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Malaysian Rubber: A Note on the Demand for Agricultural Loans

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This study uses the partial adjustment adaptive expectation model to determine how rubber producers form their expectations on future rubber prices as their decision variable when borrowing decisions are made. The results suggest that expectations about future rubber prices play an important role in influencing the rubber producers' borrowing decision.

The agricultural sector (including rubber) is often subject to various uncertainties. Given the susceptibility of agricultural commodity prices to the world demand and supply forces, producers make their production decisions with imperfect knowledge of the possible outcome. Therefore, the producer has to form his view about the future, such as the likely sale of the commodity, cost of production, the price of the commodity, government policies and other producers' reactions, before deciding the optimal production for the next year. The view about the value of the above crucial economic variables is frequently referred to as 'expectation', that is, what the producer expects to happen.

The importance of expectation has been recognised by economists for over a decade. One of the most popularly used expectation formation process is Nerlove's adaptive expectation model. Askari and Cummings[1] listed more than 600 studies in which variants of Nerlove's expectation model were employed. However, most of these studies on farmers' expectations concentrated on agricultural response, particularly, on farmers' planting and crop selection decisions. Studies on farmers' expectation formation in the agricultural loans market seem to be neglected particularly in the developing countries.

This paper analyses the determinants of the demand for agricultural loans for the rubber sector and the role of expectation at the time when borrowing decisions are made. The model to be used in the analysis is also discussed.

THEORETICAL FRAMEWORK

The Model

Credit is one of the many factors needed for agricultural production. Credit is not a direct factor of production but it is generally used to acquire factors of production. It is commonly noted that credit is used for purchase of machinery, crop and livestock inventory, maintenance of plant and buildings and improvements on the land. Credit for these items is usually classified as long-term credit. On the other hand, the short-term credit is normally used as working capital to finance seasonal inputs such as fertilisers, pesticides and labour services for land preparation, planting and harvesting in the agricultural activities. The normal source of institutional short-term credit in the private sector is the commercial banks[2].

Studies on factors that determine the demand for agricultural credit have been numerous[3–7]. Following Habibullah[8], the models of the demand for agricultural loans for the rubber sector are specified as follows:

Basic model

$$RL_t^* = f(RP_t^*, RAG_t, RFA_t, RA_t) \qquad \ldots 1$$

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Expectation model

$$RP_t^* - RP_{t-1}^* = e\,(RP_{t-1} - RP_{t-1}^*) \qquad ...2$$

Adjustment model

$$RL_t - RL_{t-1} = z\,(RL_t^* - RL_{t-1}) \qquad ...3$$

Derivation of the final models is shown in *Appendix A*.

Equation 1 postulates that the desired demand for agricultural loans by producers in the rubber sector (thereafter referred to as rubber loans), RL_t^*, is a function of the expected rubber price, RP_t^*, rate of interest on agricultural loans (cost of borrowing), RAG_t, opportunity cost of using own funds, RFA_t and area of land planted with rubber, RA_t.

A decision to borrow means that there is a financial obligation which the farmer will have to comply throughout the repayment period in future years. Thus, the farmer will have to allocate a portion of his cash flow for servicing and repayment of the loaned funds. However, future periods are uncertain, and therefore, the farmer's income will also be uncertain. If there is an increase in the price of rubber, the farmer's income may subsequently increase and *vice versa*. Thus, if farmers are profit-motivated, then product price will be relevant information in their decision to borrow[9,10,11]. Since the price of rubber in the future is unknown, the farmer will have to form an expectation about the future rubber price. Expectation formation can take the form specified in *Equation 2*.

The rate of interest reflects the cost of borrowing. If a higher interest rate is levied, then lower amount of loans will be demanded because a higher interest rate means a higher cost of production. Therefore, an inverse relationship can be expected between loans demanded and interest rate.

