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A Short Note on Agricultural Credit and Policy Analysis

by

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ABSTRACT

This paper sets rural financial market analysis within a macroeconomic framework. An agricultural credit demand model is constructed. A preliminary test of the model is conducted using restricted least squares. It is noted that the model can be used to generate supply parameters required for an agricultural multimarket model which may be helpful in making credit policy analysis.

A Short Note on Agricultural Credit and Policy Analysis

Carlos C. Bautista[1]

This note presents an agricultural credit model that can be easily implemented empirically. The model introduces a marginal borrowing cost approach due to Bruno (1979). The first section provides a background on agricultural credit studies or more generally rural financial market (RFM) analysis. The second section describes a model of agricultural credit demand. The third section makes an initial test of the model. The last section comments further on the theoretical base and empirical implementation.

I. RFM Analysis

One-of the earliest works on RFM analysis was done by McKinnon (1973) using the well known Fisherian approach in explaining self-financing. On the assumptions of investment indivisibilities and absence of organized credit markets, the Fisherian approach permits an analysis of self-finance that leads to non-convexities in the production set and the perverse relationship of money and capital. McKinnon's work has influenced third world economists and policy makers into pursuing a financial liberalization program designed to improve the

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functioning of agricultural credit markets and eliminate financial repression.[2]

In the Fisherian framework, credit market imperfections due to interest rate ceilings lead to credit rationing (See Krugman, 1981). This is the traditional view of rationing applied to credit markets. Stiglitz and Weiss (1981) developed a model where credit rationing is the result of assymetric information rather than government pricing policies. Because the interest rate is used as a screening device, lenders set interest rates by discretion depending on their assessment of the risks involved. In their model, there can exist an equilibrium rate of interest even if supply does not match credit demand and the existence of private (informal) moneylending is implicitly assumed away.

The South Asian literature on agricultural credit provides detailed microeconomic analysis of private moneylending activities and the market interlinking phenomenon (See for example Basu, 1983 and Gangopadhyay and Sengupta, 1988). The basic idea is that the absence or incompleteness of markets provides an efficient mechanism by which related activities are unified with only two parties being involved. For example, a rice trader provides credit (in kind or in cash) to the farmer who promises to sell his output to him at a predetermined discount over the market price. Applications of this theory for the Philippines can be seen in Floro (1986).

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[2]*The financial crash that accompanied the liberalization program of some Latin American countries is documented in Diaz-Alejandro (1981).*

This paper sets RFM analysis within a macroeconomic framework that is still consistent with some of the studies mentioned. It is observed that credit scarcity in rural areas is a direct consequence of restrictive monetary policies in combination with several Central Bank regulations that bestow monopoly positions to the banking system.[3] The latter permits banks to set interest rates by discretion. Credit scarcity resulting from monetary restraint gives rise to a curb market where excess demand for credit is satisfied at rates higer than the formal market.

The approach is derived from an aspect of the macroeconomics of less developed countries which examines the supply effects of credit restrictions (See Bruno, 1979). This framework stresses the working capital needs of the production unit. The analysis proceeds by pointing out that a time lag between receipt of sales proceeds and payments to labor and other raw materials within the production period exists. There is in effect a crucial financing gap in the production process. In terms of the production decision sequence, the farming unit is faced with a given set of input prices from which it decides the

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[3] *A concrete case of government regulations that inhibit appropriate credit delivery to the rural areas is the restrictive rule on bank branching and the special treatment of rural banks. The policy states that no commercial bank branch can be opened in a locality if there is an operating rural bank for a certain distance and if the area is deemed overcrowded. The latter condition is quite nebulous since the definition of overcrowded is not clearly stated. While the Central Bank may have good intentions of fostering growth of rural banks, it also reinforces the oligopolistic tendencies of the banking system (See CB Circular no. 739). Other regulations are also stated in this circular.*

picked up by private moneylenders and individual savings amounting to $c - c_o$.[4]

Assume that the borrowing cost incurred by the farming unit is $b = b[c(q)]$. The total cost to the farming unit including borrowing cost is then $c + b$. Profit maximization requires that:

$$6) \qquad p = c_q(1 + r),$$

where p is the price of the farm output and $r = \delta b/\delta c$ is the marginal borrowing cost.

