Local Economy-wide Impact Evaluation (LEWIE) of Ethiopia's social cash transfer pilot programme

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Local Economy-wide Impact Evaluation (LEWIE) of Ethiopia's social cash transfer pilot programme

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Abstract

The Ethiopia Social Cash Transfer Pilot Programme (SCTPP) was introduced in 2011 in two *woredas* of the Tigray region by the regional Government with the support of the United Nations Children's Fund (UNICEF). The goal of the SCTPP is to "improve the quality of life for vulnerable children, the elderly, and persons with disabilities" in programme households. Although the programme targets the poorest of the poor, the actual benefit to the local economy goes beyond programme beneficiaries. When beneficiaries spend the cash transfer, they transmit the impact of the programme 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 productive assets.

The impact of the SCTPP on the local economy was simulated using a LEWIE (Local Economy Wide Impact Evaluation) model applied to the two areas that received the transfer, the *tabias* of Hintalo-Wajirat and the town of Abi-Adi. The LEWIE model found that each birr distributed in Hintalo-Wajirat generated an extra 1.52 birr via local market linkages, for a total income multiplier of 2.52. Similarly, each birr distributed in Abi-Adi generated an additional .35 birr, for a total income multiplier of 1.35. Thus the initial transfer of 5.58 million birr in Hintalo-Wajirat and 1.62 million birr in Abi-Adi potentially generated 14.06 million birr and 2.19 million birr respectively. However if credit, capital and other market constraints limit the local supply response, the increase in demand brought about by the cash transfer programme may also lead to increased prices and consequently a lower income multiplier. Simulations incorporating such constraints find a "real" income multiplier of 1.84 birr for Hintalo-Wajirat and 1.26 birr for Abi-Adi. In both cases non-beneficiaries and the local economy as a whole benefit significantly from cash transfer programmes via trade and production linkages. Maximizing the income multiplier may require complementary interventions that target both beneficiary and non-beneficiary families.

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Executive summary

The programme

The Ethiopia Social Cash Transfer Pilot Programme (SCTPP) was introduced in 2011 in two *woredas* of the Tigray region by the regional Government with the support of the United Nations Children's Fund (UNICEF). The goal of the SCTPP is to "improve the quality of life for vulnerable children, the elderly, and persons with disabilities" in programme households. The main objectives of the pilot programme are to reduce poverty, hunger, and starvation in selected households; to increase access to basic social welfare services such as health care and education; and to generate information on the feasibility, cost-effectiveness, and impact of a social cash transfer scheme administered by the local administration. The SCTPP targets households that are both extremely poor and labour-constrained. The programme geographically targets the town of Abi-Adi and the rural *woreda* of Hintalo-Wajirat, within which eight neighbouring *tabias* where selected by the SCTPP. The payment process follows a mechanism whereby selected households queue to collect transfers in their *woreda* every month according to a fixed schedule. Payment size depends on the number of household members and their characteristics. For one or two adult households, the basic grant is 155 birr (approx. US$8.50) with additional amounts for children, disabled members, and dependent elderly.

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. As the cash is spent, the transfers' impacts immediately spread from the beneficiary households to others inside (and outside) of the targeted villages. Income multipliers within the targeted areas are set in motion by doorstep trade, purchases in village stores, periodic markets and purchases outside the village. Some impacts extend beyond the programme area, potentially unleashing income multipliers in non-target sites.

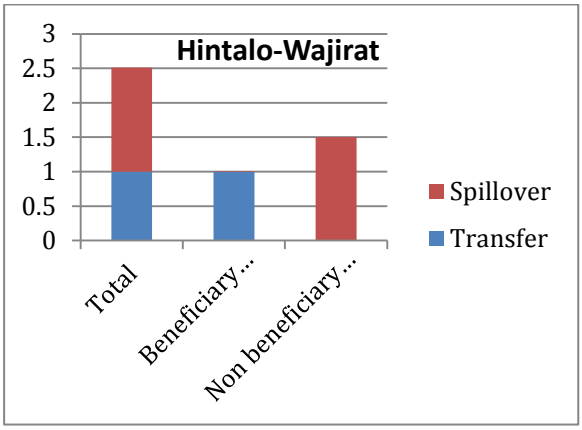
The local economy-wide impact evaluation (LEWIE) methodology is designed to detail the full impact of cash transfers on local economies, including on the income and productive activities of both beneficiary and non-beneficiary groups. Two separate LEWIE models are constructed to reflect the different economies of the two regions in which the SCTPP was implemented.

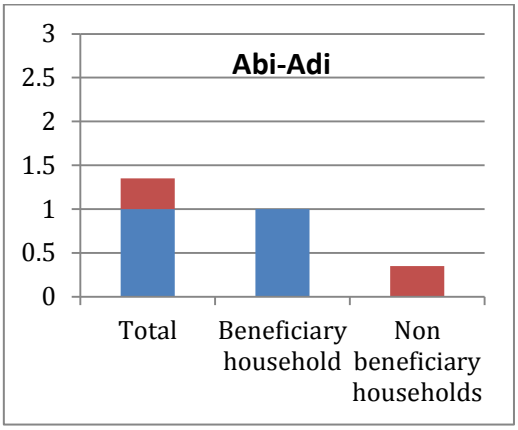
The LEWIE model for the SCTPP

Results

The LEWIE model found that each birr distributed in Hintalo-Wajirat generated an extra 1.52 birr via local economic linkages, for a total income multiplier of 2.52. Similarly, each birr distributed in Abi-Adi generated an additional .35 birr, for a total income multiplier of 1.35. Thus the initial transfer of 5.58 million birr in Hintalo-Wajirat and 1.62 million birr in Abi-Adi potentially generated 14.06 million birr and 2.19 million birr respectively. However, when credit, capital and other market constraints limit the local supply response the increase

in demand brought about by the cash transfer programme may lead to increased prices and consequently a lower income multiplier. Simulations incorporating such constraints find a "real" or price-adjusted income multiplier of 1.84 birr for Hintalo-Wajirat and 1.26 birr for Abi-Adi. In both cases non-beneficiaries and the local economy benefit from cash transfer programmes via trade and production linkages. Maximizing the income multiplier may require complementary interventions that target both beneficiary and non-beneficiary families.





