Food gifting, kinship networks and household food security

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1. Introduction

Widespread chronic food insecurity and threats of famine are amidst the central challenges facing the region of Sub-Saharan Africa (SSA). Numerous risks to agricultural production are one of the leading causes to food insecurity in this region. Millions of smallholder farmers produce food in extremely challenging production environment characterized by a combination of low land productivity and harsh weather conditions (i.e., high average temperature and scarce precipitation), which results in very low levels of agricultural production and severe food insecurity at both household and national levels. Apart from from vagaries of weather facing by small-scale subsistence farmers, Life in SSA is also plagued by risks resulted from pest, crop disease and damage, job opportunities, health and other geographic and demographic variates, for which households may incur unforeseeable large expenditures, or suffer from income variations, causing a severe issue of hunger and food insecurity. Given the situation, rural households need coping mechanisms to manage risks and mitigate income and consumption shocks which can have devastating consequences among smallholder households.

Walker and Jodha (1986) classified risk management activities as risk reducing and risk coping strategies. Inter-household transfers, such as gifts, provide an important means of risk-coping mechanism, particularly in less developed agrarian economies where weak market system and the absence of legal enforcement restrict access to market transactions and formal risk-sharing arrangements by smallholder farmers. People in poor countries have long developed interpersonal relationships help shape economic exchange and risk-sharing mechanism. A system of solidarity networks which work as a mutual insurance to minimize the risk of food insecurity in a moral economy

has been well documented in preindustrial society (Scott 1976; Posner 1980; Platteau 1991; Fafchamps, 1992), although criticisms to the mutual solidarity system also arise, aiming at the sustainability and efficiency of the voluntary risk-coping arrangement (Popkin,1979). Gift giving converts social resources into a system of mutual assistance with not necessarily immediate reciprocation: households in need today receive help from those who may be in need tomorrow (Adams, 1993). Interpersonal gifting usually occurs among relatives and friends, lacking explicit and enforceable contracts. However, altruism and reciprocity based on kinship relations are proved to be able to facilitate informal risking-sharing institutions. Study by Foster and Rosenzweig (2001) and La Ferrara (2003) have respectively shown how altruism and reciprocity facilitate inter-household gifts and informal credit. However, many other studies suggest that idiosyncratic risks are not able to be fully insured through kinship-based networks (Altonji, Hayashi, and Kotlikoff, 1992), even though a significant degree of consumption smooth has been proved to achieved via family-based transfers (Rosenzweig, 1988; Rosenzweig and Stark, 1989; Rosenzweig and Wolpin, 1994).

Although inter-household gifting as an informal risk-coping arrangement and its efficiency have been extensively examined in the literature and most scholars allege that it provides only partial insurance to risks, however, if households with higher earnings are willing to give transfers to those with lower earnings, how would this affect the incentives of low-income households to implement other risk-management strategies, such as ex ante risk-reducing strategies, and what are the welfare implications of gifting behavior, e.g., how gifting affects household food security? These two issues remain unaddressed and are to be explored in our study. Our study provides both a conceptual and an empirical methods to examine the relationship between gifting behavior, altruism which is based on interpersonal networks and food security at the household level. We follow Walker and Jodha (1986)

to define inter-household gifting as a risk-coping strategy, relative to risk-reducing strategies, such as crop and income diversification. Risk-reducing strategies are costly and determine the probability distribution over output levels. The risk-aversion households first choose the degree of risk reduction caused by the implementation of risk-reducing strategies. Once all households' outputs have been realized, the households with higher level of income choose to share some of their outputs with those who are plagued by risks and earn lower level of output. The motive for inter-household transfers is altruism which appears in high-income households' utility function. In the end, social welfare of the gifters is examined. Survey conducted in rural Tanzania in 2011 enables us to empirically investigate the relationship between food gifting behaviour and food security status of smallholder farmers in the study areas. Food gifting is a common activity that is believed to be a mechanism by which many local families cope with bouts of food scarcity. The main questions we address using the collected data are as follows. First, what are the determinants of various food gifting regimes, which are differentiated by different levels of altruism? Second, how household food security status differs across groups of households engaging in different food gifting regimes? Third, what are the effects of various food gifting regimes on household food security?

The remaining of the paper is organized as follows. In section 2, a conceptual model is formulated to describe a two-stage game between the gift giver and recipient. The ex anti risk-reduction, the recipient's expenditure on the ex anti risk-reducing strategies and the gifts the giver transfers to the recipient are determined in the game. In section 3, household welfare, represented by Food Consumption Score (FCS) and total income, of the households who engage in different types of food gifting is investigated using an endogenous switch model. Section 4 summarizes the results from the conceptual framework and empirical analysis.

2. Literature

Our study focuses on the role of gift giving as an informal risk-coping mechanism in a rural economy. Theoretical understanding of the performance of informal risk-sharing are provided by Kimball (1988), Foster (1988) and Coate and Ravallion (1993), etc. They all claim that informal risk-sharing arrangement based on reciprocal relationship between self-interested agents can be sustained in the long run. A number of risk-sharing literature specifically examine the role of gifts as an informal risk-sharing arrangement. Fafchamps (1999) analyzes the limitations of gifts and then argues that zero-interest quasi-credit can overcome some of the limitations of pure gift giving. Empirical studies indicate that reciprocal gifts fail to achieve Pareto efficiency in risk-sharing (Fafchamps and Lund, 2003), but they are found to respond to shocks (Fafchamps and Gubert, 2006).

