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A RECURSIVE MODEL OF CONSUMPTION: THE CASE OF TAIWAN'S FARM FAMILIES, 1964 - 66

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The present paper is a report on a study of the consumption behavior of Taiwan's farm families, 1964 - 66. The study was attempted to answer the following questions:

(1) The economy of Taiwan has observed a remarkable increase in its rate of national savings since 1960.[1] What we would like to investigate is how much the farm sector may have contributed to savings out of its increased income as compared to other sectors of the economy. In other words, the question is what is the saving potential of the farm sector out of its increased income.

(2) Taiwan is a densely populated island.[2] It is usually asserted that the island is overpopulated and this weakens the saving potential especially of the farm sector. We would therefore like to investigate whether the farm families of Taiwan are overpopulated.

(3) It is usually argued that the demonstration effect on consumption is an adverse factor to saving potentials of developing economies. We would also like to investigate whether there is

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a significant demonstration effect on consumption in the case of Taiwan's farm families.

The first question will be investigated by estimating the marginal propensity to consume (mpc) for the farm sector and comparing it with that of the economy as a whole. The second question will be studied by estimating the marginal cost of living and the marginal productivity of farm family members. A comparison of these two marginal estimates will show whether the farm families are overpopulated and whether the population density weakens the saving potential of the farm sector. Since educational level of the family head and off-farm contact of family members may increase the exposure of the family to demonstration effect, the third question will be analyzed by relating family consumption to educational attainment of family head and to a farm income ratio respectively. The farm income ratio is defined as the ratio of farm income to total farm family income and is supposed to be able to measure the degree of off-farm contact of family members. The entire study of all these questions will be conducted under a general recursive model of consumption, which links the farm families' consumption behavior to their income-generating behavior.

Data

Data used in this study are for Taiwan's bookkeeping farm families. The bookkeeping data were published in averages by the Provincial Government of Taiwan in its annual Report of Farm Record-Keeping Families in Taiwan. In order to conduct a cross-sectional study, we have obtained data of individual farm families from records kept by the Provincial Government. The study period is from 1964 to 1966. A good feature about this period is the relative stability of prices. According to Taiwan Statistical Data Book, 1968 [6, p.113], general prices of farm products were about 1% lower in 1965 than in 1964, and about 2% higher in 1966 than in 1965. On the other hand, prices paid by farmers were 0.8% higher in 1965 than in 1964 and 0.3% higher in 1966 than in 1965 for productive supplies; and 0.7% higher in 1965 than in 1964 and 3% higher in 1966 than in 1965 for daily necessities. It is because of the relative stability of prices and because of a large variation in the composition of the bookkeeping families from year to year that we will take advantage of large samples by pooling the three-year data together, treating each year-family as an individual data unit. The three-year sample includes a total of 707 year-families.

Our cross-sectional data include the following items: (1) Family Consumption, including purchased and farm-produced consumptions which are inclusive of almost every consumption item except housing cost; (2) Family Income, including farm income and off-farm income; (3) Farm Income, including sales and inputed values of farm output minus production cost; (4) Total Assets, which are mainly for productive use and can be classified into a category of "major productive assets" including values of farm land and livestock inventory, and a category of "other assets"; (5) Number of Family Adults; (6) Number of Family Youngsters; and (7) Education of Family Head in school years. While items (1) through (3) are flow data for the year, items (4) through (7) are stock data at year end. It may be noted that data on net wealth are not included in our three-year sample. If net wealth is a significant factor in determining consumption, a study without including it will yield distorted results. Fortunately, the Provincial Government of Taiwan published the bookkeeping data for 1963 on a family-by-family basis [7, 1963], which include the item of net wealth. A single-equation study of the consumption function including net wealth among others on the basis of 1963 data shows no signi-

ficant effect of net wealth on consumption.[3,4] We may therefore ignore the effect of net wealth in our large study.

The Recursive Model

The consumption function is specified as follows:[5]

$$\ell n C = \alpha_0 + \alpha_1 \ell n Y + \alpha_2 \ell n N_a + \alpha_3 \ell n N_c + \alpha_4 F + \alpha_5 E + U_1 \qquad (1)$$

where

C = family consumption in New Taiwan Dollars (NT$)

Y = family income in NT$

N_a = number of family adults

N_c = number of family youngsters

F = farm income ratio (farm income over total family income) in percentage point

E = level of educational attainment of family head in school years

U_1 = error term.

