CHANGES IN FARM LEVEL SAVINGS AND CONSUMPTION IN TAIWAN 1960-1970

DISSERTATION

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* * * * *

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The objectives of this study were: (1) to document the growth of farm family income in Taiwan during the 1960's, (2) to assess and compare estimates of cross sectional savings capacity with estimates derived from time series analysis, (3) to identify how changes in farm family income and other factors affected consumption saving behavior, and (4) to draw appropriate policy recommendations about the possibilities for mobilizing voluntary institutional savings from rural areas in developing countries based on the findings.

Cross sectional and time series data were obtained from a Taiwan Farm Record-Keeping project. Data from 53 panel farms covering the period 1964-1970 were also analyzed. The method of analysis used was consumption function estimation through the use of least squares regression techniques. Linear, quadratic, double logarithmic and semi-logarithmic functions were used to estimate the cross sectional savings

capacity for the various homogeneous economic subgroups in different years. A Keynesian consumption function and a modified Duesenberry's saving function were used to estimate the time series saving potentials for various subgroups. The fixed coefficient regression and the random coefficient regression methods were additional techniques used to estimate an aggregate consumption function from the panel data.

Significant increases in farm families' real income occurred in Taiwan during the 1960's. An important part of this increase in income came from off-farm employment. Yearly variation in farm income resulted mainly from changes in weather.

The random coefficient regression technique proved to be the most tenable method in estimating the aggregate function since the panel farms were heterogeneous in consumption behavior. Based on the estimates from this method, income, lagged consumption, net worth, and the rate of return to operating assets yielded positive consumption responses. The rate of return to total assets and the ratio of farm-income-to-farm-family-income were negatively related to consumption expenditures.

Overall the results of the analysis suggested that there was a surprisingly high savings capacity among Taiwanese farmers during the 1960's. The cross sectional savings

potentials were generally higher than that of time series. Taiwanese policies encouraged the voluntary mobilization of these resources into the credit system and also encouraged farmers to invest in their own operating units. Attractive interest rates, the availability of savings institutions, and security that savings would be repayed were necessary conditions. In other less developed countries policy makers should be alert to similar possibilities. Being alert to saving mobilization possibility and responding with appropriate savings incentives were the two major recommendations of the study.

DEDICATION

TO MY PARENTS

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CHAPTER I

INTRODUCTION

The Problem and Study Justification

It is generally recognized that increases in production capital are a strategic factor in economic development. As a result a number of studies have focused on capital formation in the industrial sector. Although one of the main contributions of the agricultural sector to the economic growth is the transference of capital into the industrial sector in the early stage of development, little is known about capital formation in agriculture itself. In part this is due to the difficulty of measuring rural capital formation. In the early stages of development subsistence considerations in the agricultural sector are important. Estimation of farm income and consumption by farm households is very difficult due to the nonmonetized character of the sector.[1] This has resulted in very little knowledge about how farmers spend increases in income during early phases of development. Furthermore, rural capital formation is largely an accretionary process

[1]Balbir S. Sahni, Saving and Economic Development, (Calcutta, India: Scientific Book Agency, 1967).

carried out inside a multitude of rural farm-household units. Little of this capital passes through national accounts and is therefore difficult to quantify. Despite the lack of firm evidence, it has been widely assumed that marginal propensities to save in rural areas were negligible in the developing countries.[2]

Taiwan provides an excellent opportunity to explore this problem. During the last two decades Taiwanese agriculture has contributed substantially to the industrial sector's growth. It has also sharply increased its own capital base or productive capacity. Intensive utilization of farm land has become one of the significant features of Taiwanese agriculture owing to the scarcity of arable land and relatively dense population. Dramatic changes in the agricultural sector during the past few years include new crop varieties, sharp increases in fertilizer use, increases in use of mechanization, expansion in credit use, and significant increases in farm family income. How farmers in Taiwan allocated this additional income between consumption and savings is the central focus of this study. The main source of data used is Taiwan Farm Record-Keeping data assembled over the 1960 to 1970 period. Panel data from 53 farms covering the period of 1964 through 1970 are also used in the study. Very little of this type of farm

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[2] W. Arthur Lewis, The Theory of Economic Growth, (Homewood, Illinois: Richard Irwin, Inc., 1955), p. 216.

level analysis of capital formation has been done.

Objectives of the Study

The main objective of the study is to explore Taiwan farmers' consumption and savings behavior and to see what factors affected this behavior during 1960-70. This will include focusing special attention on the savings capacity of farmers during this period.

The specific objectives of this study are as follows:

1. to document the growth of farm family income in Taiwan during the 1960's.

2. to assess and compare estimates of cross-sectional savings capacities with estimates derived from time series analysis.

3. to identify how changes in farm family income and other factors have affected consumption-savings behavior.

4. to draw appropriate policy conclusions about the possibilities for mobilizing institutional savings from rural areas in developing countries.

The Hypotheses

The hypotheses to be tested in the study are as follows:

1. The marginal propensities to save of the farms with large farm size, low dependency ratios, and/or high ratios of farm-income-to-farm-family-income are greater

that those of farms with small farm size, high dependency ratios, or low income ratios.

2. Short-run marginal propensities to save based on cross sectional analysis are hypothesized to be greater than long-run marginal propensities to save estimated from time series analysis.

3. The consumption function is hypothesized to be positively related to current income, lagged consumption and net worth, and to be negatively related to the ratio of return to capital and the ratio of farm-income-to-farm-family-income.

4. The sample farms are hypothesized to be heterogeneous in consumption behavior. This hypothesis will be tested by using statistical models with random coefficients.

Organization

The discussion which follows is divided into six chapters. Chapter II presents a brief review of literature on consumption theory. Chapter III presents an overview of the methodology used in this study. Chapter IV briefly reviews the economic development policies of Taiwan in the past two decades, and also summarizes some general descriptive farm data presented as background for the study. Chapter V discusses how changes in farm income were distributed into savings and consumption among various economic sub-groups of farmers and compares the cross section and time series

marginal propensities to save.

Chapter VI presents the estimates of the consumption function based on panel data and identifies how changes in current income and other variables affected consumer behavior. Chapter VII summarizes the findings, presents some policy conclusions and suggests additional related topics for further research.

CHAPTER II

REVIEW OF LITERATURE

Most economic research on consumption-savings behavior in less developed countries (LDC's) has been restricted to macro studies. The limited amount of research done on household savings in LDC's has been based mainly on cross sectional analysis. There have been few studies which have attempted to use both cross sectional and time series data in the same analyses. The main concern of the macro studies has been with how consumption-savings behavior was related to economic stability, a train of thought which was first stimulated by J. M. Keynes.[1]

Due to the lack of appropriate data, even fewer studies on rural household savings have been done in LDC's. It has been widely assumed that little savings capacity exists in rural areas of LDC's. In the past two decades, interest in rural savings has focused on how to transfer agricultural

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[1]J. M. Keynes, General Theory of Employment, Interest and Money, (New York: Harcourt, Brace, & World, Inc., 1936).

savings or surpluses to the industrial sector.[2] Little emphasis has been placed on farmers' voluntary financial savings and the role they might play in overall development. As a result of this lack of research it is not clear how various agricultural policies might affect farmers' savings behavior. That is, how some policies may stimulate and other policies discourage voluntary rural savings.

The main focus of this review of literature will be on the factors affecting consu ption-savings behavior in the rural areas of less developed countries, especially Asia. Only a partial review of general consumption studies will be attempted.[3] The following general topics which have been extensively discussed in the literature as major determinants of consumption will be emphasized in the review: (1) the level of per capita income and wealth, (2) lagged consumption, (3) the rate of increase in income

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[2]Ragnar Nurkse, Problems of Capital Formation in Underdeveloped Countries, (New York: Oxford University Press, 1953); W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labor," Studies in Economic Development, edited by B. Okun and R. W. Richardson, (New York: Holt, Rinehart, and Winston, 1961), pp. 279-303; and G. Ranis and J. C. H. Rei, " A Theory of Economic Development," American Economic Review, Vol. 51, September 1961, pp. 533-565.

[3]For an excellent review of this general literature see: Daniel B. Suits, "The Determinants of Consumer Expenditure: A Review of Present Knowledge," Macroeconomics: Selected Readings, edited by Walter L. Johnston and David R. Kamerschen, (Boston: Houghton Mifflin Co., 1970); also Michael K. Evans, Macroeconomic Activity: Theory, Forecasting, and Control, (New York: Harper and Row, 1969), pp. 13-72.

and the permanent income hypothesis, and (4) income sources and age composition of the family.

Income and Wealth as Determinants of Consumption

J. M. Keynes stressed income as the major determinant of consumption.[4] He assumed that if tastes, price expectation, income distribution and asset holdings were unchanged, a smaller proportion of income tends to be consumed at higher absolute levels of income. That is, the marginal propensity to consume will be lower at higher absolute levels of income. He did not clearly point out whether this behavior was hypothesized to hold over time or to simply apply to the behavior of different income groups at a given time period.

The variable "wealth" was introduced into the expansion of the Keynesian consumption function by Pigou. He suggested that the real value of liquid assets would be one of the important factors affecting consumption. Pigou held that a rise in the real value of liquid assets will cause an increase in wealth and this will stimulate consumption expenditures.[5] Similarly, Ackley also argued that the accumulation of wealth accounts for a rise in the level

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[4] J. M. Keynes, op. cit.

[5] A. C. Pigou, "The Classical Stationary State," Economic Journal, Vol. 53, December 1943, pp. 343-351.

of consumption, assuming that income is unchanged.[6]

Traditional Keynesian consumption studies have been carried out in several cross-section and international comparison studies. For instance, Houthakker's study indicated that domestic savings as a proportion of national income in developed countries is larger than that in less developed countries.[7] Friend and Taubman concluded from their study that the "assets effect" in the savings function, seemed to make a significant negative contribution to savings.[8]

Lagged Consumption

Klein, Goldberger and others have argued that consumption analysis ought to include current income and past patterns of consumption as independent variables.[9] Lagged consumption represents previously acquired habits. Consumers

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[6]Gardner Ackley, Macroeconomic Theory, (New York: The MacMillan Co., 1961), pp. 269-273.

[7]H. S. Houthakker, "On Some Determinants of Saving in Developed Countries and Underdeveloped Countries," in Problem in Economic Development, edited by E. A. G. Robinson, (London: MacMillan and Co., 1965), pp. 212-227.

[8]Irwin Friend and Paul Taubman, "The Aggregate Propensity to Save, Some Concepts and Their Application to International Data," The Review of Economics and Statistics, Vol. 48, May 1966, pp. 113-123.

[9]Lawrence R. Klein, Economic Fluctuations in the United States, 1921-1941, (New York: John Wiley & Sons, 1950); and Lawrence R. Klein and Arthur Goldberger, An Econometric Model of the United States, 1929-1952, (Amsterdam: North Holland Publishing Co., 1955).

are slow to change those habits. Also, the purchase of a consumer durable in one time period should affect expendutire decisions in later time periods. That is, it is not necessary to buy a refrigerator every year.

Evans has argued that estimates of the coefficients in the consumption function vary depending on the length of the time period covered.[10] In the short run the average propensities to consume (APC) are generally larger than the marginal propensities to consume (MPC). In the long run the APC and MPC are of similar magnitudes. In short-run consumption analysis a close relationship exists between consumption and income for a certain time period, say, a year. Average propensities to consume decline as income increases, and they are usually less than unity and greater than the marginal propensities to consume.

Rate of Growth of Income and the Permanent Income Hypothesis

A number of Post-Keynesian economists have argued that there is a close relationship between consumption and the rate of income growth. The reason given to support this proposition is that consumers with the same current income but with unequal previous incomes appear to have different consumption patterns. The consumer feels more affluent when his income is rising. In general, he is

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[10]Michael K. Evans, op. cit.

inclined to spend a higher proportion than an individual with decreasing income. Duesenberry's relative income hypothesis, Modigliani and Ando's life cycle hypothesis and Friedman's permanent income hypothesis are based on this relationship. Friedman emphasized that consumption is dependent upon expected future income and wealth. He also suggested that consumption was the result of a continuous decline of the effect of past habits rather than a "ratchet effect" as suggested by the Duesenberry-Modigliani hypotheses.[11]

According to Friedman's "permanent income hypothesis," the individual's consumption expenditure is determined by his permanent income, that is, by expected lifetime earnings and wealth. He argues that income is made up of two components: permanent income and transitory income. These income concepts are easy to state but hard to observe precisely. Therefore, the test of the validity of this hypothesis has always rested on the consistency of the individual's reactions to total income changes, or to the average movement of total income changes.

In a recent international study, Friend and Taubman reported that tastes together with income and assets largely determine savings.[12] The more homogeneous the

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[11] Milton Friedman, A Theory of the Consumption Function, (Princeton: Princeton University Press, 1957).

[12] Irwin Friend and Paul Taubman, op. cit.

groups, the smaller the tastes problem is in the savings function. They redefined permanent income as the average movement of three years' income. They concluded that marginal propensities to save out of permanent income and out of transitory income are quite different depending on whether the income variable is measured in absolute level or as a change from previous income. Williamson's study in Asia treated the influence of permanent and transitory incomes on aggregate personal savings.[13] His finding was that marginal propensities to save (MPS) out of transitory income were greater than out of measured and permanent income, and that transitory income contributes greatly in MPS in Asia.

Income Sources and Age Composition of Household

Another important proposition in cross-section consumption analysis has been that the proportion of an individual's disposable income which is saved depends on his income sources and age composition of the household. Kelley and Williamson looked at household savings among 490 urban and rural families in Indonesia interviewed in

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[13]Jeffrey Williamson, "Personal Saving in Developing Nations: An Intertemporal Cross-Section from Asia," The Economic Record, June 1968, pp. 194-210.

1958 and 1959.[14] They concluded that (1) sources of income and occupation are major determinants of savings, and that (2) savings is a function of the age composition of the household.

Leff's study supported the proposition that the age composition of the household is a determinant of savings.[15] He introduced the dependency ratio into the savings function. The dependency ratio was defined as the sum of the population aged 14 or less, plus those aged 65 or older over the total number of people in the family. Including this ratio in the analysis improved the statistical fit over just including per capita income as the only independent variable in the consumption function.

Mizoguchi and Joshi also suggested that household savings are dependent upon the sources of income and occupation of the head of the household.[16] Mizoguchi's analysis of Japanese data indicated that the farm household savings

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[14]Allen Kelley and Jeffrey Williamson, "Household Saving Behavior in the Developing Economics: The Indonesian Case," Economic Development and Cultural Change, Vol. 16, No. 3, April 1968, pp. 385-403.

[15]Nathaniel H. Leff, "Dependency Rates and Savings Rates," The American Economic Review, Vol. 78, December 1969, pp. 886-896.

[16]Toshiyuki Mizoguchi, "Consumption Functions and Saving Functions for Japanese Farmer's Families in Post-War Japan," Rural Economic Problems, Vol. 4, No. 1, December 1967, pp. 20-35; and V. H. Joshi, Saving Behavior in India," Indian Economic Journal, Vol. 17, April-June 1970, pp. 515-528.

ratio was lower than that of non-farm worker's. He used Japanese time-series and cross-section data for the period 1950 to 1965. Joshi reported that the MPS in the rural household sector was very low, averaging only 0.012, and that in the urban household sector the MPS was higher, averaging 0.119. His analysis was based on Indian cross sector data for the 1951-52 to the 1962-63 period.

As suggested by Adams and Singh a comprehensive study of firm-household consumer behavior should include the above mentioned determinants, as well as the rates of return to various investment alternatives.[17] Little economic research has been done on these aspects of the saving problem. Empirical finding by Mizoguchi, however, hint that the savings ratio of farm households have a close relationship with the productivity of agricultural resources.[18]

Some attention has also been directed at the sociological factors affecting savings behavior.[19] Extended family assistance, the wife's role, and the hierarchy of

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[17]Dale W Adams and I. J. Singh, "Capital Formation and the Firm-household Decision Making Process," Economics and Sociology Occasional Paper No. 111, The Department of Agricultural Economics and Rural Sociology, The Ohio State University, October 1972.

[18]Toshiguki Mizoguchi, op. cit.

[19]Gelia Tagumpay-Castillo, "Sociological Factors in Savings and Capital Accumulation: Some Research Findings," Philippine Economic Journal, Second Semester, 1964, pp. 189-197.

values held by the community influence the savings decision. Unfortunately, these factors are very difficult to quantify.

CHAPTER III

METHODOLOGY AND VARIABLE DEFINITIONS

This chapter outlines the analytic models which were used to explain consumption behavior of Taiwan farm families in the decade of the 1960's. The theoretical framework and statistical models are presented in the first section of this chapter. The deviation of the models is discussed in the following section.

Theoretical Framework and Statistical Model

A major thrust in the study is to determine how Taiwanese farmers distribute their income between consumption, savings, and on-farm investment. This includes determining what factors affect their consumption-savings behavior. Economic theory as well as empirical studies suggest that income is a dominant factor in consumption. However, other variables may contribute to changes in consumption. In this study the degree to which current income affects consumption is tested by time-series and cross-section data over the 1960-1970 period. The relationships between consumption and a number of other variables are also measured through the use of panel data from 53 farms spanning the 1964-1970 period.

The first set of models used in the analysis were designed to derive the short run, cross sectional marginal propensities to consume for various economic sub-groups of farmers over various years. In most cross-section consumption-savings studies, usually only one functional form, either simple linear or double logarithmic function, have been used to test the coefficients of the consumption function. Generally, ordinary least squares has been used. Houthakker, however, got a better goodness of fit in his study of international data using double logarithmic functions.[1] He also used consumption rather than savings as the dependent variable since savings may be negative and consequently does not fit into a double logarithmic equation. For the same reason consumption rather than savings will be used in this study as the dependent variable.

A main concern with the cross-section analysis is that, over time, the average and marginal propensities to consume may change substantially. That is, the goodness of fit of a particular function may change through time. Therefore, four functional forms which are the linear, the quadratic, the double logarithmic, and the semi-logarithmic will be used in this study to test the coefficients of per capita income. The goodness of fit of these various functional forms will be tested. The statistical models

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[1]H. S. Houthakker, op. cit.

for the four functional forms are as follows:

(1) $C_i = b_o+b_1Y_i+U_i$ (2) $C_i= b_o+b_1Y_i+b_2Y_i^2+U_i$

(3) $\log C_i = b_o+b_1 \log Y_i+U_i$ (4) $C_i= b_o+b_1 \log Y_i+U_i$

C stands for current per capita consumption expenditures including cash and non-cash expenses for a calendar year. Y is current per capita farm family income from both farm and off-farm sources for a year. U represents the disturbance term. All the coefficients are the parameters in the respective equation and i indicates the individual unit for each sub-group.

These functional forms were used in the preliminary analysis of the data. The major objective here was to test the extent to which current income explained consumer behavior, to see how the shape of the simple consumption function changed during the 1960's, and to compare the marginal propensities to save between different subgroups under the same classification.

A second set of models were used to derive the time-series marginal propensities to consume or to save for the different sub-groups over the 1960-1970 period. The variables used for these models were measured in 1970 New Taiwanese dollars (NT dollars).[2] That is current NT $ were deflated

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[2]The conversion market rate of NT dollars into US dollars was NT$41.02 = US $1 in 1970: Taiwan Statistical Data Book 1971, published by Council for International Economic Cooperation and Development, (CIECD), (Taipei, Taiwan: CIECD, 1971), p. 127.

by using the Index of prices-received-by-farmers.[3]

Two functions were used in a second set of analyses in estimating the time-series marginal propensity to save: (1) a Keynesian consumption function where real per capita income was the independent variable and real per capita consumption expenditure was the dependent variable, and (2) a modified Duesenberry's saving function where the saving ratio was a function of the growth rate of real per capita income. The statistical models are:

(1) Keynesian consumption function $C_t = b_o + b_1 Y_t + U_t$

(2) Modified Duesenberry's saving function $\frac{S_t}{Y_t} = b_o + b_1 \frac{Y_t}{Y_{t-1}} + U_t$

C stands for real per capita consumption expenditures including cash and non-cash expenses for a calendar year. Y represents real per capita farm family income for a calendar year. S denotes real per capita savings for a calendar year, which is defined as per capita farm family income minus consumption expenditure. U is the disturbance term. All coefficients are the parameters in the equation, and t indicates the time period for each sub-group.

The major objectives in this set of models were to show which function had the best fit and to test the hypothesis that, the cross section marginal propensities

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[3]This Index is reproduced in Appendix A.

to save are higher than those derived from the time-series data.

A third more comprehensive analysis was carried out on the data through the use of a lagged consumption function model. The model was applied to 53 panel farmers who participated in the record keeping project from 1964-1970. Per capita consumption expenditure served as the dependent variable in this model. This expenditure was linearly regressed against per capita farm family income, net worth, the ratio of farm-income-to-farm-family-income, lagged consumption, and the rate of return on capital. All variables were expressed on a per capita basis. They are also measured in terms of 1970 NT dollars deflated by the previously mentioned Index of prices-received-by-farmers. The single equation was expressed in the following way.

$$C_{it} = b_0 + b_1 X_{1it} + b_2 X_{2it} + b_3 X_{3it} + b_4 X_{4it} + b_5 X_{5it} + U_{it}$$

$$(i = 1, \ldots, n, \quad t = 1, \ldots, T)$$

Where C = Real per capita consumption expenditures including cash and non-cash expenses for a calendar year.

