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Local Economy-wide Impact Evaluation (LEWIE) of Zambia's Child Grant Programme

PtoP from PROTECTION to PRODUCTION

Local Economy-wide Impact Evaluation (LEWIE) of Zambia's Child Grant Programme

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For more information, please visit PtoP website: http://www.fao.org/economic/ptop

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Abstract

The Zambia Child Grant Programme (CGP) provides a bi-monthly cash transfer to households with children under five years of age, with the goal of reducing "extreme poverty and the intergenerational transfer of poverty" in programme households. The CGP provides a significant infusion of cash into Zambia's rural economy. When beneficiaries spend the cash transfer they transmit the impact to others inside and outside the local economy, more often to households not eligible for the cash transfer who tend to own most of the local businesses. The impact of the CGP on the local economy was simulated using a LEWIE (Local Economy Wide Impact Evaluation) model, focusing on the three districts where the programme is located and included in the CGP impact evaluation. The LEWIE model for the CGP found that the transfers could lead to relatively large income multipliers of ZMK 1.79. That is, every Kwacha transferred to poor households had the potential to raise local income by ZMK 1.79. Eligible households receive the direct benefit of the transfer, while ineligible households receive the bulk of the indirect benefit. However, if labour, capital and land markets do not function well upward pressure on prices could result. This would raise consumption costs for all households and lead to a real income multiplier that is lower than the nominal multiplier. This real income multiplier could be as low as ZMK 1.34. Complementary programmes that increase the supply response (such as access to credit to invest in capital) could increase the real-income and production impacts of the programme.

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Executive summary

The programme

The overarching goal of the Zambia Child Grant Programme (CGP) is to "reduce extreme poverty and the intergenerational transfer of poverty" in programme households. The objectives of the programme are to: supplement and not replace household income; increase the number of children enrolled in and attending primary school; reduce mortality and morbidity rates among children under five; reduce stunting and wasting among children under five; increase the number of households owning assets such as livestock; and increase the number of households that have a second meal a day. The CGP is eligible to all households in programme districts with a child under the age of five. The programme is geographically targeted to the three districts in Zambia with the highest rates of mortality, morbidity and stunting among children aged under five: Kalabo and Shangombo districts in Western province, and Kaputa district in Northern province. The CGP transfers a flat ZMK 60 per month to each household, which on average in 2010 represented 27 percent of monthly expenditure (Seidenfeld and Handa, 2011).

Viewed from a local economy-wide perspective, the beneficiary households are the conduit through which cash is channelled into the local economy. The programme's immediate impact is to raise the purchasing power of beneficiary households. These households spend approximately 95 percent of their income within the local economy. As the cash is spent, the transfers' impacts immediately spread from the beneficiary households to others inside (and outside) the targeted villages. Income multipliers within the targeted areas are set in motion by doorstep trade, purchases in village shops, periodic markets and purchases outside the village. Some impacts extend beyond the programme area, potentially unleashing income multipliers in non-programme sites.

The Local Economy-Wide Impact Evaluation (LEWIE) methodology is designed to detail the full impact of cash transfers on local economies, including on the productive activities of both beneficiary and non-beneficiary groups, how these effects change when programmes are scaled up to include larger regions and why such effects occur. The resulting simulations can provide inputs into programme design and for explaining related potential impacts.

The LEWIE model for the CGP

The LEWIE model for the CGP begins by nesting household farm models for eligible and ineligible households within a region of interest. The household models describe each group's production activities, income sources and expenditure patterns. In a typical model households participate in activities such as crop and livestock production, retail, service provision and other activities, as well as in the labour market. These activities, as well as household expenditures, are modelled using data from household surveys.

Household groups in a given village are linked through local trade, and villages are linked through regional trade. The entire programme region interacts with the rest of the country, importing and exporting goods and selling labour. Interactions among households within the

programme area, and between the programme area and the rest of the economy, are modelled using the survey data. The parameters in the LEWIE model are estimated econometrically. Sensitivity analysis, combined with Monte Carlo methods, allows one to test the robustness of simulated impacts for errors in parameter estimates and model assumptions.

The Zambia CGP LEWIE model is built for treatment and control villages and includes households both eligible and ineligible for inclusion in the CGP. The LEWIE model draws on baseline and follow-up household survey data collected in 2010 and 2012 in the three programme districts as part of the randomized control trial impact evaluation of the CGP commissioned by the Zambian Government. The LEWIE model also utilized the business enterprise survey that was implemented at follow-up, as well as the nationally-representative Living Conditions Measurement Survey (LCMS).

The LEWIE simulations assume that locally grown crops, livestock, retail and other services, including labour, were traded locally. Given high transaction costs with the rest of the country and abroad, it is reasonable to assume that the prices of the goods produced were determined in local markets. A nearly perfectly elastic labour supply (η=100) was assumed, which reflects excess labour supply in rural Zambia. This can be expected to lower inflationary pressures from the programme by limiting wage increases. It does not remove inflationary pressures completely, however, because land and capital constraints may continue to limit the local supply response.

Results

The LEWIE model simulations show that the CGP has a potential total income multiplier of ZMK 1.79 in nominal terms, with a 90 percent confidence interval (CI) of 1.73-1.85. That is, each Kwacha transferred to poor households raises local income by ZMK 1.79. However, if supply constraints are binding—that is, if local production or supply of goods does not increase sufficiently to meet the increased demand brought on by the cash transfer—then the cash transfers can result in upward pressure on prices. This would raise consumption costs for all households and could result in a real-income multiplier that is lower than the nominal multiplier. According to the CGP LEWIE, the real income multiplier of the programme could be as low as ZMK 1.34 (CI: 1.29–1.39).

These findings illustrate that, without efforts to ensure an adequate supply response in the local economy, part of the programme's impact may be inflationary rather than real. Even a relatively small increase in the local consumer price index (CPI) can result in a smaller real income multiplier because it potentially affects all expenditures of all household groups. The higher the local supply response, the larger the real expansion in the local economy and the smaller the resulting inflation effect.

Eligible households receive the direct benefit of the transfer while ineligible households would receive the bulk of the indirect benefit. Of the ZMK 1.79 nominal income multiplier, ineligible households would receive ZMK 0.62 for each Kwacha given to eligible households, while the eligible households receive the value of the transfer plus an extra ZMK 0.17, for a total of ZMK 1.17. Beneficiary households thus would benefit both directly and indirectly from the transfer programme.

The simulated impact of the CGP varies considerably across sectors. The cash transfers stimulate the production of crops and livestock by ZMK 0.47 and ZMK 0.09 per Kwacha transferred, respectively. The largest positive effects are on retail, which has a multiplier of ZMK 1.91. Like the income multipliers, much of these impacts occur in the ineligible households.

The trade-off between supply response and inflation depends on the availability of factors to produce commodities. Complementary programmes that increase the supply response (such as access to credit to invest in capital) could increase the real-income and production impacts of the programme. A key finding of this study is thus that measures to increase the local supply response may be important if the intention is to increase the positive spillover effects of the CGP. These complementary measures should be targeted not only at CGP beneficiary households but also at non-eligible households that provide many of the goods and services in the local economy.