Total assets is not included in the consumption function because usually assets variable is included as a proxy of property income. In the case of Taiwan's farm families, almost all the total assets are productive in nature and the family income is a combination of labor and property incomes. Hence, once total

income is used as an explanatory variable in the consumption function, it is inappropriate to use total assets as an additional explanatory variable.[6,7] Although we would like to investigate the effect of "other assets" defined as total assets minus major productive assets, there is a difficulty inherent in the nature of our data. Since the assets data are year-end data and since, due to land reform regulations, the farm families of Taiwan are not in a good position to expand their major productive assets at will especially in so far as farm land is concerned, whenever they have a build-up of assets they will build up the more liquid "other assets". Hence, the year-end "other assets" data actually include the residual part of income which is not consumed during the year, i.e., savings of the year. Obviously it is inappropriate to include savings as an explanatory variable in the consumption function.[8] It is for these reasons that "other assets" is not specified in equation (1) either.

As mentioned before, income of farm families is a combination of labor and property incomes. Since farm labor in Taiwan is mainly provided by family members, the number of family members is not only a consumption determinant but also an income con-

tributor. Similarly, education of the family head may help to manage farm production better and is thus an income contributor in addition to being a consumption determinant due to possible demonstration effect. As calculated from sample data, the simple correlation coefficients between income and family adults, family youngsters and education of family head are respectively 0.5246, 0.2179, and 0.3029. Hence, either from theoretical or statistical point of view, a single-equation study of consumption is not appropriate. We therefore specify in addition an income-generating function as follows:

$$\ell n Y = \beta_0 + \beta_1 \ell n A_p + \beta_2 \ell n N_a + \beta_3 \ell n N_c + \beta_4 E + U_2 \qquad (2)$$

where A_p is major productive assets in NT$ and the other variables are as defined before.

Equations (1) and (2) constitute the recursive model of consumption with C and Y being endogenous variables and the others being exogenous variables. Since equation (1) is exactly identified, it can be estimated by the method of indirect least-squares (ILS).[9] The reduced-form of the model is

$$\ell n C = \gamma_0 + \gamma_1 \ell n A_p + \gamma_2 \ell n N_a + \gamma_3 \ell n N_c + \gamma_4 F + \gamma_5 E + U_3 \qquad (3)$$

plus equation (2) because the reduced-form for $\ell n Y$ is equation (2)

itself. Once the reduced-form equations are estimated by ordinary least-squares (OLS), consistent estimates of the structural coefficients of the consumption function can be derived according to the following relations:

$$\alpha_1 = \gamma_1/\beta_1 \tag{4}$$

$$\alpha_o = \gamma_o - \alpha_1\beta_o \tag{5}$$

$$\alpha_2 = \gamma_2 - \alpha_1\beta_2 \tag{6}$$

$$\alpha_3 = \gamma_3 - \alpha_1\beta_3 \tag{7}$$

$$\alpha_4 = \gamma_4 \tag{8}$$

$$\alpha_5 = \gamma_5 - \alpha_1\beta_4 \tag{9}$$

Since the ILS estimation of the structural coefficients of equation (1) is equivalent to instrumental-variable estimation, the significance test of the estimates of the structural coefficients can be conducted by way of instrumental-variable estimation.[10]

Each of the structural coefficients of equation (1) measures the partial effect of the variable on consumption. Similarly, each of the structural coefficients of equation (2) measures the partial effect of the variable on income. Each of the reduced-form coefficients of equation (3) especially for those variables which appear in both equations (1) and (2), i.e., N_a,

N_c and E, measures the gross effect of the variable on consumption. As can be seen from equations (6), (7), and (9), the gross effect on consumption is the sum of two component effects: one may be called the "net" consumption effect and the other, the "income" consumption effect. The former is the variable's effect on consumption net of its effect on income and is measured by its consumption coefficient (α). The latter is the variable's effect on consumption out of its effect on income and is measured by income elasticity of consumption (α_1) times its income coefficient (β). These remarks are important to our later interpretation of the results of empirical estimation.