Following Bruno (1979), assume that the marginal borrowing cost is a constant elasticity function of the ratio of cost to rationed credit:

$$7) \qquad 1 + r = A(c/c_o)^{\alpha},$$

where A is a constant equal to $1 + r_o$; $\alpha > 0$ for $c \geq c_o$ and $\alpha = 0$ for $c < c_o$. Notice that if $c < c_o$ where there are no financial constraints (perfect financial markets), the

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[4]A compilation of survey results by Sacay et al, p. 80 and 82, from 1950 to 1980 showed that 66 to 93.5 percent of respondents obtained additional credit from the informal sector. The share of informal credit to total credits granted to the agriculture sector ranged from 31 to 80 percent.

marginal borrowing cost is just equal to the formal interest rate (i.e., $r = r_o$).[5]

Using (4), (5) and (7) in (6) gives the supply function of the farming unit,

$$8) \qquad \hat{q} = \frac{1}{1-\theta+\alpha}[\theta\hat{p} - (1 + \alpha)\Sigma_{i=1}^{n}\theta_i\hat{w}_i + \alpha\theta\hat{c}_o],$$

which shows farm output as a function of the output price, input prices and nominal credit. Notice that equation (8) is homogenous of degree zero in all prices *and* in nominal credit -- $[\theta - (1 + \alpha)\theta + \alpha\theta]/(1 - \theta + \alpha) = 0$. It must also be pointed out that with perfect credit markets and under constant returns to scale ($\alpha = 0$ and $\theta = 1$), the output equation is undefined.[6]

The effect of credit restraint is to limit output growth. To isolate the effects of the constraint, (8) is rewritten as:

$$9) \qquad \hat{q} = \frac{-1}{1-\theta+\alpha}[\Sigma_{i=1}^{n}\theta_i(\hat{w}_i - \hat{p}) + \alpha\Sigma_{i=1}^{n}\theta_i(\hat{w}_i - \hat{c}_o)].$$

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[5] *That the formal rate is greater or lesser than the informal rate in nominal terms is an empirical issue. Moneylender rates are quite difficult to estimate. In a study by TBAC (1980), informal rates are much higher than bank rates. Computations by the study showed rates of as much as 200 percent. For different economies as in India the converse holds (See for example Gangopadhyay and Sengupta, 1968.)*

[6] *This is a result in standard theory. Inverting the equation and using the given values of the parameters show that output price growth is a linear combination of input price growth rates. Maintaining the fixed factor assumption, $\theta = \Sigma_i\theta_i < 1$, while $\alpha = 0$ yields an upward sloping Neoclassical supply curve.*

The first term in square brackets is the effect of real factor costs on output supply. The second term is the effect of the marginal financial constraint.

3. A Preliminary Test

In this section, the model above is empirically implemented using aggregate data. Only one input, labor, is assumed. The agricultural income and price data came from the National Accounts of the Philippines while credit data were obtained from the 1985 Agricultural Credit Study of TBAC and the 1988 Credit Report of the Agricultural Credit Policy Council.

Except for credit, all the data used in this paper are also used in the PIDS annual macroeconometric model. Output (q) is the real agricultural output as defined in the national accounts of the Philippines. Output price (p) is the implicit price deflator for agriculture. The wage rate index (w) for the unskilled worker is used. c_o is the total credits granted to the agriculture sector in nominal terms. A time variable was included to account for productivity changes not captured by the variables.

The period covers 1967 to 1987. The parameters are estimated using ordinary least squares with restrictions. After logarithmic transformation of the data, equation (8) is estimated with and without a linear constraint on the parameters. The

estimating equation is written as follows:

$$q^* = d_1 + d_2 p^* + d_3 w^* + d_4 c_o^* + d_5 \text{time} + e \quad ; \; \Sigma_{j=2}^{4} d_j = 0$$

where asterisks indicate logarithmic transformations. e is the error term and d's are coefficients. The linear constraint serves to impose the homogeneity condition of the supply function as shown in the previous section. The results are presented below (values in parenthesis are standard errors).

The results show a poor performance of the unconstrained specification as the standard errors are quite high (See column 1).

The constrained estimate imposes a restriction on the sum of the coefficients of the independent variables. This estimate shows an improvement over the unconstrained equation. However the price variable remains insignificant (See column 2). The F value permits the acceptance of the linear hypothesis. The estimated regression coefficients are the elasticities. α can be computed as the ratio of the credit and price elasticity of supply, i.e., $\alpha = d_4/d_2$. Calculations show that $\alpha = 5.1056$ while the Cobb-Douglas parameter is $\theta = 0.1041$.

The standard supply function is also estimated. Column 3 shows the regression estimate without the credit variable. No restrictions were imposed on this estimate. The variables are

correctly signed and the coefficient of output price is also insignificant.

