Phone: 301-8236212, Fax: 301-8238249, 8226204

Abstract

The ready availability of credit on easy terms has proved to be instrumental in stimulating agricultural investments until the 1970's. After that period, there was a marked slow-down in investment activity, a trend that characterised the entire Greek economy. This is primarily due to the fact that since then credit had been increasingly tight.

The aim of this paper is, on the one hand, to quantify Greek farmers' investment behaviour both at the aggregate level and by broad type of investment and, on the other hand, their demand for loans to finance this investment. Thus, a simultaneous equations econometric model was used to describe the demand for credit and investment by Greek farmers. In particular, credit needs for agricultural investment were estimated using a combination of a partial adjustment model and the adaptive expectations model. Farmers' investment behaviour was examined by employing a synthesized traditional model for aggregate and three types of investment. The rational expectations model is alternatively used. The traditional model was estimated by the 2SLS method and the rational expectations model by the generalized method of moments. Then, the empirical results derived from the rational expectations model are compared with those obtained from the application of the traditional model. Finally, the main findings are summarized and some policy implications are drawn.

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1.Introduction.[*]

The aim of this paper is to quantify, on the one hand, Greek farmer's investment behaviour both at the aggregate level and by broad type of investment, and on the other hand, their demand for loans to finance this investment. Such a quantitative approach to these two closely interrelated issues should provide valuable guidelines in any attempt to formulate efficient credit policies for institutional lenders to the farming sector.

A simultaneous equations econometric model was used to describe the demand for credit and investment by Greek farmers. In particular, credit needs for agricultural investment were estimated using a combination of a partial adjustment model and the adaptive expectations model. Farmers' investment behaviour was investigated by employing a synthesized traditional model for both aggregate and three individual types of investment.

Since the classical econometric model of adaptive expectations and partial adjustment have been criticised, mainly for their inadequate theoretical basis, the rational expectations model is alternatively used. Then, the empirical results derived from the rational expectations model are compared with those obtained from the application of the classical model.

The paper has seven sections. In the second section, the developments with regard to

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application of the classical model. Finally, the main findings are summarized and some policy implications are drawn.

2. **Credit and capital formation policy in Greek agriculture**

Between 1950 and 1992, total gross fixed asset formation in Greek agriculture increased in real terms at an average annual rate of 2.6%. The year-on-year rates of increase were considerably higher during the period up to 1973. After that year, there was a marked slow-down in investment activity, which accelerated again in the eighties, with the exception of 1977 and 1985. This phenomenon has also characterised the entire Greek economy (Baltas and Sakellis, 1988). Here, too, we observe more-or-less the same trend in private investment, despite the financial support provided to the agricultural sector by FEOGA since 1981.

In the same period, the shares of agricultural gross value added in GDP and of agricultural investment in total investment gradually declined, with minor yearly fluctuations, from 33% and 10% in 1950 to 15% and 6% in 1990 respectively, reflecting the farming sector's decreasing weight in the overall economy as the industrialisation process got under way. When we break total agricultural investment into its private and public components, we observe a fairly steady relationship on 1:2 in favour of private investment, except for a few years in the early sixties and in the late eighties (Diagram 1), when the private and public components of agricultural investment were almost equal.

Private fixed asset formation in agriculture is broken down in official statistical sources into the following types of investment: (i) non-residential buildings, (ii) machinery and equipment and (iii) other constructions and works. The bulk of private investment -around half or more-went to

1973 and then, showing a declining trend, more-or-less stabilized at considerably lower levels. As for public agricultural investment, by far the largest share, around nine tenths or more, was channelled to fixed assets other than machinery and equipment and, predominantly, to land improvements, which alone typically took up to three fifths or more of the total.

Turning now to the financing of private investment activity in the farming sector, the first thing to note is that until very recently the exclusive institutional lender to agriculture had been the state-owned Agricultural Bank of Greece (ABG). As a result, bank financing of the primary sector's investment is no other than the amount of medium and long-term credit extended by the ABG. Throughout the post-war period and up to the early eighties, an easy credit policy was adopted towards the farming sector. The main tools were a low interest rates regime (many of which were subsidised), longer pay-off periods, etc. The rationale for this treatment is twofold: first, the recognition, given the overwhelmingly family character of Greek agriculture, of owner-occupiers' limited scope for self-finance; second, the provision of a strong incentive for the sector's modernization and structural improvement.

