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Agricultural Productivity and Credit Use of Small Farmers in Jamaica

ABSTRACT

This paper examines agricultural productivity and credit use. Survey results and production function analyses indicate over-utilisation of labour, little formal credit activity, off-farm earnings as an important source of farm liquidity, and widespread savings activity.

INTRODUCTION

This paper examines agricultural productivity and credit use among small farmers in Jamaica. The productivity of the small farmers in Jamaica is an important issue since this group is believed to provide most foodstuffs for the domestic market. Government policymakers and other researchers commonly see the problem of increased food production from this group not as one of low productivity, but of

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structural constraints which restrict the rate of growth of agricultural production. In line with this, past government policies have been designed to generate structural change and reduce constraints faced by farmers. However, their efforts have met with little success [Jefferson 19; Stone 28; Pollard 24]. Further, those government investments that might have enhanced small farm productivity have either not been undertaken or, if partially enacted, have only benefited a very small percentage of the farming community and an even smaller percentage of output [Pollard 24]. An example of this type of policy initiative is the Crop Lien Credit Programme for small farmers undertaken by the People's National Party (PNP) government in late 1977. Approximately one-third of the farmers received loans, but apparently only 5 per cent of production was affected [Pollard 24]. The issue to be addressed here is whether capital (in the form of credit) was a constraint to these farms and if additional credit would generate further increases in output.

Investigation of agricultural productivity will be undertaken using farm household data from two traditional small farmer regions within Jamaica. Cobb-Douglas production functions are estimated for each region and the marginal products of labour and capital are derived. From these derivations small farm productivity is inferred. The derived marginal products will also be used to analyze the appropriateness of extending credit as a means to stimulate domestic food production.

CONCEPTUAL MODEL

The following model is used to examine agricultural productivity and credit use.[1] Under profit maximization and assuming a twice differentiable production function, the derived demand for the ith input used in production is given by $P_i = Pf_i$ (where P_i equals the input price of i, P is the product price and f_i is the marginal product of the ith input).

This demand curve can be traced by varying P_i holding P and f_i constant. The value of the marginal product (Pf_i) indicates the return to the farmer from the use of any input given that input's price. When the marginal value product is greater (less) than the input price, then it pays the farmer to use more (less) of that input. Knowledge of prevailing input prices and marginal products of inputs then allows one to determine how much can be gained by increasing the use of inputs.

In many less developed countries (LDCs) it is believed that the productivity of additional input use would generate promising rates of return if only farmers could obtain financing (credit). However, several studies have shown that on the one hand, low farm productivity limits the effective use of increased credit as a means of increasing output [Schultz 26; Barker 4; von Pischke 29]. On the other hand, the transaction costs of obtaining credit from formal lenders can discourage credit use among small farmers [Adams and Nehman 2]. Hence, farmers may be forced to use alternative means of financing hired inputs such as labour-sharing agreements, off-farm employment and borrowing from informal sources.

Moreover, many farmers contribute their own inputs such as labour, land and accumulated savings to the farm operations. Taking this into account, the amount of inputs to be financed is then equal to the excess demand for any input (the total demanded at a given input price minus the farmer's own contribution). Given a downward sloping demand curve for an input there then exists an inverse relationship between the input price and the quantity of credit demanded.

METHODOLOGY AND DATA

The methodology to be used is as follows: First, descriptive analysis is undertaken on credit use, off-farm employment and savings activities within the regions in question. Second, a Cobb-Douglas production function of the form presented below is estimated for each region:

$$\ell nY = \ell nA + a_1 \ell nLAB + a_2 \ell nCAP + a_3 \ell nLAND + E \quad (1)$$

where: Y is output, LAB is labour in man days, CAP is capital in dollar value terms, LAND is acres cultivated, E is an error term.

Equation 1 is estimated using the ordinary least squares (OLS) regression technique. This will yield unbiased estimates of a_1, a_2, and a_3. Simultaneous equation bias is avoided if one makes the assumption that farmers make input decisions based on anticipated output and not actual output [Hoch 17]. This assumption is valid for agriculture due to the conditions of uncertainty (weather variability, insect damage, etc.) the farmer faces in trying to achieve the expected output from a given level of input use. The marginal products to be derived are:

for capital: $MP_{CAP} = \hat{a}_2 \times Y/CAP$ and

for Labour: $MP_{LAB} = \hat{a}_1 \times Y/LAB$ (where $\hat{a}_1$ is the estimate of $\hat{a}_1$ and $\hat{a}_2$ is the estimate of $\hat{a}_2$ from equation 1).