The role of kinship networks based on interpersonal relations also has been extensively examined in the literature. One important role of kinship networks is to facilitate informal risk sharing (e.g., Fafchamps, 1992; Fafchamps and Lund, 2003; La Ferrara, 2003). The reasons that kinship ties can facilitate informal risk-sharing are mainly attributes to reciprocity and altruism in the existing literature. La Ferrara (2003) examined the credit sector and provided evidence that kinship band networks can shape individual incentives in economic transactions through social enforcement and reciprocity. The representative studies of altruism between members of kinship networks have been done by Coate (1995), Foster and Rosenzweig (2001) and Alger and Weibull (2010). Coate constructs a framework to examine the efficiency of public provision of transfers to the poor in consideration of the free-riding effect of altruism. He concluded that adverse efficiency consequences occur if individuals do not take out insurance in anticipation of charity. Foster and Rosenzweig examine the role of altruism in risk sharing under imperfect commitment and found that altruism plays an important role in ameliorating

commitment constraints and thus in increasing the gains from risk-pooling. Alger and Weibull's study focuses on the effect of mutual altruism on production incentives. In their study, they model effort to produce output as a determinant of the probability distribution over output levels. Because of the two-sided altruism, there exists not only free-riding effect, but also empathy effect defined as desire to be able to help one's family member.

Our study is linked to the existing literature on altruism and risk-sharing in the following aspects. First, we look at the role of gifts as risk-sharing mechanism. Second, we argue that altruism not only facilitate inter-household gifting but also resulting in a free-riding effect on efforts on preventive risk-reducing strategies, and hence an adverse effect on household welfare. However, we extend the literature by (a) defining gifting as a risk-coping strategy to distinguish it from ex ante risk-reducing strategies; (b) modelling risk reduction as a determinant of the distribution of output level; (c) empirically examining the difference in household food security between gifters with different levels of altruism.

3. A risk-sharing model

3.1 The model

3.1.1 Notations and assumptions

The model below builds upon earlier work by Alger and Weibull (2010). Our contribution is to incorporate the effect of ex ante risk-reducing strategies which can mitigate the probability that a bad state of income will be realized. Consider a village economy consisting of two households A and B. Household A, who is vulnerable to uncertainties, faces two states of income: good and bad. His income in the bad state is y_l and in the good state is y_h. The probability of the bad state is $\pi \in [0,1]$. He is assumed to be risk-averse with $u_{(x)}^{A} = lnx$.

Household B is assumed not to be as vulnerable as household A and he is capable to cope with the uncertainties, without badly impacted in his income. This means household B's income is always y_h, regardless of the state of income. To simplify the problem, household B is assumed to be risk-neutral with respect to his own consumption, and he cares about the welfare of household A facing uncertainty. Thus the utility function for household B is $u^B_{(x)} = x + \alpha u^A_{(x)}$, where α is altruism that household B has on household A.

To mitigate the production uncertainties caused by weather, crop disease and pest, and other type of income shock, e.g., human disease, household A can choose one or more ex ante risk-reducing strategies to reduce the probability of being in a bad state in which y_l is realized. Given the realization of y_l, household A may receive a transfer, e.g., food gifts, from household B who earns y_h and may want to share some of his output with household A. In this context, household A's expected utility is written as: $(\pi - s)u^p(y_l + t) + (1 - \pi + s)u^p(y_h) - I$, where I is the expenditure household A spends on risk-reducing strategies, s represents the risk reduction of being in a bad state, and t is a transfer from household B to household A. Household B's utility function can be written as $(y_h - t) + \alpha[ln(y_l + t) - I]$.

3.1.2 The game

The timing of the interaction between household A and B is as follows.

In the first stage, income of both households is generated. Household A who faces income uncertainty has an opportunity to choose a risk-reducing practice, e.g., growing a variety of crop, to reduce the likelihood that the bad state occurs. If he chooses one or some risk-reducing practice, expenditure I is incurred and the probability that bad state occurs is reduced to $\pi - s$, where s denotes risk reduction and $s = s(I) = \pi - e^{-I}$, where $s' > 0, s'' < 0$.

In the second stage, a decision of an inter-household transfer is made, once the state of income is revealed[1]. By observing household A's income y_l, household B chooses whether or not to make a transfer t to household A. At the end of the second stage, the realized total income of each household therefore is equal to his income plus/subtracts the transfer received from /gave to the other household.

In this two-stage game, a pure strategy for household A and B is $(s_{A,}I_A, t_B)$, which determines the total utility to each household. A well-behaved Household A's expected utility is

$$u^A = (\pi - s)u^A(y_l + t) + (1 - \pi + s)u^A(y_h) - I, \quad (1)$$

where $I = -ln(\pi - s)$ and $I' > 0$ and $I'' > 0$. Equation (1) can be written as

$$u^A = (\pi - s)ln(y_l + t) + (1 - \pi + s)ln(y_h) + l\,n(\pi - s). \quad (2)$$

A well-behaved Household B's utility, given household A is in the bad state is

$$u^B = u^B(y_h - t) + \alpha u^A(y_l + t), \quad (3)$$

which can be written as

$$u^B = (y_h - t) + \alpha[ln(y_l + t) + l\,n(\pi - s)]. \quad (4)$$

Before we go to the analysis of the equilibrium of the two-stage game, we first examine a baseline case when household B can commit to a level of transfers before the poor makes his risk-reducing decision.

