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A Linear Programming Analysis of the Regulatory Response of Rural Banks in the Philippines

Donald W. Larson, Severino B. Vergara, and Warren F. Lee

Abstract

The Philippine government through the Central Bank has tried to influence the rural banks' allocation of funds in favor of small farmer loans through changes in regulatory policy. A linear programming model was developed to evaluate changes in the small farm loan portfolio resulting from selected regulatory changes. Results indicate that neither seed funds to support supervised credit programs nor preferential interest rates on rediscounted funds for agricultural loans increase the flow of credit to small farmers. Such policies increase bank profits, discourage banks from mobilizing local deposits, and increase their dependence on Central Bank rediscount funds.

Key words: Philippines, small-farmer credit, rural banks, linear programming.

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An increase in the supply of institutional credit to the agricultural sector, particularly the food sector which is dominated by the small farmers, has been one of the policy objectives of the Philippine government to achieve increased agricultural productivity and more equitable income distribution during the last two and a half decades. The most well known of these programs is the Masagana 99 (M99) program launched in 1973 to achieve self-sufficiency in rice production. M99 integrated under one umbrella low cost production credit as a vehicle for income transfers to small rice farmers, a fertilizer subsidy, price support, technical assistance, and other agricultural support services (Esguerra). In addition, the government, through the Central Bank (CB), initiated the development of the rural banking system. The CB provided tremendous technical and financial support to ensure the viability and success of the rural banks. At the same time, it has tried to influence the rural banks' allocation of funds in favor of small farmer loans through changes in the regulatory policies. No previous study has been conducted to analyze the effects of those policies on the allocative behavior of banks.

The objectives of the present study are: (a) to determine the profit-maximizing level of small farm loans of a representative rural bank, given the available alternative assets, internal operating constraints, regulatory policies of the CB, and other external constraints, and (b) to evaluate the changes in the small farm loan portfolio of a representative rural bank resulting from changes in selected regulatory policies.

The Analytical Approach of the Study

Linear programming (LP) is the analytical approach employed to achieve the objectives of this study. The assumption of profit maximization for the bank and the linearity of all the constraints facing the bank suggest the suitability of the LP technique for the present study. A multiperiod model is used to avoid suboptimal decisions which might result from a myopic view that ignores the relevant aspects of the future. The bank is assumed to have a one-year planning horizon that is partitioned into 12 monthly planning periods. The choice of the monthly planning periods was dictated in large part by the fact that rural banks are required by the CB to submit monthly financial statements used to determine compliance with the regulatory constraints imposed on them. These constraints are discussed in the next section of this paper.

The general form of the LP model estimated in this study is:

$$\text{Maximize } \pi = \sum_{t=1}^{12} \left(\sum_i r_i A_{it} + \sum_j C_j L_{jt} + FC_t \right)$$

$$\text{subject to: } R_{kt} (A_{it} - L_{jt}) \leq \beta_{kt}$$

where π = expected net profit during the planning horizon.

r_i = expected net return on asset i.

C_j = expected cost of liability j.

A_{it}, L_{jt} = average stock of asset i and liability j, respectively, during period t.

R_{kt} = coefficient matrix for individual asset and liability accounts associated with constraints K at time t. (K = 1, ...n; n = number of constraints).

β_{kt} = vector of stipulations associated with constraints k at time t.

FC_t = fixed costs at time t.

As formulated above, the objective function used is the maximization of the monthly flows of net profit or income. This is equivalent to the maximization of the return on stockholders' equity (ROE) at the start of the planning period since it is assumed that there is no capital expansion through the sale of new shares of stock; i.e., reinvestment of profits is the only source of additional capital in the model.

The model is not meant to accurately describe the detailed behavior of the banks; nor is it intended to generate results needed in the day-to-day decision making of the bank managers. Rather, it is an analysis of the effects of changes in specific regulations on the balance sheet choices of the banks. This study attempts to simulate the actions of a bank manager who does not use sophisticated models for choosing the portfolio. Thus, it seems reasonable that a model including only the kind of knowledge and expectations a manager might have would be preferred over more complicated models.

While profit maximization is the goal assumed in this study, it does not mean that it is the only goal pursued by the firm. Bank firms in fact, are assumed to have other goals but with profit maximization as the dominant goal. In a sense, the other goals act as constraints to profit maximization. A liquidity goal and the maintenance of a certain-level-of-risk goal are just some of the other legitimate goals of the bank. This recognition of multiple goals for the banking firm has led some researchers to suggest a goal or lexicographic programming approach to study bank behavior (Keown). The difficulty with this approach is that it requires specification of the priority-weighting structure among the different goals identified in the model, a task which could very well form a separate study in itself.