Since 1984, credit has been increasingly tight, because of the liberalization of the banking system following Greece's entry to the E.C. (Diagram 3). Controls imposed on the size of agricultural credit and its allocation among various crops started to relax and were eventually removed. The final stage in this development was the conversion of the ABG from a state-owned, specialized institutional lender to a "normal" bank with the legal status of societe anonyme, whose sole shareholder, however, is the Greek State.

Throughout the period under discussion, ABG loans covered about 50% of private farm investment. In fact, ABG finance has followed the same trend as that of private farm investment. Thus, ABG loans as a percentage of private farm investment increased from 39% in 1958 to 71%

agriculture showed relative stability in relation to the rapid and frequent fluctuations of the inflation rate (Diagram 5). In fact, the adjustment of interest rates to changes of inflation occurred at considerably lower levels and with a time lag, except in the 1957-63 and 1987-92 subperiods. The recent developments in interest rates and their adjustment to levels equal to or even higher than inflation rates are a major factor in the drop in the demand for loanable funds by farmers (Diagram 5).

Regarding the share of ABG loans by type of investment, we notice that in the case of "non-residential buildings"[1] these ranged from 70 to 90 percent, while for "machinery and other equipment" ABG's share fluctuated between 14 and 86 percent. Lastly, bank lending for "other constructions and works" covered 40 percent of realised investment of this type, the major part of which was granted at subsidised interest rates until the late 1970's (Baltas, 1980).

3. The econometric model

In order to describe the interrelationship between financing and capital formation at the aggregate level and by type of investment, a simultaneous equations econometric model was employed comprising two behavioural equations: investment finance and private investment expenditure.

[1] For a few years the share of ABG loans in investment on "non-residential buildings" exceeded 100 percent. This can be attributed to the fact that some investment projects might have been realized first and financed by the ABG later when the required credits had become available.

of investment (I_t)2 and of the nominal interest rate (r_t)3 :

$$M_t^* = a_0 + a_1 I_t^* + a_2 r_t + u_t \quad 4 \qquad (1)$$

It is further assumed that the farmer gradually adjusts the actual level of financing to the desired level, depending on progress made in carrying out the investment projects and the availability of finance by the ABG. The rate of adjustment of actual financing towards a new equilibrium position depends on the difference between the current desired level of financing and the past actual level, as well as on the speed of adjustment of the desired level to the actual one:

$$M_t - M_{t-1} = \lambda (M_t^* - M_{t-1}) + v_t \quad 0 < \lambda \quad 5 \qquad (2)$$

Equation (2) indicates the way by which the actual level of financing adjusts towards its long-run equilibrium. The coefficient of adjustment (λ) represents the proportion of the adjustment towards equilibrium which occurs in a given time period. The adaption of investment towards the desirable level takes place according to the adaptive expectations model which postulates that the expected investment is adjusted in each time period by a proportion of the difference between the current period's actual investment (I_t)6 and its previous period expected investment.

$$I_t^* - I_{t-1}^* = \mu (I_t - I_{t-1}^*) + w_t \quad 0 < \mu \leq 1 \quad 7 \qquad (3)$$

Equation (3) can be written:

$$(1 - L + \mu L)\, I_t^* = \mu I_t + w_t \quad 8, \qquad (4)$$

where L is the lag operator. Therefore equation (2) becomes

$$\lambda M_t^* = (1 - L + \lambda L)\, M_t + v_t \quad 9 \qquad (5)$$

Substituting equation (4) and (5) into (1) and re-arranging terms we obtain:

$$M_t = b_0 + b_1 I_t + b_2 M_{t-1} + b_3 M_{t-2} + b_4 r_t + b_5 r_{t-1} + \varepsilon_t \quad 10, \qquad (6)$$

will be immediate and full (Alogoskoufis and Baltas, 1991, p.83). The reduced form simplifies to

$$M_t = b_{0'} + b_{1'} I_t + b_{2'} M_{t-1} + b_{3'} r_t + \varepsilon_{t'} \text{ 12,} \qquad (7)$$

where

$$b_0 = a_0\lambda, b_{1'} = a_1\lambda, b_{2'} = 1-\lambda, b_{3'} = \lambda a_2, \quad 13$$
$$b_{4'} = \lambda a_3, \varepsilon_{t'} = \lambda(u_t + w_t) + v_t.$$