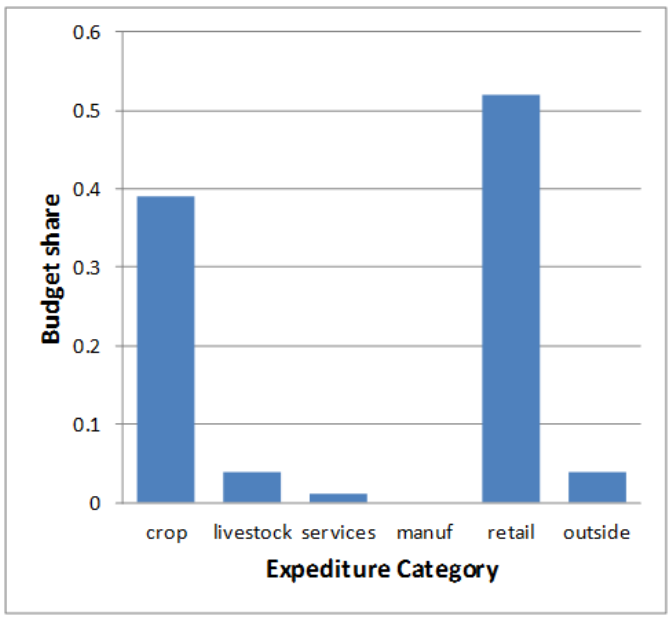
1. Introduction

The Child Grant Programme (CGP) is an unconditional cash transfer administered by the Government of Zambia through the Ministry of Community Development, Mother and Child Health (MCDMCH). The overarching goal of the CGP is to "reduce extreme poverty and the intergenerational transfer of poverty" in programme households. The objectives of the programme are to: supplement and not replace household income; increase the number of children enrolled in and attending primary school; reduce the rate of mortality and morbidity among children under five years old; reduce stunting and wasting among children under five years old; increase the number of households owning assets such as livestock; and increase the number of households that have a second meal a day (Seidenfeld *et al.*, 2013).

All households with a child under the age of five are eligible for the CGP; this is one of several targeting schemes for cash transfer programmes currently being piloted in Zambia. The programme is geographically targeted in Kalabo and Shangombo districts in Western province, and Kaputa district in Northern province. These three districts have the highest rates of mortality, morbidity and stunting among children under age five in Zambia. The CGP transfers a flat ZMK 60 per month to each household, which on average in 2010 represented 27 percent of per capita monthly expenditure (Seidenfeld and Handa, 2011; Seidenfeld *et al*., 2013).

The CGP provides a significant infusion of cash into Zambia's rural economy. Viewed from a local economy-wide perspective, the beneficiary households are the conduit through which cash is channelled into the local economy. The programme's immediate impact is to raise the purchasing power of beneficiary households. These households spend over 95 percent of their income inside the local economy (Figure 1), primarily at retail shops. As the cash is spent, the transfers' impacts immediately spread from the beneficiary households to others inside (and outside) the targeted villages. Income multipliers within the targeted areas are set in motion by doorstep trade, purchases in village shops, periodic markets and purchases outside the village. Some impacts extend beyond the programme area, potentially unleashing income multipliers in non-programme sites.

Figure 1 **Budget shares by expenditure categories, CGP beneficiaries**



The Local Economy-Wide Impact Evaluation (LEWIE) methodology is designed to detail the full potential impact of cash transfers on local economies, including on the productive activities of both beneficiary and non-beneficiary groups, how these effects change when programmes are scaled up to include larger regions and why such effects occur.[1] Our analysis uses a new Monte Carlo method to construct confidence bands around simulation results. This is made possible by the availability of micro-survey data and the use of econometrics to estimate LEWIE model parameters. The resulting simulations can provide inputs into programme design and help explain potential impacts.

The construction of the LEWIE model for the CGP in Zambia is part of the From Protection to Production (PtoP) Project[2] which is studying the impact of cash transfer programmes on household economic decision making, the local economy and community dynamics in seven countries in sub-Saharan Africa. The research project seeks to understand the potential productive and economic impacts of cash transfers on the rural poor. PtoP aims to provide insights on how social protection interventions can contribute to sustainable poverty reduction and economic growth at household and community levels. The project uses a mixed method approach, combining econometric analysis of impact evaluation data, local economy LEWIE models and qualitative methods.

[1] An in depth treatment of the analysis of treatment effects in general equilibrium settings can be found in Taylor and Filipski (forthcoming).
[2] http://www.fao.org/economic/ptop/en/. The first formulation of the LEWIE methodology for the From Protection to Production project can be found in Taylor (2013).

2. The design of the CGP impact evaluation

In Zambia, the LEWIE forms part of, and draws on, the randomized control trial (RCT) impact evaluation of the CGP.[3] The three-year impact evaluation is led by the American Institute for Research (AIR) under contract with the UNICEF country office in Zambia. The baseline was carried out in September–October 2010, the first follow-up in the same period in 2012, with a final follow-up in July-August 2013. Baseline and first follow-up data collection occurred at the beginning of Zambia's lean season (September to February), the period when people have reduced stores of food left from the previous harvest, and the threat of hunger is at its greatest. Collaboration with the PtoP project resulted in the inclusion of additional data at the first follow-up required for the construction of the LEWIE model, including a complementary business enterprise survey. The impact evaluation data cover 2 515 households, of which 1 228 are treatment and 1 287 control. Randomization was conducted at the level of the Community Welfare Assistance Committee (CWAC), which represented a cluster of villages. CWACs were randomly assigned to treatment (and incorporated into the programme in December 2010) or control (to be brought into the programme at the end of 2013). The baseline data collection began before villages were randomly assigned to treatment or control groups. Analysis of the baseline data shows that randomization was effective; greater detail on the randomization process, sample design and power calculations can be found in Seidenfeld *et al.* (2013).

The LEWIE analysis focuses on the spillover effects that occur when beneficiary households spend the cash transfer. Given trade linkages between villages and regions, these spillovers are transferred beyond the confines of treated CWACs. If control households are located within the treated CWACs, or nearby, then the possibility exists that they too could be affected by these spillover effects. In the case of the randomized cluster design in Zambia, control households are not chosen from the same or neighbouring villages. This lowers the potential for 'contamination' of the control group, while randomization assures that on average the household and community characteristics between treatment and control groups will be balanced. In one portion of this evaluation we will consider spillovers from treated to non-treated (that is, ineligible) households within the treated clusters assuming that the cluster design avoids spillovers to control households. Data on expenditure locations indicate that households in both the treated and control CWACs shop for some retail commodities at central markets in the district capital. We model the potential for spillovers through this shared market in a second evaluation scenario.

It might be possible to verify assumptions about control group contamination ex-post. For example, it might be possible to test for changes in economic outcomes in the control households closest to treated clusters, following an approach similar to the one used (in a different context) by Miguel and Kremer (2004). Once the CGP is scaled up geographically, of course, the dichotomy of treated and control breaks down entirely.