As Cohen and Hammer report, there are alternative choices for consideration in the specification of the objective function to use in a bank behavior model: (a) maximize the value of the stockholder's equity during the final period of the planning horizon; (b) maximize the present value of the net income stream plus realized capital gains (and losses) during the planning horizon; and (c) maximize the present value of the

net income stream plus realized capital gains (and losses) during the planning horizon plus the present value of the stockholders' equity during the final period of the planning horizon. Obviously, these choices are more appropriate for banks whose capital stocks are being traded in the stock market, as in the case of large commercial banks. This is not the case, however, for rural banks in the Philippines. These banks are closely held corporations and although the sale of new stocks and stock transfers is allowed, these transactions are regulated by the CB. In practice, a majority of the stock transfers and new stock sales are transacted among the existing stockholders and their familiies.

In contrast to the above specifications of the objective function which are in terms of present value, the objective function for the rural banks in our model is in terms of current values. For a one-year planning horizon the differences between discounted and nondiscounted values would be slight, so that the use of nondiscounted values may slightly overstate profits. Except for medium and long-term loans which account for a very small share of Philippine rural bank loan portfolios, all the asset activities in the model have maturities of less than one year. Also, interest income is assumed to be deducted in advance for all loans. Hence, the problem introduced by not using present value originates mainly from the differences in the monthly repayment flows among the loan variables.

The Constraints in the LP Model

The profit-maximizing goal of the bank is restricted by three categories of constraints: those imposed on it by the regulatory authorities, the *regulatory constraints;* those that are related to the market, the *market constraint;* and a *funds-availability constraint* used merely to specify that total uses of funds equal total funds available.

Regulatory Constraint[1]

Reserve requirement. The required reserve is 14 percent for demand deposits and eight percent for time and savings deposits. At least 10 percent of the total required reserves must be in the form of cash deposited with the CB. The balance of the required reserves may be held in the form of vault cash and/or CB-supported securities. However, holding securities eligible as reserves cannot exceed 18 percent of the total required reserves (or 20 percent of the maximum 90 percent allowable reserves held in the form of CB-supported securities and/or vault cash).

Risk-to-asset ratio. By regulation, a rural bank must maintain a risk-to-asset ratio of not less than 10 percent. This ratio is computed by dividing total assets less risk-free assets by capital funds. Risk-free assets include cash on hand and due from banks, CB-supported securities, loans secured by deposits, bank premises, furniture, fixtures and equipment, and supervised credit loans covered by guarantee.

Operating capital ratio. The bank's operating capital (cash on hand plus the amounts due from the CB and from other banks) must be less than or equal to 40 percent of total deposit liabilities (exclusive of special deposits). This requires that the bank reduce its own liquid assets to this level before borrowing from the CB.

Past-due loan ratio. The ratio of past-due loans to the total loans outstanding of the bank cannot exceed 25 percent if the bank is to avail itself of the special rediscounting privilege with the CB as well as other privileges. Excluded from past-due computation are loans covered by guarantee and M-99 loans in litigation (since M-99 loans are most likely to be covered by guarantee, guaranteed loans must be excluded to avoid double counting.)

Rediscounting constraints. There are two separate ceilings on the amount of loans that rural banks can rediscount with the CB. The ceiling depends on whether or not the loans are supervised. For supervised loans, the rediscounting limit is 400 percent of net worth plus 100 percent of monthly average savings and time deposits (STD) during the three months immediately preceding the date of rediscount application. The corresponding figures for nonsupervised loans are 200 percent of net worth plus 50 percent of monthly average STD. All of the outstanding balances of supervised loans can be rediscounted with the CB, but only 80 percent of nonsupervised loans can be discounted. Only loans with original maturities of less than one year are rediscountable.

[1]The bank-premises ratio and the furniture, fixture, and equipment ratio were not included in the model but are a part of the total assets. It was assumed that there will be no purchase and sale of these assets during the programming period.

Market Constraints

Loans. In the context of rural financial markets in the Philippines, interest rate ceilings on loans are set by the CB and typically these rates have been less than the annual rate of inflation. The low, even negative, real rates of interest on these loans lead to an excess loan demand from potential borrowers and credit rationing by lenders (Adams). Regulators attempt to influence rural bank lending by changing the spread between the fixed lending rate and the bank's cost of funds. In the model it is assumed that the bank will not lend more than is forecast in any loan category during any period. This implies that there is no incentive for banks to compete for loans in general. However, for certain loans, specifically those with low default risks, some degree of competition may be present depending on the structure of the market. Therefore, the forecast should be linked to a certain level of loan risk. Beyond this forecast, the bank is restricted by risk considerations from further lending, and hence, will simply say "no" to particular loan requests. There is a real need to specify the market limits on the loans in the model. Since it is likely that net rates of return among types of loans would differ, the model operates such that, ceteris paribus, all the available funds will be channeled into loans offering the highest return. Loan demand forecasts were based on the amounts granted by the bank in the previous year with a 20 percent upward adjustment for the expected rate of inflation and additional increases in real loan demand.

