

DYNAMIC POVERTY PROBLEM AND THE ROLE OF INFRASTRUCTURE*

Yasuyuki Sawada**

SUMMARY

In this paper, two dynamic concepts of poverty, namely chronic poverty and transient poverty, are reviewed from the theoretical and demonstrative aspects, and then the role of infrastructure in reducing poverty is discussed. In order to avoid transient poverty, households in developing countries use various risk management strategies for income smoothing and risk coping strategies (self insurance and mutual insurance strategies) for consumption smoothing.

It is generally believed that infrastructure development has direct and indirect effects on reducing chronic poverty. However, the stabilization of production processes through provision of disaster prevention, electricity and water services, and the integration of a country's goods, labor and capital markets through the development of roads, railways, ports, and communication systems, are also important in the reduction of transient poverty.

1. INTRODUCTION

This paper will first present theoretical and empirical issues on the two types of dynamic poverty, namely chronic poverty and transient poverty. Then the important role played by infrastructure in reducing poverty will be discussed from the viewpoints of reducing these two types of dynamic poverty.

Chronic poverty is generally defined as a state in which the household living standard is constantly below the poverty line. On the other hand, transient poverty refers to

the state in which the average household living standard is above the poverty line, but the household is confronting the possibility of falling below this line in the short term. In other words, transient poverty is a condition of poverty that has a stochastic nature. This type of poverty is often called "stochastic poverty". The concepts here are arranged somewhat strictly following Morduch (1994). Suppose that permanent income is Y^p , current consumption level is C , and the poverty line is Z . Here, chronic poverty can be expressed as the condition of $Y^p < Z$. On the other hand, transient poverty can be expressed as the condition of $C < Z < Y^p$.

This distinction of two different concepts of poverty is extremely important from the standpoint of policy (World Bank, 1990; Baulch, 1996; Lipton and Ravallion, 1995, section 5). Transient poverty continues only for a short time. Suitable policy intervention in the situation where transient poverty is rampant must be policies such as the micro-credit program that compensates for deficiencies in the capital markets, crop insurance and employment insurance programs, and policies that promote the stabilization of prices. Such policies can be seen as providing an insurance device for smoothing incomes and consumption for poor households that temporarily fall into poverty. On the other hand, chronic poverty has the characteristic of continuing over a long period of time. Therefore, continuous policy interventions that raise the standard of living for poor households are needed in order to reduce chronic poverty. An example of such a long-term policy intervention is the set of policies known as the "green revolution" aimed at developing and spreading new high yield varieties in order to boost agriculture production. There are various other

* This paper was prepared for a seminar in Research Institute for Development and Finance, the Japan Bank for International Cooperation (JBIC). Advice and comments from the following parties proved to be valuable: Harold Alderman (World Bank), Marcel Fafchamps (Oxford University), Emmanuel Jimenez (World Bank), Anjini Kochar (Stanford University), Takashi Kurosaki (Hitotsubashi University), Martin Ravallion (World Bank), Pan Yotopoulos (Stanford University), and various participants of the JBIC. However, any errors remaining in the paper are solely the responsibility of the author.

** Associate Professor, Department of Advanced Social and International Studies, University of Tokyo

policy interventions aimed at reducing chronic poverty. These include land reform, price support policies, income redistribution policies, and policies to improve the returns to human and physical assets.

What are the distinguishing characteristics of these two types of poverty? What is the role to be played by infrastructure in reducing these two types of poverty? This paper reviews existing research focusing on these two questions. Generally speaking, improvements to infrastructure are believed to directly and indirectly help to lower chronic poverty. However, improving disaster prevention infrastructures, stabilizing production through the provision of electric and water power, and stabilizing prices and wages by developing roads, railways, ports and communications systems to better integration of the nation's goods, labor and capital markets all are important elements for reducing transient poverty.

This paper is organized in the following manner. Section 2 mainly discusses the problem of the static poverty concept. Section 3 summarizes current research on consumption smoothing, risk management strategies and risk coping strategies. Section 4 presents methods for quantifying the two poverty concepts. Section 5 brings together the results of demonstrative research on the effects of transient poverty on investment behavior. Section 6 considers the role of infrastructure in reducing transient poverty, and Section 7 discusses the incentive problem with policy targeting and the role of public works. Finally, Section 8 provides a simple overview of the problem of data as a future issue to address.

2. IMPORTANCE OF THE TWO CONCEPTS OF DYNAMIC POVERTY AND THE PROBLEM OF THE STATIC POVERTY CONCEPT

First, the examples of poverty indicators used to measure these two poverty concepts are examined here. According to a survey conducted by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), roughly 70% of the households in three villages in Southern India were under transient poverty (Walker and Ryan, 1990: pp93-97). Most of these households were landless and Harijans, and only 20% of the households were chronically poor. These observations show the seriousness of transient

poverty in the rural areas of India. The state of poverty that households are faced up with is mostly short-term, and it is thought that for many households, particularly medium-sized agricultural cultivation households, the standard of living always moves above and below the poverty line. The importance of transient poverty was also indicated by the results of a survey of about 800 households in 44 Pakistani villages conducted by the International Food Policy Research Institute (IFPRI) using panel data (Adams and He, 1995). Furthermore, an analysis of data on some 39,000 households in China's poorest regions in Guangxi Province, Guizhou Province and Yunnan Province showed that roughly 50% of poverty could be explained as transient poverty (Jalan and Ravallion, 1998a; 1998b). This study indicated the importance of state-contingent policy intervention for dealing with transient poverty. Interestingly, large transient poverty impact can be seen in Guangdong Province, which is one of China's well-developed regions. This finding suggests that the influence of chronic poverty is reduced in accordance with economic development.

Here, we summarize some of the problems associated with the conventional concepts of poverty while taking into consideration the definitions and the quantitative importance of the two poverty concepts explained above. Although remarkable progress has been made in the theorization of poverty indicators in the 1970's and 1980's, it should be noted that the conventional theories and analyses of these poverty measurements were based on static arguments¹. Based on Sen (1976), it is generally argued that poverty indicators should satisfy the Monotonicity Axiom and Transfer Axiom. The Foster, Greer, Thorbecke (FGT) poverty index (1984) is an index that satisfies the above two axioms under certain conditions, and has been proven to be a practically useful index. The continuous FGT poverty index $P(\alpha)$ can be defined in the following manner:

$$P(\alpha) = \int_0^z \left(\frac{Z-C}{Z} \right)^\alpha f(C) dC, \alpha \geq 0,$$

where indicates the above-mentioned poverty line. C is the standard of living index which, for instance, shows a consumption level, and the density function is indicated as $f(C)$. The FGT poverty indicator includes special cases such as head count ratio (case of $\alpha = 0$) and poverty gap ratio (case of $\alpha = 1$). $P(\alpha)$ generally satisfies transfer sensitivity

1. Papers included in Esho and Yamazaki eds. (1998) provide many excellent poverty research results and views in Japan. Kurosaki (1998b) explains in great detail the importance of the dynamic view of poverty.

axiom ($\alpha > 2$) in addition to the Monotonicity Axiom ($\alpha > 0$) and the transfer axiom ($\alpha > 1$).

Furthermore, this index can possibly be decomposed into sub-groups such as separate regions and consistent comparisons among sub-groups are possible (satisfies the Subgroup Monotonicity Axiom). Accordingly, the FGT indicator is known to be very useful when determining poverty targets. For example, Besley and Kanbur (1988) indicated that when the policy target is to reduce $P(\alpha)$, it is sufficient to conduct the allocation of public expenditures based on the $P(\alpha-1)$ index between the groups targeted by the policy intervention.² In order to clarify this principle, let us consider the problem of a government determining the optimal transfer for two regions based on the Lipton and Ravallion (1995; Section 3.3.2) example. This government transfers a total income of T to a northern region (region N) and a southern region (region S) to minimize poverty for the entire nation. In this case, the problem of minimizing poverty being faced by the government can be expressed as follows:

$$\begin{aligned} \underset{\{T_N, T_S\}}{\text{Min}} P(\alpha) = & n_N \int_0^{Z-T_N} \left[\frac{Z - (C+T_N)}{Z} \right]^\alpha f_N(C) dC \\ & + n_S \int_0^{Z-T_S} \left[\frac{Z - (C+T_S)}{Z} \right]^\alpha f_S(C) dC \end{aligned}$$

s.t. $T = n (n_N T_N + n_S T_S)$

Here n is the total population of that country, n_N and n_S represent the shares of the populations for the northern and southern regions, respectively. Among the total T of income transfer, the government allocates per capita T_N to the northern region and per capita T_S to the southern region. Also, $f_N(\bullet)$ and $f_S(\bullet)$ represent the income density functions of the northern and southern regions, respectively. From the first-order condition for this problem, the condition that must be satisfied by the optimal income transfer is expressed as:

$$\int_0^{Z-T_N} \left[\frac{Z - (C+T_N)}{Z} \right]^{\alpha-1} f_N(C) dC = \int_0^{Z-T_S} \left[\frac{Z - (C+T_S)}{Z} \right]^{\alpha-1} f_S(C) dC$$

Namely, it is best for the government to determine income transfers in order to equalize the poverty indicators $P_N(\alpha-1)$ and $P_S(\alpha-1)$ for the northern and southern regions, respectively. This indicates the poverty reduction for the entire nation by conducting income transfers among the regions by the government in accordance with the $\alpha-1$ FGT poverty indicator. That is, the government, which has the goal of minimizing the poverty indicator $P(\alpha)$ for the entire nation, should place greater emphasis on income transfers

to the regions with a higher $P(\alpha-1)$ poverty indicator. Accordingly, the poverty indicators for each region serve as policy intervention criteria that take into consideration the government's policies towards reducing poverty.

Expanding on the above argument, social sector indicators can be included into variable C . For example, C can represent the number of years of education and Z can represent the number of years of compulsory education. In order for the government to attain higher achievement of compulsory education, the best course of action is to implement educational assistance policies targeting the regions where there is a large population of those at an educational level below that of the compulsory education. If C represents the level of health, the government should also execute preferential policy interventions targeting on the regions with high population with poor health situations.