The demand for an input depends also on the availability of funds. There are two sources of funds — external borrowing and internal funds generated from past profits. We would expect that external borrowing and internal financing would substitute each other. When producers use their own funds in the process of production, there is an opportunity cost incurred. The producer could have generated income from the fund if they invest in other investments, for example, depositing the funds in interest-bearing assets. Thus, the rate of interest on these interest-bearing assets can be a proxy for the opportunity cost of the internal funds. Johnson[12] indicated that farmers are well versed about other investment opportunities and therefore rational farmers would invest their funds in these profitable investments. As a matter of fact, Melichar[13] indicated that over the years, farmers tend to increase their debt financing rather than employ their own income stream, probably due to the above arguments. While we have no evidence of such a trend for rubber, we can postulate such a relationship. Therefore a positive relationship between rubber loans demanded and the interest rate on interest-bearing assets would suggest that internal funds are lacking and thus, a farmer would resort to external borrowing.

The demand for loans for purposes of agricultural production is positively related to the area planted[7]. A larger area would mean that more labour is needed to maintain and work on the land, more fertilisers and more chemicals are used in the production and subsequently, a larger loan is needed.

Equation 2 characterises the expectation formation process and e, is the coefficient of expectation. It was first suggested by Cagan[14] and later refined by Nerlove[15]. *Equation 2* postulates that each year producers revise the price they expect to prevail in the coming year in proportion to the error they make in predicting the price during this period[15]. That means, the difference in expected value ($RP_t^* - RP_{t-1}^*$) equals a proportion of the difference between actual (RP_{t-1}) and expected value (RP_{t-1}^*) in the past. As Leeuw and McKelvey[16] pointed out, this hypothesis implies an element of learning, since expectations are revised in accordance with the last forecasting error.

Lastly, *Equation 3* is the stock adjustment model proposed by Chow[17] and z is the coefficient of adjustment. The partial adjustment model implies that the change in the demand for loan between Year t-1 and Year t, is proportional to the difference between the desired demand in Year t, and the actual demand in Year t-1. Thus, a farmer takes time to adjust his demand for loan in response to changing prices and his full response will be spread over several periods of time.

The Estimating Model

Equation 1 cannot be estimated because the variables RL_t^* and RP_t^* are unobservable. In order to make estimation possible, *Equations 2* and *3* are substituted into *Equation 1*. Subsequent rearrangement of terms and after a tedious process of derivation, the following functional forms are ready for estimation:

Option I

$$RL_t = g\ (RP_{t-1}, RAG_t, RAG_{t-1}, RFA_t, RFA_{t-1}, RA_t, RA_{t-1}, RL_{t-1}, RL_{t-2}, W_t) \quad \ldots 4$$

Option II

$$RL_t = h\ (RP_{t-1}, \Delta RAG_t, RAG_{t-1}, \Delta RFA_t, RFA_{t-1}, \Delta RA_t, RA_{t-1}, RL_{t-1}, RL_{t-2}, V_t) \quad \ldots 5$$

where
$$\Delta RAG_t = RAG_t - RAG_{t-1}$$
$$\Delta RFA_t = RFA_t - RFA_{t-1}$$
$$\Delta RA_t = RA_t - RA_{t-1}$$

We can see that the regressors comprise variables in their t period, (t-1) period and (t-2) period for RL. W_t and V_t are the disturbance terms assumed to have zero mean and constant variance.

Recently, some studies indicated that it is not appropriate to include the partial adjustment mechanism in the demand for loan model. Studies by Valentine[18], Standen[19] and Barry[20] found that the adjustment from the desired level to the actual level is short and there is no justification for a longer lag between desired and actual levels for loan demanded. In view of this evidence, the following models were tested without the partial adjustment mechanism:

Option I

$$RL_t = m\ (RP_{t-1}, RAG_t, RAG_{t-1}, RFA_t, RFA_{t-1}, RA_t, RA_{t-1}, RL_{t-1}, Y_t) \quad \ldots 6$$

Option II

$$RL_t = n\ (RP_{t-1}, \Delta RAG_t, RAG_{t-1}, \Delta RFA_t, RFA_{t-1}, \Delta RA_t, RA_{t-1}, RL_{t-1}, Q_t) \quad \ldots 7$$

The variable RL_{t-2} disappears from the model and Y_t and Q_t are the disturbance terms assumed to have zero mean and constant variance.

