The Impact of Unconditional Cash Transfer Programs on Farmers: Evidence From Ex-ante Simulations

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Abstract
Direct cash transfer interventions have become more and more popular in developing countries in the last twenty years, but their impact on farmers has not been clearly determined. My goal in this paper is to investigate the indirect effects of unconditional cash transfer programs in rural areas, such as production response. I also look at the consequences of mistargeting (giving cash to non-poor people) and at the impact on non-beneficiaries. For that, I consider a farm household model and simulate transfers in cases of complete and missing markets using GAMs. Results show that the sign of the change in production can be positive or negative depending on which markets are missing. Other indirect effects also vary similarly. Policy implications include the potential of cash transfers interventions for stimulating local production and the need to take into account market conditions when implementing such programs.

Keywords
cash transfers, development program, farm household model, GAMs simulations, missing markets

Introduction

During the 1990s, a new type of development program named Conditional Cash Transfers (CCT) emerged and rapidly grew in importance, mostly in Latin America and the Caribbean. These programs give cash directly to targeted beneficiaries (i.e., the poorest part of the population) as long as they met certain behavioral requirements. This "conditionality" usually regards human capital factors such as school attendance for children, achievement of nutrition or health standards, etc. Thus, these programs aim to both support poorer household's short-term consumption as a safety net and promote long-term human capital investment.

Today, over thirty countries have adopted a form of CCT (see the World Bank website at http://go.worldbank.org/BWUC1CMXM0), implemented by national governments, NGOs, and international agencies. On the other hand, some poorer countries are currently thinking about implementing the same types of programs with no conditions attached: Unconditional Cash Transfer (UCT). Reasons for the absence of conditions range from the administrative complexity of the conditionality to the limitations of education and health supply (i.e., good schools and hospitals) in those countries. These are mostly located in Sub-Saharan Africa; they include among others: Burkina Faso, Cameroon, Ghana, Kenya, Malawi, Mozambique, Niger, and Senegal.

Rigorous ex-post evaluations of CCT have been conducted by researchers in Latin American and other regions to assess the results of a program during and after its implementation based on qualitative and quantitative indicators. They generally showed a success of the programs (Rawlings & Rubio, 2005), especially regarding the conditionality side (e.g., schooling indicators, health visits). More recent studies have started to look at the indirect effect of transfers, for instance the impact on investment (P. Gertler, Martinez, & Rubio-Codina, 2006; P. J. Gertler, Martinez, & Rubio-Codina, 2012) or on non-beneficiaries (i.e., people not receiving cash from the program; Angelucci & De Giorgi, 2009). However, evaluations are still needed for different types of environments, such as Sub-Saharan African (SSA), and for Unconditional Cash Transfers (Devereux, 2006). Except through a few studies, for instance examining children's health in South Africa (Aguero, Carter, & Woolard, 2007) or comparing transfers in food and cash in Ethiopia (Sabates-Wheeler & Devereux, 2010), the impact of Unconditional Cash Transfer programs in SSA is largely unknown.

In this paper, I investigate the indirect effects of unconditional cash transfer programs in rural areas. This means that I will go beyond the impact on consumption of households receiving cash, and look at the impact on both consumption and production of all households in the local economy. Indeed, households can change their production decisions (e.g., how much fertilizer and labor they invest in for their fields) when they get cash transfers. This phenomenon may be especially pronounced when markets are missing (e.g., when agricultural goods are only traded locally) because the introduction of significant amounts of cash can destabilize the entire economy. How do beneficiaries and non-beneficiaries of the program adjust their consumption and production? When markets are missing, how do prices adjust to these changes, and how does this affect all the households participating in the local economy? To answer these questions, I conducted ex-ante simulations using a mathematical farm household model and looked at households' optimal response to the change introduced by the reception of cash transfers. These simulations are run with the General Algebraic Modeling System (GAMs) software, which computes households' optimizing behaviors.

Several researchers (Bourguignon, Ferreira, & Leite, 2003; Rawlings & Rubio, 2005) emphasize the importance of generating ex-ante simulations to help design new programs and enhance their efficiency. Indeed, even when it is possible to conduct ex-post evaluations, ex-ante simulations can help test different alternatives or counter-factual, or allow researchers to estimate marginal effects (e.g., what would happen if the program were not implemented or if the amount of cash were different; Bourguignon et al., 2003). Thus, these ex-ante simulations are a powerful tool to help design cash transfer programs. Moreover, a better understanding of the possible impact of the programs will help generate the political support that these programs need in order to be adopted. Lastly, ex-ante simulations can bring insights regarding targeting (i.e., reaching the intended beneficiary, usually the poor) by looking, for instance, at the cost-efficiency of an investment or at the optimal part of the population that the program should target.

Today, most ex-ante evaluations are simple “arithmetic simulations,” consisting in measuring the effect of the transfers on poverty indicators (Narayan & Yoshida, 2005; Nguetse-Tegoum & Stoeffler, 2012). Some more advanced simulations have been realized for Brazil (Bourguignon, et al., 2003) in order to look at the impact of a CCT program (Bolsa Escola) on child labor. The issue I want to investigate here is different. In Sub-Saharan Africa, several cash transfer programs target rural households, including a pilot program in Cameroon, where 95.5% of the poor live in rural areas (Nguetse-Tegoum & Stoeffler, 2012), and in Ethiopia (Sabates-Wheeler & Devereux, 2010). These programs aim at having an impact on consumption, as do all cash transfers programs, but also on production. This impact on production can occur via several channels, such as productive asset creation, investment, and risk-taking behavior, or a multiplier effect generated by the spending of the transfer (Devereux, 2002; Sadoulet, Janvry, & Davis, 2001), which means that one dollar given to a household has an effect on several other households because of links between these households (e.g., they sell and buy goods to and from each other). In this paper, I mostly consider this later factor by looking at market effects and household responses.

