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Imperfect Commitment, Altruism and the Family: Evidence from Transfer  
Behavior in Low-Income Rural Areas

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## I. Introduction

Altruism or mutual “caring” among family members has been hypothesized to play an important role in facilitating risk sharing, particularly in environments with less developed markets (Becker, 1991). Indeed, recent studies have provided evidence that family-based income transfers do contribute to consumption smoothing (Rosenzweig, 1988; Rosenzweig and Stark, 1989; Rosenzweig and Wolpin, 1994). However, there is also evidence suggesting that within families idiosyncratic risk is not fully insured (Altonji et al., 1992), and that the transfer of resources among family members in response to income fluctuations does not conform fully to simple models of altruism (Cox, 1987; Altonji et al., 1997).

A problem with existing empirical studies of altruism is that they do not model explicitly the well-known constraints on insurance arrangements that altruism may not fully overcome, such as barriers to information that give rise to moral hazard and the commitment problems that arise when individuals cannot enter into binding contracts. The implications derived from the assumption of altruism in such models thus may be misleading. Moreover, if, for example, costly state verification is the principal problem in attaining perfect insurance, it may be that the family is prominent in risk sharing not because of altruism but because of familial information advantages.

Recent work on self-enforcing contracts (Coate and Ravallion (1993), Thomas and Worrall (1995)) has provided insight into the structure of constrained-efficient insurance contracts in the presence of imperfect commitment. However, this work does not explore the interactions between commitment problems and altruism in determining risk-sharing arrangements and fails to explain the pervasive fact that transfers, in both high and low-income countries, frequently occur between family members. In a world in which contracts are either self-enforcing or enforceable by a third party, there would seem to be no particular reason for this to be the case: it seems likely that households other than those to which one is related would in general be able to provide one with more complete risk sharing than would those to

which one is connected through family ties if, for example, the incomes of non-kin are less correlated than those of kin. In a world in which contracts are not enforceable, however, altruism may play an important role. To the extent that households entering into a risk sharing arrangement care about each others' welfare we would expect that they will gain more from insurance than they would otherwise and thus that the scope of risk-sharing contracts will be greater.

In this paper, we examine empirically whether risk pooling is more advantageous among altruistic compared to selfish agents in a framework where individuals cannot make binding commitments. We incorporate altruism into the recent model of risk sharing under imperfect commitment of Thomas and Worrall (1995) to establish tests of the roles of both altruism and commitment problems in determining the extent of insurance and the intertemporal movements in interhousehold transfers.<sup>1</sup> We show that it is possible to implement the tests in terms of directly measurable variables, only some of which have been used in prior studies assessing alternative income smoothing mechanisms. In particular we show that how much past transfers affect current transfers - the "transfer asset effect" - and how much of a contemporaneous income shock is shared by transfer partners - the "income shock effect" - differ in specific ways by both whether the transfer partners are altruistic and by partner income covariances in the presence of commitment problems. The tests are carried out using three panel data sets from two countries of rural South Asia that provide detailed information on

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<sup>1</sup>Thomas and Worrall (1995) use an approach developed in the context of implicit labor contracts (Thomas and Worrall (1988)) to examine the question of whether optimal implementable risk sharing contracts are non-stationary. This question was raised by Coate and Ravallion (1993) who, building on work by Foster (1988) and Kimball (1988), examined optimal stationary risk-sharing contracts. Ligon, Worrall and Thomas (forthcoming) provide an empirical test of this model using one of the three data sets employed in this paper. While their results support the imperfect commitment model relative to perfect insurance and autarchy, their approach (in particular the fact that explicit information on transfers by partners are not used) does not permit an assessment of the role of altruism as a commitment device. It should also be noted that the Ligon, Worrall and Thomas (forthcoming) approach focuses on intra-village risk sharing, and thus does not permit an assessment of inter-village risk sharing arrangements, which play an important role as shown below.

transfers and enable the measurement of income shocks.<sup>2</sup>

In section II we characterize the optimal implementable risk sharing contract under imperfect commitment and illustrate using model simulation how the degree of altruism among transfer partners and the magnitude of their income correlation influence this contract. The model simulations show that although sufficiently altruistic families with less than perfectly correlated incomes will optimally engage in risk pooling arrangements, non-altruistic individuals will not engage in risk pooling when income correlations are sufficiently positive. We also show that if transfers play an insurance role but do not achieve full insurance then transfers will respond to both contemporary income shocks and to the history of previous transfers, with the latter arising as a result of the inability of households to commit to make first-best state-contingent transfers. Moreover, the history dependence of transfers and their degree of responsiveness to income shocks depend on the degree of altruism. In particular, we demonstrate that i) the existence of binding imperfect commitment constraints implies that households that have made net transfers in previous periods are less likely to provide subsequent transfers, given the current state of the world, than are households that have been net recipients of transfers, but ii) contemporaneous transfers are less responsive to transfers in the past and more responsive to current income shocks, for given partner income correlations, when partners are altruistically linked compared to when they are not.

In section III, we show that estimates of linear approximations to the transfer functions implied by the model are capable of identifying the roles of imperfect commitment, altruism and income covariances in determining transfer behavior. We also use the simulations to investigate the robustness of the results to lack of symmetry among transfer partners and to assumptions about the relationships between kinship, income correlation and information. The data from three rural panel surveys that are

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<sup>2</sup>Wolpin (1984), Paxson (1992), Behrman, Foster, and Rosenzweig, (1997), Udry (1994, 1996), Rose (forthcoming) use various measures of income shocks to test for consumption smoothing behavior and to assess the importance of particular smoothing mechanisms, including financial savings, asset divestiture, and labor supply.

used to estimate these functions, specific aspects of the empirical implementation and the empirical results are presented in Section IV. The estimates provide strong support for the notion that imperfect commitment substantially constrains informal transfer arrangements, whether kin-based or not, but also provide evidence that altruism plays an important role in ameliorating commitment constraints and thus in increasing the gains from income pooling.

## II. Theory and Simulations

To capture the basic elements of interhousehold interactions and yet keep the model structure as simple as possible we assume that there are two households  $i=1,2$ . In every period  $t$  each household  $i$  receives an income  $y_i(s_t)$  where  $s$  is the state of nature in period  $t$ .<sup>3</sup> Income cannot be stored or saved across periods. We allow for altruism between the households by assuming that household single-period utility is separable in own and other household consumption. In particular, the utility functions for households 1 and 2 are assumed to be:

$$u(c^1) + \gamma v(c^2) \tag{1}$$

$$v(c^2) + \gamma u(c^1), \tag{2}$$

where  $u()$  and  $v()$  are increasing and concave and  $\gamma < 1$  reflects the degree of altruism. Households are infinitely lived, discount the future with discount factor  $\delta$ , and are expected utility maximizers.<sup>4</sup>

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<sup>3</sup>Because income is exogenous in the model, we are assuming away problems of moral hazard. Hoff (1997) formulates a model which shows how moral hazard limits the extent of insurance and makes insurance arrangements vulnerable to wealth shocks. In that model, however, it is assumed that contracts are enforceable and the share of income that is pooled is endogenously chosen by the median voter, but responds to shocks with a lag. Hoff presents evidence that there is concern about moral hazard in some low-income country contexts. However, incorporating moral hazard considerations into a model in which contracts must be self-enforcing and there is nonstationarity, as here, would add considerable complexity. Moreover, the empirical assessment of the additional role of moral hazard would require data on the behavior of all transfer partners that are not available.

<sup>4</sup> As noted by Coate and Ravallion (1993) and Thomas and Worrall (1995) the assumption that households are infinitely lived is not as stringent as it would seem: the model incorporates the possibility that the players believe that any insurance arrangement will, for reasons exogenous to the history of states and transfers, fail with some positive probability (e.g., as a result of the death of one participant), in each period. In this case, the failure probability is absorbed into the discount factor.

Because of risk aversion when the incomes of the two households are not perfectly correlated the households can, in principle, benefit through sharing of resources. It is assumed, however, that contracts are not legally enforceable. As a consequence, enforcement of any contract must rely solely on the potential consequences for the two parties of violating the contract. In particular, it is assumed that if either of the households does not meet the terms of the contract then the households revert to a sequence of static Nash equilibria (SSNE), which can be of two types: for sufficiently low levels of altruism the households operate in autarchy, as in standard models of imperfect commitment, but at higher levels some limited risk-sharing still obtains. This latter possibility means that while altruism may increase the willingness of an individual to make a transfer to a partner when his income is relatively high, it may also decrease the ability to penalize deviant behavior by reducing the credibility of the threat of autarchy.<sup>5</sup>

The task is to specify the set of contracts that can be supported. In general, a risk-sharing contract in the context of this model can be characterized as a transfer function  $\tau(h_t)$  that dictates the (possibly negative) transfer from household 1 to household 2 that should occur if the contract is in force in period  $t$  after history  $h_t$ , where the latter is defined as the sequence of states up to and including the state realized in period  $t$ :  $h_t = \{s_1, s_2, \dots, s_t\}$ . The transfer function for the static Nash equilibrium given state  $s$  is denoted<sup>6</sup>

$$\tau^N(s) = \begin{cases} t \text{ s.t. } u'(y_1(s)-t)/v'(y_2(s)+t) = \gamma & \text{if } u'(y_1(s))/v'(y_2(s)) < \gamma \\ t \text{ s.t. } u'(y_1(s)-t)/v'(y_2(s)+t) = 1/\gamma & \text{if } u'(y_1(s))/v'(y_2(s)) > 1/\gamma \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

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<sup>5</sup>On the other hand, if information among family members is generally superior to that among non-kin, the threat of relegation to the limited risk-sharing state may be more credible, as the family member whose transfer arrangement is discontinued will find it more difficult to find another altruistic partner. We consider in section III the empirical implications of this potential informational advantage for families in enforcing punishments.

<sup>6</sup>Note that in line 1 of equation 1 the transfer is positive, and in line 2 it is negative. Intuitively, the better-off household will make a transfer to the worse-off household in the static Nash equilibrium when he cares sufficiently about that household that he is better off doing so than he would be by accepting the autarchic allocation.

Define  $U(h_t)$  as the expected discounted utility gain from the risk-sharing contract relative to the SSNE after history  $h_t$  so that:

$$U(h_t) = u(y_1(s_t) - \tau_t(h_t)) - u(y_1(s_t) - \tau^N(s_t)) + \gamma v(y_2(s_t) + \tau_t(h_t)) - \gamma v(y_2(s_t) + \tau^N(s_t)) + E \sum_{j=t+1}^{\infty} \delta^{j-t} (u(y_1(s_j) - \tau_t(h_j)) - u(y_1(s_j) - \tau^N(s_j)) + \gamma v(y_2(s_j) + \tau_t(h_j)) - \gamma v(y_2(s_j) + \tau^N(s_j))) \quad (4)$$

and let  $V(h_t)$  denote the analogous expression for household 2. The assumption that the contract is enforced through reversion to the SSNE implies that a given contract can be implemented only if the expected discounted utility gain from the contract relative to the SSNE is non-negative,  $U(h_t) \geq 0$  and  $V(h_t) \geq 0$ , for each history  $h_t$ . We refer to these constraints subsequently as the implementability constraints.<sup>7</sup>

The set of implementable contracts can be characterized by a history-dependent convex function  $W_s(U)$  that describes the maximal (over all implementable contracts) expected discounted utility gain that can accrue to household 2 in state  $s$  if household 1 receives a utility of  $U$ .<sup>8</sup> Further, the optimal contract can be characterized in terms of the evolution of the ratio of marginal utility

$$\lambda(h_t) = \frac{v'(y_2(s_t) + \tau_t(h_t)) + \gamma u'(y_1(s_t) - \tau_t(h_t))}{u'(y_1(s_t) - \tau_t(h_t)) + \gamma v'(y_2(s_t) + \tau_t(h_t))} = -W_{s_t}'(U_t(h_t)) \quad (5)$$

over time, where  $-\lambda$  is the slope of the Pareto frontier. In particular for each state  $s$  there is a history independent interval  $[\lambda_s^L, \lambda_s^U]$  corresponding to the set of implementable points on the Pareto efficient frontier in state  $s$  such that the  $\lambda(h_t)$  evolve according to:

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<sup>7</sup>Whenever  $\gamma > 0$ , even the one-shot game (defined in (3)) can support some transfers. The question is how much better can the players do under a time-linked contract. The implementability constraint is simply the statement that the latter contract must provide utility no less than under the one-shot game.

<sup>8</sup>Thomas and Worrall (1995). Although the proof by Thomas and Worrall (1995) refers to the non-altruistic case ( $\gamma = 0$ ) the extension to the altruistic case is straightforward.

$$\lambda(h_{t+1}) = \begin{cases} \lambda_s^L & \text{if } \lambda(h_t) < \lambda_s^L \\ \lambda(h_t) & \text{if } \lambda(h_t) \in [\lambda_s^L, \lambda_s^U] \\ \lambda_s^U & \text{if } \lambda(h_t) > \lambda_s^U \end{cases} \quad (6)$$

The optimal contract may thus be characterized as follows. Upon entering the contract, the two households choose a desired distribution of expected utility gains given the current state (i.e., a point on  $W_s(U)$ ). The negative of the slope on the Pareto frontier at this point,  $\lambda(h_0) = -W_{s0}'(U)$  corresponds to a ratio of marginal utilities that the households will attempt to implement subsequently. In subsequent periods, the level of transfer is specified so that, given the incomes of the two households, the ratio of single-period marginal utilities equals this prespecified  $\lambda$  as long as the distribution that results satisfies the implementability constraints given the current state and assuming that the continuation payoffs (i.e., what the players expect to receive if the contract is maintained) are determined by the point on the frontier  $W_s(U)$  that corresponds to the  $\lambda$  from the immediately preceding period. If one of the implementability constraints is binding (i.e., the one for the household required to make a positive transfer), however, both the current allocation of resources and the continuation payoffs are adjusted together, with the adjustment being as small as possible in order to just relax the implementability constraint. The resulting  $\lambda$  and thus the new ratio of single-period marginal utilities is then maintained until a subsequent implementability constraint binds.

