of agriculture. Not only can it remove the financial constraints, but it may also provide incentives to adopt new technology" (Scobie and Franklin 1977). More particularly the availability of credit is seen as leading to more efficient utilisation of production factors through the introduction of new inputs which enable existing inputs to be used more productively.

The role that agricultural credit plays in agricultural development appears to differ in quantitative and qualitative terms among individuals and societies.

There are a number of empirical micro-studies which support the hypothesis that insitutional credit is necessary to allow the introduction of technological packages which are capital intensive and significantly increase small farmers' agricultural efficiency (Baker and Bhargava 1983, Rask 1971, Colyer and Jimenez 1971).

The consensus emarging from empirical findings is that credit plays an important role in small farmers' adoption of new methods (Singh and Ramanna 1981, Schluter 1974, Agarwal and Kumawat 1974, Baker and Bhargava 1983).

However, in spite of the above evidence supporting the importance of credit for the adoption of new technology, there are a number of studies which indicate that the provision of credit is not the whole solution to the problem (Owasu-Acheampong 1986, Johnson 1971). Adams and Graham (1981) argue that the availability of credit does not necessarily raise the rate of return to farm investment or induce small farmers to adopt new methods and so change output and income.

The purpose of this paper is to examine the impact of agricultural credit on structural changes of farmers in Iran. The paper focuses on production function analysis and in particular to test the hypothesis that; "Farmers who use credit differ from non-credit users in terms of production,resource use and efficiency".

Data for analysis were collected from a farm level survey of 200 drawn from two states of Iran (i.e. Isfahan and Chaharmohal) and conducted in 1987/8. As the majority of farmers in Iran do not keep records cross section data was thought to provide better grounds for obtaining information which would allow the hypothesis to be examined.

2. Credit, Technological Change and Production Function

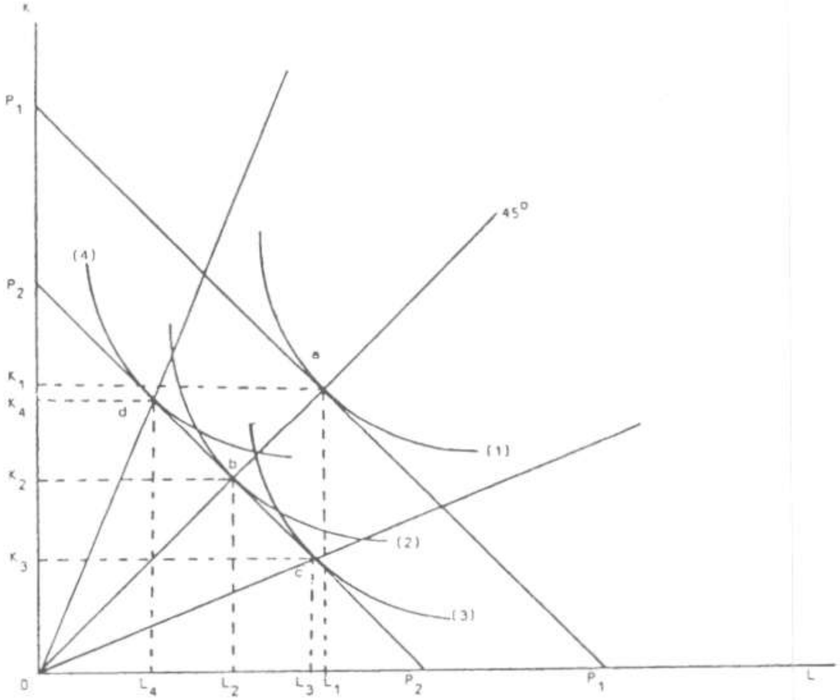
In terms of the theory of production economics, agricultural credit relaxes the capital constraint and facilitates investment and the adoption of new methods of production which have the potential to increase productivity. In other words, credit is expected to result in an increase in productivity by shifting farmers to a higher production function (i.e. technological change). Thirlwall (1986) describes "technological change as an umbrella head to cover all those factors which contribute to the growth of total productivity". Some economists describe changes in the factors of production such as quality improvements in one or more factors of production as technological change (Kennedy and Thirlwall 1972). Technological change in the production process can be classified as neutral or non-neutral (Brown 1966, and heathfield and Wibe 1987).