X_1 = Real per capita farm family income including cash and non-cash income from both farm and off-farm sources for a calendar year.

X_2 = The ratio of farm-income-to-farm-family-income.

X_3 = Real per capita net worth at the beginning of a year.

X_4 = Real per capita consumption expenditure including cash and non-cash expenses for the previous calendar year.

X_5 = Average rate of return to on-farm investment in a previous year.

U denotes the disturbance term.

The b_0, b_1, ..., b_5 are the parameters.

The i indicates the individual farm and t stands for time in year.

In a fourth set of analyses the variables which are statistical significance by ordinary least squares estimation will be included in fixed coefficient regression (FCR) and random coefficient regression (RCR) models. The objective of this set of models is to compare the estimation equations by three different methods--the ordinary least squares, the FCR and the RCR which are explained in the next section of this chapter.

An explanation of the definition, composition, and economic rationale for the use of the variables in these three sets of models are presented in the following.

Consumption

Per capita consumption expenditures is the dependent variable in this analysis. It is defined as the consumption

expenditures of the farm family for the calendar year divided by the total number of people residing on the farm who are dependent on the household for a living. Adjusting consumption figures as well as other independent variables to a per capita basis removes the family size influence. No adjustments are made for age composition of the family. Per capita consumption expenditures include all cash and non-cash outlays that occurred during the year for living expenses. Consumption expenditures include purchases of food, consumer durables, recreation, education, medical care, and all other living expenses. Consumption expenditures also include produce raised on the farm and directly consumed by the family.

Farm Family Income

Per capita farm family income includes net farm income plus net income derived from off-farm activities. Farm income is defined as the net farm income derived from on-farm enterprises. The value of farm products includes those consumed by the family and those sold. Imputed management returns, capital depreciation, and a value for family labor used on farm have not been subtracted from this net income figure. Off-farm income mainly comes from labor income outside the farm and from sideline activities. As with the consumption figure the farm family income for the calendar year is divided by the total number of people

residing depending on the household for a living.

Lagged Consumption

As stated earlier in the review of literature, the influence of past consumption behavior on present consumer behavior will be represented by lagged consumption not lagged income.[4] Per capita lagged consumption includes all cash and non-cash consumption expenditure for the previous calendar year. It is presumed that the lagged consumption expenditure and current consumption expenditure are positively related.

Net Worth

A basic modification of Keynesian theory has been the argument that wealth should be included in the consumption function. Net worth is here used to represent the wealth effect on consumption.[5] Net worth at the beginning of the year influences the consumption expenditure during the year. By definition in the Taiwan farm record-keeping data, net worth in the balance sheet is total assets minus total liabilities at the beginning of the year. Hence, net worth represents the assets owned by the farm including both physical and monetary assets. The value of rental property and equipment are excluded.

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[4]Daniel B. Suits, op. cit.

[5]Net worth can also represent a proxy of permanent income.

Ratio of Income Sources

The ratio of income sources is total farm income divided by total farm family income. Farm family income is made up of farm income and off-farm income. A farm family is closer to full-time-farming the higher the ratio.

Rate of Return on Capital

The most appropriate measure of the rate of return to capital would be the marginal efficiency of investment as derived from production function analysis.[6] Lacking this type of information it was decided to use as a proxy gross farm income divided by capital. Capital is classified into three groups: (1) stock capital or total assets (this is mainly made up by land), and (2) total assets excluding value of land, (3) flow capital or operating assets during the year directly contributing to production. These three different definitions of capital will be used as explanatory variables for the farmers' consumer behavior of Taiwan. It is assumed in this study that when the rate of return on capital is high, consumption expenditures will decline and savings will rise.

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[6]An alternative way of measuring production efficiency is based on the rate of return to labor. This would be a suitable measurement in the farm activity with relatively scarce labor and ample capital.

Model Estimation

Three sets of equations will be estimated from the cross section, time series and panel data respectively by the stepwise ordinary least squares methods. Only under certain assumptions does the ordinary least squares method yield unbiased and consistent estimates of the coefficients for the general function as follows:

$$Y = b_0 + b_1X_1 + b_2X_2 \ldots + b_kX_k + U$$

Where Y is the dependent variable, X_1, X_2 ... X_k are independent variables, b_0, ..., b_k are the parameters, and U is the disturbance term. These assumptions are: (1) that the disturbance terms are random variables with zero expectation, (2) that the disturbance terms are uncorrelated and embody the constant-variance specification, (3) that the independent variables are a sample which is a set of fixed numbers, and (4) that there is no exact linear relationship among the independent variables, and the number of parameters is less than the number of observations.

A main interest of this study is to estimate a macro consumption function from the panel data. Estimation of the macro parameters of the mean vectors of the coefficients can be obtained by aggregating individual micro equations. The FCR and RCR methods will be used as the techniques in this part of the study. The main difference between the

FCR and the RCR methods is as follows. The parameters are assumed to be fixed in the FCR model. On the other hand, in the RCR model, the parameters are presumed to be random coefficients. In the RCR model it is assumed that the sample is heterogeneous in behavior. A review of the methodological developments of estimating panel data or time series of cross section data is presented in Appendix B.

The main limitation of the panel data used in this study is that each farm has only six observations from 1965-1970. Since lagged variables are involved in the function, each farm loses one year. Thus, four independent variables, at most, can be included in the macro consumption function. The variables which are statistically significant at the ten percent level in the stepwise ordinary least squares analysis will be included in the FCR and the RCR models.

FCR Estimation

Consider the model

$$Y_{it} = b_{1i} X_{1it} + \ldots + b_{ki} X_{kit} + U_{it} \quad \begin{array}{l} i = 1, \ldots, n \\ t = 1, \ldots, T \end{array}$$

which represents a temporal cross-section situation with the subscript t standing for time periods, and i, the micro individual units. There are n individual units and each individual has the same number of observation T. Each observation Y_i is a linear function of the observation X_i

plus the disturbance term U_i. The compact matrix notation can be written for the model as

$$\underset{(T\times 1)}{Y_i} = \underset{(T\times k)}{X_i}\ \underset{(K\times 1)}{b_i} + \underset{(T\times 1)}{U_i} \qquad (i = 1, \ldots n)$$

To make statistical inference possible for the above two equations it is necessary to assume the following:

(i) $E\ U_i = 0$

(ii) $E\ U_i\ U_j' = \begin{cases} \sigma\ \text{iiI} & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases}$

Assumption (i) states that the disturbance term is a random variable with expectation zero. Assumption (ii) states that this disturbance term has variance σ_{ii} and covariance zero for each individual macro unit. That is, there is an absence of any serial correlation in the disturbance term. It also implies that U_i and U_j are mutually independent.

A further assumption in the FCR model is that the regression coefficient vector b_i in the matrix equation are non-random or fixed for all n individual units, that is $b_1 = b_2 = \ldots = b_n = b$. Under this strict assumption, the macro equation can be formed. If these coefficient vectors are non-random but different for all individuals, that is, $b_1 \neq b_2 \neq \ldots \neq b_n$, then only n individual regression equation can be estimated, but the macro equation cannot be formulated.

Under the assumption of $b_1 = b_2 = \ldots = b_n = b$, the

macro equation is

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} X_1 & & & \\ & X_2 & & 0 \\ 0 & & & \\ & & & X_n \end{bmatrix} b + \begin{bmatrix} U_1 \\ U_2 \\ \vdots \\ U_n \end{bmatrix}$$

Converted into the compact matrix form

$$Y = Xb + U$$

$$(nTx1) \quad (nTxk) \quad (Kx1) \quad (nTx1)$$

Where $Y = [Y_1', Y_2', \ldots Y_n']$, $X = \text{diag}\ [X_1', \ldots, X_n']$ is a block diagonal matrix, and $U = [U_1' \ldots U_n']$. The expectation vector and variance-covariance matrix of the macro disturbance term are:

$$EU = 0 \text{ and } EUU' = \Omega = \begin{bmatrix} \sigma_{11}I & & & \\ & \sigma_{22}I & & 0 \\ & & & \\ 0 & & & \\ & & & \sigma_{nn}I \end{bmatrix}$$

The best linear unbiased estimator of or BLUE of b can be obtained by Aitken's generalized least squares.[7]

$$\hat{b} = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}Y = \left[\sum_{i=1}^{n} \frac{X_i'X_i}{\sigma_{ii}}\right]^{-1} \left[\sum_{i=1}^{n} \frac{X_iY_i}{\sigma_{ii}}\right]$$

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[7]Phoebus J. Dhrymes, Econometrics: Statistical Foundations and Applications, (New York: Harper & Row, 1970), pp. 150-153.

and the variance-covariance matrix of the estimator b is

$$\text{Varcov } \tilde{b} = (X'\Omega^{-1}X)^{-1} = \left[\sum_{i=1}^{n} \frac{X_i'X_i}{\sigma_{ii}}\right]^{-1}$$

Since the σ_{ii}'s are unknown, the unbiased estimator $\hat{\sigma}_{ii}$ is used to substitute for this unknown parameters. The estimate of b is a consistent and an asymptotically efficient estimator.

$$\hat{\sigma}_{ii} = \frac{Y_i'M_iY_i}{T-k}$$

Where $M_i = I - X_i(X_i'X_i)^{-1}X_i'$ is an idempotent matrix obtained from the ordinary least squares of each ith equation.

RCR Estimation

The RCR estimation procedure will use the same basic equation as was used in the FCR analysis:

$$\underset{(T\times 1)}{Y_i} = \underset{(T\times k)}{X_i}\,\underset{(K\times 1)}{b} + \underset{(T\times 1)}{U_i} \qquad (i = 1 \ldots, n)$$

The basic concept of the RCR model is that the intercept and the slope of a regression equation are random variables.[8] A set of assumptions for the model are:

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[8] P.A.V.B. Swamy, "Efficient Inference in a Random Coefficient Regression Model," Econometrica, Vol. 38, No. 2, March 1970, pp. 311-323.

(i) $E\,U_i = 0 \quad ; \quad E\,U_i U_j' = \begin{cases} \sigma_{ii} I & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases}$

(ii) $E\,b_i = \bar{b} \quad ; \quad E(b_i - \bar{b})(b_j - b)' = \begin{cases} \Delta & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases}$

(iii) b_i and U_j are mutually independent for $i \neq j$

Assumption (i) states that the disturbance term U_i has mathematical expectation of zero, variance σ_{ii} and covariance zero for each individual unit. It implies the serial independence of the disturbance term for each individual, and U_i and U_j are uncorrelated and independent for $i \neq j$. Assumption (ii) states that the coefficient vector is distributed across units with the same mean and the same variance-covariance matrix for the individual unit. But the variance-covariance matrix of the coefficients for the two pairwise individuals is zero which implies that b_i and b_j are uncorrelated andindependent for $i \neq j$. Assumption (iii) indicates b_i is not affected by the jth individual's disturbance term.

Let $b_i = \bar{b} + d_i$ $(i = 1, \ldots, n)$ where d_i is a kxl vector of random elements. The mean and variance of d_i are:

$$Ed_i = 0 \quad ; \quad E\,d_i d_j' = \begin{cases} \Delta & \text{if } i = j \\ 0 & \text{if } i \neq j \end{cases}$$

The above equation can, therefore, be written

$$Y_i = X_i \bar{b} + X_i d_i + U_i \qquad (i = 1, \ldots, n)$$

The main point is to estimate $\bar{b}$ in the aggregate equation. The matrix form of the macro equation is then derived.

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} \bar{b} + \begin{bmatrix} X_1 & & & \\ & X_2 & & 0 \\ 0 & & \ddots & \\ & & & X_n \end{bmatrix} \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_n \end{bmatrix} + \begin{bmatrix} U_1 \\ U_2 \\ \vdots \\ U_n \end{bmatrix}$$

The above equation can be written more compactly as:

$$\underset{(nTx1)}{Y} = \underset{(nTxk)}{X}\underset{(kx1)}{\bar{b}} + \underset{(nTxnT)}{D}\underset{(nTx1)}{d} + U$$

where $Y = [Y_1', \ldots, Y_n']$; $X = [X_1', \ldots, X_n']$, $D = \text{diag}\,[X_1', \ldots, X_n']$, $d = [d_1', \ldots, d_n']$ and $U = [U_1', \ldots, U_n']$

Let $V = Dd + U$ be the disturbance term in the macro equation. The macro disturbance term V has

$$E\,V = 0 \quad ;$$

$$EVV' = \Sigma = \begin{bmatrix} X_1 \Delta X_1' + \sigma_{11} I & & & \\ & X_2 \Delta X_2' + \sigma_{22} I & & 0 \\ & & \ddots & \\ 0 & & & X_n \Delta X_n' \sigma_{nn} I \end{bmatrix}$$

The macro coefficient vector $\bar{b}$ can be efficiently estimated from using panel data be applying Aitken's generalized least squares to the above compact matrix operation. The BLUE of $\bar{b}$ can be obtained as:

$$\bar{b} = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}\,Y$$

$$=\left[\sum_{i=1}^{n} X_i'\left\{X_i\Delta X_i'+\sigma_{ii}I\right\}^{-1}X_i\right]^{-1}\sum_{i=1}^{n} X_i'\left\{X_i\Delta X_i'\sigma_{ii}I\right\}^{-1}Y_i$$

Applying the matrix result suggested by Rao,[9] then

$$\hat{\bar{b}} = \sum_{i=1}^{n} W_i^*\hat{b}_i$$

where $W_i^* = \left[\sum_{i=1}^{n}\left\{\Delta+\sigma_{ii}(X_i'X_i)^{-1}\right\}^{-1}\right]^{-1}\left\{\Delta+\sigma_{ii}(X_i'X_i)^{-1}\right\}^{-1}$

and $\hat{b} = (X_i'X_i)^{-1}X_i'Y_i$

The variance-covariance matrix of the estimator $\hat{\bar{b}}$ is

$$\text{Varcov}\,(\hat{\bar{b}}) = \left[\sum_{i=1}^{n} X_i'\left\{X_i\Delta X_i' + \sigma_{ii}I\right\}^{-1} X_i\right]^{-1}$$

$$= \left[\sum_{i=1}^{n}\left\{\Delta+ \sigma_{ii}(X_i'X_i)^{-1}\right\}^{-1}\right]^{-1}$$

The estimator $\hat{\bar{b}}$ can be recognized as the weighted average of the estimator of $\hat{b}_i$ $(i = 1,\ldots, n)$ with weights inversely proportional to their covariance matrix.

Since Δ and σ_{ii} $(i = 1,\ldots, n)$ are usually unknown, the unbiased estimator $\hat{\sigma}_{ii}$ can be obtained as shown earlier and the unbiased estimator $\hat{\Delta}$ is

$$\hat{\Delta} = \frac{Sb}{n-1} - \frac{1}{n}\sum_{i=1}^{n}\hat{\sigma}_{ii}\,(X_i'X_i)^{-1}$$

where $Sb = \sum_{i=1}^{n}\hat{b}_i\hat{b}_i' - \frac{1}{n}\sum_{i=1}^{n}\hat{b}_i\sum_{i=1}^{n}\hat{b}_i'$ is obtained from the ordinary least squares of each ith equation.

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[9] C. R. Rao, Linear Statistical Inference and Its Applications, (New York: John Wiley & Son, 1965), p. 29 (2.9).

After obtaining $\hat{\Delta}$ and σ_{ii} the estimate of $\bar{b}$ is, therefore, a consistent, asymptotically normal, and efficient estimator with asymptotic variance-covariance matrix.

In short, an attempt will be made to estimate a macro consumption function by the different sets of estimators of the FCR and the RCR. The preliminary analysis, via use of ordinary least squares of panel data, will test the explanatory power of each variable. The variables which have significant effects on the dependent variable will be involved in the macro consumption function. Then the macro consumption function will be estimated in the following two ways:

1. Panel data will be used to estimate the macro equation and also used to identify those coefficients which are assumed to be non-random.
2. Panel data will also be used in estimating the macro equation with the assumption that all coefficients are randomly distributed through the years.

CHAPTER IV

AGRICULTURAL DEVELOPMENT POLICIES AND ECONOMIC CONDITIONS OF TAIWAN FARMERS

For a clear understanding of consumption-savings behavior some background on development policies in Taiwan is necessary. Taiwan agriculture has made tremendous progress in the past two decades. A few of the highlights of this remarkable growth will be covered in this brief discussion. Part of this progress has been due to the agricultural policies which are discussed in the first section of this chapter. The final section of the chapter presents an overview of the general economic condition of Taiwan farm record-keeping families, and evaluates the extent to which this sample represents the whole island.

Agricultural Development Policies in Taiwan

Taiwanese agriculture has performed very well. As can be seen in Table 1, agricultural output responded very rapidly to development activities during the 1950's and 1960's. Overall the annual growth of output increased at a rate of approximately five percent per year. Growth rates in fisheries and livestock production were much higher than this average.

Table 1 Indexes of Agricultural Production in Taiwan 1952-1970

Year	Crops	Forestry Product	Fisheries	Livestock	General Agricultural Index	General Agricultural Index Growth Rate
			(Base 1952 = 100)			
1952	100	100	100	100	100	---
1954	110	104	122	128	112	2.2
1956	117	107	151	143	121	7.8
1958	131	146	175	180	140	7.5
1960	134	179	190	171	143	1.4
1962	146	201	234	201	159	2.1
1964	163	241	271	214	178	12.7
1966	185	228	309	254	201	5.2
1968	202	248	404	306	226	6.1
1970	204	247	483	362	237	6.0
Averages						
1953-1960						4.6
1961-1968						5.9
1961-1970						5.2
1953-1970						4.9
1965-1970						4.9

Source: Council for International Economic Cooperation and Development, (CIECD), Taiwan Statistical Data Book 1971, (Taipei, Taiwan: CIECD, 1971), pp. 35-36.

The value of agricultural products and processed agricultural products exported more than tripled during the past two decades.[1] The predominant factor was a strong increase in value of processed agricultural exports.

During the Second World War agricultural output decreased rather sharply. By 1952, however, agricultural production moved back up to its prewar levels. The migration of large numbers of mainlanders to Taiwan, substantial deficit spending and lagging agricultural production caused prices to move up sharply during the late 1940's and early 1950's. In order to counter inflation, very high nominal interest rates were offered to attract institutional savings.[2] This, plus the increase in agricultural production resulting from favorable prices for farm products and the supply of chemical fertilizer from United Nations Relief and Rehabilitation Administration (UNRRA) helped to curb price increases during the late 1950's.[3]

A number of important changes were made in rural areas which boosted agricultural development after 1950.

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[1]Council for International Economic Cooperation and Development (CIECD), Taiwan Statistical Data Book 1971, (Taipei, Taiwan: CIECD, 1971), p. 134.

[2]Irvine J. Reed and Robert F. Emery, "Interest Rates as an Anti-Inflationary Instrument in Taiwan," The National Banking Review, Vol. 4, No. 1, September 1966, pp. 29-39.

[3]Teng-hui Lee, Intersectoral Capital Flows in the Economic Development of Taiwan, 1895-1960, (Ithaca, New York: Cornell University Press, 1971), pp. 32-46.

The land reform program started in 1949 was successfully completed by the end of 1953. It was carried out through three successive stages: rent reduction, sale of public land, and finally giving land to the tiller. This comprehensive land reform sharply improved farmers' incentives to invest, increased the labor absorptive capacity in rural areas, and vastly improved the access of rural people to the widening income streams.[4] A broadly based increase in rural effective demand, plus a major build up of on-farm capital have resulted. Major public investments in irrigation facilities, rural education, rural roads, and agricultural research also increased rural productivity capacity. In the earlier 1950's, only six years of compulsory education were offered. In the 1960's this was increased to nine years.

Various four-year development plans provided an additional boost to agricultural production. These were carefully balanced policies which gave farmers substantial production incentives.[5] The first four-year plan started in 1953. In order to make the best utilization of limited

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[4]Chao-chen Chen, "Land Reform and Agricultural Development in Taiwan," Conference on Economic Development of Taiwan, (Taipei, Taiwan: Academia Sinica, June 1967), pp. 126-152.

[5]Council for International Economic Cooperation and Development (CIECD), Four Year Plan for Economic Development, plans one through five, (Taipei, Taiwan: CIECD, 1953, 1957, 1961, 1965 and 1969).

land resources emphasis was placed on developing water resources, effective use of fertile land and marginal slope lands, and preventing further fragmentation of farm land. Investment in irrigation, utilization of more fertilizer, uses of new crop varieties, diversification of production, and better crop-rotation systems have made major contributions to the growth of crop production. A livestock improvement program introduced modern feeding techniques and control of livestock diseases.