The important point regarding the above-mentioned FGT poverty indicator and targeting based on this index is that they can quantify some common ideas by placing them into a concrete formula. However, such poverty indicators are only utilizing the static information on average income and consumption levels for a set time or a year, as well as on social indicators. Therefore they cannot clearly grasp the problems of dynamic poverty. In order to better understand this problem, consider the table below, which shows comparisons in the standards of living for two regions, the northern and southern regions. For the sake of simplicity, only three households are included for each region. Numbers in each box represent consumption level C as the indicator of the standard of living for each household, and 10 is set as the poverty line Z .

Based on the consumption level data shown in Table 1, the static poverty indicator (head count ratio) was exactly the same 67% for both regions at all times. Therefore, based on the argument put forth by Besley and Kanbur (1988), it is best to have the government transfer provided evenly to both regions.

Suppose that the existence of permanent poverty can be captured by the average consumption level for a household over multiple periods. The head count ratio in the northern region is 67% in terms of average consumption level, which indicates the existence of permanent poverty. However, in the southern region all of the households have an average consumption level of 11, which is just above the poverty line of 10. This means that permanent poverty does not exist at all. The poverty problem in the southern region is purely a transient poverty problem. Clearly the

2. Sawada (1996) verifies poverty reduction effect of aid allotment from various donors based on this type of framework.

Table 1 Regional Comparisons of Consumption Levels (poverty line = 10)

	1999	2000	2001	Average Consumption Level (chronic poverty indicator)
<u>Northern Region (N)</u>				
Household 1	20	20	20	20
Household 2	7	7	7	7
Household 3	6	6	6	6
Head Count Ratio ($\alpha = 0$)	67%	67%	67%	67%
<u>Southern Region (S)</u>				
Household 1	20	6	7	11
Household 2	7	20	6	11
Household 3	6	7	20	11
Head Count Ratio ($\alpha = 0$)	67%	67%	67%	0%

poverty characteristics of the two regions are entirely different, and the relevant policy interventions should be asymmetric in accordance with the actual situations in each region. In other words, in order to improve the long-term standards of living for households #2 and #3 in the northern region, the government will need to implement continuous policies for redistributing the income from household #1. In the southern region the government will need to implement policies that provide insurance devices to each household. However, when based on conventional static poverty indicators, it fails to grasp the serious problem of transient poverty in the southern region. Therefore it would be unable to accurately classify its poverty prevention measures which are derived from the differences between chronic and transient poverty. Furthermore, the long-term and sustainable policy intervention especially in the southern region might be ineffective in spite of the large costs involved. Hence, a doubt remains, from the viewpoint of intervening the optimal policy, about any intervention policy that removes the notion of transient poverty (Baulch, 1996). This shows the importance of targeting based on dynamic poverty indexes as put forth by Jalan and Ravallion (1998a). They used panel data from households in China to estimate that the cost of removing permanent poverty according to static poverty indicators was three to four times the costs based on dynamic indexes.

3. CONSUMPTION SMOOTHING AND RISKS

In order to theoretically grasp these two types of poverty in developing countries, the main environmental factors

confronting the households in the developing countries must be understood and the behavior of these households must be clearly examined. This section examines some of the existing research on analyzing transient poverty.

3.1 CONSUMPTION SMOOTHING

Agricultural production essentially involves price and production risks. The type and degree of these risks depend largely on the agricultural system, the production environment and climate conditions. Still, the influence of these risks is the most serious for peasants and farmers without land in the semi-arid regions of developing countries. The problems of poverty in the rural areas of developing nations, especially in South Asia, are firmly rooted in these essential agricultural production risks (Walker and Jodha, 1986). Also, agricultural production is seasonal by nature. Therefore, the income of the farmers tends to be concentrated at certain periods, such as the harvesting period. Since the purchase of input goods for agricultural production is irregular, net income for farmers is considered to be always changing. Even in the industrial and commercial sectors, there are various risks in the handling of products, intermediate purchases of goods and employees. A variety of risks through undelivery of goods, non-payment for commercial transactions, low level of effort by laborers, have grave impacts on commercial goods and production activities of small and medium-sized manufacturers in many developing countries. Furthermore, instabilities of goods prices exert an influence not only on the supply activities in the agricultural and commercial industries, but also a direct negative influence on the household welfare as consumers. The contraction risk of tropical diseases generates instability in the health status

of members of a household and can cause a large drop in income for that household.

Recent research on micro-development economics has studied these idiosyncratic income variations faced by households, the aggregate production risks for communities and entire nations, underdeveloped financial markets, information problem, and households' consumption and production smoothing behavior (Besley, 1995b; Deaton, 1997; Fafchamps, 1992; Morduch, 1995; Townsend, 1994; 1995a; 1995b). The new field of Micro-Development Econometrics has been evolved to investigate optimal household production and consumption behavior, intertemporal resource allocation decisions, formal and informal organizations and systems, and the role of information. It is also important to note that remarkable improvements in collecting household data have been made, which have promoted research in this field³. (Deaton, 1997; 1995; Udry, 1997).

The basic problem being faced by households in developing countries is how to reconcile stable consumption and income fluctuation. This problem can be theoretically captured as "the problem of intertemporal consumption smoothing under a stochastic income process." The consumption smoothing issue is one of the standard topics in macroeconomics with a microeconomic foundation. For example, issues of consumption insurance are examined not only for households in developing countries, but also in the context of households in advanced nations and of international macroeconomics (Kurosaki and Sawada, 1999a).

3.2 RISK MANAGEMENT STRATEGIES

Farmers have traditionally managed agricultural production risks through crop diversification, inter-cropping, mixed crops, flexible production investment, the use of low-risk technologies, and contractual forms such as share cropping. In order to avoid the non-fulfillment of contracts on goods and service transactions in the commercial and industrial sectors, long-term business relationships are often formed through kinship or ethnicity based networks. This type of business practice compensates for the lack in the legal system. Generally speaking, these risk management strategies are ex ante measures for reducing production and transaction risks. In other words, these risk management strategies are defined as "activities for reducing income instabilities at the stage before the resolution of uncertainties". Morduch (1995)

referred to these strategies as income smoothing.

Generally, risk management strategies are analogous to an investor's behavior in the financial market trying to construct the optimum portfolio. For example, Rosenweig and Binswanger (1993) discussed the role of assets to reduce ex ante risks based on the mean-variance model. Specifically, using the data from India collected by ICRISAT, Resenzweig and Binswanger (1993) show the degree of risk aversion, asset ownership, and the dispersion of rainfall affect the optimal portfolio of households. Using the survey data of agricultural households in Pakistan, Kurosaki (1998, Chapter 6) revealed that the agricultural production decisions for income smoothing are influenced by consumption decisions under the existence of agricultural production risks and an incomplete insurance market. This indicates that the separability between income smoothing and consumption smoothing behavior breaks down under the incomplete markets. It also implies that there is an estimation bias for partial equilibrium analysis that analyzes only the risk management behavior for the production side.

Assuming a tradeoff between risk and return, risk management strategies would naturally involve some welfare costs. According to the simulation results based on data for Pakistani households, Kurosaki (1998) shows that the reduction of risks resulted in a 20% drop in the household welfare for small farmers.

3.3 RISK COPING STRATEGIES

Households confront many ex post shocks that could not have been avoided through risk management strategies. For example, crops and livestock can be thoroughly destroyed by typhoons, floods, fires and other natural disasters. Also, burglaries of shops and factories can result in huge losses for small shopkeepers and factory owners. There is a possibility that the economic situation of households can become precarious when the procurement of input goods is delayed due to some unforeseen reasons, or when there is some sudden disappearance of laborers or employers, or when there is a sudden drop in sales. The household economic activities can also be severely disrupted when the household head or family members become sick, are involved in an accident, or suddenly die. Furthermore, households' real incomes fall sharply when macroeconomic management of the government authorities fails, resulting in currency crisis, debt crisis,

3 Some typical examples include the Village Level Studies conducted in India by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and the Living Standards Measurement Surveys (LSMS) conducted by the World Bank. See Kurosaki (1998a) and Grosh and Glewwe (1996, 1998) for an overview of recent research.

or hyperinflation⁴. Households of developing nations have developed various strategies to cope with these ex post shocks and to smooth consumption. Risk coping strategies are to reduce consumption fluctuations ex post, given that there are income fluctuations. They are defined as ex post strategies for avoiding poverty. Poor households facing poverty have the substantial motives for adopting risk coping strategies.

Kurosaki and Sawada (1999b) made a general summary of these risk coping strategies in the following manner. First, there is “self-insurance” which is consumption smoothing behavior of households that adjust own resources intertemporally. The second important dimension is “mutual insurance”, namely informal risk-sharing arrangements among family members, relatives, neighbors and friends.

3.3.1 Risk Coping Based on Self-Insurance

Self-insurance, the consumption smoothing behavior through adjusting own resources intertemporally, can be decomposed into the following five strategies for the sake of convenience.

The first strategy is to cope with income risks by lowering the quality of consumption and reducing the amount of expenditures, while smoothing the amount of calories and nutrients that are consumed. The “income elasticity of calorie intake” is one indicator related to this strategy. Also it is an important indicator when considering poverty reducing policies through income subsidies (Strauss and Thomas, 1990). There has, however, been some dispute over the measurements of this elasticity. For example, Behrman and Deolalikar (1987) indicated that the null hypothesis of the income elasticity of calorie being zero cannot be rejected. This result suggests the existence of risk coping behavior through which consumption expenditures are reduced by shifting to less expensive foodstuffs with the same amount of calories against the income decrease. (Strictly speaking, this intertemporal allocation of calorie intake has been ignored by existing research.) It is widely observed that the quality of food consumption is generally lowered corresponding to decrease in income. For example, the consumption of meats may be replaced with beans, or there could be a reduction in spending on education, medical expenses and other luxury goods. These may be important intertemporal risk coping strategies. In fact, Frankenberg, Thomas, and Beegle

(1999) quantitatively indicated a sharp reduction in spending on health and education by Indonesian households that had to face an unanticipated drop in real income brought about by the currency crisis.

