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Agricultural Spillover Effects of Cash Transfers: What Does LEWIE Have to Say? [1]

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Growing numbers of Sub-Saharan African (SSA) countries are implementing social cash transfer (SCT) programs, which distribute cash to extremely poor and vulnerable rural households. All have objectives that go beyond raising consumption and welfare in beneficiary households, from promoting better nutrition and health to increasing school attendance and discouraging risky sexual behavior. Inspired by findings from some micro-econometric research that SCTs may loosen liquidity constraints on investments (e.g., Sadoulet, de Janvry, and Davis 2001), an initiative spearheaded by the United Nations Food and Agriculture Organization (FAO) and the United Nations Children's Fund (UNICEF) seeks to test whether Africa's new SCT programs generate productive impacts, particularly on agriculture, the sector from which most rural households derive their main livelihoods.

On the face of it, the design of these programs would seem to work against the creation of positive production spillovers. Targeting strategies limit eligibility to resource-constrained and labor-poor households; most beneficiaries are elderly or infirm, and some are child household heads. To date, randomized control trials (RCTs) offer some evidence that SCTs may have productive impacts on beneficiary households in SSA (Covarrubias, Davis and Winters 2012; Asfaw et al. 2012). The question of whether or not SCTs have positive impacts on production is important, because if they do not, there is a tradeoff between social and productive objectives and a potentially high opportunity cost of using scarce public funds for transfer programs.

We argue that SCTs may indeed have significant productive impacts, but impact evaluation research, which focuses on beneficiary households, may be looking for these impacts in the wrong places. From a local economy-wide perspective, the beneficiary households are a conduit through which new cash enters the rural economy. As they spend their cash, the beneficiary households unleash general equilibrium (GE) effects that transmit program impacts to others in the economy, including non-beneficiaries. Most households that do not receive SCTs are ineligible because they fail to meet poverty-related criteria and are not labor constrained. They may be better positioned to expand production when SCTs stimulate local demand.

We employ a local economy-wide impact evaluation (LEWIE) model to simulate effects of SCTs on production in Kenya, which is scaling up its cash transfer programs nationwide. Our model is grounded in the micro economy-wide impact simulation approach developed by Taylor and Filipski (2012). It integrates treated and non-treated households into a GE model of project areas, designed to uncover spillovers from government programs and other external shocks. The model parameters are estimated econometrically with data from household surveys created for RCT evaluations but expanded to include ineligible households, as well as a business enterprise survey implemented alongside household surveys. Standard errors from the parameter estimates are used along with Monte Carlo techniques to construct confidence intervals around simulated production impacts of Kenya's Cash Transfer Program for Orphans and Vulnerable Children (CT-OVC).

The Program

The CT-OVC program transfers a flat monthly payment of Ksh 1500 (approximately US $21, increased to Ksh 2000 in 2011/12) to households that are ultra-poor and count orphans or vulnerable children (OVC) among their members. The program reached over 130,000 households across the country in 2011 and is projected to reach 300,000 households (details in Asfaw et al. 2012).

The primary goal of the CT-OVC program is to build human capital and improve the care of OVC (OPM. 2010); however, there are reasons to believe that the program affects the economic livelihood of both beneficiary and non-beneficiary households. The program transfers represent a significant share of beneficiary-household income (14%, by our calculations) and inject a considerable amount of liquidity into local economies. As the beneficiary households spend their income, they transmit program impacts to other households within the local economy, including ineligible households. Whether the new demand stimulated by the transfers results in a real expansion of the local economy or price inflation depends on the local supply response as well as the local economy's integration with outside markets.

The Model

LEWIE simulations are designed to assess the likely impacts of government programs like the CT-OVC on the local economy, including indirect effects on ineligible households. The households modeled in LEWIE are thus categorized following the CT-OVC program selection criteria. Group A includes eligible households, which meet the poverty criterion and include OVCs. Group C (non-poor) and Group E (no OVC) are both ineligible (see table 1).