1. Introduction

The Ethiopia Social Cash Transfer Pilot Programme (SCTPP) was introduced in 2011 in two *woredas* of the Tigray region by the regional Government with the support of the United Nations Children's Fund (UNICEF). The SCTPP aims to "improve the quality of life for vulnerable children, the elderly, and persons with disabilities (PWD)" in selected households. The objectives of the pilot programme are to reduce poverty, hunger and starvation in eligible households that are both extremely poor and labour-constrained; to increase access to basic social welfare services such as health care and education; and to generate information on the feasibility, cost-effectiveness, and impact of a social cash transfer scheme administered by the local administration.

The SCTPP is targeted towards households suffering extreme levels of poverty and which are labour-constrained. The programme geographically targets two *woredas*, the town of Abi-Adi and the rural *woreda* of Hintalo-Wajirat, in which eight adjacent *tabias* where selected by the SCTPP. The payment process follows a conventional mechanism whereby selected households queue to collect transfers in their *woreda* every month according to a fixed schedule. Payment size depends on the number of household members and their characteristics. For one or two adult households, the basic grant is 155 birr (approx. US$8.50) per month with additional amounts for children (35 birr each), disabled members (40 birr for a disabled child, 50 birr per disabled adult) and dependent elderly persons (60 birr each) (see Table 2 for details).

The local economy-wide impact evaluation (LEWIE) methodology was designed to capture the full impact of cash transfer programmes on local economies, including on the income and productive activities of both beneficiary and non-beneficiary households.[1] The resulting simulations can provide input into programme design and help explain potential impacts. From a local economy-wide perspective, households that receive cash transfers are the conduit through which new cash enters the rural economy. As they spend their cash the beneficiary households generate general equilibrium effects that transmit programme impacts to others in the economy, including non-beneficiaries. The LEWIE estimates the extent of this impact on the local economy. LEWIE model parameters are estimated using econometric techniques; we use a new Monte Carlo method to construct confidence intervals around programme simulation results.

The LEWIE model for the SCTPP in Ethiopia forms part of the From Protection to Production (PtoP) project[2] which is studying the impact of cash transfers in seven countries in sub-Saharan Africa using a mixed method approach that combines econometric analysis, LEWIE models and qualitative methods. The research project seeks to uncover the potential productive and economic impacts of cash transfers on beneficiary households and the communities and local economy in which they live and work. The PtoP project aims to

[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. The first formulation of the LEWIE methodology for the From Protection to Production project can be found in Taylor (2013).

provide insight on how social protection interventions can contribute to sustainable poverty reduction and economic growth at the household and community levels.

The *woredas* selected by the programme are located in urban (Abi-Adi) and rural (Hintalo-Wajirat) areas of the Tigray region. Abi-Adi is a small market town of around 16 000 people, located between the cities of Mekelle and Adwa, and is the economic centre for many surrounding villages. On the other hand, the Hintalo-Wajirat rural *woreda* is composed of geographically dispersed villages mainly characterised by agriculture-based economies. The two *woredas'* different economic structures require that a separate LEWIE be built for each. Both models encompass eligible and ineligible households for inclusion in the SCTPP and draw on household survey data and the business enterprise survey collected in 2012.

1.1 Design of the SCTPP Impact Evaluation

The Ethiopia social cash transfer pilot programme was implemented in the Tigray region and initiated in 2011 by the regional state government with support from UNICEF. Tigray is one of the most vulnerable areas of the country, prone to severe environmental shocks and characterised by chronic food shortfalls. The main objective of the SCTPP is to enhance the living conditions of orphans and vulnerable children, the elderly and persons with disabilities as well as to improve their access to essential social welfare services. During the development if the social cash pilot, the Social Protection (SP) steering committee decided to implement the pilot SCTPP in both an urban and a rural area.

The committee used the following criteria to identify their selection of each: high prevalence of extreme poverty; high prevalence of food insecurity; high prevalence of adverse living circumstances (OVC, female-headed households, PWD, the elderly); targeted households have little to no overlap of benefits with existing major SP interventions by other donors or programmes; commitment of local administrative bodies; and two areas located in disparate (i.e. non-adjacent) zones. Based on these criteria, the steering committee selected the town of Abi-Adi and Hintalo-Wajirat *woreda*. The programme covers eight geographically adjacent *tabias*[3] in the Hintalo-Wajirat rural *woreda* and the three *kebeles* from Abi-Adi town.[4] The SCTPP-selected *tabias* in Hintalo-Wajirat, located in a rural area south of Mekelle and east of the main north-south motorway, were non-randomly selected to facilitate the implementation of the programme and to reduce administrative costs (see Figure 1).

The baseline household survey was carried out from May to August 2012,[5] while monitoring surveys were (or will be) fielded once in 2012, three times in 2013 and once in 2014, with a final full follow-up household survey in 2014. As described in Table 1, the quantitative survey sample is comprised of 3 384 households, of which 1 494 were beneficiaries and 1 889 did not receive the transfer. Participants in the SCTPP were selected via a multistage process. A crucial component of this process was the development of a ranked list of eligible