The baseline case: household B can commit not to make a transfer

The optimal level of risk-reducing strategies is determined through household utility maximization problem

$$\underset{s}{Max}\ (\pi - s)ln(y_l) + (1 - \pi + s)ln(y_h) + l\,n(\pi - s)\,. \quad (5)$$

From equation (5), s is determined by the first-order condition

[1] There are two possible states of income for household A: y_h and y_l. To conform to the our dataset in which we observe gifs have been transferred, in the second state we only consider the case in which inter-household transfers occur, which means household A earns lower income y_l and household B earns higher income y_h.

$$-lny_l + lny_h = \frac{1}{\pi - s}, \tag{6}$$

which yields

$$s^* = \pi - \frac{1}{ln\frac{y_h}{y_l}}. \tag{7}$$

We can see that s^* increases with π, which means the more risks household A faces, the more risks will be reduced by implementing risk-reducing strategies and then the less likely the bad state of income is realized eventually. Thus household A's optimal level of risk reduction without the anticipation of charitable transfers from household B is represented by equation (7). We use it to compare with the level of risk reduction in the case that household A anticipates household B is not able to commit not to make a transfer. In next section, we examine how household A's expenditure on risk-reducing strategies are determined and what level of risk reduction is realized, given that household A anticipates charitable transfers from household B.

The second case: household B cannot commit not to make a transfer

Let's take a look at household B's utility maximization problem at the second stage, after a transfer is made to household A to whom the bad state of income is realized. Household B's problem is

$$\underset{t}{Max}(y_h - t) + \alpha[ln(y_l + t) + l\,n(\pi - s)]. \tag{8}$$

The first order condition with respect to transfer t is

$$\frac{\alpha}{y_l + t} = 1. \tag{9}$$

Equation (9) yields

$$\hat{t} = \begin{cases} 0 & if\ \alpha = \tilde{\alpha} = y_l \\ \alpha - y_l & if \alpha > \tilde{\alpha} = y_l. \end{cases} \tag{10}$$

Equation (10) suggests that $if \alpha > \tilde{\alpha} = y_l$, an increase in altruism α results in an increase in charitable transfers $\hat{t}$, which means the higher altruism household B has to household A, the more he transfers to household A. Let go back to the first stage, in which household A decides the level of risk reduction.

Household A's utility maximization problem is

$$\underset{s}{Max}\ (\pi - s)ln(y_l + \hat{t}) + (1 - \pi + s)ln(y_h) + l\,n(\pi - s). \tag{11}$$

We plug $\hat{t} = \alpha - y_l$ into equation (11) and get

$$\underset{s}{Max}\ (\pi - s)ln\alpha + (1 - \pi + s)ln(y_h) + l\,n(\pi - s). \tag{12}$$

The first order condition with respect to s is

$$-ln\alpha + \ln(y_h) = \frac{1}{\pi - s}. \tag{13}$$

Equation (13) yields

$$\hat{s} = \pi - \frac{1}{ln\frac{y_h}{\alpha}}. \tag{14}$$

From equation (14), we can see that and increases in α leads to a decrease in risk reduction $\hat{s}$. The higher altruism is, the less risk is reduced and then the more likely household A is in the bad state. Further, we see that an increase in π leads to an increase in $\hat{s}$, which means the higher level of risk household A faces, the more risk reduction occurs. By comparing the value s^* in the baseline case and $\hat{s}$ in the second case, we get the following proposition.

Proposition 1: *in anticipation of a charitable transfer t from his network, risk reduction resulted from the implementation of risk-reducing strategies by household A, is less than that with no anticipation of a charitable transfer.*

Proof: see Appendix 1.

Turning from behavior to welfare, it is straight forward to compute the total welfare which is represented by total income of both households and derive the following proposition.

Proposition 2: *the total welfare of both households decrease with altruism α, as well as risk reduction s and expenditure on risk-reducing strategies I.*

Proof: see Appendix 2.

Figure 1,2 and 3 respectively plots the relationship between household A and B's total income c, risk reduction s by household A and expenditure by household A in ex ante risk-reducing strategies I, and altruism α, given $y_h = e\text{^}2$, $y_l = 0$, and $0 < \alpha < 1$, $\pi = 0.5$. Figure 1 demonstrates that total welfare decreases with an increase in altruism α. Figure 2 shows that the higher the altruism is, the less likely the household that engage in a risk-reducing activity and then the more likely he is in the bad state. Figure 3 illustrates a decreasing expenditure in risk-reducing strategies with an increase in altruism.

3.2 Results

A number of findings can be emphasized as follows from the conceptual framework.

First, altruism has a free-riding effect on the vulnerable household's effort on ex ante risk-reducing strategies. An increase in high-income's altruism household results in a decrease in the vulnerable household's investment in preventive risk-reducing strategies, and hence a decrease in the risk reduction of the probability being in a bad state of income.

Second, altruism has an adverse effect on the social welfare of households adopting inter-household transfers as a risk-coping strategy. The source of the loss of the social welfare is the disincentives of undertaking ex ante risk-reducing strategies.

4. The empirical method

According to the predicted results of the conceptual model, we can conclude that households that engage in gifting through kinship networks (as known as family gifters with a higher altruism) are less prone to implement ex ante risk-reducing strategies and more likely to be food insecure than those engaging in non-kinship gifting (as known as non-family gifters with a lower altruism). In this section, we explore the relationship between food gifting, kinship networks and household food security to find the free-riding effect and adverse welfare effect of altruism which is proxy by interpersonal relations. Specifically, we address the following questions. First, what are the determinants of household food gifting decisions? We are particularly interested that whether capacity-building activities and risk-reducing strategies have impacts on household food gifting behavior. Second, does household food security status vary across groups of households engaging in different food gifting regimes? Our focus is on the role of kinship networks in food gifting and exploring the relationship between altruism and gifting behavior. Last, what are the effects of food gifting behavior on household food security status? We are interested in the role of the voluntary gifting behavior in coping risks and affecting food security at the household level.