LEWIE nests household-farm models for each of these household groups. The household models describe productive activities, income sources, and expenditure patterns. Household groups participate in crop and livestock production, retail, service, and other production activities, as well as in the labor market. Production activities combine five different factors (hired labor, family labor, land, capital, and purchased inputs) using Cobb-Douglas technologies, with intermediate-input demands described by Leontieff input-output relationships. Household groups follow Stone-Geary preferences to purchase goods and services either locally, in village stores (which obtain most of their merchandize from outside the village), or in the rest of Kenya. There are three levels of market clearing. Household groups in a given village are linked by local trade, and villages are linked by regional trade. The whole region also interacts with the rest of the country, “importing” and “exporting” goods and selling labor. The equations in the GE-LEWIE model are summarized in an on-line Appendix.

Data, Parameterization, and Monte Carlo Simulation

This paper reports analyses for two eastern districts (modeled as a single region), Garissa and Kwale, which are part of the program evaluation area in Phase 2 of the pilot study (2007 to 2009). We selected these districts because they are less market-integrated than the other districts in the evaluation area. Table 1 reports average per-capita expenditures by household group and average household expenditure shares on items bought beyond the village and neighboring villages.[2] Weaker interactions with outside markets mean fewer leakages and thus greater potential to detect impacts within the local economy.

Survey data have two main purposes in the construction of LEWIE models: they provide initial values for all variables in the model along with the data to econometrically estimate each model parameter and standard error. We use four data sources to collect income and expenditure information for each household group and business type (activity): the 2009 and 2011 iterations of the Kenya Health, Economic, Demographic and Social Survey of Families with OVC (HEDS-OVC);[3,4] the 2004-2005 Kenya

Integrated Household Budget Survey (KIHBS);[5] a 2011 business enterprise questionnaire developed specifically for this project.

Income and expenditure data were culled from the 2001 HEDS survey (Group A) and the two rounds of KIHBS (groups C and E).[6] They were used to estimate totals and marginal budget shares for Stone-Geary utility functions without subsistence minima. Production data are from the KIHBS and business survey. Because the KIHBS is a national survey unrelated to the CT-OVC rollout, we took care to identify the household groups and program region using geographic, demographic, and income criteria. All values were inflated to 2011 Ksh.[7]

Base values for variables and estimated values for parameters (with standard errors) were obtained for all sectors and households and organized into a data input spreadsheet designed to interface with GAMS, where the LEWIE model resides. (The complete data input spreadsheets are available in an on-line appendix.) The model is calibrated directly from this spreadsheet rather than from a Social Accounting Matrix (SAM), as is usually done in GE analysis (the methodology is described in Taylor 2012).

Validation is always a concern in GE modeling. Econometrics provides us with a way to validate the model's parameters: significance tests provide a means to establish confidence in the estimated parameters and functions used in our simulation model. If the structural relationships in the simulation model are properly specified and precisely estimated, this should lend credence to our simulation results. Assumptions concerning functional form are critical to GE models, but they are equally critical to any econometric estimation exercise (including those involving experiments). The same methods used to choose among functions in econometric modeling can be used to decide upon functions in a simulation model. The same methods used to verify any econometric model (e.g., out-of-sample tests) are relevant when parameterizing simulation models.

Econometric estimation of model parameters opens up a new and interesting possibility in regard to validation. The estimated standard errors for each parameter in the model can be used together with Monte Carlo methods to perform significance tests and construct confidence intervals around project impact simulation results. We proceed as follows. First, we make a random draw from each parameter distribution obtained from the micro-data (assuming normality and truncating at zero when necessary). We repeat this J (here, 500) times for each parameter, thus obtaining J sets of model parameters. Each set calibrates a different baseline for the LEWIE model. Each baseline is used to simulate the cash transfer, yielding J sets of simulation results. For each outcome of interest Y, we can then construct percentile confidence intervals over the J simulated values, as is done for bootstrapping.

This Monte Carlo procedure allows us to use what we know about the variances of all the parameter estimates simultaneously to perform a comprehensive sensitivity analysis grounded in econometrics. If the model's parameters were estimated imprecisely, this will be reflected in wider confidence bands around our simulation results, whereas precise parameter estimates will tend to give tighter confidence intervals. The precision of some parameter estimates might matter more than others within a GE framework. Structural interactions within the model may magnify or dampen the effects of imprecise parameter estimates on simulation confidence bands.