Probably the most remarkable aspect of Taiwan's agricultural experience has been the creation and strengthening of rural institutions which support the developmental process. The Taiwanese have shown a good deal of flexibility and imagination in constructing new organizational rules for linking together and stimulating economic behavior.[6] Agricultural institutions, especially government agencies, Farmers' Associations, and the Joint Commission on Rural Reconstruction (JCRR), made a substantial contribution to agricultural development.[7] The contribution of the government agricultural agencies in the 1950's consisted

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[6]S. C. Hsieh and T. H. Lee, Agricultural Development and Its Contributions to Economic Growth in Taiwan, Economic Digest Series No. 17, (Taipei, Taiwan: Joint Commission on Rural Reconstruction, April 1966), pp. 103.

[7]Wen-fu Hsu, "The Role of Agricultural Organizations in Agricultural Development in Taiwan," Conference on Economic Development of Taiwan, (Taipei, Taiwan: Academia Sinica, June 1967), pp. 112-125.

mainly of creation of infrastructure and the institutional framework, and in later years concentrated on the promotion and extension of technology. Farmers' Associations have also played a major role in Taiwan's rural development. They have not only provided a political organization for farmers, but have also provided agricultural financing, and product and input marketing services.

The growth performance of agriculture in the face of steady and substantial net transfers of capital out of rural areas is a testimony to the effectiveness of Taiwan's agricultural policies. Heavy land and irrigation taxes, forced savings, low administered product prices, high input prices, and rural-to-urban migration of human capital have siphoned off a substantial amount of capital from agriculture.[8] Taiwan has clearly invested a good deal in its agricultural sector, but it has also clearly withdrawn a good deal of capital.

Several recent changes in Taiwan's agriculture are of particular interest. The first is that the rural labor force in Taiwan has reached its peak and is starting an absolute decline. A drop in population growth rate, an

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[8] T. H. Lee, op. cit.; A. B. Lewis, "The Rice-Fertilizer Barter Price and the Procution of Rice in Taiwan, Republic of China," Journal of Agricultural Economics, (Taiwan) No. 5, June 1967, pp. 127-130; and T. E. Lin and H. H. Chen, "Rural Labor Mobility in Taiwan," Journal of Agricultural Economics (Taiwan), No. 11, June 1971, pp. 123-147.

increasing spread between rural and urban incomes, and increased rural education have accelerated occupational and locational movement away from agriculture. In the recent years, some serious labor shortages threatened the agricultural sector, agricultural wages have moved up sharply, and farm mechanization has accelerated. Almost four thousand additional power tillers were purchased in 1970, double the number purchased in 1968.[9] Policy makers are seriously considering a set of measures which would further stimulate mechanization to replace labor.

Economic Conditions of Taiwan Farms 1960-1970

The Taiwan farm record-keeping project will provide the main source of data for the time-series and cross-section analysis in this study. The Provincial Department of Agriculture and Forestry (PDAF), is in charge of this project. Initially data collection was started by ten agricultural vocational schools in 1953. But, in 1960 the program was switched to local Farmer's Associations and PDAF began closer supervision of the data collection and tabulation. PDAF also publishes a summary of the Farm Record-Keeping Reports each year. As shown in Table 2, up through 1963 the farm record-keeping families were distributed mainly in

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[9] W. C. Lai, "Current Situation and Problems of Farm Management on the Mechanized Farming in Taiwan," unpublished paper, Joint Commission on Rural Reconstruction, Taipei, Taiwan, August 1971.

Table 2 Numbers of Farmers' Associations, Agricultural Regions, Individual Farmers and Panel Numbers In Farm Record-Keeping Project in Taiwan, 1960-1970

Year	Number of			
	Farmers' Associations	Agricultural Regions	Individual Farmers	
			Total	Panel Farms[a]
1960	7	3	95	5
1961	17	3	207	9
1962	18	3	223	11
1963	21	3	277	15
1964	40	8	535	53
1965	40	8	501	73
1966	28	8	430	115
1967	28	8	402	142
1968	36	8	416	227
1969	36	8	411	308
1970	36	8	404	404

[a]Panel farms are those for which yearly data from 196x to 1970 is available.

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families in Taiwan, yearly reports running from 1960 to 1970 (Nantou, Taiwan: PDAF, 1961 through 1971).

three regions: the northern, middle, and southern rice regions. The record-keeping project, however, was expanded to cover the entire island in 1964 with 535 farm families taking part in the project. A summary of the numbers of Farmers' Associations, agricultural regions and individuals participating in the project is also shown in Table 2. This table gives a summary of the panel farms for 1960 through 1970. As mentioned earlier, panel farms are those individual units which participated in the record-keeping project over a number of years.

The farm records include rather comprehensive information on land use, farm and family income, farm operating expenses, household living expenses, farm assets, liabilities and net worth, and farm labor use. A copy of the summary form from which this data was drawn is presented in Appendix C.

Participation in the project is voluntary. Thus, individuals who participate are generally more progressive than the average Taiwanese farmer. They are also better capitalized and more educated than the average.

The information presented here is intended to show how representative the farm record-keeping families are of the total population of farms in Taiwan, and to describe the economic conditions of the sample families.

For easier understanding of the farm record-keeping information all of the income-expenses figures have been

transformed into 1970 values.[10]

In order to understand the extent to which farm record-keeping families represent all Taiwanese farmers, a brief comparison is made between the record-keeping farms and more representative Farm Income Survey data.[11] The surveys were carried out in 1952, 1957, 1962, and 1967. Thus, two of these years overlap the farm record-keeping data: 1962 and 1967.

Due to the sampling procedure used, the farm income surveys represented the entire population of farms on Taiwan. The sample farms were chosen for the survey by two stage stratified random sampling methods in which sample townships were drawn from the agricultural regions of the whole island and then the sample farms were selected from each sample township.

As can be shown in Table 3, the farm sizes record-keeping sample were about one quarter larger than the income survey samples. The average farm land of record-keeping farms was 1.39 hectares, whereas the average farm

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[10]See Appendix A.

[11]The main purposes of the farm income surveys were: (1) to collect farm income data to facilitate the estimation of national income, (2) to investigate farm and off-farm income by farm size and by agricultural regions, (3) to examine the significance of the sources and seasonal distribution of farm income, (4) to analyze the cost of farm production with a view to improving the efficiency in farm operation, and (5) to provide some basic data for economic planning and policy.

Table 3 Comparisons Between Taiwan Record-Keeping Project and Taiwan Farm Income Survey of General Economic Condition of Average Farm Families in 1962 and 1967 (in 1970 prices)[a]

	1962		1967	
	Record-Keeping Project	Farm Income Survey	Record-Keeping Project	Farm Income Survey
Number of farms	223	1947	402	1640
Farm Land (hectares)	1.36	1.12	1.39	1.08
Family Size (persons)	8.90	8.58	8.29	8.30
Farm Family Disposable Income (NT$)	48,522	30,401	55,543	43,196
Farm Family Consumption Expenditures (NT$)	38,405	26,100	40,673	39,753
Average Propensity to Consume	0.79	0.86	0.73	0.92
Average Propensity to Save	0.21	0.14	0.27	0.08

[a]Converted to 1970 prices using the general index of prices received in Appendix A. NT$ 41.02 = US$ 1 at the market exchange rate in 1970.

Source: Computed from Joint Commission on Rural Reconstruction (JCRR), Taiwan Farm Income Survey of 1967, with a Brief Comparison with 1952, 1957 and 1962. (Taipei, Taiwan: JCRR, 1970); and Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families in Taiwan, 1962 and 1967 issues, (Nantou, Taiwan: PDAF, 1963 and 1968)

in the income surveys had only 1.08 hectares in 1967. In 1962 farm sizes were more similar with 1.36 and 1.12 hectares respectively. As for farm family size, the average farm record-keeping family was larger in 1962. In 1967, however, the two samples had almost the same family size.

The record-keeping farms also realized higher income and spent more on consumption than did the Income Survey farms. Because of the way the Income Surveys were carried out, a one shot interview, it is likely that incomes may be somewhat underestimated in the Income Surveys.[12] The average propensity to save in the farm record-keeping project was also somewhat higher than in the farm income surveys. (Table 3).

The farms used in this study, therefore, have somewhat higher incomes than the average farm in Taiwan, are more commercially-minded, better capitalized, more progressive, better educated and more closely tied with Farmers' Associations. Because of the relatively homogeneous nature of the farms in Taiwan, the farm record keeping units probably come closer to representing the entire population than would similar accounts in the United States. The data is probably

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[12]The voluntary nature of the record-keeping project probably induced farmers to report most of their income. It is likely, therefore, that the income spread between the two samples was less than reported in Table 3.

strongest in indicating directions and, to some extent, rates of change. It also provides strong insights into structural changes which are occurring in rural area. The absolute values of the variables cited in the following, however, should be qualified somewhat because of the nature of the sample.

A description of major economic conditions of the record-keeping farms is presented in the following. This includes a description of farm size and land utilization, family size and employment, farm family income and expenses, consumption expenditure and savings, and asset and capital structures.

Farm size and land utilization

Because of the comprehensive land reform program most farms in Taiwan are quite small. As can be seen in Table 4, record-keeping farms generally averaged less than 1.60 hectares. Most of this land, however, is in intensive production. In many cases two or more crops are grown on a given parcel of land in one calendar year. The overall cropping index for the record-keeping farms has been close to 200 over the 1960-1970 period.[13] This index is somewhat higher than that of average farms. The cropping index for

[13]The cropping index is defined as the ratio of the total areas in crops to the area of farm land for the calendar year.

Table 4 Farm Size and Land Utilization of Farm Record-Keeping Families, Average Amount Per Family 1960-1970

Year	Farm Size (hectares) (1)=(2)+(3)	Farm Land (hectares) (2)	Non-farm Land (hectares) (3)	Crop Area (hectares) (4)	Cropping index (5) = (4)÷(2)
1960	1.59	1.37	0.22	3.13	225
1961	1.48	1.44	0.04	3.24	223
1962	1.47	1.40	0.07	3.19	223
1963	1.41	1.36	0.05	3.08	223
1964	1.37	1.25	0.12	2.54	200
1965	1.41	1.30	0.11	2.65	202
1966	1.49	1.43	0.06	2.92	203
1967	1.52	1.39	0.13	2.80	200
1968	1.58	1.46	0.12	2.99	203
1969	1.48	1.35	0.13	2.72	197
1970	1.52	1.35	0.17	2.60	190

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families in Taiwan, yearly reports running from 1960 to 1970 (Nantou, Taiwan: PDAF, 1961 through 1971).

all of Taiwan ranged from 182-190 during 1960-1970.

The record-keeping farms generally had less than 1.50 hectares of farm land, or cultivated land. About two-thirds of this land was irrigated rice land (paddy) and the remaining was dryland. The average farm had less than 0.20 hectares of non-farm land which included building sites, ponds, pasture and forestry.

Family size and employment

As can be seen in Table 5, the average family size of record-keeping families has declined from 9.65 to 8.11 persons during 1960-70. Again for the island as a whole in 1970, the average farm family size was 6.81 persons.[14]

The age composition of farm families has changed significantly during the 1960's. As can be noted in Table 5, the numbers of dependent people in the family, defined as the number of old people above 60 years old plus the number of children under 15 years old, was 5.24 persons and accounted for 54 percent of the average family in 1960. This ratio dropped to 3.82 persons and accounted for 47 percent of the average family in 1970. Decreases in the ratio have helped to improve living standards and

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[14]Calculated from: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Taiwan Agricultural Yearbook, 1971 Edition, (Nantou, Taiwan: PDAF, 1971), pp. 49-50.

Table 5 Family Size of Farm Record-Keeping Units, By Age Groups, Average Number Per Family 1960-1970

Year	Number of Persons In Family				Dependency Ratio[a]
	Total	Adults (15 to 60 years old)	Old People (60 yrs.+)	Children (-15 yrs.)	
1960	9.65	4.41	0.62	4.62	0.54
1961	9.05	4.27	0.47	4.31	0.53
1962	8.90	4.25	0.47	4.18	0.52
1963	8.84	4.21	0.52	4.11	0.52
1964	8.21	3.93	0.41	3.87	0.52
1965	8.23	3.96	0.47	3.80	0.52
1966	8.48	4.01	0.49	3.98	0.53
1967	8.29	4.07	0.47	3.75	0.51
1968	8.59	4.39	0.47	3.73	0.49
1969	8.21	4.30	0.50	3.41	0.48
1970	8.11	4.29	0.52	3.30	0.47

[a]The dependency ratio is defined as the ratio of individuals aged 15 or less plus those aged 60 or older to the total number in the family.

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports ranging from 1960 to 1970, (Nantou, Taiwan: PDAF, 1961 through 1971).

saving potentials. The ratio has declined because of improvements in educational attainment in the rural area, rural-to-urban migration, reduction in birth rates, and also the group of farmers with whom PDAF is working has gotten older.

As can be noted in Table 6, the total amount of labor used on record-keeping farms has been constant-to-slightly declining during the 1960's. Total farm labor used is the sum of family and hired labor.[15] Self-employed workers and unpaid family workers contributed from 85 to 89 percent of total labor used on the farms in this period. As can be seen in Table 6, about 40-50 percent of farm labor came from female work.

Farm family income and expenses

Despite the substantial net capital outflow from agruculture during the past decade, farm family incomes have shown a steady increase. Farm family income is defined as the sum of total gross farm and off-farm income less farm and off-farm expenses. As can be noted in Table 7, average farm family income of Taiwan farm record-keeping

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[15]Total farm labor used was measured in man days. One man day is defined as 10 hours of farm work by an adult male aged between 15 and 60. The conversion factors were females of age between 15 and 60 considered as 0.8, a male aged below 15 or above 60 as 0.5; and female aged under 15 or above 60 as 0.4

Table 6 Farm-Labor Use By Farm Record-Keeping Families, Average Number of Man Days Per Farm 1960-1970[a]

Year		Total[b]	Family Labor	Hired Labor
1960	Total[b]	693	622	71
	Male	N/A	N/A	N/A
	Female	N/A	N/A	N/A
1961	Total[b]	573	505	68
	Male	341	298	43
	Female	232	207	25
1962	Total[b]	572	503	69
	Male	345	301	44
	Female	227	202	25
1963[c]	Total[b]	592	511	80
	Male	364	312	52
	Female	228	200	28
1964[c]	Total[b]	490	412	78
	Male	307	255	52
	Female	183	158	26
1965	Total[b]	518	435	83
	Male	325	271	54
	Female	193	164	29
1966	Total[b]	569	484	84
	Male	346	293	53
	Female	223	192	31
1967	Total[b]	576	485	92
	Male	337	285	52
	Female	239	199	40
1968	Total[b]	596	515	81
	Male	350	301	49
	Female	246	214	32
1969	Total[b]	490	416	74
	Male	300	255	44
	Female	190	160	30
1970	Total[b]	511	432	79
	Male	304	261	42
	Female	207	171	36

[a]A man day is defined as 10 hours of work by an adult male on farm work. Conversion factors used were:

	Age In Years		
	Under 15 yrs.	Between 15 & 60	Over 60 yrs.
Male	0.5	1.0	0.5
Female	0.4	0.8	0.4

[b]May not equal sum of sub-groups due to rounding.
[c]The drop in labor use 1963 to 1964 was mainly due to a change in the composition of the record keeping sample. Prior to 1964 most of the record keeping farms were intensive rice producers, an activity requiring a good deal of labor. After 1963 a larger proportion of the farms included less intensive enterprises.

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports running from 1960 to 1970 (Nantou, Taiwan: PDAF, 1961 through 1971)

Table 7 General Economic Conditions of Farm Record-Keeping Families, Average Value Per Family 1960-1970, in 1970 NT$[a]

Year	Gross Farm Income (1)	Total Farm Expenses (2)	Net Farm Income[b] (3)=(1)-(2)	Gross Off-farm Income (4)	Total Off-farm Expenses (5)	Net Off-farm Income (6)=(4)-(5)	Total Family Disposable Income[b] (7)=(3)+(6)	Total Household Consumption Expenditures (8)	Gross Savings[b] (9)=(7)-(8)
1960	64,657	28,410	36,247	5,630	114	5,516	41,763	33,762	8,001
1961	69,829	30,550	39,279	6,333	163	6,170	45,449	37,218	8,231
1962	70,581	29,910	40,672	7,764	375	7,390	48,062	38,405	9,657
1963	72,095	30,440	41,655	6,933	260	[illegible]	48,330	37,134	11,196
1964	62,360	25,773	36,588	8,769	659	8,110	44,698	34,270	10,427
1965	67,191	28,250	38,942	9,909	517	9,392	48,334	37,095	11,240
1966	78,574	33,865	44,709	10,542	513	10,028	54,737	39,574	15,162
1967	78,786	34,451	44,335	11,209	1,014	10,195	54,529	40,673	13,857
1968	83,148	36,793	46,354	12,654	1,112	11,542	57,896	41,466	16,430
1969	71,455	35,819	35,637	16,529	2,012	14,519	50,155	44,385	5,770
1970	73,291	35,312	37,979	15,100	530	14,570	52,550	42,133	10,416

[a]Deflated using Index of Prices-received-by-farmers, see Appendix A.

[b]May not be equal to sum of various sub-groups due to rounding.

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports running from 1960 to 1970 (Nantou, Taiwan: PDAF, 1961 through 1971)

families increased from NT$41,763 to $52,550 in real terms during the 1960's. Aside from 1969 when adverse weather substantially decreased farm output and farm income, there has been a steady increase.

As can be noted in Table 7, farmers have sharply increased net off-farm income. Changes in off-farm income have made up the bulk of the increase in total farm family incomes. Family income among record-keeping farmers increased by 26 percent from 1960 to 1970. Almost two-thirds of this increase came from additional off-farm income which mainly consisted of estate rentals and off-farm wages.

On the farm income side, real farm income, the difference between real gross farm income and farm expenses, increased slightly from NT$36,247 to $37,979 during this period. This slow rate of increase was due to heavy land and irrigation taxes, low administered product prices, and high input prices. Farm incomes were held down by the substantial increase in farm expenses from 1960-1970 shown in Table 7.

It should be noted that farm expenses are somewhat under-estimated on the farm record-keeping families, because the imputed wages of farm family labor working in the field and imputed land rent were not included. Moreover, the depreciation on fixed assets was not included. Among farm expenses, the most important single item is fertilizer costs,

hired labor, feeds, animals purchased, and farm taxes and assessment. Expenses for insect and pest control generally increased but land rent declined during the period under study.

As mentioned earlier, off-farm sources of income became more important, especially in the later parts of the 1960's. Average real off-farm income of the sample farms increased from NT$5,516 to $14,570 over the decade. This trend shows that farmers tended to consider farm work as a part-time job instead of traditional full-time work. The main sources of off-farm income came from labor income outside farming and income from sideline activities.

Consumption expenditure and savings

Changes in household expenditures from 1960 to 1970 were equal to about four-fifth of the increase in total real farm family income. As shown in Table 8, average real household consumption increased during the period 1960-1970 from NT$33,762 to $42,133. The increase in farm family purchases of items like radios, televisions, bicycles, clothes, household appliances, etc., have been a major factor in providing markets for industrially produced goods in Taiwan.

The degree of subsistence of Taiwan farmers also has declined. As can be noted in Table 8, the percentage of cash consumption expenditure to total consumption expenditure

Table 8 Household Consumption Expenditure of Farm Record-Keeping Families 1960-1970, in 1970 NT$[a]

	Total			Percentage		
	Total[b]	In Cash	In Kind	Total	In Cash	In Kind
1960	33,762	19,741	14,021	100.0	58.5	41.5
1961	37,218	21,353	15,865	100.0	57.4	42.6
1962	38,405	22,934	15,470	100.0	59.7	40.3
1963	37,134	23,711	13,424	100.0	63.9	36.1
1964	34,270	23,297	10,973	100.0	68.0	32.0
1965	37,095	25,556	11,539	100.0	68.9	31.1
1966	39,574	27,567	12,008	100.0	69.7	30.3
1967	40,673	29,058	11,615	100.0	71.4	28.6
1968	41,466	29,926	11,541	100.0	72.2	27.8
1969	44,385	32,840	11,545	100.0	74.0	26.0
1970	42,133	30,625	11,508	100.0	72.7	27.3

[a]Deflated using Index of Prices-received-by-farmers, see Appendix A.

[b]Total may not equal sum of the group due to rounding.

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports running from 1960 to 1970 (Nantou, Taiwan: PDAF, 1961 through 1971).

increased from 58 percent in 1960 to 73 percent in 1970. The farmers' consumption behavior was more dependent upon their own direct production in 1960 than in 1970. As the agricultural sector developed, farmers become more commercialized in production as well as in sales.

Taiwan farm families have improved their diet and nutrition as disposable incomes have increased. Expendtures on principal food items such as rice and flour almost remained constant, while purchases of more nutrition foods increased substantially during 1960-1970.

Clearly, however, not all increases in income have been consumed. The real gross savings, the difference between the real disposable income and real consumption, increased from NT$8,001 to $16,430 from 1960 to 1968 (Table 7). This decreased to NT$5,770 due to the bad weather in 1969, and then rose again to NT$10,416 in 1970.