Data

The data used in this study were collected from a survey of 121 farm-households in the southern region of the parish of St. Elizabeth and 215 farm households in the northern region of St. Catherine. The data are for the production period January 1979–August 1979.

Variables

Farm output (Y) is measured in Jamaican dollars (i.e., gross crop revenue received by the farmer for his crops). Livestock farm revenue is excluded and those farms that ob-

tained at least half of their income from livestock enterprises were dropped from the production analysis.

Labour (LAB) use is measured in man-days and is composed of hired labour, actual days worked by head of households and the estimated family contribution to farm work. One man-day is equivalent to an 8-hour work day by a male between the ages of 18 to 60. Field experience and other studies that have estimated family labour contribution [Shih 27; Ytopolus 31; Rao 25; Pollard 24; Nehman 23] were used to derive family man-days that have estimated family labour contribution. The method assumed there were 150 man-days available in the production period. A male, 18-60, would work 1/4 the time and a woman 18-60 (given a strength differential) was 0.8 equivalent of a man or worked 1/5 the time. Children 12-17 were in school and only contributed the equivalent of 0.25 man-days; and people over 60 contributed 0.6 (males) and 0.5 (female) man-days for one-fourth of the production period.

Capital (CAP) is defined as the expenditure on current operating expenses – fertilizer, farm machinery rented, fuel, chemicals (insecticides and weedicides) and seeds.

Land (LAND) is the amount of land cultivated from which a crop was either harvested or lost between January 1, 1979 - September 1979.

DESCRIPTIVE ANALYSIS

Previous work has set forth the descriptive analysis of credit use, off-farm employment, savings and marketing activities of farms in the parishes of St. Elizabeth and St. Catherine [Graham *et. al.* 11]. Those descriptive findings of particular relevance to the issue of small farm productivity and credit use are summarized in Tables 1, 2 and 3. The data come from 215 farms in Northern St. Catherine and 121 farms in Southern St. Elizabeth.[2]

Tables 1 and 2 contain data on input expenses, farm size and land use within the two regions. There is much contrast between the two regions. In Southern St. Elizabeth, (Table 1, Panel B.) 80-90 per cent of the farms use modern inputs – fertilizer and chemicals – while only 20 per cent use farm machinery. This input usage is consistent with the small size and type of domestic food crop farm in St. Elizabeth (Table 2, Panel B.). In Northern St. Catherine there is little use of 'modern inputs' (fertilizer and chemicals) and mechanization is nil (Table 1, Panel A). Heffernan [15] reports that the soil type in this region does not require much fertilizer use. As in St. Elizabeth, the small size and type of holdings in this area (along with the hilly topography) prevents the use of mechanization by many farms (Table 2, Panel A).

The findings on credit, savings and off-farm employment activities in these areas are summarized in Table 3. In the last five years formal credit was used by roughly 20 per cent of the farms in both regions (Table 3, Panel A, row 1). However, if we use the last year for reference only 10 to 11 per cent of the farmers had access to formal credit (Table 3, row 1b). This low formal credit use could be either due to a supply constraint or lack of demand by farmers. In another article in this journal, Heffernan and Pollard concluded that lack of participation in formal credit was due to lender behaviour (the supply side). The argument for a supply constraint is reinforced here by the number of farmers who applied unsuccessfully for formal credit (Table 3, row 2). As a result, many farmers have turned to informal sources of financing such as credit from neighbours or relatives and earnings from off-farm employment. These other sources of funds appear to substitute in part or in full for the shortage of formal credit since they are a cheaper or more accessible alternative.

The findings pertaining to farmers denied formal credit or who had both formal and informal credit also support this.