A neutral change includes a technology[1] where more output is obtained from a given level of inputs or the same output from less inputs. The neutral shift affects all inputs equally. By contrast the non-neutral change (i.e. a change in the marginal rate of substitution[2] between inputs) has a biased effect on inputs, for example it may result in labour or capital saving in a two factor production function (Upton 1976). Upton (1976) argues that the neutral change occurs when the average and marginal product of each input increase in the same proportion and non-neutral change occurs when the marginal product of each input increase in different proportions. These two features of technological change are shown in Figure 1.

1. "Technology is the pool of productive activities currently used by a society" (Upton 1976).

2. Marginal rate of substitution refer to the rate at which one factor must be substituted for another leaving output unchanged (Thirlwall 1986).

FIGURE 1 : A NEUTRAL AND NON-NEUTRAL SHIFT OF PRODUCTION FUNCTION



L and K represent labour and capital inputs in a production function with two inputs (figure1)

$$Q_1 = A \,.\, f(K,L) \tag{1}$$

where:

- Q_1 is output.
- L is labour
- K is capital
- A is the constant term.

Iso-quant (1) represents a production function for a farmer who uses existing technology which is less efficient and less productive than iso-quants 2, 3 and 4. Point *a* where the price line (P_1P_1) is tangential to iso-quant (1), represents the optimum combination of resources under a given technology.

Assume that a credit programme is in operation with the primary objective of inducing farmes to use new technology and that it is successful in its objective. The effect of new technology is shown by a shift from iso-quant (1) to a different production function represented by iso-quants (2, 3, and 4). If the shift in isoquant towards the origin is neutral as a result of change in technology[3] (i.e. same inputs used to produce more output) and the marginal rate of substitution remains unchanged, the isoquant (2) will represent the production function and point *b* in figure 1, where the price line (P_2P_2) is tangential to isoquant (2), will represent the optimal point. At point *b* the relative marginal productivities of the inputs are the same as those at point *a* in figure 1.

Equation (2) indicates that the difference between the two production functions Q_1 and Q_2 is represented by parameter A which has altered from A to A_1.

$$Q_2 = A_1 \,.\, f(K,L) \tag{2}$$

With neutral technical progress the production function shifts such that the new point of tangency lies on the same expansion path (Thirlwall 1986). This means that there is no change in the marginal rate of substitution between labour and capital in our two factor production function i.e. the ratio of marginal products is the same at the same labour to capital ratio. In other words equal proportionate amounts of the two factors are saved.

Iso-quant (3) and (4) represent two possible production possibilities for a non-neutral

3. Thechnical changes may include: (1) mechanical (e.g. tractor) (2)biological (e.g. improved seeds) (3) chemical (e.g. fertiliser) (4) agronomic (e.g. improved cultural practices, marketing, management techniques etc.).

shift in the production function. Point c and d in figure 1 represent two such optimal points that might be achieved following such a shift. Equation (3) represents the new production function resulting from a non-neutral shift.

$$Q_3 = A_2 \, . \, f\,(K_1, L_1) \qquad (2.3)$$

In the shift from *a* to *c* the ratio of a the marginal product of labour to capital is higher than at point *a* in figure 1. Thus to move from Q_1 to Q_3 represents a labour intensive or capital saving type of technological change. On the other hand, if the shift is from *a* to *d* where the ratio of marginal product of labour to capital is lower than at *a*, then the change is said to be capital intensive or labour saving technology.