Investments. Except for equity investments, there are no market constraints on the amount of new investments a bank can make during each period. It is assumed that the supply of government securities and money market instruments is infinitely elastic. Equity investments are regulated very strictly by the CB and for our purposes they can be assumed to be zero. Of course, the reduction or sale of investment assets is constrained by the initial amount available.

Deposit variables. As in the case of loans the increase in deposit variables is limited to the forecast levels during the period. The variables are measured in terms of net monthly balance so there is no need to include another set of variables to represent withdrawals, new accounts, interest credits, and so forth, in the model. Intertemporal relationships are of prime importance in a multiperiod model since they express the interdependence of variables over time. This is particularly true with respect to the maturity of the accounts, and hence, the associated liquidity flows. In addition to maturity flows, an autonomous flow variable is associated with each account at each time period. When the flow is positive, the account is accumulating; when the flow is negative, the account is being depleted. Asset and liability flows are assumed to take place at constant rates during the period. Under this assumption, purchases, sales, and maturations of assets are presumed to occur at constant rates during the period and hence the rate of change in the stocks of the balance sheet accounts themselves will be constant over time. The advantage of this assumption is that the average stock of an account during a period can be defined simply as the arithmetic mean of the initial balance and the end-of-period balance.

Default risks on each loan are assumed to be independent, and default risks across types of loans are also assumed independent. Although this assumption may be somewhat implausible for borrowers in the same industry, it is necessary for the independence of coefficients and constraints in the model. Default risk on the bank's investment portfolio, primarily national government bonds and Central Bank Certificates of Indebtedness, is assumed to be zero.

Determination and Selection of Sample Banks

This study was limited to banks operating in the Central Luzon region of the Philippines. A large proportion of the small farmers in the country are located in this region, and it has been a hotbed of social and political unrest in the country. The economic plight of the

small farmers in this region has consistently been accorded top priority in the government's agricultural development programs. Since the analytical thrust of the study is the identification of changes in CB policies needed to influence rural bank credit allocation in favor of the small farmers, the choice of this region as the study area is logical.

A random sample of 15 rural banks was included in the study. This constitutes over 10 percent of the rural bank population in the region (exclusive of those banks less than three-years old). After distributing the number of banks to be sampled among the six provinces in the region, in proportion to the number of rural banks operating for more than three years, the CB Agricultural Credit Supervisors (ACS) were instructed to select randomly the banks to be included in the sample. Because of the confidentiality of bank information, the selection of sample banks had to be done by the ACS assigned to the region; however, the sample selection was carefully designed and personally supervised by the researcher. One condition made in the sample selection was that the selected banks should have assets of no more than P30 million nor less than P4 million to prevent extremely small and large banks from introducing significant bias in the sample.[2] Data needed for the LP model were gathered through the use of a structured and pretested questionnaire.

In terms of total assets, the average size of the 15 sample banks covered in the study was P10,404,207 as of October 31, 1979 (table 1). The size varies from P4,194,084 to P22,108,270 with a standard deviation of P4,861,233. The banks are distributed with eight banks above the average, seven below it, and 10 of the 15 are within one standard deviation of the mean. The average sample bank has 84 percent of its total assets in loans, 89 percent of which are agricultural. Deposit liabilities constitute 38 percent of the total liabilities (including capital) of the average sample bank. Borrowings from the CB account for 36 percent of the total liabilities, almost 89 percent of which is in the form of rediscounting. The total capital accounts of the average sample bank is P1,171,787, about 11 percent of total assets. The total capital account for 11 of the 15 banks is within one standard deviation of the mean. More than 45 percent of the capital is in common stocks and almost 52 percent is in undivided profits and surplus accounts. Preferred stocks account for the balance.

Table 2 shows the expected net returns on assets and the total cost of liabilities of the sample rural banks, including the estimated administrative costs of different classes of assets and liabilities and the risk of default losses of different classes of assets. Small supervised agricultural loans (SSL) have administrative costs of 1.56 percent, followed closely by small ordinary agricultural loans (SOL), 1.54 percent. Large supervised (LSL) and large ordinary agricultural loans (LOAL) involve much lower administrative costs, 0.98 percent and 0.96 percent, respectively. Medium- and long-term agricultural loans (MLL) have the highest estimated default risk, 4.3 percent, followed by SSL at 3.3 percent. The default risk associated with each type of loan was based on the bank management's estimate of default, the type of security required on loans, and an analysis of past-due loans by type for each bank.