The relation between this contract and the first-best contract is straightforward. As is well known (see, e.g., Townsend 1994), the first best risk-sharing contract involves equating the marginal utilities at all points in time and in all states of the world. Thus, for example, in the case of iso-elastic utility functions, the first-best contract will involve simply pooling income in every period and then dividing it according to some fixed distribution rule. Given imperfect commitment and sufficient impatience, however, in a state of the world in which one household does particularly well the better-off household



would have an incentive to renege on this first-best contract by withholding his transfer and accepting the SSNE transfers in the future. The optimal implementable contract specified here removes this incentive by allowing the distribution rule to be shifted in favor of the better-off household. Changes in the distribution of resources, and thus the loss relative to the first-best arrangement, are kept to a minimum by allowing both current and future distribution to be affected by the implementability constraints when they bind.<sup>9</sup>

It is not possible except in cases with very limited state spaces to derive analytical solutions for decision rules from the model. We thus explore the qualitative implications of combinations of different degrees of altruism, imperfect commitment and income covariances using simulations. We show that because of the nonstationarity character of the optimal implementable insurance contract for given current incomes, a household that has recently received transfers is less likely to receive subsequent transfers than a household that has recently provided transfers. Thus, except in the case that full risk-sharing is implementable (in which case the implementability constraints are never binding), transfers should behave like credit in the sense that the results of past behaviors (i.e., outstanding debt) importantly affect current behaviors (current borrowing). We also show that altruism influences the extent of commitment problems as manifested in optimal implementable insurance contracts. However, while we show that altruism may facilitate risk sharing, it is still necessary to explain why there are risk-sharing arrangements among non-kin, even in low-income environments that lack formal risk-sharing institutions. An important reason is income covariance. We thus also consider the implications of

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<sup>9</sup>The fact that *both* the current and subsequent allocations of transfers are affected when an implementability constraint binds implies that the optimal implementable contract devised by Thomas and Worrall (1995) is an improvement upon the optimal stationary contract considered by Coate and Ravallion (1993). In the latter case only current allocations of resources are altered to meet the implementability constraint resulting in less perfect risk sharing. The difference can be substantial: in a numerical simulation Thomas and Worrall (1995) found that for sufficiently low discount factors that the optimal stationary contract resulted in no risk sharing, whereas the optimal non-stationary contract could achieve most of the gain from full insurance.

covariance in incomes for the nature of risk-sharing arrangements. An additional implication is that income covariances among non-kin contracting households are endogenously determined and possibly related to whether family-based risk-sharing arrangements are feasible.

To carry out the simulations we assume that  $u()$  and  $v()$  are logarithmic and thus that the period specific-utility for households 1 and 2 are  $\ln(c_1)+\gamma\ln(c_2)$  and  $\ln(c_2)+\gamma\ln(c_1)$ , respectively. Incomes for each household take on one of two values, 2 or 4, each with probability  $\frac{1}{2}$ , with varying degrees of correlation. To capture these differences in correlation we let the state  $s$  take on 4 values, 1, 2, 3, and 4 with  $y_1(s)$  equal to 2 if  $s=1$  or  $s=3$  and 4 otherwise. Similarly, we let  $y_2(s)$  equal 2 if  $s=1$  or  $s=2$  and 4 otherwise. Then, the case of independence corresponds to each state occurring with probability  $\frac{1}{4}$ , the case of a positive correlation of 0.5 can be represented by assuming states 1 and 4 occur with probability  $\frac{3}{8}$  and states 2 and 3 with probability  $\frac{1}{8}$ , and the case of a negative correlation of -0.5 can be represented by assuming states 1 and 4 occur with probability  $\frac{1}{8}$  and states 2 and 3 with probability  $\frac{3}{8}$ . In the simulations that are presented below the discount factor is set to  $0.75^{10}$  and the degree of altruism  $\gamma$  is allowed to vary from 0 to 0.6. We focus on symmetric optimal implementable contracts, i.e., those for which the households agree to have equal expected utility gains from the contract at the start. We examine below how the results are altered when the partners are engaged in a non-symmetric relationship.

The solutions to this problem may be characterized as follows.<sup>11</sup> Starting from period 0,

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<sup>10</sup>The discount factor is chosen so that the key features of the contract may be illustrated. For more usual discount factors (e.g.,  $\delta=0.9$ ) the optimal implementable contract achieves close to the first best contract even in the absence of altruism. Our results, presented below, provide evidence consistent with the properties of our simulated model for the low discount factor used here. While this is consistent with the notion that rural households are impatient or, as noted, that they face a significant exogenous risk of having the agreement terminated, it may also be attributed to other simplifications of the model. For example, we make the extreme assumption that a deviant household must subsequently consume at SSNE levels. We relax this assumption by allowing for a positive probability of nonenforcement below.

<sup>11</sup>Solutions for the value and transfer functions for each set of parameters were found by reducing the problem, through appropriate substitution, to one of solving two non-linear equations in two

households attempt to split the available income. As long as states 1 and 4 are realized no transfers will take place. As soon as either state 2 or 3 is realized the household with the higher income transfers some resources to that with the lower income. In, say, state 2, the transfer will be 1 if the implementability constraint does not bind, but less than 1 otherwise. Subsequently, anytime state 2 is realized the same transfer is made and if state 3 is realized the same transfer is made in the opposite direction. Whenever states 1 or 4 are realized, (i) if states 2 and 3 permit complete risk sharing (a transfer of one) the transfer will be zero; (ii) if states 2 and 3 permit only partial risk pooling then there will be a partial transfer in the opposite direction as that dictated by the most recently realized of states 2 and 3. It is worth noting that in this simple model with four states it is only in states 1 and 4 that history matters; in the other states transfers are not affected by past realizations. Finally, under the one-shot Nash equilibrium outcome, if incomes are equal or incomes are unequal and  $\gamma \leq 1/2$  then there are no transfers but if  $\gamma > 1/2$  and incomes are unequal then there is a transfer of  $(4\gamma - 2)/(1 + \gamma)$  from the high to the low-income partner.

The solutions can be characterized graphically in terms of two summary measures. The first measure is the degree of risk sharing, as measured by the difference in consumption share received by 1 when state 1 [4,2] is realized and that received when state 4 is realized [2,4]. Under full risk sharing, the consumption share will be the same in both periods, yielding a zero difference. In the absence of any risk sharing, each partner will consume his own income, so the difference in consumption share is 1/3. Figure 1 shows that risk sharing is facilitated both by low levels of correlation and high degrees of altruism between transfer-partners. At a zero level of altruism it is evident that some risk-sharing takes place except in the case of positive income correlations, with a difference between consumption shares in the two states of 0.22 and 0.32 for the negative- and zero- correlation cases, respectively. As altruism increases, the degree of risk sharing increases so that there is less and less difference in the consumption

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unknowns. The solution to the latter were obtained numerically. Copies of the program used to carry out the simulations are available from the authors on request.

share achieved by the individuals in states 2 and 3. At levels of altruism greater than 0.3 (0.41), full risk-sharing is achieved under negative (zero) correlation. Interestingly, when altruism reaches 0.5 for the positive-correlation case there are only limited additional gains in terms of risk-sharing from achieving higher levels of altruism. This reflects the fact that at these higher levels of altruism the threat of reverting to autarchy following a violation of the agreement is not credible.

The second summary measure characterizes the degree of history dependence. In particular, Figure 2 presents the difference in consumption share for partner 1 given equal incomes in the current period between the case in which 1 had higher income in the previous period (state 2) and the case in which 1 had lower income in that period (state 3). When this measure is zero then there is no history dependence in the model: optimal transfers depend only on the current incomes of the transfer partners.

Here the pattern is more complex. At high levels of altruism corresponding to those in which full risk sharing is achieved (see Figure 1), there is no history dependence. There is also no history dependence in circumstances in which no risk sharing takes place, that is given positive correlations and for altruism below .18. The degree of history dependence initially rises at low levels of altruism and falls at higher levels, with the peak occurring at a lower level of altruism for the negatively correlated case than the positively correlated case.<sup>12</sup> Thus the degree of history dependence is positively related to the degree of income correlation at high levels of altruism but negatively related to the degree of income correlation for low levels of altruism.

Figure 3, summarizes the expected discounted utility gain of the optimal symmetric implementable contract (normalized by  $1+\gamma$  for ease of comparison) relative to that obtained under the

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<sup>12</sup>To the left of this peak the optimal implementable transfer given equal incomes is determined by the maximum consumption share that 2 is willing to provide 1 under equal incomes, which is increasing in the degree of altruism. To the right of the peak the optimal implementable transfer given equal incomes is determined by the minimum consumption share that 1 is willing to accept when he has higher income, which is decreasing in the degree of altruism. The peak occurs at the point where the minimum consumption share partner 1 will accept in the state in which he has higher income is just equal to the maximum consumption share for 1 that 2 will accept when they have equal incomes.

SSNE. It shows clearly the value of altruism and negative income correlations in sustaining insurance under imperfect commitment. First, for each level of correlation, the surplus generated by the optimal implementable risk-sharing contract rises sharply with altruism and then levels off, a pattern conforms with the measure of the degree of risk sharing presented in Figure 1. The surplus also declines when altruism exceeds  $\frac{1}{2}$ , reflecting the fact that autarchy is no longer a credible threat when the partners are sufficiently altruistic. Second, the degree of correlation importantly affects the surplus generated by the risk sharing contract, with uncorrelated and negatively correlated incomes yielding 2 and 3 times the surplus available under positively correlated incomes, respectively, at high levels of altruism. Interestingly the difference in the curves is roughly constant so that even at low levels of altruism the advantages of negatively correlated incomes are significant. Third, as was evident from Figure 1 no risk-pooling can be implemented under positively correlated incomes for low levels of altruism: the surplus generated remains at zero until the altruism parameter reaches a value of  $\gamma=0.19$ .<sup>13</sup>

Given that altruism is likely to be greater among family than non-family members, Figure 3 has implications for the relative value of inter and intra-family transfer arrangements and for the types of non-kin household pairs participating in mutually-beneficial insurance arrangements. In the presence of commitment problems, the family will play a primary role in the provision of insurance because greater surplus is provided by family households for a given income correlation. However, because the number of potential family partners is small, family-based insurance is likely to be insufficient. Households thus will also make use of non-family partners, selecting from the set of potential non-family partners those with which they have relatively low income correlations. As a consequence of this process of selection and the fact that one has relatively limited scope for choosing the income covariance of one's family

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<sup>13</sup> By comparison, it may be shown that the optimal stationary risk-sharing contract (i.e., that arising in the Coate and Ravallion (1993) model) given positively correlated incomes permits no risk sharing until  $\gamma=.3$ , at which point the optimal non-stationary contract is already providing 75% of the first-best surplus.

partners, non-family transfer partners are likely on average to have lower income correlations than will family transfer partners.<sup>14</sup>

### III. Estimating Transfer Functions in the Presence of Imperfect Commitment and Altruism

#### a. Symmetric transfer arrangements

While Figures 1-3 provide a detailed characterization of the structure of optimal transfer arrangements and how this structure varies with altruism and income correlation among partners, they are of limited value in providing directly testable implications that may be obtained from the limited transfer data obtained from household surveys. For example, Figure 2 shows clearly that history matters in the sense that past transfers affect current transfers net of contemporaneous income shocks, and that the degree of history dependence is affected by the degree of altruism and income correlation. However, it is also apparent from the model that an exact representation of the way that current shocks and history affect current transfers requires a complete specification of the joint distribution of incomes faced by two households. Even if such information were available, the analytic and computational burden associated with specifying the exact theoretical relationship between past and current transfers would be prohibitive for different degrees of altruism and income correlations.

We therefore employ an alternative approach which captures the essential features of the model and accounts for the type of information typically available in household panel data in which we specify i) an approximation to the transfer function for a household and ii) an estimation procedure. We use observations drawn from the simulation model to determine how variations in income correlations and altruism influence the estimates obtained by applying this procedure. Comparison of these estimates with those obtained based on the same specifications and estimation procedure but applied to actual data thus permits an assessment of the extent to which altruism among family members facilitates risk sharing due

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<sup>14</sup>However, Rosenzweig and Stark (1989) discuss how the choice of marital partners in rural India reflect the consideration of income covariances. And the data from Pakistan that we examine below suggests that not all kin-based transfer arrangements involve small distances between transfer partners.

to problems of imperfect commitment.

The approximation to the transfer function is generated by solving equation (5) for  $\tau$  in terms of  $\lambda(h_t)$ ,  $y_1(s_t)$ , and  $y_2(s_t)$  and linearizing. We then substitute for  $\lambda(h_t)$  a convenient summary measure of history, the sum of past transfers, which may be interpreted as the "stock of transfer assets".<sup>15</sup> Let  $\tau_{it}$  denote the net transfers out by household  $i$  at time  $t$  so that the transfer asset stock is

$$T_{it} = \sum_{t=0}^{t-1} \tau_{it} \quad (7)$$

Then the approximate linear transfer function is

$$\tau_{it} = \alpha_0 + \alpha_1 T_{it} + \alpha_2 y_{it} + \alpha_3 y_{-it} \quad (8)$$

where  $y_{-it}$  denotes the income of the household with which  $i$  is contracting to provide insurance. The results in Figure 2 indicate that, if the approximation is reasonable, when transfers are significantly affected by imperfect commitment  $\alpha_1 < 0$ --an increase in past transfers-out results in fewer transfers out in the current period.