Whether the shift in production function is neutral or non-neutral the important point is that technological change can alter the production process and improve efficiency. Credit influences farm level resource use by removing the financial constraint so that farmers can adopt an improved technology and choose the optimum combination of inputs. Hence it is expected that farmers who make use of borrowed funds to invest in new technology are likely to be more productive and efficient than non-borrowers.

Production function analysis can provide a basis for comparisons of average production from a given set of inputs on different farms (Upton 1987). Thus production function analysis provides a basis for investigating the nature of possible differences between two production functions (borrowers and non-borrowers). This can be achieved by measuring the difference in factor shares and differences in the constant term. Hence a comparison of production functions provides a simple measure of structural differences between borrowers and non-borrowers.

Production function analysis has its own shortcomings. Multicollinearity is often a problem and substitution and attribution problems exist. Upton (1979) identified a number of limitations associated with the use of production functions based on farm-level survey data. Valuing capital inputs, aggregation procedures, estimation and selection of an appropriate functional form are all identified as potential major problems when using production function analysis.

The analysis begins by focusing on structural differences between borrowers and non-borrowers in terms of their production process (i.e. differences in the process of transforming inputs into output).

A number of functional forms can be used to explain the relationship between output and inputs. In this case a translog production function with the following general form was chosen.

$$\ln Q = \ln A + \sum_i \alpha_i \ln X_i + 1/2 \sum_i \sum_j \alpha_{ij} \ln X_i \ln X_j \tag{3}$$

where, $\alpha_{ij} = \alpha_{ji}$ for all i.j.

Q = gross output.
$X_{i,j}$ are inputs
A is a constant parameter.
$\alpha_{i,ij}$ = parameters attached to the variables.

3. Testing for Differences Between Borrowers and Non-Borrowers Production Functions

The simplest way of detecting differences between borrowers and non-borrowers is to test the hypothesis that 'The production function is the same for both borrowers and non-borrowers'.

The first step in the analysis involved using the ordinary least squares technique (OLS) to estimate the relative parameters for two unrestricted sub-group models (borrowers and non borrowers) and the overall pooled sample (the restricted model).

The variables used in the analysis include all the quantifiable farm output, and conventional inputs including land, stock assets, variable inputs and labour. Production functions are usually specified as the relationship between physical quantities of inputs and a physical quantity of outputs. However, where the aim is to aggregate together items measured in different units, then money values rather than physical values are used. Thus the analysis will be undertaken using money values of outputs and inputs.

i. *Gross Farm Output* (Q) is defined as the sum of gross values of crops and livestock products produced during year 1987/88. Where output was given away or consumed by the farmer family it was valued at market price.

ii. *Land* (X_1): In order to obtain a logical base for the land input, the cropped area (effective farm size) was used rather than total farm area. Where multiple cropping occurred on the same land the value used was the area of crops grown not the land area. Area was measured in "Jirib" (0.1 hectare).

iii. *Stock Assets* (X_2) : The stock assets refer to the total value of machinery on the farm including tools and equipment, the value of livestock, private irrigation facilities (e.g. pump) and agricultural buildings (e.g. stores).

iv. *Variable inputs* (X_3) : Represents expenditure on those inputs which are used up during a single production year. They include intermediate materials such as seeds, fertiliser, pesticides, fuel and oil, livestock feed, and services such as contract hire of machinery.

v. *Labour* (X_4): Initially two variables were included for labour, hired labour and household labour. Household labour was measured according to the estimated standard man days required by the different crops and livestock activities minus the hired labour used. However, before estimating the production functions, a check for multicollinearity was made by inspecting the matrix of partial correlation of variables and also using Klein's Rule (Maddala 1979). The results indicated a strong correlation between land and imputed family labour. This finding suggested the presence of a multicollinearity problem which is likely to result in a high standard error. Therefore to overcome this problem the family labour variable was eliminated from the model. The first three variables all reflect opportunities for credit to increase the quantities used whiles the fourth (labour) may also lead to increased working capital requirements and hence increase in use where there is access to borrowed funds. There are other variables which may affect the production function which are difficult to quantify in financial terms (e.g. management ability, soil quality) which could not be included as variables in the equation.