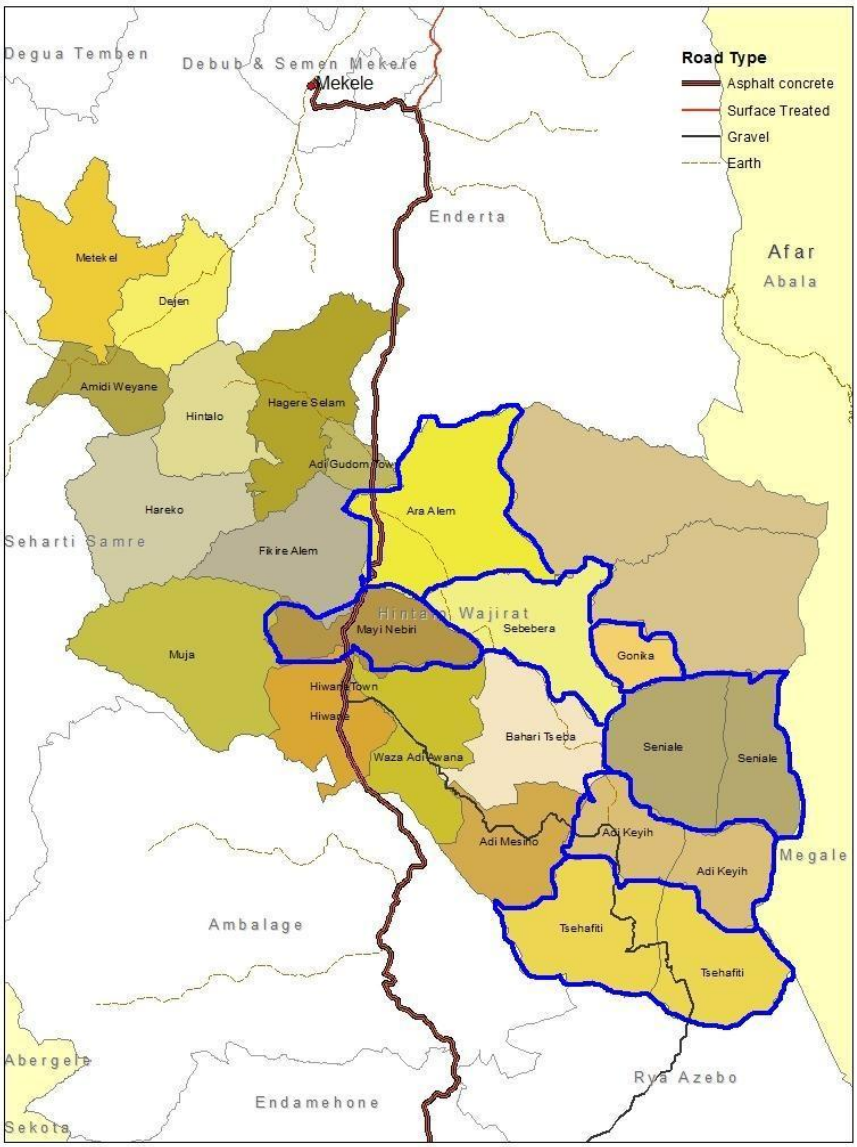
[3] Initially only seven of the 22 Hintalo Wajirat *tabias* (i.*e.* Tsehafiti, Sebebera, Gonka, Senale, May Nebri, Ara Alemsigeda, and Adi Keyih) located east of the main north-south motorway, were included in the SCTPP. Afterwards additional funds became available that permitted the extension of the programme to the Bahr Tseba *tabia*.
[4] Abi-Adi is technically a *woreda* that is called Abi-Adi town due to its location.
[5] In Bahri Tseba, the first payment to beneficiaries was made after the survey was completed.

households according to need. These lists were then used to form kushet/ketene-level rankings of all households that appeared to meet the targeting criteria. Households selected for inclusion in the programme constitute the population from which the "treatment" sample is drawn. BOLSA provided the household survey team with the list of beneficiaries. There are four beneficiary types within this list: the elderly, the disabled, child-headed households and female-headed households. The smaller groups (such as child-headed households) were oversampled to make it easier to identify impacts in these groups. A list of ineligible non-beneficiaries was also drawn from those who did not receive the transfer but resided in the treated *tabias* (Berhane et. al, 2012).

Collaboration with the PtoP project resulted in the inclusion of additional data collected at the community level and a business enterprise survey[6] of 404 rural businesses (201 in Abi-Adi and 203 in Hintal-Wajirat) containing additional information required for the construction of the LEWIE model.

[6] The business enterprise survey took place right after the completion of the baseline household survey in 2012.

Figure 1 Location of SCTPP *tabias* within Hintalo-Wajirat



Source: Berhane *et al.* (2012)

Table 1 **Household grouping in Ethiopia SCTPP, actual population and total transfers received**

	Woreda		
	Hintalo-Wajirat	**Abi-Adi**	**Total**
Sample size			
Beneficiary (treatment)	846	649	1,495
Non-beneficiaries (ineligible)	1091	798	1,889
All	**1,937**	**1,447**	**3,384**
Actual population	**55,351**	**16,115**	**71,466**
Total transfer received (birr)	**5,577,420**	**1,618,740**	**7,196,160**

Table 2 **Volume of transfers within beneficiary households (1USD=18 birr)**

Household grant	**Amount in birr**
Basic grant within household	
Basic household grant	155
Dependence grant within household	
Child	25
Child disability	40
if the disabled child goes to school	50
Adult disability	50
Elders	60
Children enrolled in primary school	25

The LEWIE analysis focuses on the spillover effects generated when beneficiary households spend their cash transfers. Given trade linkages among households located in different villages, these spillovers occur beyond the confines of the treated *woredas*. In the case of the impact evaluation design in Ethiopia control households were chosen from the same or neighbouring villages as treatment households and control households located within the treated *woreda* or nearby could be affected by these spillover effects. The control households were also economically somewhat better off than the treated households inasmuch as they were higher up on the ranking list of potential beneficiaries. Thus the LEWIE model treats the control group as part of the group of non-beneficiaries along with the ineligible households mentioned above.

Additionally, the LEWIE models are constructed based on the behaviour of households when the survey took place, essentially fixing the behaviour throughout the transmission of the transfer through the economy. This may not be true as the expenditure shares and underlying technology of the different activities may or may not change over time. One way to test this is to construct additional LEWIEs based on data generated by the end-line household survey. This would determine if behaviour change occurred and in what way. We leave this research however to a future report when the data become available.

2. The Local Economy-Wide Impact Evaluation in Ethiopia

The Ethiopia LEWIE models household economies and the interactions between households in the two *woredas*, Hintalo-Wajirat and Abi-Adi, where the SCTPP is being implemented. Hintalo-Wajirat contains *tabias* that are mostly rural. The participating *tabias* consist mainly of small villages with few local businesses and a population devoted primarily to agriculture. The villages are connected to market towns which contain most of the businesses and traders within the economy. Abi-Adi, on the other hand, is a large town that has many service, retail, and production enterprises. It has few agricultural activities and its population obtains most of its goods and services from within the town rather than neighbouring markets. The LEWIE is constructed to model the local economy as accurately as possible and since the two *woredas* are quite different two different models have been constructed.

Thus the study area of the two models consists of (1) Abi-Adi and (2) the SCTPP *tabias* of Hintalo-Wajirat. Within each area there are two household groups; Group A are the treated SCTPP (beneficiary) households and Group B are the ineligible, non-beneficiary households (see Table 3 below).

Table 3 **Household groupings for the LEWIE models**

Model 1	Model 2
Hintalo-Wajirat (SCTPP *tabias* only)	Abi-Adi
Group A (beneficiaries)	Group A (beneficiaries)
Group B (non-beneficiaries)	Group B (non-beneficiaries)

Both models are 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, together with factors (labour, capital, purchased inputs) and markets outside the programme area, constitute the accounts in our model. Table 4 summarises 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 village/town shops which obtain some of their goods from outside the local economy. 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.