There are a number of problems with the estimation of equation (8) that must be addressed in practice. Most importantly, neither,  $y_{-it}$ , the income of the transaction partner, nor  $T_{it}$ , the complete history up to time  $t$  of transfers, will in general be observed by the researcher. In order to deal with this problem we assume that income  $y_{it}$  is the sum of a fixed anticipated component and an unanticipated i.i.d. component,  $y_{it} = \bar{y}_i + \varepsilon_{it}$ , model the correlation between the transfer partners' error terms as  $\varepsilon_{-it} = \rho \varepsilon_{it} + u_{-it}$  and difference (8) over two consecutive periods to obtain

$$\Delta \tau_{it} = \alpha_1 \tau_{it} + \alpha_4 \Delta \varepsilon_{it} + \alpha_3 \Delta u_{-it} \quad (9)$$

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<sup>15</sup>We establish below that this summary measure of history, given the econometric approach used, is reasonable in that the application of the estimation procedure to data simulated based on the model provides results that are readily interpreted.

where  $\Delta$  denotes a forward first difference and  $\alpha_4 = \alpha_2 + \alpha_3\rho$ . This procedure removes the fixed parts of  $T_{it}$  and  $y_{it}$  from the estimation, requiring only that there be information on transfers in two periods.

Moreover, as long as partners' incomes are imperfectly correlated, the sign of the coefficient on the own shock  $\alpha_4$  will correspond to the sign of  $\alpha_2$  ( $\alpha_3 = -\alpha_2$  in the symmetric case) and will be less positive the stronger the income correlation.

There remains an estimation problem, however, even when the own shocks  $\varepsilon_{it}$  are observed because the idiosyncratic part of the unobserved partner's shock  $u_{-it}$  will in general be correlated with the contemporaneous transfer  $\tau_{it}$ . In addition, any measurement error in transfers will result in a negative bias in the  $\alpha_1$  in (9). Thus one must use instruments as well as differences to estimate equation (8). A natural set of instruments are period  $t$  and  $t-1$  shocks which predict transfers and are, by assumption, independent of  $u_{-it}$ .

Figure 4 presents the coefficient estimates obtained using the approximation given by (9) of the transfer asset effect ( $\alpha_1$ ) for different values of altruism and for three levels of income correlations, obtained from the observations generated from the simulation model. A comparison of this figure with the underlying degree of history dependence in Figure 2 yields important similarities as well as differences. Figure 4 clearly identifies the combinations of altruism and income correlation that yield no history dependence as evident in Figure 2. However, the estimated asset effects in Figure 4 are monotonic in altruism while those in Figure 2 are rising and then falling. The reason for this is straightforward: the effect of transfer history on current transfers is influenced by the degree of history dependence as illustrated in Figure 2, and the magnitudes of past transfers which as implied by Figure 1, are increasing in altruism. Thus over the range in which both history dependence and the magnitude of transfers is rising it is not obvious how the measured effect should be changing—Figure 4 shows, indeed, that the measured effect changes little with the degree of altruism over the relevant range. A further implication of this fact is that no transfer effect can be measured under circumstances in which there are



no transfers—thus no effect can be calculated for positive income correlations at levels of altruism in which there was no risk pooling as evident in Figure 1.<sup>16</sup>

There are two important qualitative implications of these patterns. First, higher degrees of altruism for given levels of income correlations are associated with less of a transfer-asset effect. Second, while the transfer asset effect is increasing in income correlation at moderate levels of altruism, there is no clear pattern at low levels. Thus family-based transfers should exhibit less of a transfer-asset effect than non-family transfer asset controlling for income correlation and family-based transfers should be less affected by transfer history for negative relative to positive income correlation; however, transfer asset effects should not necessarily be related to the degree of correlation for non-family transfer arrangements.

Figure 5 presents the estimate of  $\alpha_4$  - the effect of the own shock on transfers out. This graph is closely related to Figure 1: transfers are more responsive to the level of the shock the greater is the degree of altruism, for a given income correlation, and the less is the income correlation, for a given level of altruism. There is an added effect of income correlation, however, arising from the fact that  $\alpha_4 = \alpha_2 + \alpha_3\rho$ . Even after full risk sharing is achieved, in which case the degree of correlation does not affect consumption shares (Figure 1), there is a differential in the estimated effect of income and transfers for different levels of correlation. In particular, higher positive correlations are associated with lower estimates of the effect of own income and transfers.

Figures 1-5 thus indicate the following: 1) Family-based transfer arrangements are preferred to non-family based arrangements for the same income correlation 2) The income correlation for non-family transfer partners should be less than that for family members 3) Insurance relationships can be constrained by commitment problems, as indicated by a negative dependence of current remittances on

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<sup>16</sup>Under these circumstances IV estimation fails because the instruments (income shocks) have no power given that the left-hand-side variable in the first-stage equation, initial period transfers, is always zero.

past transfer outflows, even for relatively high levels of altruism. 4) Family insurance transfers will exhibit a weaker negative dependence on past transfers and a more positive relationship with own income shocks than will non-family transfers, for the same partner income correlations. 5) For both family and non-family partnerships, transfers out will be less positively correlated with income shocks the higher the correlation of the incomes of the transfer partners. 6) For intermediate levels of altruism history dependence will be greater when incomes are positively correlated than when they are negatively correlated. However, as indicated in Figure 3, the effects of cumulative transfers for positively correlated and independent income correlations cross at low levels of altruism. Thus, no such ranking can be provided at low levels of altruism.

#### b. Asymmetric transfer arrangements

A potential shortcoming of the above theoretical framework model in terms of its ability to provide testable predictions regarding the effects of transfer asset and income shocks on transfers by level of altruism and income correlation is that attention has been limited to the consideration of symmetric strategies among symmetric players. While evidence presented below suggests that there are some environments for which the assumption of symmetry is quite reasonable, there are other settings in which asymmetric transfers are in evidence.

There is reason to believe, however, that the central predictions derived above for the symmetric case also apply in the asymmetric context. The basic notion is that under an asymmetric transfer arrangement average transfers will be non-zero, but as long as there is some need for insurance on the part of the transfer partners, variation in transfers around this average level will respond to relative levels of income and be influenced by problems of imperfect commitment in much, if not entirely, the same way as they are in a symmetric arrangement in which the average transfer is zero. Because our empirical strategy involves differencing transfer equations across time for each household, any difference in average transfers across time for a given household will be removed and thus will not substantially

influence coefficient estimates.

To establish that this intuition is correct we alter the symmetric transfer model by allowing incomes for the first partner to be twice the levels assumed in the symmetric context.<sup>17</sup> In particular, we assume that partner 1 achieves an income of 4 in states 1 and 3 and 8 in states 2 and 4. We then solve for the optimal asymmetric transfer arrangement.<sup>18</sup> In cases in which more than one asymmetric arrangement is sustainable we select the one that is *ex ante* optimal from the perspective of the better-off household.

Figure 6 plots for each level of income correlation and level of altruism the fraction of periods in which transfers flow from the richer to the poorer household. As a point of reference, we also plot this figure for the symmetric case, in which case the fraction is  $\frac{1}{2}$ , regardless of the degree of altruism or income correlation. The figure shows that the model yields the desired results: transfer arrangements are characterized by transfers that tend to flow in one direction. The figure also suggests that the relative degree of asymmetry differs depending on the level of altruism and the direction of the income correlation. In particular, asymmetric arrangements only arise at moderate levels of altruism or higher. At low levels the richer household has no motivation to make positive transfers on average to the poor household, but benefits from insurance by sending transfers in periods in which its income share is high and receiving transfers when its income share is low just as is the case for symmetric arrangements. The fact that the larger household always has at least as much income as the poor household plays little role. Figure 6 also suggests that differences in the extent of asymmetric transfers reflect the fact that with

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<sup>17</sup>It is possible to set up a model of optimal asymmetric transfers with symmetric transfer partners but such a model would be uninteresting. Because of the need for continuation payoffs to be as high as possible to ensure compliance when full insurance is not implementable, an optimal asymmetric transfer arrangement with symmetric partners mimics an optimal symmetric arrangement as soon as a commitment constraint binds for the first time. Therefore in the absence of data on the start date of transfer arrangements, optimal asymmetric transfer arrangements with symmetric partners cannot be distinguished from optimal symmetric transfer arrangements.

<sup>18</sup>The solution method is directly analogous to that used in the symmetric case. The only distinction is that, given the absence of symmetry, one must examine more possible orderings of the allocations at which commitment constraints bind for different states of the world (5 versus 2).

sufficient altruism the poor household only makes net transfers out in the 3<sup>rd</sup> state, when each household has the same income, and the probability that this state is achieved is higher when incomes are negatively correlated.

Figures 7 and 8 exhibit the coefficients for income shocks and transfer assets that are obtained when the proposed estimation procedure is applied to data simulated according to the above asymmetric model. The qualitative implications of these figures correspond for the most part to those implied by Figures 5 and 4, respectively. In particular, higher altruism increases the shock effect and decreases the magnitude of the transfer asset effect while higher income correlations decrease the shock effect. At low levels of altruism, the effects of increases in income correlation on transfer assets is non-monotonic while at moderate levels the largest-magnitude transfer asset effects are observed for positive income correlations.<sup>19</sup>

#### c. Families, information and the nonenforcement of penalties

Although we have thus far emphasized the notion that differences in transfer arrangements between family and non-family partners are distinguished largely because of the importance of altruism in the former, there are other potentially important distinctions between these two types of arrangements. One possibility is that information sharing among potential partners about past violations of transfer-based insurance agreements is more complete among family partners. If this is indeed the case then the SSNE penalties that importantly constrain behavior given imperfect commitment may be more credibly

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<sup>19</sup>The primary anomalies relative to Figures 4 and 5 are that the shock effect continues to rise after full insurance is achieved in the asymmetric case and that there is a small decline in the shock effect for negative income correlations at the level of altruism (0.27) at which full insurance becomes implementable. The difference arises because although there is always a unique optimal arrangement under symmetry and under asymmetry for less than complete insurance, there is a continuum of optimal arrangements under full insurance when asymmetric arrangements are considered. Because of the assumption that the arrangement most favorable to the rich household will be chosen when multiple optima arise, there is a discrete jump at the point in which full insurance is reached and the arrangement continues to change (in favor of the rich household) as altruism increases and the range of possible optimal asymmetric arrangements expands.

imposed in the context of family transfer arrangements than in that of non-family arrangements. We believe, however, that information about contractual violations would be reasonably complete among households located in the same village. Thus, distinctions in transfer behavior between kin and non-kin transfer arrangements for partners located within villages will predominantly reflect the role of altruism. For inter-village arrangements, however, the superior information among kin may also be manifested in differences between of kin and non-kin transfers.

In order to assess how the ability of families to make more credible threats affect transfer behavior in arrangements involving partners for which information barriers may be important, we augmented the symmetric transfer model by assuming that, in the event of a deviation, the transgressor only reverts to the SSNE with probability  $1-q$ . We then constructed graphs that indicate how variation in the nonenforcement probability  $q$  affects the level of the shock and transfer asset effects obtained using the proposed fixed-effects instrumental variables estimation procedure. This amounts to multiplying by  $q$ , for any given period  $t$ , the expected gain relative to the SSNE of conforming to the arrangement starting in period  $t+1$ .

Figures 9 and 10, which correspond to Figures 5 and 4 respectively, suggest that there are only relatively minor qualitative differences between the roles of altruism and information as a means of distinguishing between family and non-family arrangements involving partners not resident in the same village. In particular, these figures show the effects of varying the nonenforcement probability  $q$  from 0 to 0.5 for the shock and transfer asset effects respectively, in the symmetric model with altruism set to  $1/3$ . As might be expected the general effect of increasing the nonenforcement probability is to weaken the extent of insurance. Figure 9 indicates that if family members have lower nonenforcement probabilities, as seems plausible, then the difference in shock effects between family and non-family transfer arrangements would be similar to that which would be expected if the family were primarily distinguished by its level of altruism. In particular, as the nonenforcement probability increases, the

effect of an income shock on transfers out decreases smoothly, reaching zero, at the point at which no insurance is being provided. Not surprisingly, this point occurs at lower levels of  $q$  when the correlation is higher and thus there is less scope for mutually beneficial insurance.

With regard to Figure 10, the increases in the nonenforcement probability leads initially to increases in the magnitude of the transfer-asset effect for non-positive income correlations and subsequently to small decreases in the magnitude. As was the case in Figure 4, the transfer asset effect is not defined at levels of the nonenforcement probability for which no transfers take place. The fact that, for example, transfer-asset effects are monotonically related to income correlations only at moderate levels of altruism in Figure 4 corresponds roughly to the fact that the transfer-effect is monotonically related to income correlation only at low nonenforcement probabilities. Figures 9 and 10 thus suggest that if it is believed that families share information more efficiently than do non-kin, it is necessary to contrast family and non-family transfer arrangement within villages to identify the role of altruism, to the extent that village-level information sharing is relatively complete. Moreover, to isolate the role of income correlation from information considerations, it is useful to compare transfers between family members separated by different distances.

#### IV. Data and Estimates

To examine the role of imperfect commitment in determining transfer behavior and to show how this role is influenced by altruism while taking into account heterogeneity among households even using the approximation function poses considerable demands on data: information is needed on transfers over at least two consecutive comparable periods and on household and/or environmental characteristics that permit estimation of income shocks. We use three data sets from South Asia that meet these criteria - the Village Level Studies (VLS) survey of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the Additional Rural Income Survey of the National Council of Applied Economic Research (NCAER), and the International Food Policy research Institute (IFPRI) Pakistan Food Security

Survey. While these data sets are sufficiently comparable to permit the examination of the robustness of our conclusions with regard to the existence of imperfect commitment in altruistic and non-altruistic transfer relationships, only the ICRISAT data permit the full array of tests suggested by the model because of the availability of partner as well as household information.

a. ICRISAT VLS Indian Data

The ICRISAT VLS data provide detailed time-series information on asset stocks and transfers for farm households over a period of up to 10 years.<sup>20</sup> Begun in the crop year 1975-6 in six villages in three agroclimatic regions of the Indian semi-arid tropics and extended to a total of ten villages by the 1984 final round, the survey collected longitudinal information approximately every three weeks on all transactions for 40 households (production, investment, sales, and purchases) in each village divided equally among four land strata - landless, small landowning, medium landowning and large landowning. In 1984, a retrospective questionnaire was administered to all households in the ten villages to obtain information on additional family details including inheritances.