The second important risk coping strategy is borrowing. Households that have this option can use borrowed money for consumption smoothing whenever there is an unexpected drop in income. If funds can be obtained, farmers can use future income to cover a present loss, making consumption smoothing possible. For example, Besley (1995b) and Eswaran and Kotwal (1989) theoretically showed that access to financial markets serves as an insurance device. Employing a panel data of households in Peru, Glewwe and Hall (1998) empirically verifies that borrowing, if ever, could become an important risk coping strategy for consumption smoothing. However, people in developing countries, especially landless farmers are often confronted with borrowing constraints due to financial repression indicated by McKinnon (1973) and information asymmetry analyzed Stiglitz and Weiss (1981) and Carter (1988). Also, the fact that households must rely on borrowings from prohibitively high-cost users is believed to be a major factor in borrowing constraints. Even if the credit market is complete, when the probability of the extremely low income occurring is not zero, not borrowing becomes the best action for the households. In such cases the households are bound to confront “self-inflicted” borrowing constraints (Carroll, 1997; Deaton, 1992). The existence of borrowing constraints makes it very difficult for households trying for consumption smoothing if there are repeated negative income shocks. This means that temporary starvation may be unavoidable (Deaton, 1991). Hence, not only the insurance market, but the credit market also has an extremely important meaning for the welfare level of farmers in developing nations. However, empirical research based on Indian household data shows that most farmers face borrowing constraints, and it is very difficult to use borrowed funds as a risk coping strategy (Bhalla, 1979, 1980; Pender, 1996).

This being the case, households confronted with borrowing constraints have had to turn to risk coping strategies not dependent on borrowing.

The third method for coping with risk involves the use of one’s own physical assets, including the selling of own land or livestock, or using formal or informal savings,

4 Refer to Sawada (1994) and Yotopoulos and Sawada (1999) for overviews of the Latin American debt crisis and the Asian currency crisis, respectively.

i.e., “precautionary savings”⁵. Paxson (1992) used Thai household data to show that the propensity to save out of permanent income was very high. This connotes that consumption behavior is dependent not only on permanent income, but also on the existence of risk, suggesting that precautionary saving is very important. Park (1996), using field survey data from China’s poorest north-central regions, showed that the farmers’ grain stocks accounted for 16% of all of their asset holdings, and served as important precautionary savings. Also, the analysis of ICRISAT data for India conducted by Rozenweig and Wolpin (1993) showed that livestock assets played an important role in consumption smoothing. However, using the same ICRISAT India data, Townsend (1995a) argued that the selling of livestock did not contribute to income smoothing, and grain reserves were important. Fachamps, Udry and Czukas (1998) reached a conclusion by analyzing ICRISAT data for Burkina Faso that income from the selling of livestock only compensated for 20%-30% of the overall drop in the income at most. It is still controversial whether or not livestock, which is an important production means, would be frequently sold as precautionary savings. Many empirical results suggest that cash holdings are an important form of precautionary savings (Townsend, 1995a). Moreover, the use of gold as precautionary savings is widely observed in developing countries.

In contrast to this third strategy, where physical and financial assets are used to cope with risk, the fourth method involves the use of human assets. When a negative income shock occurs, a household head can cope with that risk by temporarily joining the labor market, or by additionally obtaining labor income from other family members. By using ICRISAT Indian data, Walker and Ryan (1990; pp. 87-88) and Kochar (1995, 1999) show that wage income gained by participating in the labor market served the role of insurance for agriculture income. As will be stated in detail later, the Employment Guarantee Scheme (EGS), a public employment insurance program in the Maharashtra State, India, is known to have played an important role in insuring employment, especially in times of drought (Cain, 1981). Furthermore, analyses of data from India by Jacoby and Skoufias (1997) and from Pakistan by Sawada (1998) directly indicated that child labor income served an insurance function for household incomes in these countries. Therefore, there is a possibility that child labor can be regarded as one of the risk coping strategies. Furthermore, the hypothesis that the birth rate in LDCs

becomes very high due to “old-age insurance motives” would imply the importance of human assets as a form of self-insurance (Nugent, 1985).

The final strategy for coping with risk involves receiving money from altruistically-related family members and relatives. When some unforeseen shock results in a drop in the parents’ income, children or relatives send money to cover the loss without asking for any compensation (Cox and Jimenez, 1990; Lucas and Stark, 1985). Such risk-coping behavior based on altruistic family relationships does not need to be reciprocal, and we can understand this as a self-insurance behavior of economic entities based on kinship. For example, based on the data analysis of ICRISAT India, Rosenzweig (1988) showed empirically that households in southern India prefer the informal consumption insurance provided by the transfer of income among family and relatives as opposed to income smoothing through borrowing.

3.3.2 Risk Coping through Mutual Insurance

Along with self-insurance, mutual insurance is also an important risk coping strategy. Mutual insurance involves informal reciprocal transfers from family members, relatives, neighbors and friends (Cox and Jimenez, 1990; Townsend, 1994; Udry, 1994; Morduch, 1991; Deaton, 1997, Chap. 6; Fachamps, 1992; Lucas and Stark, 1985). This mutual insurance strategy has also been called “risk sharing”. The important point here is that long-term reciprocity is maintained based on long-term relationships within a community setting (Coate and Ravallion, 1993). Conversely, the unique reciprocal systems, customs and contracts in the rural areas in developing countries can be understood as a framework resulting from the need to compensate for incomplete insurance and credit markets, as well as information problems (Hayami, 1995; Chap. 9; Besley, 1995b; Rosenzweig, 1988).

Risk sharing mechanisms within an exchange economy can be explained based on the numerical example of the “banana economy” shown below. First, consider a

Table 2 **The Banana Economy**
(Poverty Line = 3)

State	Household A	Household B	Perfect risk sharing
S1	1	9	5
S2	7	1	4

5 It is theoretically known that “precautionary saving” will be conducted under the condition of income uncertainties when the tertiary differential of the utility function is positive (Leland, 1968).

community made up of two households, A and B. There are two latent states within the economy, and each state has the same 50% chance of incidence. The banana endowments are supplied to each household depending on the state as shown below.

Here it is assumed that the bananas cannot be stored and there is no credit market. It is also assumed that three bananas are needed for household survival. In state S1, since the banana resources for household 1 has fallen below the poverty line, the household is confronted with a subsequent crisis. However, household B has secured the amount of banana resources needed for its existence. However, in state S2 household A has secured an excessive amount of bananas, while the amount of bananas held by household B is insufficient for their survival. As each state has a 50% chance of incidence, each household is faced with the 50% chance of starvation.

Here, consider the case where both of these households agree to implement risk sharing. This risk sharing refers to a framework in which the bananas obtained by both households are pooled in a community, and then redistributed based on a certain weight. In the case shown in Table 2, if there is an agreement to share evenly total banana resources, the amount of bananas that can be consumed by each family is 5 in state S1 and 4 in state S2. Here, both families are able to avoid shortage risks caused by idiosyncratic income fluctuations.

Furthermore, by using a repeated game framework, this type of risk sharing based on long-term communal relationships can be achieved without any explicit contract (Kimball, 1988; Coate and Ravallion, 1993). Consequently, this long-term reciprocity can be maintained within the community that has close long-term relations. This aspect will be examined in detail in a later section.

The per-household share of four bananas in state S2 is less than the per household share of five bananas in state S1. This indicates that the unavoidable aggregate risk of the community does exist in the risk sharing scheme of the community. In this case, a further risk sharing mechanism that extends beyond the community framework is needed.

3.3.2.1 Verification of Perfect Mutual Insurance Mechanism

The existence of the “mutual insurance” scheme can be verified statistically by testing whether or not consumption by households faced with idiosyncratic income fluctuations

can be smoothed through tacit risk sharing agreements among relatives and neighbors. The perfect risk sharing hypothesis based on a complete insurance market model involves the pooling of the fluctuating incomes from each household for the entire village and then redistributing to the entire village. Namely, idiosyncratic income fluctuations for each household are completely absorbed by other households through a reciprocal system. Hence the consumption paths for each household are determined only by the village’s aggregate shock, but not by household idiosyncratic income fluctuations.

To verify this complete risk-sharing hypothesis, we can test statistically whether or not changes in household consumption should respond to idiosyncratic income changes after the aggregate shock is controlled. Townsend (1994) employed the following model⁶.

$$\Delta C_{it} = a_0 + a_1 \Delta C^*_{it} + \zeta \Delta Y_{it} + \Delta u_{it}$$

Here C_{it} is the household consumption for period t , while C^*_{it} is the village average consumption during the same period. Δ is the operator expressing the difference and Δu_{it} is a stochastic error term. The permanent component of a household i ’s income, Y_{it} , is removed by taking the first difference. The impact of the aggregate shock on the village level is also controlled by including the changes in average consumption for the village, ΔC^*_{it} , as an explanatory variable. Therefore, ΔY_{it} is the proxy variable showing the idiosyncratic fluctuations in the household income. The efficient risk-sharing hypothesis stating that there is no impact from idiosyncratic income movements can be verified by statistically testing the null hypothesis $H_0: \zeta = 0$. As the parameter a_1 is theoretically taken to be 1, Townsend (1994) also reported his estimated results using that restriction.

Townsend (1994) examined this type of risk-sharing model using ICRISAT panel data for three villages in southern India over 10 years and showed that even though the perfect mutual insurance model can be statistically rejected, the impact of an idiosyncratic 1 rupee fluctuation in the household income was estimated to be merely between 0.05 to 0.12 rupee and most household consumption remained in line with the average for the village. Mordoch (1991) concluded that the mutual insurance was viable in terms of food consumption in the same ICRISAT villages used by Townsend (1994).

6 This empirical model can be derived from the social planner problem of maximizing the social welfare function, assuming the constant absolute risk-averse (CARA) utility function. See Kurosaki and Sawada (1999a, 1999b).