Results

The LP bank model was solved using the average balance sheet conditions of the sample banks as of October 31, 1979. Three versions of the basic model were also solved to evaluate the impact of changes in the regulatory policies. The first version incorporated a parameterized increase of 50 percent over the original loan demands used in the basic model to deal with the uncertainties associated with the demand forecasts.[3] The second version analyzed the impact of the suspension of special time deposits as a seed fund to support the supervised credit program of the rural banks. The third version examined how equalizing the interest rates on rediscount funds for supervised agricultural loans and ordinary agricultural loans (one percent and three

[2]The exchange rate in October of 1979 was about P9.50 per U.S. dollar.

[3]The loan demand forecasts have been parameterized in such a way that they cover increases of 10 percent, 20 percent, 30 percent, 40 percent, and 50 percent over the original. However, the solution values do not differ much between 10 percent and 40 percent and hence only the results for 50 percent are presented.

Table 1. The Average Balance Sheet Characteristics of the 15 Sample Rural Banks as of October 31, 1979, Central Luzon, the Philippines

Assets	
Cash and Due from Banks:	
Cash on Hand (CH_0)[a]	P 106,424
Due from CB (CC_0)	98,996
Due from other banks (COB_0)	687,534
	892,955
Loans and Discounts	
Small supervised agricultural loans (SSL_0)	2,015,608
Small ordinary agriculture loan (SOL_0)	1,038,108
Large supervised agriculture loan (LSL_0)	2,511,297
Large ordinary agriculture loan ($LOAL_0$)	1,887,502
Medium- and long-term agriculture loan (MLL_0)	370,597
Commercial loan (COM_0)	524,392
Industrial loan (INL_0)	249,107
Other loan (OL_0)	164,933
Less: Allowance for probable losses	(238,455)
Net Loans and Discounts	8,523,090
Investments:	
CB Certificate of Indebtedness	
reserve eligible ($ERES_0$)	56,486
nonreserve eligible ($XRES_0$)	89,527
Preferred stock redemption (PSR_0)	8,110
Agrarian Reform Credits (ARC_0)	35,881
Other Assets:	
Bank premises (BPREM)	156,265
Furniture, fixtures, and equipment (FFE)	79,990
Other bank assets (OBNA)	
Total Assets	P 10,404,207
Liabilities:	
Reserve Deposits:	
Demand deposits (DD_0)	7,748
Savings deposits (SD_0)	2,327,666
Time deposits (TD_0)	1,581,454
Nonreserve Deposits:	
Special time deposits (STD_0)	712,294
Barrio Guarantee Fund (BGF_0)	21,715
Barrio Savings Fund (BSF_0)	78,769
Special Savings Deposits ($SSDC_0$)	95,269
Bills Payable:	
Rediscounting-supervised (RED_0)	2,783,228
Rediscounting-ordinary ($REDO_0$)	570,499
CB-IBRD ($IBRD_0$)	361,832
Other Bills Payable (OBIL)[b]	71,018
Other Liabilities ($OLIAB_0$)	620,921
Capital Accounts (CAP_0)	1,171,787
Total Liabilities[c]	P 10,404,207

Source: Vergara

[a]The subscript of zero (0) indicates that the figure opposite the balance sheet variable serves as the initial value of these variables during the first programming period

[b]Restructured borrowings from the CB

[c]The exchange rate in October of 1979 was about P9.50 per U.S. dollar

percent, respectively) with that on commercial and industrial loans (four percent), affected the allocation of funds among different types of loans. Due to the size and complexity of the model, table 3 contains results only for selected variables pertinent to this study, and only year-end balances or total yearly results are included. Monthly and yearly results were calculated for a total of 65 variables (Vergara).

All the results from the basic model are as expected, given the constraints imposed and the relative returns and costs of the various asset and liability variables. They are also consistent with the profit-maximizing goal of the bank. The results cannot be expected to correspond exactly with the actual balance sheet composition of the rural banks operating under real world conditions; however, the substantive results from the model and their implications are plausible under real world conditions.

A gross profit of P422,220 was obtained from the basic model. Adjusting this for the other operating expenses and other income throughout the 12 programming periods resulted in actual net profit (P) of P213,177 (table 3). This represents the sum of all the

Table 2. The Expected Net Returns on Assets and the Total Costs of Liabilities of the Sample Rural Banks, Central Luzon, the Philippines, November 1979–October 1980