In this context, it is also crucial to understand the effect of mistargeting. Cash transfer interventions give cash only to selected (poor) households rather than to every household. To accomplish this, they employ several targeting methods such as geographic, community, or proxy-means targeting (PMT). This latter technique consists of targeting beneficiary households based on variables that are easy to collect and check, such as household characteristics, house material, belongings, etc. Obviously, there are several definitions of what being “poor” means, and different definitions are used in different programs, but no targeting can achieve perfection (i.e., reach all, and only, the intended poor population; Alatas, Banerjee, Hanna, Olken, & Tobias, 2012). For this reason, there are always poor households excluded from the program and non-poor households included among beneficiaries. Targeting issues have received a lot of attention during the last fifteen years and generated debates, largely stimulated by the use of targeting methods in CCT programs (Castañeda et al., 2005; Coady, Grosh, & Hoddinott, 2002; Grosh, Del Ninno, Tesliuc, & Ouerghi, 2008). However, this debate has been focused on targeting methods and on the efficiency of targeting itself rather than on the impact of good or bad targeting. One obvious impact of mistargeting is that non-targeted poor do not receive transfers. Nevertheless, as shown by a recent paper on the “indirect effect” of transfers (Angelucci & De Giorgi, 2009), non-beneficiaries might still change their production and consumption behaviors because of transfers received in their community.

Farm household models have the potential to simulate this multiplier effect and these changes of behavior. A farm household model specifies a production function and a consumption function for the same household, since a farm unit is both a producer of goods (agriculture) and a consumer of goods (household). This allows us to see that, for instance, an increase in the price of food has potentially two effects for the farm household: a positive effect when the household sells food products and a negative effect when it consumes food. Since their development in the 1970s and 1980s (Singh, Squire, & Strauss, 1986), farm household models have been widely used to show the link between consumption and production in agricultural households due to missing markets (De Janvry, Fafchamps, & Sadoulet, 1991). For that reason, they appear to be an adequate tool for studying the impact of cash transfers under different scenarios (e.g., efficient or inefficient targeting, complete or missing markets). In this paper, I consider these scenarios through simulations, using parameters (i.e., actual values) estimated from data in Taiwan (Lau, Lin, & Yotopoulos, 1978; Yotopoulos, Lau, & Lin, 1976) for the demand and supply of a farm household model.

The following section presents the theoretical farm household model employed in this paper. After this, the data, calibration of the model, and the different scenarios simulated are discussed. The results section includes an explanation of the robustness checks used. Finally, the concluding section summarizes the results of the simulations and discusses their policy implications.

Theoretical Framework: The Farm Household Model

The farm household model here is used to reproduce a village economy, either totally or partially integrated to the rest of the country. Farm households have the particularity to be both producers of goods (as a farm) and consumers of goods (as a household). Their production decisions may be related to their consumption behavior in the case of missing markets—a phenomenon called non-separability (Singh et al., 1986). For this reason, an impact on consumption via cash transfers may have consequences on the production side of the farm.

To keep the model as simple as possible, I start with only two types of households: poor and non-poor. The actual differences between poor and non-poor, and all other parameter values, are described in the next section. In some of the simulations, I consider four types of households because of the difference made between beneficiaries and non-beneficiaries because of mistargeting (i.e., poor receiving transfers and poor non-receiving transfers [errors of exclusion] on the one hand, non-poor not receiving transfers and non-poor receiving transfers [errors of inclusion] on the other hand). In some market situations, these different types of households are linked together by a common market. For instance, in case of a missing market for food, total food consumed in the village has to be equal to the total food produced in the village. For that reason, transferring cash in the village has an impact on all households, beneficiary or not.

These different households consume and produce the same types of goods. One type of goods (food) is produced using four inputs (labor-time, animal input, mechanical input, and fertilizer) and two primary factors (capital assets and land). Three goods are consumed: food, non-food, and leisure (time), where leisure is the time not used as labor supply. Consequently, two of the three goods consumed are also present in the production function: time (labor) as an input and food as an output. This allows us to look at two possible missing markets, food and labor.

The model I use draws on previous work in Taiwan for the production side (Yotopoulos et al., 1976) and for the consumption side (Lau et al., 1978). Similar to these papers, the functional form used is a Cobb-Douglas restricted profit function for production and a Linear Logarithmic Expenditure (LLE) System for consumption. Production is represented by three sets of equations for profit, output, and input, respectively:

$$\ln(\pi/p_f) = \ln(A) + \sum_k \{\beta_k * \ln(w_k/p_f)\} + \sum_j \{\gamma_j * \ln(z_j)\} \tag{1}$$

$$y_f = \frac{\pi}{p_f} * (1 - \sum_k \beta_k) \tag{2}$$

$$x_k = -\frac{\pi}{w_k} * \beta_k \tag{3}$$

where π is profit, p_f is price for food produced, w_k is price of inputs, z_j primary factors, and $k = l, an, m, ft$ for labor, animal inputs, mechanical inputs and fertilizers, and $j = ca, land$ for capital assets and land.