[3] A summary of this report forms part of the overall two-year impact evaluation report (Seidenfeld *et al.*, 2013)

3. The local economy-wide impact evaluation in Zambia

The Zambia LEWIE models household economies and the interactions between households in the three districts where the CGP impact evaluation is being implemented. Districts are organized into around 100 CWACs which are the tasked with administering the CGP and other social protection programmes. The CGP has continuous enrolment, meaning households are enrolled in the CGP after a child is born, and age out when the child reaches five years of age. Targeting was conducted in 30 CWACs per district, which form the evaluation sample from which the surveyed households were selected. After the baseline survey was conducted half of the targeted CWACs in each district were selected into treatment. Thus each district contains both treated and untreated (including the control sample) CWACs. For the purposes of the evaluation, only eligible households with a child aged under three were included because these households would remain in the CGP programme for the entire evaluation period.

The intersection of eligibility at the household level and treatment at the CWAC level creates four groups of households in the study area. Group A are the treated (beneficiary) households, Group B are non-beneficiary (ineligible) households in the treated CWACs, Group C are control households (eligible households) in untreated CWACs[4], and Group D are non-beneficiaries (ineligible households) in untreated CWACs. Table 1 illustrates the four groups.

Table 1 **Household groupings in the CGP LEWIE**

	Household Type	
	Eligible	Ineligible
Treated CWAC	Group A (Beneficiaries)	Group B (Non-beneficiaries, Treated CWACs)
Control CWAC	Group C (Control)	Group D (Non-beneficiaries, Non-treated CWACs)

The model structure is centred on the principal economic activities in which these households participate, the households' income sources, and the goods and services on which households spend their income. These will constitute the accounts in the LEWIE model. Table 2 summarizes these accounts. Household groups participate in crop and livestock production, retail, service and other production activities, and in the labour market. The retail sector includes shops in the village (which obtain most of their goods outside the village), in the rest of the programme area and in the rest of Zambia. It also includes households' spending outside the village but within the programme area. Production activities use different factors: hired labour, family labour, land, capital, livestock and purchased inputs.

[4] These households are modelled on the control households for the experimental evaluation.

It is important that we include the ineligible households in our model because they interact with the eligible households through businesses, the labour market and inter-household transfers in a given CWAC, and the spillovers among the different groups can have important income-generating effects. The treated and non-treated CWACs also interact through shared "Zone of Influence" (ZOI) markets. Finally, communities are linked with the rest of Zambia, importing and exporting goods and selling labour.

Table 2 **Accounts in the Zambia LEWIE**

Households	
A	CGP Beneficiaries
B	Non-beneficiary (in treated CWAC)
C	Control (eligible households in non-CGP CWACs)
D	Non-beneficiaries (ineligible households in non-CGP CWACs)
Activities	
crop	Crops
live	Livestock
ret	Retail
ser	Services
prod	Other production activities
Commodities	
crop	Crops
live	Livestock
ret	Retail
ser	Services
prod	Other production
outside	Produced outside the ZOI
Factors	
HL	Hired labour
FL	Family labour
Land	Land
K	Capital
Purch	Purchased (intermediate) inputs
Herd	Herd (livestock)
ROW	Rest of World (exogenous to model)

3.1. Sources of data and the region of study

We use four data sources: the 2010 and 2012 iterations of the CGP household survey (CGP-HH); the 2012 CGP business enterprise survey (BES); and the 2010 LCMS household survey. The three CGP surveys were designed specifically to evaluate the CGP programme, while the LCMS is a nationally-representative household survey conducted by the Central Statistical Office of Zambia.

The BES contains information on costs and revenues from a selection of businesses operating in the programme districts. Random selection of businesses would require a list of individual businesses in the study area, which was not available. Instead we listed the different types of businesses in the area (retail, services and production) and interviewed at least one from each category in each CWAC. We assume businesses of each type use the same technology, and we use the BES data to estimate that technology.

The 2010 and 2012 iterations of the CGP-HH survey are household surveys administered to eligible households selected in the CWACs forming part of the impact evaluation. We use the 2010 CGP-HH for the majority of the information on household expenditures and incomes because it was conducted before the first transfer occurred. We fill in location information and the sector of business ownership using the 2012 CGP-HH since this is the only survey that contains that information. Additionally, we use the 2012 iteration to estimate production functions for crop and livestock production, though we are able to recover the intermediate demands for those activities from the 2010 data. As treated and control CWACs may share markets, using the control (non-treated, but eligible) households from 2012 to model the eligible households might be problematic because spillovers from the programme may have reached these households.

The CGP-HH surveys only cover eligible households. We use the LCMS survey to fill in the expenditures and incomes for the ineligible households, which constitute the majority of households in the community. The data collected by the 2010 CGP and LCMS are very similar with respect to expenditures and incomes. We could not reach a sufficient sample by restricting the LCMS sample to the programme districts, thus the ineligible households are modelled on all ineligible rural households in the CGP provinces.

3.2. Scale of the CGP

An important component of the LEWIE involves the scale of the programme, because the share of households in a community that receives the CGP shapes the distribution of programme spillovers between household groups. In Zambia, approximately one-third of the CWACs over all three districts were initially selected for the CGP programme. To model the impacts of the CGP in a community and in a district we need to know the share of households in a CWAC that receive CGP, as well as the share of population that is in a CWAC which receives the CGP transfer.

Table 3 shows the population in the CGP districts. While only district-level populations are available, we know that approximately one-third of all CWACs were selected for the programme. Assuming equally-sized CWACs allows us to estimate the number of households in treated CWACs (Panel A). The Ministry of Community Development (MCD) provided information on the number of recipient households in each district in 2010 which allows us to calculate the percentage of households in treated CWACs that received the CGP grant (Panel B). We used the 2010 Census information to predict the percentage of the district-level population eligible for the CGP.

Table 3 2010 Populations in programme districts

Panel A

District name	Number of households (2010 Census)	Total number of CWACs (Ministry of Community Development (MCD))	Number of CWACs in SCT (MCD)	Number of households in treated CWAC (calculated)
Kaputa	23 740	80	35	10 386
Shangombo	19 029	133	36	5 151
Kalabo	26 480	132	30	6 018

Panel B

District name	Number of recipient households in 2010 (MCD)	Percent treated in programme CWACs in 2010	Number of eligible households (2010 Census)	Percent eligible in district
Kaputa	2 981	29%	15 360	65%
Shangombo	3 000	58%	11 649	61%
Kalabo	3 846	64%	15 434	58%

There is a large variation in the percentage of households eligible for the CGP in the above table. Additionally, mop-up exercises could increase the number of households receiving the grant. The number of eligible households may not accurately reflect the number of households that actually received the programme once targeting began (hence the difference between columns 3 and 5 of Panel B). Finally, the population in the three CGP districts may be different than the rest of rural Zambia.