Three equations were estimated stepwise (using F values for independent variables of greater than 0.40 and less than 0.35 as criteria to exist and enter the equation respectively and a minimum tolerance test of 0.00001). The estimated coefficients and their T-test values together with the regression statistics are presented in table 1.

Table 1: Production Function Estimation For Borrowers, Non-Borrowers and the Pooled Sample - Coefficients and Regression Statistics

Variable Inputs	Borrowers	Non-Borrowers	Pooled Sample
lnX_1	0.3578*** (4.023)	0.3586** (1.916)	0.5692*** (6.840)
lnX_2	-0.1476*** (3.092)	-0.0983** (2.040)	-0.1155*** (3.356)
lnX_3	-0.0871 (1.279)	-0.1073 (1.531)	-0.1067** (2.145)
lnX_4	-0.1177** (2.377)	- (2.209)	-0.0971**
lnX_1^2	-	0.0568 (1.413)	-
lnX_2^2	0.0149*** (4.370)	0.0128*** (3.552)	0.0139*** (5.162)

Table 1 continued on next page.

Table 1 (continued):

Variable Inputs	Borrowers	Non-Borrowers	Pooled Sample
lnX_3^2	0.0079	0.0079	0.0089***
	(1.798)	(1.890)	(2.847)
lnX_4^2	0.0168***	0.0057**	0.0136***
	(3.766)	(2.363)	(3.328)
$lnX_1 lnX_2$	-	-0.0142	-0.0114*
		(1.446)	(1.655)
$lnX_1 lnX_3$	-	-	-
$lnX_1 lnX_4$	-0.0103	-0.0272***	-0.0135**
	(1.130)	(2.549)	(2.145)
$lnX_2 lnX_3$	-	-	-
$lnX_2 lnX_4$	-0.0026*	0.0023	
	(1.620)	(1.401)	
$lnX_3 lnX_4$	-	-	-
Intercept	12.2551***	11.9010***	11.7314***
	(35.114)	(32.559)	(42.037)
R^2	0.84	0.78	0.79
$\bar{R}^2$	0.81	0.74	0.78
F-value	28.89***	22.65***	50.35***
RSS	10.93	18.79	36.25
n	93	107	200

Source: Survey Data (1987/88).
* Significant at 10 percent level.
** Significant at 5 percent level.
*** Significant at 1 percent level.
The figures in parentheses are t-values.

The "Chow-Test" described by (Koutsoyiannis 1977 and Hebden 1983) was used to test the restricted model against the two unrestricted models.

$$F^*_{(K+1, m+n-2(K+1))} = \frac{\left[RSS_{(n+m)} - (RSS_{(m)} + RSS_{(n)}\right] / K+1}{\left(RSS_{(m)} + RSS_{(n)}\right) / [m+n-2(K+1)]} \tag{4}$$

Where,
$RSS_{(m+n)}$ is the residual sum of squares for the pooled sample.
$RSS_{(m)}$ is the residual sum of squares for the borrower group.
$RSS_{(n)}$ is the residual sum of squares for the non-borrower group.

m is the number of the borrowers group.
n is the number of the non-borrower group.
m + n is the number of the pooled sample.
K + 1 is the number of the overall regression coefficient estimated.
(K + 1, m+n-2(k+1) is the degrees of freedom.

The computed value of F in equation (4) indicates whether there is any significant difference between the two subgroups (i.e. borrowers and non-borrowers). If the computed value for F is larger than the tabulated value for F we reject the hypothesis (i.e. similarity of the two groups production functions) otherwise we accept it.