A key feature of the VLS data set is that it provides information on the characteristics of transfer partners. In particular, information is available on the location (inside and outside of the village) and type (family, money lender, shopkeeper, etc.) of each transfer partner for eight years in three of the villages and for five years in two of the villages. Restricting attention to those periods and villages in which partner-code information is available and reasonably complete, we are left with a sample of 207 households in 5 villages contributing a total of 969 annual observations. We divide transfers into four categories based on the information on transfer partners - whether or not the transfer was from or to a family member or friend and whether or not the transfer originated from or went to a partner residing inside the village.

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<sup>20</sup>Transfers exclude gifts associated with weddings and any labor services but include all other transfers in kind such as food or clothing.

Transfer transactions are pervasive among the households in the ICRISAT villages. In all but 14 of the 969 household-year observations, each household was either receiving a transfer or providing one. Transfers were not only frequent but appear to be relatively balanced for many households, consistent with a high degree of symmetry among transfer partners. As seen in the simulations in Figure 6, households in symmetric pairs should on average be transferring out half of the time. Moreover, if the probability of transferring out each year is .5 and the income shocks are i.i.d., the standard deviation of the mean fraction of out-transfers over the eight-year sample period should be .177 and that for the five-year period should be .224.

Table 1 provides the empirical means and standard deviations of the fraction of households in each of the four ICRISAT VLS land class strata for each of the five villages who were on net transferring out over the relevant eight- and five-year sample periods. The table includes statistics only for those households with complete information over the sample period, excluding those households who were dropped from the sample before the end of the survey and those households included after the start of the survey as replacements.<sup>21</sup> As can be seen, for this balanced sample in all villages but one the overall mean proportion of net out-transfers is close to (and not statistically significantly different from) the theoretical value for symmetric arrangements of .5, with the standard deviations only slightly higher than those predicted from both partner symmetry and independence. Moreover, a chi-square test applied to the middle two land classes (small and medium) indicates non-rejection of the hypothesis that the fractions are the same for both of these land classes ( $\chi^2(1)=.677$ ). The same test rejects the hypothesis that all land classes are equally symmetric as the middle two land classes, however ( $\chi^2(3)=32.0$ ), and indeed, the table suggests that the landless households are on average net recipients of transfers every year while the largest landowners are net providers of financial support.

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<sup>21</sup>These households are included in the econometric analysis as long as there were two consecutive years of transfer information.



Table 2 provides the average amounts of gross in- and out-transfers, mean profits and average assets, by asset type, for each of the ICRISAT villages. Consistent with the patterns for the incidence of transfers in Table 1, for all villages but one, Rampura, the average amounts of in-transfers balance those for transfers out. In Rampura, the average level of transfers out dominate. The profit and asset figures also suggest that the households in that village are also substantially wealthier than those in the other four villages - mean values of financial assets and farm equipment are twice those in the other four villages, debt is less than one-fifth and the value of livestock is more than threefold. There clearly is a persistent redistributive component to inter-village transfers exhibited in Rampura.<sup>22</sup>

The average amounts of gross and net transfers and the three-year incidence of transfers by partner type - family or non-family - and by location - whether or not the partners were located inside or outside the village - are presented in Table 3. These figures suggest that there is overall symmetry within each partner-type, with non-family, within-village transfers the most prevalent and non-family, external village gross transfers the second-most prevalent and the highest in magnitude.

b. Empirical implementation using the ICRISAT data

The estimation procedure we adopt follows the procedure discussed in Section III and implemented using the simulated data. The model also assumes, however, that the consumption good is perishable and income is i.i.d., while in fact farmers and their transfer partners hold assets that affect income or accrue interest, these assets change over time, and changes in non-financial assets may interact

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<sup>22</sup>However, our first-difference estimation procedure eliminates any permanent component of transfers, and the simulation-based estimates in Figure 7 suggest that the estimates of the transfer function based on our estimation strategy are robust to permanent imbalances among transfer partners. We additionally assess the robustness of the estimates to the presence of asymmetry in partner transactions by estimating the transfer function using data from Pakistan villages, all of which are characterized by strong net inflows of transfers, principally from family members residing in foreign countries, reported below.

with changes in financial assets such as financial savings and transfers.<sup>23</sup> To construct a household-specific time-varying income measure that conforms more closely to the i.i.d. assumption, we used the fixed-effects estimates from Rosenzweig and Binswanger (1993) of a normalized Generalized Leontief profit function obtained from the same data to estimate a profit “shock”. An important feature of the technology specification in the Rosenzweig-Binswanger study is the incorporation of household (farm)-specific weather effects that vary by asset type. Our measure of the farm-specific shock for household  $i$  in village  $j$  at time  $t$  is thus:

$$\varepsilon_{ijt} = \sum_k \delta_k A_{ijkt} (\omega_{jt} - \omega_j) \quad (10)$$

where  $\delta_k$  is the estimated asset-specific coefficient from the profit function from Rosenzweig and Binswanger,  $A_{ijkt}$  is the share of the  $k$ th asset in household total wealth at time  $t$ ,  $\omega_{jt}$  is the weather shock in village  $j$  at time  $t$  measured by the deviation of the onset date of the monsoon from July 1, and  $\omega_j$  is the average village-specific onset date over the whole survey period.

Because the estimated income shock contains measurement error, we use instruments that predict  $\tau_{it}$  to predict  $\varepsilon_{ijt}$ . These include two major inherited asset variables (inherited irrigated and dry land), each household’s inherited wet and dry land interacted with village and time dummies, and the lagged weather measure (monsoon onset). The household’s initial state variables, indicated by their inherited assets, combined with the past history of shocks should be reasonable predictors of a household’s current state (asset) variables that also importantly affect the influence of weather events on profits in a setting in which there are constraints on consumption smoothing and credit but should otherwise have no effect on

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<sup>23</sup>The model also assumes that there are no alternative means of consumption smoothing, in particular that credit markets are non-existent. Only one of the villages in the ICRISAT VLS (Kanzara) is proximate to a bank (Morduch 1991). Although there is evidence that the level and importance of transfers is strongly affected by bank proximity (Behrman, Foster and Rosenzweig (1997)), we could not reject the hypothesis that the transfer function was not significantly different in Kanzara than in the other four ICRISAT villages in our sample ( $F(5, 863)=1.61$ ) based on the aggregate transfer specification discussed below (or for any of the disaggregated transfer functions).

contemporaneous profits (given the i.i.d. assumption). This because a household's initial asset position affects its capacity to invest for any given income shock..

To take into account non-perishability, we estimate an augmented version of (8) which includes, in addition to transfer assets, other asset stocks - the values of net financial savings, farm equipment, animals, and financial debt. Note that like the change in the stock of transfer assets (i.e.,  $\Delta T_{it} = \tau_{it}$ ) the change in asset stocks reflect decisions about the allocation of financial resources in response to income shocks.<sup>24</sup> These changes need also to be treated as endogenous with respect to any unmeasured components of the income shocks (i.e.,  $u_{it}$ ).

c. Estimates from the ICRISAT VLS data

We exploit the partner data in the India ICRISAT sample to examine the separate and interdependent roles of altruism and income correlation in determining transfers by estimating the transfer function for each of the four transfer types defined by relationship and location. For each partner type, the "own" effect on current transfers of changes in transfer assets is estimated using only the corresponding transfer history, e.g., estimates of equation (8) for family members outside the village include only the effect of the stock of transfer assets attributable to family members outside of the village.<sup>25</sup> For comparison to estimates from conventional data that do not provide such partner

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<sup>24</sup>For evidence, see Rosenzweig and Wolpin (1994) and Udry (1996). Neither of these studies include transfer assets among the state variables, although in the former study the theoretical framework assumes that transfers play an insurance role.

<sup>25</sup>In preliminary analysis we included in each of the disaggregated specification all four of the transfer asset types. We could not reject the hypothesis that the set of cross effects for the alternative transfers had no statistically significant effect on each of the transfer types. The F-statistics ( $F(3, 865)$ ) were 1.91, 2.45, 1.12, 0.20 for family transfers inside and outside the village and non-family transfers inside and outside the village, respectively. This result suggests that the behavior of transfer partnerships is independent and that the separability assumption of a model that devotes attention to one smoothing mechanism is not overly strong.

information, we also report estimates of the transfer function that aggregates all types of transfers.<sup>26</sup>

Table 4 provides the instrumental-variables fixed effect estimates from two specifications of the transfer function, one using the estimated profit shock derived from the Rosenzweig-Binswanger profit function estimates and the other using actual profits, for both the aggregated transfer function and for the partner-specific transfer functions. Table A in the appendix provides the estimates from the first-stage equations predicting transfer assets by partner type, the other asset types, and the profit shock. As reported in that table, in each first-stage equation the set of identifying instruments is statistically significant at at least the .05 level. Comparison of the fixed effects estimates, which do not use instruments, reported in appendix Table B, and the IV fixed effects estimates in the first five columns of Table 4 indicate that, as expected, without taking into account the error correlation between transfer assets and the change in transfers, the transfer asset effect is biased negatively, and measurement error in the profit shock measure results in a bias to zero in the profit shock coefficients.

The set of estimates in the first column of Table 4 are consistent with transfers playing an insurance role, as the profit shock has a positive effect on net transfers out, although the effect is not estimated with precision. The coefficient on the transfer asset variable indicates the role of imperfect commitment in constraining the behavior of interhousehold transfers, as current transfers are negatively and significantly related to transfer assets. The aggregated estimates in column one mask important differences related to partner distance (income correlation) and kinship, however, as seen in the next four columns of Table 4 which distinguish transfers by whether or not they are between family members and whether they take place solely within the village.

The pattern of estimates of the disaggregated transfer functions indicate that imperfect commitment effects are important for both family and non-family partners, regardless of the location of

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<sup>26</sup>We rejected the hypothesis that each of the wealth variables had the same effect on transfers in all equations reported in Table 4.

the partners. In particular, for each type of transfer defined by the kinship and location of partners, an increase in transfer assets attributable to that set of partners decreases transfers paid out to the respective partners in the current period. Moreover, the differences in the magnitudes of the transfer asset effects and of the effects of the income shock on transfers across the categories appear consistent with the basic patterns that emerged from the limited commitment model simulations.

Consider first the relationship between partner income correlations and transfer asset and income shock effects. The model indicated that for at least moderate levels of altruism, transfers should be more responsive to shocks but less history-dependent the lower is the income correlation. The clearest evidence of the effects of income correlation is the contrast in estimated transfer asset and shock effects for family-based transfers that are within-village and that cross villages, the estimates in columns two and three. These differences in estimated coefficients reflect principally differences in the income correlations of the partners for the same degree of altruism and, roughly, the same extent of information sharing, and are consistent with the imperfect commitment framework - the transfer asset effect is less negative and the shock effect is greater for the cross-village compared with the within-village transfers. The test statistic for the hypothesis that the two sets of coefficients are equal indicates rejection at the .004 level ( $F(2, 3468)=5.51$ ).<sup>27</sup>

Note that the model is ambiguous with respect to the relationship between income correlation and transfer asset effects for transfers between partners for whom the level of altruism is low. And the estimates of those effects for non-family partners, in columns four and five, while indicating less history dependence for the transfers among non-altruistic partners separated by longer distances, are not

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<sup>27</sup>An alternative hypothesis is that the differences reflect different degrees of altruism for different types of relatives. As shown in Rosenzweig and Stark (1989), family transfer partners who reside outside the village are likely the daughters of the head or parents-in-law of the coresident head's sons. Non-coresident family members residing within the village, however, are likely to be brothers of the of the head, given land inheritance practices (Foster (1990)). The results in columns two and three of table 4 are thus consistent as well with stronger altruistic feelings for daughters than for siblings.

significantly different ( $F(1, 3468)=2.13$ ). The shock effects, however, are estimated with too little precision to conclude that they differ by income correlation in accord with the framework.

The second clear test permitted by the data is of the influence of altruism on transfer behavior based on the contrast, for given income correlation, between the estimates of the determinants of family and non-family transfers. As noted, a comparison of family and non-family transfers that does not control for income correlations can yield misleading results due to the fact that correlations between family and non-family transfer partners are not likely to be the same on average. This problem may be addressed in general by conditioning on location and in particular by focusing on within-village transfers (columns two and four) as income correlations across partners within a village are likely to be more similar than are income correlations across partners who reside in different villages and differences in information sharing is minimized. The estimates indicate, in conformity with the imperfect commitment framework, that altruism between partners reduces the commitment problem - the within-village family-based transfers are less history dependent, by over 7%, and substantially more responsive to income shocks than are the within-village non-family transfers. Again, these differences are statistically significant at the .004 level ( $F(2, 3468)=5.61$ ). Despite the likely higher level of heterogeneity in partner income correlations, the differences in history dependency of and shock effects on transfers associated with altruism are also exhibited by the estimated intervillage transfer functions in columns three and five, but only the difference in the transfer asset effects is statistically significant ( $F(1,3468)=8.30$ ).