Assuming that equations (1), (4) and (5) have been expressed in log-linear form[3], we can obtain the investment finance equation in a double-log formulation.

$$\log M_t = c_0 + c_1 \log I_t + c_2 \log M_{t-1} + c_3 \log M_{t-2} + c_4 \log r_t + e_t \text{ 14} \qquad (8)$$

In the case where μ=1, the double-log formulation is converted into:

$$\log M_t = c_{o'} + c_{1'} \log I_t + c_{2'} \log M_{t-1} + c_{3'} \log r_t + e_{t'} \text{ 15.} \qquad (9)$$

3.2Private investment expenditure

The traditional approach to modelling investment behaviour requires assumptions about both the adjustment process and the desired level of capital. Various theories about the adjustment process have been proposed. First, Koyck suggested a geometric distributed lag

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[2] Coefficients λ and μ enter asymmetrically in equation (6) and hence it is impossible to estimate them separately.

[3] In the double-log form it is assumed: first, that the desired level of financing is a log-linear function of the desired level of investment; second, that the adjustment of financing is proportional to the percentage difference between actual investment in the previous year and desired investment in the current year; and, third, that the rate of growth of desired investment is an exponential function of the ratio of actual investment in the current period to desired investment in the previous period. These assumptions refer to the expected values of logarithms.

The specification of desired capital has been based on four major theories. Clark's approach (1917), known as capacity utilization, assumed that desired capital is proportional to output because a firm's incentive to invest will increase with the output produced by capital. In agriculture, Girao, Tomek and Maint (1974) found that the change in output between periods is more appropriate to capture the demand for investment.

Third, Tinbergen (1938) proposed an alternative theory in which investment depends on the level of expected future profits. Higher profitability increases future expectations - which in turn stimulate current investment - and may also ease any constraints on the supply of funds to finance expansion.

Part of the rationale for using expected profitability involves the importance of internal liquidity. According to Campbell (1958), this "residual funds" hypothesis is relevant to agriculture because the sector is comprised mostly of family-based production units. Capital formation is achieved through the direct efforts of individual members and lower profitability or fewer available internal funds may prevent attainment of the desired capital stock level much more readily than in an industrial firm which has greater access to outside capital.

Jorgenson (1971), based on neoclassical theory, developed a model in which owners maximize the present value of their equity under conditions of perfect competition. The optimal capital stock is found by equating the marginal value product to its cost. Jorgenson and Siebert (1968) were the first to incorporate the influence of tax structures in the cost of capital.

The traditional investment models have been criticised because they have been based on *ad hoc* specifications for the adjustment process and desired capital level. More recent models have cast the firm in a dynamic optimization framework in order to derive its investment behaviour equation. Examples are found in Berndt, Buss and Waverman (1978) and subsequently in behaviour with respect to aggregate and three distinct types of investment. The independent theories were integrated into a single, unified approach, where desired capital (K_t^*)17 is a function of capacity utilization, ΔY_t18 (accelerator), the expected revenues (profits), Y_t19, the nominal interest rate, r_t20, and public investment in the agricultural sector G_t21. Since there is no unanimous agreement in applied economics on the measurement of expected revenue and no data is available on the latter, alternative variables are used: gross agricultural income with a time lag of n years Y_{t-n}22 or an implicit price deflator of agricultural income with a time lag of n years, P_{t-n}. 23

$$K_t^* = d_0 + d_1 \Delta Y_t + d_2\ Y_{t-n} \text{ or } d_{2'}\ P_{t-n} + d_3\ r_t + d_4\ G_t \text{24.} \qquad (10)$$

This equation for desired capital was substituted into Chenery's (1952) flexible accelerator model.

$$I_t = K_t - K_{t-1} = \lambda\,(K^*_t - K_{t-1})\text{25} \qquad (11)$$

The resulting investment equation is

$$I_t = \lambda d_0 + \lambda d_1 \Delta Y_t + \lambda d_2 Y_{t-n} \text{ or } \lambda d_{2'}\ P_{t-n} + \lambda d_3\ r_t + \lambda\ d_4\ G_t - \lambda\ K_{t-1}\text{.26} \qquad (12)$$

Following Gardner and Sheldon (1975) and Waugh (1977a,b), the speed of adjustment is then modeled as a linear function of available internal and external funds[4] relative to desired investment,

$$\lambda = \lambda_1 + \frac{\lambda_2 Y_t + \lambda_3 M_t}{K_t^* - K_{t-1}}\text{27,} \qquad (13)$$

where λ_1 , λ_2 28 and $\lambda_3$29 are constants to be determined. Completing

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[4] It is important to mention that, in the Greek case, bank financing covered 40 to 60% of private farm investment throughout the period.