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 *woreda*, and the spillovers among the different groups can have important income-generating effects. The treated and non-treated households also interact through shared "Zone of Influence" (ZOI) markets; for Abi-Adi the ZOI includes the town's neighbouring villages,

whereas for Hintalo-Wajirat it consists primarily of the market towns but also neighbouring villages. Finally, communities are linked with the rest of Ethiopia and abroad, importing and exporting goods and selling labour. Our model does not capture the possible multiplier effects of programme impacts in the rest of Ethiopia outside the ZOI.

Table 4 **Accounts in the Ethiopia LEWIE**

Households	
A	SCTPP beneficiaries
B	Non-beneficiaries (Ineligible households)
Activities	
crop	Crops
live	Livestock
ret	Retail
ser	Services
prod	Other production
Commodities	
crop	Crops
live	Livestock
ret	Retail
ser	Services
prod	Other production activities
outside	Produced outside the ZOI
Factors	
HL	Hired labour
FL	Family labour
Land	Land
K	Capital
Purch	Purchased (intermediate) inputs
ROW	Rest of world (exogenous to model)

2.1 Sources of data and the study region

We use two data sources to construct the models: the 2012 baseline household impact evaluation survey and the 2012 business enterprise survey. The baseline household survey took place between May and August, 2012 and was combined with community level data collection during the same period. The business enterprise survey took place in December, 2013. Specific questions were added to these surveys to collect the data necessary for the construction of the LEWIE model. Key information on locations and expenditures, not usually included on impact evaluation surveys, was collected in order to build the model accounts.

The inception report (Berhane *et al.* 2012) provides a detailed explanation of the choices made in developing the impact evaluation strategy. It includes an explanation of the choice of locations for the data collection, the groups in the quantitative household survey, the choice and content of survey instruments and sample size calculations.

We use the 2012 baseline household survey to obtain information on household expenditures and incomes. This includes extensive information on the kinds of food purchased and where they were purchased, inside the village (or town, in the case of Abi-Adi), in a neighbouring village or from outside the area. Data were gathered on income derived from wages and the

location of wage work, various family enterprises in agriculture, livestock and non-agricultural businesses and transfer income from the government, local residents and outside. These data allowed us to estimate the crop and livestock regressions which provide the parameters for the LEWIE models.

The business enterprise survey provides information on costs and revenues from a selection of businesses operating in the programme districts. A list of businesses was obtained for each *woreda* with the help of the local Bureau of Labour and Social Affairs Office (BOLSA). Randomly selected samples of different types of businesses in the area (retail, services and production) were then drawn. We assumed businesses of each type use a similar technology and we used the business enterprise survey data to estimate that technology. A sufficient sample of each business type in each area was surveyed to ensure an accurate representation of the technology used. We also used this survey to estimate the intermediate demand shares for goods and services supplied as inputs from other businesses inside or outside the programme area.

In summary, for the businesses, we derived the underlying technology and intermediate demand shares from the business enterprise survey and the income from household businesses was estimated from the household survey. Business income from the household survey makes it possible to link businesses to the beneficiary and non-beneficiary households' income and expenditures. The business enterprise survey provides the critical inputs to estimate production functions for each business.

2.2 LEWIE data input

The baseline household survey data serve two main purposes in the construction of LEWIE models. First, the data 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 necessary 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 5 is an excerpt from the LEWIE data input spreadsheet showing the parameters and initial values in birr, related to retail for each household group in just the Abi-Adi model (the Hintalo-Wajirat input sheet structure for retail is similar). The initial values were obtained from the sample means of the household survey scaled up to the actual population size of the treated area as given in Table 1. 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 baseline values for each household group.

Table 5 **LEWIE panel for retail production and consumption**

Variable	Factor	Abi-Adi	
		Treatment households	Non-beneficiary households
Expenditure share on in village retail		0.903	0.958
Standard error on expenditure share		0.012	0.006
Retail spending on retail		32 468	3 605 793
Retail spending on services		8 977	997 022
Retail spending on other production		17 161	1 905 826
Retail spending on outside		51 4320	57 119 278
Factor Demand	Hired Labour	223 373	24 807 315
Factor Demand	Family Labour	153 511	17 048 629
Factor Demand	Capital	93 012	10 329 673
Hired labour share of revenue		0.475	0.475
Family labour share of revenue		0.327	0.327
Capital Share of Revenue		0.198	0.198
Standard error for hired labour share		0.116	0.116
Standard error for family Labour share		0.117	0.117
Standard error for capital share		0.084	0.084
Cobb-Douglas shift parameter		6.075	6.075
Standard error for shift parameter		0.774	0.774

In this model, the first rows contain consumption function parameters: the average expenditure share of a type of household (either beneficiary or non-beneficiary) on retail goods and the standard error from its estimation. Below these two rows are the average retail production demands for the four types of intermediate inputs used in this activity which come from retail, services, other production, and purchases from outside the local economy. These are purchases from other businesses in the local economy and in outside markets. It is noteworthy that in the retail sector there is a large relative demand for outside goods. This will have consequences for the local economy in that it creates a significant leakage to the outside resulting in a smaller multiplier effect of the transfer (this will be discussed further in the report).

Below these rows are three kinds of factors: hired labour, family labour and capital. These are the factors used in the production of retail goods. Revenue is distributed to these factors depending on their relative size. The production function for retail (and the other activities in the economy) uses a Cobb-Douglas specification which allows easy recovery of relative factor shares. The standard errors are reported below the factor shares. Finally, regression

estimates calculate the Cobb-Douglas shift parameter and its standard deviation which represents technological change or the residual output not captured by the factors.[7]