There are other examples where this model was applied to developing countries. Deaton (1997) analyzed survey data for households in the Republic of Cote d'Ivoire, Townsend (1995a) conducted such research in Thailand, Jalan and Ravallion (1996) used panel data on rural areas in China, and Gillani (1996) and Kurosaki and Sawada (1999b) used data from Pakistan. Data collected by the World Bank's LSMS in the Republic of Cote d'Ivoire also rejected the perfect risk-sharing hypothesis (Deaton, 1997, Chap. 6). Townsend (1995a) used survey data of households throughout Thailand to show that the perfect risk-sharing hypothesis could be statistically rejected in all regions. Yet the estimated coefficient for ζ was between 0.3 and 0.4, and 60% to 70% idiosyncratic income fluctuations were absorbed by some type of insurance mechanism. Townsend (1995a) suggested that the perfect risk-sharing hypothesis was rejected due to information problems of moral hazard and adverse selection. According to Jalan and Ravallion (1996), the estimated coefficient for ζ in China is between 0.14 and 0.26. This is considered to be similar to the estimated results from the ICRISAT data for southern India. According to Gillani (1996) the value for ζ is a rather small 0.011 to 0.022 based on data for Pakistan collected by the International Food Policy Research Institute (IFPRI). Kurosaki and Sawada (1999b) obtained an estimated coefficient of 0.09 to 0.17. The results from these research projects indicate that income shocks in the rural areas in developing countries are not directly reflected in consumption fluctuations and are lower than previously expected. It is noteworthy that the mutual insurance mechanisms in rural areas function better than had been expected.⁷

3.3.2.2 Voluntary Risk-Sharing in a Non-cooperative Game and the Scott-Popkin Controversy

Can the above-mentioned mutual insurance framework based on tacit agreements be maintained over the long-term? Scott's (1976) study of the behavior of villages in Southeast Asia indicated ethical and reciprocal principles for avoiding risk and maintaining existence. Scott (1976) implied that the above-mentioned mutual insurance mechanism is maintained on a moral basis, which differs from economic rationale. However, Popkin (1979) has stated that villages are controlled by individual economic rationality even before modernization and opportunity-

oriented behavior of farmers is widely manifested. Therefore, reciprocal and altruistic mutual insurance mechanisms in developing countries cannot always be explained. This section discusses the rationale of reciprocity.

Recall the banana economy shown in Table 2. Suppose that each household is risk-averse and the utility from the banana consumption, c , can be described by the positive segment of the concave utility function $c^{1/2}$. In this case each household strategically decides whether or not to maintain the "implicit" risk-sharing arrangement, which can be expressed as the 2x2 game with the payoff of expected utility. The payoff for two households is expressed as (P_A, P_B) . The following four cases are possible based on the strategies of the two households.

- (1) Both households A and B maintain the risk-sharing agreement (A's strategy = C, B's strategy = C). In this case, the amount of bananas that can be consumed by each household is 5 in S1 and 4 in S2. Therefore, the payoff (expected utility) is as follows.

$$(0.5 \cdot 5^{1/2} + 0.5 \cdot 4^{1/2}, 0.5 \cdot 5^{1/2} + 0.5 \cdot 4^{1/2}) \\ = [0.5 \cdot (2.236 + 2), 0.5 \cdot (2.236 + 2)] = (2.12, 2.12)$$

- (2) Both households A and B decide not to maintain the risk-sharing agreement (A's strategy = D, B's strategy = D). In this case the consumption for each household is based on their own banana endowments. Here, the payoff can be expressed as the following.

$$(0.5 \cdot 1^{1/2} + 0.5 \cdot 7^{1/2}, 0.5 \cdot 9^{1/2} + 0.5 \cdot 1^{1/2}) \\ = [0.5 \cdot (1 + 2.65), 0.5 \cdot (3 + 1)] = (1.83, 2)$$

- (3) Only household A maintains the risk-sharing agreement (A's strategy = C, B's strategy = D). When the amount of bananas produced by household B is low (S2), sharing is voluntarily performed and the banana consumption becomes 4 for both households A and B. However, when household B has good banana production (S1), there is no transfer to household A. Therefore, banana consumption in the state of S1 becomes 1 for household A and 9 for household B. Here, the payoff can be expressed as the following.

7 By using data for households in northern Nigeria, Udry (1994) discovered that borrowing relationships involve state-contingent loans. Observations of villages in Nigeria showed that risks were pooled by borrowers and lenders through state-contingent lending, and this lending of funds served as a type of mutual insurance. Yet, an analysis by Townsend (1995b) of data collected from a field survey in northern Thailand suggested risk sharing was not established.

$$(0.5 \cdot 1^{1/2} + 0.5 \cdot 4^{1/2}, 0.5 \cdot 9^{1/2} + 0.5 \cdot 4^{1/2}) \\ = [0.5 \cdot (1+2), 0.5 \cdot (3+2)] = (1.5, 2.5)$$

(4) Only household B maintains the risk-sharing agreement (A's strategy = D, B's strategy = C). When the amount of bananas produced by household A is low (S1), sharing is voluntarily performed and the banana consumption becomes 5 for household A and 5 for household B. However, when household A has good banana production (S2), there is no transfer to household B. Therefore, banana consumption in the state of S2 becomes 7 for household A and 1 for household B. Here, the payoff can be expressed as the following.

$$(0.5 \cdot 5^{1/2} + 0.5 \cdot 7^{1/2}, 0.5 \cdot 5^{1/2} + 0.5 \cdot 1^{1/2}) \\ = [0.5 \cdot (2.236 + 2.65), 0.5 \cdot (2.236 + 1)] = (2.44, 1.62)$$

Here it can be seen that the mutual insurance is based on the results of the strategies put forth by the two households. Table 3 shows the game payoff.

Table 3 Risk-Sharing Game Pay-off Matrix in the Banana Economy

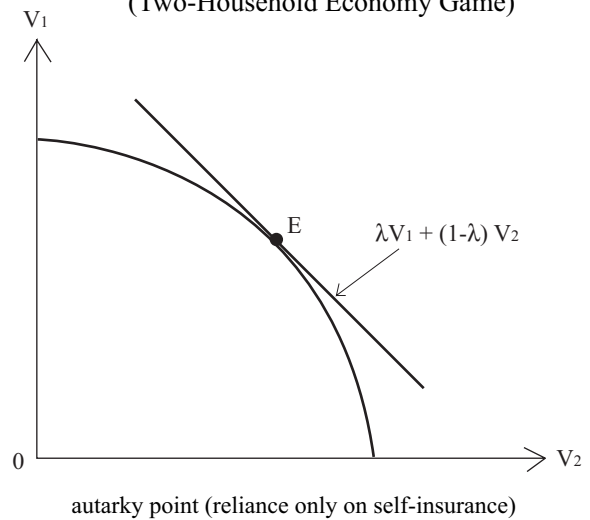
		Household A	
		Share Risks (C)	Do Not Share Risks (D)
Household B	Share Risks (C)	2.12	2.44
	Do Not Share Risks (D)	2.5	2

In the risk sharing game shown in Table 3, the D strategy is the dominant strategy for both households. The Nash equilibrium when both households act selfishly (non-cooperation) is expressed as D,D. That is, there is no voluntary risk sharing. Such situation can be grasped as a consequence of rational behavior by farmers as indicated by Popkin (1979). However, the combination of C,C strategies or risk sharing is desirable for both parties. As such, this game is the standard "prisoner's dilemma".

There will be no incentive to voluntarily participate in risk sharing, if both households decide to participate in risk sharing from the standpoint of their own self interest in the prisoner's dilemma.

However, as is well-known by the proof of Friedman

Figure 1 Selection of the Optimal Allocation Point based on the Pareto Frontier and the Negishi's Social Welfare Function (Two-Household Economy Game)



(1971), when this game is repeated infinitely, C,C can be achieved not only as the Nash equilibrium but also as a sub-game perfect Nash equilibrium (Gibbons, 1992; p.97). These results imply that reciprocity can be voluntarily maintained within a community with close, long-term relationships (Kimball, 1988; Coate and Ravallion, 1993).

Hence, the community reciprocity referred to as the "Moral Economy" by Scott (1976) can also be described as the consequence of selfish rational behavior. This brings about an integrated view for the Scott-Popkin controversy. This is simply because the rational farmers' long-term relationships which possess the moral economy, can be explained by consistent logic (Posner, 1980; Fafchamps, 1992).

The combination of cooperation solution realized by the repeated game can be expressed intuitively using the Pareto frontier shown in Figure 1. In Figure 1 V_i is the sum total of the discounted present value of the utility standard for individual i . As mentioned in note 6 in the previous section, we can interpret the complete risk sharing problem to be solved by social planners as the problem for selecting the optimal point E from the set of Nash equilibria with the Negishi's social welfare weight λ .

3.3.2.3 Various Forms of Risk Sharing

There are various forms of risk sharing, including reciprocal informal transfers⁸, income pooling mechanisms of rotating

8 It corresponds to the concept called "equilibrium reciprocity" in anthropology. A long-term, stable mutual insurance relationship within the community is maintained through grants on both ways.

savings, use of communal land, informal credit market within the community, trading physical assets such as livestock, grain, gold and jewelry, and the exchanging non-physical assets such as labor. For example, Ravallion and Dearden (1988) discovered “moral economy” in Indonesia as a social security system with relatively large income transfers for the elderly, unemployed and other socially disadvantaged. This transfer of funds between households was especially seen in rural areas, and it acted as an income redistribution device. Platteau and Abraham (1987) shows that reciprocal credit system in fishing villages in Kerala State in India served as an insurance for those faced with the risk of starvation. This indicates the existence of mutual insurance mechanisms between households. Lund and Fafchamps (1997) also showed that, by using survey data of the highlands of the Philippines, informal zero-interest loans between close relatives contributed to consumption smoothing of households. Fafchamps (1992) pointed that, in the Sahel region in Africa, labor pooling and joint harvesting of three or four individuals are widely observed to cope with unexpected shocks.

However, risks such as climate and droughts can impact the entire rural area. As shown in Table 2, aggregate risk essentially cannot be avoided through mutual insurance mechanisms within the village. In such cases households need to have insurance schemes that extend the framework of the village. A field study of nine villages in Karnataka State in southern India conducted by Caldwell, Reddy and Caldwell (1986) showed that some households with decreased income due to drought were able to maintain consumption through money received from relatives living outside the village. Furthermore, Lucas and Stark (1985) observed in data for Botswana that money was often sent from relatives living in the city whenever drought occurred. This transfer served as a risk coping strategy for protecting family assets in a village. This indicates that sending household members to regions with little income correlation provides an informal income insurance device for the household. Household members living in the city provide insurance against drought. This makes it possible for the overall family to make higher risk, higher return investments. An analysis of ICRISAT data for India conducted by Rosenzweig and Stark (1989) showed that the transfer from a married daughter made a huge contribution to smoothing the household’s food consumption. Accordingly, households confronting a larger agriculture income fluctuation tend to have marital relations

at greater distances. This indicates that income transfers from daughter’s husband or his family serves as an insurance device.