Method of Estimation and Data

In this study, four equations were estimated. Given the presence of lagged dependent variables in all the four models, ordinary least squares were not appropriate as these variables tended to correlate with the error terms and hence yielded biased estimates. To correct for autocorrelation, the maximum likelihood estimation method[21] was employed.

This study is based on Malaysian annual time series data over the period 1962–83. Most of the data on amount of loans, interest rate on agricultural loans, rate on interest-bearing assets and rubber prices are obtained from Bank Negara Malaysia's publications such as the *Annual Report* and *Statement of Accounts*, and *Quarterly Economic Bulletin*. Data on rubber acreage, are collected from Department of Statistics' publications such as *Rubber Statistics Handbook*.

RESULTS

The estimated regression equation was divided into two adaptive expectation models; without partial adjustment (*AE*) and with partial adjustment *(PA-AE)*. Both these models were tested for the two options mentioned earlier.

To arrive at the best adaptive expectation model, the criteria used were: the overall significance of the independent variables (based on t-tests on individual variable coefficients)

TABLE 1. RESULTS OF THE MAXIMUM LIKELIHOOD ESTIMATION FOR RUBBER SECTOR — THE ADAPTIVE EXPECTATION MODEL

Option	Results
I	
Without partial adjustment)	RL_t = 101.72 (0.37160) + 0.01871RP_{t-1} (2.1327)* − 26.872RAG_t (−3.1357)*** + 9.9206RAG_{t-1} (1.5367) + 49.234$RGS5_t$ (2.5570)** − 38.532$RGS5_{t-1}$ (−2.4295)** − 0.14645RA_t (−0.40184) + 0.12269RA_{t-1} (0.48889) 1.1016RL_{t-1} (6.0783)*** R^2 = 0.9656 SER = 15.2954 D.W. = 2.2399 d.f. = 14
With partial adjustment	RL_t = 849.84 (1.9953)* + 0.03075RP_{t-1} (3.5054)*** − 34.852RAG_t (−3.7802)*** + 20.240RAG_{t-1} (2.3391)** + 63.779$RGS5_t$ (3.1483)*** − 63.805$RGS5_{t-1}$ (−3.5220)*** − 0.87841RA_t (−1.8147)* + 0.44720RA_{t-1} (1.5887) + 1.1726RL_{t-1} (3.5624)*** − 0.32725RL_{t-2} (−1.0516) R^2 = 0.9816 SER = 13.9212 D.W. = 2.4522 d.f. = 12
II	
Without partial adjustment)	RL_t = 101.72 (0.37160) + 0.01871RP_{t-1} (2.1327)* − 26.872RAG_t (−3.1357)*** − 16.952RAG_{t-1} (−2.4964)** + 49.234$RGS5_t$ (2.5570)** + 10.701$RGS5_{t-1}$ (0.84356) − 0.14645RA_t (−0.40184) − 0.02376RA_{t-1} (−0.16741) + 1.1016RL_{t-1} (6.0783)*** R^2 = 0.9656 SER = 15.2954 D.W. = 2.2399 d.f. = 14
With partial adjustment	RL_t = 849.84 (1.9953)* + 0.03075RP_{t-1} (3.5054)*** − 34.852RAG_t (−3.7802)*** − 14.612RAG_{t-1} (−2.5066)* + 63.779$RGS5_t$ (3.1483)*** − 0.02614$RGS5_{t-1}$ (−0.00215) − 0.87841RA_t (−1.8147)* − 0.43121RA_{t-1} (−1.9173)* + 1.1726RL_{t-1} (3.5624)*** − 0.32725RL_{t-2} (−1.0516) R^2 = 0.9816 SER = 13.9212 D.W. = 2.4522 d.f. = 12

*** Statistically significant at the 1% level
** Statistically significant at the 5% level
* Statistically significant at the 10% level

Figures within brackets are '*t*-statistics'.

in the model; the correct signs shown by the coefficient of the estimated parameters; the coefficient of multiple determination (R^2), and the value of the standard error of the regression (*SER*).