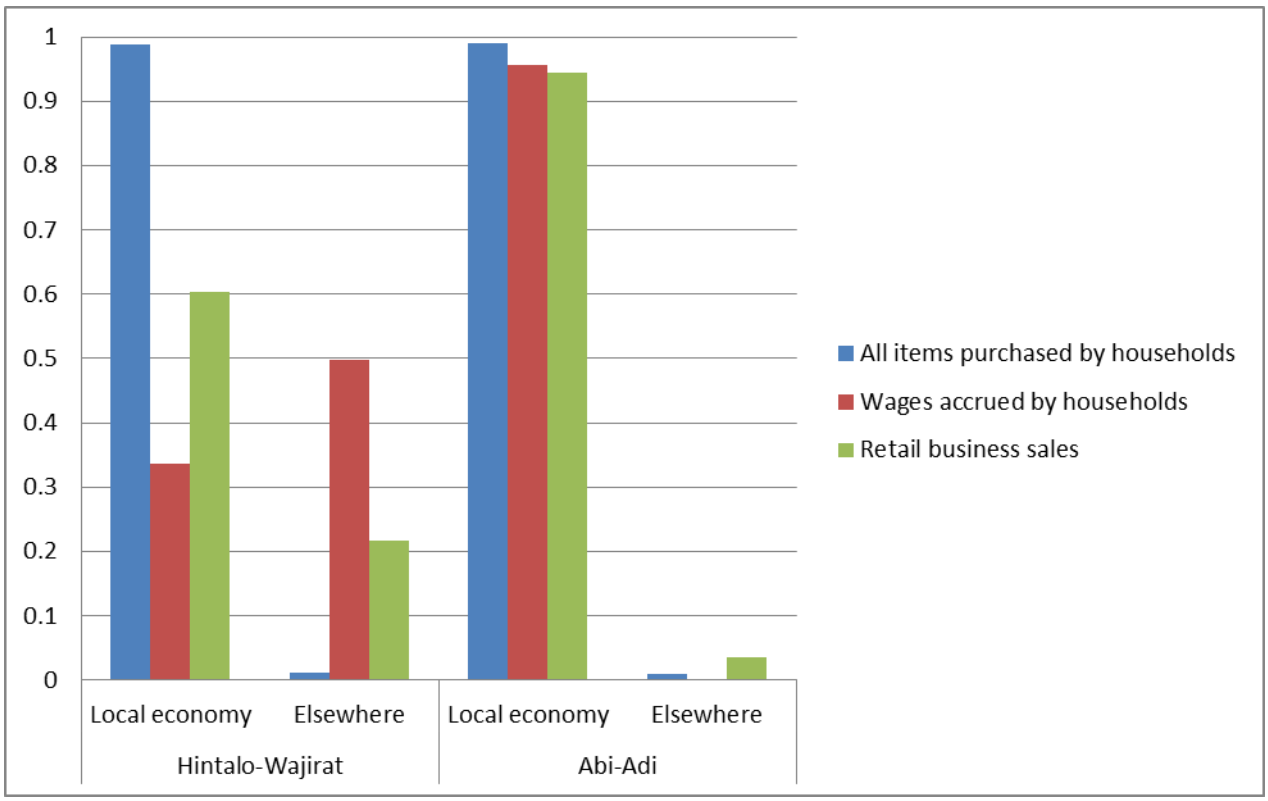
In the Ethiopia LEWIEs, this data sheet includes similar panels (not shown below) detailing production and consumption of each of the other commodities; crop, livestock, services and other production. These vary in terms of factors and derived demands but are similar to the one depicted in Table 5.

The spatial organization of the Zone of Influence (ZOI), the region across which we simulate the impacts of the SCTPP transfers, is also represented in the LEWIE input sheet. Households consume and produce local commodities and they can export production (that is, sell it outside the programme area) or import outside goods. The ZOI for the Ethiopia LEWIEs includes the villages in Hintalo-Wajirat (or town for Abi-Adi) and nearby villages, which have larger markets visited by people from many communities (this is especially true for Hintalo-Wajirat); the initial values for intermediate demands, factor demands, and consumption of commodities include these expenditures.

Figure 2 illustrates how expenditures vary dramatically depending on the two models. Hintalo-Wajirat, which consists of mostly small remote villages and a few central market towns, has much lower local economy (ZOI) shares than Abi-Adi. Abi-Adi, on the other hand, is a town with many of the amenities that households need on a daily basis. The town also meets much of the demand of local businesses. These data suggest the need for two separate LEWIE models. In each model 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 or leak into markets outside the programme area.

[7] Important underlying assumptions of the model include the implications of the Cobb-Douglass utility function for income and price elasticities and that programme money is spent in the same way as other sources of income.

Figure 2 **Different hh/business expenditure and income patterns**



3. The Direct and Indirect Impacts of the SCTPP: 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. This could be problematic if behaviour changed in the short period between the receipt of transfers and the surveys used to parameterize our models. The linearity assumptions allow one to simulate the SCTPP's impacts in an unconstrained social accounting matrix (SAM) accounting 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 local economy. 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 birr 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 a multiplier analysis could overstate the multiplier effect of the cash transfer.

In light of these concerns, we follow the alternative approach of using the parameter estimates and baseline data (Table 5) to calibrate a general equilibrium (GE) LEWIE model. Here, the LEWIE is analogous to the computable general equilibrium 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. If household and business behaviour changed between the times the first transfers were made and that of the survey this could create problems for the GE-LEWIE, like the SAM multiplier, approach. However, the general GE-LEWIE model is more flexible and arguably more realistic than LEWIE SAM multiplier models, and the general equilibrium model lends itself to validation in ways that SAM multiplier models 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.

3.1 The general equilibrium-LEWIE model

SAMs are the basic data input for GE 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 a 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 5.

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 parameterising 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 SCTPP 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 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 p^{th} 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 would be reflected in wider confidence bands around our simulation results, whereas precise parameter estimates would 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 SCTPP transfers increase spending in the treatment households. This increases the demand for goods supplied inside the treated communities as well as outside the communities. The impact of increased demand 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 SCTPP on the economy 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; from the point of view of the programme area they are "imports". Because of this, retail is largely an import sector, making tradables from outside available to households and businesses within the cluster of villages that make up the local economy. 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 local economy). 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 village. These processes are simulated in the LEWIE models.

3.2 LEWIE findings

The LEWIE model was used to simulate the impacts of the transfer of 7.2 million birr on the two programme-area economies, taking into account nonlinearities and local price effects. In these simulations prices may be determined inside or outside the village.

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 wheat, an Ethiopian staple, 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 SCTPP there is little reason for transfers to affect prices outside the treated areas 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 Ethiopia changes in local demand may nonetheless affect the prices of food and livestock products purchased directly from producers in the treated villages (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).[8] This reflects excess labour supply in rural Ethiopia: 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 remove inflationary pressures, however, 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 SCTPP under assumptions which we believe reasonably reflect the structure of markets in the villages receiving the transfer. Later on we see how the LEWIE models change in response to the loosening or tightening of constraints.