Items[a]	Nominal Return (1)	Service Charge (2)	Administrative Cost[b] (3)	Risk of Default Loss (4)	Net Return[c] (Total Cost) (5)
	Percent per annum				
Assets					
SSL	10.71	2.00	1.56	3.32	7.83
LSL	10.71	2.00	.98	2.85	8.88
SOL	10.71	3.00	1.54	2.38	9.79
LOAL	10.71	3.00	.96	2.79	9.96
MLL	12.50	3.00	1.91	4.36	9.23
COML	10.71	3.00	2.47	3.14	8.10
INL	10.71	3.00	1.52	.68	11.51
OL	10.71	3.00	0.00	.94	12.77
CCB	3.0	0.00	0.00	0.00	3.00
XRES	3.0	0.00	0.00	0.00	3.00
ERES	10.32[d]	0.00	0.00	0.00	10.23
PSR	10.32	0.00	0.00	0.00	10.23
ARC	10.32	0.00	0.00	0.00	10.23
Liabilities					
SD	9.50		1.00		10.50
TD	13.50		.59		14.09
STD	3.00		.25		3.25
BGF	9.50		1.41		10.91
BSF	0.50		.46		9.96
SSDC	0.0		1.27		1.27
REDS	1.0		.35		1.35
REDO	3.0[e]		.99		3.99
IBRD	9.0		.58		9.58
OBIL	0.0		1.53		1.53
OUAB	0.0		.20		.20

Source: Vergara

[a]See table 1 for a definition of the variables.

[b]Only direct costs were included in estimating the administrative costs of the balance sheet items in the model. This includes salaries and compensation expense and litigation and asset acquisition expense. These expenses were allocated in proportion to the time spent by bank personnel on each of the classes of assets and liabilities. Depreciation and overhead costs are treated as fixed costs in the model. The latter affect the size of the loan portfolio but not its composition.

[c]Net return on asset equals (1 + 2) – (3 + 4) and total cost of liability equals 1 + 3.

[d]The computed average rate of return on securities is 9.875 percent per annum. Since the return is tax-exempt and the average bank is at a 4.31 percent tax bracket, the before-tax return equals 10.34 percent.

[e]The rediscount interest rate on commercial and industrial papers is four percent per year.

Table 3. Optimal Solution Values of the Structural Variables in the Basic Rural Bank LP Model and Three Alternative Versions, Central Luzon, Philippines, 1980

Variables[a]	Base Model		Version No. 1: A 50% Increase in Loan Demand		Version No. 2: Elimination of Special Time Deposit Seed Fund		Version No. 3: Equalization of Interest Rates on Rediscount Funds	
	Period 12	Total	Period 12	Total	Period 12	Total	Period 12	Total
	P 000							
ICCB							217.4	
CCB	807.5		783.4		783.4		1,000.7	
COB		2,398.6						
SSLC	145.5		218.2	3,747.9	145.5	2,197.6	145.5	
SSL	1,919.7		2,694.1		1,900.3		1,919.7	
SOLC	67.4	1,180.7	101.1	1,771.0	67.4	1,180.7	67.4	1,180.7
SOL	1,003.5		1,441.9		1,003.5		1,003.5	
LSLC	196.1	3,436.6	294.2	5,154.9	196.1	3,436.6	196.1	3,436.6
LSL	2,854.2		4,010.5		2,854.2		2,854.2	
LOLC	128.9	2,259.1	193.4	3,388.7	128.9	2,259.1	128.9	2,259.1
LOAL	2,065.1		2,925.7		2,065.1		2,065.1	
MLLC	39.7	476.6	39.7	476.6	39.7	476.6	39.7	476.6
MLL	847.2		847.2		847.2		847.2	
COMLC	81.5	978.6	81.5	978.6	81.5	978.6	81.5	978.6
COML	608.5		608.5		607.1		608.5	
INLC	46.1	553.4	46.1	553.4	46.1	553.4	46.1	553.4
INL	429.9		429.9		429.9		429.9	
OLC	29.5	345.9	29.5	345.9	29.5	345.9	29.5	345.9
OL	242.1		242.1		242.1		242.1	
XRESC	111.9		43.4		69.3			
XRES	111.9		43.4		654.0			
ERES	56.5		56.5		56.5		56.5	
ARC	997.0		1,320.00		994.9		997.0	
SDC	34.4	355.4	34.4	355.4	34.4	355.4	34.4	355.4
SD	2,683.0		2,683.0		2,683.0		2,683.0	
TDC	74.7	512.4	74.7	512.4	74.7	512.4	74.7	512.4
TD	1,226.1		1,226.1		1,226.1		1,226.1	
BGFC	0.7		0.7		0.7		0.7	
BGF	7.5		7.5		8.2		7.5	
BSF	78.8		78.8		78.8		78.8	
SSDC	157.1		235.7		157.1		157.1	
SREDSC		2,352.1		3,527.6		2,052.1		2,143.3
SREDS	1,316.5		1,974.8					
LREDSC		3,240.5		4,860.7		3,240.5		3,118.9
LREDS	2,000.7		3,001.1					
SREDOC		425.7		1,046.6		511.9		
SREDO	135.4		611.1					
LREDOC		612.7		1,488.4		998.2	776.8	
LREDO	57.1		655.1					
CREDOC		167.9		260.9		256.7	260.9	
IREDOC		73.8		119.9		184.4	147.6	
IBRDC	35.3	423.7	35.3	423.7	35.3	423.7	35.3	423.7
IBRD	569.0		569.0		569.0		569.0	
OUABC	41.9	404.6	42.0		42.0		42.0	404.6
OUAB	1,025.5		1,025.5		1,025.5		1,025.5	
UI	394.7		546.8		394.7		394.7	
APL	387.4		380.4		286.7		287.4	
P	16.6	213.1	37.3	363.8	15.7	178.6	15.4	157.7
CAP	1,384.9		1,536.1		1,350.4		1,329.5	

Source: Vergara

[a]See table 4 for definition of variables.

period net profits and translates into an optimal return on equity (ROE) to stockholders of 16.68 percent. The average ROE for the 15 rural banks was 22 percent in the previous year.