We used the population information to construct ratios of eligible to ineligible households in the treated CWACs, and we used these ratios to scale the LEWIE input sheet. The number of treated households is normalized to one, while there are 2.1 (Table 4) (or 0.6 inTable 5) ineligible households for each eligible household in a treated CWAC.

The ratios in Table 4 are the most conservative with respect to the percentage of the population that receives the CGP grants. It assumes about one-third of households are eligible for the programme, and that one-third of CWACs within a district are treated initially. We use these ratios for our base model. The ratios in Table 5 reflect that potentially two-thirds of households are eligible for and receive the CGP. We use these ratios to show how the distribution of benefits would change if a larger percentage of the population were brought into the programme.

Table 4 **Ratios of household groups in Shangombo and Kalabo, Zambia**

	Household type	
	Eligible	Ineligible
Treated CWAC	1.0 (A)	2.1 (B)
Control CWAC	2.0 (C)	4.2 (D)

Table 5 **Ratio of household groups in Kaputa, Zambia**

	Household type	
	Eligible	Ineligible
Treated CWAC	1.0 (A)	0.6 (B)
Control CWAC	2.0 (C)	1.2 (D)

3.3. LEWIE data input

The baseline survey data have two main purposes in the construction of LEWIE models. First, they provide initial values for each variable of interest: output of crop and other activities; demand for commodities and factors for each activity; consumption expenditures, public and private transfers, and so on. Second, they provide the data to econometrically estimate each of the parameters of interest in the model and their standard errors: exponents and shift parameters in Cobb-Douglas production functions for each activity, marginal budget shares and subsistence minima for consumption functions, etc.

Table 6 is an excerpt from the LEWIE data input spreadsheet for Zambia showing the parameters and initial values related to crops for each household group. The data input table was structured to interface with GAMS, the software programme where the LEWIE model resides. The columns give the names of variables or parameters, the names of the commodities produced or demanded, the factors used in production, and the values for each household group.

The baseline values in the table are weighted totals of each household income and expenditure category by household group (A, B, C, and D). This ensures that we have the correct relative sizes of spending and incomes by each group and a balanced representation of the treated (and control) CWACs.

In this model, crop production demands three types of intermediate inputs (INTD): Crop, Services, and Retail; and five kinds of factors (FDs): Hired labour, Family labour, Land, Capital and Purchased intermediate products (see Table 2 for a description of factors and commodities). The first three rows give baseline levels of intermediate demand for each household group. The next five rows give baseline levels of each factor. We do not expect all

inputs to generate value added; the intermediate inputs are not substitutable for other inputs, and their demand is represented by Leontief input-output coefficients. The following rows give the estimated Cobb-Douglas production function exponents (beta) and standard errors of these estimates (se). The estimated production function shift parameter and its standard error (acobb and acobbse) follow. The remaining rows contain consumption function parameters: alpha and aphase are the estimated budget share and standard error, and the last row, the intercept, is assumed to be zero (corresponding to a Stone-Geary utility function without subsistence minima).

In the Zambia LEWIE, this panel is followed by similar panels for detailing production and consumption of each of the other commodities; livestock, services, retail, and other production. The businesses canvassed in the businesses survey were not representative of the composition of local businesses. We alternately use the expenditures in the ZOI or the household income from each activity to determine the size of each industry.

Table 6 **LEWIE panel for crop production and consumption**

Variable	Commodity2	Factor	Households A	Households B	Households C	Households D
INTD	ser		253.1	17320.9	552.9	36291.4
INTD	ret		2650.5	27699.9	5645.4	58037.8
INTD	outside		11.3	1432.6	15.8	3001.7
FD		FL	233115.8	2591517.1	459015.6	5429845.4
FD		HL	10938.5	53914.6	3777.3	112963.8
FD		LAND	47668.5	515748.4	90198.5	1080615.7
FD		PURCH	7241.0	186930.7	12639.0	391664.4
FD		K	71602.9	774705.8	135487.2	1623193.2
beta		FL	0.4277	0.4277	0.4277	0.4277
beta		HL	0.0094	0.0094	0.0094	0.0094
beta		LAND	0.0852	0.0852	0.0852	0.0852
beta		PURCH	0.3497	0.3497	0.3497	0.3497
beta		K	0.1280	0.1280	0.1280	0.1280
se		FL				
se		HL				
se		LAND	0.0271	0.0271	0.0271	0.0271
se		PURCH	0.0367	0.0367	0.0367	0.0367
se		K				
acobb			1.8706	1.8706	1.8706	1.8706
acobbse			0.8206	0.8206	0.8206	0.8206
alpha			0.3610	0.1560	0.3610	0.1560
alphase			0.0092	0.0842	0.0092	0.0842
cmin			0	0	0	0

The spatial organization of the ZOI, the region across which we simulate the impacts of the CGP transfers, is also represented in the LEWIE input sheet. Households consume and produce local commodities, and can export production or import outside goods. The ZOI for the Zambia LEWIE includes the village and nearby villages as well as the closest town, which has a large market visited by people from many communities; the initial values for intermediate demands, factor demands and consumption of commodities include these expenditures. Table 7 illustrates how expenditures vary across space by commodity. Retail and animal products are purchased primarily in the village while crop inputs and retail inputs come primarily from the town and farther afield. The linkages between the ZOI and the rest of the world determine how the transfer flows between households in the local economy, and whether spillovers accrue to households locally.

Table 7 **Locations of purchases of different commodities and factors by businesses and eligible households**

	Village	Nearby village	Town	Elsewhere (incl. gov.)
Item purchased				
Retail items purchased by households	0.545	0.172	0.281	0.002
Purchased input for crop production	0.117	0.095	0.535	0.252
Retail inputs purchased by businesses	0.172	0.095	0.444	0.289
Animal products purchased by households	0.820	0.131	0.049	0.000

4. The direct and indirect impacts of the CGP: LEWIE results

The simplest behavioural assumption we can make is that future behaviour is proportional to past behaviour. This means that households will spend the same share of an additional unit of income as the share spent from current income on a given good or service; that input-output coefficients in production activities remain stable before and after the transfer, that the share of income transferred to other households will remain constant, and so on. The linearity assumptions allow one to simulate the CGP's impacts in an unconstrained social accounting matrix (SAM) multiplier model. The boon of a multiplier model is its computational simplicity.

However, SAM multiplier models assume that all responses are linear and there are no price effects within the village clusters. Linearity means that there are not diminishing marginal returns to production activities. The absence of price effects reflects the assumption that all supplies (of factors as well as goods) are perfectly elastic; thus, a one-Kwacha increase in demand for labour, food, etc., stimulates an equivalent increase in supply. This assumption may be appropriate in an economy with surplus labour and where producers have the ability to adjust their output before increases in demand push up prices in the ZOI. However, the assumptions of linearity and elastic supplies in such a multiplier analysis could otherwise overstate the multiplier effect of the computable general-equilibrium (CGE) model.