Findings: Local Economy-wide Production Multipliers of Cash Transfers

The GE-LEWIE model was used to simulate the impacts of the initial CT-OVC on the project-area economy, taking into account nonlinearities and local price effects. Simulations require making assumptions about where and how prices are determined (that is, market closure, which usually is not known); we test the sensitivity of findings to these assumptions. The simulations presented below assume some goods and factors are only traded locally, reflecting high transaction costs with the rest of the country and abroad. Land inputs are fixed in each activity. Services and family labor are only traded locally at a village price or wage, while local crops, livestock, and hired labor can be traded regionally at regional prices. Conversely, “other production” (cash crops, crafts, etc.), commercial inputs for production, and goods purchased outside the region all have exogenous prices. Local retailers purchase most of their merchandise (72%) at fixed prices outside the local economy but sell them at a price that includes an endogenous markup rate. This limits the extent to which increases in local retail demand can exert upward pressure on retail prices, and it makes the retail sector a major source of income leakages. In addition, the base simulation assumes that capital is fixed and purchases of commercial inputs are limited by a liquidity constraint, reflecting the lack of a well-functioning credit market. It also assumes labor supply is nearly perfectly elastic (elasticity=100), reflecting high levels of un- and under-employment typical of poor rural areas. Excess labor supply can be expected to lower inflationary pressures by limiting wage increases.[8] These last three assumptions are relaxed in simulations 2 and 3.

Table 2 presents the simulated impacts of the CT-OVC in terms of production and income multipliers (expressed in shillings per shilling transferred), with 90% CIs in parentheses. The first column reports results from Simulation 1, the base scenario with highly elastic labor supply, fixed capital and a liquidity constraint on input purchases.

The findings reveal that the CT-OVC has a positive effect on local production. Each shilling transferred increases the nominal value of total production in the treated economy by 1.14 shillings, with a CI of [1.03,1.25]. The production multiplier is greater than 1, reflecting a relatively low degree of integration with outside markets. Local demand relies mostly on local markets (for locally-produced goods) and local retail (for outside goods). Section c of table 2 reports production multipliers by activity. The CT-OVC stimulates crop, livestock and service production, but its largest impact is on local retail, which has a multiplier of 0.98. As in textbook microeconomic models, increased demand stimulates these four sectors by putting some upward pressure on prices. The higher the local supply response, the larger the real expansion in the local economy and the smaller the resulting inflation impact. The fifth sector, "other production," is assumed to have prices set outside the local economy; its output decreases slightly (-0.09).

Section d of table 2 provides a breakdown of production impacts by household group. Most of the production spillovers accrue to the ineligible households. The overall production multiplier for group A is 0.05, versus 0.35 and 0.74 for groups C and E, respectively. Target households comprise 11% of the population but account for little more than 4% of the productive response. This finding reflects the eligibility criteria of the program, which targets asset- and labor-poor households.

As a result of production spillovers, total income increases by significantly more than the amount transferred. The nominal income multiplier is 1.81 overall (CI: 1.74 to 1.89). The difference between the income multiplier and 1 equals the transfers' indirect impacts, via local production. Nevertheless, higher demand puts upward pressure on local prices. This raises consumption costs for all households and results in a real-income multiplier of 1.22 (CI: 1.14 to 1.30) that, although significantly greater than 1.0, is lower than the nominal impact.

Most of the spillover effects of the cash transfer accrue to non-beneficiary households. Section f of table 2 gives simulated impacts on the nominal and real incomes of each household group. Treated households (Group A) capture a very small share of the additional income generated by GE effects. Their nominal income increases by 1.05 Ksh per shilling transferred: 1 Ksh of actual transfer plus 0.05 Ksh of GE feedback. This translates to 0.98 Ksh in real terms. Ineligible households benefit only through spillovers: for each shilling transferred *to group A*, the real incomes of groups C and E rise by 0.17 and 0.07 respectively.