$h_o=\lambda_1 d_o$; $h_1=\lambda_1 d_1$; $h_2=\lambda_1 d_2+\lambda_2$; $h_3=\lambda_1 d_2'+\lambda_2$; $h_4=\lambda_1 d_3$; $h_5=\lambda_1$; $h_6=\lambda_1 d_5$; $h_7=\lambda_3$.

In a log-linear form, the investment model is

$$\log I_t = h'_o + h_{1'} \log \Delta Y_t + h_{2'} \log Y_{t-n} \text{ or } h_{3'} \log P_{t-n} 33$$

$$+ h_{4'} \log r_t + h_{5'} \log G_t + h_{6'} \log K_{\tau-1} + h_{7'} \log M_t 34. \qquad (15)$$

Parameters d_2 and λ_2 cannot be determined because the number of unknown is greater than the number of equations.

4.The rational expectations model

The adaptive expectations and partial adjustment models have been criticised mainly for their inadequate theoretical basis and the statistical estimation problems arising when the ordinary least squares method is used[5]. The dynamic element in these models is introduced without a formal theory but on the simple ad hoc assumption that in each period, if we are dealing without discrete time, a fraction of the difference between the current period and the long-run equilibrium is eliminated. The criticism also refers to the underpininning adjustment and expectations mechanism in which these are expressed in terms of a geometric lag of past observations. However, it is claimed that to impose this structure on the data is unacceptable from the point of view of both economic theory and time series analysis because it is assumed that the expected values of past observations follow a moving average procedure in their first differences, i.e ARIMA

[5] See Baltas (1987), p.196.

yields, we can make use of a simplified model of rational expectations which consists of two behavioural equations. We assume that farmers are rational in the sense, that they respond to the various signals given out by the economic environment and formulate their own expectations about their agricultural income taking into consideration developments in the CAP, credit policy, etc.

The investment finance equation is given by

$$M_t = b_o + b_1 I_t^* + b_2 M_{t-1} + b_3 M_{t-2} + b_4 r_t + b_5 r_{t-1} + u_t \quad (16)$$

[35]

$$b_1 > 0;\ b_2 > 0;\ b_3 < 0;\ b_5 > 0,$$

and the private investment expenditure equation is given by

$$I_t = h_o + h_1 \Delta Y_t + h_2 Y_{t-n} \text{ or } h_3 P_{t-n} + h_4 r_t + h_5 G_t + h_6 K_{t-1} + h_7 M_t^* + v_t \quad (17)$$

[36]

$$h_1 > 0;\ h_2 > 0;\ h_3 > 0;\ h_4 > 0;\ h_5 > 0;\ h_6 < 0;\ h_7 > 0$$

where $I_t^* = E(I_t / T_{t-1})$ and $M_t^* = (M_t / T_{t-1})$[37] are the farmers' current expectations about investment expenditure and investment finance respectively (E is the mathematical expectation and T denotes the information set upon which expectations depend) and u_t, v_t are random disturbances with zero means and a diagonal variance-covariance matrix.

$$\begin{pmatrix} u_t \\ v_t \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_u^2 & \sigma_{12} \\ \sigma_{21} & \sigma_v^2 \end{pmatrix}\right] \quad (18)$$

[38]

Solving equations (16) and (17) for the two endogenous variables M_t and I_t (having first imposed the rational expectations hypothesis for $I_t^* = E(I_t/T_{t-1})$ and $M_t^* = E(M_t/T_{t-1})$), we obtain the following reduced form equations:

$$+\beta_8 E(G_t / T_{t-1}) + \beta_9 E(K_{t-1} / T_{t-1}) + \varepsilon_{2t},$$

where α and β are the reduced-form coefficients, which depend on b and h, and ε are the reduced-form disturbances, which depend on b, h, u and v. We may note from equations (19) and (20) that credit and investment depend on credit granted in the two previous years, the anticipated interest-rate of the current year and that of the previous year, the anticipated change in income, the income of previous years, the anticipated public investment and the capital stock of the previous year.