TABLE 1: TYPES OF INPUT EXPENSES AND SELECTED MEASURES OF DISTRIBUTION

Panel A. St. Catherine

Farm Expense	Number Incurring Expense (1)	Per cent Incurring Expense (2)	Mean (3)	Std. Dev. (4)	Minimum Value (5)	Maximum Value (6)	Coefficient of Variation (7)
Farm Machinery (hired)	3	1.4	$46.67	20.14	$30	$ 75	.43
Transport (hired)	34	15.8	89.50	131.34	2	431	1.46
Fertilizer	50	23.2	72.96	71.32	2	329	.98
Chemicals	38	17.7	57.16	61.95	2	300	1.08
Seeds	92	42.8	31.12	48.20	1	241	1.55
Power	18	8.4	129.78	226.95	8	1000	1.75

Panel B. St. Elizabeth

Farm Expense	Number Incurring Expense (1)	Per cent Incurring Expense (2)	Mean (3)	Std. Dev. (4)	Minimum Value (5)	Maximum Value (6)	Coefficient of Variation (7)
Farm Machinery	25	20.7	$57.46	69.21	$ 20	$320	1.20
Transport	54	44.6	55.89	98.12	1	660	1.76
Fertilizer	111	91.7	165.31	243.07	13.5	1350	1.47
Chemicals	98	81.0	99.99	243.56	4.5	2000	2.44
Seeds	79	65.3	28.20	42.12	1	200	1.49
Power	22	18.2	18.52	23.65	1	96	1.28

Source: Pollard [24]; and Heffernan [15].

TABLE 2: ACRES IN PRODUCTION, OWNED, OR AVAILABLE AND SELECTED MEASURES OF DISTRIBUTION

Panel A. St. Catherine

	Mean (1)	Std. Dev. (2)	Minimum Value (3)	Maximum Value (4)	Coefficient of Variation (5)
Acres in Production[1]	3.16	3.47	.10	21.5	1.10
Acres Owned[2]	2.87	3.70	0.00	16	1.29
Acres Available[3]	4.35	3.99	.10	21.5	.92

Panel B. St. Elizabeth

	Mean (1)	Std. Dev. (2)	Minimum Value (3)	Maximum Value (4)	Coefficient of Variation (5)
Acres in Production[1]	1.7	2.25	0.1	13.3	1.33
Acres Owned[2]	4.7	7.0	0.0	54.0	1.49
Acres Available[3]	6.3	7.7	0.5	54.0	1.22

[1]Only acres cultivated by the farmers.

[2]Only acres owned by the farm whether acreage used in production or not.

[3]Includes acres owned and rented by the farm whether the acres are used in production or not.

Source: Same as for Table 1.

Farmers denied formal loans applied, on average, for loans larger than those granted by the PC banks or Crop Lien Programme (Table 3, Panel B, Rows 2, 3, 4). Furthermore, many farmers have loans from both formal and informal sources. This suggests that the formal market alone does not meet the existing credit demand [Pollard 24; Heffernan 15]. The fact that many small farmers engage in off-farm employment (Table 3, panel A, lines 4 and 5) and use these earnings to help cover farm expenses highlights the importance of this source of funds in relaxing the liquidity constraint growing out of a shortage of formal credit.

Formal savings is also an important activity for small farmers. This activity is undertaken by approximately one-third of the farmers in both regions. The vast majority of these farmers save with a commercial bank. However, in both regions, commercial banks make almost no loans to this class of borrowers. Given the high risks and costs of servicing small farmers with credit, commercial banks only draw savings from this group, transferring the funds out of these regions for urban loans. The government, at the same time, draws on general tax funds to support loan programmes in rural areas on the false assumption that there is no way to mobilize local savings for loans. The problem here is not the alleged limited local savings potential, but rather the low productivity and low economic rate of return (and high risk) to farming in these areas. This will be dealt with in the following sections.