4.1 Data

The survey data were collected in rural areas of Tanzania in 2011, under a project titled Crops and Goat Project (CGP), which is sponsored by the International Development Research Centre (IDRC) and Canadian International Development Agency (CIDA). 552 households from four program and four comparison villages in Kongwa and Mvomero districts were interviewed. Only villages where root crop (cassava and sweet potato) gifting occurs are retained. The total sample size of our study is 471 households. We use root crop-cassava and sweet potatoes-gifting to proxy for general food gifting, as cassava and sweet potatoes are one of the staple crop in the study areas and seen as critically valuable

by the smallholders to survive dry seasons and more and more farmers want to cultivate these crops in the future. Detailed questions on cassava and sweet potatoes gift giving and receiving, household income and expenditure, household dietary diversity and food consumption, services, information sources and capacity building information, and household demographic characteristics were asked in the survey aimed at smallholder households. Crop production information was also collected. Questions related to risk management strategies were also asked. For example, whether or not use improved drought-tolerant variety and intercropping, and what crops are planted. These variables, as well as income diversification, are employed as risk-reducing (ex ante) strategies, in contrast with gifting as a risk-coping (ex post) strategy. The access to information and service variables are thought of as capacity building strategies, which aim at building resilience to protect vulnerable population from uncertainties and shocks.

Table 1 demonstrates the descriptive statistics of all variables, by food gifting regimes, employed in our study, including dependent variables (FCS and total household income), household asset variables, risk-reducing variables, food gifting regimes, capacity-building variables and demographic variables. We found that households face three mutually exclusive root crop gifting strategies to cope with low income in rural Tanzania. The food gifting variable is differentiated by: (a) gifting or not, and (b) through or not through kinship networks. We classify all the households into three groups: autarkists (non gifters), family gifters and non-family gifters. Autarkists are households who are not involved in cassava and sweet potato gifting. Family gifters are those engaging in cassava and sweet potato gifting within kinship networks. Non-family gifters gift cassavas and sweet potatoes outside kinship networks, e.g., with friends and neighbours.

The descriptive statistics suggest that family gifters always have lower FCS and income than non-family gifters, which is consistent with the predicted result based on the previous conceptual model. The average FCS falls around 50 which is higher than the "acceptable" line of 35, which means at the survey time, food insecurity is not a severe problem in the study areas of rural Tanzania. We can also observe that services, such as crop and livestock market information and financial service, are more accessible for family gifters. However, if we focus on risk-reducing variables, we find that except for "improved variety", the percentages of non-family gifting households that adopt are higher than family gifting households. The results of the descriptive statistics indicate that non-family gifters are more prone to adopt risk-reducing strategies, as compared with family-gifters, but the difference in adoption is not significant.

4.2 The Econometric model

In this section, we specify a two-stage endogenous switching model to describe food gifting decision and food security. Households' decisions on food gifting (whether or not and with whom) is voluntary and based on individual self-selection. Households that engage in food gifting through a particular network are not a random sample of the original population; they may have systematically different characteristics from farm households that do not gift with others or gift through a different network. Unobservable characteristics of households may affect both the food gifting decision and household food security status, resulting in inconsistent estimates of the effect of food gifting on household food security.

We address these issues by estimating a multinomial endogenous switching regression model of through a two-stage procedure that allows us to produce selection-corrected household food security status. In the first stage, a selection model where a representative household chooses to give gifts or

receives gifts from family members or non-family members (e.g., friends or neighbours). The first-stage selection model is specified as

$$y_{ij}^{*} = z_i\gamma - u_i \tag{15}$$

$$D_i = \begin{cases} 1, iff\ y_{i1}^{*} > \max\limits_{k\neq 1}(y_{ik}^{*}) \\ 2, iff\ y_{i2}^{*} > \max\limits_{k\neq 2}(y_{ik}^{*}) \\ 3, iff\ y_{i3}^{*} > \max\limits_{k\neq 3}(y_{ik}^{*}) \end{cases} \tag{16}$$

In this stage, one of the three mutually exclusive food gifting regimes is chosen by farm households, according to a criterion represented by the selection equation. The variables included in the vector of z_i are household demographic variables, household asset variables, risk-reducing strategies, and capacity building variables to improve household resilience.

In the second stage, household outcome (FCS and income) equations are regressed against capacity building variables and other control variables. Through the first-stage procedure of the model, we can address the first question: what are the determinants of household food gifting decisions? Using the results of the second stage of the model, we can compute and compare the predicted value of household FCS and income, and hence the second question is addressed. The second-stage outcome equations are

$$\text{Regime 1: } y_{i1} = x_i\beta_1 - \sigma_1\rho_1 * \frac{\phi(\gamma' z_i)}{\Phi(\gamma' z_i)} + \varepsilon_{i1}\ ,\ iff\ D_i = 1 \tag{17}$$

$$\text{Regime 2: } y_{i2} = x_i\beta_2 - \sigma_2\rho_2 * \frac{\phi(\gamma' z_i)}{\Phi(\gamma' z_i)} + \varepsilon_{i2}\ ,\ iff\ D_i = 2 \tag{18}$$

$$\text{Regime 3: } y_{i3} = x_i\beta_3 - \sigma_3\rho_3 * \frac{\phi(\gamma' z_i)}{\Phi(\gamma' z_i)} + \varepsilon_{i3}\ ,\ iff\ D_i = 3. \tag{19}$$

For the model to be identified it is important to use exclusion restrictions as selection instruments, which are variables that directly affect the selection variable but not the outcome variable. In our study,

we use the variables related to capacity building to improve household resilience to cope with risk, for example, whether or not have access to market information, access to pipe water and boreholes, and access to savings and credits.

