One plus one can be greater than two: evaluating synergies of development programs in Malawi

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Abstract

Although there are multiple programs designed to tackle the different causes of hunger and poverty in developing countries, there are only a very limited number of impact evaluations that investigate the impact of individual food security/poverty reduction programs and their synergies with other programs with similar objectives. This paper aims to contribute to the literature on anti-poverty program evaluation by shedding light on the interplay between the Social Cash Transfer Program (SCTP) and the Farm Input Subsidy Program (FISP) in Malawi. We take advantage of data collected from a seventeen-month evaluation (2013-2014) of a sample of households eligible to receive the SCTP, which also provided information about inclusion into the FISP. Adopting a difference-in-difference approach with generalized propensity score weighing adjustment, we provide doubly robust estimates of the average stand-alone and joint treatment effects of the two interventions, as well as their synergies on a variety of outcomes including household expenditure and food security and contributing outcomes such as productive activities, agricultural inputs and livestock.

Keywords: cash transfers, agricultural subsidies, program complementarity, impact evaluation, household expenditure, productive impact.
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1 Introduction

There is a growing body of literature on the impacts of policy interventions implemented in developing countries to tackle hunger and poverty in the short and long run. These programs include cash transfers, food and/or supplements, provision of subsidies for agricultural inputs and activities, provision of information and/or training sessions on matters broadly related to education and health. It is plausible that there are interactions between these programs, yet program evaluators are generally only able to estimate the stand-alone impact of each program without much attention to the potential synergies and degree of complementarity between them. However, this kind of analysis is relevant for several reasons. First, resources are scarce: it is necessary to run programs that reinforce each other rather than programs that reciprocally reduce their effectiveness. Second, if the synergies and the degree of complementarity is high and significant, policy makers could in principle reduce the resources allocated to various programs to reach the same desired results. Third, if the degree of substitutability is high and significant, policy makers should carefully prioritize desired outcomes and define a realistic timeline to avoid 'crowding out' the effects of the various programs.

This paper focuses on the experience of a Sub-Saharan country, Malawi, in which in recent years the Social Cash Transfer Program (SCTP) and the Farm Input Subsidy Program (FISP) have been implemented simultaneously as instruments for reducing poverty and vulnerability to hunger among poor households that mostly rely on agriculture as main source of income.

The FISP and SCTP are expected to have direct impacts on several outcomes. The FISP is expected to directly influence production decisions, but its contribution towards reducing hunger and poverty is mediated by factors such as access to land, water and labor for food production, responsiveness of yields to increased inputs, climatic factors, and the relative position of small poor farmers as net buyers or net sellers of grains in food markets. The SCTP program is a welfare intervention that acts directly on the consumption capability of the recipients: the additional cash can be used directly to increase both quantity and quality of food. Recipients of the cash can, in addition, use this for purchasing productive inputs and assets. Several prior studies focus on the isolated impact of the SCTP (Covarrubias et al. 2012; Handa et al. 2015; Asfaw et al. 2015) and FISP in Malawi (among others, Arndt et al. 2015; Chirwa and Dorward, 2013; Jayne and Ricker-Gilbert, 2011; Dorward et al. 2013).

This paper is the first attempt to shed light on the interplay between the FISP and the SCTP using survey data. More specifically, the paper investigates the impacts on poor and ultra-poor households when these participate in either the FISP or the SCTP alone or when these participate in both programs simultaneously. We focus on a variety of outcomes, including household expenditure (food and non-food),

food security and on contributing outcomes such as productive activities (crop production, input use) and livestock. In assessing the impacts of the two combined interventions, we focus on two types of synergies: i) we study whether there is complementarity between SCTP and FISP, i.e. whether the impact of both interventions run together is larger than the sum of the impacts of these interventions when run separately; ii) we estimate the incremental impact of receiving the FISP when a household already receives the SCTP, as well as the incremental impact of receiving the SCTP when a households already receives the FISP. More formally, consider two interventions (in this paper FISP and SCTP) whose impact on, for example, per capita expenditure when offered separately are, respectively, α and β, and whose impact when offered together is γ. For outcomes that are expected to be positively affected by each treatment (per capita expenditure or value of production, for example), the two interventions are complementary if $\gamma > \alpha + \beta$, i.e. when the joint impact of two interventions when implemented together is greater than the sum of impacts when run separately (Gertler et al. 2011). Furthermore, the difference between γ and α measures the incremental impact of FISP when a household already receives SCTP, and the difference between γ and β measures the incremental impact of SCTP when a household already receives FISP.