Finally, to ascertain if the patterns of the estimated transfer assets effects by partner type and location would be affected by the specification of the income variable we used actual profits, treated as endogenous, in place of the estimated profit shock. These estimates, reported in columns six through ten in Table 4 indicate that the pattern of transfer assets effects are not sensitive to at least this respecification of the income variable - the ordering of the transfer asset coefficients across columns six through ten is identical to that in columns two through four and the magnitude of the coefficients within

partner type and location are similar.

d. NCAER Additional Rural Incomes Survey of India and the IFPRI Pakistan Food Security Survey

To further examine the robustness of our results obtained from the ICRISAT VLS sample we estimate transfer functions using the two other rural panel data sets from similar environments that provide the requisite multi-period information on transfers. These two data sets provide an interesting contrast because, although the households face similar environmental conditions, in one transfer arrangements are clearly non-symmetric and involve partners who are family members separated by long distances. The first of these, from the NCAER ARIS, provides longitudinal information on asset stocks and flows and on net transfers for 4,118 households from a national probability sample of all Indian rural households for the crop years 1968-69, 1969-70 and 1970-71. The survey does not distinguish the transfer recipients or donors by relationship or location or permit the construction of household-specific income shocks. There is, however, village-level information on the experience of adverse weather conditions as reported directly in the survey by a village informant.<sup>28</sup> The ARIS data were augmented with information from the NCAER 1981-82 Rural Economic and Demography Survey. This latter survey, which reinterviewed approximately two-thirds of the households interviewed in 1970-71 (those in which the household head had remained the same up through 1981), provides information on the assets inherited by the household heads prior to the 1968 round of the ARIS survey. This information is used to construct instruments, as we did for the ICRISAT data, to predict  $\tau_{it}$ , that include the period t-1 adverse shock and that shock interacted with the inheritance variables (wet and dry land, animals, and farm equipment).

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<sup>28</sup>It is not possible to use the village-level shock data to estimate individual household shocks by interacting the measures of village shocks with household assets, as is done for the Indian ICRISAT survey households (see below), because of the absence of information on asset levels in the data. The ARIS panel survey only provides flows of assets across crop years.

The second of these panel data sets, the IFPRI the Pakistan Food Security Survey, provides information in twelve rounds for a sample of 926 households residing in 52 villages in three major wheat-growing provinces of Pakistan - Punjab, Sind and the Northwest Frontier Province - followed over the period July 1986 through September 1989. Unlike the NCAER ARIS survey, this survey elicited information on transfers received from and remitted to relatives but on no other types of transfers. Thus transfers are solely between households with presumably some altruistic connection.

The Pakistan survey data also contains information on inherited land (wet and dry) and on current production costs, inputs and outputs. This information was collected in sufficiently closely-spaced rounds to identify specific crop stages (planting and harvesting) within each of two annual crop-cycles (Rabi and Kharif) in four of the twelve rounds. The detailed nature of this information permits estimation of a stage-specific conditional profit function. We use the residual from the estimated harvest-stage conditional (Generalized Leontief) profit function estimated from these data in Behrman, Foster and Rosenzweig (1997) as the measure of the shock component of income.<sup>29</sup> As in the ICRISAT analysis, because this residual shock measure contains measurement error, it and transfer assets are predicted using instruments, which include the inherited land variables and village, time and inherited-land interactions as in the ICRISAT VLS analysis.

To restrict our sample to environments that conform most closely to the assumption that there are no alternative mechanisms for smoothing consumption, we use only households from the NCAER ARIS and the IFPRI Pakistan data sets that are located in villages more than five kilometers from a credit institution, based on village-level infrastructure information provided in both data sets. The sample sizes from which we obtain estimates are thus 2700 households for the NCAER data and 205 households for the IFPRI data. Table 5 presents, for each of these two samples and, for comparison, for the ICRISAT

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<sup>29</sup>Details of the computation of the shock, including estimates of the normalized Generalized Leontief profit function used to obtain the shocks, and the test establishing that the estimated shock is unanticipated at the time of the planting state, are presented in Behrman, Foster and Rosenzweig (1997).



sample, comparable prevalence measures for transfers and the means and standard deviations of net transfers and gross transfers among those with positive transfers and farm profits<sup>30</sup>. The flow measures indicate that transfers occur often in at least two of the samples and are large relative to agricultural income when they occur. Both the NCAER national sample and the ICRISAT VLS data indicate that on average net flows are small. In contrast, there is a large average net inflow from the Pakistan sample households. This reflects the fact that a large proportion of the rural Pakistan households had relatives residing and working in foreign countries, most likely in Middle Eastern countries, who were evidently remitting payments back to the family. Indeed, the data indicate that 67.1% of all transfer inflows in the Pakistan sample originated from outside Pakistan.

The Pakistan data thus clearly contain households characterized by persistent non-symmetric transfer arrangements among family members separated by considerable distances. Given these differences between the Indian and Pakistan survey households and the nature of the transfer information provided in the two surveys, we would expect that, as long as the asymmetry of transfer arrangements does not importantly affect the transfer function relationships, as our simulations have indicated, history dependence would be less important in the transfers observed in the Pakistan sample, which are kin-based and long-distance, compared with those in the Indian sample, which include both kin and non-kin transfers and which on average are likely characterized by smaller inter-partner distances.

With respect to the share of households exhibiting transfer activity it is interesting that for the ICRISAT sample all households reported some form of transfer in each consecutive 3-year period that they appeared in the sample while less than 10% of the India NCAER households reported a non-zero net

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<sup>30</sup>Differences between the data sets in levels are due in part to the different years in which the data were collected. In particular, the NCAER values are in 1971 Indian rupees, those for ICRISAT in 1984 Indian rupees, while those for Pakistan are in 1988 Pakistan rupees. Taking into account exchange rate differences and inflation rates would suggest that in real terms farm profits in the Pakistan survey are only slightly higher than the Indian average in 1971 and higher than those in the ICRISAT VLS villages, which are in a poor region of India.

transfer during the three-year panel. This difference likely reflects at least in part the fact that the NCAER survey information is based on an annually administered question on net transfers whereas the other two surveys were collected over shorter periods and constructed from a series of questions about gross flows.<sup>31</sup>

e. Estimates from the NCAER India and IFPRI Pakistan Data

Table 6 presents estimates of the approximation to the transfer function for the India NCAER and IFPRI Pakistan panels.<sup>32</sup> The estimates from both data sets indicate that, as among the ICRISAT VLS households, transfers play an insurance role - the experience of positive profit or weather shocks leads to greater remittances sent out. The estimates also demonstrate the role of imperfect commitment in constraining the behavior of interhousehold transfers, even those that are family-based and presumably altruistic as in the Pakistan sample.<sup>33</sup> In particular, the transfer-asset effect is strong and highly significantly different from zero in both samples. While the shock coefficients are not comparable across samples because of differing definitions, the transfer asset variables are comparably constructed. The point estimates for this variable indicate that in the Indian sample each additional Rupee that has been sent out in the past results in almost a one-for-one decline in additional transfers out,<sup>34</sup> given the current

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<sup>31</sup>Despite this apparent difference in the degree of coverage our results for the different samples with regard to the effects of transfer assets on transfers are quite similar.

<sup>32</sup>The four asset variables are combined into one wealth variable. In both data sets we could not reject the hypothesis that the effect of each of the four asset types on transfers was the same. The test statistics are:  $F(3, 2693)=0.03$  for the NCAER India sample and  $F(3, 170)=2.45$  for the Pakistan sample.

<sup>33</sup>Hausman-Wu tests of the orthogonality of the regressors with the error term yielded the following test statistics:  $F(2, 2694)=0.22$  for the NCAER India sample and  $F(4, 170)=3.78$  for the IFPRI Pakistan sample.

<sup>34</sup>It is instructive to note that the fact that the transfer asset effect for the NCAER data is close to -1 does not imply that the arrangement is a pure credit arrangement in the sense that repayment is state independent given what was borrowed. To illustrate this point we applied our estimation procedure to simulated data using the incomes and probabilities for the symmetric model with zero correlation but assuming that the transfer data were generated according to a simple model of credit. In particular, it was assumed that transfers could take the value -1, 0, or 1 and that if a household received a transfer in period

shock, while in the Pakistan sample transfers decline by only one-third of a Rupee for the same change in transfer history. This lesser history dependence exhibited by transfers in the Pakistan sample, which is restricted to family-based transfers, is consistent with the clearly more prominent role of altruism and with the fact that the transfers received by the Pakistan households originate from partners with less correlated incomes compared with those for the NCAER households because of the large fraction of Pakistan family members who are located outside of the country. As suggested by our model, both the lower partner income correlations and the higher proportion of family transfer partners (by survey design) in the Pakistan sample lower the history dependence of transfers relative to that in the NCAER India data.

## V. Conclusions

In this paper we have examined the role played by altruism in determining the degree of insurance provided by informal risk sharing arrangements in a setting in which households are unable to enter into binding contracts. In particular, we used three panel data sets from rural South Asia to test a proposition that has emerged from the theoretical literature examining the implications of imperfect commitment for risk-sharing arrangements: if households cannot fully commit themselves to make state-contingent payments that are consistent with full insurance then the optimal achievable insurance contract is not a pure insurance contract but a form of credit contract in which the history of recent transfers influences current transfers. Our results provide support for the notion that imperfect commitment plays a significant role as a barrier to efficient response to risk. Despite the fact that in theory altruism may lessen the extent of risk-sharing, the empirical evidence also indicates that the commitment constraint is attenuated, but not eliminated, among altruistically-linked households. We are thus able to provide new insight into the well-documented prominent role played by the family in the

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t then it would have to repay that transfer in period  $t+1$  and no additional transfers could take place until period  $t+2$ . Under these circumstances the estimated transfer asset and income shocks coefficients were -1.5 and .2, respectively.

provision of insurance and more precise evidence of both altruistic behavior and the limitations of insurance mechanisms.

It is important to note that in constructing and testing a specific model of transfers and how they differ between family and non-family partners we have abstracted from a variety of other possible conditions that may also importantly affect the nature of transfer arrangements in developing countries. For example, it has been established in the context of labor markets that in the presence of repeated moral hazard, optimal wage contracts exhibit history dependence (Rogerson, 1985). It is possible that a model of transfer arrangements incorporating imperfect information regarding household effort and in which family partners can better monitor effort than non-family partners might yield similar predictions to those obtained here. While it would be interesting to see if a model developed along those lines could be distinguished empirically from one with imperfect commitment, such an effort is most likely to be fruitful, in our view, if information is available on the behavior of all of the partners involved in transfer arrangements, rather than just one as is the case for the data sets considered here.

The fact that commitment problems limit the ability of households to fully insure themselves against idiosyncratic risk even among households with altruistic ties suggests that commitment problems may play a significant role in other behaviors, particularly those related to the intertemporal transfer of resources. For example, commitment issues may also play a role in childbearing and parental investment in human capital in developing countries to the extent that children cannot commit to provide parents with a secure source of support in old age. (e.g., Becker, 1991; Cigno, 2000). More generally, commitment problems have also been cited as a significant issue in such diverse other arenas, where altruism is less salient, as in informal credit markets (Hoff and Stiglitz, 1998), markets for health insurance (Coate, 1995), wage setting and labor contracts (Thomas and Worrall, 1988; Ritter and Taylor, 1994), and sovereign debt (Kletzer and Wright, 1990). Our findings from three low-income rural areas suggest that commitment constraints may have real importance, but additional data are required if the full

array of constraints on consumption smoothing are to be jointly considered.

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Table 1  
ICRISAT Data: Fraction of Net Transfer-Out Households, by Village and Land Class

Village/Land class	Aurepalle	Shirapur	Kanzara	Boriya	Rampura	All Villages
Landless ( $\pi$ =Rs682)	.361 (.182) <sup>a</sup>	.472 (.186)	.354 (.135)	.467 (.325)	.556 (.208)	.434 (.213)
Small ( $\pi$ =Rs1189)	.486 (.192)	.694 (.253)	.500 (.195)	.429 (.253)	.733 (.252)	.569 (.250)
Medium ( $\pi$ =Rs3302)	.578 (.125)	.542 (.265)	.425 (.151)	.425 (.188)	.740 (.256)	.535 (.229)
Large ( $\pi$ =Rs8822)	.638 (.182)	.583 (.178)	.700 (.161)	.640 (.323)	.800 (.213)	.664 (.218)
All classes	.517 (.203)	.573 (.237)	.510 (.207)	.503 (.292)	.708 (.249)	.556 (.242)
Number of years	8	8	8	5	5	34
Number of households	38	38	38	31	37	182

<sup>a</sup>Standard deviation in parentheses.

Table 2  
ICRISAT Data: Means and Standard Deviations of Transfers, Farm Profits and Assets,  
by Village

Village/Land class	Aurepalle	Shirapur	Kanzara	Boriya	Rampura	All Villages
Transfers out	546.3 (1990) <sup>a</sup>	532.0 (1325)	197.7 (655.8)	590.0 (1365)	2546 (9976)	708.2 (3780)
Transfers in	334.7 (1480)	791.2 (2056)	281.9 (732.1)	800.0 (1428)	1193 (3041)	609.6 (1815)
Net Farm Profits	2755 (4432)	2899 (4224)	3875 (6884)	705.8 (1510)	6558 (9283)	3283 (5824)
Farm Equipment	2836 (9176)	979.3 (1601)	1449 (2721)	1456 (2388)	5312 (7438)	2125 (5663)
Financial Assets	3476 (636)	1222 (2475)	2628 (6966)	853.7 (2799)	4237 (7301)	2426 (5632)
Liabilities	3165 (7800)	3148 (4932)	2564 (4265)	2120 (2177)	537.7 (1192)	2575 (5220)
Livestock	486.4 (738.9)	1343 (2520)	978.8 (1848)	414.7 (565.6)	3793 (5720)	1238 (2782)
N	235	272	230	114	118	969

<sup>a</sup>Standard deviation in parentheses. All values in 1994 Rs.