The alternative is to use the parameter estimates and baseline data (Table 6) to calibrate a general equilibrium LEWIE model. Here the LEWIE is analogous to the CGE model widely used for policy analysis. However, the LEWIE consists of separate models of household

groups calibrated and nested within a model of the programme area economy. The general-equilibrium LEWIE model is more flexible and arguably more realistic than SAM LEWIE multiplier models, and the general-equilibrium model lends itself to validation in ways that SAM multipliers do not. The model can be used to test the sensitivity of transfer impacts to the local supply response and distinguish nominal from real (price-adjusted) income multipliers, as described below.

4.1. The general-equilibrium LEWIE model

One can think of the SAM-based LEWIE model, above, as the output of a general-equilibrium model that includes all production activities, incomes, and household expenditures in the cluster. SAMs[5] are the basic data input for CGE models; many or most of the parameters in a CGE model can be computed directly from a SAM. The SAM-based LEWIE is different from a conventional SAM, however, because it is constructed using parameters econometrically estimated from the baseline data. Thus we do not need the SAM to parameterize our general-equilibrium LEWIE model; both the SAM and general-equilibrium models are constructed from the same data input sheet illustrated in Table 6.

Validation is always a concern in general-equilibrium modelling. 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 general-equilibrium 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 modelling 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 with 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 programme impact simulation results, using the following steps:

1. Use parameter estimates and starting values for each variable obtained from the micro-data, consistent with the household SAMs, to calibrate a baseline general-equilibrium LEWIE model.

2. Use this model to simulate the CGP cash transfer to eligible households.

3. Make a random draw from each parameter distribution, assuming it is centred on the estimated parameter with a standard deviation equal to the standard error of the estimate. This results in an entirely new set of model parameters. Using these

[5] Taylor (2013) explains how to use a SAM-based LEWIE to parameterize production and expenditure functions.

parameters, calibrate a new baseline general-equilibrium LEWIE model and use this model to simulate the same programme again.

4. Repeat step 3 *J* (say, 1 000) times. This will yield 1 000 observed simulation results on each outcome of interest.
5. Construct percentile confidence intervals $(\hat{Y}^*_{1-\alpha/2}, \hat{Y}^*_{\alpha/2})$, where $\hat{Y}^*_p$ is the pth quantile of the simulated values $(\hat{Y}^*_1, \hat{Y}^*_2, ..., \hat{Y}^*_J)$. For example, for a 90 percent confidence interval, we find the cutoffs for the highest and lowest 5 percent of simulated values for the outcome of interest. This is similar to the percentile confidence intervals in bootstrapping.

This Monte Carlo procedure allows us to use what we know about the variances of all our 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 general-equilibrium framework. Structural interactions within the model may magnify or dampen the effects of imprecise parameter estimates on simulation confidence bands.

In the general-equilibrium LEWIE model, the CGP transfers increase spending by the treatment households. This increases the demand for goods supplied inside the treated communities as well as outside them. The impact of increased demands on production and on the local income multiplier depends on the supply response to prices. The more elastic the supply response, the more the transfers will tend to create positive spillovers in the economy. The more inelastic, the more transfers will raise prices instead of stimulating production. If the production supply response is very inelastic (that is, constraints limit producers' ability to raise output), the transfers will tend to be inflationary rather than having a real effect on the local economy. Higher output prices benefit producers but harm consumers. If wages increase employed workers will benefit, but producers will be adversely affected. The total impact of the CGP on the economy of the treated clusters depends on the interplay of these price and output effects.

The retail sector purchases some goods locally; however most of the items sold in local shops come from outside the local economy. Because of this retail is largely an "import" sector, making tradables from outside available to households and businesses within the village cluster. The mark-up (difference between sale and purchase prices) represents the value-added of the retail sector. It is the non-tradable component of retail sales. An increase in households' demand for retail goods does not affect the prices shops pay for their inventory (these prices are set outside the cluster). However it can have an influence on the mark-up. Increases in the demand for locally produced food and livestock products can affect the prices of these goods. In response, households may resort to buying food, livestock, and non-agricultural goods from local shops, periodic markets or other sources linked to markets outside the cluster.

4.2. LEWIE findings

The LEWIE model was used to simulate the impacts of the initial CGP on the programme-area economy, taking into account nonlinearities and local price effects. In these simulations, prices may be determined inside or outside the village cluster or ZOI.

A challenge in general-equilibrium analysis is that we generally do not know exactly where prices are determined. In real life changes in prices outside of an economy may be transmitted into the economy; for example, higher world prices for maize might have an effect on domestic prices at the port of entry into the country (if trade policies permit this), and changes in port-of-entry prices may be transmitted to a greater or lesser extent through the rural economy. Given the size of the CGP and the randomized cluster design, there is little reason for transfers to affect prices outside the treated cluster in the initial phase of the programme.

Transaction costs in local markets can limit the transmission of prices. If transaction costs are high, prices may be determined by the interaction of local supply and demand. In Zambia changes in local demand may nonetheless affect the prices of food and livestock products purchased directly from producers in the treated cluster (including the implicit prices of home-produced food), unless retail purchases are a perfect substitute for these goods.

We do not know what the elasticity of labour supply is. We assume a nearly perfectly elastic labour supply (η=100).[6] This reflects excess labour supply in rural Zambia: it is similar to the way labour is treated in SAM multiplier models. Excess labour supply can be expected to lower inflationary pressures by limiting wage increases. It does not however remove inflationary pressures because land and capital constraints continue to limit the local supply response.

Simulations require making assumptions about where prices are determined, that is, market closure. We first evaluate the impacts of the CGP under assumptions that we believe reasonably reflect the structure of markets in the treated clusters. Later we will test the sensitivity of our simulation results to these closure assumptions as well as to the elasticity of labour supply.

Table 7 summarizes the results from the base LEWIE model for the CGP evaluation. The base model has an elastic labour supply and all prices except purchased factors and outside goods are determined within the village cluster (CWAC). In addition to the multiplier effects 90 percent confidence bounds were constructed using 1 000 random draws from each parameter distribution.

[6] Higher elasticities do not have an appreciable effect on CGP multipliers.

Table 8 Simulated income multiplier of the CGP programme

	Base model
Income multiplier	
Nominal	1.79
(CI)	(1.73 – 1.85)
Real	1.34
(CI)	(1.29 – 1.39)

The LEWIE model for the CGP finds that, if households spend the transfer as they spend other cash, the transfer could generate a total income multiplier of ZMK 1.79 in nominal terms with a confidence interval of 1.73 to 1.85. That is, each Kwacha of transfer can potentially generate 1.79 Kwacha of total income within the ZOI. However, if land, capital and/or other constraints limit supply response, higher demand for local commodities may put upward pressure on prices. Higher prices could raise consumption costs for all households and result in a real-income multiplier that is lower than the nominal multiplier. According to the CGP LEWIE, under these assumptions, the real income multiplier of the CGP could be as low as ZMK 1.34, with a confidence interval of 1.29 to 1.39. Although the real income multiplier is lower than the nominal multiplier, it is still significantly greater than 1.0. Sensitivity analysis reveals that, as supply elasticities in the local economy increase, the real multiplier increases and converges toward the nominal one. ZMK 1.79 may thus be considered as the upper bound on the CGP income multiplier in the local economy.