The last question, which is to evaluate the effects of various food gifting regimes on household food security, is addressed through a counterfactual analysis as follows.

$$E(y_{i2}|D=2) - E(y_{i1}|D=2) = (\gamma_{i2} - \gamma_{i1})'x_i + (\sigma_1\rho_1 - \sigma_2\rho_2) * \frac{\phi(\gamma' z_i)}{\Phi(\gamma' z_i)} \quad (20)$$

$$E(y_{i3}|D=3) - E(y_{i1}|D=3) = (\gamma_{i3} - \gamma_{i1})'x_i + (\sigma_1\rho_1 - \sigma_3\rho_3) * \frac{\phi(\gamma' z_i)}{\Phi(\gamma' z_i)} \quad (21)$$

4.3 Results

4.3.1 Determinants of food gifting behavior

Results of the estimation of food gifting decision equation are demonstrated in table 2. Column 5 and 6 show the results with risk-reducing strategies as regressors, as compared with without risk-reducing strategies in column 2 and 3. We found that most household assets variables, such as land, livestock and physical asset have significant effects on the propensity to gift with family members, as compared with autarkists. But after including the risk-reducing strategies, most of them become insignificant. If we look at the capacity building variables which we use as instrumental variables, we found some of these variables have significant effect on gifting choice. For example, access to financial service-savings and credit- societies—have significantly positive effect on the propensity to gift with others, regardless of the presence of risk-reducing strategies. The financial service as a risk-coping strategy is seen a substitute for gifting through social networks, but the significant and positive effect provides evidence that gifting through social networks can facilitate financial service in rural area. A possible explanation is that social networks can help disseminate knowledge and information. Access

to pipe water is a driver for gifting outside kinship networks, but access to crop and livestock market information discourages gifting outside family networks. One reason for the positive effect of pipe water is that people gathering to fetch pipe water have more chances to build up their social networks outside family relations. Most of the risk-reducing variables also have significant effects on gifting behavior. For example, the use of improved varieties, the use of intercropping and income diversification all have significantly negative effect on the propensity to be a family-tied gifter. Crop diversification has a significantly positive effect on being a non-family gifter. We also find that households with smaller size tend to gift with relatives. The significant negative effect of risk-reducing variables on the probability to gift within kinship networks show that family-tied gifters are less likely to implement risk-reducing strategies as preventive actions, even given the high-risk environment they face. There might be two reasons to explain this. First, the households anticipate a potential transfer from their relatives, given the bad state of income realizes. Second, the households are too poor to afford the cost of implementation.

4.3.2 The implications on household food security

We now turn to the welfare implications of adopting a particular strategy on households' food security status indicated by household FCS and total income[2]. Table 3 and 4 show the results of second-stage estimation of FCS and income equation. Column 2-4 of each table are results based on human capital, natural resources and household wealth as regressors. Column 5-7 show results with consideration of risk-reducing strategies as regressors. From table 3, we see that age has significantly negative effects on both family and non-family gifters' FCS. Formal education increases non-gifters's FCS by 14.9%. Men-lead households' FCS is 7.6% higher than that of women-lead households.

[2] We use the natural logarithm form for both household FCS and total income.

The use of intercropping has a negative effect on autarkists' FCS. The use of improved variety has a significant and positive effect on family gifters' FCS. Income diversification has a significant and positive effect on non-family gifters FCS. Physical home asset have significant and positive effect on all households' FCS. Livestock asset is found to significantly and positively affect autarkists' FCS, but negatively affect family gifters' FCS. Household cash income has significant and positive effects on all gifters' FCS. Interestingly, we find that some risk-reducing variables have significantly positive effect on gifters' FCS. For example, the use of improved variety has significantly positive effect on non-family gifters' FCS, with a huge increase by 42.2%. Income diversification increases non-family gifters' FCS by 7.3%. After controlling for risk-reducing strategies, coefficients of the correction terms "millratio" all show no significance, suggesting that selection bias, due to unobservable characteristics, is not found in estimating household FCS.

Table 4 shows that the effects of risk-reducing strategies on household income are more significant, as compared with on household FCS. The use of improved variety and diversification of crop have significant and positive effect on income of autarkists, and the effect of use of intercropping on income of autarkists is significant and negative. Crop diversification has positive effect on income of all types of non-gifters and gifters, with 13.8% on autarkists, 23.0% on family gifters and 16.1% on non-family gifters. We also find that the correction term for autarkists are negative and significant, implying that unobserved household characteristics that are associated with a higher probability of non-gifting regime are linked to lower levels of household total income.

Based on the estimation of second-stage equation, the answers of the second question, i.e., does household food security differ between family and non-family gifters are demonstrated in table 5, which suggests no matter whether the risk-reducing activities are controlled or not, family gifters

always have lower level of FCS and income than non-family gifters. One-way ANOVA test indicates that the means of predicted FCS are not significantly different across groups, but the means of predicted household income are significantly different across groups.

4.3.3 Effects of food gifting behavior

Table 6 and 7 respectively demonstrate the effect of food gifting behavior which is based on a counterfactual analysis, before and after controlling for risk-reducing activities. The results show that food gifting behavior of different types does not have significant impact on household food consumption and income. The main findings from the empirical study are:

First, households adopting risk-reducing strategies are less prone to gift with family households. For example, we find households who use improved variety and diversify income source are less likely to choose to be family gifters, which means the probability that family gifters invest in risk-reducing strategies is lower than non-family gifters.