5.The data and the method of estimation

The behavioral equations of the model have been estimated using annual data obtained from the National Accounts of Greece and the Agricultural Bank of Greece. The data for capital stock have been supplied by T. Papaelia's study (1992) covering the 1972-90 period. For the estimation of the model at the aggregate level, the data used cover the period 1951-91, while the "by type of investment" available data cover the period 1958-91. A list of the variables employed in the model is provided in the Appendix.

As it is known, the OLS method is inappropriate[6] for estimating the parameters of the

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[6] The inappropriateness of OLS can be attributed to three main reasons: first, the estimates of the parameters would be biased; second, since both lagged and non-lagged endogenous variables are included in the system, the estimates would be inconsistent; and third OLS cannot trace out the interdependence of economic phenomena. Only a simultaneous consideration of the interaction between the model's variables can achieve this.

6. Empirical results

The use of the rational expectations model in our attempt to explain the interrelationship between financing and capital formation in Greek agriculture does not always provide clearly superior results to those obtained by the classical econometric model of adaptive expectations and partial adjustment (see Tables 1 and 2). This will be made evident below when we consider investment financing and capital formation at the aggregate level and by type of investment in which the limited explanatory capacity is a feature of all rational expectations models employed in our analysis.

In the case of the credit function for aggregate private investments (Table 1) we can see that capital formation is the major explanatory variable while credit extended in the previous year and the rate of interest only slightly affect the level of credit in the current period. As to the insignificant influence exerted on the level of borrowing by the amount of credit supplied in the previous year, this should be attributed to the fact that agricultural investment, and especially on-farm investment, tends to be smaller scale and to have a shorter gestation period than that undertaken in the other economic sectors. Similar results we reobtained in our previous study (Baltas, 1983). Second, it should be noticed that the interest rate elasticity value is very low (-0.07). This can be attributed to the credit rationing that prevailed over most of the period, which made credit supply given for many farmers.

Turning now to the aggregate investment function, the decisive variable was medium - and long - term credit (cf. Baltas, 1983). This is true for both econometric models. Farmers' decisions buildings" we can notice that the two models are almost identical (Tables 1 and 2). Thus, the speed of adjustment is the same for both credit and investment ($\mu=\lambda=0.9$), which means that, given its small scale, this type of investment is more or less completed within a single-year. With regard to the investment equation, the empirical results reveal that credit is the decisive factor in this case as well, whilst farmers' decisions to invest are influenced by the interest rate.

Next, we have the two functions relating to investments in "machinery and other equipment". The results under the rational expectations model were not substantially different from those under the classical econometric model. From the first equation, it is clear that the demand for loans is related to the level of investment and to the interest rate. The partial adjustment coefficient is $\lambda= 0.99$ and that of the adaptive expectations one is $\mu=1$. In other words, credit adjustment takes place within a little over one year while the rate of investment adjustment is even faster. This is explained by the ready availability of credit that has provided a strong incentive for the mechanization of Greek agriculture for many years.

Coming now to investment in "machinery and other equipment", we notice that this is heavily influenced by the level of agricultural income in the previous year implying a high elasticity value (3). As for the capital stock, it does have the anticipated sign and seems to play a negative role on farmers' decision to mechanize their production given the high degree of mechanization of the farming sector in recent years and the sector's structural weakness (small and multi-fragmented farms). In contrast to our previous study, the amount of credit fails the statistical significance test in the classical model, although it passes the test in the rational expectations model.

Finally, in the case of investment in "other constructions and works" a comparison of the estimates arrived at under the two approaches reveals that the rational expectations model of the

Indeed, in the classical econometric model the level of investment in "other constructions and works" is satisfactorily explained by the relevant amount of credit provided, by the level of farm income in the two previous years and by the interest rate. The statistical significance of public investment is explained by the fact that this variable is being overwhelmingly devoted to major land improvement and irrigation schemes and its infrastructural character is a precondition for undertaking on-farm investment.

In the classical econometric model of the credit equation, it is worth noting the strong influence exerted by the medium -and long-term loan variable lagged by two years, in contrast to what we found in the previous two types of investment. The obvious reason for this divergence is that because this category of investment mainly refers to on-farm land improvement and irrigation projects and to tree and vineyard planting, a longer gestation period is necessary.