One the one hand, this finding confirms that the CGP can generate income multipliers within the treated clusters that are significantly greater than 1.0 regardless of whether they are measured in nominal or real terms. On the other hand, the simulation results illustrate that, without efforts to ensure a sufficient supply response in the local economy, part of the impact may be inflationary instead of real. Even a relatively small increase in the local consumer price index (CPI) can result in a much smaller real income multiplier because it potentially affects all expenditures by all household groups.

Figure 2 Distribution of CGP nominal and real income multipliers by beneficiaryand non-beneficiary households

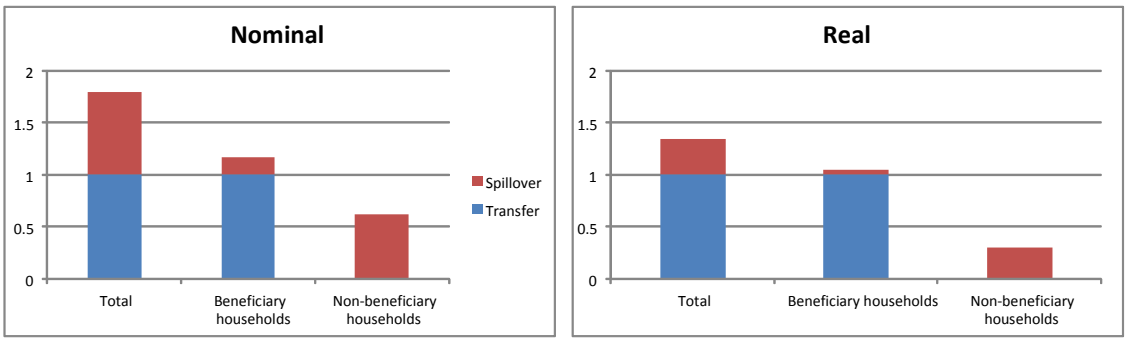
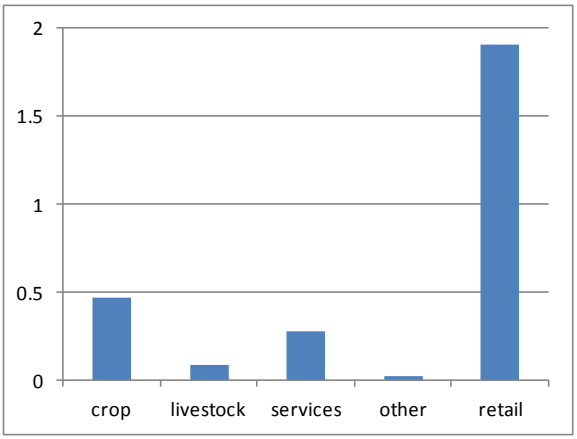


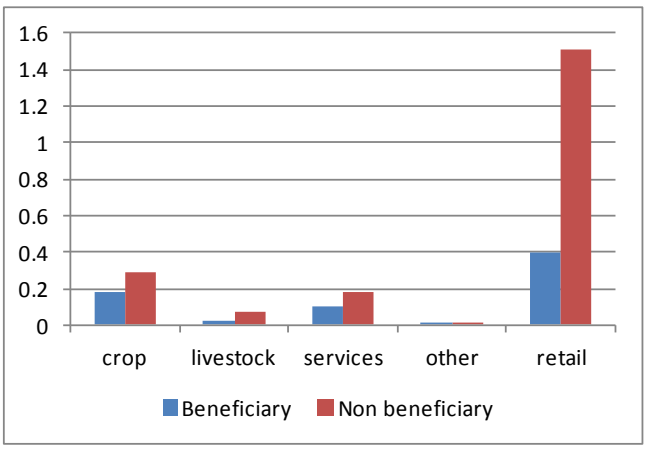
Figure 2 and the middle panel of the Table A1 in the Appendix give the simulated impacts on the nominal and real incomes of each household group. Beneficiary (or treated households) in Group A receive the direct benefit of the transfer and a small spillover effect of ZMK 0.17 for each Kwacha transferred. The ineligible households do not receive the transfer but would still benefit from a ZMK 0.62 increase in nominal income per each Kwacha transferred. The corresponding real income multipliers are smaller 0.05 and 0.30 respectively—but still significant.

Figure 3 CGP production multipliers



The income multiplier works through productive activities, and Figure 3 (and Table A1) show the corresponding production multipliers. According to the LEWIE model, the transfers stimulate the production of crops by ZMK 0.47, of livestock by ZMK 0.09 and services by ZMK 0.28 per Kwacha transferred. The largest effect is on the retail sector, which has a multiplier of ZMK 1.91. Like the income multipliers, much of these impacts occur in the ineligible households. Not surprisingly, production multipliers are largest for beneficiary households, particularly in retail (Figure 4 and Table A1). Increasing demand stimulates these sectors by putting upward pressure on prices. Prices are the mechanism by which impacts are transmitted within the local economy. The higher the local supply response, the larger the real expansion in production and the smaller the resulting inflation level.

Figure 4 CGP production multipliers, by beneficiary status



4.3. Robustness tests

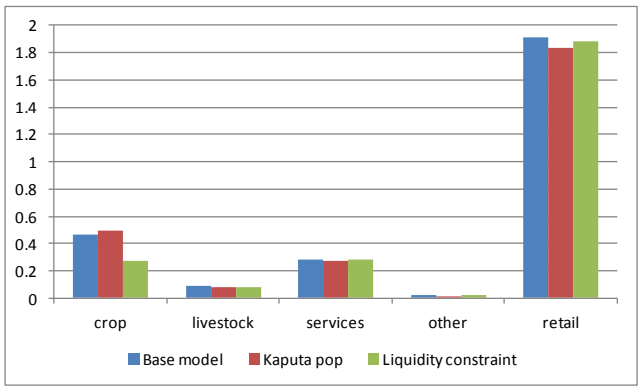
We tested the robustness of the simulation results to different assumptions concerning market closure, the liquidity constraint, and population composition. First we ran the base simulation using the population ratios from Table 5, where a larger percentage of households within a CWAC were eligible for the programme (two-thirds versus one-third). The first and second columns of Table 9 compare the results of the base simulation with the original populations and the larger eligible shares. The third column of Table 9 shows the simulated results with a liquidity constraint on the purchased factor.

Table 9 **Simulated effects of population composition and liquidity constraints on the CGP income multiplier**

	Base model (one-third eligible)	Larger eligible population share (two-thirds eligible)	Liquidity constraint
Income multiplier			
Nominal (CI)	1.79 (1.73 – 1.85)	1.81 (1.75 – 1.87)	1.81 (1.68 – 1.92)
Real (CI)	1.34 (1.29 – 1.39)	1.34 (1.30 – 1.37)	1.12 (0.99 – 1.24)

There are no significant differences between the total multipliers in the three simulations in Table 9, as can be seen in the overlapping confidence intervals. Similarly, only the crop production multiplier for the constrained scenario is significantly different from the other production multipliers (Figure 5 and Table A2). This is expected because the liquidity constraint limits the supply response of crop production by fixing purchased inputs at the base level.