The emerging consensus in micro development econometrics, drawn from the analysis of household data such as those presented above, is that self insurance and mutual insurance, while incomplete, are much more developed than have been previously recognized. It would not be an overstatement to say that many of the affluent households are with complete insurance and credit markets (Morduch, 1995, p.103).

4. QUANTIFYING THE TWO POVERTY CONCEPTS

Then, how can we quantify the two poverty concepts? Suppose that permanent income is Y^P and transitory income as Y^T . Here, household income Y can be expressed as $Y = Y^P + Y^T$. These two income concepts correspond with the two poverty concepts, namely chronic and transient poverty (Ray, 1998, page 252). However, strictly speaking there are some problems in handling these two concepts in terms of income. Ideally, poverty would be measured by the consumption level and, moreover, then other aspects would need to be included in the poverty concept and measurement of living standard⁹. However, from the viewpoint of tractability, income levels are used to indicate poverty levels.

The regression analysis approach by Paxson (1992) is one method that divides income into the two components. Paxson (1992) used the Thailand’s Socio-Economic Survey (SES) data to estimate the savings function. At the first stage of Paxson’s two-stage estimation framework, permanent income and transitory income can be obtained through estimating the following income equation.

$$Y = \beta_0 + X_P\beta_P + X_T\beta_T + u,$$

Here X_P denotes an exogenous variable for permanent income; X_T , for transitory income. Specifically, X_P is a matrix of human asset variables such as family member composition and education level of members, and X_T includes a variable for rainfall changes and others. If this specification is correct, the estimated values for $X_P\beta_P$ and $X_T\beta_T$ should yield consistent estimates of permanent and transitory incomes, respectively.

9 See Baulch (1996) and World Bank (1990) for a summary of these issues.

5. NEGATIVE EFFECTS OF TRANSIENT POVERTY ON INVESTMENT BEHAVIOR

Transient poverty has more than just a direct impact on welfare levels. It also has a negative effect on various household investment activities. For example, poor households, especially landless households under strict borrowing constraints, would have to confront high marginal utility for their current consumption whenever there is an unexpected drop in income. In this situation, a drop in their standard of living would be unavoidable if there wasn't sufficient access to self or mutual insurance. Under such conditions, even if there were the opportunity to make a high-return investment, the poor households would not invest as a consequence of rational behavior. The reason is that when measured by the marginal utility of the current consumption, the cost for the current investment opportunity becomes very high.

Sawada (1999) formalized this mechanism based on a two-period model. First, when the transitory income falls, families faced with borrowing constraints must confront the high marginal utility of their consumption. As a result, this household is motivated to shift resources from the next period to the current period by lowering the level of their current investments. Thus transitory income has a negative impact on the investment level. Investments are adjusted as a risk coping strategies to smooth consumption.

Changes in permanent income have the two conflicting effects, and the impact on investment is usually smaller than is the case with changes to transitory income. First, a decline in permanent income reduces the resources for possible consumption during current period. As such, households faced with borrowing constraints are tempted to expand the consumption and promote smooth consumption by lowering the level of investment for this period (substitution effect). This substitution effect is the same as the investment effect that transitory income has. However, when there is this drop in permanent income, the resources for possible consumption in the next period are also decreased. This provides motivation to increase the level of investment during this period to increase resources for the next period. Consequently, a drop in permanent income also has the effect of increasing investment (income effect). The overall effect of these two conflicting effects is mainly dependent on the form of the

utility function, and is generally undetermined. However, we can easily verify that for households faced with borrowing constraints, transitory income usually has a larger impact on investment than permanent income. When the capital market is imperfect, investment behavior is more sensitive to transient poverty than to chronic poverty.

Sawada's (1997) study of educational investment behavior among poor farming households in Pakistan is consistent with the aforementioned theoretical estimations¹⁰. Sawada (1997) empirically analyzed education investment behavior by using three years of panel data collected by IFPRI. This data covered three comparatively backward regions in Pakistan, namely Dir in the North-West Frontier Province, Attock in the Punjab Province, and Badin in the Sind Province, in addition to Faisalabad in Punjab Province, which is a comparatively advanced farming region. Roughly 800 households were surveyed over a 5-year period with 14 follow-up surveys (See Alderman, 1996). First, school enrollment probability q is defined as a transition probability of a child from not enrolled in school to enrolled. If the theoretical conclusions are correct, q would be influenced by transitory income and this influence would be greater than permanent income effect. The actual school enrollment behavior is observed as two qualitative variables whether or not such transition was implemented.

Sawada (1997) used the logit model, including fixed effects at the village level, to statistically analyzes what factors influenced this school transition probability. Here permanent income (average household income over a time series) and transitory income (deviation from average household income) as indicators for chronic poverty and transient poverty are employed respectively. The estimation results showed that both permanent income and transitory income statistically had a positive influence on the school attendance probability q . However, when compared with the coefficients, the transitory income effect is larger. This asymmetric relationship between the transitory income effect and the permanent income effect is consistent with the theoretical conclusions. These empirical results indicate that the existence of transient poverty has a serious impact on education investment activities for households in Pakistan that do not have a sufficient income insurance device and are confronted with borrowing constraints.

Sawada (1997) obtained the same measured results for the probability of a child dropping out of school.

10 Jacoby and Skoufias (1997) used ICRISAT panel data for India to show that seasonal income changes, especially unforeseen income fluctuations, influenced educational activities. This suggested that transient poverty was a major hindrance to educational investment.

Furthermore, Sawada (1999a) and Sawada and Lokshin (2000) showed measured results that transitory income had an even larger influence on girls' education. Female education was largely influenced by the parents' transitory income, indicating the existence of dynamic gender gap. We can conclude that the educational investments for girls are largely sacrificed due to the existence of transient poverty.

6. ROLE OF INFRASTRUCTURE IN REDUCING THE TWO TYPES OF POVERTY

The percentage of Japan's developmental assistance dedicated to infrastructure exceeds 30%, which is a very high level by international standards. General examples of such economic infrastructures include power stations, dams, regional electrification, railways, highway networks, port facilities, transport systems, telephone networks and communication systems, irrigation, waterworks and sewerage.

The development of such infrastructures provides large benefits to the production activities of the agriculture, business and industrial sectors. It is believed that the development of such infrastructure compliments private sector investment activities. As will be explained in greater detail below, there is a large volume of research showing that this type of infrastructure development contributes to increased productivity and economic development (Antle, 1983; Canning, 1998, 1999; Lipton and Ravallion, 1995; pp.2630-2631; Jimenez, 1995; p.2780).

However, Lipton and Ravallion (1995; p.263 and Jimenez (1995; p.2788) indicated that research clearly analyzing the direct influence that infrastructure has on poverty reduction is very limited. Here we will discuss what contribution physical infrastructure has on poverty reduction from the viewpoints of chronic and transient poverty. Human assets, such as households with a high degree of education and health, are also believed to contribute to poverty reduction. However, the role of human infrastructure on poverty reduction is not discussed in this paper (see Jimenez 1995).

6.1 INFRASTRUCTURE AND CHRONIC POVERTY

Chronic poverty is generally seen as the state of poverty continued over a long period of time. In order to reduce this type of poverty, continuous government intervention is needed to raise the productivity of the economic activities

of the poor households (Lipton and Ravallion). The development of physical infrastructure increases agricultural production and the return on human and physical assets through the provision of public goods by the government. Such infrastructure development is also believed to ultimately raise permanent household incomes. Consequently, infrastructure development has the effect to reduce chronic poverty.

Canning (1999) provides a valuable analysis of this aspect. Canning (1999) used multi-country data covering 57 countries over a 40-year period from 1950 to 1990 to estimate augmented macro production functions including physical infrastructure stocks and human assets as factors of production. Canning's model corresponded to the analysis of the Solow model's "level effect" investigated by Mankiw, Romer, Weil (1992). First, Canning (1999) estimated the income elasticity of production for infrastructure stock to be 0.37. He revealed that the within the various physical infrastructure stock, the contribution to production by power generation and transport infrastructures had the same elasticity of 0.37. However, estimated production elasticity for human assets from the point of view of the level of education was 0.1, which means its contribution was much lower than that of the physical infrastructure. This would indicate that physical infrastructure has a relatively high degree of importance for the average household income level. More importantly, the telecommunications infrastructure represented by the number of telephones per worker has more "level effect" than a contribution to production as a physical infrastructure, since a roughly 0.14 additional income elasticity of production has been observed for telecommunication infrastructure. Therefore the marginal production of communication infrastructure has more significance than other physical stocks. This suggests that communication systems in developing countries have a very strong external effect. If there were an under-supply of communication infrastructure, policies to allocate more funds to communication infrastructures would be justifiable in order to generate externalities. Simply stated, the most important implication of Canning's (1999) empirical results is that the development of physical infrastructure will raise long-term production and income levels by the externalities, and thus such infrastructure makes a large contribution to the reduction of chronic poverty.

Japan's developmental assistance in recent years has placed a greater emphasis on comparatively small-scale infrastructures with the aim of assisting regional and agricultural development. Examples of such projects include, electrification of agriculture regions, road construction in rural areas, small bridge construction,

development of regional fishing ports, and improvement of regional telephone networks. Such projects target regions with relatively large populations of poor people, and aim to more directly increase household production, and the production of agricultural sectors and the overall regional economy. Consequently, it is very likely that the resulting increase in average incomes has the direct effect of reducing chronic poverty.