7. Concluding remarks and policy implications

Having compared the empirical results obtained by the classical econometric model with those obtained by the rational expectations model, it is evident, on the basis of economic criteria, that one cannot be in favour of the latter approach. On the contrary, in two cases results were less satisfactory (aggregate private investment and other constructions and works). In the case of machinery and other equipment a slight improvement was observed while remained the same in non-residential buildings.

Overall, the empirical analysis shows that capital formation is the major explanatory variable of the demand for credit followed in some cases by the credit extended in the previous

1980's.

$a_o = -5.833, \quad a_1 = 1.633, \quad a_2 = -0.059, \quad \lambda = \mu = 1$

$$\text{(b) } \log RI_t = -2.569 + 0.682 \log RY_{t-2} - 0.183 \log r_t \; 0.270 \log G_t$$
$$(1.356) \quad (3.034) \quad (2.117) \quad (2.714)$$

$$+ 0.232 \log RM_t \qquad 42$$
$$(2.262)$$

$$N = 37, \quad \overline{R}^2 = 0.930, \quad DW = 2.064, \quad \hat{R}_1 = 0.479, \quad \hat{R}_2 = -0.400$$
$$(2.825) \quad (2.333)$$

Rational Expectations Model

$$\text{(a) } \log RM_t = -5.373 + 1.548 \log RI_t + 0.034 \log RM_{t-1} - 0.069 \log r_t$$
$$(5.698)(11.039) \quad (0.479) \quad (1.118)$$

$$N = 35, \quad \overline{R}^2 = 0.846, \quad DW = 1.497 \qquad 43$$

$$a_o = -5.562, \quad a_1 = 1.602, \quad a_2 = -0.071, \quad \mu = 1, \lambda = 0.966$$
$$\text{(b) } \log RI_t = -3.048 + 0.672 \log RY_{t-2} - 0.153 \log r_t + 0.592 \log RM_t$$
$$(3.335) \; (5.201) \quad (2.401) \quad (7.878)$$

44

$$N = 35, \quad \overline{R}^2 = 0.841, \quad DW = 1.472$$

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[7] Figures in parentheses denote t-statistics. The values $\hat{R}_1$ **Error! Main Document Only.** and $\hat{R}_2$ **Error! Main Document Only.** express the first- and second- order autoregressive coefficients. The values a_0, a_1, a_2, μ and λ show the estimates of the parameters of equations (1), (2) and (3).

$a_o = 43.224, \quad a_1 = 0.671, \quad \mu = \lambda\ 0.792 \quad \bar{e}_{RIK} = 0.592$

(b) $RIK_t = 400.944 - 22.881\, rK_b + 1.019\, RMK_t$

$(1.387) \quad (1.635) \quad (3.295)$

$N = 30, \quad \bar{R}^2 = 0.891, \quad DW = 2.162, \quad \hat{R}_1 = 0.388, \quad \hat{R}_2 = -0.052$ 46

$(1.847) \quad (0.261)$

$\bar{e}_{rK} = -0.291, \quad \bar{e}_{RMK} = 0.749$

Rational Expectations Model

(a) $RMK_t = -62.924 + 0.537RIK_t + 0.137RMK_{t-1} - 0.055RMK_{t-2}$

$(1.188) \quad (5.715) \quad (1.082) \quad (0.666)$

$N = 27, \quad \bar{R}^2 = 0.881, \quad DW = 2.508$ 47

$a_o = 68.562, \quad a_1 = 0.585, \quad \mu = \lambda = 0.958, \quad \bar{e}_{RIK} = 0.722$

(b) $RIK_t = 425.254 - 25.334rK_t + 0.979RMK_t$

$(1.239) \quad (1.603) \quad (2.904)$

48

$N = 27, \quad \bar{R}^2 = 0.902, \quad DW = 1.423, \quad \bar{e}_{rK} = -0.323, \quad \bar{e}_{RMK} = 0.727$

[8] Notes as for Table 1

$a_o = 683.826, \quad a_1 = 0.313, \quad a_2 = -42.625, \quad \mu = 1 \quad \lambda = 0.965$