Substituting the relevant calculated values in equation 4 the F^* value was calculated in equation(5).

$$F^* = \frac{(36.25) - (10.93 + 18.79)/15}{(10.93 + 18.79)/170} = 2.49 \qquad (5)$$

The tabulated value of F with 30 and 170 degree of freedom at 1 percent significant level is 1.79. The value of $F^*>F$ (i.e. 2.49>1.79), and the hypothesis that the production function is the same for borrowers and non-borrowers is rejected at 1 percent level. We therefore concluded that borrowers and non-borrowers significantly differ in terms of their production functions.

In the translog functional form the relationship between output and each input is not only explained by the coefficient attached to an individual input, but it is also depends on the levels of the other inputs used. Therefore, the small positive values or negative signs for a particular coefficient should not be interpreted as reflecting the total relationship between output and that particular input (Rao and Chatigeat 1981).

4. The Nature of the Difference

As was pointed out earlier structural (technological) differences between producers (i.e. borrowers and non-borrowers) may be of neutral or non-neutral nature. The analysis therefore proceeded to try identify the value of difference between borrowers and non-borrowers by testing the following hypotheses;

(1) "The difference in production functions is a neutral shift (i.e. difference in intercept variables)".

(2) "The difference in the production functions is a non-neutral shift (i.e. difference in slopes)

Covariance analysis described by Johnston (1984) and Hebden (1983) [4] was applied to test the hypotheses and the results are presented in table 2 was applied and the results are presented in table 2.

Two dummy variables for the intercept and slopes were used in the unrestricted model and given a value of 1 for borrowers and zero for non-borrowers. Two equations (6 and 7) with the following forms were estimated.

$$LnQ = 1nA + \beta D + \sum_i \alpha_i lnX_i + 1/2 \sum_i \sum_j \alpha_{ij} lnX_i 1nX_j + \mu_i \qquad (6)$$

$$1nQ = 1nA + \beta D + \sum_i (\alpha_i + \beta_i D) lnX_i + 1/2 \sum_i \sum_j \alpha_{ij} + \beta_{ij} D) lnX_i lnX_j + \mu_i \qquad (7)$$

Where, D is the dummy variable and ß's are the parameters for the dummy variables. The results of estimated equations are presented in table 2. In column (1) the regression coefficients without dummy, and in column (2) and column (3) regression coefficients with the intercept and slope dummies respectively.

4.

$$F = \frac{[(RSS^* - RSS)]/K^* - K}{RSS/[n-K]}$$

where RSS* is the residual sum of squares for restricted model.
RSS is the residual sum of squares for unrestricted model.
K*–K is the numbers of restriction imposed in the restricted model.
n – K is the degrees of freedom.

Table 2: Production Functions Estimates for Pooled Sample with Intercept Dummy.

Variable inputs	Pooled data (1)	Pooled data (2)	Pooled data (3)
lnX_1	0.5692***	0.4202***	0.4121***
	(6.840)	(3.103)	(3.055)
lnX_2	-0.1155***	-0.1103***	-0.1138***
	(3.356)	(3.378)	(2.389)
lnX_3	-0.1067**	-0.0908**	-0.0975
	(2.145)	(1.943)	(2.030)
lnX_4	-0.0971**	-0.0891**	-0.0760*
	(2.209)	(2.106)	(1.782)
lnX_1^2	-	0.0280	-0.0285
		(1.010)	(1.037)
lnX_2^2	0.0139***	0.0136***	0.0131***
	(5.162)	(5.380)	(5.202)
lnX_3^2	0.0089***	0.0079***	0.0079***
	(2.847)	(2.691)	(2.648)
lnX_4^2	0.0136***	0.0133***	0.1040***
	(3.328)	(3.463)	(2.667)
$lnX_1 lnX_2$	-0.0114*	-0.0120*	-0.0104
	(1.655)	(1.714)	(1.461)
$lnX_1 lnX_3$	-	-	-
$lnX_1 lnX_4$	-0.0135*	-0.0167***	-0.0194***
	(2.145)	(2.603)	(2.805)
$lnX_2 lnX_3$	-	-	-
$lnX_2 lnX_4$	-	-	0.0023*
			(1.754)
$lnX_3 lnX_4$	-	-	-
Intercept Dummy	-	0.3185***	-
		(5.250)	
$DlnX_1$		-	-
$DlnX_2$		-	-
$DlnX_3$		-	-
$DlnX_4$		-	-
$DlnX_1^2$		-	-
$DlnX_2^2$		-	0.0019***
			(3.369)
$DlnX_3^2$		-	-
$DlnX_4^2$		-	0.0059***
			(3.768)
$DlnX_1 lnX_2$		-	-