On one hand, these findings confirm that the CT-OVC generates local income multipliers significantly greater than 1.0, regardless of whether they are measured in nominal or real terms. On the other hand, they illustrate that, without efforts to ensure a high supply response in the local economy, part of the impact may be inflationary instead of stimulating a real expansion of the economy. The next section illustrates how factor supplies can shape this response and tests robustness to market closure assumptions.

Robustness Tests

In Simulation 2 (column 2 in table 2), only land remains a constraint on production. There is no liquidity constraint on input purchases, and capital is allowed to expand as needed to prevent upward pressure on local rents.[9] This scenario corresponds to an environment in which there is unused capital that could be brought on line to support local production, or (less likely), access to credit or savings to invest in new capital. Under such assumptions, the transfer induces larger production and income multipliers (1.58 and 1.54 respectively). All impacts are invariably higher than in Simulation 1. There is no need to reallocate scarce resource between activities, so even "other production" is positively stimulated. The flexibility in factor and input markets greatly reduces inflationary pressures: local inflation is so limited that the confidence bounds on real income and nominal income effects overlap ([1.49, 1.60] and [1.60, 1.71], respectively).

Simulation 3 is the counterpart to Simulation 2: it assumes rigidities in all factor and input markets. This simulation retains the fixed-capital and the liquidity constraint assumptions of Simulation 1 and in addition imposes a low labor-supply elasticity (1 instead of 100), consistent with a high level of utilization of all factors, including labor, prior to the intervention. While we consider this scenario unlikely, it illustrates the importance of factor constraints in shaping local outcomes of SCTs. In Simulation 3, total production value increases only by 0.5 shillings per Ksh transferred. The productive response by group E is not significantly positive (CI: [-0.02, 0.48]), nor is the livestock production impact (CI: [-0.01, 0.01]). Factor constraints force a large shift away from "other production" to satisfy local demand. The wedge between nominal and real incomes widens: simulation 3 results in the highest income multiplier in nominal terms (1.91) but the lowest in real terms (0.93). Group E suffers a negative impact of the program in real terms (-0.17), due to inflationary pressures. The total real income multiplier in Simulation 3 is significantly lower than 1.0 (CI: [0.87, 0.99]). Thus, in the presence of factor constraints, we cannot assume positive income spillovers in real terms.

Conclusions

LEWIE simulations suggest that there are positive production spillovers from SCT programs. In nominal terms, total production multipliers are always significantly greater than zero, and nominal income multipliers are always greater than one. However, real impacts depend on supply elasticities and market closure assumptions. To date, studies do not point to inflationary impacts of SCTs (OPM, 2012a; OPM, 2012b), although the evidence on price effects is very limited. This suggests that Simulation 2 best characterizes the production impacts of SCTs, which target poor economies with under-utilized factors. This simulation reveals a minimal inflationary impact and real production value-added multipliers of 1.58 Ksh per shilling transferred.

A key finding of LEWIE is that the production impacts are concentrated in non-beneficiary households. This is not surprising given the program's eligibility criteria, which target the most asset and labor-constrained households. RCTs focusing on treated households are likely to miss many or most of the productive impacts of social cash transfer programs. This finding reaffirms the importance of a local economy-wide approach if we wish to capture the transfers' full impact.

Finally, our findings underline the importance of local supply constraints in shaping the impacts of transfer programs. In the high unemployment environment characterizing rural Kenya, we believe it unlikely that there are significant labor constraints on production. Nevertheless, production constraints limit program benefits, particularly in non-beneficiary households, which are far and away the main source of new supply. When production bottlenecks generate inflation, transfers may even negatively affect some households. Interventions focusing on local production constraints in non-beneficiary as well as beneficiary households may be needed to unlock the productive potential of SCTs.