Table 3  
ICRISAT Data: Means, Standard Deviations, and Prevalence of Transfers,  
by Source

	Family		Non-Family	
	Inside Village	Outside Village	Inside Village	Outside Village
Annual Net Transfers Out by Partner (Rs)	2.06 (89.3) <sup>a</sup>	2.25 (100.3)	105 (2269)	-38.5 (1312)
Average Remittances In	172.8 (219.6)	243.8 (327.2)	224.7 (633.7)	665.7 (2092)
Average Remittances Out	87.9 (231.3)	163.1 (314.2)	440.8 (2926)	415.7 (1137)
Percent of Households With Transfers for 3 Year Periods by Partner <sup>b</sup>	62.2	56.7	100	88.8

<sup>a</sup>Standard deviations in parentheses

Table 4  
IV Fixed-Effects Estimates of Transfer Functions in ICRISAT Villages<sup>a</sup>

Variable	Net Transfers to Family			Net Transfers to Non-Family		Net Transfers to Family			Net Transfers to Non-Family	
	Total Net Transfers	Inside Village	Outside Village	Inside Village	Outside Village	Total Net Transfers	Inside Village	Outside Village	Inside Village	Outside Village
Own Transfer Asset Effect	-.867 (12.3)	-.862 (7.33) <sup>b</sup>	-.416 (3.58)	-.926 (18.9)	-.838 (7.73)	-.845 (10.6)	-.930 (8.66)	-.662 (6.68)	-.967 (19.9)	-.937 (7.69)
Profit Shock <sup>c</sup>	.591 (1.01)	.0998 (2.78)	.136 (3.68)	-.263 (0.83)	.682 (1.46)	-	-	-	-	-
Total Profits	-	-	-	-	-	.143 (1.98)	.00022 (0.06)	.00663 (1.53)	.0697 (1.99)	.0796 (1.33)
Value Farm Equipment (Rs)	-.00724 (0.07)	-.00029 (0.04)	-.00944 (1.39)	-.0794 (1.38)	.0827 (0.98)	.0273 (0.25)	.00174 (0.28)	-.00446 (0.78)	-.0667 (1.26)	.0922 (1.02)
Financial Assets (Rs)	.161 (3.20)	-.00694 (2.27)	.00047 (0.15)	.0645 (2.40)	.108 (2.75)	.120 (2.25)	-.0066 (2.37)	.00079 (0.28)	.0524 (2.01)	.0901 (2.04)
Net Liabilities (Rs)	.00437 (0.11)	.00280 (1.16)	.00577 (2.37)	.00148 (0.07)	-.0015 (0.05)	.00622 (0.16)	.00141 (0.71)	.00145 (0.71)	.00941 (0.51)	-.00384 (0.12)
Value Farm Animals (Rs)	.0848 (1.24)	.00490 (1.17)	-.00512 (1.19)	-.0124 (0.83)	.0889 (1.61)	.0989 (1.28)	.00619 (1.53)	-.00398 (0.98)	-.00048 (0.01)	.0981 (1.48)

<sup>a</sup>Analysis based on 207 households from 5 villages contributing 1178 total observations. All specifications include village x time dummies (not shown). These control for contemporaneous variation in aggregate village conditions inclusive of wages, prices and aggregate income shocks. Right-side variables other than village x time dummies are treated as endogenous. Instruments include initial values of state variables, inherited assets, inherited assets interacted with village x time dummies, and lagged weather shocks.

<sup>b</sup>Absolute values of asymptotic t-ratios in parentheses.

<sup>c</sup>Profit shock computed from weather x asset coefficients from the estimated conditional profit function in Rosenzweig and Binswanger (1993) and annual weather and asset data. See text.

Table 5  
Descriptive Statistics on Transfers from Three South Asian Longitudinal Household Data Sets

	Pakistan 1985-88 (IFPRI)	India 1968-71 (NCAER)	India 1976-84 (ICRISAT)
Average Annual Net Transfers Out by Partner (Rs)	-3180 (9188)	-29.8 (756.5)	46.8 (2638)
Average Transfers In <sup>b</sup>	7758 (14542)	906.8 (2946)	644.3 (2785)
Average Transfers Out <sup>b</sup>	2742 (5049)	1364 (8429)	496.7 (1582)
Percent of Households With Transfers for 3 Year Periods by Partner <sup>b</sup>	84.1	7.8	100.0
Average Annual Agricultural Income (Rs)	31498 (26738)	2284 (3354)	3429 (6232)

<sup>a</sup>Standard deviations in parentheses

<sup>b</sup>Average transfers in and out and percent for NCAER sample are based on annual net transfers while those for Pakistan and ICRISAT sample are based on gross transfers. Average transfers in and out exclude zeros.

Table 6  
IV Fixed-Effects Estimates of Transfer Functions: Rural India and Northwest Pakistan

	India 1968-71 (NCAER) <sup>a</sup>	Pakistan 1985-88 (IFPRI) <sup>b</sup>
Net Transfer Assets (Rs)	-0.951 (8.65) <sup>c</sup>	-.326 (3.85)
Profit Shock <sup>d</sup>	22.6 (1.41)	.034 (2.28)
Wealth (Rs) <sup>e</sup>	.0308 (0.48)	-.0822 (1.40)

<sup>a</sup>Analysis for NCAER data based on 2700 households. Each household contributes three observations. All right-side variables other than the profit shock are treated as endogenous. Instruments include inheritance of land and other assets, adverse shock in initial period, and interactions of initial adverse shock with inheritance variables.

<sup>b</sup>Analysis for IFPRI data based on 205 households. Each household contributes two observations. Specification also includes village x time dummies, food stocks, inventories, and values of household labor endowments. The village x time dummies control for contemporaneous variation in wages and prices. Right-side variables other than village x time dummies are treated as endogenous. Instruments include initial crop-cycle state variables (other than the production shock), inherited assets, household composition, land ownership and village x time x land inheritance interactions.

<sup>c</sup>Absolute asymptotic t-ratios in parentheses.

<sup>d</sup>The profit shock for NCAER data is a respondent-reported village-level indicator (0,1) of whether crop output was not adversely affected by weather. Profit shock for IFPRI data is the residual from conditional harvest-stage profit function estimates in Berhman, Foster and Rosenzweig (1997). See text.

<sup>e</sup>Wealth=net financial savings + value of farm equipment + value of animal stocks - net liabilities.

Table A  
Fixed-Effects First-Stage Estimates, ICRISAT Villages<sup>a</sup>

Endogenous variable:	Family Transfer Assets		Non-Family Transfer Assets		Other Assets				Profit Shock
Instrument	Inside Village	Outside Village	Inside Village	Outside Village	Financial	Farm Equipment	Liabilities	Animals	
Lagged Financial Assets	.00206 (2.94) <sup>b</sup>	.00373 (4.88)	-.0235 (0.75)	.0129 (1.08)	-.107 (3.49)	.0244 (2.20)	.0446 (1.55)	.0375 (2.93)	.0055 (1.83)
Lagged Farm Equipment	.00544 (6.32)	-.00198 (2.11)	.0178 (0.46)	.00117 (0.08)	.111 (2.95)	-.129 (9.45)	.402 (11.4)	.108 (6.88)	-.0238 (6.47)
Lagged Net Liabilities	-.00063 (0.78)	-.00171 (1.97)	-.0214 (0.60)	.00415 (0.31)	-.0334 (0.96)	.0323 (2.55)	-.511 (15.6)	-.0742 (5.03)	.0251 (7.38)
Lagged Animal Stock	-.00417 (2.65)	.00021 (0.12)	.0839 (1.19)	-.00986 (0.37)	.253 (3.70)	.141 (5.67)	-.290 (4.49)	-.416 (14.4)	.0108 (1.62)
Inherited Dry Land	-.00010 (0.07)	.00021 (0.22)	.0200 (0.51)	.0211 (1.42)	-.0152 (0.081)	.0072 (0.52)	-.0077 (0.21)	.0019 (0.12)	-.0083 (0.45)
Inherited Irrigated Land	-.00149 (0.35)	.00212 (0.54)	-.120 (0.62)	.0179 (0.24)	.0154 (0.40)	-.275 (4.03)	-.184 (1.04)	.0423 (0.51)	-.0013 (0.34)
Year of Asset Division	-.0349 (0.05)	.110 (0.15)	120.1 (3.90)	.252 (0.02)	2.79 (0.09)	-.12.5 (1.14)	-14.5 (0.51)	-3.86 (0.29)	.689 (0.24)
Lagged Month of Monsoon Onset	.0319 (0.08)	.331 (0.80)	19.5 (1.15)	.795 (0.12)	-12.2 (0.74)	-7.13 (1.19)	17.7 (1.14)	-4.26 (0.59)	.924 (0.57)
Lagged Total Rainfall	-.00309 (0.06)	-.146 (2.45)	-.198 (0.08)	.0475 (0.05)	.171 (0.07)	.647 (0.75)	-3.40 (1.52)	-.281 (0.27)	-.068 (0.29)
Inheritance-year interactions F (42, 812)	3.83 p=.000	1.95 p=.000	0.18 p=.98	1.62 p=.009	1.57 p=.013	2.37 p=.000	1.64 p=.007	3.63 p=.000	1.62 p=.009
All identifying instruments F (61, 812) <sup>c</sup>	3.56 p=.000	2.53 p=.000	1.33 p=.049	2.13 p=.000	2.85 p=.000	4.50 p=.000	6.05 p=.000	6.64 p=.000	2.97 p=.000

<sup>a</sup>All specifications include village x time dummies and inherited assets interacted with village x time dummies and lagged weather variables (not shown). <sup>b</sup>Absolute values of t-ratios in parentheses. <sup>c</sup>Excludes village x time dummies, which are included in the second-stage.

Table B  
Fixed-Effects Estimates of Transfer Functions in ICRISAT Villages<sup>a</sup>

	Net Transfers to Family			Net Transfers to Non-Family		Net Transfers to Family			Net Transfers to Non-Family	
	Total Net Transfers	Inside Village	Outside Village	Inside Village	Outside Village	Total Net Transfers	Inside Village	Outside Village	Inside Village	Outside Village
Own Transfer Asset Effect	-.970 (56.9)	-.930 (19.9)	-.715 (16.6)	-.997 (102.5)	-.890 (24.2)	-.988 (53.0)	-.934 (22.5)	-.786 (21.6)	-.994 (101.4)	-1.04 (25.2)
Profit Shock <sup>c</sup>	.146 (0.74)	.00311 (0.25)	.0211 (1.74)	.156 (1.40)	.00630 (0.04)	-	-	-	-	-
Total Profits	-	-	-	-	-	.0415 (1.86)	.00153 (1.25)	.00115 (0.94)	.00592 (0.53)	.0460 (2.37)
Value Farm Equipment (Rs)	.0384 (0.83)	.00066 (0.29)	.00063 (0.22)	-.0156 (0.79)	.0600 (1.62)	.0394 (0.84)	.00216 (0.84)	.00101 (0.40)	.00216 (0.84)	.0408 (1.01)
Financial Assets (Rs)	.00012 (0.01)	-.00069 (0.64)	.00530 (4.89)	-.00656 (0.70)	.00018 (0.01)	-.0333 (0.17)	-.0006 (0.61)	.00526 (5.09)	-.00063 (0.61)	.00286 (0.17)
Net Liabilities (Rs)	.0405 (2.21)	-.00109 (0.95)	-.00029 (0.25)	.0330 (3.35)	.0104 (0.35)	.00596 (0.33)	-.0011 (1.13)	-.00106 (1.07)	-.00112 (1.13)	-.0202 (1.27)
Value Farm Animals (Rs)	-.00116 (0.03)	.00066 (0.29)	-.00084 (0.37)	-.0156 (0.79)	.0104 (0.35)	.00437 (0.12)	.00032 (0.15)	-.00067 (0.33)	.00032 (0.16)	.0247 (0.75)

<sup>a</sup>Analysis based on 207 households from 5 villages contributing 1178 total observations. All specifications include village x time dummies (not shown). These control for contemporaneous variation in aggregate village conditions inclusive of wages, prices and aggregate income shocks.

<sup>b</sup>Absolute values of t-ratios in parentheses.

<sup>c</sup>Profit shock computed from weather x asset coefficients from the estimated conditional profit function in Rosenzweig and Binswanger (1993) and annual weather and asset data. See text.



Figure 1  
 Difference in Consumption Share Between High and Low Income  
 States by Degree of Altruism and Income Correlation