There is a large volume of empirical research verifying that infrastructure development in rural areas would contribute to the development of regional economy (Antle, 1983, Lipton and Ravallion, 1995). One example is the comparative analysis of 58 countries summarized by Jimenez (1995; p.2780). Jimenez showed that a 1% improvement to irrigation, paved roads or the density of regional roads generated 1.62%, 0.26% and 0.12% improvements in agricultural productivity respectively. Access to high-quality roadways and transport systems can help increase the level of agricultural production technologies, stabilize the provision of financing and increase production. Lipton and Ravallion (1995; p.2630) called this the “direct effect” on poverty reduction brought about by the provision of infrastructure.

Improvements to paved roads and transportation systems in the local regions helped to improve employment mobility for the farmers. Increased employment mobility can provide the farmers with expanded opportunities to earn higher wages and to diversify economic activities, ultimately leading to significant increases in income. Lipton and Ravallion (1995; p.2630) said that the development of infrastructure increases the mobility of information, goods, services and employment and reduce poverty. They called this contribution to poverty reduction an “indirect effect”. This “indirect effect” can be interpreted as expanding “entitlements” exchange possibility which is described by Sen (1981).

Connecting links between collection of the ownership rights for resources, goods and labor, and other different collection of ownership rights based on specified rules, were called the “entitlements relationship” by Sen (1981). Sen considered that households that failed in the exchange of these entitlements could fall into a state of starvation. Infrastructure development can increase the possibility for the exchange of ownership rights of the poor and contribute to the reduction of chronic poverty. For example, improved access to infrastructure for the poor helps improve access to market and greatly reduce expenses associated with purchases and sales of goods and services. By greatly expanding the range of entitlement exchange possibilities, farmers can improve their standard of living by shifting

from the situation of self-sufficient production and consumption to the exchange of goods and services in the market. Furthermore, improvements on roads and transportation systems lowers costs for farmers to access the non-farm labor market, which in turn helps to raise non-farm incomes. This not only improves incomes for farmers but also contributes to urban economic development.

In sum, the development of infrastructure directly and indirectly raises welfare standards and contributes to the long-term reduction of chronic poverty, by increasing agricultural production, raising non-farm incomes, and bringing about a smooth transition to a market economy. It is also believed that the development of such infrastructure provides long-term improvements to social indicators by lowering transaction costs for accessing education and medical services. Hence, there is a complementarity between these small-scale physical infrastructures, the development of the social sector, and the development of human infrastructures. Important policy interventions are needed to promote these complementarities.

6.2 INFRASTRUCTURE AND TRANSIENT POVERTY

What influence does infrastructure development have on transient poverty? This section will discuss the role played by infrastructure as a risk management strategy and a risk coping strategy.

When a household’s participation in the market is limited due to the inaccessibility to infrastructure, the household must employ self-management strategies of risks. For example, there is the risk of serious public health problems when a stable supply of safe water cannot be obtained due to incomplete waterworks. Consequently, the households cannot avoid risks of diseases and falling into transient poverty. Likewise, heavy rains can cause flooding that could severely damage crops and destroy physical and human assets if a proper flood prevention system is not in place.

Physical infrastructure development helps to reduce the huge risks of natural disasters, while at the same time greatly reducing transaction costs involved in accessing markets and buying and selling goods and services. This means that the possibilities for exchanging entitlements for the poor are greatly expanded. For example, farmers can escape from the state of self-supporting production and consumption to the state of achieving better income smoothing by gaining stable, non-farming income. The provision of electricity and waterpower helps to stabilize the production process. Roads, railways, ports and

communication systems help to better integrate the country's goods, services and labor markets, and stabilize prices and wages accordingly. These are all extremely important factors for reducing transient poverty.

Floods, landslides, earthquakes, typhoons, strong winds, tidal waves and volcanic eruptions are all components of "natural disasters", which can seriously damage a household's physical and human assets. Disaster prevention aims to reduce the risks of such disasters and can be divided into two categories, preventative measures before a disaster occurs and rescue operations and restoration projects after a disaster strikes. Preventative measures are aimed at reducing negative effects before the realization of a disaster, and corresponds to household-level risk management strategies. Post-disaster measures are policy interventions aimed at reducing the impact after the realization of disaster which corresponds to household-level risk coping strategies. However, it is very difficult for households to prevent and cope with the causes of natural disasters and therefore the role of the government becomes important.

Infrastructure development plays a central role in disaster prevention. Infrastructure such as embankments, riverwalls, flood control dams, and dams to prevent volcano ash flows are investments based on disaster-prevention engineering, typhoon engineering, quakeproof engineering etc. They reduce the expected loss of human and physical assets caused by disasters. Furthermore, after a flood or some other natural disaster occurs, it is important to take measures for river walls and to minimize the impact the disaster has on the lives of people. As mentioned earlier, the development of infrastructure helps to greatly reduce transaction costs and increase opportunities for exchanging entitlements among the poor, while at the same time contributing to the stabilization of wages and prices for goods and services, and providing a huge effect for reducing transient poverty. Therefore, we can assume that infrastructure investment and development play very large roles in complementing risk management and risk coping at the household level.

In order to summarize these points formally, we can employ the static supply and demand functions. First, farm household and business production activities can basically be described as supply function $Y = f(A, p, r, w)$. Here, Y is the amount of goods produced, p is the price of the goods, r is capital (borrowing) costs, and w is the wage level. A is a productivity variable representing the technology level and other factors. Suppose this supply function can be expressed as a linear function in the following manner.

$$Y = \alpha A + \beta p + \alpha_1 r + \alpha_2 w$$

Here, A, p, r, w are each seen as independent random variables. In this case variance of income which is a risk management indicator can be written as a sum of variances of productivity, output price and input price.

$$\text{Var}(Y) = a^2\text{Var}(A) + \beta^2\text{Var}(p) + \alpha_1^2\text{Var}(r) + \alpha_2^2\text{Var}(w)$$

The development of infrastructure by the government lowers the productivity uncertainty variable $\text{Var}(A)$. Furthermore, the development of electric power, transport and communication systems reduces transaction costs and reduces the variances of various prices p, r, w by the market integration. Therefore, infrastructure lowers the income variance, $\text{Var}(Y)$, and contributes to income smoothing.

On the other hand, household consumption behavior can be represented by the Marshallian demand function $C = C(p, Y)$ if a static framework is adopted for simplicity. Suppose this demand function can be seen as the following linear approximation:

$$C = \gamma_1 p + \gamma_2 Y$$

If the covariance term is ignored for the sake of simplicity, the consumption smoothing indicator can be shown by the following formula:

$$\text{Var}(C) = \gamma_1^2 \text{Var}(p) + \gamma_2^2 \text{Var}(Y)$$

We can easily see that a decrease in the price fluctuations of consumer goods contributes to income smoothing by lowering $\text{Var}(Y)$ while at the same time lowering consumption fluctuations directly. The development of economic infrastructure contributes to consumption smoothing indirectly through income smoothing, as well as directly. This type of mechanism promotes consumption smoothing beforehand and thus infrastructure plays the important role of complementing risk management strategies.

Returning to the discussion of the mutual-insurance model mentioned in section 3.3.2.1, the relationship between mutual-insurance and infrastructure can be discussed. As indicated by Kurosaki and Sawada (1999a), credit markets and various production goods / factor markets are not integrated and incomplete in the actual rural economy. In the empirical research on risk sharing model, the fact that the $\zeta = 0$ null hypothesis is rejected on many occasions implies that the markets are not completely integrated or developed. Therefore, the development of infrastructure can help to integrate the markets by increasing the mobility of goods, services and information,

while complementing the mutual-insurance mechanism.

7. THE INCENTIVE PROBLEM WITH POLICY TARGETING AND THE ROLE OF PUBLIC WORKS

As stated earlier, infrastructures are thought to complement various household risk management strategies. But what are the benefits provided by economic infrastructure to subsequent risk coping strategies? Here, we will discuss practical aspects of infrastructure followed by Li (1998) and Ravallion (1991). First, we examine the idea of “conditional compensation” and the incentive problem involved in policy implementations. Then the relationship between targeting and workfare programs for infrastructure development will be briefly discussed.

7.1 CONDITIONAL COMPENSATION APPROACH AND THE INCENTIVE PROBLEM

The reason that households must adopt risk coping strategies is because risk management is incomplete due to the undeveloped insurance and credit markets. The best policy for reducing transient poverty is to directly intervene in incomplete markets where market failure is occurring. Therefore, it is important for governments to encourage the development of incomplete markets or enact various compensatory policies. Such policies include Rotating Savings and Credit Associations (ROSCAs), e.g., the Grameen Bank-type small-scale credit associations for women, conditional subsidies of nationwide crop and livestock insurance in the event of floods, drought or other natural disasters, and the promotion of public workfare programs. In general, the state-contingent subsidies, or the “compensating the victims” approach are considered to be desirable and effective for all the poor households, since the costs are significantly lower than comprehensive policy interventions.

However, we should note that such state-contingent compensation approach is embraced with information problem. For example, a household has always an incentive to accurately tell only about their difficulties in order to obtain assistance from the government programs. It implies that there is serious adverse selection problem when choosing target households for the state-contingent subsidies. There is also the concern that households receiving subsidies will not use these funds for suitable

investment activities, but may use the funds for further unnecessary goods or to indulge in luxuries. This is the “moral hazard” problem. Crop insurance programs have been tried in many developing countries, but it is known that most of these programs ended in failure due to the information problems (Besley, 1995a; pp.2159-2161). The distortion of incentives resulting from these information problems is a grave issue which should be sufficiently overcome in the actual policy implementations (Lipton and Ravallion, 1995).

Therefore, the allocation of state-contingent subsidies must be executed in keeping with the appropriate design of intervention scheme that mitigates information and incentive problems. These issues go beyond the scope of this paper. However, intervention programs based on the so-called “participation approach”, and managed by the community could be an effective means for reducing the information problems through a peer-monitoring scheme (Sawada, 1999b; Jimenez and Sawada, 1999). A conditional compensation approach seems to be important in which households can receive the benefits of policy interventions only if they express their incentives correctly¹¹.

School lunch programs are an example of such conditional compensation policies. Parents can receive benefits of the programs based on the parents’ “correct” behavior of sending their children to school. The free distribution of cooking oil to students and other such activities have a similar mechanism. The subsidies are all provided with the condition that the parents are investing in their children’s education.