	Unconstrained	Constrained	without Credit
	1	2	3
d_2	0.02338 (0.05416)	0.01762 (0.05385)	0.05325 (0.05252)
d_3	-0.18644 (0.09407)	-0.10601 (0.04638)	-0.30622 (0.05458)
d_4	0.05653 (0.03683)	0.08839 (0.01749)	-
d_5	0.04106 (0.01071)	0.03075 (0.00218)	0.05524 (0.05632)
constant	10.12220 (0.33580)	9.79736 (0.05914)	10.52650 (0.21630)
adj. r-sqr	0.99216	0.99218	0.99134
d.w.	1.54860	1.43460	1.56880
F(1, 16)	-	0.95600	-

4. *Remarks*

Theory

The theoretical framework may be viewed as an extension of the standard concept of the firm. In this paper, the economic agent engages in a two stage optimization process where he minimizes total factor cost (and indirectly, borrowing cost) after which he then equates output price with marginal cost inclusive of borrowing cost.

The model can be used at the highest aggregation level. Allowing the formal interest rate to vary and following the steps in arriving at equation (8), an aggregate supply equation can be derived as follows:

$$\hat{q} = \frac{-1}{1-\theta}[\Sigma_{i=1}^{n}\theta_i(\hat{w}_i - \hat{p}) + \alpha\theta(\hat{c} - \hat{c}_o) + \theta\beta\hat{r}_o].$$

where $\beta = 1/(1 + r_o)$. c represents money demand while c_o corresponds to money supply. At the macroeconomic level, this equation states that aggregate supply responds to real factor costs, to monetary disequilibrium and to the interest rate. An increase in the rate of interest raises working capital cost and subsequently restricts output supply. A similar equation was estimated by Cavallo (1977) for the Argentine economy.

Applications

The supply equation (8) can be estimated for different crops and the parameters of the model can be recovered from these estimates to show relative degrees of capital market imperfections. Survey results of previous studies should come in handy.

The next thing that can be done is to use the estimated elasticities in a multimarket model of the agriculture sector. This modelling approach popularized by Braverman et al (1987) is a compromise between single market analyses and computable general equilibrium models. With the elasticities of supply and

demand available, numerical exercises on credit and resource allocation can easily be done.

Finally, the model is convenient to handle empirically because it avoids the use of informal credit data which is difficult to collect. This paper however does not say that informal credit is unimportant nor does it say that it is undesirable and must be shunned. It is precisely the lack of formal credit that informal creditors flourished. A gap is filled and the benefits of such a credit delivery system cannot readily be said as inferior to that of a formal one.

References

ACPC, "1986 Year End Formal Agricultural Credit Report," Monograph Series No. 67-01.

Basu (1983) "The Emergence of Isolation and Interlinkage in Rural Markets." *Oxford Economic Papers.*

Braverman, Hammer and Gron (1987), "Multimarket Analysis of Agricultural Price Policies in an Operational Context: The Case of Cyprus." *The World Bank Economic Review.*

Bruno, M. (1979), "Stabilization and Stagflation in a Semi-Industrialized Economy." in Dornbusch and Frenkel (eds.) *International Economic Policy: Theory and Evidence*, Johns Hopkins Press.

Cavallo, D. (1981), "Stagflationary Effects of Monetarist Stabilization policies in Economies with Persistent Inflation." in Flanders and Razin (eds.) *Development in an inflationary World*, Academic Press.

Central Bank Circular no. 739 (1980), Manila.

Diaz-Alejandro, C. (1981), "Good-bye Financial Repression, Hello Financial Crash." Unpublish Manuscript.

Floro, S. (1986), "Credit Relations and Market Interlinkage in Philippine Agriculture," Ph.D. Dissertation, Food Research Institute, Stanford University.

Gangopadhyay and Sengupta (1988), "Small Farmers, Moneylenders and Trading Activity." *Oxford Economic Papers.*

Krugman, P. (1981), "Equity and Efficiency Effects of Interest Rate Ceilings." Unpublished Manuscript.

McKinnon, R. (1973), *Money and Capital in Economic Development.* Brookings Institution.

Sacay, Agabin and Tanchoco (1985), *Small Farmer Credit Dilemma*, Technical Board for Agricultural Credit, Manila.

Stiglitz and Weiss, (1981), "Credit Rationing in Markets with Imperfect Information." *American Economic Review.*

TBAC (1980), *A Study on the Informal Rural Financial Markets in Three Selected Provinces of the Philippines*, Manila.

____ (1985), *Agricultural Credit Study*, Manila.