For the empirical analysis we take advantage of data collected from a seventeen-month evaluation (2013-2014) on a sample of households eligible to receive the SCTP, which also provided information about inclusion into the FISP. Since only the assignment into SCTP is random, we deal with potential sample selection issue adopting Uysal's (2015) strategy that allows to obtain doubly robust estimates of causal effects through a combination of regression analysis, implemented through difference-in-difference approach, and generalised propensity score weighting adjustment. Since the impacts of the two programs are likely to differ across different groups of the study population, we carry-out the analysis by groups of households with different labour endowments (unconstrained versus constrained households), as well as on the whole sample. We define a household as labour constrained if there is no able-bodied member of household who is fit-to-work, i.e. no adult without chronic illness and/or disabilities. Labour constraints are factors that can be considered proxies of wealth and capacity to generate income and therefore likely to mediate the effect of both SCTP and FISP.

The rest of the paper is organized as follows. Section 2 discusses previous evidence on the impacts of input subsidies and social cash transfers programs in Sub-Saharan Africa. Section 3 describes the FISP and SCTP. Section 4 presents the empirical approach and the estimation method. The main results are presented and discussed in Section 5. Finally, section 6 concludes.

2 Literature Review

This paper fits into three branches of the literature: i) the impact evaluation of social protection interventions through randomized field experiments; ii) the analysis of agricultural subsidy programs in low income countries; and iii) the joint evaluation of social protection and agricultural development interventions. Given the main focus of this paper, in this section we focus only on contributions relating to the experience of African countries. For contributions concerning the experiences of countries in Latin America or Asia we refer to three broad literature reviews by Tirivayi et al. (2013), Jayne and Rashid (2013), and Veras et al. (2016) respectively for the impact evaluation of social protection interventions, the effects of agricultural subsidy programs, and the combined effects and synergies between the two.

2.1 Impacts of fertilizer subsidies programs in sub-Saharan Africa

Input subsidy programs are one of the most debated policy interventions in Africa. According to Jayne and Rashid (2013), the general lack of consensus on the value and impacts of these kinds of interventions in Africa is mainly due to differences in beliefs, values, worldviews, and political interests. The Chicago tradition associated to Schultz (1964) argued that farmers are rational profit maximizers who will choose optimal fertilizer levels to use. Thus, subsidies are seen as distortionary and as reducing social welfare. Other arguments against subsidies include negative environmental externalities (World Bank 2008) and regressive distribution schemes resulting from political influence and elite capture (Kilic et al. 2013, Chibwana et al. 2011, Pan and Christiaensen 2012, Lunduka et al. 2013). In contrast, supporters of subsidies point to market failures that would lead fertilizer use levels under laissez-faire policies to be less than socially optimal. Moreover, they point to the strong relationship between fertilizer use and agricultural yields observed in Asia as evidence in support of implementing input subsidy programs in Africa. The literature on the impacts of input subsidy programs in sub-Saharan Africa finds mixed results (among others, see Arndt et al. 2015, Jayne and Rashid 2013, Sachs 2012, World Bank, 2008, Dorward and Chirwa, 2011). Given the focus of the current paper we only review previous contributions related to three key points, i.e. the impact of input subsidy programs on total fertilizer use, agricultural growth and poverty reduction, and the impact on price and wage levels.