Table 2 continued on next page

Table 2 (continued):

Variable inputs	Pooled data (1)	Pooled data (2)	Pooled data (3)
$DlnX_1 lnX_3$		-	-
$DlnX_1 lnX_4$		-	-
$DlnX_2 lnX_3$		-	-
$DlnX_2 lnX_4$		-	-0.0055*** (3.552)
$DlnX_3 lnX_4$		-	-
Intercept	11.7314*** (42.037)	11.7447*** (42.859)	11.9096*** (43.465)
R^2	0.79	0.81	0.82
$\bar{R}^2$	0.78	0.80	0.81
F-value	50.35***	55.55***	28.52***
RSS	36.25	30.54	29.73
n	200	200	200

* Significant at 10 percent level.
** Significant at 5 percent level.
*** Significant at 1 percent level.
The figures in parentheses are t-values.

The regressions were tested using covariance analysis by calculating the computed F* value and compared with the tabulated F-value. The computed values of F are presented in table 4.

Table 4: Computed F-values

Tests	Computed F-value
Test - I: Different in intercept	34.42*
Test - II: Different in slope	0.33

Source: survey Data (1987/8).
Tabulated value of F at the 1 percent level is 1.79.

According to table 4 the computed value of F for two equations one without a dummy (1) and the other with intercept dummy (2)is greater than its tabulated value at 1 percent level (i.e. (34.42)>(1.79)). This result rejects the hypothesis at the 1 percent significance level and indicates that the intercept is different for borrower and non-borrower groups which suggests inter-farm efficiency differences. The positive and significant value of the intercept dummy implies that the borrowers' production function has shifted upwards.

Despite the fact that three slope dummies are significant at the 1 percent level the computed F value (0.33) for the overall equation is less than the tabulated value of F (1.79) at the 1 percent level. This suggests that there is no difference in the slopes of the production functions for borrowers and non-borrowers and that the hypothesis that 'there is a non-neutral shift' can rejected. This implies that there is no difference in the marginal productivity of the inputs, but rather that all units of input have become more productive. In other words the efficiency progress amongst the borrower group has not acted in such a way to alter the relative marginal productivity of any input. Thus it may be concluded that there is a neutral shift in borrowers production functions compared to non-borrowers. This may be due to factors which could not be quantified and which were not included in the model such as management ability, soil quality etc. In essence it suggests that variables omitted from the equation must account for borrowers obtaining greater output for a given level of inputs than non-borrowers.

The differences in production structure and efficiency might be attributed to a whole range of factors which happen to be associated in different degrees with borrower and non-borrower farmers.

The comparison of borrowers and non-borrowers using multivariate analysis (i.e.discriminant analysis) reported in Yazdani (1991) suggested that borrower and non-borrower groups are significantly different in a number of other respects. The borrowers group tend to comprise younger farmers who are better educated and have more agricultural training. Not surprisingly they own more assets than farmers who do not borrow. Discriptive analyses of the borrower and non-borrower groups had also revealed that borrowers tended to farm large areas of land than non-borrowers. These variables are likely to explain part of the structural and efficiency differences.