Asset and capital structures

An analysis of the balance sheets for farm record-keeping families shows that significant changes have occurred in the asset structure and the financial structure of the farm families. On the asset side, the average sample farm was shown to have NT$346,435 worth of the assets per farm in 1970, a fifty percent growth over 1960 (Table 9). Among the farm assets, more than 83 percent were fixed and less than 17 percent were liquid assets during

Table 9 Year-End Balance Sheet of Farm Record-Keeping Families, Average Values Per Family 1960-1970, in 1970 NT$[a]

Year	Assets			Liabilities			
	Total[b]	Liquid Assets	Fixed Assets	Total[b]	Liquid Liabilities	Fixed Liabilities	Net Worth
1960	229,744	30,480	199,265	12,360	7,659	4,701	217,385
1961	264,038	32,546	231,493	11,154	8,932	2,224	252,8[illegible]
1962	269,378	37,042	232,338	12,830	12,224	605	256,549
1963	260,249	35,581	224,668	12,038	11,885	153	248,211
1964	214,860	36,313	178,546	12,291	12,157	133	202,569
1965	244,291	40,863	203,428	12,762	12,680	82	231,529
1966	311,826	49,213	262,612	17,958	17,933	26	293,867
1967	310,083	48,670	261,414	19,982	19,821	160	290,102
1968	369,589	52,409	317,179	19,475	19,475	0	350,114
1969	386,908	46,462	340,446	21,205	21,205	0	365,703
1970	346,435	44,404	302,030	20,970	20,970	0	325,465

[a]Deflated using Index of Prices-received-by-farmers, see Appendix A.

[b]May not be equal to sum of various sub-groups due to rounding

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports running from 1960 to 1970, (Nantou, Taiwan: PDAF, 1961 through 1971).

the period of 1960-1970.

Overall, the values of land and buildings contributed around 75-85 percent of the total assets during the period. Land which is the most important single item of farm assets accounted for seventy-percent-plus of total farm assets in 1970. Buildings, which are second in importance including living quarters, animal and poultry shed, account for about nine percent of total assets.

The sharp growth in cash held, and in bank deposits indicates a growing willingness and capacity on the part of farmers to increase institutional savings. They have increased at annual rates of 13.1 percent and 11.3 percent respectively during 1960-1970. The fact that Taiwan has offered incentive rates of interest for time deposits during the 1960's is also apparently important in explaining the growth in savings.[16]

The capital structure can be divided into two subheadings: total liabilities and net worth. Alternatively, it can be called external as well as internal sources of farm capital. Among farm record-keeping families, external

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[16]Farmers' Associations are the major factor in institutional rural savings in Taiwan. During the 1960's they paid nominal rates of interest on time deposits of from 6 to 10 percent per year. Taiwan has experienced only modest rates of inflation during the 1960's. This has resulted in positive real rate of interest being paid on savings.

sources of investments only accounted for about five percent of this capital. The rest came from internal sources. Credit, however, has been important. As can be noted in Table 9, total liabilities increased about 70 percent ranging from NT$12,360 to $20,970 during 1970-1970. The increase in credit use more than offset the increase in cash operating expenses experienced by these farmers.

By 1968 record-keeping families had little or no long term debt. Long term Land-to-tiller-long-term borrowings under land reform program was entirely paid by 1967. The liquid liabilities rapidly increased, however. Short-term borrowings which made up the largest component of liabilities stemmed from institutional and non-institutional sources.

Overall the average farm net worth increased fifty percent from 1960 to 1970. Increases in land value, improved irrigation facilities, labor investments in land improvement, the build-up in farm machinery and investments made in land consolidation have been important features of this net worth increase.

Several additional measures of the economic position of record-keeping families are presented in Table 10. This includes liquid-asset-to-liquid-liabilities ratios, capital-output ratios, and total-asset-turnover ratios. As can be noted in the table, liquid assets declined relative to liquid liabilities over the 1960-1970 period. Debt became

Table 10 Liquid-Asset-to-Liabilities Ratio, Capital-Output Ratio and Total-Asset-Turnover Ratio of Farm Record-Keeping Families, 1960-1970

Year	Liquid Asset-Liabilities Ratio[a]	Capital-Output Ratio[b]	Total Asset Turnover[c]
1960	3.98	3.55	0.28
1961	3.64	3.78	0.26
1962	3.03	3.82	0.26
1963	2.99	3.61	0.28
1964	2.99	3.45	0.29
1965	3.22	3.64	0.29
1966	2.74	3.97	0.28
1967	2.46	3.94	0.25
1968	2.69	4.44	0.22
1969	2.19	5.41	0.18
1970	2.12	4.73	0.21

[a]The liquid asset-liabilities ratio is defined as the total liquid assets divided by the total liquid liabilities.

[b]The capital-output ratio is defined as average investment in farm assets divided by average gross farm income.

[c]The total asset turnover is the reciprocal of capital-output ratio.

Source: Calculated from: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports running from 1960 to 1970, (Nantou, Taiwan: PDAF, 1961 through 1971).

a more important part of the farm operation. It can also be noted that the capital-output ratio increased. Or, said another way, the rate of asset turnover decreased. To the extent that assets were made up by productive capital, it might be concluded that the marginal efficiency of capital had declined over the time period under analysis.

In summary, the record-keeping farm size is quite small, though somewhat larger than average. Most of the land is in intensive production. Self-employed labor contributed about 85 percent of total labor used on the farms. Sharp increases in farmers' real incomes, consumption and saving occurred during the 1960-1970 period. Cash consumption also became more important. The investments made by the Taiwanese farms are predominantly in the category of fixed farm assets. More than 83 percent were fixed assets in which farm land and building were the major components. The liquid assets shared a minor part in the total assets. Among liquid asset categories, cash and bank deposits increased sharply during 1960-1970. Investments were predominantly financed from internal sources which contributed about 95 percent of total assets. Credit offset five percent of total assets.

CHAPTER V

ANALYSIS OF AVERAGE AND MARGINAL PROPENSITIES TO SAVE

This chapter is divided into three sections. The first section discusses how the record-keeping farms were classified into various subgroups. The average propensities to save (APS) and the marginal propensities to save (MPS), calculated from simple cross sectional analysis by subgroups in various years from 1960 to 1970, are presented in the second section. The last portion of the chapter compares the magnitudes of the time series MPS with the cross section MPS for various subgroups.

Farm Subgroup Classification

In order to compare the difference in the APS and the MPS among relatively homogeneous consumption-behavior farms, it was necessary to classify the sample farms into several economic subgroups. As mentioned earlier, the more homogeneous the groups, the smaller the taste problems in the consumption function. The subgroups used in the study were defined by farm size, farming region, family dependency ratios, and the ratio of farm-income-to-farm-family-income.

The first classification method used was based on

the amount of land included in the farm operation. This includes irrigated land (paddy land), dry land, forest and land in other uses. Three farm size groups under this classification were specified: (1) a small sized farm which has less than one hectare of land, (2) a medium sized farm which has between one and two hectares of land, and (3) a large sized farm which has more than two hectares of land.

As can be noted in Table 11, the percentage of farms in each size group did not change much through time. Data available outside this study suggests there has been little change in the farm size in Taiwan during the 1960's. The small and medium sized farms accounted for 80 percent of the sample in various years.

The second criteria employed to classify farm types was on the basis of agricultural regions. Taiwan's agricultural areas are divided into eight regions. Each region has similar cropping systems. They include the northern rice region, the middle rice region, the southern rice region, the tea region, the southwestern mixed farming region, the southwestern sugarcane and rotation region, banana and pineapple region, and the eastern mixed farming region (Figure 1).

The breakdown of the total sample into these agricultural regions is shown in Table 12. As mentioned earlier, prior to 1964 most of the farm record-keeping

Table 11 Distribution of Farm Record-Keeping Families by Farm Size and Year, 1960-1970

Year	Number				Percentage			
	Total	0-1.00 ha.	1.01-2.00	2.00+	Total	0-1.00 ha.	1.01-2.00	2.00+
1960	95	38	41	16	100.0	40.0	43.2	16.8
1961	207	69	98	40	100.0	33.3	47.4	19.3
1962	223	78	90	55	100.0	35.0	40.4	24.6
1963	277	107	114	56	100.0	38.6	41.2	20.2
1964	535	265	160	110	100.0	49.5	29.9	20.6
1965	501	253	152	96	100.0	50.5	30.3	19.2
1966	430	183	153	94	100.0	42.6	35.6	21.8
1967	402	164	139	99	100.0	40.8	34.6	24.6
1968	416	158	156	102	100.0	38.0	37.5	24.5
1969	411	169	157	85	100.0	41.1	38.2	20.7
1970	404	153	166	85	100.0	37.9	41.1	21.0

Source: Computed from Taiwan Farm Record-Keeping Data, 1960-1970.

Figure 1. Map of Taiwan's Agricultural Regions

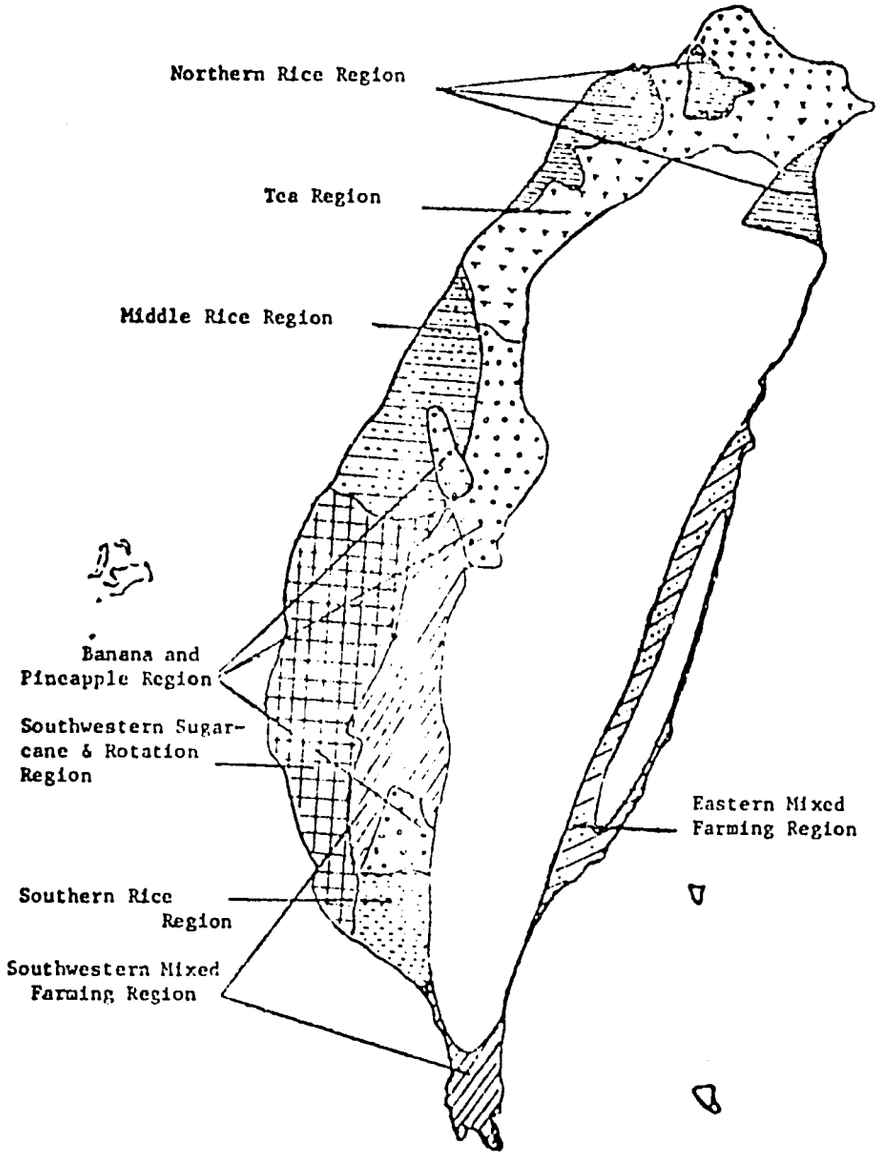

Table 12 Number of Farmers Participating in Farm Record-Keeping Program By Agricultural Region and Year, 1960-1970

Agricultural Region	Year 1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
1. Northern Rice	26	43	47	58	70	64	30	31	47	42	33
2. Middle Rice	43	60	73	81	78	76	58	49	75	80	72
3. Southern Rice	14	38	39	41	51	50	51	37	33	33	26
4. Tea Region		13	14	14	59	58	48	46	38	39	37
5. Southwestern Mixed Farming					67	49	41	49	50	51	55
6. Southwestern Sugarcane & Rotation	12	39	37	69	52	92	110	107	95	82	98
7. Banana & Pineapple		14	13	14	103	68	48	48	41	48	42
8. Eastern-Mixed Farming					55	44	44	35	37	36	41
Total	95	207	223	277	535	501	430	402	416	411	404

Source: Department of Agriculture and Forestry, Provincial Government of Taiwan (PDAF), Report of Farm Record-Keeping Families In Taiwan, yearly reports from 1960 to 1970, (Nantou, Taiwan: PDAF, 1961 through 1971).

families were located in the three major rice regions. After 1964 farms from all eight regions were included in the project.

The third classification method used was based on the dependency ratio of the farm family. The dependency ratio is here defined as the number of children of less than 15 years of age plus number of people over 60 years of age who resided in the household divided by the total number of members living in the household. Under this classification the samples were divided into two subgroups: (1) families with dependency ratios between zero and .50, and (2) families with dependency ratios over .50.

The sample distribution by dependency ratios for various years is shown in Table 13. As can be noted, the percentage of the sample with ratios between zero and .50 generally increased during the 1960's. That is, the dependency ratios of the farm family declined during 1960-1970.

The fourth classification method is based on the ratio of farm-income-to-farm-family-income. On the basis of this ratio two groups were formed: (1) farms with ratios from lowest through .70, and (2) farms with ratios higher than .70. As can be observed in Table 14, the percentage of farms in the first subgroup increased during 1960-1970. Farm families have increasingly relied on off-farm income. The main reason for this has been the rapid

Table 13 Distribution of Record-Keeping Farms By Dependency Ratio Group 1960-1970[a]

Year	Number Total	Number 0-0.50	Number 0.50+	Percentage Total	Percentage 0-0.50	Percentage 0.50+
1960	95	37	58	100.0	38.9	61.1
1961	207	95	112	100.0	45.9	54.1
1962	223	107	116	100.0	48.0	52.0
1963	277	125	152	100.0	45.1	54.9
1964	535	263	272	100.0	49.2	50.8
1965	501	242	259	100.0	48.3	51.7
1966	430	194	236	100.0	45.1	54.9
1967	402	206	196	100.0	51.2	48.8
1968	416	243	173	100.0	58.4	41.6
1969	411	246	165	100.0	59.9	40.1
1970	404	244	160	100.0	60.4	39.6

[a]The dependency ratio is defined as the number of children of less than 15 years of age plus people over 60 years of age who reside in the household divided by the total number of members of the household.

Source: Computed from Taiwan Farm Record-Keeping Data, 1960-1970.

Table 14 Distribution of Record-Keeping Farms By Ratio of Farm-Income-To-Farm-Family-Income, 1960-1970

Year	Number Total	Number 0-0.70	Number 0.70+	Percentage Total	Percentage 0-0.70	Percentage 0.70+
1960	95	14	81	100.0	14.7	85.3
1961	207	27	180	100.0	13.0	87.0
1962	223	30	193	100.0	13.5	86.5
1963	277	44	233	100.0	15.9	84.1
1964	535	127	408	100.0	23.7	76.3
1965	501	131	370	100.0	26.1	73.9
1966	430	92	338	100.0	21.4	78.6
1967	402	90	312	100.0	22.4	77.6
1968	416	110	306	100.0	26.4	73.6
1969	411	162	249	100.0	39.4	60.6
1970	404	166	238	100.0	41.1	58.9

Source: Computed from Taiwan Farm Record-Keeping Data, 1960-1970.

growth in off-farm employment possibilities caused by overall development in Taiwan. Other previously mentioned factors in the rural area have also tended to retard the growth of farm general income. This includes: (1) the high cost of agricultural production. Over the past two decades fertilizer costs have been quite high in Taiwan. Fertilizer is a major farm expense. The distribution of fertilizers has been carried out through a fertilizer paddy barter system under the control of Taiwan Provincial Food Bureau (TPFB).[1] The unfavorable fertilizer exchange rates have been widely criticized by farmers and scholars.[2] In the early 1970's more favorable fertilizer-rice exchange rates for the farmers were adopted. Agricultural wages have also risen sharply in recent years, especially since 1968. The real rate of increases in rural wages was 60 percent from 1961 to 1970.[3] The combination of high fertilizer prices and high rural wages have kept farmers operating expenses high and net farm incomes down.

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[1]A. B. Lewis, op. cit.

[2]Chi-lien Huang, Wages and Incomes of Agricultural Workers in Taiwan, (Taipei, Taiwan: The Research Institute of Rural Socio-Economics, National Taiwan University, December 1968), pp. 33-34.

[3]Calculated from Monthly Statistics on Price Received & Price Paid by Farmers in Taiwan, published by Bureau of Accounting and Statistics, Provincial Government of Taiwan (PBAS), (Nantou, Taiwan: PBAS, December 1970), p. 43.

(2) Heavy taxation on farm income has been a further factor in keeping farm income down. There are at least eight kinds of direct taxes on farms in Taiwan: land tax, house tax, income tax, estate tax, license tax, defense surtax, educational surtax and slaughter tax. The average taxation per farm on the whole island was NT$2,428 (in 1970 NT $). The farm tax rate was 6.24 percent of gross farm income in 1968. The most important single tax item was land tax which accounted for 73 percent of total farm taxation.[4]

(3) Low prices for agricultural products have also retarded farm incomes. In general, the government closely controls food prices to prevent price fluctuation and inflation. The prices of most crops are set by various agencies and finally approved by the government. Under the forced rice sales program farmers are required to sell a given quantity of their rice production to the government at prices about 20 percent lower than the market price. Unfavorable, for the farmer, fertilizer-rice barter terms have also contributed to low product prices.[5]

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[4] I. C. Kuo, "Research on the Survey of Farm Taxation in Taiwan," (in Chinese) unpublished paper, Taiwan Provincial Chung-Hsin University, June 1970, pp. 11-12.

[5] Wade F. Gregory, "Economic Development of Agriculture in Taiwan," Summary Report of Seminar on Agricultural Development, (Taipei, Taiwan: The Joint Commission on Rural Reconstruction, 1969), pp. 32-53.

An Analysis of Average and Marginal Propensities to Save From Cross-section Data for 1960-1970

The limitation of cross-sectional analysis is that a single year's data does not adequately reflect the long run structure of the system within which the variables are operating. Factors such as adverse weather or an extreme disease problem for example may make a significant difference in the APS and MPS for that given year's data. These types of factors would tend to be less important over a period of time. It is possible, however, to get some ideas of structural changes in consumption behavior from a series of linked cross sectional analysis.

The statistical results of cross-sectional consumption function analysis for the years 1960-1970 are presented in this section. Complete estimation models are reported for only the overall samples in each of the 11 years. Changes in the APS and MPS among various subgroups and years were also analyzed and some of these results also will be reported in the text.

For the reasons previously stated per capita consumption rather than savings was used as the dependent variable in this behavior analysis. As mentioned earlier, in some years farmers savings were negative and did not fit into a double logarithmic savings function. It was assumed that savings is the residual income after the consumption

activity has been completed. It was thus felt that farmer's savings behavior might be indicated through the consumption function.

Four functional forms were used in the analysis to estimate per capita consumption function: (1) a linear form, (2) a quadratic form, (3) a double logarithmic form, and (4) a semi-logarithmic form. The specification of the statistical form of these functions was covered in Chapter III. In each case, per capita consumption expenditures were regressed against current per capita farm family income.[6] Ordinary least square procedures were used to estimate these four functional forms.

The estimates of the four functional forms for all of the farms in each of the 11 years 1960-1970 are presented in Table 15. As can be noted in the table, aside from the estimates of the coefficients in the variable of "square of per capita income" in the quadratic form in 1964, all estimates of the coefficients in the four functional forms for the 11 years are significantly different from zero at the five percent signficance level.

In most years, and for most functional forms, the

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[6]In some cross-sectional consumption analysis carried out in other less developed countries, for instance in Brazil, wealth or net worth has been important in explaining consumption. For example see: Evert W. Denny, "An Analysis of Income, Consumption and Savings Potential at the Farm Level in Southern Brazil," unpublished thesis, The Ohio State University, 1970, pp. 60-85.