As far as the impact of input subsidy programs on total fertilizer use is concerned, empirical evidence suggests that the receipt of subsidized fertilizer induces some farmers to buy less fertilizer from commercial retailers than they otherwise would have done in the absence of the subsidy program. This "crowding out" of commercial fertilizer tends to be less when subsidy programs are targeted to relatively poor farmers and in areas where the commercial demand for fertilizer is low (Mason and Jayne 2013, Ricker-Gilbert et al. 2011). Meanwhile, Liverpool-Tasie (2012) found evidence of "crowding in" of commercial fertilizer demand in a pilot subsidy scheme in one district of Nigeria where fertilizer vouchers where mainly targeted to areas where private commercial markets were relatively weak and to households that were relatively poor. Results from randomized control trials (RCTs) on the impact of input subsidy programs have found mixed evidence on their effectiveness at raising fertilizer utilization (Duflo et al. 2011, Carter et al. 2014). Through a RCT in Western Kenya, Duflo et al. (2008) provide empirical evidence of the relevance of behavioral factors in explaining the small impact of an input subsidy program on fertilizer use. They find that small, time-limited reductions in the cost of purchasing fertilizer at the time of harvest induce substantial increases in fertilizer use, comparable to those induced by much larger price reductions later in the season. They conclude that a policy of small, time-limited subsidies may be attractive because they increase fertilizer use for present-biased farmers, but would create minimal distortions in the behavior of farmers who were not present-biased. However, they find that the impacts on fertilizer use is null in the following seasons in which the subsidies are not provided. Differently, analyzing experimental data collected through a RCT in Mozambique, Carter et al. (2014) find positive effects of input subsidies on fertilizer use that persist up to two annual agricultural seasons beyond the season in which the subsidies were offered.

As far as poverty reduction is concerned, the review of the micro-level evidence by Jayne and Rashid (2013) shows that the input subsidy programs have raised national food production. Arndt et al (2015) study the economy-wide impact of FISP in Malawi adopting a computable general equilibrium model. Their approach that also account for indirect benefits, yields benefit-cost ratios about 60 per cent higher than existing partial equilibrium studies. However, the effects of these kinds of programs are highly asymmetric across the distributions of farm size and wealth. This is mainly due to the fact that poor households tended to receive proportionately less of the subsidy than wealthier farmers. Jayne et al (2011) for example find that better off farmers (those who own 10-20 hectares of land) received around seven times more subsidized fertilizer than smaller farmers (those who own less than 2 hectares), which led to great differences in production levels. Ricker-Gilbert and Jayne (2012) estimate quantile regressions to measure the return to fertilizer use in Malawi and find that the distribution of the input subsidy is far from equal: farmers at the 10th percentile of the maize production distribution obtain 0.75 kg additional output per kg fertilizer received, while farmers at the 75th percentile of the maize production distribution gain 2.61kg additional output. Many households at the bottom of the distribution seem to be unable to generate a substantial response from the subsidized fertilizer acquired (Marenya and Barrett, 2009; Tittonel and Giller, 2012). The unequal distribution of food production gains may explain why rural poverty rates have not declined in either Malawi or Zambia between the early 2000s and 2010 (50.7 per cent in Malawi and 60.5 per cent in Zambia in 2010). Rural headcount poverty rates in Zambia have consistently floated around 80 per cent throughout the 10-year period of the implementation of the farm input support program (Mason et al. 2013). However, results from a RCT in Mozambique (Carter et al. 2014) show that the input subsidies program had a positive and statistically significant effect on several poverty indicators, such as household consumption asset holdings and housing improvements. Beck et al. (2013) re-estimate poverty incidence from the 2010/11 Integrated Household Survey dataset and find an 8.2 percentage point decrease in national poverty from 2004/5 to 2010/11. Besides the direct impact on beneficiaries, it is sometimes argued that the relevance of input subsidy programs is magnified through their general equilibrium effects on output prices and wage rates. Reduction of food prices and increase of agricultural wage rates are two potential desirable effects of the input subsidy programs which should enhance the growth processes. Unfortunately, there is a scarcity of empirical evidence in support of this hypothesis. Ricker-Gilbert et al. (2013) study the effect of the input subsidy programs in Malawi and Zambia on maize price levels. They found a significant but small effect in both countries. Takeshima and Liverpool-Tasie (2013) found small and insignificant effects on domestic maize, rice, and sorghum prices in Nigeria.