EMPIRICAL RESULTS

The results of the estimated Cobb-Douglas production function specified in Equation 1 are given in Table 4. As suggested by Wallace [30] one should test either for the significance of the individual coefficients by a "t" test or the significance of the regression by an F-test. This is because the two tests are not independent. Here, we test for the significance of the regression. The regressions are significant at the 1 per cent level and the hypotheses that all regression coef-

TABLE 3: SUMMARY OF CREDIT, OFF-FARM EMPLOYMENT AND SAVINGS ACTIVITY IN SURVEY AREAS IN ST. CATHERINE AND ST. ELIZABETH

Panel A. Number and Per cent of Farms with Selected Activities

Activity	St. Catherine		St. Elizabeth	
	No. of Farms	Per cent of Sample[1]	No. of Farms	Per cent of Sample[1]
1. Number of Farms with:				
(a) Formal Credit in Last 5 Years	49	(22.8)	24	(19.8)
(b) Formal Credit in 1978-79	23	(10.7)	12	(9.9)
2. Number of Farms Who Applied Unsuccessfully for Formal Credit	29	(13.5)	15	(12.4)
3. Number with Informal Credit[2]	95	(44.1)	38	(31.4)
4. Number of Farms with Off-Farm Work	69	(32.1)	67	(55.4)
5. Number of Farms with Off-Farm Earnings Used for Farm Expenses	47	(68.1)	49	(73.1)
6. Number of Farms with Savings Accounts	70	(32.5)	47	(38.8)

Panel B. Dollar Values of Selected Activities (J$)

	St. Catherine	St. Elizabeth
1. Average Size of Formal Loan	$705	$2733
2. Average Size of PC Loan	547	518
3. Average Size of Crop Lien Loan	321	716
4. Average Size of Formal Loan Applied for Unsuccessfully	927	1500
5. Average Size of Informal Loan[2]	98	253

[1]Sample size is 215 farms for St. Catherine and 121 farms for St. Elizabeth.

[2]Informal credit refers only to credit from friends/relatives and partners groups.

Source: Pollard, 1980; Heffernan, 1981; various Tables.

TABLE 4: ESTIMATES OF THE COBB-DOUGLAS PRODUCTION FUNCTION FOR ST. CATHERINE AND ST. ELIZABETH

	St. Catherine	St. Elizabeth
lnA	2.31	4.269
	(1.35)1	(0.761)
lnCAP	0.165	0.125
	(0.083)	(0.075)
lnLAND	0.546	0.550
	(0.136)	(0.116)
lnLAB	0.446	0.182
	(0.269)	(0.134)
R^2	0.2511*	0.2822*
F-Static	11.18	15.332

*Significant at .01 level.

[1]Number in parenthesis is the standard error.

ficients are equal to zero is rejected for both regions. The marginal products for capital and labour are given by:[3]

$$MP^{SL}_{CAP} = 0.125 \times \hat{Y}/CAP \quad (2)$$

$$MP^{SC}_{CAP} = 0.165 \times \hat{Y}/CAP \quad (3)$$

For labour:

$$MP^{SL}_{LAB} = 0.182 \times \hat{Y}/LAB \quad (4)$$

$$MP^{SC}_{LAB} = 0.446 \times \hat{Y}/LAB \quad (5)$$

where $\hat{Y}$ is the predicted value of output given specified levels of capital and labour.

Equations (2)–(5) are used to derive the value of the marginal products at the geometric means of capital and labour. These derivations are given in Table 5 for both regions. The marginal products for both regions imply that there is little payoff to the farm in utilizing additional inputs of capital and labour. True, there does appear to be some

TABLE 5: MARGINAL PRODUCTS OF CAPITAL AND LABOUR DERIVED FROM THE COBB-DOUGLAS PRODUCTION FUNCTION

Region	Marginal Product of Capital ($/$)	Marginal Product of Labour ($/man-day)	Geometric Mean of Capital ($)	Geometric Mean of Labour (Man-days)
St. Catherine	1.66	0.67	$26.6	179
St. Elizabeth	0.34	0.26	$12.3	230

return to using more capital in the St. Catherine region. However, if this is so, one wonders why more farmers don't report higher levels of capital use. One answer is that the soil type of St. Catherine requires little fertilizer use. Further, the marginal products of labour suggest that farmers overutilize labour in both regions.

Optimal capital use also depends on the prevailing cost of capital. That is, a dollar of capital input must not only return a dollar, but all costs of acquiring it as well. Using the interest rate set for small farmer loans from government sources (6%) the price of capital then becomes $1.06. Even assuming no transaction cost of obtaining a loan beyond the interest rate and a 30 per cent rate of inflation, the real cost of capital is $0.76. The optimal level of capital use is then $50 for St. Elizabeth and $68 for St. Catherine, which is low as expected from the marginal products.