Empirical Estimation

When the recursive model is applied to our sample of 707 farm families, we first estimate the reduced-form equations (2) and (3) as follows:

$$\begin{aligned} \ln Y = {} & 6.2579 + \underset{(32.890)}{0.2898}\ln A_p + \underset{(16.229)}{0.3689}\ln N_a + \underset{(11.488)}{0.1425}\ln N_c \\ & + \underset{(5.415)}{0.0359}\ E \qquad\qquad R^2 = 0.5302 \qquad\qquad (10) \\ & \qquad (4.016) \end{aligned}$$

$$\ln C = \underset{(44.606)}{7.0954} + \underset{(13.489)}{0.2109}\ln A_p + \underset{(16.014)}{0.4306}\ln N_a + \underset{(9.004)}{0.1985}\ln N_c$$

$$\underset{(-4.722)}{-0.0031F} + \underset{(3.437)}{0.0261E} \qquad R^2 = 0.5722 \qquad (11)$$

where figures in parentheses are computed t-values of the estimates. Using relations (4) through (9), we then derive the estimation of equation (1) as follows:[11]

$$\ln C = \underset{(18.308)}{2.5413} + \underset{(5.406)}{0.7277}\ln Y + \underset{(5.245)}{0.1621}\ln N_a + \underset{(-6.300)}{0.0948}\ln N_c$$

$$\underset{(-6.300)}{-0.0031F} - \underset{(-0.004)}{0.0000E} \qquad (12)$$

As indicated by the computed t-values, the estimates of all the structural and reduced-form coefficients are significant even at the 0.5% level of a one-tail test except for the structural consumption coefficient of education whose estimate is practically equal to zero.

The ILS estimate of income elasticity of consumption (α_1) as given in equation (12) is 0.7277 which implies an mpc including housing cost equal to 0.5880 for an average family of the sample.[12] Considering that the average family of the sample is somewhat upward biased in terms of income, the mpc of an average family of the farm sector as a whole should be higher than what is estimated above for an average family of the sample. For example,

the average area of cultivated land per family for all farm families of Taiwan is 1.05 hectares in 1964 - 66,[13] while that for the bookkeeping farm families is 1.32 hectares in the same period.[14] The latter is about 0.3 standard deviation larger than the former.[15] Since no information is available for income comparison, farm land may be used as the best proxy of farm income. As calculated from our estimates, the mpc is 0.6155 for families with income 0.3 standard deviation lower than that of the average family of the sample. Hence, 0.6155 may be taken as an estimate of the mpc of an average family of the farm sector as a whole.[16] National income of Taiwan increased from 1960 to 1966 by NT$ 40,513 million and from 1963 to 1966 by NT$ 24,305 million at 1964 constant prices while the rate of net national savings climbed from 6.6% in 1960 to 12.1% in 1963 and to 18.5% in 1966 [6]. This implies a national mpc equal to 0.65 over the period from 1960 to 1965 or equal to 0.62 over the period from 1963 to 1966. These figures are very close to what was estimated for an average family of the farm sector as a whole. Hence, our answer to the first question set out at the beginning of the paper is that the farm sector may have contributed to savings out of its increased income at

least no less than other sectors of the economy.

As given in equation (11), the estimated gross consumption effect of family adult or gross adult elasticity of consumption (γ_2) is 0.4306. This is equal to the sum of the estimated "net" consumption effect (α_2) which is equal to 0.1621 as given in equation (12) and the estimated "income" consumption effect ($\alpha_1\beta_2$) which is equal to 0.2685 or 0.7277 times 0.3689 as given in equations (12) and (10) respectively. The estimated gross consumption effect of adult implies an mpc or marginal living cost with respect to adult equal to NT$ 3,576 for an average farm of the sample when an estimate of housing cost[17] is added to consumption data. On the other hand, the estimated adult elasticity of production (β_2) is 0.3689 which implies a marginal productivity of adult equal to NT$ 3,792. As compared with his marginal living cost, the marginal adult of an average family actually earns more than he consumes. Similarly, the marginal living cost of youngster is calculated at NT$ 1,769 with housing cost included, and the marginal productivity is calculated at NT$ 1,572. The youngster's marginal productivity is almost sufficient to cover his marginal living cost. Based upon these findings, our answer to the second question under investigation

is that one can hardly claim that the farm families of Taiwan are over-populated if by over-population one uses either the criterion of zero marginal productivity or the criterion of excess of marginal living cost over marginal productivity.