On the consumption side, demand (expressed in budget shares) is represented by one set of equations:

$$\frac{p_i * q_i}{I} = \alpha_i + \sum_j \beta_{ij} * \ln(p_j{}^*) + \sum_h \varepsilon_{ih} a_h \tag{4}$$

where $p_i{}^*$ is the normalized price of consumer goods, q_i is quantity consumed, a_h parameters represent the effect of household demographic characteristics, and $i = a, c, z$ for food consumed, non-food consumed, and leisure. The normalization is used to obtain α_i equal to sample market shares at the initial values: $p^* = \frac{p}{I} * \frac{I_{init}}{p_{init}}$ where I_{init} is initial income and p_{init} are initial prices (the sample average), so that $p^* = 1$ at the initial equilibrium.

Income is the sum of profit from the farm, labor (i.e., total time, which can be consumed as leisure), and existing transfers. When the unconditional cash transfers are simulated, they are added to income:

$$I = \pi + w_l * a_1 * T + trans + UCT \tag{5}$$

where I is income, a_1 is number of adult-equivalent working, T is total time, $trans$ are existing transfers and UCT are unconditional cash transfers (equal to 0 without treatment, and to the value of the transfer after treatment). Thus, income is computed as if households were receiving a wage for all their available time and then buying their leisure time back, as in most household models (Becker, 1965).

Part of this total time is used as labor supply, which is strictly positive, meaning that households cannot consume more leisure than they have total time:

$$L_s = a_1 * T - q_z \quad (6)$$

Two equations represent price linkages between consumer and producer prices:

$$p_f = p_a \quad (7)$$

$$p_z = w_l \quad (8)$$

Finally, two equations represent village quantities linkages when food or labor markets are missing (i.e., the market clearing conditions):

$$\sum_i {y_f}^i = \sum_i {q_a}^i \quad (9)$$

$$\sum_i {L_s}^i = \sum_i {q_z}^i \quad (10)$$

where i is the household type, with $i = p, np$ for poor and non-poor. In case of mistargeting, I differentiate between households receiving transfers and those not: $i = p, np, puct, npuct$ for poor not receiving UCT, non-poor not receiving UCT, poor receiving UCT, and non-poor receiving UCT, respectively. Equation (9) is added when the market for food is missing, and (10) when there is no market for labor.

Thus, the total number of equations included in the system depends on the scenario considered. This total number of equations ranges from 13 for a scenario with one type of household and no missing markets and up to 72 for two missing markets and mistargeting (i.e., four types of households).

Several restrictions are imposed on parameters to guarantee homogeneity and desirable properties of the indirect utility function such as convexity. On the production side:

$$\beta_k \leq 0, \forall\, k \quad (11)$$

$$\sum_i \gamma_j = 1 \tag{12}$$

$$\sum_i \alpha_i = -1 \tag{13}$$

$$\sum_i \beta_{ij} = -1, \forall\, j \tag{14}$$

$$\beta_{ij} = \beta_{ji}, \forall\, i, j \tag{15}$$

$$\sum_i \varepsilon_{ij} = 0, \forall\, j \tag{16}$$

All these specifications are those of the study conducted in Taiwan (Lau et al., 1978), which I follow for this theoretical framework. I also used their work for the calibration of the model (i.e., the numerical estimates of the parameters), as shown in the next section.

Data, Model Calibration, and Settings

It would have been possible to calibrate the production and consumption functions with micro-data from Sub-Saharan Africa and to use these parameters for the simulations. However, I preferred to use the parameters already calibrated for Taiwan in previous work (Lau et al., 1978; Yotopoulos et al., 1976). Indeed, the estimation for Taiwan has received a lot of attention by Lau, Lin, and Yotopoulos, who devoted several seminal articles to this work. For this reason, it seemed more robust to use their parameters rather than estimating with unknown data, since my work is not applied to a given country but is an illustration of the potential effect of cash transfers. This assures that the results are driven by the simulations themselves rather than by a new estimation of the parameters. Besides, the data is only used to *calibrate* the model (i.e., put actual values on the parameters presented in the previous section). However, an extension of this work could be to produce similar estimations with production and consumption functions estimated in a Sub-Saharan Africa context (see also Discussion section).

The data used for this work come from the *Report of Farm Record-Keeping Families in Taiwan* of the Taiwan Provincial Government, for the years 1967 and 1968. They contain information on 400 households. Data are aggregated over two years, five size classes of farms, and eight agricultural regions, which are assumed to have identical consumption and production functions.

Functions parameters are presented in Table 1 below and are the same in all the simulations. However, I performed a sensitivity analysis on these parameters at the end of this section for simulation 2.

Table 1. Parameter values for production and consumption equations

Parameter	Value	Parameter	Value
β_2	-0.9798	β_{AA}	-0.0250
β_3	-0.0356	β_{AC}	-0.0420
β_4	-0.0017	β_{CC}	-0.1390
β_5	-0.2306	ε_{A2}	-0.0630
γ_1	0.0702	ε_{C2}	0.0
γ_2	0.9298	a_1	3.7
α_A	-0.1450	a_2	1.0
α_C	-0.3290	T	365

Sample averages are presented in Table 2 below. These values are used as starting values for simulations with one type of household and no missing markets, and then adjusted to provide an initial equilibrium when types change or when markets are missing. This means that pre-existing transfers, for instance, are adjusted so that at the initial equilibrium, total supply of food is equal to total demand for food, in the case of a missing market for food. To differentiate poor from non-poor, for instance, I lowered the values of capital assets, land, and transfers for the poor households, since poor households are typically deprived of these resources.