2.2 Impacts of social cash transfers programs in sub-Saharan Africa

There is evidence from numerous countries that cash transfers generally affect total household consumption and food security worldwide. Evidence on the impacts of cash transfer programs in seven countries (Ethiopia, Ghana, Kenya, Lesotho, Malawi, Zambia and Zimbabwe) in sub-Saharan Africa shows that overall these improved food consumption (FAO, 2016). In Kenya, the Cash Transfer for Orphan and Vulnerable Children program (CT-OVC) significantly increased food consumption coming from home production (Asfaw al. 2014). In Zambia the Child Grant (CG) model of the Social Cash Transfer increased expenditure, with the majority of the increases going to food, health and hygiene, clothing and transportation (Handa et al. 2015a). A large body of evidence shows that food security and child nutrition improved as a result of these interventions (Tiwari et al. 2016; FAO, 2015; Hjelm, 2016). A meta-review identified 17 out of 20 studies that reported an increase in food intake, diversity and quality, all factors that contribute to food security (IEG, 2011). Qualitative findings on the LEAP program in Ghana and CT-OVC in Kenya showed improvements in the quantity and diversity of food produced (OPM 2013a;

OPM 2013b).

As far as the effects of social cash transfers on production activities are concerned, the majority of the available evidence from sub-Saharan Africa shows that social protection encourages investments and the accumulation of agricultural assets, but to varying degrees and depending on several factors, such as the availability of labor given the demographic profile of beneficiary households, the relative distribution of productive assets, the local economic context, the relevance of messaging and soft conditions for social spending, the regularity and predictability of the transfers themselves and finally, the level of transfer as a share of per capita income (Tirivayi et al. 2013). Andersson et al. (2011) found that the Productive Safety Net Program in Ethiopia increased the number of trees planted by beneficiaries. In Zambia, the CG program increased the share of households planting maize, groundnuts and rice, and increased crop input expenditures and the value of crop production, but did not have a significant impact on the quantity harvested (Handa et al. 2015a). The study suggested that the inconsistency between increased crop input expenditure and the small impact on output harvested may have been due to inefficient use of inputs by beneficiaries. In Ghana and Kenya, qualitative assessments suggested that unconditional cash transfers modestly increased farm production, but only for economically active beneficiaries (OPM 2013a; OPM 2013b).

As for the effects of cash transfer programs on farm implements and livestock ownership, the CG in Zambia and the SCT in Malawi had positive and significant effects (Handa et al. 2015a; Covarrubias et al. 2012; Boone et al. 2013). As with the programs in Zambia and Malawi, the Kenya CT-OVC program led to a modest increase in the ownership of sheep and goats (Asfaw et al. 2014), while the Ghana LEAP program had no impact on agricultural assets or livestock (Handa et al. 2013). Qualitative assessments show that unconditional cash transfers in Ghana (LEAP) and Kenya (CT-OVC) stimulated asset acquisitions for economically active beneficiaries or those with relatively higher asset endowments only, leaving behind the elderly, infirm and poorest households (OPM 2013a; OPM 2013b). In other research, qualitative assessments of cash transfer programs in Zambia and Lesotho showed that they increased livestock ownership (Devereux et al. 2005).

2.3 Joint evaluation of social protection and agricultural interventions in sub-Saharan Africa

This section focuses on previous contributions that investigated the potential synergies between social protection and agricultural development interventions in sub-Saharan Africa. To the best of our knowledge, only five papers enter into this category, i.e. Carter et al. (2015), Dewbre et al. (2015), Ellis and Maliro (2013), Matita and Chirwa (2014) and Thome et al. (2014).[1]

Carter et al. (2015) investigate the complementarities between input subsidies and a saving-oriented financial services intervention on household consumption and asset holding in Mozambique. In their experiment, study participants were randomly assigned to being offered either a subsidy for modern agricultural inputs, entrance into a saving facilitation program, or both. They examine the impacts of subsidies and savings, separately and together, and they find that from the standpoint of raising consumption, subsidies and savings appear to be substitutes rather than complements. Study participants use either treatment to increase consumption to similar extents but experience no further increases when they get both treatments compared to when they get just one of them.