Table 15 Estimates of Consumption Functions Using Four Functional Forms, Aggregate Farm Record Keeping Data in Taiwan 1960-1970, in Current NT$

	1960				1961				1962				1963			
Basic Data[a]	N=95	$\bar{Y}$=3,733 $\bar{C}$=3,065			N=207	$\bar{Y}$=4,474 $\bar{C}$=3,644			N=223	$\bar{Y}$=4,545 $\bar{C}$=3,572			N=227	$\bar{Y}$=4,968 $\bar{C}$=3,820		
Functional Form	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.
Constant Term	739.3	1467.3	2.9164	-15182	1219.8	594.5	2.2907	-18117	1355.7	910.6	2.7723	-17187	1675.6	534.1	3.0196	-17390
Per Capita Income	.6230	.3066	.6202	2241.3	.5420	.7870	.7035	2689.5	.4877	.6488	.6420	2494.1	.4316	.7978	.6135	2520.7
(SE)	.0449	.1121	.0565	230.0	.0258	.0847	.0299	131.39	.0259	.0791	.0340	144.4	.0267	.0651	.0333	154.1
Square of P.C. Income[d]		.00003				-.00002				-.00001				-.00002		
(t-value)		3.0565				3.0327				2.1527				6.0980		
R^2	.6745	.7045	.5643	.5052	.6826	.6963	.7304	.6715	.6159	.6239	.6170	.5743	.4868	.5481	.5520	.4932
F Ratio	192.7	109.7	120.5	95.0	440.9	233.9	555.3	419.0	354.4	182.5	356.1	298.2	260.8	166.2	338.8	267.6
S. E. of Estimate	736.9	705.9	720.3	908.6	778.7	763.6	675.3	792.3	886.2	879.0	823.1	933.0	1106.3	1040.0	960.5	1099.4
Ave. Prop. to Consume	.8211	.8211	.8211	.8211	.8145	.8145	.8145	.8145	.7859	.7859	.7859	.7859	.7689	.7689	.7689	.7689
Marginal Prop. to Consume[b]	.6230	.5306	.5092	.6004	.5420	.6080	.5730	.6011	.4877	.5579	.5045	.5488	.4316	.5991	.4718	.5074

Table 15 Estimates of Consumption Functions Using Four Functional Forms, Aggregate Farm Record Keeping Data in Taiwan 1960-1970, in Current NT$ (Continued 1)

	1964				1965				1966				1967			
Basic Data[a]	N=535 $\bar{Y}$=5,105 $\bar{C}$=3,898				N=501 $\bar{Y}$=5,487 $\bar{C}$=4,194				N=430 $\bar{Y}$=5,973 $\bar{C}$=4,308				N=402 $\bar{Y}$=6,343 $\bar{C}$=4,802			
Functional Form	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.
Constant Term	1364.7	1321.9	1.6213	-11942	1013.6	1656.3	2.5417	-24493	2426.0	1455.5	3.6988	-16492	1372.6	1809.7	2.8701	-25263
Per Capita Income	.4962	.5094	.7794	1882.7	.5797	.3956	.6718	3379.9	.3151	.5806	.5369	2426.3	.5406	.4286	.6373	3479.3
(SE)	.0162	.0372	.0181	95.4	.0198	.0454	.0250	152.9	.0181	.0521	.0256	125.1	.0246	.0634	.0325	197.4
Square of P.C. Income[d]		c				.00001				-.00001				.00001		
(t-value)		.3962				4.4822				5.4086				1.9147		
R^2	.6377	.6378	.7774	.4222	.6322	.6465	.5910	.4949	.4149	.4524	.5063	.4677	.5475	.5517	.4896	.4373
F Ratio	938.2	468.4	1861.2	389.5	857.8	455.4	721.2	488.9	303.5	176.4	439.0	376.1	484.0	245.5	383.6	310.8
S.E. of Estimate	1026.4	1027.2	992.2	1296.2	1400.6	1374.5	1163.9	1641.4	1293.6	1252.9	1158.7	1233.8	1675.3	1669.7	1568.7	1868.3
Ave. Prop. to Consume	.7636	.7636	.7636	.7636	.7644	.7644	.7644	.7644	.7213	.7213	.7213	.7213	.7571	.7571	.7571	.7571
Marginal Prop. to Consume[b]	.4962	.5094	.6089	.3688	.5797	.5053	.5135	.6160	.3151	.4611	.3873	.4062	.5406	.5555	.4823	.5483

Table 15 Estimates of Consumption Functions Using Four Functional Forms, Aggregate Farm Record Keeping Data in Taiwan 1960-1970, in Current NT$ (Continued 2)

	1968				1969				1970			
Basic Data[a]	N=416	$\bar{Y}$=6,994	$\bar{C}$=5,047		N=411	$\bar{Y}$=6,107	$\bar{C}$=5,397		N=404	$\bar{Y}$=6,778	$\bar{C}$=5,409	
Functional Form	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.	Linear	Quad-ratic	D. Log.	S. Log.
Constant Term	1850.9	1243.8	5.0058	-13607	1433.4	2667	3.2031	-27560	1813.0	1053.8	2.6869	-26416
Per Capita Income	.4570	.6043	.3942	2141.7	.6489	.3070	.6152	3841.0	.5306	.7236	.6677	3657.0
(SE)	.0194	.0575	.0238	147.5	.0310	.0854	.0304	238.9	.0251	.0647	.0296	186.1
Square of P.C. Income[d]		-.00001				.00002				-.00001		
(t-value)		2.7174				4.2845				3.2340		
R^2	.5731	.5806	.3979	.3374	.5170	.5378	.5008	.3873	.5264	.5385	.5590	.4990
F Ratio	555.8	285.9	273.6	210.8	437.8	237.4	410.4	258.6	446.9	233.9	509.6	386.2
S.E. of Estimate	1565.0	1553.0	1713.0	1949.8	2230.8	2184.9	1816.5	2512.5	1775.5	1754.9	1676.1	1842.6
Ave. Prop. to Consume	.7216	.7216	.7216	.7216	.8837	.8837	.8837	.8837	.7980	.7980	.7980	.7980
Marginal Prop. to Consume[b]	.4570	.4644	.2844	.3062	.6489	.5513	.5437	.6290	.5306	.5881	.5329	.5395

[a]N = Number of observations.
$\bar{Y}$ = Average per capita income for a calendar year in current NT$.
$\bar{C}$ = Average per capita consumption expenditures for a calendar year in current NT$.

[b]Four functional forms were used to estimate the per capita consumption function: (1) a linear form, (2) a quadratic form, (3) a double logarithmic form, and (4) a semi-logarithmic forms. Ordinary least squares procedures were used to estimate the following forms.

(1) $C = b_o + b_1Y + U$, (2) $C = b_o + b_1Y + b_2Y^2 + U$,

(3) $\log C = b_o + b_1 \log Y + U$, (4) $C = b_o + b_1 \log Y + U$

where C is per capita consumption expenditures for a calendar year, Y is per capita farm family income from both farm and off-farm sources for a calendar year, and U is the disturbance term. The marginal propensities to consume (MPC) were computed at the arithmetic income mean for the particular group from the estimate of the four functional forms. The MPC were computed in the following ways:

(1) the linear form MPC = b_1
(2) the quadratic form MPC = $b_1 + 2b_2 \bar{Y}$
(3) the double logarithmetic form MPC = $b_1 \frac{\bar{C}}{\bar{Y}}$
(4) the semi-logarithmetic form MPC = $\frac{b_1}{\bar{Y}}$

[c]The estimate of this coefficient is negligible and not significant at the five percent significance level.

[d]The t-values of the coefficients of the variable "square of per capita income" are reported here. The standard errors of these coefficients were very small.

coefficient of multiple determination, the R^2 values, ranged from .40 to .80 in the estimates of consumption function. That is, about .40 to .80 percent of the variation in per capita consumption expenditures was explained by changes in current income. Hence, it was noted that the consumption-savings behavior of Taiwanese farmers also was influenced significantly not only by current income but by other economic factors and non-numerically measurable sociological, psychological and political factors. In the developed countries, most empirical studies have shown that more than 90 percent of the variation in per capita consumption was determined by changes in current income.[7]

The analysis of data in Table 15 suggests that the goodness of fit of different functional forms changes as one moves across various disaggregate subgroups and years. That is, the scatter of per capita consumption as plotted against per capita income apparently changes substantially through various disaggregate subgroups and years. Unfortunately, there is no consistent trend in which functional form gives the best fit under various economic conditions.

The average propensities to consume (APC) and the marginal propensities to consume (MPC) were computed from

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[7]H. S. Houthakker, op. cit.; and Nathaniel H. Leff, op. cit.

the estimates included in the regression equations. MPC's were calculated at the arithmetic income mean for the group under study. The average propensities to save (APS) is defined as one minus the average propensities to consume which is the average per capita consumption expenditures divided by the average per capita income. Similarly, the marginal propensity to save (MPS) is defined as one minus the marginal propensities to consume.

As can be seen in Table 16, the APS for the aggregate samples have been remarkably high throughout the decade. This evidence challenges the general hypothesis that little savings capacity exists in rural households of LDC's. These high saving ratios have played an important role in the rapid changes in farm technology and increases in on-farm fixed capital and working capital investment. In general the APS increased between 1960 and 1968. The farmers had a savings capacity which ran from about one-fifth to almost three-tenths of their income. In 1969, farm incomes were depressed due to bad weather, and farmers' savings capacity declined to only 12 percent of their income. However, the APS increased again to 20 percent in 1970.

It can also be noted in Table 16 that the APS generally increased with increases in farm size in the various years. No consistent pattern emerges in changes in APS among farm

Table 16 Average Propensities to Save Based on Taiwan Farm Record-Keeping Data by Year and Various Economic Sub-Groups, 1960-1970[a]

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
1. Total Farms	.18	.19	.21	.23	.24	.24	.28	.24	.28	.12	.20
By Farm Size (hectares)											
2. 0 - 1.00	.15	.14	.16	.21	.17	.18	.19	.19	.23	.07	.13
3. 1.01-2.00	.16	.21	.22	.21	.25	.26	.28	.25	.27	.10	.23
4. 2.01+	.28	.19	.26	.30	.32	.30	.39	.29	.34	.19	.24
By Region											
5. Northern Rice Region	.20	.13	.23	.30	.22	.24	.15	.23	.24	.07	.14
6. Middle Rice Region	.19	.19	.18	.20	.24	.20	.24	.20	.20	.06	.18
7. Southern Rice Region	.19	.30	.23	.26	.22	.20	.34	.22	.33	-.06	.19
8. Tea Region	b	.11	.21	.05	.15	.15	.16	.14	.25	.12	.20
9. Southwestern Mixed Farming Region	b	b	b	b	.27	.33	.32	.24	.25	.20	.25
10. Southwestern Sugar Cane & Rotation Region	.07	.11	.25	.23	.23	.23	.28	.28	.27	.09	.19
11. Banana and Pineapple Region	b	.14	.18	.06	.27	.25	.15	.22	.30	.16	.14
12. Eastern Mixed Farming Region	b	b	b	b	.27	.30	.45	.37	.40	.32	.32
By Dependency Ratios[c]											
13. 0 - .5	.20	.19	.24	.24	.24	.23	.27	.22	.28	.10	.20
14. .5+	.16	.18	.17	.22	.23	.24	.29	.28	.27	.15	.22
Ratio of Farm Income[c] to Farm Family Income											
15. 0 - .7	.09	.18	.24	.14	.16	.22	.22	.20	.23	.07	.14
16. .7+	.19	.19	.21	.25	.26	.24	.30	.26	.29	.15	.24

[a]The average propensity to save is defined as one minus the average propensity to consume, which in turn is per capita household expenditures over per capita total family income.
[b]No observations available from this region for this year.
[c]See notes c and d in Table 17.

size groups over the 1960 to 1970 period.

The APS among different agricultural regions also showed no consistent pattern. Adjustments in income from region to region and years to years appear to be more the result of changes in weather and income variability than structural differences in consumption-savings behavior among regions.

The savings pattern, when analyzed by dependency ratios, also shown in Table 16, indicate that families with low dependency ratios generally had higher APS. Part of the difference between groups may have been due to an income level affect. In the whole study period, per capita disposable income was higher in the low dependency ratio group.

The consumption-saving behavior was quite heterogenous among the groups when analyzed by the ratio of income sources. Farms with a high ratio of farm-income-to-farm-family-income had higher per capita farm family incomes, and generally had higher APS than those of the other group. That is, the APS increased as the proportion of farm-generated income increased.

As to the marginal propensities to save, the results of the lowest and highest propensities to save calculated from the four functional forms by years and by various subgroups are presented in Table 17. As with the APS, the aggregate marginal propensities to save did not have

Table 17 A Summary of Ranges of Marginal Propensities to Save, Using Various Functional Forms, Based on Taiwan Farm Record Keeping Data By Year and Various Economic Sub-Groups, 1960-1970[a]

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
1. Total Farms	.38-.49	.39-.46	.44-.51	.40-.57	.39-.63	.39-.49	.54-.68	.44-.52	.54-.72	.33-.46	.41-.47
By Farm Size											
2. 0 - 1.00	.60-.66	.37-.44	.42-.50	.30-.68	.30-.68	.38-.47	.43-.50	.46-.52	40-.60	.43-.50	.34-.42
3. 1.01-2.00	.24-.31	.44-.45	.46-.55	.50-.64	.36-.46	.39-.49	.52-.68	.34-.45	.46-.55	.26-.44	.40-.56
4. 2.01+	.77-.79	.37-.51	.37-.50	.37-.50	.57-.61	.34-.65	.71-.79	.45-.62	.58-.84	.19-.53	.33-.46
By Region											
5. Northern Rice Region	.44-.46	.27-.29	.45-.53	.51-.81	.41-.52	.34-.48	.23-.74	.33-.48	.37-.51	.22-.45	.20-.34
6. Middle Rice Region	.57-.61	.27-.41	.55-.57	.40-.46	.38-.54	.21-.38	.49-.64	.41-.52	.46-.50	.41-.59	.38-.50
7. Southern Rice Region	.12-.38	.41-.50	.24-.52	.35-.50	.33-.47	.19-.46	.62-.69	.28-.53	.51-.66	.03-.46	.52-.68
8. Tea Region	b	.34-.39	.54-.68	.56-.71	.20-.84	.30-.33	.31-.37	.32-.42	.60-.67	.19-.35	.27-.37
9. Southwestern Mixed Farming Region	b	b	b	b	.47-.55	.60-.69	.57-.61	.48-.62	.31-.53	.26-.50	.25-.42
10. Southwestern Sugar Cane & Rotation Region	.53-.60	.40-.44	.47-.78	.47-.59	.54-.58	.42-.50	.39-.65	.47-.56	.45-.86	.33-.50	.51-.58
11. Banana and Pineapple Region	b	.32-.34	.55-.59	.55-.73	.46-.56	.52-.59	.36-.42	.49-.54	.50-.54	.32-.62	.01-.49
12. Eastern Mixed Farming Region	b	b	b	b	.54-.56	.61-.66	.84-.94	.60-.66	.53-.66	.48-.52	.46-.56
By Dependency Ratios[c]											
13. 0 - .5	.32-.48	.31-.44	.44-.51	.32-.57	.36-.69	.32-.43	.56-.67	.36-.50	.44-.54	.30-.45	.30-.46
14. .5+	.48-.53	.45-.51	.52-.58	.59-.62	.44-.54	.51-.58	.60-.74	.58-.62	.51-.85	.51-.55	.53-.61
Ratio of Farm Income to Farm Family Income[d]											
15. 0 - .7	.26-.38	.53-.58	.52-.60	.34-.40	.21-.29	.33-.42	.36-.60	.26-.36	.41-.81	.15-.49	.26-.37
16. .7+	.39-.56	.35-.45	.43-.49	.42-.59	.43-.69	.41-.55	.62-.71	.49-.58	.46-.59	.42-.52	.52-.56

[a]The marginal propensities to save (MPS) are defined as one minus the marginal propensities to consume (MPC) which were computed at the arithmetic income mean for the particular group from the estimate of the four functional forms (shown in the footnote of Table 15). The methods of computation are shown in a note to Table 15.

[b]No observations available from this region for this year.

[c]The dependency ratio is defined as the number of children of less than 15 years of age plus people over 60 years of age who reside in the household divided by the total number of members of the household.

[d]Farm income is defined as the net farm income derived from on-farm enterprises. Inputed management returns, capital depreciation, and a value of family labor used on farm were not subtracted from this net income figure. Farm family income includes net farm income plus net income derived from off-farm activities.

a consistent tendency in the 11 years under study. The analysis of the total farm data suggested that the range of the MPS lay between one-third and two-thirds. As suggested in Chapter I, these are exceptionally high MPS's given past evidence on rural saving behavior. In the years of good harvest (1966 and 1963), the cross section marginal propensities to save were relatively high, and in the year of bad harvest (1969) these were low. No consistent pattern emerged with respect to the different farm size or agricultural region subgroups during 1960-1970. Therefore, the hypothesis that the MPS of the farm with large size is assumed to be greater than that of the farm with small size was not substantiated from the data.

The MPS's were, however, quite different in the two dependency ratio groups. Surprisingly, the MPS's in the high dependency ratio group were generally higher than those in the low ratio group. This result fails to confirm the hypothesis that the dependency ratio and savings behavior are inversely related. It might be explained that the high dependency ratio group faced more unexpected consumption expenditures, for example, medical care for old people, and that expected future educational expenses for their children may force savings at the margin.

The MPS between the two groups of farmers classified by the ratio of income sources were also quite different. The results showed that the farms with a large part of

their income coming from agricultural sources had higher MPS than those with the lower ratio. This was true except for the years 1961 and 1962. This evidence generally supports the hypothesis that the MPS of farms with high ratios of farm-income-to-farm-family-income is assumed to be greater than that of farms with low ratios. As mentioned earlier, farms with a high ratio of farm-income-to-farm-family had higher per capita farm family incomes. This supports the Keynesian hypothesis that the MPS will be higher at the higher absolute income levels. It might also be concluded that the farm family engaged in part-time farming is more likely to be affected by the demonstration effect of urban consumption behavior. These farmers may have had a mixed consumption behavior pattern affected both by rural and urban influences. It was different for the closer-to-full-time farm who had more opportunities for on-farm investment.

Overall, it can be concluded that both average and marginal propensities to save among the disaggregate sub-groups and the overall samples in the study were remarkably high. As discussed earlier, the farms included in the study were generally better than the average farms in Taiwan. It would expect that the APS's and MPS's calculated from Taiwan farm record-keeping data would be higher than those of the average farms in Taiwan. There is little doubt,

however, that the average farm has also had substantial APS and MPS.

This savings capacity has been expressed in the following ways: first, investment in on-farm assets. This includes productive assets and some liquid assets such as value of livestock and poultry in store, and value of by-products and processing products in store. The second way is financial savings which have flowed into the rural financial markets, either institutional or non-institutional systems. There are a number of savings agencies in Taiwan.[8] Deposits in Farmers' Associations and in postal savings are the most common place for institutional financial savings. Non-institutional savings flow into rotating credit associations (huis) or loans to friends or relatives. The third method of saving is off-farm investment which includes investments in urban housing, businesses and equipment. This appears to be a minor part of farmers' savings in Taiwan. General ideas about changes in the first two forms of savings during the 1960's were discussed in Chapter IV.

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[8]The agencies for financial savings include the Farmers' Associations, the Land Bank of Taiwan, the Cooperative Bank of Taiwan, the Farmers' Bank of Taiwan, credit cooperatives, savings companies, postal savings, and some commercial banks.

An Analysis of Marginal Propensities to Save From Time Series Data, 1960-1970

The main purpose of this section is to estimate the time series MPS of Taiwanese farmers in the 1960's, and then to compare these results with the cross sectional MPS's which were presented in the previous section.

For easier comparison, time series consumption-savings functions were examined using the same subgroup classification as used in the cross section MPS analysis. Two functions were used in testing the time series MPS by ordinary least squares. First, a Keynesian function was used which simply stated that per capita consumption expenditure was a linear function of per capita farm family income. Second, a modified Duesenberry's savings function was used to test the relative income hypothesis. This function included a measure of whether real income in a given time period rose more or less rapidly than in the preceding time period. These two functions were used to examine the extent to which the Keynesian hypothesis and the relative income hypothesis explained time series consumer behavior.

Values of the variables used in the time series functions were in terms of 1970 prices. The deflator used was the Index of price-received-by-farmers in Taiwan, shown in Appendix A.