Figure 5 **CGP production multipliers under alternative scenarios: base model, population composition and liquidity constraint**



The different ratio of beneficiary to non-beneficiary households within a CWAC represented by the first two columns of Table 9 affects the distribution of the spillovers between the two household groups. Because there are more beneficiary households in the second simulation,

they receive a larger share of the spillovers as they own a larger share of the factors of production. This can be seen in Figure 6 and Table A3. Moreover the source of these differences in income can be seen in the size of the production multipliers by beneficiary status in Figure 7 and Table A3. In the figure we focus on the shift in the crop and retail sector multipliers between the base model and the population composition simulation.

Figure 6 **Household level multipliers under alternative scenarios: base model, population composition and liquidity constraint**

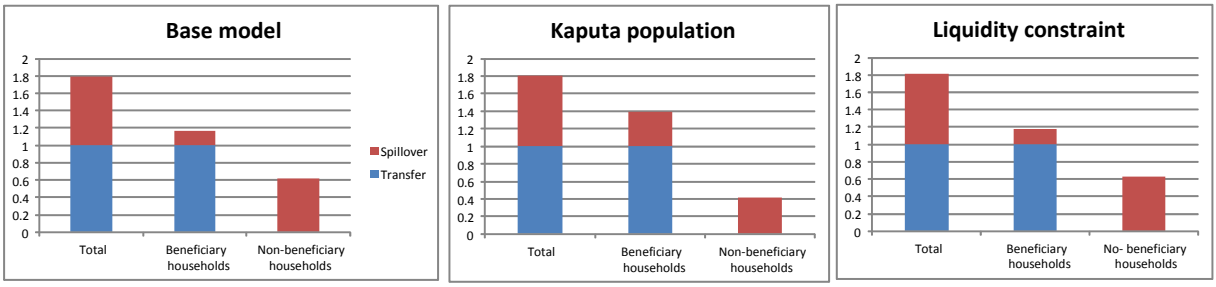
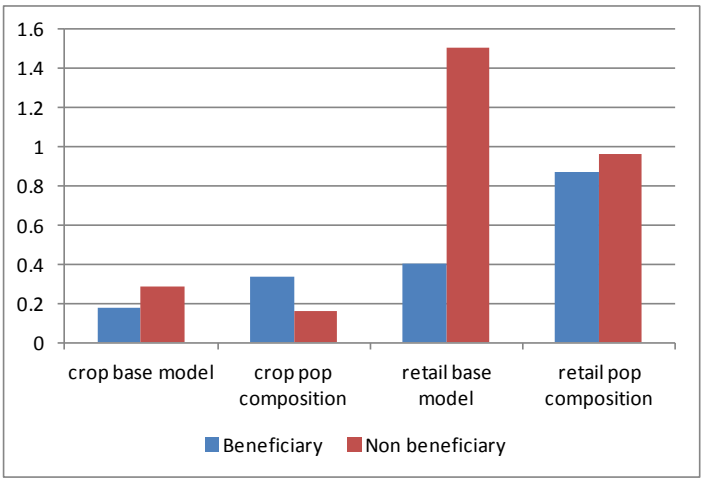


Figure 7 **CGP crop and retail production multipliers by beneficiary status under alternative scenarios: base model and population composition**



The results of additional simulations are reported in Table 10. These include an alternate market closure model (column 2) and programme scale-up (column 3). In the base model all markets are local (i.e. prices are determined within a village cluster/CWAC). In the alternate market closure model the CGP and non-CGP CWACs interact in shared ZOI (district) markets for all commodities. The scale-up experiment also uses shared markets, and simulates a situation where all the eligible households (Groups A and C) in a district receive the CGP transfers.

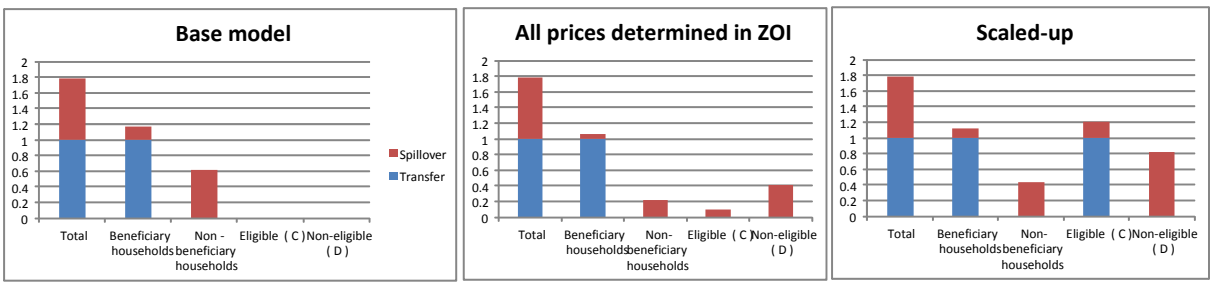
Table 10 **Simulated effects of alternative market closure and scale-up on the CGP income multiplier**

	Base model	ZOI markets	ZOI markets and scale-up
Income multiplier			
Nominal	1.79	1.79	1.79
(CI)	(1.73 - 1.85)	(1.75 - 1.84)	(1.75 - 1.92)
Real	1.34	1.36	1.36
(CI)	(1.29 - 1.39)	(1.34 - 1.39)	(1.33 - 1.39)

The total income multipliers (real and nominal) in the alternate models are not significantly different from the base model nor are the aggregate production multipliers (not shown). Instead, we see the influence of ZOI markets in the allocation of spillovers among the households and communities. When all markets are local, as in the base model, there is no way for prices to transmit increases in demand to other CWACs. This does occur, however, when different communities share markets.

Household Groups C and D, which are located in non-CGP CWACs, receive significant spillovers from CGP in the situation where they share markets with treated communities (Figure 8 and Table A3). Moreover the spillover benefits in the CGP community are smaller; because some of the increase in demand is for products traded in the shared market, the benefits accrue proportionally to the households that sell goods in those markets. The non-CGP communities have larger populations and thus own proportionally more factors and receive more spillover income.

Figure 8 **Household level multipliers under alternative market closure and scale-up**



As before, the multipliers in the scale-up experiment (column 3 of Tables 10 and A3) can be interpreted as the multiplier for one Kwacha transferred to each recipient. In Zambia the population in the original beneficiary CWACs is about half of that in the non-treated CWACs. The spillovers and production effects in the C group are about double the impacts on the A group due to the relative population sizes (see Figure 8 above). In theory, the relative magnitudes of the income and production multipliers within and between CWACs are a reflection of both the relative population sizes of the groups and their income and expenditure patterns. Since the B and D groups are modelled off the same population, and the A and C

groups are very similar (because the C are good controls from the RCT evaluation), we would not expect to see significant differences in multipliers deriving from the scale-up.