Table 6 summarises the multiplier results from the base LEWIE models. The base model has an elastic labour supply and all prices except purchased factor, production and outside goods are determined within the ZOI. It also assumes that land and capital are fixed – a standard short-run assumption in agricultural household models. We believe that these assumptions are likely to reflect conditions in the programme area; however, we later test the sensitivity of our simulation findings to these assumptions. In addition to the multiplier effects, 90 percent confidence bounds were constructed using 1 000 random draws from each parameter distribution.[9]

[8] Higher elasticities do not have an appreciable effect on SCTPP multipliers.
[9] For the full results of this simulation and the additional simulations see the corresponding tables in Appendix A (e.g. the full result of Table 6 is given in Table 6A).

Table 6 **Simulated income multiplier of the Ethiopia SCTPP base model**

	Hintalo-Wajirat	Abi-Adi
Income multiplier		
Nominal	2.52	1.35
(CI)	(2.09 – 2.80)	(1.33 – 1.38)
Real	1.84	1.26
(CI)	(1.52 – 2.05)	(1.25 – 1.26)

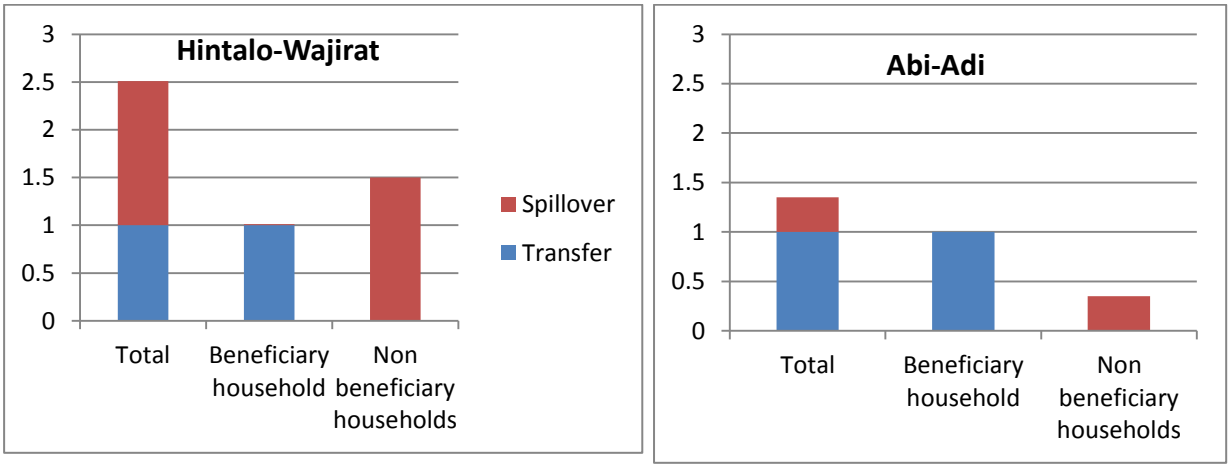
The LEWIE model found that each birr distributed in Hintalo-Wajirat generated an extra 1.52 birr via the local economy, for a total income multiplier of 2.52. Similarly each birr distributed in Abi-Adi generated an extra .35 birr, for a total income multiplier of 1.35. Thus the initial transfer of 5.58 million birr in Hintalo-Wajirat and 1.62 million birr in Abi-Adi potentially generated 14.06 million birr and 2.19 million birr respectively.

However, when credit, capital and other market constraints limit the local supply response the increase in demand brought about by the cash transfer programme may lead to increased prices and consequently a lower income multiplier. Simulations incorporating such constraints find a "real" income multiplier of 1.84 birr for Hintalo-Wajirat and 1.26 birr for Abi-Adi.

On the one hand, this finding confirms that the SCTPP can generate income multipliers within the treated regions 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 sufficiently high supply response in the local economy, part of the impact may be inflationary instead of real. Even a relatively small increase in the local current price index (CPI) can result in a much smaller real income multiplier because it potentially affects all expenditures by all household groups.

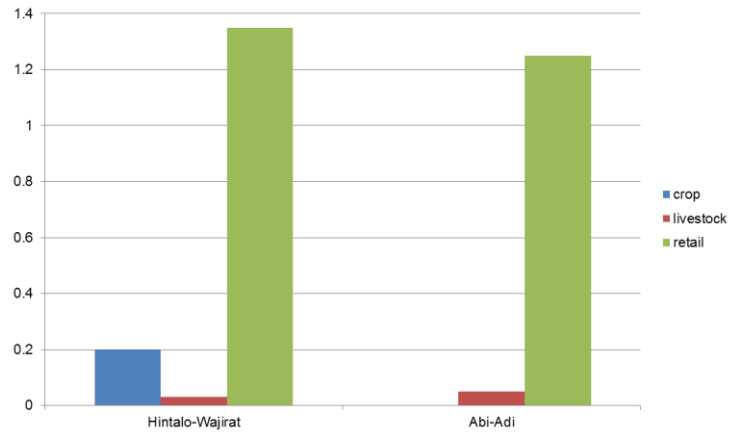
Figure 3 gives the simulated impacts of the nominal multiplier on the incomes of each household group in Hintalo-Wajirat and Abi-Adi. Beneficiary households in Hintalo-Wajirat receive the direct benefit of the transfer and a very small spillover effect of 0.02 birr for each birr transferred (even smaller for Abi-Adi). The non-beneficiary households in Hintalo-Wajirat do not receive the transfer, but they benefit from their economic interactions with beneficiary households: a 1.52 birr increase in nominal income per each birr transferred (0.35 for Abi-Adi). Thus, because of their ownership of productive assets, the non-treated households are beneficiaries of the SCTPP.

Figure 3 **Distribution of SCTPP nominal income multiplier on beneficiary and non-beneficiary households**



The income multiplier works through productive activities and Figure 4 shows the corresponding production multipliers. According to the LEWIE model the transfers stimulate the production of crops by 0.2 birr per birr transferred in the rural Hintalo-Wajirat, for a total increase of 1.1 million birr. The production multiplier for crops in Abi-Adi is 0.0, showing again the difference in economic activities between the town and the more rural economy of Hintalo-Wajirat. The largest effect for both areas is on the retail sector which has a multiplier of 1.35 birr for Hintalo-Wajirat and a slightly smaller one of 1.25 birr for Abi-Adi per birr transferred.