7.2 ROLE OF EMPLOYMENT GENERATING PUBLIC WORKS

The “Employment Generating Public Works” is a notable successful case based on the conditional compensation approach. Such programs include the Employment Guarantee Scheme (EGS) carried out in the Maharashtra State of India, the Rural Landless Employment Program and National Rural Employment Program, (two public works programs carried out in India on a nationwide level) and the Food for Work Program (FFW) program in Bangladesh. These programs are mainly for road construction, irrigation and drainage development, embankments, and reforestation. These programs widely employ unskilled laborers and the requirements for employment are generally very loose.

This self-targeting mechanism is an important

11 This line of thinking is similar to the “contingent rent” concept developed by Aoki, Murdock, Okuno-Fujiwara (1996).

condition of these employment generating programs. In other words, individuals decide themselves to participate in such a program only when the opportunity costs become lower than the wages and other benefits from participating in the employment program. In sum,

People participate in public employment programs if opportunity costs < program participation benefits.

Consequently, when wages for public works programs are low, only those with low income and low opportunity costs will voluntarily participate in the program. Such a program satisfies the conditional compensation property and consequently it is considered that incentive problems, especially the adverse selection problem when choosing target groups, are avoided.

Next we consider whether or not this mechanism actually works based on the results of existing analyses. First, the EGS in India's Maharashtra State satisfies the self-selection mechanism. EGS was first conducted between 1970 and 1973 during the drought season, and has since employed roughly 500,000 workers on average each month. 90% of EGS participants' income was below the poverty line, which indicates that the self-selection targeting mechanism works effectively. In addition, 60% of the participants in Bangladesh's FFWP are from the lowest 25% income bracket in the rural areas (Ii, 1998).

Secondly, this type of public works has a role of subsequent insurance. This is because households can participate in these types of programs as a risk coping strategy when there is an unexpected income shock. Income fluctuations for landless farmers in regions with EGS were 50% smaller than the income fluctuations of landless farmers in regions without EGS, which shows that EGS acts as an effective risk coping strategy. EGS employment peaks during the off-farm season between March and June. EGS employment also increases during times when there has been large damage due to hurricanes or droughts. These observations support the existence of an insurance role of Employment Generating Public Works.

Conditional compensation conditions are satisfied by Employment Generating Public Works and incentive problems are solved through the self-selection mechanism.

Furthermore, this type of public works has important infrastructure output for the agriculture sector. As mentioned earlier, the development of infrastructure contributes to income and consumption smoothing and provides a risk management strategy. As mentioned above, public works programs also provide income insurance as a type of risk coping strategy. Hence, we may conclude that

these mechanisms provide a continuous effect for transient poverty reduction.

The self-selection targeting mechanism is likely to increase the reservation wages for women, who have an even poorer position in the household. Therefore, there is the possibility for increasing the bargaining power of women (Haddad and Kanbur, 1992). This possibility is extremely important from the viewpoint of intrahousehold resource allocation. More detailed future research on this point will be needed.

8. DATA ISSUES

Detailed and systematic information about households and individuals is indispensable for accurately grasping the poverty situation and selecting the best policy intervention. Household survey data on poverty is widely used not only for academic purposes but also for practical purposes. One such example is the Living Standard Measurement Study (LSMS) household surveys conducted in many countries with the cooperation of the World Bank's Development Research Group. The survey conducted by Grosh and Glewwe (1998) provides a very useful overview of LSMS. More detailed information can be found on the LSMS homepage (<http://www.worldbank.org/html/prdph/lsms/index.htm>).

This report concludes with a brief examination of the future issue of quantifying transient poverty. As indicated by Jalan and Ravallion (1998a), the seriousness of transient poverty depends on the level of economic development. Therefore, we should note that the selection of actual policy intervention or more precisely, the selection of a policy against transient poverty or chronic poverty may differ depending on the country and region. The collection of basic information is very important in order to accurately identify an appropriate policy. In particular, continuous household surveys, effective data collection, and the construction of a sustainable poverty monitoring system are all very important (Grosh and Glewwe, 1996, 1998). Morduch (1994) stated that in order to quantify transient poverty, it is necessary to adopt indicators that not only show average income levels but also clearly express information regarding the fluctuations of income. This refers to indicators that also incorporate the dispersion of income and consumption. In any event, panel data (time series surveys of each household) is essential for gathering this type of information. Therefore, it is very important to conduct continuous household surveys by, for example, preparing household account books as databases.

REFERENCES

- Adams, R. H. Jr. and Jane J. He (1995), *Sources of Income Inequality and Poverty in Rural Pakistan*, IFPRI Research Report 102.
- Alderman, H. (1996), "Saving and Economic Shocks in Rural Pakistan," *Journal of Development Economics* 51, 343-365.
- Antle, J. M. (1983), "Infrastructure and Aggregate Agricultural Productivity: International Perspective," *Economic Development and Cultural Change* 31, 609-619.
- Aoki, M., H. Kim, and M. Okuno-Fujiwara (1997), "Beyond *The East Asian Miracle*: Introducing the Market-Enhancing View," in M. Aoki, H. Kim, and M. Okuno-Fujiwara, eds., *The Role of Government in East Asian Economic Development*, Clarendon Press, Oxford.
- Baulch, R. (1996), "Neglected Tradeoffs in Poverty Measurement," *IDS Bulletin* 27, January.
- Behrman, Jere B. and Anil Deolalikar (1987), "Will Developing Country Nutrition Improve with Income?" *Journal of Political Economy* 95, 492-507.
- Besley, T. (1995a), Savings, Credit and Insurance, in J. Behrman and T. N. Srinivasan eds., *Handbook of Development Economics* IIIA, 2125-2207.
- Besley, T. (1995b), "Nonmarket Institutions for Credit and Risk Sharing in Low-Income Countries," *Journal of Economic Perspectives* 9, 115-127.
- Besley, T. and R. Kanbur (1984), "Food Subsidies and Poverty Alleviation," *Economic Journal* 98, 701-719.
- Bhalla, Surjit S. (1980), "The Measurement of Permanent Income and Its Application to Savings Behavior," *Journal of Political Economy* 88 (4), 722-744
- Bhalla, Surjit S. (1979), "Measurement Errors and the Permanent Income Hypothesis: Evidence from Rural India," *American Economic Review* 69 (3), 295-307
- Cain, M. (1981), "Risk and Insurance: Perspectives on Fertility and Agrarian Change in India and Bangladesh," *Population and Development Review* 7, 435-474.
- Caldwell, J. C., P. H. Reddy, and P. Caldwell (1986), "Periodic High Risk as a Cause of Fertility Decline in a Changing Rural Environment: Survival Strategies in the 1980-1983 South Indian Drought," *Economic Development and Cultural Change* 34, 677-701.
- Canning, D. (1998), "A Database of World Stocks of Infrastructure, 1950-1995," *World Bank Economic Review* 12 (3), 529-47.
- Canning, D. (1999), "The Contribution of Infrastructure to Aggregate Output," *mimeo*, the World Bank.
- Carroll, D. (1997), "Buffer Stock Saving and the Permanent Income Hypothesis," *Quarterly Journal of Economics* 112, 1-55.
- Carter, Michael R. (1988), "Equilibrium Credit Rationing of Small Farm Agriculture," *Journal of Development Economics* 28, 83-103.
- Coate, S. and M. Ravallion (1993), "Reciprocity Without Commitment: Characterization and Performance of Informal Insurance Arrangements," *Journal of Development Economics* 40, 1-24.
- Cox, D. and E. Jimenez (1990), 'Achieving Social Objectives through Private Transfers: A Review,' *World Bank Economic Review* 5 (2), 205-218.
- Deaton, A. (1991), "Saving and Liquidity Constraints," *Econometrica* 69, 1221-1248.
- Deaton, A. (1992), *Understanding Consumption*, Oxford University Press.
- Deaton, A. (1997), *The Analysis of Household Surveys: A Microeconomic Approach to Development Policy*, Johns Hopkins University Press.
- Eswaran, M. and A. Kotwal (1989), "Credit as Insurance in Agrarian Economies," *Journal of Development Economics* 31, 37-53.
- Esho, H. and Yamazaki, K., eds. (1998), "Development and Poverty – Toward the Economic Analysis of Poverty (in Japanese)", *Institute of Developing Economies*
- Fafchamps, M. (1992), "Solidarity Network in Pre-Industrial Societies: Rational Peasants with a Moral Economy," *Economic Development and Cultural Change* 41, 147-174.
- Fafchamps, Marcel, Christopher Udry, and Katherine Czukas (1998), "Drought and Saving in West Africa: Are Livestock a Buffer Stock?," *Journal of Development Economics* 55, 273-305.
- Foster, James, Joel Greer and Erik Thorbecke (1984), "A Class of Decomposable Poverty Measures," *Econometrica* 52 (3), 761-766.
- Frankenberg, E., D. Thomas, and K. Beegle (1999), "The Real Costs of Indonesia's Crisis: Preliminary Findings from the Indonesian Family Life Surveys," *mimeo*, Rand Corporation.
- Friedman, J. (1971), "A Non-cooperative Equilibrium for Supergames," *Review of Economic Studies* 38, 1-12.
- Gibbons, Robert (1992), *Game Theory for Applied Economists*, Princeton University Press.