$\bar{e}_{RIM} = 0.808, \quad \bar{e}_{rM} = -0.610$

(b) $RIM_t = -2985.915 + 60.798\, RPY_{t-1} - 0.118\, MK_{t-1} + 0.498\, RMM_t$
(1.078) (2.270) (1.467) (0.860)

$N = 17, \quad \bar{R}^2 = 0.424, \quad DW = 2.165, \quad \hat{R}_1 = 0.004,$ 50
(0.019)

$\bar{e}_{RPY_{-1}} = -3.267, \quad \bar{e}_{MK_{-1}} = -1.158, \quad \bar{e}_{RMM} = 0.186$

Rational Expectations Model

(a) $RMM_t = -361.772 + 0.412 RIM_t + 0.009 RMM_{t-1} - 36.529 rM_t$
(0.960) (3.251) (0.047) (2.588)

$N = 17, \quad \bar{R}^2 = 0.675, \quad DW = 1.589$
51

$a_o = 365.057, \quad a_1 = 0.416, \quad a_2 = -36.861, \quad \mu = 1, \quad \lambda = 0.991,$

$\bar{e}_{RIM} = 1.127, \quad \bar{e}_{rM} = -0.547$

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[9] Notes as for Table 1

(b) $\log RIL_t = -0.786 + 0.516 \log RY_{t-2} - 0.047 rL_t + 0.225 \log G_t$
(0.444)(2.905) (4.624) (1.964)

$+ 0.153 \log RML_t$
(2.208) 54

$N = 30, \quad \overline{R}^2 = 0.863, \quad DW = 2.473, \quad \hat{R}_1 = 0.021, \quad \hat{R}_2 = -0.688$
(0.136) (4.401)

Rational Expectations Model

(a) $\log RML_t = -3.538 + 1.181 \log RIL_t + 0.239 \log RML_{t-2}$
(2.153)(3.786) (1.421)
55

$N = 27, \quad \overline{R}^2 = 0.665, \quad DW = 1.959$

(b) $\log RIL_t = -5.392 + 0.936 \log RY_{t-2} - 0.069 rL_t + 0.468 \log G_t + 0.099 \log RML_t$
(2.153)(1.376) (2.431) (1.932) (0.456)
56

$N = 27, \quad \overline{R}^2 = 0.764, \quad DW = 1.867$

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[10] Notes as for Table 1

Endogenous variables

RM:Medium-and long-term loans for agricultural private investment deflated by the implicit price index of agricultural private investment, P,(1970=100).

RI:Agricultural private investment at constant 1970 prices.

RMK:Medium-and long-term loans for agricultural private investment in non-residential buildings deflated by the implicit price index of agricultural private investment in non-residential buildings, PK, (1970=100).

RIK:Agricultural private investment in non-residential buildings at constant 1970 prices.

RMM:Medium-and long-term loans for agricultural private investment in machinery and other equipment deflated by the implicit price index of agricultural private investment in machinery and other equipment, PM, (1970 = 100).

RIM:Agricultural private investment in machinery and other equipment at constant 1970 prices.

RML:Medium-and long-term loans for agricultural private investment in other constructions and work deflated by the implicit price index of agricultural private investment in other constructions and works, PC, (1970 = 100).

RIL:Agricultural private investment in other constructions and works at constant 1970 prices.

Predetermined variables

RM_{-i}:Real medium- and long-term loans for agricultural private investment lagged i years (i=1,2).

RMK_{-i}:Real medium - and long-term loans for agricultural private investment in non-residential buildings lagged i years (i=1,2).

RMM_{-i}:Real medium- and long-term loans for agricultural private investment in machinery and other equipment lagged i years (i = 1,2).

RML_{-i}:Real medium- and long-term loans for agricultural private investment in other constructions and works lagged i years (i = 1,2).

ΔY:Changes in gross agricultural income at constant 1970 prices.

RY_{-n}:Gross agricultural income lagged n years at constant 1970 prices.

RPY_{-n}:Implicit price index of agricultural income deflated by the implicit price index of gross domestic product (1970=100).

r:Nominal interest rate paid for medium - and long-term loans for agricultural private investment.

KK_{-1}:Agricultural private capital stock in non-residential buildings lagged one year at constant 1970 prices.

MK_{-1}:Agricultural private capital stock in machinery and other equipment lagged one year at constant 1970 prices.

LK_{-1}:Agricultural private capital stock in other constructions and works lagged one year at constant 1970 prices.

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