The results of the Keynesian function analysis are shown in Table 18. The simple R^2 lay between .60 and .80

Table 18 Estimates of A Keynesian Time-Series Consumption Function Based on Farm Record Keeping Data in Taiwan 1960-1970[a]

Group	Number of Observations	Coefficient of b_0	Coefficient of b_1	Standard Error of Estimate	Simple R^2	F-Ratio	Durbin-Watson D	Marginal Propensities to Save
1. Aggregate	11	1013.5[c] (771.9)	.6124 (.1257)	298.4	.7250	23.7225	2.0428	.3876
By Farm Size (hectares)								
2. 0 - 1.00	11	372.5[c] (621.0)	.7600 (.1183)	243.0	.8209	41.2412	2.0399	.2400
3. 1.01 - 2.00	11	1424.4[c] (803.5)	.5498 (.1255)	301.7	.6808	19.1919	1.9850	.4502
4. 2.01 +	11	1063.4[c] (998.9)	.5684 (.1339)	492.6	.6670	18.0246	2.1118	.4316
By Agricultural Region								
5. Northern Rice Region	11	807.8[c] (1070.8)	.6668 (.1784)	409.2	.6083	13.9770	1.5561	.3332
6. Middle Rice Region	11	942.6[c] (725.2)	.6265 (.1306)	350.5	.7188	23.0034	1.0914	.3735
7. Southern Rice Region	11	4876.2[c] (2745.4)	.1586[c] (.3396)	920.0	.0237	.2183	2.2770	.8414
8. Tea Region	10	1593.0 (819.4)	.5516 (.1493)	261.1	.6306	13.6558	3.2661	.4484

[a]The Keynesian time series consumption function was estimated by ordinary least squares from the function $C_t = b_0 + b_1 Y_t + U_t$, where C is per capita consumption expenditures for a calendar year, Y is per capita farm family income for the calendar year, U denotes the disturbance term and t indicates time period.

Table 18 Estimates of A Keynesian Time-Series Consumption Function Based on Farm Record Keeping Data in Taiwan 1960-1970 (Continued)

Group	Number of Observations	Coefficient of b_0	Coefficient of b_1	Standard Error of Estimate	Simple R^2	F-Ratio	Durbin-Watson D	Marginal Propensities to Save
9. Southwestern Mixed Farming Region	7	-497.3[c] (1169.5)	.8082 (.1669)	334.8	.8242	23.4455	1.5934	.1919
10. Southwestern Sugarcane & Rotation Region	11	1477.0 (610.6)	.5309 (.1047)	327.9	.7406	25.6921	1.3879	.4691
11. Banana & Pineapple Region	10	1539.0[c] (891.1)	.5495 (.1474)	388.5	.6348	13.9067	1.7722	.4505
12. Eastern Mixed Farming Region	7	2534.3 (1057.9)	.2958 (.1451)	350.4	.4540	4.1573	2.3944	.7042
By Dependency Ratio								
13. 0 - 0.5	11	827.1[c] (982.1)	.6551 (.1451)	374.4	.6937	20.3794	2.1913	.3449
14. 0.5 +	11	1769.8 (544.0)	.4515 (.0994)	186.5	.6961	20.6137	1.4959	.5485
Ratio of Farm Income to Farm Family Income								
15. 0 - 0.7	11	955.4[c] (763.9)	.6681 (.1260)	348.4	.7576	28.1288	1.6637	.3319
16. 0.7 +	11	1377.5 (665.8)	.5360 (.1050)	256.2	.7323	24.6188	2.1458	.4640

[b]Standard error of the coefficient appears in the parenthesis beneath the coefficient.

[c]Denotes the coefficients are not significantly different from zero at the five percent significance level.

[d]Classification see notes c and d in Table 17.

for all subgroups except for the southern rice and the eastern mixed farming regions. That is 60 to 80 percent of per capita consumption variation can be explained due to changes in per capita income during 1960-1970. These R^2 values are higher than those from the cross section consumption function analyses for different subgroups and for various years.

The estimates of per capita income coefficients are significant at the five percent level for all subgroups except for the southern rice region in the Keynesian function. The constant terms may be negligible for those groups, since they are insignficantly different from zero at the five percent level. It would be expected that these functions go through the origin just like the theoretically expected time series consumption function.

Only the estimates of the modified Duesenberry's savings function for the aggregate data and the southern rice region in the duration of 1961-1970 are shown here. The estimated results for all subgroups are presented in Appendix D.

Aggregate Data

$$\frac{S_t}{Y_t} = -.0587 + .2705 \frac{Y_t}{Y_{t-1}}$$
$$(2.3159) \quad (.2219)$$

$$R^2 = .1567 \qquad F = 1.4863$$

Standard Error of Estimate = .0475

Durbin-Watson = 1.4659

Southern Rice Region $\frac{S_t}{Y_t} = -.8532 + 1.0602 \frac{Y_t}{Y_{t-1}}$

$(.7175) \quad (.2203)$

$R^2 = .7433 \quad F = 23.1643$

Standard Error of Estimate = .0677

Durbin-Watson D = 1.9097

$\frac{S_t}{Y_t}$ denotes the savings ratio and $\frac{Y_t}{Y_{t-1}}$ is the growth rate of income. The standard error of each coefficient appears in parenthesis beneath the corresponding coefficient.

In the aggregate data, R^2 was only .16 which was lower than that of the Keynesian estimates. Both coefficients are insignificantly different from zero at the five percent level by using one-tailed t-test. All subgroups except the southern rice region had similar results to the aggregate samples.

As for the southern rice region, R^2 was .74, higher than that of the Keynesian one. The estimated coefficient of the growth rate of income was significantly different from zero at the same level.

The estimated results show that the Duesenberry's function did not fit better than the Keynesian function in either the aggregate data or in the disaggregate subgroups, except for the southern rice region; the R^2 in the Duesenberry's function was generally less than that of the Keynesian one. In other words, the relative income hypothesis is a more appropriate explanation of consumer behavior

only in the southern rice region.

The time series MPC and MPS were calculated from the estimates of Keynesian consumption function since this function did a better job of estimation. As can be shown in Table 18, the time series MPC ranged between .54 and .76 for all subgroups except for the southern rice region. The time series MPS is defined as one minus the time series MPC. The calculated time series MPS then lay between .24 and .46.

The time series results indicate changes in farm consumer behavior averaged over time. As mentioned earlier the cross section analysis indicates the behavior in any given time period. The comparison between these two MPS's shows that the time series MPS were about .15 lower than the cross section MPS. This might reflect the effects of transitory income variation in the time series analysis as suggested by Friedman.[9] Unfortunately, the data covers only 11 years and the permanent income hypothesis is not directly tested in the study.

The analyses in this chapter suggests that farm size, the ratio of farm-income-to-farm-family-income, the dependency ratios, and per capita income are useful explanatory variables of changes in consumption expenditure. Different types of cropping systems and the growth rate of income do not

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[9]M. Friedman, op. cit.

significantly explain variations in consumption.

In the following chapter the aggregate consumption function is estimated from data drawn from 53 panel farms in the period 1964-1970. The independent variables used in the function includes income, the ratio of farm-income-to-farm-family-income, lagged consumption, net worth, and the rate of return to capital. The importance of income and the ratio of farm-income-to-farm-family-income are derived from the analyses in this chapter. Economic theory and previous studies suggested that lagged consumption and net worth and the rate of return to capital were important factors affecting consumption behavior.

CHAPTER VI

CONSUMPTION FUNCTION ANALYSIS OF PANEL DATA

The main purpose of this chapter is to identify how changes in farm family income and adjustments in other factors affected the consumption savings behavior of a group of panel farm families. The variables selected for the models are based on the analysis done in Chapter V. The panel data from 53 farms covering the period of 1964 through 1970 were used. An analysis is presented of aggregate and cross section marginal propensities to save for these farms. Statistical estimates of an aggregate consumption function which includes pooling of time series of cross sectional data are also presented. Three different estimation techniques are used: ordinary least squares, the fixed coefficient regression (FCR) and the random coefficient regression (RCR) methods.

An Analysis of the Aggregate and Cross Section Propensities To Save for the 53 Panel Farms 1964-1970

The cross section consumption function fails to indicate what happens through time but represents farm household behavior in any given time. In contrast, the

time series function indicates changes in farm household behavior averaged over time, but cannot explain the behavior in any given period. Only panel data or pooling time series of cross section data can be used to estimate changes in consumer behavior over time. The first two types of analyses were discussed in the previous chapter. The panel data analysis is presented in this chapter.

The panel of 53 farms covering the 1964-1970 period was selected because it included a sufficient sample size and covers a reasonably long period of time when compared with other panel possibilities (see Table 2). The breakdown of the panel farms into agricultural regions is shown in Table 19. These farms were not representative samples of their respective agricultural regions nor of all Taiwanese farms from the viewpoint of sampling distribution theory. As can be noted in Table 20, however, the APS and MPS of the 53 farms from 1964-1970 were roughly of the same order of magnitude as reported in Tables 16 and 17 for the entire sample of farms. From 1964 to 1968 roughly one-quarter of their income was not consumed. Aside from 1969 roughly one-third to two-thirds of their income at the margin was saved.

In an attempt to estimate the aggregate MPS and to compare this with the cross sectional MPS, per capita consumption was regressed against per capita income and per capita lagged consumption. As pointed out earlier,

Table 19 Number of Panel Farms (1964-1970) in Taiwan Farm Record Keeping Program by Agricultural Region

Agricultural Region	Number of Farms
Northern Rice Region	2
Middle Rice Region	7
Southern Rice Region	6
Tea Region	12
Southwestern Mixed Farming Region	4
Southwestern Sugarcane & Rotation Region	15
Banana & Pineapple Region	6
Eastern Mixed Farming Region	1
Total	53

Source: Calculated from Taiwan Farm Record Keeping Accounts.

Table 20 Average and Marginal Propensities to Save Based on Data for 53 Panel Farms by Year, 1964-1970

Year	Average Propensities to Save[a]	Ranges of Marginal Propensities to Save[b]
1964	.25	.43 - .68
1965	.28	.31 - .57
1966	.27	.46 - .60
1967	.22	.44 - .60
1968	.28	.43 - .58
1969	.03	.07 - .28
1970	.15	.18 - .45

[a]The average propensity to save is defined as one minus the average propensity to consume, which in turn is per capita consumption expenditure over per capita farm family income.

[b]Marginal propensities to save are calculated from various functional forms, calculation precedures were shown in notes to Table 17.

T. M. Brown, Goldberger and Evans and others have suggested that lagged consumption represents the past pattern of consumption which in turn affects current consumer behavior. The statistical model is:

$$C = b_0 + b_1 Y + b_2 C_{-1} + U$$

Where C = Real per capita consumption expenditures including cash and noncash expenses for a calendar year.

Y = Real per capita farm family income including cash and noncash income from both farm and non-farm sources for a calendar year.

C_{-1} = Real per capita consumption expenditures including cash and noncash expenses for a previous calendar year.

b_0, b_1 and b_2 are the parameters, and U denotes the disturbance term.

All variables were measured in terms of 1970 New Taiwanese dollars (NT dollars). That is current values were deflated by the Index-of-prices-received-by-farmers shown in Appendix A. Since a lagged variable is included in the model, one year observation for each farm is lost. The total sample was 318 observations which consisted of six years of data for 53 panel farms over the 1965-1970 period.

Theoretically when lagged consumption is introduced as an independent variable it no longer is independent of the disturbance term. Thus, ordinary least squares

assumptions may not hold.[1] For simplicity, this variable is still treated as nonstochastic independent variable in the study.

Several additional research techniques are used in this chapter which have not been used in previous chapters. These are the fixed coefficient regression (FCR) and random coefficient regression (RCR) methods. In addition ordinary least squares (OLS) estimating techniques will also be used. The main differences among the three methods lie in their assumptions. The disturbance terms are assumed to be homoskedastic in the OLS techniques. Both FCR and RCR assume heteroskedasticity in the disturbance term. In the FCR method, the parameters are assumed to be fixed. On the other hand, the parameters are presumed to be randomly distributed in the RCR model.

The estimated results of these three different techniques are presented in the following. In the final part of the section the aggregate MPS will be calculated from the estimations and compared with the cross section results.

The Ordinary Least Squares Estimates

Under the strict OLS assumption, behavior is homogeneous over the sample through time. The estimated OLS

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[1]Arthur S. Goldberger, Econometric Theory, (New York: John Wiley & Sons, Inc., 1964), pp. 272-278.

equation is given below:

$$C = \underset{(19.8754)}{1086.4} + \underset{(.0273)}{.3805}\, Y + \underset{(.0462)}{.3356}\, C_{-1}$$

$$R^2 = .6912 \qquad S.E. = 1586.0$$

The standard error of each coefficient appears in parenthesis beneath each corresponding coefficient. The standard error of estimate for the equation is denoted by S.E. All coefficients are statistically different from zero at the five percent level performed by one-tailed t-test.

The Fixed Coefficient Regression Estimates

The above model estimated by ordinary least squares techniques assumed a homoskedastic disturbance term or a homogeneous sample. As mentioned earlier, the panel farms were distributed in different agricultural regions. It is doubtful if the homogeneity property for this sample holds. It is more reasonable to assume that the sample has a heteroskedastic disturbance term. In order to test this question Aitken's generalized least squares (GLS) was applied to the aggregate consumption function. Minimum variance linear unbiased estimates were obtained through use of the FCR techniques. The assumption here being that the coefficients are non-random or fixed for all individuals. This assumes no restriction on the distribution of income, no differences in the past and

present consumption pattern among panel farms. Aggregate consumption then can be defined as a function of aggregate income and aggregate lagged consumption.

The 53 micro functions for the consumption function were estimated by ordinary least squares. The results indicate that individual variance of the disturbance term are substantially different across the samples. The OLS estimates were less efficient, apparently, because of non-homogeneous samples. The FCR method was then used to estimate this function under the assumption of (1) heteroskedasticity of the disturbance term and (2) the fixed or non-random coefficients. Following the appropriate procedures, the efficient estimates were obtained and presented as:

$$C = \underset{(51.1468)}{470.5} + \underset{(.0206)}{.2424}\, Y + \underset{(.0129)}{.3746}\, C_{-1}$$

The standard error of each coefficient is shown in the parenthesis beneath each corresponding estimate. All coefficients are stochastically different from zero at the five percent level by one-tailed t-test. These FCR estimates are obviously more efficient when comparing the variance of the coefficients estimated by this method and ordinary least squares.[2]

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[2]Phoebus J. Dhrymes, op. cit.

The Random Coefficient Regression Estimates

If the regression coefficients are fixed but different for individuals, there is no way to get the aggregate consumption function by the FCR method without introducing bias into the estimation. If this is true it is necessary to use the RCR method. The homogeneity statistic to be tested is:[3]

$$H = \sum_{i=1}^{n} \frac{(b_i-d)'(X_i'X_i)(b_i-d)}{S_{ii}}$$

$$\text{where } d = \sum_{i=1}^{n} \left[\frac{X_i'X_i}{S_{ii}}\right]^{-1} \sum_{i=1}^{n} \frac{X_i'X_i}{S_{ii}} b_i$$

b_i is the ordinary least squares estimates for the individual i, and n denotes the numbers of panel farms.

Under the hypothesis that the coefficients are non-random, the asymptotic distribution of $H/K_{(n-1)}$ can be approximated by F-distribution with the degrees of freedom of $(n-1)K$, $n^{(T-K)}$. K denotes the number of independent variables including the constant term in the model, and t indicates the time period of each panel farm observations.

The results of this calculation of $H/K_{(n-1)}$ was 7.44. This fell within the rejection region of F distribution with the degrees of freedom of (156, 159). Therefore, the

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[3]P.A.V.B. Swamy, op. cit.

regression coefficients were assumed to be randomly distributed and not fixed for all micro units. It also implied that the farm is heterogeneous in consumer behavior with heteroskedastic disturbances.

The RCR method stated in Chapter III was used to estimate the function and the results are presented here.

$$C = 334.1 + .4661Y + .2539C_{-1}$$

The standard error of the estimate is not presented under this estimation, since the RCR estimated variance of the constant term had a negative sign. With reasonable assumptions on the variance matrix of the disturbance term for the model, an unbiased estimate of the negative variance of a coefficient might be due to sampling fluctuations when there is a low probability of the coefficient taking a nonzero value or when the variance is not estimated.

In general, the RCR estimates were the most efficient of the three techniques, after the homogeneity statistic test was rejected. It was concluded that these panel farms were not homogeneous in consumer behavior and that farms in various geographic location have different consumption patterns.

The aggregate marginal propensities to consume were calculated from the estimated income coefficient divided by one minus the estimate of lagged consumption. That is

the aggregate MPC = $b_1/(1-b_2)$. The aggregate marginal propensities to save are defined as one minus the aggregate marginal propensity to consume.

The aggregate MPC, shown in Table 21, ranged from .57 to .68 under the three different techniques. Thus, the aggregate MPS lay between .32 and .43. The highest MPS is shown from the estimate of the OLS and the lowest one is from the FCR estimates. The aggregate MPS is a representative MPS for farm household accounted for changes over time. This magnitude of MPS further confirms that the savings capacity in rural Taiwan has been remarkably high.

As mentioned earlier, the farm record-keeping farms are at a somewhat higher economic level than the average Taiwan farm. The cross section MPS ran between about one-third and two-thirds of the income at the margin for all recrod-keeping samples or panel farms in various years, except 1969. In general, the cross section MPS's were about .20 higher than the aggregate MPS. And the time series MPS was about .05 higher than the aggregate MPS.

Aggregate Consumption Function Analysis

Additional variables are introduced into the consumption function analysis in this section. The model treated here assumes that consumption is not only related to farm family income and lagged consumption, but with other variables such as net worth at the beginning of the

Table 21 Aggregate Marginal Propensities to Consume and to Save Calculated from Three Different Estimation Techniques[a]

Estimation Technique	Aggregate Marginal Propensity to Consume	Aggregate Marginal Propensity to Save
The Ordinary Least Squares	.57	.43
The Fixed Coefficient Regression	.68	.32
The Random Coefficient Regression	.62	.38

[a]The aggregate marginal propensity to save is defined as one minus the aggregate marginal propensity to consume which is calculated as $b_1 / (1-b_2)$ from the estimates of the aggregate consumption function

$$C = b_0 + b_1 Y + b_2 C_{-1}$$

Where C = per capita consumption expenditure for a calendar year.

Y = per capita income for a calendar year.

C_{-1} = per capita consumption expenditure for a previous year.

year, the ratio of farm-income-to-farm-family-income, and the rate of return to capital in a previous year. In most cases it has been thought that consumption depended on current income, previous consumption behavior, and net worth. These additional variables seldom have been included in consumption function analyses, however. An attempt is made here to integrate these variables into the aggregate consumption analysis.

On the basis of previous analysis income and lagged consumption are expected to be positively related to consumption. The ratio of farm-income-to-farm-family-income is also introduced because of the results from the time series and cross section subgroup analyses.

The rapid growth of the Taiwanese economy has enlarged the income differentials between urban and rural areas. Farmers increasingly have engaged in off-farm employment. The reduction of farm labor in the field and promotion of farm mechanization in the late 1960's partially resulted from this off-farm drift. The ratio of farm-income-to-farm-family-income is used to estimate the affect of this structural change on consumption behavior.

The ratio of farm-income-to-farm-family-income indirectly influences the consumer behavior through the following factors: the investment alternative on farm, the nonfarm investment opportunities, income security, prices of industrial goods and the demonstration effect. That

is, a negative relationship between this ratio and consumption may be due to attractive on-farm investments, farm income instability, and attractive rates of return to off-farm investments.

As already pointed out, Pigou, Ackley and others have suggested that the wealth effect influences consumption. It is generally assumed that net worth and consumption are positively related. With the data available in the record-keeping project it appeared that either liquid assets or net worth were the best available proxies for measuring the influence of wealth on consumption. On the farms under analysis both values have increased over time as the farms expanded their economic activities. Preliminary analysis of the farm record-keeping data showed that "liquid assets" were not significantly related to consumption. Therefore, net worth was chosen as the wealth proxy. Net worth was defined as the assets owned by the farm family including both physical and monetary assets, excluding value of rental property and equipment.

The rate of return to capital is the factor used to connect farm production decisions with household consumption behavior. Mizoguchi stated that this return might affect consumption, but he did not test how important this factor was in the Japanese agriculture.[4] The best measure

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[4]Toshiyuki Mizoguchi, op. cit.

of return to capital is the marginal efficiency of investment in the production process. It was impossible within the scope of this study to derive these types of estimates. Some indication of the attractiveness of capital investments, however, can be derived from the average return to capital. Various measures of this return are entered into the consumption analysis which follows. The average rate of return to capital is defined in this study as gross farm income divided by capital. Three different definitions of capital and thus rates of return are used: (1) the rate of return to total assets, (2) the rate of return to operating assets, and (3) the rate of return to total assets excluding the value of land.

High returns to capital are generally assumed to provide credit-use incentives to farmers. High returns also encourage savings and other investment activities which in turn trade off against consumption. The relationship between the return to capital and consumption can be either positive or negative. The sign of the relationship depends on the source of the investment funds. If funds come from reducing consumption to increase savings, the sign is negative. On the other hand, if funds come from increased credit use or shifting other investment opportunity to farm investment, a positive relationship is implied.

The statistical model of the consumption function which will be tested is as follows:

$$C = b_0 + b_1Y + b_2C_{-1} + b_3NW_{-1} + b_4RIS + b_5RRC_{-1} + U$$

Where C = Real per capita consumption expenditures including cash and noncash expenses for a calendar year.

Y = Real per capita farm family income including cash and noncash income from both farm and off-farm sources for a calendar year.

C_{-1} = Real per capita consumption including cash and noncash expenses for a previous calendar year.