In this study, to proxy for the opportunity cost of using internal funds, we tested varieties of interest rates on Malaysia's financial assets which include Treasury bill rates (three-month, six-month and twelve-month), government security rates (five-year and twenty-year), commercial bank saving deposit rates and commercial bank fixed deposit rates (three-month, six-month, nine-month and twelve-month). The best interest rate on financial assets selected is the five-year government security rate (*RGS5*), and therefore variable *RGS5* has been used throughout the analysis.

The results for the estimated regression equations are presented in *Table 1* for *Options I* and *II* for both models, *AE* and *PA-AE*. Comparing the results, *Option II* seems to be better than *Option I* in terms of the significance of the independent variables and the correct signs shown. Further, the results for *Option I* may have been tampered with the presence of multicollinearity among the independent variables as shown by RAG_t and RGS_{t-1}, $RGS5_t$ and $RAS5_{t-1}$, have wrong signs for RAG_t and $RGS5_{t-1}$ were obtained.

Looking at the results for *Option II*, it can be seen that the *PA-AE* model performs better compared to the *AE* model, in terms of the significance of the independent variables, the sign of the coefficient, a higher R^2 and a lower standard error of regression. The results suggest that there is a time lag for the producers to adjust their desired demand to the actual demand for loans as shown by the variable RL_{t-1}. The results of the estimated regression equation in *Option II* for partial adjustment — adaptive expectation model show that the lagged one year rubber price is significant at the 1% level, suggesting that expectation about future rubber prices plays an important role in the farmers' decision making at the time when borrowing decision is made. If the farmers are profit-motivated, and anticipate that future rubber prices will increase, the demand for loans will also increase.

The rate of interest on loans is also an important factor in influencing the producers' behaviour towards loans. The variables ΔRAG_t and RAG_{t-1} are significant at the 1% and 5% levels, respectively. The results suggest that a lower interest rate on loans would induce the farmer to borrow, and a higher interest rate on loans is not likely to attract producers to demand for such loans.

On the other hand, the rate of interest on interest-bearing assets, *RGS5*, shows interesting results: except for variable $RGS5_{t-1}$, variable $RGS5_t$ is significant at the 1% level. The positive relationship between RL_t and $\Delta RGS5_t$ implies that a higher interest rate on interest-bearing assets would induce producers to use their own funds to invest in these earning assets. This subsequently would induce the farmer to substitute for external borrowing since funds to finance working capital and other expenses are lacking.

The importance of acreage is shown by the variables RA_t and RA_{t-1}, which signify that the change in current acreage and the lagged one year acreage planted influence the current amount of loan demanded. These variables are significant at the 10% level, but show a negative sign. However, one must be cautious in interpreting the effect of *RA*. The inverse relationship between *RL* and *RA* may be due to the fact that the increase for external borrowing is for financing rubber land with oil palm cultivation.

CONCLUSION

The results as a whole, have provided evidence that expectations about future rubber prices play a major role in influencing producers' demand for loans. Thus, a rubber farmer or rubber farm-firm would anticipate how the future rubber prices would be, because as they are profit-motivated, they are aware that income would be affected by their decision to borrow. The results also imply that the rate of interest on loans is also a main factor that affects the behaviour of rubber farmers/farm-firm to borrow. On the other hand, the results also suggest that there is substitution between external borrowing and the farmer's own funds, if the farmer/farm-firm is given an alternative for the fund to be utilised optimally.