- Gillani, Syeda Fizza (1994), "Evidence of Risk Sharing and the Role of Transfers and Loans: The Case of Rural Pakistan," unpublished Ph.D. dissertation, Department of Economics, Boston University.
- Gillani, Syeda Fizza (1996), "Risk-sharing in Rural Pakistan," *Pakistan Development Review* 35(1): 23-48.
- Glewwe, Paul and Gillette Hall. 1998. "Are Some Groups More Vulnerable to Macroeconomic Shocks than Others?" *Journal of Development Economics* 56(1), 181-206
- Grosh, Margaret E. and Paul Glewwe (1996), "Household Survey Data from Developing Countries: Progress and Prospects," *American Economic Review* 86 (2), 15-19.
- Grosh, Margaret E. and Paul Glewwe (1998), "Data Watch: The World Bank's Living Standards Measurement Study; Household Surveys," *Journal of Economic Perspectives* 12 (1), 187-96.
- Haddad, Lawrence and Raiv Kanbur (1992), "Intrahousehold Inequality and the Theory of Targeting," *European Economic Review* 36, 372-378.
- Hayami, Y. (1995), "Development Economics: Poverty and Wealth of Nations", Oxford University Press
- Ii, M (1998), "Public Spending and Targeting Toward the Poor (in Japanese)". Editing by Esho, H and Yamazaki, K, "Development and Poverty – Toward the Economic Analysis of Poverty", *Institute of Developing Economies*.
- Jacoby, H. and E. Skoufias (1997), "Risk, Financial Markets and Human Capital in a Developing Countries," *Review of Economic Studies* 64, 311-335.
- Jalan, J., and M. Ravallion (1996), "Consumption Insurance and Savings Behavior in Rural China," *mimeo*, the World Bank.
- Jalan, J., and M. Ravallion (1998a), "Transient Poverty in Postreform Rural China," *Journal of Comparative Economics* 26, 338-357.
- Jalan, J., and M. Ravallion (1998b), "Determinants of Transient and Chronic Poverty," *Policy Research Working Paper* No. 1936, Development Research Group, the World Bank.
- Jimenez, Emmanuel (1995), Human and Physical Infrastructure: Public Investment and Pricing Policies in Developing Countries, in J. Behrman and T. N. Srinivasan eds., *Handbook of Development Economics* IIIB, 2773-2843.
- Jimenez, Emmanuel and Yasuyuki Sawada (1999), "Do Community Managed Schools Work?: An Evaluation of El Salvador's EDUCO Program," *World Bank Economic Review* 13 (3), September 1999, 415-441.
- Kimball, Miles S. (1988), "Farmers' Cooperatives as Behavior Toward Risk," *American Economic Review* 78, 224-232.
- Kochar, Anjini (1995), "Explaining Household Vulnerability to Idiosyncratic Income Shocks," *AEA Papers and Proceedings* 85, 159-164.
- Kochar, Anjini (1999), "Smoothing Consumption by Smoothing Income: Hours-of-Work Responses to Idiosyncratic Agricultural Shocks in Rural India," *Review of Economics and Statistics* 81 (1), 50-61.
- Kurosaki, A (1998a), "Comprehensive Analysis of Rural Economy by Agricultural and Household Individual Data", *World Trend*, Institute of Developing Economies, 1998 November Issue: pp17-20.
- Kurosaki, A (1998b), "Poverty and Risk – Microeconomic Perspective". Editing by Esho and Yamazaki, "Development and Poverty – Toward the Economic Analysis of Poverty", Institute of Developing Economies
- Kurosaki, A and Sawada, Y (1999a), "Stabilization of Household Consumption in Rural Areas of Developing Countries – Research Prospects and Application to Pakistan (in Japanese)", *Hitotsubashi University Institute of Economic Research, Discussion Paper Series* No.361
- Kurosaki, A and Sawada, Y (1999b), "Stabilization of Household Consumption in Rural Areas of Developing Countries – Primarily for Pakistani Cases (in Japanese)", *Economics Review (Keizai Kenkyu)* Vol.50 No.2, pp155-168.
- Kurosaki, Takashi (1998), *Risk and Household Behavior in Pakistan's Agriculture*, Institute of Developing Economies.
- Leland, H. E. (1968), "Saving and Uncertainty: The Precautionary Demand for Saving," *Quarterly Journal of Economics* 82, 465-473.
- Lipton, M. and M. Ravallion (1995), Poverty and Policy, in Behrman, Jere and T. N. Srinivasan eds., *Handbook of Development Economics*, Volume 3B, Elsevier Science, North Holland, 2551-2657.
- Lucas, R. E. B. and O. Stark (1985), "Motivations to Remit: Evidence from Botswana," *Journal of Political Economy* 97, 905-926.
- Lund, S. and M. Fafchamps (1997), "Risk-Sharing Networks in Rural Philippines," *mimeo*, Stanford University.
- Mankiw, G., D. Romer and D. N. Weil (1992), "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics* 107, 407-437.

- McKinnon, R. I. (1973), *Money and Capital in Economic Development*, The Brookings Institution, Washington D.C..
- Morduch, J. (1991), "Consumption Smoothing across Space: Test for Village-Level Response to Risk," *mimeo*, Harvard University.
- Morduch, J. (1994), "Poverty and Vulnerability," *AEA Papers and Proceedings* 84, 221-225.
- Morduch, J. (1995), "Income Smoothing and Consumption Smoothing," *Journal of Economic Perspectives* 9, 103-114.
- Nugent, J. (1985), "The Old-Age Security Motive for Fertility," *Population and Development Review* 11.
- Park, A. F. (1996), "Household Grain Management under Uncertainty in China's Poor Areas," unpublished Ph.D. Dissertation, Food Research Institute, Stanford University.
- Paxson, C. H. (1992), "Using Weather Variability to Estimate the Response of Savings to Transitory Income in Thailand," *American Economic Review* 82, 15-33.
- Pender, J. (1996), "Discount Rates and Credit Markets: Theory and Evidence from Rural India," *Journal of Development Economics* 50, 257-296.
- Platteau, J. P. and A. Abraham (1987), "An Inquiry into Quasi-Credit Constraints: The Role of Reciprocal Credit and Interlinked Deals in Small-scale Fishing Communities," *Journal of Development Studies* 23, 461-490.
- Popkin, S. L. (1979), *The Rational Peasant*, University of California Press.
- Posner, Richard A. (1980), "A Theory of Primitive Society, with Special Reference to Law," *Journal of Law and Economics* 23, 1-53.
- Ravallion, Martin (1991), "On the Coverage of Public Employment Schemes for Poverty Alleviation," *Journal of Development Economics* 34, 57-79.
- Ravallion, Martin and Shubham Chaudhuri (1997), "Risk and Insurance in Village India: Comment," *Econometrica* 65(1): 171-184.
- Ravallion, M. and L. Dearden (1988), "Social Security in a "Moral Economy": An Empirical Analysis for Java," *Review of Economics and Statistics* 70, 36-44.
- Ray, Debraj (1998), *Development Economics*, Princeton University Press.
- Rosenzweig, M. R. (1988), "Risk, Implicit Contracts and the Family in Rural Areas of Low-Income Countries," *Economic Journal* 98, 1148-1170.
- Rosenzweig, M. R. and H. P. Binswanger (1993), "Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments," *Economic Journal* 103, 56-78.
- Rosenzweig, M. R. and K. I. Wolpin (1993), "Credit Constraints, Consumption Smoothing, and the Accumulation of Durable Production Assets in Low-Income Countries: Investments in Bullocks in India," *Journal of Political Economy* 101, 223-244.
- Rosenzweig, M. R. and O. Stark (1989), "Consumption Smoothing, Migration, and Marriage: Evidence from Rural India," *Journal of Political Economy* 97, 905-926.
- Sawada, Y. (1999), "Two Dynamic Poverty Concepts in the Process of Economic Development (in Japanese)," *Studies on International Relations* No.13, pp21-37
- Sawada, Y. (1994), "Are the Heavily Indebted Countries Solvent? Tests of Intertemporal Borrowing Constraints," *Journal of Development Economics* 45, 325-337.
- Sawada, Y. (1996), "Aid and Poverty Alleviation: An International Comparison," *IDS Bulletin* 27 (1), 100-108.
- Sawada, Y. (1997), "Human Capital Investment in Pakistan: Implications of Micro-Evidence from Rural Households," *Pakistan Development Review* 36 (4), 695-712.
- Sawada, Y. (1999a), "Income Risks, Gender, and Human Capital Investment in Rural Pakistan," *mimeo*, Department of Economics, Stanford University.
- Sawada, Y. (1999b), "Community Participation, Teacher Effort, and Educational Outcome in El Salvador," *Davidson Institute Working Paper Series* No. 307, the William Davidson Institute, University of Michigan Business School., November 1999. (PDF file is available from <http://eres.bus.umich.edu/docs/workpap-dav/wp307.pdf>)
- Sawada, Y. and M. Lokshin (2000), "Sequential Schooling Decisions of Households: Evidence from Field Surveys in Rural Pakistan," *mimeo*, Development Research Group, The World Bank.
- Scott, J. (1976), *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia*, Yale University Press.
- Sen, A. K. (1976), "Poverty: An Ordinal Approach to Measurement," *Econometrica* 63 (5), 1225-1230.
- Sen, A. K. (1981), *Poverty and Famines*, Clarendon Press

- (Translation by Kurosaki,A and Yamazaki,K, Iwanami Shoten in 2000)
- Strauss, John and Duncan Thomas (1995), "Human Resources: Empirical Modeling of Household and Family Decisions," in Jere Behrman and T. N. Srinivasan, eds., *Handbook of Development Economics* Volume 3A, North-Holland, Section 2.2.
- Stiglitz, J. E. and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review* 71, 393-419.
- Townsend, R. M. (1994), "Risk and Insurance in Village India," *Econometrica* 62, 539-591.
- Townsend, R. M. (1995a), "Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies," *Journal of Economic Perspectives* 9, 83-102.
- Townsend, R. M. (1995b), "Financial Systems in Northern Thai Villages," *Quarterly Journal of Economics*, November, 1011-1046.
- Udry, C. (1994), "Risk and Insurance in a Rural Credit Market: An Empirical Investigation in Northern Nigeria," *Review of Economic Studies* 61, 495-526.
- Udry, C. (1997), "Recent Advances in Empirical Microeconomic Research in Poor Countries: An Annotated Bibliography," *Journal of Economic Education* 28, 58-75.
- Walker, T. S. and N. S. Jodha (1986), "How Small Farm Households Adapt to Risk," in P. Hazell et. al. eds., *Crop Insurance for Agricultural Development: Issues and Experience*, Johns Hopkins University Press.
- Walker, T. S. and J. G. Ryan (1990), *Village and Household Economies in India's Semi-Arid Tropics*, the Johns Hopkins University Press.
- World Bank (1990), *World Development Report*, the World Bank.
- Yotopoulos, P. A. and Y. Sawada (1999), 'Free Currency Markets, Financial Crises and the Growth Debacle: Is There a Causal Relationships?,' *Seoul Journal of Economics* 4, 419-456.
-