NW_{-1} = Real per capita net worth at the beginning of a calendar year.

RIS = The ratio of farm-income-to-farm-family-income for a calendar year.

RRC_{-1} = The average rate of return to capital in a previous year.

$b_0,\ldots,b_5$ are the parameters, and U denotes the disturbance term.

The Ordinary Least Squares Estimates

In an attempt to integrate different rates-of-return to-capital into the aggregate consumption functions, three different measures were used in each regression run. These, plus income, lagged consumption, net worth, and the ratio of farm-income-to-farm-family-income were freely entered into the three separate models and interpreted at the ten percent significance levels.

Multicollinearity among variables was not a serious problem. Among the independent variables, net worth,

lagged consumption, and income were closely related. The partial correlation coefficients between income and lagged consumption, income and net worth, and net worth and lagged consumption were .6773, .7282, and .6649 respectively. Other pairs of independent variables were less related.

The assumption behind ordinary least squares procedures is that all samples are homogeneous in behavior regardless of time changes. Three estimated models are presented as follows. The results were examined for validity with respect to economic theory.

Model I

$$C = \underset{(37.2870)}{1699.2^{*}} + \underset{(.0321)}{.3544^{*}}\, Y + \underset{(.0490)}{.3149^{*}}\, C_{-1}$$

$$+ \underset{(.0034)}{.0049^{**}}\, NW_{-1} - \underset{(3.9571)}{6.8934^{**}}\, RIS$$

$$R^2 = .6961 \qquad S.E. = 1580.8$$

Model II

$$C = \underset{(37.4257)}{1777.9^{*}} + \underset{(.0373)}{.3741^{*}}\, Y + \underset{(.0462)}{.3300^{*}}\, C_{-1}$$

$$- \underset{(3.8186)}{5.5139^{**}}\, RIS - \underset{(3.0848)}{5.8371^{*}}\, RRCA_{-1}$$

$$R^2 = .6976 \qquad S.E. = 1577.0$$

Model III

$$C = \underset{(44.4197)}{1970.7^{*}} + \underset{(.0273)}{.3273^{*}}\, Y + \underset{(.0464)}{.3294^{*}}\, C_{-1}$$

$$- \underset{(3.8323)}{5.9359^{**}}\, RIS - \underset{(.9214)}{1.5800^{**}}\, RRCO_{-1}$$

$$R^2 = .6980 \qquad S.E. = 1578.6$$

Where $RRCA_{-1}$ represents the average return to total assets in Model II, and $RRCO_{-1}$ denotes the average rate of return to operating capital in Model III. The remainder of the variables were explained earlier.

In the above estimated models, the standard error of each coefficient appears in parenthesis beneath the corresponding coefficient. The standard error of estimate for the equation is denoted by S.E.

The statistical tests of the hypotheses were performed by one-tailed t-test. The coefficients statistical different from zero are denoted by "*" at the five percent significance level and by "**" at the ten percent level.

In each model, income was selected first into the aggregate consumption function. Lagged consumption and the ratio of farm-income-to-farm-family-income came into the models subsequently. Net worth, the average rates of return to total assets and to operating assets were finally chosen in the fourth priority in the three models respectively. The t-value did not allow the fifth variable

to enter the models.

In general these three models almost had similar R^2 values. The explanation power of the four variables with respect to variation in consumption in the three different models was about 70 percent. The remaining portion of consumption variation might be explained by education, age of the farm operator, age composition of the family, market interest rates as well as other economic, social and political factors.

In the above models, per capita farm family income, consumption for a previous year, and the average rates of return to total assets were statistically different from zero at the five percent level. Net worth, the average rate of return to operating assets and the ratio of farm-income-to-farm-family-income were significant at the ten percent level.

As can be noted in the above results, a change in income is positively associated with a change in consumption as expected. Increases in one dollar of farm family income will increase .35 - .38 dollars of consumption or .62 - .65 dollars of savings. The income coefficient, however, was probably underestimated. This is due to the fact that part of increase in consumption, which is really due to rising income, is attributed to the growth of other factors in the model.

Changes in lagged consumption are shown to be positively related to changes in current consumption. This coefficient is slightly lower than the income coefficient.

As expected, an increase in net worth was positively related to a rise in the level of consumption, assuming other things unchanged. An increase of one dollar in net worth increased consumption by .0049 dollars in Model I.

The ratio of farm-income-to-farm-family-income is negatively associated with consumption as estimated by ordinary least squares. The magnitudes of this coefficient ranged from -6.39 to -5.51 in the three models. The farms with more dependence on farm income sources showed more tendency to defer consumption in order to increase their saving. As suggested earlier, this was probably due to the uncertain future farm income, and/or they may have had more investment alternative on farm. In contrast, the farms with a high proportion of off-farm income tended to consume a large proportion of this income. This may have been due to more stable flows of off-farm income, and the demonstration effect of working near or with urban consumer.

The model results show that the rates-of-return-to-capital were negatively associated with consumption. The negative signs of the coefficient suggest that funds for

investment trade off against consumption. High returns to on farm investments apparently have been strong incentive for farm families to defer consumption. For example, a one percent increase in the return-to-total-assets in Model II reduced consumption by 5.84 dollars. In Model III a one percent increase in the return-to-operating-assets decreased consumption by 1.58 dollars. Assuming other things being equal, the rate-of-return-to-total-assets appeared to more strongly influence consumption fluctuations than the other two measures of return-to-capital used in the analysis. The return-to-total-assets excluding land values was not an important factor in explaining variation in consumption. T-values did not allow this variable into the consumption equation.

The Fixed Coefficient Regression Estimates

As suggested earlier in this chapter, the FCR procedure allows one to test data under the assumptions of fixed coefficients and heteroskedasticity. Because the panel data used only covered 6 years (1965-1970) only four independent variables, excluding the constant term, could be used in each equation in the FCR consumption function estimates. Fortunately, only five independent variables in the OLS analysis turned out to be significantly different from zero: current income, lagged consumption, net worth, income ratio by source, and return-to-capital.

Various combinations of the last three of these variables are used in the following analysis to restrict the number of variables used to four.

Again, the individual functions for three separate models were estimated by ordinary least squares. The results showed that the estimated individual disturbance terms varied substantially across all panel farms. The OLS assumption of the homoskedastic disturbance term, thus appeared unrealistic. A more efficient estimate can be obtained by the FGR method.

The data was analyzed using Aitken's generalized least squares which yields consistent and asymptotically efficient estimates for the parameters. The results of the three models are as follows:

Model I

$$C = \underset{(15.3082)}{2936.0} + \underset{(.0024)}{.2324}\, Y + \underset{(.0034)}{.1787}\, C_{-1}$$

$$+ \underset{(.0003)}{.0339}\, NW_{-1} - \underset{(.1313)}{9.7470}\, RIS$$

Model II

$$C = \underset{(71.4213)}{1149.0} + \underset{(.0000)}{.3519}\, Y + \underset{(.0127)}{.3863}\, C_{-1}$$

$$- \underset{(.3545)}{4.8720}\, RRCA_{-1} - \underset{(.4915)}{.8393}\, RIS$$

Model III

$$C = \underset{(42.0119)}{-387.0} + \underset{(.0079)}{.4923}\,Y + \underset{(.0104)}{.4223}\,C_{-1}$$

$$+ \underset{(.1059)}{.5038}\,RRCO_{-1} + \underset{(.3945)}{2.8750}\,RIS$$

All symbol identifications were shown in pages 109 and 111. Again, the standard error of each coefficient appears in the parenthesis beneath each corresponding estimate. All coefficients are significantly different from zero at the five percent significance level.

Overall, coefficients for income, lagged consumption, and net worth had positive signs. The ratio of farm-to-farm-family-income and the average rate of return to total assets had negative signs in the first two Models. The signs of the return to operating assets and the ratio of farm-income-to-farm-family-income were positive in Model III.

In each of the models the relationship between income and consumption was positive. Only the size of the relationship changed. An increase of one dollar in income increased consumption by .23, .35, and .49 dollars in the three models respectively.

The effect of lagged consumption on current consumption is slightly lower than the current income effect in Models I and II. The magnitude of this coefficient ranged from .18 to .42 in the models. More variation of

the coefficient in the three models was shown in the FCR than the OLS analysis.

An increase in the ratio of farm-income-to-farm-family-income caused a reduction in consumption in Model I and Model II. A one percent increase in the ratio reduced consumption by 9.75 and .84 dollars in Model I and Model II respectively. A rise in this income ratio resulted in increases in consumption shown in Model III. A one percent increase in this ratio caused consumption increases of 2.68 dollars.

An increase of one percent in the rate-of-return-to-total-assets reduced consumption by 4.88 dollars in Model II. This negative relation was expected. In contrast, as the rate-of-return-to-operating-assets increases one percent, per capita consumption increased .50 dollars in Model III. The explanation of the positive relation between these two factors is: (1) when the return to operating costs are high, farmers need not sacrify their past levels of consumption in order to create saving for investment in the next crop season, (2) in some cases farmers used credit or shifted resources from other assets to operating investment. Taiwan farm record-keeping farms rapidly increased short term loans during the 1960's.

The Random Coefficient Regression Estimates

The calculated homogeneity statistic value of $H/K(n-1)$ were 214.9, 16.8, and 13.7 for the three models respectively. These values fell within the rejection region of F distribution at the five percent significance level with the degrees of freedom (265, 53). The tests, therefore, did not support the hypothesis of fixed coefficients. One could conclude as a result that the aggregate consumption functions were more efficiently estimated by the RCR methods.

Following the RCR procedures, the mean values of the parameters are estimated below:

Model I

$$C = 1762.0 + .1970\ Y + .4353\ C_{-1} + .0062\ NW_{-1} - 8.1100\ RIS$$

Model II

$$C = -7519.0 + .0375\ Y + .1142\ C_{-1} - 86.5200\ RRCA_{-1} - 88.1800\ RIS$$

Model III

$$C = 1281.0 + .2992\ Y + .7398\ C_{-1} + .3338\ RRCO_{-1} - 27.7300\ RIS$$

The standard error of each estimate are not presented because some of them are negative. The reasons for the negative sign were discussed earlier.

In summary, all estimated coefficients had the expected sign in Model I. The estimated coefficients, except for the ratio of farm-income-to-family-income, had the expected sign in Model II. In Model III, the coefficients of income and lagged consumption had positive signs. The average rate-of-return-to-operating-assets had a different sign than the OLS estimate but the same sign as the FCR estimates. The coefficients of the ratio of farm-income-farm-family-income had negative signs in this estimation method which was the same sign as the OLS estimate but the opposite direction determined via the RCR estimation procedure.

In the above RCR models, income and consumption are positively related with consumption. But the magnitude was comparatively smaller than that in the OLS and the FCR models. Surprisingly, the income coefficient was only .0375 in Model II.

In general, the importance of the lagged consumption variable is larger than income in the three RCR models. This was the reverse of the result obtained from the OLS and FCR methods.

Net worth and consumption are positively related. A net worth increase of one dollar caused consumption

increases of .0062 dollars in Model I. This figure is higher than the OLS estimate but lower than the FCR estimate.

The ratio of farm-income-to-farm-family-income varied widely in the three models as compared with the OLS and FCR estimation. The coefficients ran from -8.11 in Model I to 98.13 in Model II.

As to investment returns affecting consumer behavior, the rate of return to total assets had a negative relationship with consumption. An increase in one percent of this rate reduced consumption by 86.52 dollars in Model II. On the other hand, a one percent increase in the return to operating assets increased consumption by .83 dollars in Model III. This suggests that credit use was the dominant source of fund for investment in operating assets.

Comparison of the Result for the three estimation procedures

In Model I, there existed consistent signs between independent variables and consumption under the three different estimation methods. Changes in income, lagged consumption, and net worth were associated with variation in consumption in a positive direction. The ratio of farm-income-to-farm-family-income also was negatively correlated with changes in consumption in all three procedures.

In Model II, there was a consistency of signs between

consumption and independent variables except with regard to the ratio of farm-income-to-farm-family-income in the RCR procedure. The coefficients of income and lagged consumption had plus signs. The rate of return to total assets had a minus sign. The ratio of farm-income-to-farm-family-income had various signs in the three procedures.

In Model III, changes in income and lagged consumption were positively related to consumption in all three estimation procedures. The ratio of farm-income-to-farm-family-income was negatively related to changes in consumption in the OLS and RCR procedures, but was positively related to the dependent variable in the FCR procedure. The rate of return to operating capital and consumption were negatively associated in the OLS procedure, but positively related in the RCR and FCR procedures.

In short, the estimates of income, lagged consumption, net worth and the rate of return to total assets had positive signs for all three models in the three different estimation procedures. The coefficient of the ratio of farm-income-to-farm-family-income and the average rate of return to operating assets had different signs in the three procedures.

The regression coefficients results from the three models were different in both direction and magnitude as estimated by the ordinary least squares procedure, the fixed coefficient regression procedure, and the random

coefficient regression procedure. A brief discussion of individual variables might provide some explanation of these differences.

Income

Every consumption function should include present per capita real income as an independent variable. In the theoretical and empirical studies, income was positively related to the variation in consumption, and no exception to this was found in the study. The magnitude of the income coefficient ranged widely, however.

Lagged Consumption

Lagged consumption represents the past pattern of consumer behavior as an independent variable in the consumption analysis. Lagged consumption consistently had a positive sign in all models. The magnitude of this coefficient was slightly less than income in the OLS estimation. In the FGR and RCR estimation procedures, lagged consumption turned out to be a more important factor affecting consumer behavior.

Net Worth

Changes in net worth are expected to change consumption. Wealth and consumption had a positive relationship no matter what kind of estimation methods were used.

The estimate of the coefficients ranged from .0049 in the OLS to .0339 in the FCR procedure.

Ratio of Farm-income-to-farm-family-income

As mentioned earlier, the ratio of farm-income-to-farm-family-income does not directly affect consumer behavior. Rather, this ratio provides an indication of income stability on farm investment opportunities and exposure to the demonstration effect of non-farm consumers. The magnitude of this coefficient is small in the OLS estimate and relatively large in the RCK procedure. It is difficult to explain these changes in the magnitude. The inconsistent signs of this coefficient are due to the different assumption under the different estimation method. This may be mainly affected by the structural and behavioral changes. In some cases, the attractive on-farm investment and income variation explain the negative relationship between this ratio and consumption. In other cases, the strong demonstration effect of consumer behavior and attractive industrial good causes the positive relationship.

Rates of Return to Capital

The rate-of-return-to-capital was used to connect production and consumption behavior. The returns to total assets and returns to operating costs were found to be

significant in the consumption function. The return to total assets excluding land value was not significant in the consumption equation.

The rate of return to total assets was negatively associated with consumption in Model II. A one percent increase in the return to total assets reduced consumption by 5.84 dollars in the OLS estimation, 4.88 dollars in the FCR estimation, and 86.53 dollars in the RCR estimation. The differences in magnitudes are due to the different estimation assumption.

Changes in the rate-of-return-to-operating-assets had both signs with respect to consumption. A one percent increase in the return to operating costs reduced consumption by 1.58 dollars in the OLS procedure, but increase consumption by .50 and .83 dollars in the FCR and RCR procedure, respectively. The positive sign might result from farmers satisfying their investment needs through credit use. This in turn allows farmers to increase consumption while responding to investment opportunities. The negative sign might be explained by farmers deferring their consumption reinvestment purposes.

Overall, the aggregate consumption function estimated from Taiwan panel farm data by the RCR procedure is the best among three different statistical techniques. In general, the more tenable the assumption, the more accurate the estimated results obtained. It was found that farmers

have different consumption pattern among the different geographic locations. The weakness of the RCR method might result from the assumption of the heteroskedastic disturances. The more accurate assumption might be the appearance of both heteroskedasticity and interdependence in the disturbance term. The study in this chapter suffers from a limitation imposed by the short length of the time series samples covered in the panel data.

CHAPTER VII

SUMMARY, POLICY RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

A summary of the major points made in the previous discussion is presented in this chapter. Policy recommendations and a list of additional research issues which emerged from this study are also presented.

The general objective of this study was to determine how farmers in Taiwan allocated their income between consumption and savings during the 1960-1970 period. An attempt was also made to identify those economic factors which affected consumption behavior. The specific objectives of the study were: (1) to document the growth of farm family income in Taiwan during the 1960's, (2) to assess and compare estimates of cross sectional savings capacity with estimates derived from time series analysis, (3) to identify how changes in farm family income and adjustments in other factors affected consumption saving behavior, and (4) to draw appropriate policy conclusions regarding the possibilities for mobilizing voluntary institutional savings from rural areas in developing countries based on these findings.

Most consumption-savings studies in LDC's have been based on cross section data. The data used in this study came from a Taiwan Farm Record-keeping project which contained cross section data as well as time series and panel data. The farmers voluntarily participate in the Farm Record-keeping project. As a result, they were generally more progressive than the average Taiwanese farmer. They were better capitalized and more educated than the average. As a whole, the farm size was slightly larger than representative Taiwanese farms. Most of their land was in intensive agricultural production. Labor used on the farm was mainly contributed by the farm family. The main research technique used in analyzing this data was ordinary least squares. Additional techniques used in the panel data analysis were fixed coefficient regression analysis and random coefficient regression method.

In the past two decades, Taiwan's agricultural has performed very successfully. The main contributions to its rapid growth were: land reform, interest rate policies, four year development plans, functional agricultural institutions, technological change, appropriate development policies, and farmers' willingness to work.

Significant increases in farm families' real incomes occurred during the 1960's in Taiwan farm record-keeping farms from NT$ 41,763 in 1960 to 52,550 in 1970. An important

part of this increase in income came from off-farm employment which contributed two-thirds of total income increases. On the consumption side, changes in household expenditures took up about four-fifth of the increases in total income. Cash expenditures also became more important over the 1960-1970 period. Major increases in expenditures for more nutritious food, education, social activity and medical care were found among record keeping farms. There was also a substantial increase in durable good consumption: refrigerators, television sets, radios, motor bikes, etc.

Various forms of savings and investments also grew substantially among the record keeping farms. Rapid increases in institutional savings were shown by sharp increases in bank deposits. Little information was available on changes in non-institutional savings. These may have also grown rather rapidly. The on-farm investment made by the Taiwanese farms were predominantly in the category of fixed assets.

In general, the savings capacities were surprisingly high in the farms studied. The average propensities to save for the total sample ranged from one-fifth to three-tenths of income in the cross section analysis. The marginal propensities to save ran between about one-third and two-thirds of changes in income. The yearly fluctuations in both APS and MPS were mainly due to weather induced changes in farm income.

The average propensity to save increased with farm size in the cross section analysis, but did not have a consistent pattern for any farm size group over time. No consistent pattern for time changes in the MPS was shown in the farm size groups. Various subsamples of farms in different agricultural regions revealed no consistent pattern for the APS and MPS over the years studied.

Farm families with low dependency ratios had higher APS than those families with high ratios. But, the reverse relationship was found in the MPS figures. Results from a subsample study of the ratio of farm-income-to-farm-family-income suggested that the large MPS were associated with higher absolute levels of income. Farms with high income ratios also tended to have high incomes. This result suggested that on-farm investment alternatives plus instability of farm income caused farmers with high income ratios to save at high rates.

The aggregate consumption study based on panel data suggested that the sample farms were heterogeneous in consumption behavior. The results implied that the random coefficient regression method was a more tenable technique for estimating aggregation consumption function.

The aggregate marginal propensity to save based on panel data was about .05 lower than the time series MPS, and about .20 lower than the cross section MPS.

Factors which are closely related to consumption according to the random coefficient regression estimates were:

1. As current income increases consumption increases.

2. Lagged consumption represents the past pattern of consumer behavior and is positively related with present consumption.

3. Increases in net worth represented the "wealth effect" and was also positively related to increases in consumption.

4. The rate of return to total assets are negatively associated with consumption.

5. The ratio of farm-income-to-farm-family-income is negatively associated with consumption.

In general, the rate of return to operating expenses are positively related to consumption. The source of funds for operating investment apparently mainly came from increased credit use or shifting other investment opportunity to farm investment instead of deferring consumption.

Policy Recommendations

There was a surprisingly high savings capacity among Taiwanese farmers during the 1960's. It is likely that this was also true during at least part of the 1950's. Although the savings capacity estimates derived from the farm record-keeping data may be higher than those of a

representative sample of farms in Taiwan, there is little doubt that rural savings have been substantial even among average farmers.

Various Taiwanese policies encouraged farmers to invest in their own operating units in order to stimulate agricultural production, which in turn boosted income and savings incentives. Interest rate policies also encouraged part of this savings capacity to be mobilized. The mobilization of voluntary rural savings have helped to provide a signficant part of the rural credit needs in Taiwan. These activities also helped to provide a firm economic base for the farmers' associations. Rapid income growth, attractive interest rates, the availability of savings institution, and security that savings would be repayed were important factors in explaining the growth in savings in Taiwan.