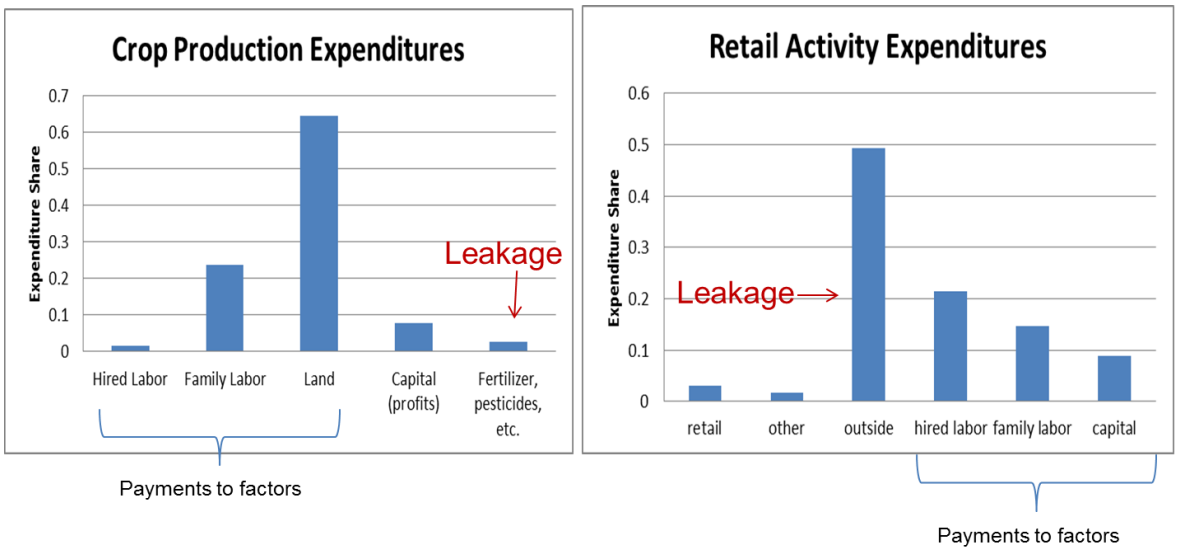
Figure 4 **SCTPP production multipliers, by model**



One reason why we see a larger multiplier in Hintalo-Wajirat than in Abi-Adi is that the urban economy relies more on retail than does the rural economy which also engages in local crop production. While the retail sector has a large output multiplier, it also creates large leakages through its purchases of imported goods. This limits the ultimate effect on income multipliers.

Crop and livestock production, however small, can stimulate the local economy because of relatively small leakages to the outside.[10] Figure 5 provides a graphical depiction of this difference.

Figure 5 **Crop and retail expenditures differ in the size of leakage to the outside economy**



3.3 Robustness tests

We tested the robustness of the simulation results against different assumptions concerning the liquidity constraint. Table 7 shows the simulated results with a liquidity constraint on the purchased factors for crop and livestock production. It simulates the idea that agricultural producers face a liquidity constraint that will not allow them to optimize their levels of purchased inputs.

Table 7 **Simulated effects of liquidity constraint on the SCTPP income multiplier**

	Hintalo-Wajirat	Abi-Adi
Income multiplier		
Nominal	2.52	1.35
(CI)	(2.09 – 2.80)	(1.33 – 1.38)
Real	1.81	1.23
(CI)	(1.49 – 2.02)	(1.22 – 1.24)

[10] Note that although Abi-Adi has more livestock production than Hintalo-Wajirat, the multiplier is limited because household meat consumption is relatively low. Compared to purchases of local crops and retail goods, livestock purchases are a small share of household expenditures (0.08 for beneficiary households in Abi-Adi and 0.002 for Hintalo-Wajirat).

In our baseline model, just presented, there are no liquidity constraints on the purchase of productive inputs which can limit income multipliers created by the SCTPP. The income multipliers associated with the liquidity constraint in the simulations in Table 7 only slightly decrease from the earlier simulation in Table 6. However the liquidity constraint reduces the real income multiplier. This is because the crop and/or livestock production multipliers under the constrained scenario are lower than in the base scenario in Table 6 (see Table 7A for the full results). The liquidity constraint limits the supply response of crop and livestock production by fixing purchased inputs at the base level. This puts upward pressure on local prices when demand increases as a result of the transfers. The result is a lower real total multiplier.

The simulation presented in Table 8 is a less constrained alternative to the baseline model in Table 6. It, like the baseline model, has no liquidity constraint on input purchases and, in addition, capital is allowed to expand as needed to prevent upward pressure on local rents.[11] In this simulation, capital (like other factors) increases to meet its increased demand when transfers stimulate the local economy, such that the change in the implicit rent is zero. 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 in order to alleviate capital constraints.

Table 8 **Simulated effects of relaxing capital constraints on the SCTPP income multiplier**

	Hintalo-Wajirat	Abi-Adi
Income multiplier		
Nominal	2.72	1.31
(CI)	(2.54 – 2.89)	(1.30 – 1.31)
Real	2.17	1.29
(CI)	(2.02 – 2.28)	(1.28 – 1.30)

Under the assumptions of this simulation, the transfer induces larger production and real income multipliers: 2.17 in Hintalo-Wajirat and 1.29 in Abi-Adi. All impacts are invariably higher than in the base scenario (see Table 8A for the full result). There is no need to reallocate scarce resources between activities, so even "other production" is now positively stimulated. Although this scenario may be unrealistic in light of the constraints households in Tigray face, it is likely to give us an upper bound estimate of potential income multipliers of the SCTPP.

[11] In rural Ethiopia, 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.

4. Conclusions and recommendations

Simulations from the LEWIE model show that the SCTPP can have a large and significant impact on incomes of both beneficiary and ineligible households in Hintalo-Wajirat and Abi-Adi. Each birr transferred generates at least 1.84 birr and 1.26 birr of real total income in Hintalo-Wajirat and Abi-Adi respectively, and possibly as much as 2.52 birr and 1.35 birr under the base model. This makes a total of at least 10.57 million birr and 2.19 million birr, which is a substantially larger benefit than the original investment of 5.58 million birr in Hintalo-Wajirat and 1.62 million birr in Abi-Adi.