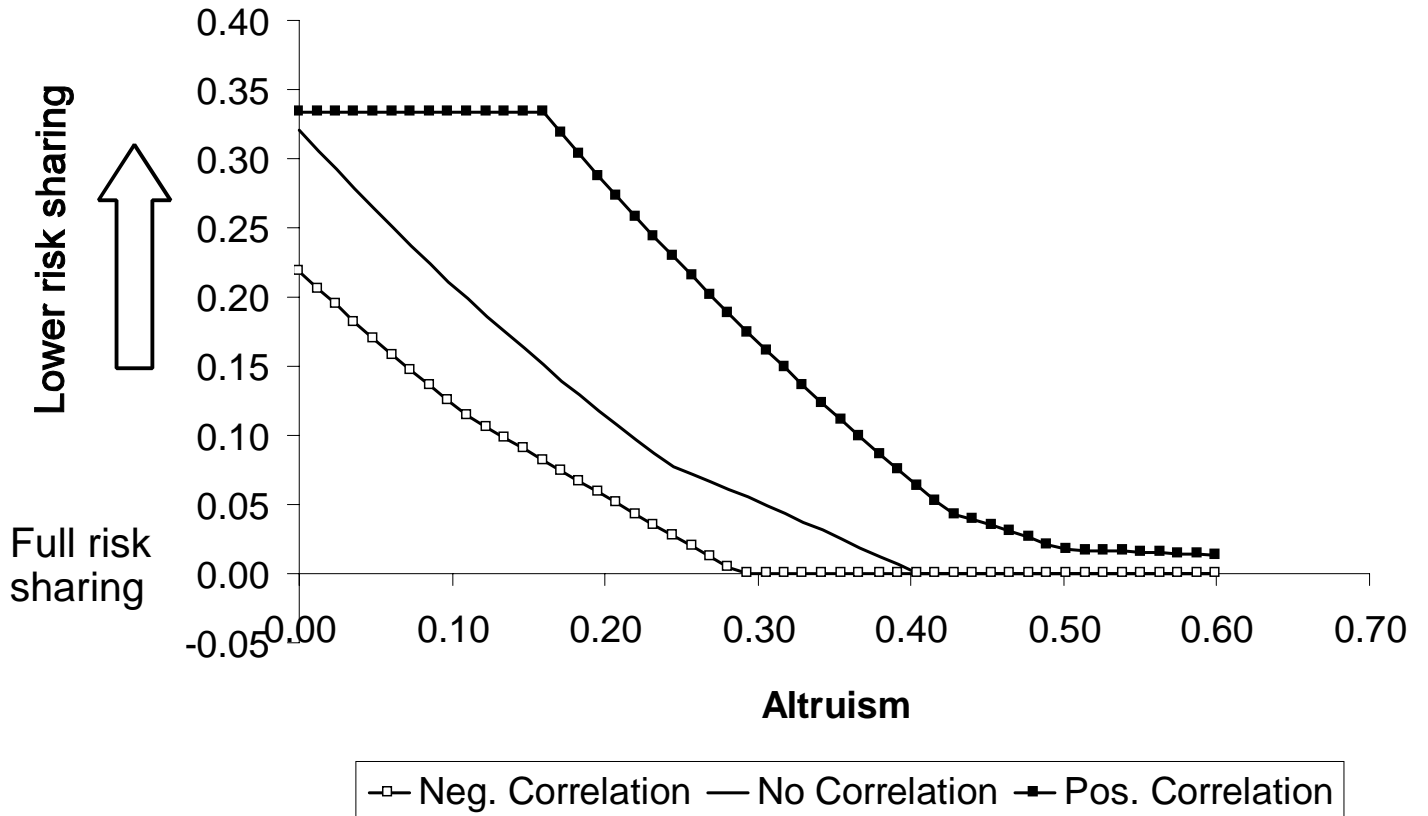
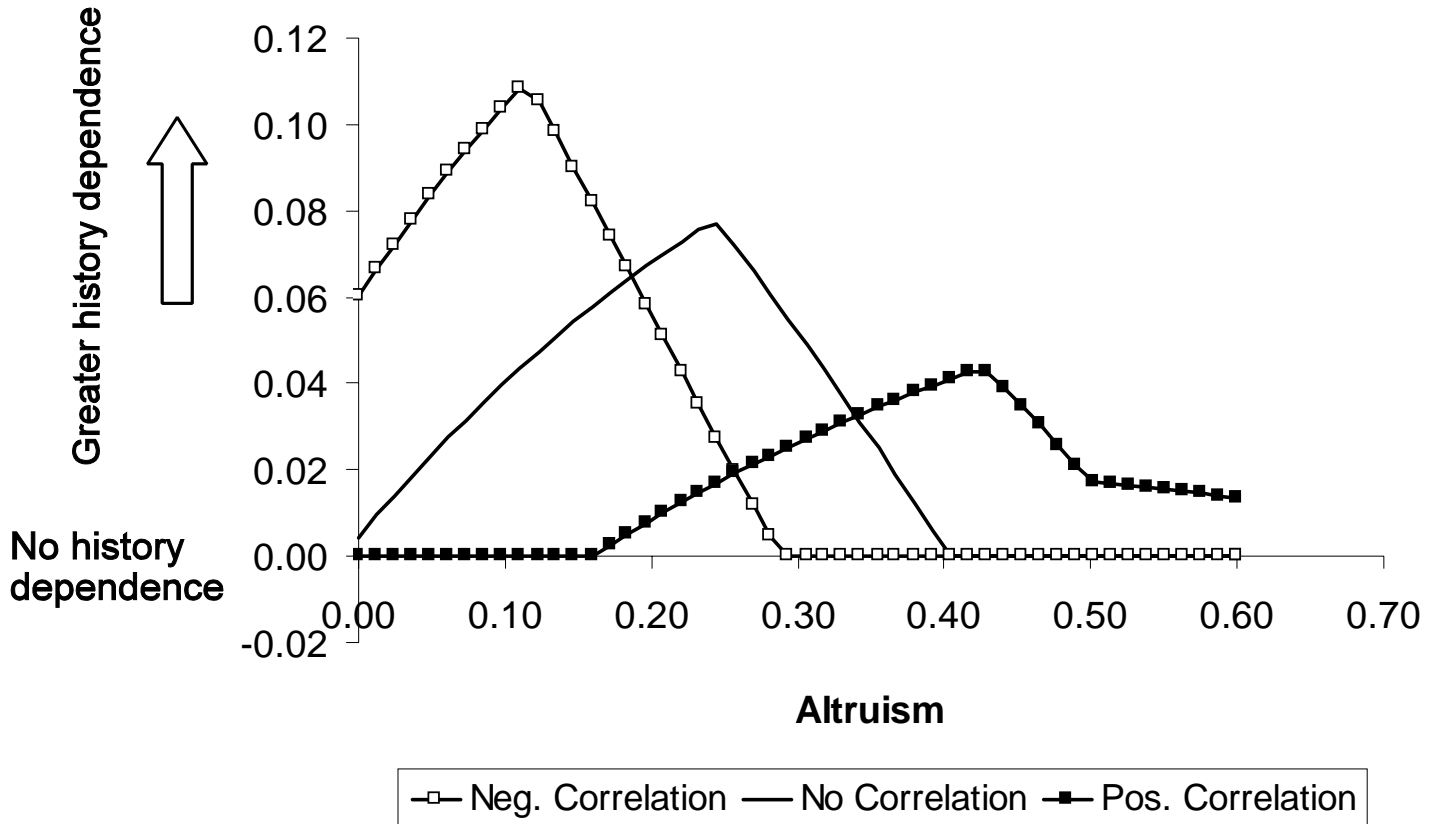


Figure 2  
 History Dependence of Consumption Share<sup>1</sup>  
 by Degree of Altruism and Income Correlation



<sup>1</sup>Equal-income state ([2,2] or [4,4]) consumption share state received by 1 when previous state was [4,2] minus that when previous state was [2,4].

Figure 3  
Expected Discounted Utility from Insurance,  
by Degree of Altruism and Income Correlation

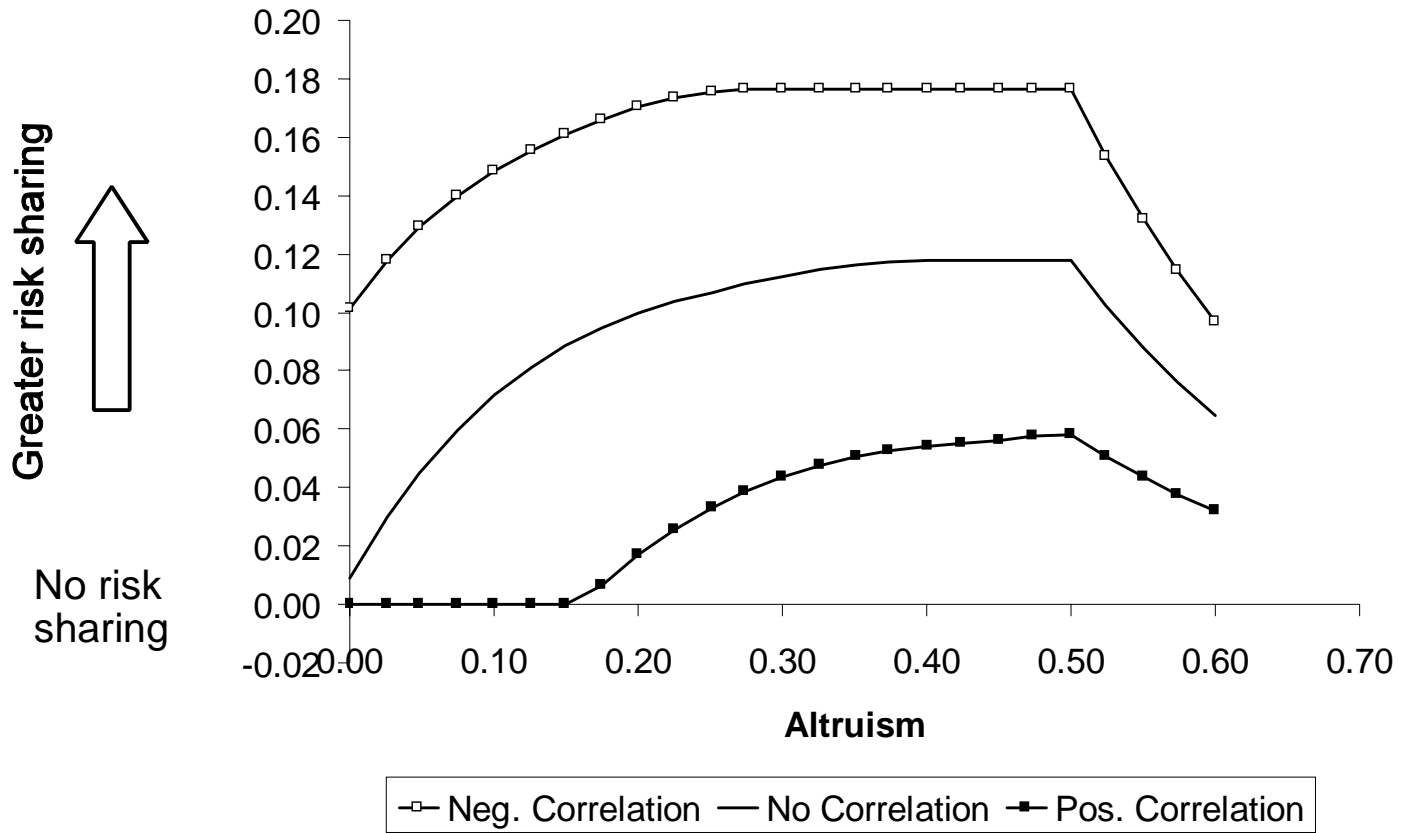


Figure 4  
 Estimated Effects of Transfer Assets on Transfers from  
 Simulated Data, by Degree of Altruism and Income Correlation

No history  
 dependence

Lower history  
 dependence

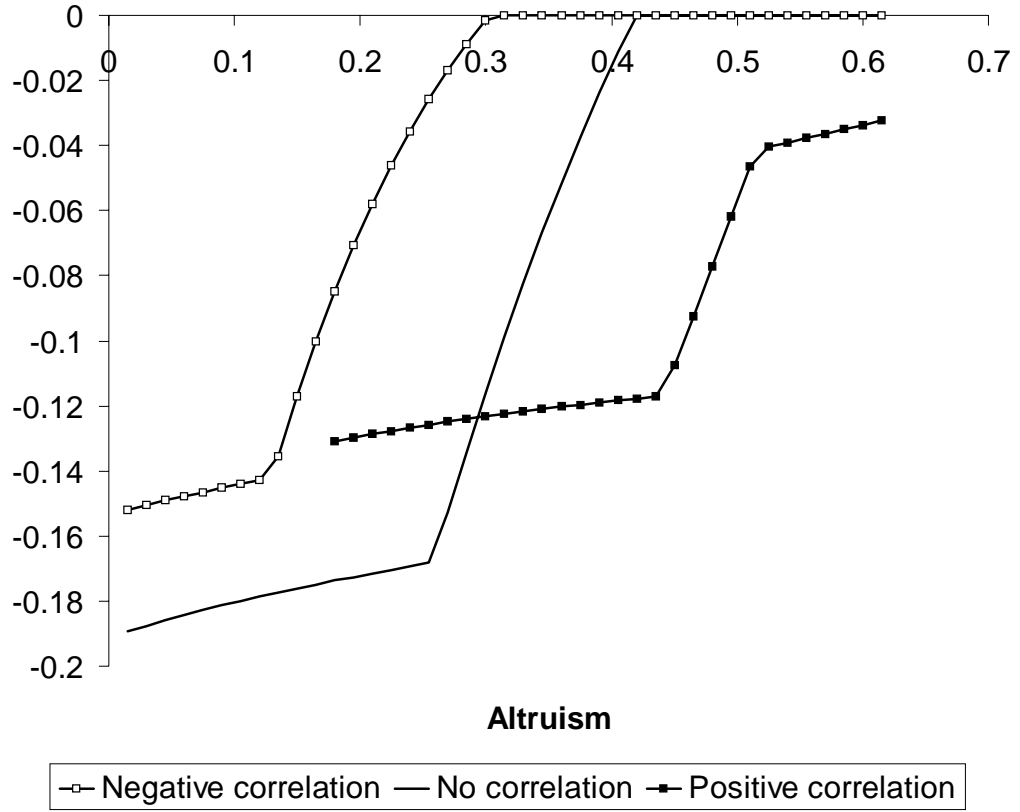
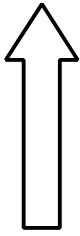


Figure 5  
Estimated Effects of Income Shocks on Transfers from  
Simulated Data, by Degree of Altruism and Income Correlation