The model solution values for the liquid asset variables—cash on hand (COH), due from Central Bank (CCB), and due from other banks (COB)—remained relatively constant throughout the year at P783,374. The liquid assets represent exactly 20 percent of the deposit liabilities with required reserves—savings deposits (SD), time deposits (TD), and demand deposits (DD). This percentage exactly matches the recommended primary reserves ratio of 20 percent that was imposed on the model. An optimal total year-end loan portfolio amounting to P9,970,253 was generated by the model (table 3). This represents the sum of the twelfth period solution values of the outstanding loan variables: SSL, SOL, LSL, LOAL, MLL, COML, INL, and OL. Short-term agricultural loans, SSL, SOL, LSL, and LOAL account for 79 percent of the portfolio. Small farm loans, SSL and SOL, constituted 29 percent of the portfolio.

New loans granted, SSLC, SOLC, LSLC, LOLC, MLLC, COMLC, INLC, and OLC, throughout the 12 programming periods summed to P11,729,642. This exceeds the total loan portfolio outstanding at the end of the final period since the latter is already net of matured loans that were repaid. More than 31 percent of the new loans granted are in small farm loans (SSLC and SOLC). For all loan classes, the levels of new loans are at the market limits. As long as the net revenue on loans is higher than the cost of funds, rural banks will maximize their profits by granting loans up to the market limits as long as funds are not limiting. As the results indicate, the availability of funds is not an effective constraint on lending.

The outstanding year-end investment portfolio equalled P1,005,135, inclusive of the investment in preferred stock redemption of P8,110 which was assumed constant during the programming periods. The increase in the investment portfolio originates solely from increases in the investments in Agrarian Reform Credits (ARC).[4] Starting with an initial level of only P383,711 during the first period, this type of investment rose to P997,025 at the end of the final period.

An optimal mix of current liabilities heavily concentrated in CB rediscount borrowings (P5,592,628 in rediscounted supervised agricultural loans, SREDSC plus LREDSC, and P1,280,053 in rediscounted ordinary loans, SREDOC plus LREDOC plus CREDOC plus IREDOC) was generated by the basic model. These rediscount funds account for almost 59 percent of the total loans granted throughout the 12 periods. There was a net increase of only P355,358 in savings deposits (SDC) which was almost exactly offset by a decrease in time deposits. New time deposits (TDC) totalled P512,386 but this was exceeded by the maturation of the old time deposits outstanding at the beginning of the first period. Since time deposits are the most expensive source of funds in the model and, except for other liabilities (OLIAB), rediscounting of supervised loans is the least expensive, these results were expected.

These results suggest that rural banks are highly dependent upon CB funds and that they cannot be expected to mobilize funds in rural areas as long as cheaper sources of funds are available from rediscount lines from the CB. However, time deposits could be attractive as a source of funds for investments if the spread between investment returns and time deposits were attractive. Since the spread is negative at current levels, relaxing the interest rate ceilings on agricultural loans would be a logical way to increase the spread and the incentive to mobilize such funds.

The Models

Version 1 (Basic Model): increase in loan demand forecast of 50 percent. In this version, it is assumed that excess demand may exist only in the case of short-term agricultural loans. Since an exact measure of the excess demand is not possible, the loan demand forecast used in the basic model was parameterized in 10 percent intervals to a maximum of 50 percent above the base loan demand. The optimal solution indicates that the net profit (P) increased to P363,800 with a 50 percent increase in loan demand. The only liabilities that change are the rediscounting variables (table 3). The increases in loan demands have been met solely from increases in rediscounting which is not unexpected since rediscount funds are the lowest cost source of funds and they are not yet at their upper limit. Evidently, without the market restrictions on loan demand, the profit and ROE will increase to an unrealistically high level that will be constrained ultimately only by the available funds. The bank's portfolio specializes in loan types that have the highest net return. This illustrates how the profit contribution of a cheap rediscounting policy is so directly linked to, and constrained by, the demand for loans.