As is given in equation (11), the estimated gross consumption effect of education is 0.0261 which is equal to the "income" consumption effect of education because the "net" consumption effect of education is practically zero. The zero estimate of the "net" consumption effect of education indicates that there is no demonstration effect on consumption via education. The estimated gross consumption effect of education means that when the education of the family head is one school year higher, its consumption is 2.6% higher. This implies an mpc of education equal to NT$ 796 for an average family of the sample.[18] On the other hand, the estimate of the production coefficient of education is 0.0359 as given in equation (10). This means that if the education of the family head is increased by one school year, its income will be increased by 3.6%. The marginal productivity of education for an average family of the sample implied herein is NT$ 1,355. Since its marginal productivity is greater than its marginal propensity to consume, education

is not only a contributor to income but also a contributor to savings.[19]

Since the farm-income ratio variable does not appear in the income-generating function, its coefficient in the consumption function is the same as in the reduced-form equation. In other words, this variable does not have an "income" consumption effect and, hence, its gross consumption effect is identical to its "net" consumption effect. The estimated consumption effect of farm-income ratio is -0.0031 which means that when a family earns its income by 1% more from off-farm sources than from farm production, its consumption will be 0.3% higher. The imputed mpc for an average family of the sample is -NT$ 95. Its interpretation is that if one average family's income is generated by 1% more from off-farm sources than another, its consumption will be NT$ 95 higher. Since the computed t-value of the estimate of the "net" consumption effect of farm-income ratio is -6.300 which is significant even at the 0.05% level of a one-tail test, there is a highly significant demonstration effect via off-farm contact.

Summary of Findings

Since the farm families' income is a combination of labor and property incomes and since there are strong correlations between income and wealth and between income and assets, either from theoretical or statistical point of view, we found no reason to include either wealth variable or assets variable in the consumption function of Taiwan's farm families. On the other hand, such exogenous variables as family members and education of family head are not only consumption determinants but also income contributors, the consumption behavior of the farm families can, more appropriately, be studied by a recursive model that links the farm families' consumption behavior to their income-generating behavior.

According to the fitting of the recursive model, the income elasticity of consumption is estimated to be 0.7277 which implies an mpc equal to 0.5880 for an average family of the sample and an mpc equal to 0.6155 for an average family of the farm sector as a whole. As compared with the national mpc of Taiwan which is 0.65 over the period from 1960 to 1965 or 0.62 over the period from 1963 to 1966, we conclude that the farm sector may have contributed to savings out of its

increased income at least no less than the other sectors of the economy of Taiwan.

The marginal living cost for an adult member of an average family of the sample is estimated to be NT$ 3,576 and his marginal productivity is estimated to be NT$ 3,792. The marginal living cost for a youngster member is estimated to be NT$ 1,769, about half of the adult's, and his marginal productivity is estimated to be NT$ 1,572. The marginal adult of the family actually earns more than he consumes and the marginal youngster's earning is almost sufficient to cover his living expenses. One can, therefore, hardly claim that the farm families of Taiwan are over-populated when over-population is either defined by zero marginal productivity or by excess of marginal living cost over marginal productivity.

Education of the family head was found to be a significant determinant of family income. The marginal productivity of education per year of schooling is estimated to be NT$ 1,355 for an average family of the sample. Education of the family head also raises consumption of the family. The mpc of education per school year is estimated to be NT$ 796. Since education-increased income is well above education-increased consumption, education is also a contributor to savings. The consumption

effect of education net of the part of consumption that is linked to its income effect is estimated to be practically zero. This not only means that there is no demonstration effect on consumption via education, but also means that higher-educated farm families consume more just because they earn more.

Also with the demonstration effect in mind, we specified in the consumption function an unconventional variable, farm-income ratio, to measure the extent of off-farm contact. Our findings strongly support the hypothesis of demonstration effect on consumption via off-farm contact. The estimation shows that when one average family's income is generated 1% more from off-farm sources than from farm production as compared with another, its consumption is NT$ 95 higher.

FOOTNOTES

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[1] The rate of net national savings increased from 6.6% in 1960 to 12.1% in 1963 and 18.5% in 1966 [6, p.19].

[2] Population density of Taiwan is 365 per square kilometer at the end of 1967, one of the highest in the world [6, p.181].

[3] The consumption function includes as explanatory variables farm family income, (Y); net wealth, (W); number of family adults, (N_a); number of family youngsters, (N_c); and the farm income ratio, (F). The single-equation estimation of the function over 277 families is as follows:

$$\ell n C = \underset{}{4.1783} + \underset{(12.747)}{0.5541}\,\ell n Y + \underset{(0.032)}{0.0008}\,\ell n W + \underset{(6.159)}{0.2201}\,\ell n N_a + \underset{(2.894)}{0.0813}\,\ell n N_c$$

$$\underset{(-1.705)}{-0.0017}\,F \qquad\qquad R^2 = 0.6558$$

where figures in parentheses are t-values of the estimates. The t-value of the estimated coefficient of net wealth is 0.032 which is highly insignificant.