The Taiwanese experience may provide some valuable lessons for other less developed countries. In LDC's where rural incomes are starting to increase policy makers should be alert to the possibilities for voluntarily mobilizing financial savings. Policy makers may have several decades in which potential voluntary savings capacities are very sizable in rural areas. Consumption patterns appear to adjust rather slowly and it takes a few years for attractive consumer goods to filter into rural areas and seriously affect this savings capacity. While it is

highly desirable that profitable on farm investments absorb part of this increased savings capacity, it is also important that surplus funds be mobilized and recycled to satisfy growing agricultural credit requirements. Results from this study strongly suggest that, if given proper opportunities, especially attractive interest rates, even very small farmers will make substantial financial savings. The need to alert policy makers to this possibility and encouraging them to respond with appropriate incentives are the two major recommendations of the study.

Further Research Issues

A number of additional research topics emerged from the analysis carried out in this study. A brief outline of these topics is presented in the following as a guide for future research.

One of the most important research needs is to extend the analysis on consumption-savings behavior among Taiwanese rural families to a more representative sample. A clearer idea is needed of the extent to which savings behavior among farm record keeping families is representative of all Taiwanese farmers. The analysis should also be extended into other geographic areas to test if savings behavior is culturally specific and if the opportunities to save vary substantially at various stages of development.

More information is also needed on the extent to which changes in the availability of different consumption bundles affects savings behavior. Is there a strong trade off between new consumption goods and savings-investment decisions?

More research also is needed to shed light on how changes in on-farm investment incentives affect savings behavior. How do changes in the marginal productivities of various inputs affect savings? How does technological change affect farmers' incentive and ability to invest? Are the main sources of farm capital formation on-farm savings or external borrowings? More research is needed to further clarify the types of on-farm investments which help to induce savings. Are farmers working with high or low altitude production functions?

Another important issue is to determine how sensitive aggregate rural savings are to changes in interest rates on financial savings and proximity of savings institutions. More work should also be done on how rural savings are allocated between formal savings institution and non-institutional systems.

Still another important research area is the relationship between credit use and consumption-savings behavior. Is credit use in rural areas of Taiwan associated with changes in consumption, or with changes in investment in productive factors? Do credit repayment problems occur

when the returns to credit use are low?

A final research recommendation is that an integrated model is necessary which connects farm household and farm firm behavior together, and examines the relevant findings for developmental planning. The integrated model should include production activities, consumption activities, and investment activities. Only this type of model will provide a comprehensive explanation of farm household savings behavior.

APPENDIX A

APPENDIX A

General Index of Prices-received-by-farmers, and Market Rate of Exchange of U.S. Dollars Expressed in New Taiwanese Dollars, 1960-1970

Year	General Index of Prices-received-by-farmers (1) 1970 = 100	Market Exchange Rate (2)
1960	81.0	42.26
1961	83.5	43.98
1962	79.3	46.99
1963	86.4	42.48
1964	89.7	45.88
1965	89.2	41.63
1966	89.0	41.00
1967	93.5	41.61
1968	98.2	41.12
1969	95.6	41.25
1970	100.0	41.02

Source: (1) Calculated from Monthly Statistics on Price Received & Price Paid by Farmers in Taiwan, published by Bureau of Accounting and Statistics, Provincial Government of Taiwan (PBAS), (Nantou, Taiwan: PBAS, December 1966 and December 1970).

(2) Council for International Economic Cooperation and Development (CIECD), Taiwan Statistical Data Book 1971, (Taipei, Taiwan: CIECD, 1971), p. 127.

APPENDIX B

APPENDIX B

Review of the Methodological Developments of Estimating Panel Data

The following presents a review of the methodological developments of estimating panel data or time series of cross section data.

Random Coefficient Regression Model in a Single Cross-Section Estimation

The basic assumption behind the use of random coefficient regression (RCR) models is that the individuals in the cross-section are heterogeneous in behavior. It differs from most of the empirical techniques used on cross section behavioral analyses which usually assume that the individuals in the sample are homogeneous in behavior. In the RCR model, different individual's behavior is assume to be affected by the different demographic, sociological, psychological and environment factors besides pure economic factors. So both the intercept and slope of a regression equation are different for different individuals in the sample. For instance, in the simple Keynesian consumption function, the relationship between consumption and income may be different between young groups and old groups in a

certain time period and for the time being.

Klein assumed that the coefficients are random for a single cross-section behavior equation, and discussed under what conditions the estimate of the coefficients are consistent estimators.[1]

In the simple behavioral equation, it follows:

$$Y_{it} = a_{0i} + a_{1i}X_{1it_o} + U_{it_o} \qquad (i = 1,\ldots,n) \quad t = t_o \text{ at a given time period}$$

A set of assumptions made for the above equation are that,

(i) a_{0i} is distributed with mean a_0 and constant variance $\sigma_o{}^2$

(ii) a_{1i} is distributed with mean a_1 and constant variance $\sigma_1{}^2$

(iii) U_{it_o} is distributed with mean zero and constant variance σ_u^2

(iv) a_{0i}, a_{1i} and U_{it_o} are mutually independent.

The estimate of the slope from the above equation by the ordinary least squares is:

$$\hat{a}_1 = \frac{\sum(X_{1it_o} - \bar{X}_{it_o})(Y_{it_o} - \bar{Y}_{to})}{\sum(X_{1it_o} - \bar{X}_{1t_o})^2}$$

where $\bar{X}_{1t_o} = \frac{1}{n}\sum_{i=1}^{n} X_{1it_o}$ and $\bar{Y}_{t_o} = \frac{1}{n}\sum_{i=1}^{n} Y_{it_o}$

Klein treated X_{1it_o} as a stochastic variable. The estimate of the slope of a_1, is a consistent estimator of

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[1]L. R. Klein, A Textbook of Econometrics, (Evanston: Row Peterson and Company, 1953).

a_1, under two conditions: (1) $a_{oit}U_{it}$ is uncorrelated with X_{lito} and (2) a_{li} is uncorrelated with X_{lito}^2 and $X_{lito}\bar{X}_{lto}$. If X_{lito} is treated as a non-stochastic variable, $\hat{a}_1$ can be easily shown as an unbiased estimator of a_1.

Klein did not make an attempt to estimate σ_o^2 and σ_1^2. They cannot be estimated from a single cross-section, but can be estimated from having such a time series of cross-sections for an identical group of individuals.

Nerlove found that it was appropriate to treat the elasticity of output with respect to inputs of factors supplied and of output demand as random variables differing from individual firm to individual firm in deriving the production function, the supply function for factors, and the demand function for a product.[2] He also mentioned the difficulties of statistically estimating this kind of model.

The Aggregation Problem and Random Coefficient Regression Model

Zellner applied a RCR model to the aggregation problem and showed that there would be no aggregation bias or inconsistency in the ordinary least squares estimation of coefficients in the macro equation obtained from

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[2]M. Nerlove, Estimation and Identification of Cobb-Douglas Production Function, (Chicago, Illinois: Rand McNally and Company, 1965), pp. 34-35.

aggregating micro equations over all micro units under certain specific assumptions.[3]

Let the multivariate economic relationship for the ith unit be given by

$$Y_i = X_i b_i + U_i \qquad (i=1,\ldots, n)$$

where Y_i is the Txl vector, X_i is the TxK matrix with rank K on non-stochastic independent variables, b_i is the Kxl vector and U_i is the Txl vector of the disturbance term with mean zero, variance σ^2 and covariance zero, and n is the number of individual observations.

The macro variables are defined by simple aggregation of micro variable for the connection between the micro and macro relationship.

$$Y = \sum_{i=1}^{n} Y_i \qquad X = \sum_{i=1}^{n} X_i \qquad U = \sum_{i=1}^{n} U_i$$

The macro equation then can be presented as follows:

$$Y = Xb + U$$

and then

$$b = (X'X)^{-1}X'Y$$

The estimate of b, therefore, is obtained from the macro-data by the ordinary least squares. How can the mathematical expectation of b relate on the micro coefficient b_i? To solve this question, let the macro parameter b be defined

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[3]A. Zellner, "On the Aggregation Problem: A New Approach to a Troublesome Problem," Report #6628, Center for Mathematical Studies in Business and Economics, University of Chicago, 1966.

as the average of the micro parameters b_i, i.e. $b = \frac{1}{n}\sum_{i=1}^{n} b_i$. Then to evaluate whether the aggregation bias appears in the estimate of b, the expectation of macro estimator can be formed as

$$E\,\hat{b} = E\,(X'X)^{-1}X'\Sigma Y_i$$
$$= E\,(X'X)^{-1}X'[\Sigma X_i b_i + U_i]$$
$$= E\,(X'X)^{-1}X'\Sigma X_i b_i$$

$(X'X)^{-1}X'X_i$ is the matrix of coefficient in the "auxiliary regressions" of the X_i on X and $\Sigma(X'X)^{-1} - X'X_i$ is an identity matrix.

$E\,\hat{b}$ can then be rewritten as

$$E\,\hat{b} = \sum_{i=1}^{n}\left[\,(X'X)^{-1}X'X_i - n^{-1}I\right] b_i + n^{-1}\sum_{i=1}^{n} b_i$$

when $b_1 = b_2 = \ldots = b_n$ for all individuals, the macro estimate of b has no aggregation bias. On the other hand, $n^{-1}I$ is the mean matrix of $(X'X)^{-1}\,X'X_i$, therefore $\Sigma[(X'X)^{-1}\,X'X_i - n^{-1}I]$ is the variance-covariance matrix. The macro estimate does not exhibit aggregation bias if the above variance-covariance matrix is null. This satisfies Theil's perfect aggregation condition.[4]

According to Zellner's approach, the random effect of the parameters is allowed in the model. Let

$b_i = \bar{b} + d_i$

d_i is a random vector with $E\,(d) = 0$.

Then, the equation $Y_i = X_i b_i + U_i$ can be rewritten as

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[4] H. Theil, Linear Aggregation of Economic Relations, (North Holland, Amsterdam, 1954), p. 16.

$Y_i = X_i\bar{b} + X_i d_i + U_i$

sum over i to obtain $\sum Y_i = (\sum X_i)\bar{b} + \sum X_i d_i + \sum U_i$ or

$Y = X\bar{b} + \sum X_i d_i + U$

The above equation is the macro equation implied mathematically by the micro-relations. The estimate of b is given by the ordinary least squares. The mathematical expectation of b equal the value of the parameter $\bar{b}$, that is,

$$E\,\bar{b} = E[(X'X)^{-1}X'Y] = E[(X'X)^{-1}X'(Xb + \sum X_i d_i + U)] = \bar{b}$$

Because $E\,(X'X)^{-1}\,X'\sum X_i d_i = 0$ and $E\,(X'X)^{-1}\,X'U = 0$. Given the random coefficient assumption, no aggregation bias exists in $\bar{b}$, the estimate of the mean vector b. If X_i are stochastic variables, and they are mutually independent of d_i and U, then $\hat{\bar{b}}$ is still an unbiased estimator of $\bar{b}$. If the independent variables contain lagged values of the dependent variable, it would be stated Plim $\hat{\bar{b}} = \bar{b}$

Decomposition of Errors in Temporal Cross-Section Analyses

Kuh's main contribution in the temporal cross-section analyses is decomposition of the disturbance term.[5] According to Kuh, he treated the panel data as follows:

$$Y_{it} = b_o + b_1X_{1it} + \ldots + b_kX_{kit} + U_{it}$$
$$(i - 1, \ldots, n;\ t = 1, \ldots T)$$

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[5]Edwin Kuh, "The Validity of Cross-Sectionally Estimated Behavior Equations in Time Series Applications," Econometrica, Vol. 27, April 1959, pp. 197-214.

Y_{it} is the dependent variable for the ith individual in the tth year, $X_{1it}, \ldots, X_{kit}$ are the independent variables, and U_{it} is the disturbance term.

In the regression analysis, the disturbance term Uit is usually specified to be a random variable distributed independent of the independent variables. Kuh redefined and decomposed the disturbance term into three additive components.

$$U_{it} = r_i + v_t + t_{it}$$

The term r_i represents a constant individual effect through time, but it differs among individuals. The term v_t is the same for all individuals but varies through time. The term t_{it} differs among individuals both at a given time or through time.

Swamy's Random Coefficient Regression Model

Until Swamy's RCR model was presented, the estimation of a time-series of cross-sections had been discussed by many scholars, but a precise method or model had not been presented. His main contribution is in presenting a better way of deriving the statistical inference of estimation in the RCR model.[6]

In the RCR model, Swamy considered both the intercept

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[6] P.A.V.B. Swamy, "Efficient Inference in a Random Coefficient Regression Model," Econometrica, Vol. 38, No. 2, March 1970, pp. 311-323.

and slope of a regression equation as random variables, and also decomposed the disturbance term in the RCR model. A consistent and an asymptotically efficient estimator for the mean vector and an unbiased estimator of the variance-covariance matrix of a regression coefficient vector were developed. The asymptotic procedure for testing linear hypotheses on the means and variance of coefficients were also developed.

APPENDIX C

Appendix C

Farm Record-Keeping Data Provided by Provincial Department of Agriculture and Forestry, Taiwan

Nantou, Taiwan

Farm Record

農家記帳 Township 鄉 ID Number 號 戶

Kinds of land areas 土地種別 _____ Chia 甲 _____ No. of lots 筆數 _____ Largest 最大 _____ Smallest 最小 _____ Average 平均 _____ Family Person 家人 _____ Adult Male 成男 _____ 人 Adult Female 成女 _____ 人 Total 計 _____ 人 Consuming Units 消費單位 _____ Total man days spent during year 全年勞動日數 _____ II/365 _____ Family labor 家庭勞動 _____ Active man-year equivalent 成年男子 _____ days 成年女子 _____ days

Major Crops 主要作物	Areas (Chia) 面積 (甲)	Product (catty) 產量 (斤)	Minor Crops 次要作物	Areas (Chia) 面積 (甲)	Product (catty) 產量 (斤)
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Period Covered by Record

from year 年 month 月 day 日 to year 年 month 月 day 日 記帳週期

Annual Income and Expenses 本年損益

Expenses	in cash 現金	in kind 實物	Total	Gross Income	in cash 現金	in kind 實物	Total
Total Farm Exps. 總農業費用				Total farm receipts 總農業收入			
種苗				Crops & Crop Prod. Receipts 出售收入			
肥料				Rice receipts 稻穀			
人工				Sweet potato receipts 甘藷			
畜工				Sugar cane receipts 甘蔗			
各種材料				Vegetable receipts 蔬菜			
病蟲害防治				Bean receipts 豆類			
租				Miscl. Grain receipts 雜糧			
其他農業費				Special crop receipts 特用作物			
(特殊費用小計)				Mushroom receipts 菇蕈及其他			
雜項物				Rec. from oranges & tangarines 柑橘及其他			
農具				Receipts from other fruits 果樹			
水				Other crop receipts 其他			
地				Livestock & Poultry receipts 畜產收入			
農業稅				Swine receipts 豬			
農業負債利息				Poultry receipts 家禽			
(間接費用小計)				Other livestock receipts 其他			
動產租賃				Rec. from on farm prod. processing 農產加工收入			
飼料				Forestry receipts 山林收入			
非農業費用				Fishing receipts 漁撈收入			
家計費用				Other farm receipts 其他農業收入			
主食				Non-farm operation 非農業收入			
副食				Rec. from cutting of min.als 礦業收入			
嗜好				Receipts outside farm 他業收入			
被服				Receipts from subsidies 補貼收入			
裝飾				Rec. from other non-farm sources 其他收入			
住宅							
家具什器							
水電燃料							
教育文化							
交際娛樂							
保健衛生							
醫療							
婚喪							
節慶							
交通通訊							
家計負債利息							
稅							
其他家計費							
本期純益 Net Surplus				本期損失 Net Loss			
合計 Total				合計 Total			

農家所得	Net Farm Family Income
農業所得	Net Farm Income
非農業所得 products of	Net Non-farm Income
第一期稻作 Rice/chia	First paddy
第二期稻作	Second paddy
作物面積	Total area in crops
複種指數	Cropping index

* 1 catty = 0.6 kilograms

Balance Sheet

資產負債表

Date 民國 年 月 日 Beginning of year 年 月 日 End of year 年 月 日

Assets: 資產:	Beginning of year 年 月 日	End of year 年 月 日
1.流動資產 liquid assets		
現金 Cash on hand		
存款應收款項預付款項 Bank deposits, receivables, Prepaid account & bonds		
貸款有價證券		
農產品 Farm products in store		
(儲存農產品)		
育苗(生長中作物) Growing prod. in field		
家畜家禽 Livestock & poultry		
(飼牛羊豬雞其他)		
副產品及農產加工品 Dairy prod. & processing prod.		
購入或未用肥料農藥		
(購入肥料) 農具及其他農用資材 Other liquid assets		
流動資產合計 Total liquid assets		
2.固定資產 Fixed assets		
土地 Land		
自有 land owned		
放領地 land under land-to-tiller program		
建築物 buildings		
家俱及設備 furniture & household equipment		
果樹林木 Orchard and trees		
農用機具 Farm machinery		
固定資產合計 total fixed assets		
資產總額 Total assets (liquid & fixed)		

負債: Liabilities	Beginning of year 年 月 日	End of year 年 月 日
1.流動負債 liquid liabilities		
借款 short-term borrowings		
應付款項 account payable		
預收款項 pre-received		
流動負債合計 Total liquid liabilities		
2.固定負債 fixed liabilities		
應付地價 land-to-tiller borrowings		
長期借款 other long-term borrowings		
固定負債合計 Total fixed liabilities		
淨值: Net worth		
資本金 capital		
盈餘 surplus or loss		
加:本年純益 add surplus during the year		
減:本年純損 subtract loss during the year		
淨值合計 Total net worth		
負債總額 Total liabilities and net worth		

APPENDIX D

Table D Estimates of A Modified Duesenberry Savings Function Based on Farm Record Keeping Data in Taiwan 1961-1970[a], in 1970 NT$

Group	Number of Observations	Coefficient of b_0	Coefficient of b_1	Standard Error of Estimate	Simple R^2	F-Ratio	Durbin-Watson D
1. Aggregate	10	-.0587 (2.3159)	.2705 (.2218)	.0475	.1567	1.4863	1.4659
By Farm Size							
2. 0 - 1.00 ha.	10	-.0448 (1.5695)	.2045 (.1495)	.0420	.1896	1.8719	1.3551
3. 1.01 - 2.00	10	-.0903 (2.1394)	.3096 (.2069)	.0476	.2187	2.2397	2.1958
4. 2.01 +	10	.4059 (1.8175)	-.1142 (.1700)	.0685	.0534	.4510	1.8755
By Agricultural Region							
5. Northern Rice Region	10	-.1294 (2.2624)	.3160 (.2159)	.0649	.2066	2.0825	1.4680
6. Middle Rice Region	10	-.0558 (1.5910)	.2431 (.1502)	.0576	.2467	2.6192	1.3002
7. Southern Rice Region	10	-.8532 (.7175)	1.0602[c] (.2203)	.0677	.7433	23.1643	1.9097

Table D Estimates of A Modified Duesenberry Savings Function Based on Farm Record Keeping Data in Taiwan 1961-1970, in 1970 NT$ (Continued)

Group	Number of Observations	Coefficient of b_0	Coefficient of b_1	Standard Error of Estimate	Simple R^2	F-Ratio	Durbin-Watson D
8. Tea Region	9	-.2008 (1.6191)	.3478[c] (.1562)	.0463	.4145	4.9564	2.6521
9. Southwest Mixed Farming Region	6	-.0450 (1.4198)	.2902[c] (.1357)	.0379	.5336	4.5755	0.7242
10. Southwest Sugar-cane & Rotation Region	10	.2934 (1.9657)	-.0716 (.1825)	.0694	.0189	.1540	1.6422
11. Banana & Pineapple Region	9	-.2309 (1.5421)	.4075[c] (.1472)	.0557	.5227	7.6660	2.1815
12. Eastern Mixed Farming Region	6	.3184 (1.5474)	.0399 (.1442)	.0664	.0188	.0767	2.1526
By Dependency Ratio							
13. 0 - 0.5	10	-.0797 (2.0571)	.2895 (.1966)	.0512	.2132	2.1682	1.7569
14. 0.5 +	10	.0594 (2.4260)	.1610 (.2350)	.0471	.0554	.4695	1.0322
Ratio of Farm Income to Farm Family Income							
15. 0 - 0.7	10	-.1361 (1.1593)	.3001[c] (.1101)	.0416	.4815	7.4276	2.2312
16. 0.7 +	10	.0501 (2.1221)	.1819 (.2028)	.0478	.0914	.8045	1.5078

[a]A Modified Duesenberry's Savings Function was estimated by ordinary least squares from the function $\frac{S_t}{Y_t} = b_o + b_1 \frac{Y_t}{Y_{t-1}} + U_t$ where S is per capita savings for a calendar year, Y is per capita farm family income, U denotes the disturbance term and t indicates time period.

[b]Standard error of the coefficient appears in the parenthesis beneath the coefficient.

[c]Denotes the coefficients are significantly different from zero at 5 percent significance level.

[d]Classification see notes in Table 17.

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