Dewbre et al. (2015) study the combination of two types of agricultural and social protection programs in Lesotho: the Child Grant Programme (CGP), an unconditional program of cash transfers, and the FAO-Lesotho Linking Food Security to Social Protection Programme (LFSSP) which provided vegetable seeds and training on homestead gardening. Their results show positive effects on homestead gardening and productive agricultural activities which seem to be driven by the combination of the two programs, more than the programs per se. Indeed, their analysis suggest that an additional year of CGP along with one year of the LFSSP achieved a number of outcomes which two years of receiving the CGP alone did not.

Ellis and Maliro (2013) compare several features of fertilizer subsidies and cash transfers, such as output and market effects, impacts on vulnerability to hunger, unintended effects, targeting accuracy, asset and resource requirements, coverage boundaries, budgeting aspects and political dimensions. These comparisons suggest that input subsidies and cash transfers may be complements across a range of attributes and that they compensate for each other's weaknesses. In particular, they find that fertilizer subsidies are more effective in improving food security among farmers that are able to combine fertilizers with land, labour and improved seeds but they seem to be less effective among farmers that lack land and labour.

Matita and Chirwa (2014) claim that targeting of SCTP and FISP should be better harmonized such that a household should not be able to participate in both programs simultaneously. Using the Integrated Household Survey 3 (IHS3), the authors identified three specific target groups: i) ultra-poor households with labour constraints to be treated under SCTP, ii) ultra-poor households with available productive labour to be treated under public works programs and FISP, and iii) moderate poor households with available productive labour to be treated under FISP. Their findings suggest that

[1] Filipski and Taylor (2012) carried out a simulation impact evaluation of rural income transfers in Malawi in which they compare the impact of three alternative transfer schemes, namely the SCTP, FISP and the output market price support program. We did not include this paper in the literature review because it does not investigate the potential synergies between the SCTP and FISP.

the gains from re-targeting households differently to FISP, SCTP and public works are greater than delivering cash transfers and input subsidies to the same households.

Thome et al. (2014) explore the synergies between SCTP and FISP using a local economy-wide impact evaluation model. Using national representative data from the IHS3 they show that the SCTP has higher overall income multiplier effects than the FISP but that the FISP tend to have higher production multipliers than the SCTP. Moreover, they find that combining FISP with SCTP improves the income multipliers of FISP and, at the same time, increases the impact of SCTP on production. While Thome et al. (2014) focus on the single and total impact of the two programs on the local economy (but not at complementarities between them), our contribution investigates the direct single impact of the two programs, the joint impact and the synergies between the two interventions among beneficiary households.

3 Background of the programs

3.1 Farm Input Subsidy Programme

After being out of favor during the 1990s and early 2000s, input subsidy programs have been reintroduced in many African countries as a major component of national agricultural policies. In Malawi, the Farm Input Subsidy Program was initiated in 2005-2006. At that time it targeted approximately 50 per cent of farmers in the country and distributed fertilizers for maize production, with further vouchers for tobacco fertilizers and for improved maize seeds. The FISP is financed by the Government with international donor support in the form of overall budget support (Chirwa et al., 2011). The Ministry of Agriculture, Irrigation and Water Development leads the design and implementation of the FISP. The primary objectives of the program are to achieve national food-sufficiency and to increase income among resource-poor smallholder farmers through increased maize and legume production driven by access to improved agricultural inputs.