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Table 1: Comparison of Household Groups in Garissa and Kwale (75.5 Ksh = US$1)

Household Group		Per Capita Expenditure (Ksh)	Expenditure share to the rest of Kenya	Number of Households	Total Transfer Received (Ksh)
OVC, Eligible	A	30286	0.03	591	10,638,000
OVC, Ineligible	C	25145	0.03	465	0
No OVC (Ineligible)	E	37136	0.11	5569	0
	Total	92567	-	6625	10,638,000

Table 2: Simulations of the Pilot Program in Eastern Districts, Under Three Alternative Market Assumptions (Multipliers Expressed in Ksh per Ksh Transferred; 90% Confidence Intervals in Parentheses)

a. Assumptions	Simulation 1		Simulation 2		Simulation 3	
Transfer to group A (mil.)	10.64		10.64		10.64	
Iterations	500		500		500	
Elasticity of labor supply	100		100		1	
Liquidity Constraint	yes		no		yes	
Capital factors	fixed		free		fixed	
b. Production Multiplier (Total)						
Total	**1.14**	(1.03,1.25)	**1.58**	(1.53,1.63)	**0.5**	(0.30,0.76)
c. Production Multiplier (by activity)						
crop	**0.08**	(0.05,0.11)	**0.1**	(0.07,0.12)	**0.06**	(0.04,0.09)
livestock	**0.01**	(0.01,0.02)	**0.06**	(0.04,0.08)	**0**	(-0.01,0.01)
retail	**0.98**	(0.91,1.04)	**1.08**	(1.05,1.12)	**0.73**	(0.68,0.78)
services	**0.16**	(0.13,0.19)	**0.3**	(0.28,0.32)	**0.13**	(0.10,0.15)
other production	**-0.09**	(-0.14,-0.03)	**0.03**	(0.02,0.05)	**-0.42**	(-0.62,-0.18)
d. Production Multiplier (by household)						
A	**0.05**	(0.03,0.07)	**0.06**	(0.05,0.08)	**0.02**	(0.01,0.04)
C	**0.35**	(0.23,0.47)	**0.45**	(0.42,0.47)	**0.27**	(0.21,0.34)

E	**0.74**	(0.58,0.89)	**1.07**	(1.03,1.12)	**0.21**	(-0.02,0.48)
e. Income Multiplier (Total)						
Nominal Terms	**1.81**	(1.74,1.89)	**1.65**	(1.60,1.71)	**1.91**	(1.79,2.05)
Real Terms	**1.22**	(1.14,1.30)	**1.54**	(1.49,1.60)	**0.93**	(0.87,0.99)
f. Income Multiplier (by household)						
A nominal	**1.05**	(1.04,1.06)	**1.04**	(1.03,1.05)	**1.05**	(1.04,1.06)
A real	**0.98**	(0.96,0.99)	**1.01**	(0.99,1.02)	**0.96**	(0.94,0.98)
C nominal	**0.23**	(0.21,0.25)	**0.17**	(0.16,0.18)	**0.26**	(0.22,0.30)
C real	**0.17**	(0.15,0.18)	**0.16**	(0.15,0.17)	**0.14**	(0.12,0.16)
E nominal	**0.53**	(0.48,0.60)	**0.44**	(0.39,0.47)	**0.6**	(0.50,0.71)
E real	**0.07**	(0.01,0.14)	**0.37**	(0.32,0.41)	**-0.17**	(-0.23,-0.12)

FOOTNOTES

[1] We are grateful to the UK Department for International Development, the European Union and the World Bank for funding this research.

[2] The populations were derived from census data used by OPM in the original sampling. We could not access district-level populations.

[3] The 2011 iteration was developed and administered by the Ministry of Gender, Children & Social Development; University of North Carolina, and Research Solutions Africa.

[4] Oxford Policy Management (OPM) carried out the 2009 iteration and original sampling.

[5] This survey was administered by the National Bureau of Statistics and the data was made available through the FAO's RIGA project.

[6] Neither survey alone could provide all the necessary data.

[7] We used the Kenyan consumer price inflation rate from the IMF International Financial Statistics.

[8] To date, data from RCTs do not find significant inflationary effects of SCTs. An elastic labor supply is consistent with this.

[9]In rural Kenya, land and capital markets are not sufficiently developed to tell us how cash transfers affect rental rates. LEWIE, however, does provide us with simulated impacts on implicit rental rates.