Second, after correcting for selection bias, we do not find significant difference in household food consumption across groups of households differentiated by different gifting regimes, however, we found significant difference in total household income across the three groups. Non-family gifters have the highest level of household income and second highest FCS.

Third, we did not find evidence that food gifting behavior has a significant effect on household food security status, given that we only consider root crop-cassava and sweet potato-gifting among households.

5. Conclusions

Our study investigates gift giving behavior in a poor economy as a means of risk-coping, and evaluate its effects on household food security. Our study in the meanwhile sheds light on the role of altruism

and kinship tied networks in gifting behavior and household food and income security. We also explore the roles alternative risk-reducing strategies which are seen as ex ante preventive measures of the occurrence of low household income, with the purpose to find out why gifting based on higher level of altruism adversely leads to food insecurity. A conceptual framework is first constructed to elaborate on the roles of gifts between a vulnerable household and an invulnerable household in risk-coping and ensuring household food security. After that the impacts of gifting on household food security are empirically evaluated, using a multinomial endogenous switching model and collected root crop-cassava and sweet potato-gifting and household food security data in rural Tanzania in 2011-2012. Both the conceptual framework and the empirical tests show that households who transfer gifts based on high levels of altruism are doing worse-off than those who transfer gifts based on low levels of altruism. An explanation of altruism's adverse effect on household welfare is that high levels of altruism discourages the implementation of ex ante risk-reducing strategies and hence results in higher level of food insecurity. Based on the results of effect evaluation, food gifting itself does not manifest significant impact on household food security, which imposes more weight on the role of risk-reducing strategies in improving household food security status. Our results, both conceptually and empirically, also indicate that households engaging in family-tied food gifting are less prone to implement risk-reducing strategies.

The adverse effect of the voluntary gifting behavior among smallholder household in a poor economy draws important policy implications. Inter-household gifts, mostly taking the form of food, may not be an effective and efficient means to cope with idiosyncratic risks, due to the free-riding effect which would exacerbate with the increase of interpersonal altruism. Vulnerable smallholders should undertake more effective strategies to reduce potential risks in agricultural production and

cope with income shocks caused by random incidents. For example, we examined the use of drought-tolerant crop varieties, the use of intercropping, crop and income diversification, which are rarely adopted by smallholders, but some of which have significant effects on household food security. Some smallholders in rural Tanzania responded they would like to try an improved crop variety, but cannot afford it. This implies decision makers can use the relevant risk-reducing strategies as interventions in developing anti-poverty programmes.

Appendix 1

the difference between s^* in the second case and $\hat{s}$ in the baseline case is

$$s^* - \hat{s} = \left(\pi - \frac{1}{ln\frac{y_h}{y_l}}\right) - \left(\pi - \frac{1}{ln\frac{y_h}{\alpha}}\right) = \frac{1}{ln\frac{y_h}{\alpha}} - \frac{1}{ln\frac{y_h}{y_l}}.$$

To determine the sign of the difference, we need to compare $ln\frac{y_h}{\alpha}$ with $ln\frac{y_h}{y_l}$, and hence $\frac{y_h}{\alpha}$ and $\frac{y_h}{y_l}$. From equation (10), we know that $\hat{t} = \alpha - y_l > 0$, thus we have $\alpha - y_l$, and then $\frac{y_h}{\alpha} < \frac{y_h}{y_l}$. We now have $ln\frac{y_h}{\alpha} < ln\frac{y_h}{y_l}$, and then $\frac{1}{ln\frac{y_h}{\alpha}} - \frac{1}{ln\frac{y_h}{y_l}} > 0$ and $s^* - \hat{s} > 0$. Proposition 1 holds in this case.

Appendix 2

let's now take a look at household welfare. Household A's expected income is

$$c^A = (\pi - s)(y_l + \hat{t}) + (1 - \pi + s)(y_h) + l\,n(\pi - s)$$

$$= (\pi - s)\alpha + (1 - \pi + s)(y_h) + l\,n(\pi - s).$$

Household B's income is

$$c^B = y_h - \hat{t} = y_h + y_l - \alpha.$$

The total income of both households is

$$c^A + c^B = (\pi - s)\alpha + (1 - \pi + s)(y_h) + l\,n(\pi - s) + y_h + y_l - \alpha$$

$$= -\alpha + \frac{\alpha}{lny_h - ln\alpha} - \frac{y_h}{lny_h - ln\alpha} - \ln(lny_h - ln\alpha) + y_h + y_h + y_l.$$

We also compute the optimal level of risk reduction chosen by household A as

$$\hat{s} = \pi - \frac{1}{ln\frac{y_h}{\alpha}},$$

and household A's expenditure on risk-reducing strategies as

$$I = -l\,n(\pi - s).$$

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Figure 1. Expected consumption of both gift givers and recipients and altruism