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APPENDIX A

DERIVATION OF THE FINAL MODELS

Given the models,

Basic model

$$RL_t^* = f\,(RP_t^*\ ,\ RAG_t\ ,\ RFA_t\ ,\ RA_t) \qquad \ldots 1$$

Expectation model

$$RP_t^* - RP_{t-1}^* = e\,(RP_{t-1} - RP_{t-1}^*) \qquad \ldots 2$$

Adjustment model

$$RL_t - RL_{t-1} = Z\,(RL_t - RL_{t-1}) \qquad \ldots 3$$

Writing *Equation 1* linearly:

$$RL_t^* = a_0 + a_1RP_t^* + a_2RAG_t + a_3RFA_t + a_4RA_t + U_t \qquad \ldots 4$$

and substituting *Equation 4* into *Equation 3:*

$$RL_t - RL_{t-1} = Z\,(a_0 + a_1RP_t^* + a_2RAG_t + a_3RFA_t + a_4RA_t + U_t - RL_{t-1}) \qquad \ldots 5$$

Rearranging the terms in *Equation 5*:

$$RL_t = Za_0 + Za_1RP_t^* + Za_2RAG_t + Za_3RFA_t + Za_4RA_t + (1\text{-}Z)\,RL_{t-1} + ZU_t \qquad \ldots 6$$

Expressing *Equation 2* as:

$$RP_t^* = eRP_{t-1} + (1\text{-}e)\,RP_{t-1}^* \qquad \ldots 7$$

Expressing *Equation 6* in terms of RP_t^*:

$$RP_t^* = -\frac{a_0}{a_1} - \frac{a_2}{a_1}RAG_t - \frac{a_3}{a_1}RFA_t - \frac{a_4}{a_1}RA_t + \frac{1}{Za_1}RL_t - \frac{(1-Z)}{Za_1}RL_{t-1} - \frac{1}{a_1}U_t \qquad \ldots 8$$

Lagging *Equation 8* by one period:

$$RP_{t-1}^* = -\frac{a_0}{a_1} - \frac{a_2}{a_1}RAG_{t-1} - \frac{a_3}{a_1}RFA_{t-1} - \frac{a_4}{a_1}RA_{t-1} + \frac{1}{Za_1}RL_{t-1} - \frac{(1-Z)}{Za_1}RL_{t-2} - \frac{1}{a_1}U_{t-1} \qquad \ldots 9$$

Substituting *Equations 8* and *9* into *Equation 7:*

$$\Big[-\frac{a_0}{a_1} - \frac{a_2}{a_1} RAG_t - \frac{a_3}{a_1} RFA_t - \frac{a_4}{a_1} RA_t + \frac{1}{Za_1} RL_t - \frac{(1-Z)}{Za_1} RL_{t-1} - \frac{1}{a_1} U_t \Big]$$
$$= e\, RP_{t-1} + (1-e) \Big[-\frac{a_0}{a_1} - \frac{a_2}{a_1} RAG_{t-1} - \frac{a_3}{a} RFA_{t-1} + \frac{a_4}{a_1} RA_{t-1} + \frac{1}{Za_1} RL_{t-1} - \frac{(1-Z)}{Za_1} RL_{t-2} - \frac{1}{a_1} U_{t-1} \Big] \qquad \ldots 10$$