Given the results of the marginal product of using capital, credit demand and credit needs are low among these farmers. For farmers with no savings the demand for production credit ranges from $50 to $68 per acre of cultivated land. For farmers with savings, and/or their own supply of inputs (i.e. labour) the demand for credit would be less since the demand for credit is defined as the excess demand for an input. Finally, the marginal products derived define a downward sloping demand curve for labour and for capital. From this it can be inferred that there exists an inverse relationship between the cost of capital and the demand for external financing.

CONCLUSIONS

The following conclusions are drawn from the descriptive analysis of the economic activities of small farms in Southern St. Elizabeth and Northern St. Catherine.

First, there is little recent formal credit activity. Despite the increase in the supply of formal credit from 1975 onwards through expansion of the SSFDP loan programme and later the launching of the Crop Lien Programme, small farmer access to formal credit channels was still clearly limited. Second, informal credit is more widespread among these farmers than formal credit. Third, many small farmers use off-farm earnings (as well as informal credit) as a means to enhance their liquidity position. Fourth, these farmers engage much more in savings activity (in commercial banks) than they do in formal credit activity. They have savings that could be mobilized in larger volumes, if given appropriate incentives such as positive real rates of interest on their deposits. Currently, these savings are placed in local commercial banks at negative real rates of interest.

Empirical results of the production function analysis indicate the following: First, the marginal products of labour reveal that labour is overutilized in both regions. Second, the

demand for credit was shown to exist for the average farmer with no savings and no transactions costs of borrowing credit. The credit demand curve for this hypothetical farmer, derived from the marginal product of capital, was downward sloping, as expected. However, this finding of the existence of a need for credit must be viewed with caution given the low numerical values of the marginal product of capital.

The farmers in this study appear to be in a state of long run traditional equilibrium as described by Schultz [26]. This conclusion is supported by the findings of the descriptive and empirical analyses. That is, these farmers, being rational decision makers, are aware of the low return from additional use of capital and therefore seek the lowest cost means of financing their farm operations. These low cost sources of funds are off-farm earnings and informal credit, not formal credit.

The implications of these conclusions are that extending credit to small farmers is neither a sufficient nor necessary condition to increase farm productivity, and that credit is not an optimal policy for society. Why then has the government undertaken investments in farm credit programmes? One reason may be that it has long been thought by many researchers, in the development field, that capital is the major constraint to increases in not only agricultural growth, but national economic growth as well. Hence, extending credit to farmers removes the capital constraint. However, Jamaican farmers do not appear to be facing a capital constraint, which is contrary to this view. Other studies have supported the finding that capital is not a major constraint to farmers [Von Pischke 29]. Another reason may be that credit is used as a means to re-enforce a system of political patronage. That is, government credit programmes are a means to distribute benefits to party members and constituents in rural areas. The result of this type of government programme is that only

a few farmers are allowed to participate, which leads to a worsening of equity within the agricultural sector.

What then needs to be considered are those government policies and investments that are necessary and sufficient conditions to increase farm productivity and improve equity. Examples of such policies and investments include: less penalizing pricing policies for farmers, a devaluation of the exchange rate, development and adoption of high yielding crop varieties, better marketing infrastructure, improvement of irrigation facilities and provision of extension services to the farmers on better land use and proper application of fertilizer and chemicals. It would appear that public funds for these projects are available when one sees how much money has been channelled into various credit programmes. What is needed is a more careful analysis of the social cost and social benefits to be desired from using these public funds in alternative uses. Improvements in the economic rate of return of farming and equity in the agricultural sector cannot be accomplished through credit programmes.

FOOTNOTES

[1] A fuller treatment of the development of the model is found in Miller, *et. al.* [21].

[2] See Graham *et. al.* [11] for a description of how these data were collected.

[3] SL is used for St. Elizabeth and SC is used for St. Catherine.

[4] The low marginal products may also be due to an under-reporting of farm income. Adjusting the farm income of the sample farms in both regions by the Ministry of Agriculture's yields and prices did not significantly change the marginal products reported. See also Pollard [24].

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