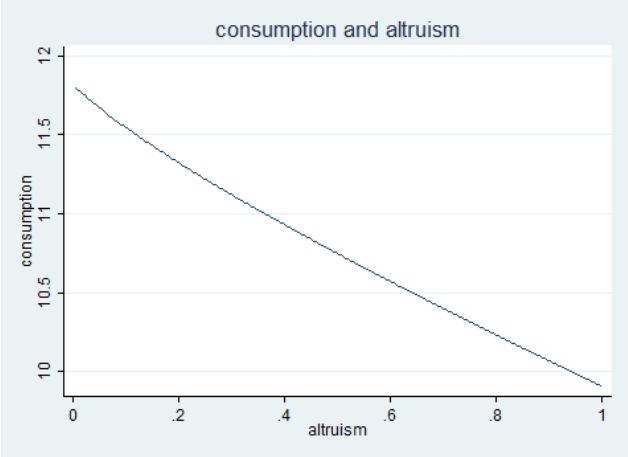

Figure 2. Risk reduction the gift recipients and altruism

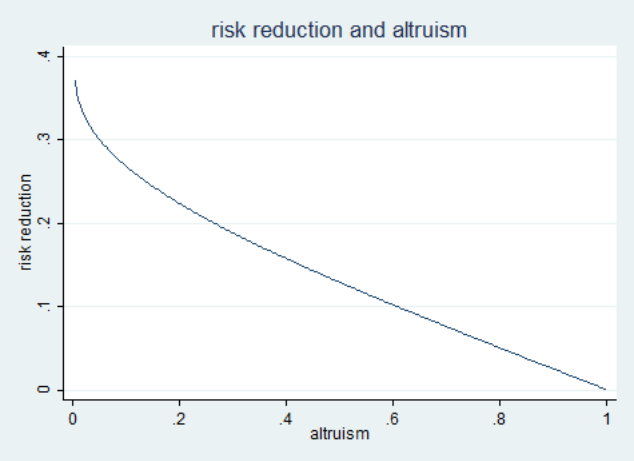

Figure3. Expenditure of the gift recipients on risk-reducing strategies and altruism

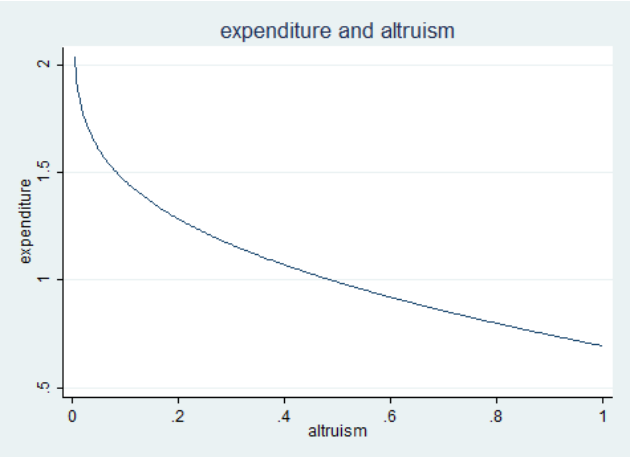

Table 1. Descriptive statistics of variables

Variable	Definition	Autarkists		Family gifters		Non-family gifters	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dependent variables							
Food Consumption Score (FCS)	Index on quantity and quality of food consumed by household members	51.440	10.015	49.021	17.199	52.083	11.745
totalincome	Total inkind and cash household income in Tanzanian Shillings	2668824	5057411	3344260	5836664	5715508	1.40E+07
Independent variables							
hhsize	Total number of household members	5.825	2.685	5.383	2.454	5.184	2.323
agehead	Age of household head in years	45.003	16.963	46.191	14.829	39.263	9.394
agesq	Squred age of household head	2312.18	1811.83	2348.87	1510.96	1627.52	787.96
educprimary	Whether the household head has a primary level of education	0.499	0.501	0.426	0.500	0.684	0.471
malehead	Whether a household is male-headed	0.794	0.405	0.787	0.414	0.842	0.370
landacres	Total land in acres owned by the household	8.312	16.425	7.606	8.019	7.428	7.040
PCAphysical	total household physical asset, index constructed using PCA	-0.019	-1.004	0.281	-1.098	0.276	-0.958
PCAlivestock	total household livestock units, index constructed using PCA	0.054	-1.045	0.208	-1.719	-0.220	0.248
mktinfo	Whether or not have access to crop and livestock market information	0.429	0.496	0.396	0.494	0.184	0.393
borehole	Whether or not have access to borehole	0.564	0.497	0.688	0.468	0.658	0.481
pipewater	Whether or not have access to pipe water	0.348	0.477	0.521	0.505	0.605	0.495
savings&credit	Whether or not have access to savings and credit societies	0.322	0.468	0.375	0.489	0.316	0.471
improve_va	Whether or not to use drough-tolerant crop variety	0.231	0.421	0.191	0.398	0.135	0.347
intercrop	Whether or not to use intercropping in production	0.283	0.451	0.234	0.428	0.270	0.450
crop	Whether or not to cultivate multiple crops	1.764	0.848	1.872	0.992	2.054	1.177
herindex	Inverse herfindex on household income diversification	1.546	0.5388	1.428	0.448	1.644	0.781
sample size		386		47		38	

Table 2. Estimated results of the selection equation

	family-gifters(2)	non-family gifters(3)	family-gifters(4)	non-family gifters(5)
Variables	Coef.	Coef.	Coef.	Coef.
hhsize	-0.115***	-0.130	-0.174***	-0.121
agehead	0.101	0.316*	0.141	0.311
agesq	-0.001	-0.004**	-0.001	-0.004*
educprimary	-0.549	0.405	-0.206	0.259
malehead	-0.158	0.013	-0.278	-0.069
landacres	-0.012***	-0.005	-0.009	-0.030
PCAphysical	0.140*	0.054	0.085	0.064
PCAlivestock	0.203***	-0.437	0.223***	-0.419
villagedum1	1.105***	0.457	1.197***	0.630***
villagedum2	-0.420	-1.468***	-0.254	-1.229***
villagedum3	-0.359***	-1.351	-0.311***	-1.216***
mktinfo	-0.306	-1.304	-0.264	-1.143*
borehole	-0.003	-0.518	0.138	-0.597
pipewater	0.823	1.123	0.864*	1.262*
savings_credits	0.634***	0.987**	0.900**	0.8479**
improve_va			-0.928***	-0.613
intercrop			-0.705**	-0.129
crop			0.165	0.494***
incomeindex			-0.633***	0.355
constant	-3.959***	-7.810***	-3.983	-8.712

Note: (a)* ,** and *** represents 10%, 5%, and 1% significant level, respectively.
(b) Clustered herteroskedasticity is corrected.