This kind of intervention was not new and actually followed decades of agricultural policy interventions that varied in terms of generosity and targeting criteria. From the mid-70s to the early 90s the government financed a universal fertilizer subsidy, subsidized smallholder credit, and controlled maize prices. This system began to breakdown in the late 80s-early 90s and collapsed in the mid-90s and there was a widespread perception that falling fertilizer support was leading to declining maize production and to a food and political crisis. As a consequence, seed and fertilizer subsidies shifted from universal price subsidies to free provision of small 'starter packs' initially to all households (in 1998/99 and 1999/2000) and then to a more limited and varying numbers of targeted households (from 2000/2 to 2004/5) (Harrigan, 2003). Despite these subsidies, many households continued to suffer from severe food insecurity, particularly after the poor 2004/5 production season. This led to a significant political emphasis on larger subsidies and in 2005/6 the Government decided to implement a large-scale input subsidy program across the country. Over time, key features of the program have undergone substantial changes: objectives (from social protection and food security for vulnerable households to national food production and self-sufficiency), scale (from a total program cost of 4,480 million MWK in 2005/2006 to 23,455 million MWK in 2011/2012), quantity of subsidized fertilizer supplies (from nearly 15,000 metric tons in 2005/6 to 216,000 metric tons in 2007/8 and its subsequent decline to around 140,000 metric tons in 2011/2012) cash redemption of vouchers (only through Smallholder Farmers' Fertilizer Revolving Fund of Malawi and Agricultural Development and Marketing Corporation in 2005/2006 and cotton inputs through Agricultural Development Divisions since 2007/2008, and the addition of tobacco inputs (Chirwa and Dorward, 2013 and Dorward and Chirwa 2011 summarize the principal changes in design and implementation arrangements).

Currently, the program targets smallholder farmers who are resource-poor but own a piece of land. The targeting criteria also recognize special vulnerable groups, such as child-headed, female-headed and orphan headed households, and households with members affected by HIV/ AIDS. These criteria remain broad and there are variations in the use of the targeting guidelines in different communities, particularly as the number of eligible households tends to be much larger than the available number of fertilizer coupons. Kilic et al. (2013) find that the FISP does not exclusively target the poor in Malawi. On the contrary it primarily reaches the middle of the income distribution. Kilic et al. (2013) explain that the limited pro-poor targeting stems from community-based targeting (i.e. open forums in which village residents identify beneficiaries in a collective fashion) that are co-opted by more influential community members. Their analysis suggests that, on average, households that are relatively well-off, connected to community leadership, and residing in agro-ecologically favorable locations are more likely to be FISP beneficiaries and receive more input coupons. In 2013/2014 the Government of Malawi introduced a new tonnage allocation formula in order to reduce fertilizer costs. Subsequently in 2015, the Government introduced further reform to allow direct private sector retailing, reduce the subsidy level (from 95 per cent to 80 per cent). Furthermore, the Government selected 1.5 million beneficiaries at random amongst a list of maize producers, with the intention of alternating the farmers on annual basis and providing the subsidies to all farmers once in three years.

Several aspects of FISP implementation are currently under discussion:

- Alignment of FISP to the National Agricultural Policy to contribute to its overall objective of increasing national production, productivity and household incomes.

- Stimulate overall fertilizer use, crop diversification and sustainable land management more actively.

- Change the targeting criteria, reducing gradually the total number of beneficiaries and/or reduce the subsidy level by shifting from subsistence towards market oriented farmers.

This should lead to a gradual shift towards more productive farmers and to a "reallocation" of poor subsistence farmers, previously included in the FISP, into social protection programs (SCTP and/or public works programs).

3.2 Social Cash Transfer Programme

The Social Cash Transfer Program (SCTP) is an unconditional cash transfer program aimed at reducing poverty and hunger among vulnerable households and increasing school enrolment. This program fits under the broader prioritization of social protection in national development strategies, including the second theme of the Malawi Growth and Development Strategy (2006-2010) and the third theme of the Malawi Growth and Development Strategy II (2011-2016). At the national level, the SCTP is managed by the Ministry of Gender, Children and Social Welfare (MGCSW), with policy and design oversight by the Ministry of Finance, Economic Development and Planning (MFEDP). The program is explicitly targeted towards ultra-poor households, defined as households unable to meet their most basic urgent needs, including food and essential non-food items, and labour-constrained households. A household is labour-constrained if there are no 'fit to work' members in the household, or if the ratio of unfit to fit exceeds three. A pilot of this program was initiated in 2006 in the district of Mchinji. The 2007-2008 impact evaluation of the pilot demonstrated that the program had a range of positive outcomes including increased food security, ownership of agricultural tools and curative care seeking (Miller et al., 2010, Covarrubias et al. 2012). Since then the program has undergone some changes in targeting and operations, as well as a significant expansion to 18 out of 28 districts in the country. As of April 2015, it reached over 100,000 households.[2] The size of the transfer to each household is adjusted to the number of household members and their characteristics. As of May 2015, households with only one adult received bi-monthly payments which were equivalent to a monthly amount of 1,000 Malawian Kwacha (MWK), i.e. around 3USD and since then 1,700 MWK, plus additional amounts for the number of children enrolled in primary or secondary school. Although the program is unconditional, 80 per cent of beneficiary households thought that they had to fulfil certain conditions in order to continue re-