Table 2. Sample average values

Variable	Value	Variable	Value
P_A (\$/kg)	\$3.40	q_A (kg)	3158.79
P_C (\$/kg)	\$26.80	q_C (kg)	909.27
P_Z (\$/day)	\$33.60	q_Z (day)	1159.52
Trans	\$-4,553.59	UCT	\$7,000
P_f (\$/kg)	\$3.40	y_f (kg)	21964.641
w_l (\$/day)	\$33.60	x_l (day)	968.864
w_a (\$/day)	\$46.00	x_a (day)	25.713
w_m (\$/hour)	\$53.23	x_m (hour)	1.062

w_{ft} ($/kg)	$2.30	x_{ft} (kg)	3331.165
z_k	43045.0	z_t	1.0

Note. P_A, P_C, P_Z: price of food, non-food, leisure (time) consumed; Trans: net value of existing transfers to the household (before UCT program); P_f: price of food produced; w_l, w_a, w_m, w_{ft}: price of labor (wage), animal inputs, mechanical inputs, fertilizer; z_k, z_t: primary factor in capital, land; q_A, q_C, q_Z: quantity of food, non-food, and leisure consumed; UCT: cash transfer amount; y_f: quantity of food produced; x_l, x_a, x_m, x_{ft}: quantity of labor inputs, animal inputs, mechanical inputs, and fertilizer inputs used.

To see the impact of cash transfers, I look at several possible scenarios regarding the targeting and the market situation. Table 3 summarizes the setting of the different simulations. Only the simulations that are most relevant for the research question are included here. Most simulations with only one household type (no difference between poor and non-poor), for instance, are not included. A base transfer of $7,000 per year is given to each beneficiary household. This means that the transfer is calibrated to represent a bit less than 10% of the household consumption (or about 20% of households' non-leisure expenditures, which is the upper bound of what is usually done in cash transfers programs in Sub-Saharan Africa). The value of transfers is lower in scenarios 4 and 5 with two missing markets, because the distortive impact would have been too high with higher cash transfers. These relatively low transfers ($2,600 per year) already provide sizeable and insightful changes in households' behavior.

Table 3. Different scenarios used in the simulations

Scenario	Missing market	Targeting	Difference between households	Value of the transfer
1	None	None	None	$7,000
2	Food	Good	Poor and non-poor	$7,000
3	Food	Mistargeting	Poor and non-poor	$7,000
4	Food and labor	Good	Poor and non-poor	$2,600
5	Food and labor	Mistargeting	Poor and non-poor	$2,600

All the simulations are programmed in GAMs using a constrained non-linear system of equations. They consist in computing the new equilibrium prices, demands and supplies based on equations (1) through (10) presented in the theoretical framework section. With additional transfers due to the UCT, consumption of goods will increase, as seen in equation (4). When a market is missing, the price will adjust so that supply equals demand in the missing market (equations 9 and 10), causing profits and production to shift ((1) and (2)). These two changes further impact consumption, since prices and profits also enter into consumption (4). In these simulations, I want to investigate which effects dominate (i.e., what is the direction and magnitude of the changes for each type of household in different scenarios).

Simulation Results

Simulation 1: Benchmark without missing markets

This simulation is only a benchmark to show what happens without missing markets. When all markets are complete, there is no connection between the consumption side and the production side of the farm household. This is the separable farm household model. Indeed, prices are exogenous in this scenario, so the change in income caused by UCT only impacts consumption. In addition, with the LLE specification, the consumption of each good increases in the same proportion: budget shares stay constant. These results are shown in Table 4.

Table 4. Simulation 1 (one type, with no missing markets)

Variable	Percentage change
Quantity of food consumed	9.45
Quantity of non-food consumed	9.45
Quantity of leisure consumed	9.45
Quantity of food produced	0
Input of labor	0
Animal input	0
Mechanical Input	0
Input of fertilizer	0
Labor supply	-57.378
Profit	0
Income	9.45

In this situation, total income increased by 9.45% because of the transfer, and so increased consumption of the three goods. One can notice a large decrease of labor supply because of the increase of leisure consumption (see next section for a discussion of this result).

Simulations 2 and 3: Missing markets for food with good and bad targeting

These two scenarios include several modifications of the benchmark model. First, a distinction is made between poor and non-poor households, where half of the households are poor and the other half are non-poor. This is modeled with two households: one poor household and one non-poor household. This 50% poverty rate is typical of the Sub-Saharan regions in which UCT programs are currently implemented. In Cameroon, for instance, the national poverty rate is 39.9%, and is higher than 60% in the two Northern provinces (Nguetse-Tegoum & Stoeffler

2012). Second, households are linked together by a missing market for food: all the food consumed in the village is produced in the village. Simulation 2 corresponds to a perfect targeting, while simulation 3 introduces mistargeting, since only half of the poor and half of the non-poor also receive transfers (so errors of exclusion and inclusion are both of 50%). Results are respectively presented in Table 5 and Table 6.