Sensitivity analysis shows that if the economy has more supply constraints, such as liquidity constraints on purchased inputs or a lack of access to capital, than as expected the income multiplier decreases. The opposite is true if capital expands with increased demand. To make sure that the models are capturing the correct economic structure additional LEWIE models could be constructed after the final survey round in 2014.

Ultimately, the LEWIE simulations show that the direct effect is only part of the net benefit of the SCTPP programme. Local market linkages transmit benefits to the non-beneficiary households via economic transactions. This is because non-beneficiary households own most of the productive assets and production expands in response to the stimulus that the SCTPP creates for local demand. Non-beneficiary households may be pleased to know that, while helping the poor in their community is surely a noble endeavour and necessary for society, local spillovers benefit them as well. An awareness of this may add to the political feasibility of these social protection programmes.

5. References

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Taylor, J.E. 2013. *A methodology for local economy-wide impact evaluation (LEWIE) of cash transfers*, PtoP project report, FAO and The World Bank.

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6. Appendix A:

Table 6A Simulated impacts of the Ethiopia SCTPP Pilot

	Hintalo-Wajirat	Abi-Adi
Elasticity of hl/fl lab supply	100/100	100/100
Liquidity constraint on/off	0ff	0ff
Village cluster markets	crop, live, ser, prod, ret, FL, HL	crop, live, ser, prod, ret, FL, HL
Treatment and control cluster markets	null	Null
Integrated markets	prod, OUTSIDE, PURCH	prod, OUTSIDE, PURCH
Transfer	A	A
Iterations	12	12
MULTIPLIERS		
Total income multiplier		
Nominal	2.52	1.35
(CI)	(2.09 – 2.80)	(1.33 – 1.38)
Real	1.84	1.26
(CI)	(1.52 – 2.05)	(1.25 – 1.26)
Hh income multiplier (nominal)		
A nominal	1.01	1
cpi increase in %	0.12%	0.02%
real	1.01	1
B nominal	1.5	0.35
cpi increase in %	0.22%	0.00%
real	0.83	0.25
Production multiplier		
Crop production	0.2	0
(CI)	(0.11 – 0.30)	(0.00 – 0.00)
Livestock production	0.03	0.05
(CI)	(0.02 – 0.05)	(0.04 – 0.06)
Services	0.12	0.02
(CI)	(0.08 – 0.15)	(0.02 – 0.02)

Other production			-0.14	0
(CI)			(-0.37 – 0.02)	(0.00 – 0.00)
Retail			1.35	1.25
(CI)			(1.11 – 1.50)	(1.24 – 1.26)
Production multiplier by hh				
	Crops	A	0	0
		B	0.2	0
	Livestock	A	0	0
		B	0.03	0.05
	Retail	A	0.03	0.02
		B	1.32	1.22

Table 7A Effects of cash constraints on the simulated impacts of the SCTPP

	Hintalo-Wajirat	Abi-Adi
Elasticity of hl/fl lab supply	100/100	100/100
Liquidity constraint on/off	On	On
Village cluster markets	crop, live, ser, prod, ret, FL, HL	crop, live, ser, prod, ret, FL, HL
Treatment and control cluster markets	Null	null
Integrated markets	prod, OUTSIDE, PURCH	prod, OUTSIDE, PURCH
Transfer	A	A
Iterations	12	12
MULTIPLIERS		
Total income multiplier		
Nominal	2.52	1.35
(CI)	(2.09 – 2.80)	(1.33 – 1.38)
Real	1.81	1.23
(CI)	(1.49 – 2.02)	(1.22 – 1.24)
Hh income multiplier (nominal)		
A nominal	1.01	1

	cpi increase in %		0.31%	0.94%
	real		1.01	0.99
B	nominal		1.5	0.35
	cpi increase in %		0.61%	0.13%
	real		0.8	0.24
Production multiplier				
Crop production			0.18	0
(CI)			(0.10 – 0.28)	(0.00 – 0.00)
Livestock production			0.02	0.03
(CI)			(0.01 – 0.03)	(0.02 – 0.04)
Services			0.12	0.02
(CI)			(0.08 – 0.15)	(0.02 – 0.02)
Other production			-0.13	0
(CI)			(-0.37 – 0.02)	(0.00 – 0.00)
Retail			1.35	1.25
(CI)			(1.11 – 1.50)	(1.24 – 1.26)
Production multiplier by hh				
	Crops	A	0	0
		B	0.28	0
	Livestock	A	0	0
		B	0.02	0.03
	Retail	A	0.03	0.02
		B	1.32	1.22

Table 8A Effects of fixed rental rates on the simulated impacts of the SCTPP

	Hintalo-Wajirat	Abi-Adi
Elasticity of hl/fl lab supply	100/100	100/100
Liquidity constraint on/off	Off	Off
Fixed rental rates for capital	On	On
Village cluster markets	crop, live, ser, prod, ret, FL, HL	crop, live, ser, prod, ret, FL, HL
Treatment and control cluster markets	null	null
Integrated markets	prod, OUTSIDE, PURCH	prod, OUTSIDE, PURCH
Transfer	A	A
Iterations	12	12

MULTIPLIERS				
Total income multiplier				
Nominal			2.72	1.31
(CI)			(2.54 – 2.89)	(1.30 – 1.31)
Real			2.17	1.29
(CI)			(2.02 – 2.28)	(1.28 – 1.30)
Hh income multiplier (nominal)				
A	nominal		1.02	1
	cpi increase in %		0.03%	0.22%
	real		1.02	1
B	nominal		1.35	0.3
	cpi increase in %		0.47%	0.01%
	real		1.15	0.29
Production multiplier				
Crop production			0.28	0
(CI)			(0.21 – 0.38)	(0.00 – 0.00)
Livestock production			0.07	0.08
(CI)			(0.04 – 0.10)	(0.07 – 0.09)
Services			0.16	0.02
(CI)			(0.13 – 0.19)	(0.02 – 0.02)
Other production			0.08	0.02
(CI)			(0.04 – 0.12)	(0.02 – 0.02)
Retail			1.53	1.26
(CI)			(1.36 – 1.62)	(1.25 – 1.27)
Production multiplier by hh				
	Crops	A	0	0
		B	0.28	0
	Livestock	A	0	0
		B	0.07	0.08
	Retail	A	0.02	0.01
		B	1.51	1.25