In view of the difference between borrowers and non-borrowers in terms of training, education, age, and farm size it was decided to incorporate intercept dummy variables for these factors in the equation. The analysis indicated that the dummies for age, education and farm size were not significant where as training was significant at 5 percent level. The covariance analysis test indicated that the inclusion of four dummy variables was not significant with a computed F value of 0.42. It was therefore decided in a further analysis of data by including slope dummies for training. This analysis, although significant at 1 percent level (computed F value 2.84 was greater than tabulated F value of 2.04) indicated no significant contribution from training on slopes. However when the dummy for borrowing was excluded whilst retaining intercept and slope dummies for training the resulting production functions were again significant at the 1 percent level (computed F value of 2.16) and a significant contribution were recorded for the training intercept dummy and for the impact of training on the slope dummy for variable costs. This suggests that one effect of training is to improve the efficient use of variable inputs. As was observed from discriminant analysis training also appears to be associated with borrowing (Yazdani1991). One possible explanation is that training increases the potential for gaining access to borrowed funds. On the basis of these results this could certainly be logical. It also means that there is the potential for multicollinearity between borrowing and training dummies if they are both included in the equation.

5. Conclusion

Production function analysis in this paper was used in order to determine the extent to which differences in resource use and farm production were associated with use of inputs or other factors. The analysis of production functions suggested a significant difference in production function and efficiency between, borrower and non-borrower groups. The result indicated that the borrowers' production function has a neutral upward shift when compared to the production function of the non-borrowers. The evidence and findings do not support the hypotheses that borrowers and non-borrowers production functions also differ in terms the slope or the marginal productivity of inputs. This implies that the differences are not related to the use of resources quantified within the production function but with factors such as management, soil quality, weather, risk aversion, crop combination, etc. which were not included in the production function. In other words this finding suggests that credit does not lead to an intensification in production by means of purchased inputs (new technology) such as improved seed, fertiliser and crop protection chemicals. This result was reconfirmed by a comparetive discriptive analysis (Yazdani 1991) which indicated that there was no significant difference between borrowers and non-borrowers in terms of input use per unit of land. These findings run counter to what had been expected from the proposition that credit is necessary to finance the uptake of new technology. On the other hand the same analysis revealed that borrowers do achieve higher levels of output per holding than non-borrowers. The explanation for these apparently contradictory findings in that land is not a limiting resource in Iran. Rather than farmers taking up credit as a means of financing more intensive production from a limited land base it appears that they use credit to fund increased use of the same mix of inputs which they employ on a larger area of land. Analysis of the area of land farmed revealed that this was significantly different between the borrower and non-borrower groups and that borrowers farmed a higher proportion of the land they owned than non-borrowers did.

References

Adams, D.W and D.H. Graham. (1981). "A Critique of Traditional Agricultural Credit Projects and Policies". *Journal of Development Economics*, 8(3) : 347-366.

Agarwal, N.L. and Kumawat, R.K. (1974). "Green Revolution and Capital and Credit Requirements of the Farmers in Semi-arid Region of Rajasthan (India). *Indian Journal of Agricultural Economics*, XXX(4) : 67-74.

Baker C.B. and Bhargava V.K. (1983). "Financing Small- Farm Development in India", pp. 117-125 in *Rural Financial Markets in Developing Countries*, edited by Von Pischke, J.D., Adams, D.W. and Donald, G., The Johns Hopkins University Press, Baltimore, 441 pp.

Brown M. (1966). *On the Theory and Measurement of Technological Change*. Cambridge University Press, Cambridge, 214 pp.

Colyer, R.W., and Jimenez, G. (1971). "Supervised Credit as a Toll in Agricultural Development". *American Journal of Agricultural Economics*. 53(4) : 639-642.

Heathfield, D.F. and Wibe, S. (1987). *An Introduction to Cost and Production Functions*. Macmillan Education, 193 pp.

Hebden, J. (1983). *Application of Econometrics*. Philip Allan Publishers Limited, Oxford, 304 pp.

Johnson, W.F.(1971). "Agricultural Credit in South East Asia. Development Digest. *Agency for International Development*, 9(2) : 55-60.