A profit-maximizing bank will arbitrage indefinitely, granting rediscountable loans, rediscounting them, and using the proceeds to make further loans until the limits on rediscount funds are reached. This, of course, assumes that the net return on rediscountable loans is invariant with the volume of loans supplied and that it is higher than the rate of discount. Since the nominal rate of return and the administrative costs are assumed constant, this is equivalent to assuming that the default risk on loans is also invariant with the supply of loans; however, a positive correlation exists between risk and the supply of loans. As the risk increases to the point where the estimated net return on rediscountable loans becomes equal to or less than the rate of discount, the optimal supply of rediscountable loans will be determined. Which of the alternative loan demand forecasts corresponds to this optimum is extremely difficult to determine.

Version 2: suspension of special time deposits (STD) as a "seed fund" to support the supervised credit program of the rural banks. To enable the banks to maximize their participation in the CB-sponsored supervised credit program, the CB has also been providing the rural banks with a seed fund in the form of a three-month STD at an annual interest of three percent. This seed fund is to augment the bank's own liquid funds at the start of the season of the program and thus enable it to accommodate as many borrowers as possible whose loans can be rediscounted later with the CB to accommodate future borrowers. Quite clearly, the overall profitability of rediscounting to the rural bank is limited by the amount of initial funds it has. In the extreme case where the initial fund is zero, the bank will gain nothing from rediscounting as it will not be able to generate new loans to rediscount later.

The results from a model without the STD as a source of funds show that new loans granted during the first period suffered the most. Considering all the periods, the increase in new time deposits remains the same as in the original model, which suggests that banks do not mobilize new funds to replace STD. Also, the overall effect on the amount of funds allocated to ARC is only P2 thousand less in this model than in the basic model (table 3). Net profit (P) over the periods is P178,600, compared to P213,177 for the basic model. This profit reduction of P31,874 when related to the average monthly STD balance of P262,653 in the basic model implies a 12.14 percent return for the use of STD. And, this represents the maximum return that the banks could offer for funds to replace the STD.

Version 3: equalization of the interest rates on various rediscount funds. Currently, on supervised agricultural loans, the interest rate on rediscount funds is set at one percent compared to three percent on ordinary agricultural loans and four percent on commercial and industrial loans. The objective of interest rate differentiation is to increase the profitability of supervised agricultural loans relative to other loans and thus induce the rural banks to allocate more of their funds to supervised loans. However, as discussed earlier, as long as the costs of funds needed to finance the various types of loans are less than the net rates of returns on loans, differences in the profitability of loans are irrelevant since availability of funds is not an effective constraint. Only the market constraints effectively limit the allocation of funds among the various types of loans. Further reductions in the costs of funds will have no effect on allocation of funds as long as the market constraints remain effective. Conversely, the costs of funds could be increased without affecting the allocation of

[4] In the Philippines all banking institutions are required to maintain at least 25 percent of the loan portfolio in agricultural loans. At least ten of the 25 percent should be loans to small farmer beneficiaries of the agrarian reform program. The banks are given the option to meet this requirement by purchasing ARC securities from the CB.

funds among the various types of loans as long as they are below the net return on certain types of loans.

As an empirical test of the above, the basic model was modified by equalizing the interest rates on rediscount funds with the rate on commercial and industrial loans as the basis. As expected, the allocation of funds among the different types of loans remains constant. Among the asset variables, only ARC and CCD were affected. The intertemporal allocation of funds to ARC changed for some periods but the overall amount of funds allocated did not change. There was, however, a reduction in the amount of liquid assets, CCBt, held by the bank. Among the liability items, only the rediscount funds were affected. There was a decrease in supervised rediscounting—SREDSCt and LREDSCt—and an increase in ordinary rediscounting—LREDOCt, SREDOCt, CREDOCt, and IREDOCt. Again this is consistent with profit-maximizing behavior since as the interest rates are equalized, the "price ratio" moves in favor of ordinary rediscounts. The equalization of discount rates resulted in a profit reduction to P157,700 (table 3). In a counterfactual sense, the profit reduction from the base model to this model represents the amount by which profit would be increased through a policy of preferential rediscount rates for agricultural loans. As evidenced by the results, however, this policy could not be expected to lead to an increase in agricultural loans unless the demand for loans increases.

Conclusions and Implications

The Philippine government, through the Central Bank (CB), initiated the rural banking system and has tried to increase allocation of loans to small farmers through changes in regulatory policy. A multiperiod linear programming model of a representative rural bank is developed to evaluate the profit-maximizing level of small farm loans given the available alternative assets, and to evaluate the impact of selected regulatory changes on small farm lending and rural bank profitability.