Simulation 2 shows several interesting effects. Poor households become richer, which makes them willing to consume more of the three goods. This is the so-called *income effect*. However, they cannot consume more food if production does not increase, which pushes prices upward and limits the increase of the consumption of food by the poor (which is lower than the increase of other goods). This is the *substitution effect*: when prices change, households buy less of the goods whose prices increase and more of the other goods. This increase of price of food also creates an increase of the production of food (by 3.65%). Input use (e.g., fertilizer) increases proportionally to this increase of profit because of the increase of production, including labor since the labor market is complete for the moment (so labor can be hired outside of the village). Increase of the quantity of non-food is the greatest because substitution effect (food is more expensive, so they switch to non-food) and income effect (profit and transfers both increase) adds up. Increase of leisure is slightly less because an increase in leisure decreases income.

For the non-poor, the quantity of food consumed decreases because of the change in prices. Again, non-food consumption increases more than leisure, for the same reason that it did with the poor. The production response is the same for poor and non-poor; since they see the same change in the price of food, so it increases for both of them. The Cobb-Douglas specification (see section 2) leads to an equal percentage change for the poor and the non-poor. However, quantities produced are not equal for poor and non-poor, before and after. Poor households supply less food and are net buyers of food, while non-poor households are net sellers. This is typical than situations observed in Sub-Saharan Africa.

Table 5. Simulation 2 (missing market for food, with good targeting)

Variable	Poor households (% change)	Non-poor households (% change)
Price of food	2.91	
Quantity of food consumed	12.16	-1.93
Quantity of non-food consumed	15.28	0.80
Quantity of leisure consumed	14.44	0.07
Quantity of food produced	3.65	3.65
Input of labor	6.67	6.67
Other inputs	6.67	6.67
Labor supply	-18.53	-0.40
Profit	6.67	6.67

Income	14.86	0.43

Introducing mistargeting in simulation 3 creates differences between responses of different types of households (poor and non-poor) and between the targeted and the non-targeted. As indicated in Table 6, targeted non-poor have a lower percentage change in consumption than the poor, since their level of consumption was initially higher. Changes for poor households that do not receive transfers are more interesting. Their food consumption decreases because of the higher price of food. However, they compensate for this decrease by increasing consumption of non-food and of leisure. The profit effect dominates: their total income increases (as for the non-targeted non-poor). This shows that transfers do not heavily penalize non-targeted households (even the mistargeted poor), since the overall effect is even slightly positive. Regarding production, changes are the same as in simulation 2, since the price change is identical.

Table 6. Simulation 3 (missing market for food, with mistargeting)

Variable	**Targeted poor households (% change)**	**Targeted non-poor households (% change)**	**Non-targeted poor households (% change)**	**Non-poor households (% change)**
Price of food	2.91			
Quantity of food consumed	12.16	7.30	-1.93	-1.93
Quantity of non-food consumed	15.28	10.28	0.80	0.80
Quantity of leisure consumed	14.44	9.48	0.06	0.07
Quantity of food produced	3.65	3.65	3.65	3.65
Input of labor	6.67	6.67	6.67	6.67
Other inputs	6.67	6.67	6.67	6.67
Labor supply	-18.53	-57.53	-0.08	-0.40
Profit	6.67	6.67	6.67	6.67
Income	14.86	9.88	0.43	0.43

Note. Changes for poor and non-poor households not receiving transfers are not identical (except for the production side) but the difference is usually seen at the second decimal.

Simulations 4 and 5: Missing markets for food and labor, with good and bad targeting

These two last simulations consider the situation in which the food and labor markets are both missing, which corresponds to the situation of a remote village or region where only non-food goods are imported from the rest of the country. Again, scenario 4 considers perfect targeting while scenario 5 represents a situation of mistargeting of half of the households (similar to scenario 3). Results for simulations 4 and 5 are shown in Tables 7 and 8, respectively.

Scenario 4 generates a much larger increase in prices than when only the food market is missing: 18.52% for the price of food (compared to 2.91% previously) and 36.52% for the price of labor. The change in labor prices makes production costs much higher. Consequently, despite the income effect for poor households (due to the transfers) which could push households to consume more food, quantity of food consumed and produced decrease. Consumption of food, however, only decreases slightly for poor household because of the income effect of transfers; it decreases much more for non-poor household. Overall, consumption of goods by poor households increases while consumption by non-poor households decreases; this shows that the income increase of poor households is positive despite this high inflation, while inflation is higher than the income increase for non-poor. Finally labor supply decreases because of this large decrease in production and because of a substitution of other inputs for labor inputs (now more expensive).

These results show that here, with two missing markets, the impact on consumption is not as high as expected (and is even negative for food) and the impact on production is clearly negative. Transfers cause prices to change greatly and behaviors to adjust similarly.

Table 7. Simulation 4 (missing market for food and labor, with good targeting)

Variable	Poor households (% change)	Non-poor households (% change)
Price of food	18.52	
Price of labor (wage)	36.52	
Quantity of food consumed	-3.00	-13.04
Quantity of non-food consumed	13.04	1.35
Quantity of leisure consumed	14.40	2.57
Quantity of food produced	-8.89	-8.89
Input of labor	-20.90	-20.90
Other inputs	7.98	7.98
Labor supply	-22.47	-16.38
Profit	7.98	7.98
Income	24.69	11.79

When I include mistargeting in simulation 6, the impact on targeted poor and non-targeted non-poor is the same as in scenario 5, but the impact on mistargeted households is severe compared to the case with only one missing market (scenario 4). Food consumption of poor mistargeted households clearly decreases (-9.50%) but is compensated by an increase in consumption of the two other goods (which represent almost 80% of the initial budget share of households here). Indeed, these households are able to compensate the decrease in consumption of food and in production by only slightly decreasing labor supply (-10.51%), and thus largely benefitting from the increase in wages (36.52%). Thus, the impact of mistargeting on poor households is mixed. The decrease in food consumption is large but is compensated by a substantial increase in the consumption of other goods.