5. Conclusions and recommendations

Simulations from the LEWIE model show that the CGP can have a large and significant impact on incomes of both beneficiary and non-beneficiary households in the treated (CGP) communities. In the base model, each Kwacha transferred to a CGP household generates ZMK 1.79 of total income within the ZOI (with a 90 percent confidence interval of 1.73 to 1.85). In other words, the income benefits of this programme are significantly larger than the amount transferred.

Nevertheless, higher demand for local commodities may put upward pressure on prices if local supply response is constrained. Inflation raises consumption costs for all households and, in our simulations, results in a real income multiplier that is lower than the nominal multiplier. This real income multiplier of the CGP can be as low as ZMK 1.34 with a 90 percent confidence interval of 1.29 – 1.39. Although the multiplier is lower than the nominal (cash income) multiplier it still is significantly greater than 1.0. The trade-off between supply response and inflation depends on the availability of factors to produce commodities. Complementary programmes that increase the supply response (such as access to credit to invest in capital) could increase the real-income and production impacts of the programme.

The LEWIE simulations show that the distribution of benefits across household groups — beneficiary and non-beneficiary, in treated and non-treated communities — is shaped by the types of commodities purchased, the relative size of the beneficiaries in the local population and the assumptions about market closure. The CGP stimulates demand in the local economy, triggering a supply response that creates production spillovers. Much, but not all, of the production and income spillovers created by the CGP are found in the ineligible households. Overall, these findings reveal that the CGP treats not only the beneficiary households, but also the economies of which they are part, with significant benefits for non-beneficiary households as well.

6. References

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7. Appendix

Table A1 Simulated impacts of the Zambia CGP

Elasticity of hl/fl lab supply	100/100
Liquidity constraint on/off	0ff
Village Cluster Markets	crop, live, ser, prod, ret, FL, HL, HERD
Treatment and Control Cluster Markets	null
Integrated Markets	outside, PURCH
Transfer	A
iterations	1001
MULTIPLIERS	
Total income multiplier	
Nominal	1.79
(CI)	(1.73 – 1.85)
Real	1.34
(CI)	(1.29 – 1.39)
Hh income multiplier (nominal)	
A nominal	1.17
cpi increase in %	1.35%
real	1.05
B nominal	0.62
cpi increase in %	1.25%
real	0.3
Production multiplier	
Crop production	0.47
(CI)	(0.41 – 0.52)
Livestock production	0.09
(CI)	(0.07 – 0.10)
Services	0.28

(CI)		(0.26 – 0.30)
Other production		0.02
(CI)		(0.01 – 0.02)
Retail		1.91
(CI)		(1.81 – 2.01)
Production multiplier by hh		
Crops	A	0.18
	B	0.29
Livestock	A	0.02
	B	0.07
Services	A	0.1
	B	0.18
Other Production	A	0.01
	B	0.01
Retail	A	0.4
	B	1.51

Table A2 **Simulated effects of population composition and liquidity constraints on the CGP income multiplier**

	BASE	Kaputa Populations	Constrained PURCH Factor
Liquidity constraint on/off	0ff	0ff	On
MULTIPLIERS			
Total income multiplier			
Nominal	1.79	1.81	1.81
(CI)	(1.73 – 1.85)	(1.75 – 1.87)	(1.68 – 1.92)
Real	1.34	1.34	1.12
(CI)	(1.29 – 1.39)	(1.30 – 1.37)	(0.99 – 1.24)
Hh income multiplier (nominal)			
A nominal	1.17	1.39	1.18
cpi increase in %	1.35%	2.87%	2.47%
real	1.05	1.13	0.95
B nominal	0.62	0.42	0.63
cpi increase in %	1.25%	2.80%	1.84%
real	0.3	0.21	0.16

Production multiplier				
Crop		0.47	0.5	0.27
(CI)		(0.41 – 0.52)	(0.46 – 0.54)	(0.20 – 0.32)
Live		0.09	0.08	0.08
(CI)		(0.07 – 0.10)	(0.07 – 0.09)	(0.07 – 0.10)
Ser		0.28	0.27	0.28
(CI)		(0.26 – 0.30)	(0.25 – 0.28)	(0.25 – 0.31)
Prod		0.02	0.01	0.02
(CI)		(0.01 – 0.02)	(0.01 – 0.02)	(0.01 – 0.02)
Ret		1.91	1.83	1.88
(CI)		(1.81 – 2.01)	(1.75 – 1.90)	(1.72 – 2.08)
Production multiplier by hh				
Crop	A	0.18	0.34	0.1
	B	0.29	0.16	0.16
Livestock	A	0.02	0.04	0.02
	B	0.07	0.04	0.06
Services	A	0.1	0.17	0.1
	B	0.18	0.09	0.18
Other Production	A	0.01	0.01	0.01
	B	0.01	0.01	0.01
Retail	A	0.4	0.87	0.39
	B	1.51	0.96	1.49

Table A3 Simulated Scale-up and Shared Market Simulations

	BASE	All shared markets	Scale up, all markets shared
Village Cluster Markets	crop, live, ser, prod, ret, FL, HL, HERD	FL	FL
Treatment and Control Cluster Markets		crop, live, ser, prod, ret, FL, HL, HERD	crop, live, ser, prod, ret, FL, HL, HERD
Integrated Markets	Outside, PURCH	outside, PURCH	outside, PURCH
Transfer	A	A	A, C
MULTIPLIERS			
Total income multiplier			
Nominal	1.79	1.79	1.79
(CI)	(1.73 – 1.85)	(1.75 – 1.84)	(1.75 – 1.84)
Real	1.34	1.36	1.36
(CI)	(1.29 – 1.39)	(1.34 – 1.39)	(1.33 – 1.39)
Household Income Multipliers			
A nominal	1.17	1.06	1.12
cpi increase in %	1.35%	0.48%	0.96%
real	1.05	1.02	1.03
B nominal	0.62	0.22	0.44
cpi increase in %	1.25%	0.44%	0.88%
real	0.3	0.11	0.21
C nominal		0.1	1.2
cpi increase in %		0.48%	0.96%
real		0.06	1.11
D nominal		0.41	0.82
cpi increase in %		0.43%	0.87%
real		0.18	0.36

Production multipliers by households				
Crop production	A	0.18	0.07	0.14
	B	0.29	0.11	0.22
	C		0.07	0.14
	D		0.23	0.45
Livestock production	A	0.02	0.01	0.01
	B	0.07	0.03	0.05
	C		0.01	0.02
	D		0.05	0.09
Services	A	0.1	0.03	0.07
	B	0.18	0.06	0.12
	C		0.07	0.14
	D		0.12	0.25
Other production	A	0.01	0	0
	B	0.01	0	0.01
	C		0	0.01
	D		0.01	0.01
Retail	A	0.4	0.13	0.26
	B	1.51	0.49	0.99
	C		0.29	0.57
	D		1.03	2.05