[4] 1963 is not included in our study period because education of family head data are not available for 1963.

[5] The consumption function and the income-generating function to be introduced later have also been fitted in simple linear forms. Since the log-linear forms produced a better fit, we will report only the result of the log-linear relations.

[6] As calculated from sample data, total assets has a simple correlation with income equal to 0.7495 while its correlation with consumption is only 0.6502. This indicates total assets is more an income-determining factor than a consumption-determining factor.

[7] This is also true for wealth variable and this furnishes another reason for not including net wealth in our consumption function. As calculated from 1963 data, the simple correlation coefficient of net wealth and income is 0.5771 while that of net wealth and consumption is merely 0.4417. This is similar to the situation of total assets mentioned in footnote 6.

[8] When a single-equation estimation is applied to a consumption function including "other assets" in addition to variables specified in equation (1), the estimated coefficient of "other assets" is -0.0185 with a t-value equal to -1.350 which is not significant at the 5% level of a one-tail test. This provides a statistical ground for not including "other assets" in the consumption function.

[9] As is well known, the ILS estimation of equation (1) is equivalent to instrumental-variable estimation using all the exogenous variables as instrumental variables in the present case.

[10] Cf. [2, pp. 551-6].

[11] The t-values of the estimates are obtained from equivalent instrumental-variable estimation as mentioned before.

[12] By an average family we mean a family with mean values of the variables. The mpc is calculated as follows:

$$\text{mpc} = \hat{\alpha}_1 (\text{apc}) = \hat{\alpha}_1 \exp\ (\overline{\ell n C} - \overline{\ell n Y})$$

where apc stands for average propensity to consume which includes the estimated housing cost given in footnote 17 below. This formula will be similarly used for N_a and N_c.

[13] Estimated from land and family data given in [5, p.8 and p. 11].

[14] Weighted average of corresponding data given in [7, 1964 through 1966].

[15] The standard deviation is estimated from data given in [7, 1964 through 1966] to be equal to 0.90 hectares.

[16] The estimated mpc may seem to be unusually low for a less-developed economy as compared with estimates for other countries [4]. It is low, however, not because the estimated income elasticity is low. For example, our estimate of income elasticity (0.7277) is comparable to Lee and Phillips' estimates for U.S. households [3]. Their estimates of income elasticity of consumption are 0.744 for urban households, 0.742 for rural nonfarm households and 0.519 for farm households. Our estimate is low because the apc of farm families is low. The calculated apc for an average family of the sample is 0.8080 and that for an average family of the farm sector as a whole is 0.8458. These figures are nevertheless comparable to national figures of Taiwan to be discussed below.

[17] The housing cost is estimated as 5% of average value of farm buildings reported in [5, 1964 through 1966].

[18] The mpc of E or F is calculated as follows:

$$\text{mpc} = \gamma_5 \text{ (or } \gamma_4) \exp(\overline{\ell n C})$$

where $\overline{\ell n C}$ includes the estimated housing cost mentioned before.

[19] This is consistent with Freedman's findings mainly for urban households of Taiwan: higher-educated people tend to consume more but are also able to make more income and even save more [1]. According to our findings of zero demonstration effect via education, we may go one step further and state that higher-educated farm people consume more only because they can earn more income.

REFERENCES

[1] Freedman, D.S., "The Role of the Consumption of Modern Durables in Economic Development," Economic Development and Cultural Change, Oct. 1970, Vol. 19, pp. 25-48.

[2] Kmenta, J., Elements of Econometrics, New York: Macmillan, 1971.

[3] Lee, Feng-Yao and K. E. Phillips, "Differences in Consumption Patterns of Farm and Nonfarm Households in the United States," American Journal of Agricultural Economics, Nov. 1971, Vol. 53, pp. 573-582.

[4] Mikesell, R. F. and J. E. Zinser, "The Nature of the Savings Function in Developing Countries: A Survey of the Theoretical and Empirical Literature," Journal of Economic Literature, March 1973, Vol. 11, pp. 1-26.

[5] Taiwan, Chinese-American Joint Commission on Rural Reconstruction, Taiwan Agricultural Statistics, 1901 - 1965.

[6] _____ , Council for International Economic Cooperation and Development, Taiwan Statistical Data Book, 1968.

[7] _____ , Provincial Government of Taiwan, Report of Farm Record-Keeping Families in Taiwan, 1963, 1964, 1965, 1966.