For the targeted non-poor households (errors of inclusion), the change in labor supply is substantial (-50.84%). For these households too, the decrease in food consumption is (largely) compensated by an increase of consumption of the two other goods. Regarding the non-beneficiaries non-poor, they are in a similar situation than the non-targeted poor, except that their initial leisure is different (lower initial labor supply). Thus, to increase leisure, they have to provide a stronger decrease of their labor supply (compared to the poor). Consequently, their food consumption falls more than consumption of the poor while leisure and non-food increase slightly. They seem clearly destabilized by the transfers in the area.

Table 8. Simulation 5 (missing market for food, with mistargeting)

Variable	Targeted poor households (% change)	Targeted non-poor households (% change)	Non-targeted poor households (% change)	Non-poor households (% change)
Price of food	18.52			
Price of labor	36.52			
Quantity of food consumed	-3.00	-8.46	-9.50	-13.04
Quantity of non-food consumed	13.04	6.69	5.47	1.35
Quantity of leisure consumed	14.40	7.97	6.74	2.57
Quantity of food produced	-8.89	-8.89	-8.89	-8.89
Input of labor	-20.90	-20.90	-20.90	-20.90
Other inputs	7.98	7.98	7.98	7.98
Labor supply	-22.47	-50.84	-10.51	-16.38
Profit	7.98	7.98	7.98	7.98
Income	24.69	17.68	16.34	11.79

Most households seem better off after the program than before, which is an important result. However, looking at the changes in prices and labor supply, we notice that this village economy is clearly destabilized by the transfers in case of two missing markets.

A summary of the results is given in Figure 1 for the change observed in food consumption depending on the simulation and on the household's type. The sign and the magnitude of the impact vary greatly in each simulation for a given household type, and also for each household type in a given simulation.

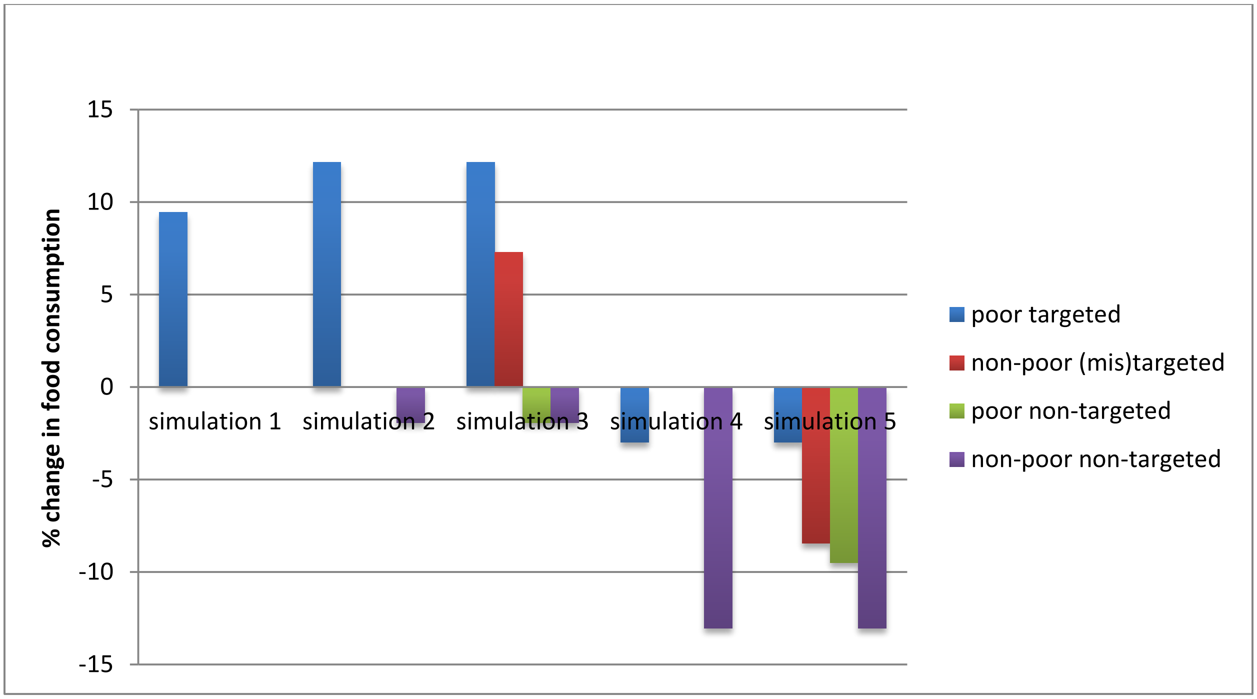

Figure 1. Change in food consumption for simulation 1 (one type, complete markets), simulation 2 (missing food market), simulation 3 (missing food market, mistargeting), simulation 4 (missing food and labor markets), and simulation 5 (missing food and labor markets, mistargeting).