Table 3. Estimated results of the FCS equation

Before controlling for risk-reducing stratgegies				After controlling for risk-reducing strategies		
Variables	FCS0(2)	FCS1(3)	FCS2(4)	FCS0(5)	FCS1(6)	FCS2(7)
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
hhsize	-0.010	-0.030	0.025	-0.011	-0.013	-0.009
agehead	0.004	0.00043	-0.067***	0.005	-0.033*	-0.078***
agesq	-0.00006	-0.00002	0.0008***	-0.00005	0.0003	0.0009***
educprimary	0.091	0.131	-0.111	0.149***	0.062	-0.126
malehead	0.057***	-0.405	-0.038	0.076*	-0.195	0.090
landacres	-0.00075	0.035***	0.0004	-0.002	0.030***	0.003
PCAphysical	0.091**	-0.005	0.071**	0.118***	0.088**	0.187***
PCAlivestock	0.055***	0.026	0.433***	0.050***	-0.123***	0.325
miincometot	0.010	0.051***	0.071	0.008	0.060***	0.126***

improve_va				-0.041	0.422***	0.051
intercrop				-0.114***	0.035	-0.148
crop				0.004	-0.046	0.033
incomeindex				0.0421	0.146	0.073*
villagedum1	0.182***	0.631***	0.264***			
villagedum2	0.134***	0.244***	0.493			
villagedum3	0.029*	0.017	0.056			
millratio	0.089	-3.778***	1.034	-0.389	0.014	0.290
constant	3.7434	0.947	5.722	3.528	4.373	5.438

Note: (a) 0 represents autarkists, 1represtns family gifters, and 2 represents non-family gifters.
(b) * ,** and *** represents 10%, 5%, and 1% significant level, respectively.
(c) Clustered herteroskedasticity is corrected.

Table 4. Estimated results of the income equation

Before controlling for risk-reducing stratgegies				After controlling for risk-reducing stratgegies		
Variables	Income0(2)	Income1(3)	Income2(4)	Income0(5)	Income1(6)	Income2(7)
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
hhsize	0.001	0.084	0.035	0.012	0.060	-0.076
agehead	-0.019	-0.090***	0.216	-0.021	-0.095	-0.068
agesq	0.0002	0.0007***	-0.003	0.0002	0.0006	0.0009
educprimary	0.283***	0.302	-0.107	0.224***	-0.338	-0.406
malehead	0.453***	-0.510	0.878***	0.435***	-0.050	1.444***
landacres	0.010*	0.038*	0.025	0.007	-0.001	-0.006
PCAphysical	0.415***	0.404**	0.095	0.419***	0.756***	0.450***
PCAlivestock	0.078	0.154***	0.638	0.1258***	0.0130	0.672
improve_va				0.137**	0.078	0.414
intercrop				-0.189***	-0.291	0.323
crop				0.138***	0.230***	0.161*
incomeindex				0.136	0.134	0.110
villagedum1	-0.058	0.317	1.091***			
villagedum2	-0.015	0.316	0.906***			
villagedum3	-0.365***	-0.42	-1.732***			
millratio	-2.493**	1.067	-4.674***	-3.357***	1.385	0.689
constant	13.203***	16.814***	5.892**	12.456	17.352	15.362

Note: (a) 0 represents autarkists, 1represtns family gifters, and 2 represents non-family gifters.
(b)* ,** and *** represents 10%, 5%, and 1% significant level, respectively.
(c) Clustered herteroskedasticity is corrected.

Table 5. Predicted FCS and income after correcting for selection bias

Before controlling for risk-reducing activities						After controlling for risk-reducing activities					
FCS			Income (ln)			FCS			Income (ln)		
Autarkists	Family gifters	Non-family gifters	Autarkists	Family gifters	Non-family gifters	Autarkists	Family gifters	Non-family gifters	Autarkists	Family gifters	Non-family gifters
3.86	3.79	3.89	14.10	14.22	14.83	3.85	3.82	3.88	14.17	14.30	14.82
(0.42)	(0.48)	(0.37)	(0.75)	(0.92)	(0.59)	(0.20)	(0.31)	(0.23)	(0.73)	(1.18)	(1.08)

Note: numbers in parenthesis is standard deviation.

Table 6. Effect of food gifting before controlling for risk-reducing activities

	FCS			Income		
Gifting	Actual	Counterfactual	Effect	Actual	Counterfactual	Effect
Family gifting	3.79	3.91	-0.12	14.22	15.05	-0.83
	(0.32)	(0.26)	(0.278)	(0.92)	(0.67)	(0.64)
Non-family gifting	3.89	59.86	-0.03	14.83	15.12	-0.29
	(0.24)	(0.20)	(0.17)	(0.82)	(0.50)	(0.62)

Note: numbers in parenthesis is standard deviation.

Table 7. Effect of food gifting after controlling for risk-reducing activities

	FCS			Income		
Gifting	Actual	Counterfactual	Effect	Actual	Counterfactual	Effect
Family gifting	3.83	4.04	-0.21	14.30	15.30	-1.00
	(0.33)	(0.26)	(0.28)	(0.94)	(0.67)	(0.64)
Non-family gifting	3.89	4.05	-0.16	14.83	15.33	-0.50
	(0.24)	(0.20)	(0.17)	(0.82)	(0.50)	(0.62)

Note: numbers in parenthesis is standard deviation.