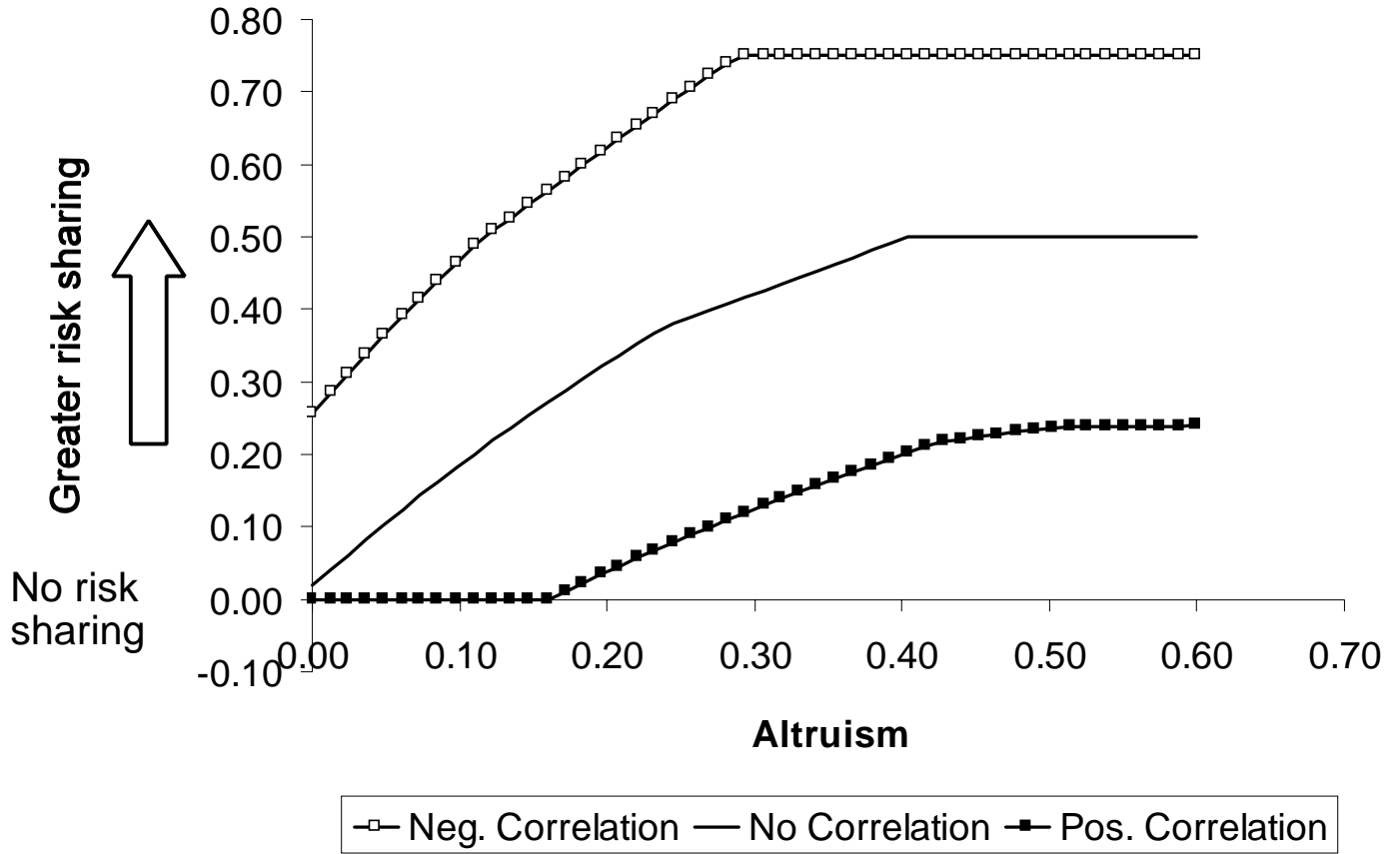


Figure 7  
Estimated Effects of Income Shocks on Transfers from Simulated Data  
with Asymmetric Partners, by Degree of Altruism and Income Correlation

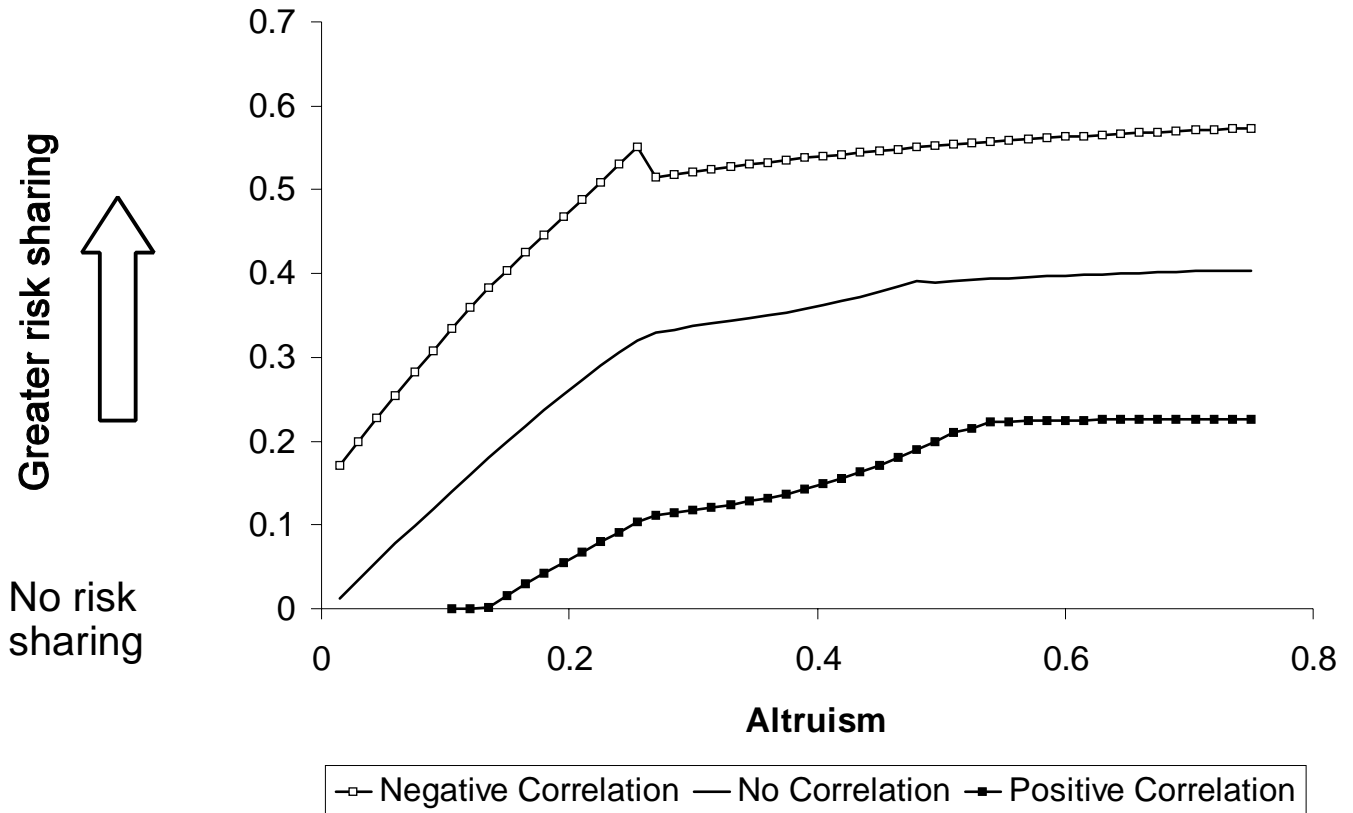


Figure 8  
Estimated Effects of Transfer Assets on Transfers from Simulated Data with Asymmetric Partners, by Degree of Altruism and Income Correlation

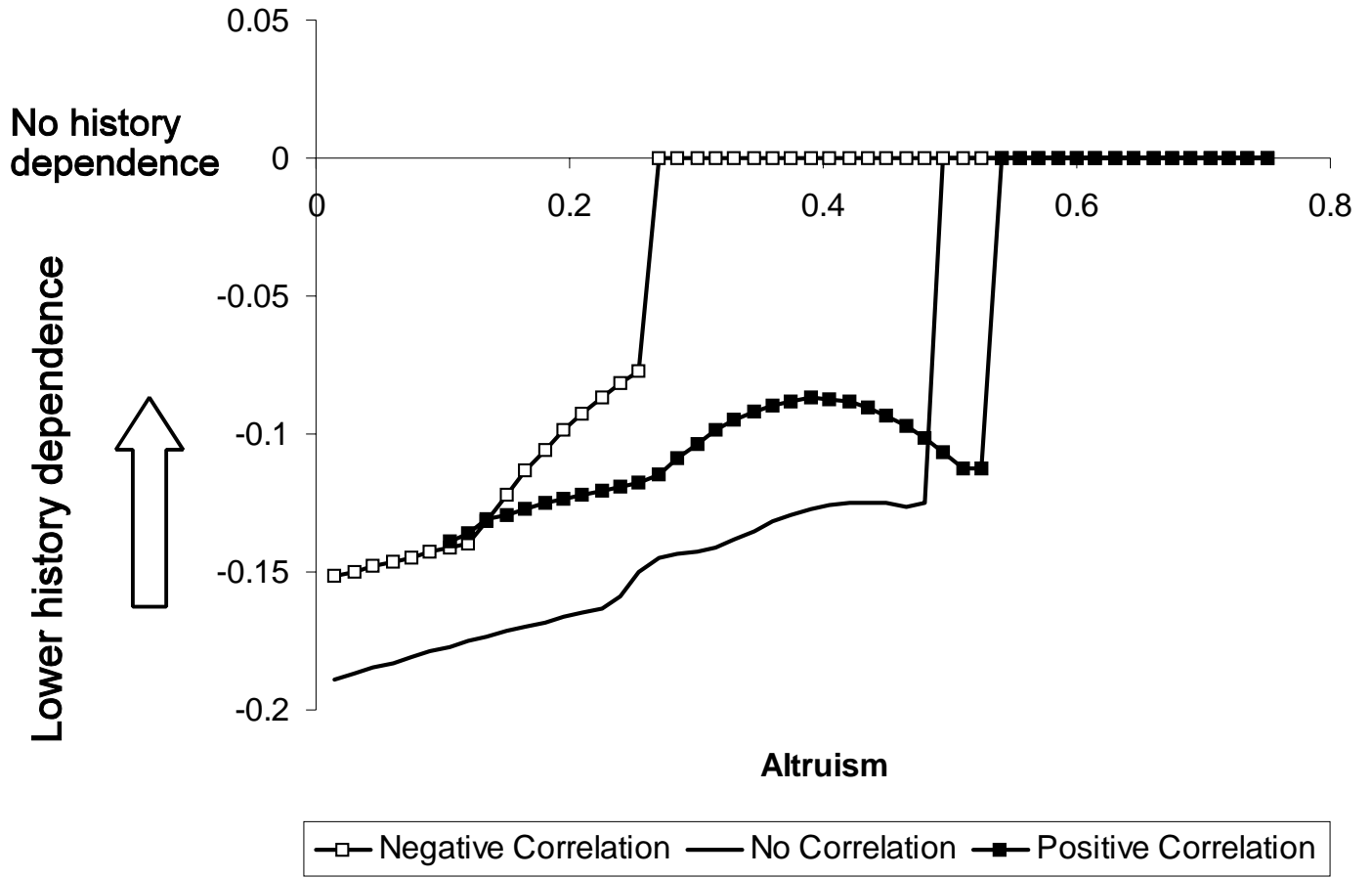


Figure 9  
Estimated Effects of Income Shocks on Transfers from Simulated Data  
by Nonenforcement Probability and Income Correlation

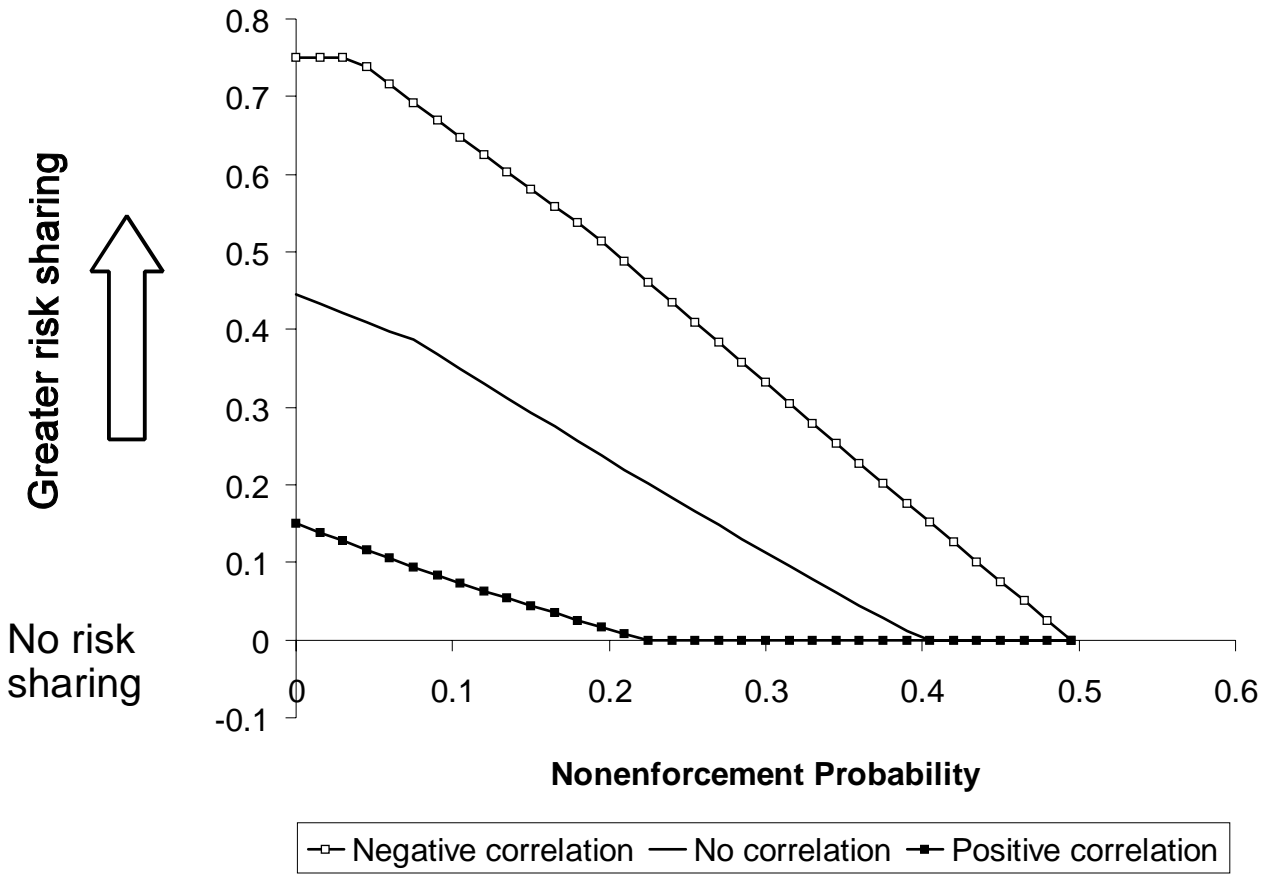




Figure 10  
Estimated Effects of Transfer Assets on Transfers from Simulated Data,  
by Nonenforcement Probability and Income Correlation