Robustness check: Systematic sensitivity analysis

A systematic sensitivity analysis has been applied to simulation 2 in order to see the robustness of the results of this simulation, using a Gaussian quadrature approach (Arndt, 1996; DeVuyst & Preckel, 1997). This shows how the results change when a systematic set of values is explored for the parameters. Simulations were re-run twenty times with different values for the parameters. The distribution of the parameters used is presented and discussed in the Appendix (Table A1). The principle limitation is that our specification does not allow for the exploration of a wide range of parameters.

The average, minimum and maximum values of the twenty simulations run with the Gaussian quadrature values are presented in Table 9. Results show that if base values clearly change when parameters are modified, the percentage change of household's production, consumption, and income is relatively limited. Indeed, the average percentage change is almost identical to our baseline scenario (simulation 2 above). More interesting are the extreme values taken by the percentage change. Again, most of the variables do not see a drastic change. A few of them deserve further attention however. First, the quantity of labor supply of the non-poor can increase or decrease but is always very close to zero. Its actual sign depends on the dominant effect between the income and substitution effect on the one hand, which pushes non-poor to consume more leisure due to the increase in food prices. On the other hand, the income effect on the consumption side is also due to the increase in food prices, which pushes non-poor household to work more to make up for loss of consumption. In any case, the magnitude of this effect is very small. Also, the extreme value taken in some cases by the labor supply of these non-poor households is explained by the fact that with our specification, in some cases, non-poor households almost never supply labor—so a small change cut up to 53.32% of the little number of days they were working. See the following section for a discussion of this leisure/labor issue. Except for this variable, all the changes have the same sign in the twenty sensitivity simulations, which indicates a strong robustness of the simulation.

Table 9. Results of the sensitivity analysis

	Average over simulations		**Minimum of the simulations**		**Maximum of the simulations**	
Variable	**Poor (% change)**	**Non-Poor (% change)**	**Poor (% change)**	**Non-Poor (% change)**	**Poor (% change)**	**Non-Poor (% change)**
Price of food	2.92		2.62		3.21	
Quantity of food consumed	12.15	-1.91	11.74	-2.18	12.79	-1.60
Quantity of non-food consumed	15.28	0.83	14.90	0.52	15.73	1.16
Quantity of leisure consumed	14.41	0.07	14.00	-0.15	14.73	0.27
Quantity of food produced	3.65	3.65	3.35	3.35	4.09	4.09
Input of labor	6.68	6.68	6.25	6.25	7.40	7.40
Other inputs	6.68	6.68	6.25	6.25	7.40	7.40
Labor supply	-18.87	-5.08	-27.43	-53.32	-11.08	1.79
Profit	6.68	6.68	6.25	6.25	7.40	7.40
Income	14.85	0.45	14.67	0.28	15.04	0.62

Discussion

Regarding the overall results presented in the previous section, a few things appear clearly. The impact of cash transfers on the consumption of the poor is always clearly positive for the targeted household, but it is not always positive for every good. Indeed, all our results crucially depend on market conditions. With missing markets only for food, both consumption and production of food increase for the poor (and production also increases for non-poor households). On the other hand, with missing markets for food and labor, both consumption and production of food decrease for the two types of households. Thus, the impact of a transfer cannot be *a priori* predicted without knowing the market situation of the area where beneficiaries live, especially regarding food consumption and production. This has been confirmed by ex-post evaluations in which disappointed results of cash transfers have been observed (Sabates-Wheeler & Devereux, 2010). This also justifies recent interest in markets and market conditions for a growing number of development economists (Barrett, 2009; Fafchamps & Hill, 2008; Stoeffler, 2009). The World Bank (http://go.worldbank.org/BWUC1CMXM0) is well aware of this limitation of cash transfers and recommends avoiding the use of cash transfer interventions during crisis situations such as wars or natural disasters for this reason. However, missing markets are not limited to such crises (De Janvry et al., 1991), which is why they deserve particular attention before implementing cash transfer programs.

These conclusions also hold for the consequences of mistargeting. When only a food market is missing, mistargeting does not severely hurt mistargeted poor households. While they seem slightly less well off, their overall consumption does not change much. When both food and labor markets are missing, the result is different. Food consumption of mistargeted poor households largely decreases, but their consumption of other goods makes up for this loss, and they end up consuming more than before. Their consumption pattern is also much more disturbed in this case overall.

However, a crucial parameter deserves discussion. Leisure demand seems to play a very large role in the observed changes. With our LLE specification (see section 2), this is due to the large initial share of leisure in household consumption. One consequence is the large change in labor supply and labor/leisure prices. This large leisure elasticity is questionable in a Sub-Saharan context for two reasons. First, high poverty levels make it unlikely that households prefer to consume leisure rather than taking advantage of higher income to consume more food and non-food goods or than using this extra income for purposes not modeled here (such as savings and investment). The second reason is that in several Sub-Saharan African countries, the agricultural season is of limited duration and follows the calendar of the meteorology (rainfalls, etc.). Consequently, labor might be constrained during these periods, and leisure forced during the rest of the year.