Johnston, J. (1984). *Econometrics Methods*. 3rd ed. McGraw Hill, New York, 568 pp.

Kennedy, C. and A. P. Thirwall (1972), "Survey in Applied Economics: Technical Progress". *The Economic Journal*, 82(325) : 11-74.

Khan, R.A.R. (1987). "Institutional Agricultural Credit and its Role on Rural Development in Pakistan". *Journal of Rural Development and Administration*, 19(1) : 19-26.

Koutsoyiannis, A. (1977). *Theory of Econometrics*. 2nd ed., The Macmillan Press, London, 681 pp.

Owasu Acheampong, J.H. (1986). "Rural Credit and Rural Development in Ghana", pp. 90-104 in *Rural Development in Ghana* edited by Brown, C. K. Ghana University Press, 325 pp.

Rao, C.H.H. (1971) "Uncertainty, Entrepreneurship and Sharecropping in India". *Journal of Political Economics*,79(3): 578-95.

Rask, N. (1971). "The Impact of Selective Credit and Price policies on the Use of New Inputs". *Development Digest*, 9(2) : 49-54.

Schluter, M. G. G. (1974). *The Interaction of Credit and Uncertainty in Determining Resource Allocation and Income on Small Farms, Surat District, India*. Occasional Paper No. 68, Cornell University, New York,76 pp.

Scobie, G. M. and Franklin, D.L. (1977). "The Impact of Supervised Credit Programmes on Technological Change in Developing Agriculture". *The Australian Journal of Agricultural Economics*, 21(1):1-13.

Singh, S.K. and Ramanna, R. (1981). "The Role of Credit and Technology in Increasing Income and Employment on Small and Large farms in Western Region of Hydarabad District, Andhra Pradesh, India". *Indian Journal of Agricultural Econometrics*, 36(3):41-51.

Thirlwall, A.P. (1986). *Growth and Development: with special reference to developing countries*. 3rd ed., Macmillan, London, 409 pp.

Upton, M. (1979). "The Unproductive Production Function". *Journal of Agricultural Economics*, 30(2):179-191.

Upton, M.(1987). *African Farm Management*. Cambridge University Press, Cambridge, 190 pp.

Von Pischke, J.D. and Adams D.W. (1980). "Fungibility and the Design and Evaluation of Agricultural Credit Projects". *American Journal of Agricultural Economics*, 62(4):719-726.

Yazdani, S. (1991). *An Evaluation of Agricultural Credit in the Islamic Republic of Iran*. Unpublished PhD thesis, Wye College (University of London).

Abstract

Agriculture is a potential engine for growth in many developing countries, however growth in agricultural productivity in Iran has been insufficient to meet the country's needs for food in the face of rapid population growth. A notable feature of Iranian agricultural is the predominance of small holdings and therefore improving small farmers productivity has been identified as an important objective of economic policy.

It is argued that many forms of the new technology such as machinery and irrigation which are seen as a means of increasing productivity, demand high capital formation which cannot be met from the farmers' own funds. This is especially so for small farmers as pre-adoption incomes are barely sufficient to provide the minimum necessities of life let alone accumulate significant savings.

The provision of adequate and timely credit has been a focus for attention in this connection and yet there has been little empirical research to confirm whether the credit which has been provided has improved agricultural productivity or not. The purpose of this paper is to examine the contribution of agricultural credit to the development of Iran's agriculture by examining its contribution towards improving productivity and efficiency in resource use.

Production function analysis was applied in an attempt to determine whether the use of credit is associated with differences in production methods. A translog functional form was selected as an appropriate model for this analysis. The analysis indicated a shift in the production function of borrowers, compared to non-borrowers, which was neutral in character and provided only limited support for the proposition that credit availability is associated with the adoption of new technology (i.e. increased use of modern inputs such as improved seeds, fertiliser and sprays).