Results from the base model are as expected, given the constraints imposed and the relative returns and costs of the various asset and liability variables. A net profit of P213,177 (16.7 percent return on stockholders equity) was obtained from the base model. An optimal year-end portfolio of P9,970,253 was generated by the model. Short-term agricultural loans account for 79 percent of the portfolio with 29 percent in small farm loans. For all loan classes, the level of new loans is at the market limits. As long as the net revenue on loans is higher than the cost of funds, rural banks will maximize profits by granting loans up to the market limits as long as funds are not limiting. The optimal mix of current liabilities is heavily concentrated (59 percent) in rediscounted agricultural and ordinary loans from the CB. Time and savings deposits are relatively unimportant as a source of funds in the model because they are the most expensive while rediscounted supervised loans are the cheapest. Rural banks are highly dependent upon CB funds and cannot be expected to mobilize deposits in rural areas as long as cheaper rediscount lines are available.

A 50 percent increase in the loan demand forecast increases the net profit of rural banks to P363,800. The increase in loan demand is met solely from increased rediscounting, which is not unexpected since rediscount funds are the lowest cost source of funds. A profit-maximizing bank will arbitrage indefinitely, granting rediscountable loans, rediscounting them and make more loans until the funds are exhausted.

Suspension of the "seed fund" causes a reduction of lending to small farmers and a reduction of banks' profits to P178,600. The results also show that banks do not mobilize new funds from time and savings deposits to replace the loss of STD. Concessional discounting policies from the CB appear to discourage banks from mobilizing local deposits.

Equalizing the interest rates on all loans reduces profits to P157,700 but does not change the allocation of funds among the various types of loans. As long as the cost of funds is less than the net rate of return on loans, differences in the profitability of loans are irrelevant since availability of funds is not an effective constraint. Only market constraints including risk considerations, effectively limit the allocation of funds among the various types of loans. As evidenced by the results, preferential interest rates increase the profitability of rural bank lending but cannot be expected to increase the flow of funds to small farmers unless their loan demand increases.

This confirms Adams's analysis that rational bankers will merely substitute cheap rediscount funds for more expensive local deposits. A piecemeal policy approach to financial reform will not likely be adequate and may only lead to unintended consequences such as increased bank profits with little or no increase in small farmer credit.

Table 4. Definition of Selected Structural Variables in the Rural Bank LP Model, Central Luzon, Philippines, 1979-1980

CCB_t: due from Central Bank in period t
$DCCB_t$, $ICCB_t$: the decrease and the increase, respectively, in CCB
COB_t: due from other banks in period t
$SSLC_t$, SSL_t: (new) supervised small agricultural loans granted and outstanding, respectively
$SOLC_t$, SOL_t: (new) small ordinary agricultural loans granted and outstanding, respectively
$LSLC_t$, LSL_t: (new) large supervised agricultural loans granted and outstanding, respectively
$LOLC_t$, $LOAL_t$: (new) large ordinary agricultural loans granted and outstanding, respectively
$MLLC_t$, MLL_t: (new) medium and long-term agricultural loans granted and outstanding, respectively
$COMLC_t$, $COML_t$: (new) commercial loans granted and outstanding, respectively
$INLC_t$, INL_t: (new) industrial loans granted and outstanding, respectively
OLC_t, OL_t: (new) other loans granted and outstanding, respectively
$XRESC_t$, $XRES_t$: (new) nonreserve eligible securities purchased and outstanding, respectively
$ERESC_t$, $ERES_t$: (new) reserve-eligible securities purchased and outstanding, respectively
$ARCC_t$, ARC_t: (new) "agrarian reform credits" securities purchased and outstanding, respectively
SDC_t, SD_t: (new) savings deposits and savings deposits outstanding, respectively
TDC_t, TD_t: (new) time deposits and time deposits outstanding, respectively
$STDC_t$, STD_t: (new) special time deposits and special time deposits outstanding, respectively
$BGFC_t$, BGF_t: decrease in Barrio Guarantee Fund (BGF) and BGF outstanding, respectively
$BSFC_t$, BSF_t: increase in Barrio Savings Fund (BSF) and BSF outstanding, respectively
$SSDC_t$: special savings deposits outstanding
$SREDSC_t$: $SSLC_t$ rediscounted in period t and become available in period t + 1
$LREDSC_t$: $LSLC_t$ rediscounted in period t and become available in period t + 1
$SREDOC_t$, $LREDOC_t$, $CREDOC_t$, $IREDOC_t$: $SOLC_t$, $LOLC_t$, $COMLC_t$ and $INLC_t$ rediscounted, respectively, in period t and become available in period t + 1
$SREDS_t$, $LREDS_t$, $SREDO_t$, $CREDO_t$, $IREDO_t$: the end-of-period balances of different types of rediscount borrowings (t=2, ..., 12)
$IBRDC_t$, $IBRD_t$: (new) IBRD and IBRD outstanding, respectively
$OLIABC_t$, $OLIAB_t$: (new) other liabilities and other liabilities outstanding, respectively
UI_t: unearned interest income for each period
APL_t: allowance for probable losses for each period
P_t: net profit/income from loans and investments for each period
CAP_t: capital accounts outstanding for each period

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