Multiplying both sides of *Equation 1]* by Za_1 , and solving for RL_t:

$$\begin{aligned} RL_t = {} & eZa_0 + eZa_1RP_{t-1} + Za_2RAG_t \\ & - (1-e)\, Za_2RAG_{t-1} + Za_3RFA_t \\ & - (1-e)\, Za_3\, \mathrm{RFA}_{t-1} + Za_4RA_t \\ & - (1-e)\, Za_4\, RA_{t-1} + [(1-e) + (1-Z)]\, RL_{t-1} \\ & - [(1-e)\,(1-Z)]\, RL_{t-2} \\ & + ZU_t - (1-e)\, ZU_{t-1} \end{aligned} \qquad \ldots 11$$

or compactly:

$$\begin{aligned} RL_t = {} & b_0 + b_1RP_{t-1} + b_2RAG_t + b_3RAG_{t-1} + b_4RFA_t \\ & + b_5RFA_{t-1} + b_6RA_t + b_7RA_{t-1} + b_8RL_{t-1} \\ & + b_9RL_{t-2} + W_t \end{aligned} \qquad \ldots 12$$

where $b_0 = eZa_0$, $b_1 = eZa_1$, $b_2 = Za_2$

$b_3 = -(1-e)\, Za_2$, $b_4 = Za_3$, $b_5 = -(1-e)\, Za_3$

$b_6 = Za_4$, $b_7 = -(1-e)\, Za_4$

$b_8 = [(1-e) + (1-Z)]$, $b_9 = -[(1-e)\,(1-Z)]$

$W_t = ZU_t - (1-e)\, ZU_{t-1}$

If *Equation 11* is further solved and the terms rearranged:

$$\begin{aligned} RL_t = {} & eZa_0 + eZa_1RP_{t-1} + Za_2\,(RAG_t - RAG_{t-1}) \\ & + eZa_2RAG_{t-1} + Za_3\,(RFA_t - RFA_{t-1}) \\ & + eZa_3\mathrm{RFA}_{t-1} + Za_4\,(RA_t - RA_{t-1}) \\ & + eZa_4RA_{t-1} + [(1-e) + (1-Z)]\, \mathrm{RL}_{t-1} \\ & - [(1-e)\,(1-Z)]\, RL_{t-2} + ZU_t - (1-e)\, ZU_{t-1} \end{aligned} \qquad \ldots 13$$

or compactly:

$$\begin{aligned} RL_t = \; & c_0 + c_1 RP_{t-1} + c_2 (RAG_t - RAG_{t-1}) \\ & + c_3 RAG_{t-1} + c_4 (RFA_t - RFA_{t-1}) \\ & + c_5 RFA_{t-1} + c_6 (RA_t - RA_{t-1}) \\ & + c_7 RA_{t-1} + c_8 RL_{t-1} + c_9 RL_{t-2} \\ & + V_t \end{aligned}$$

$$\begin{aligned} \text{where } c_0 &= eZa_0 \,,\; c_1 = eZa_1 \,,\; c_2 = Za_2 \\ c_3 &= eZa_2 \,,\; c_4 = Za_3 \,,\; c_5 = \mathrm{eZa}_3 \\ c_6 &= Za_4 \,,\; c_7 = eZa_4 \,,\; c_8 = [(1-e) + (1-Z)] \\ c_9 &= -[(1-e)(1-Z)],\; V_t = ZU_t - (1-e)\, ZU_{t-1} \end{aligned} \qquad \ldots 14$$

Accordingly, *Equations 12* and *14* can be written in the following functional forms respectively:

$$\begin{aligned} RL_t = \; & g\,(RP_{t-1}, RAG_t, RAG_{t-1}, RFA_t, RFA_{t-1}, \\ & RA_t, RA_{t-1}, RL_{t-1}, RL_{t-2}, W_t) \end{aligned} \qquad \ldots 15$$

and

$$\begin{aligned} RL_t = \; & h\,(RP_{t-1}, \Delta RAG_t, RAG_{t-1}, \Delta RFA_t, RFA_{t-1}, \\ & \Delta RA_t, RA_{t-1}, RL_{t-1}, RL_{t-2}, V_t) \end{aligned} \qquad \ldots 16$$

Equations 12 and *14* are known as the partial adjustment adaptive expectation models.

However, to arrive at the adaptive expectation model (without the adjustment model), the above processes are repeated, but *Equations 3, 5* and *6* are deleted and $RL_t^* = RL_t$ is assumed.