Here it is important to understand that leisure should not be understood as passivity in a Sub-Saharan Africa context. Indeed, in this context leisure embraces domestic work and childcare for instance. In addition, a decrease of labor supply might be due to a decrease of child labor. Consequently, an increase of leisure might be an outcome as desirable as an increase of the consumption of food. Still, even with these explanations, it is difficult to believe that poor households receiving transfers would *both* decrease their consumption of food and increase their consumption of leisure, which is what we see in the scenario with two missing markets. Adopting a more realistic household behavior in our model might change some of the results regarding production, which could possibly increase in all our scenarios if leisure does not increase.

In order to improve our model in this direction, several features would be desirable. First, it would be appropriate to estimate production and consumption functions using recent data from countries in Sub-Saharan Africa. Then, more flexible functional forms for the production and utility functions might be useful (i.e., functions that constrain fewer households' behavior). The Cobb-Douglas specification used here is especially restrictive on the production side, but the consumption function should also be more flexible in order to avoid this large leisure effect. Finally, it might be desirable to separate poor and non-poor households when production and consumption functions are estimated, in order to obtain different parameters for these two types of households. Indeed, it is likely that the poor have different elasticity parameters. For instance, they are probably less willing to decrease food consumption than non-poor households given their low initial level of consumption. Their production response might also be different. This separation between categories of households has not been made in the articles I followed (cf. sections 3) because of the small sample size but is absolutely feasible in further research.

However, even with those improvements, it seems that the model would miss a large part of the impact of UCT, as mentioned in the introduction. First, transfers have an impact on production behavior through risk aversion, which usually decreases when income increases thanks to the transfers. Farmers receiving transfers are expected to be able to diversify their production and increase their profit through riskier investments. A crop portfolio model would be needed to capture this additional effect. Second, other "indirect effects" of the transfers have also an important role: investment, relaxation of the cash constraints, and gifts and credits to non-beneficiaries. These effects have an impact at the level of the household, but also a larger "multiplier" effect in the area. This is why neglecting them might largely underestimate the impact of the transfers. This might be a natural limitation of household models in predicting the impact of large cash transfers, and calls for the use of a dynamic programing approach.

That being said, household models are an excellent way to illustrate one of the consequences of these indirect effects of cash transfers (i.e., price changes and households' adjustments). The limitations mentioned also make them more tractable than more complex models, and different causes stay clearly identifiable here. Moreover, most of the changes in prices and consumption or production behaviors have a clear intuitive interpretation. There is still room for improvement. Even so, the model presented here decidedly shows expected responses and various possible situations under different market conditions and targeting scenarios.

Conclusion

The goal of this paper was to examine the effect of cash transfers on a village economy by using a farm household model and to simulate (ex-ante) the impact of the transfer with the GAMs software. This allowed us to see changes in consumption—what food, goods, and leisure the household consumes—but also in agricultural production when some markets are missing. The principal simulations looked at the case of a missing food market first (i.e., all the food is traded locally) and then at the case of both missing food and labor markets (i.e., all the labor is also found locally, in the village). I considered perfect targeting, but also bad targeting, when some non-poor get the cash supposed to go to the poor. The results show a decisive influence of the market conditions, resulting in opposite impact for some crucial variables such as food consumption and food production, depending on which markets are missing. The impact of mistargeting is also more or less important depending on which scenario is considered. Further research should try to expand this simple farm household model to correct non-realistic features and enrich its structure.

While the model presented here can be improved, policy implications are clear. A substantial production response has to be envisaged in one way or another when cash is given to poor households. Since households adjust to the new conditions and prices, and since the transfers also have an impact on non-beneficiaries, they have the potential to stimulate agricultural production. Consequently, cash transfer programs must be considered not only as social assistance programs to the poorest, but also as development programs having the potential to stimulate the local economy and get households out of poverty traps. However, since cash transfers can also have adverse effects (especially by decreasing agricultural production) special attention must be given to the market conditions before starting cash transfers programs in rural Sub-Saharan Africa.

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Appendix: Parameter Distribution for Sensitivity Analysis Using the Gaussian Quadrature Approach

I assumed a uniform distribution for the parameters of the profit and LLE functions. To respect the homogeneity conditions, only independent parameters vary and other parameters adjust to this change. The range of values possibly explored is limited because of our non-flexible forms (or not-very-flexible form for the LLE). Indeed, it was necessary to guarantee convexity of the utility function and to have negative price elasticity of labor supply and positive price elasticity of food supply from the households. Another difficulty was to avoid giving to too much elasticity to leisure, since total consumption of leisure cannot exceed total time (in other words, labor supply cannot be negative). This forces us to keep a restricted range of values for the parameters. The mean, minimum, and maximum values used to compute the Gaussian quadrature are presented in Table A1.

Since I test the sensitivity of the estimate of ten varying parameters, twenty simulations are needed to cover the different combinations of the Gaussian quadrature method. Each of these simulations parallels scenario 2: missing market for food and good targeting.

Table A1. Range of values used in the sensitivity analysis

Parameters	Mean	Lower	Upper
β_2	-0.98	-1.0666	-0.8934
β_3	-0.036	-0.066	-0.006
β_4	-0.0017	-0.0032	-0.0002
β_5	-0.23	-0.3062	-0.1538
γ_1	0.0702	0.0402	0.1002
α_A	-0.145	-0.195	-0.095
α_C	-0.329	-0.429	-0.229
β_{AA}	-0.025	-0.045	-0.005
β_{AC}	-0.042	-0.068	-0.016
β_{CC}	-0.139	-0.2065	-0.0715