[2]For details about the program implementation and funding, see Asfaw et al. 2015 and Handa et al. 2015b.

ceiving payments. In particular, of those households that believed that there was a conditionality, most thought that they were required to use the funds to purchase school supplies (70 per cent), invest in farm or non-farm businesses (59 per cent), or provide adequate food and nutrition for children (57 percent).

4 Empirical analysis

4.1 Econometric method

The estimation of the causal effects of SCTP and FISP is slightly more complex than general impact evaluation of randomized control trials for two reasons: 1) we are considering three intervention groups (only SCTP, only FISP, and SCTP and FISP received jointly) that have to be compared with the control group, as opposed to a unique treatment group compared with the control group; 2) only inclusion into SCTP was randomized and in principle the groups may be different at baseline. If this problem occurs, than estimates that do not take into account these differences are biased. In order to deal with these features of the study design, we adopt a doubly robust method implemented by Uysal (2015) which combines regression modeling (based in our paper on a difference-in-difference approach) and generalized propensity score (GPS) weighting approach by Imbens (2000) applied to multiple treatments' intervention. The advantage of using the combination of these two methods is that the parameters of interest can be consistently estimated even if one of the model specifications is wrong, which is not the case when the methods are used alone. This approach is closely related to the method used by Hirano and Imbens (2001) for the binary treatment case but allows in addition to estimate the causal effect of multivalued and multiple programs. In this sense the method is similar to that proposed by Cattaneo (2010) but, differently from its contribution, we consider the parametric estimation of probabilities to be included in one treatment group or in one other.

The basic setup of Uysal's approach is based on Imbens (2000) and Lechner (2001). We are interested in estimating the causal effects of the treatment on some outcome variable (in this paper, household expenditure, food security, agricultural activities and livestock), where the treatment of interest, T_i, takes the integer values between 0 and K (in this paper K is equal to three). Consider N units (households) which are drawn from a large population. For each household i, $i = 1, ..., N$, the triple (Y_i, T_i, X_i) is observed. X_i denotes the vector of characteristics at household and community level (covariates) for the i^{th} household. Y_i represents the outcomes for household i. For each household there is a set of potential outcomes $(Y_{i0}, ..., Y_{iK})$. Y_{it} denotes the outcome for each household i, for which $T_i = t$ where

$t \in \Im = (0, ...K)$. Only one of the potential outcomes is observed depending on the treatment status. Indeed, households can be included in one of the three treatment groups: only SCTP, only FISP, both SCTP and FISP received jointly. Adopting the framework introduced by Rubin (1974), the observed outcome Y_i can be written in terms of treatment indicator, $D_{it}(T_i)$, and the potential outcomes, Y_{it}:

$$Y_i = \sum_{t=0}^{K} D_{it}(T_i) Y_{it} \tag{1}$$

where $D_{it}(T_i)$ is the indicator of receiving the treatment t for household i:

$$D_{it}(T_i) = \begin{cases} 1, & \text{if } T_i = t \\ 0, & \text{otherwise} \end{cases}$$

Lechner (2001) defines several pairwise treatment effects. The first is the average effect of the treatment m relative to treatment l:

$$\tau^{ml} = E[Y_{im} - Y_{il}] = \mu_m - \mu_l \tag{2}$$

τ^{ml} measures the mean effect of treatment over the entire population. The second treatment effect is the expected effect for an household randomly drawn from the population of participants who receive the treatment m:

$$\gamma^{ml|m} = E[Y_{im} - Y_{il} | T_i = m] = \mu_{m|m} - \mu_{l|m} \tag{3}$$

We are mainly interested on estimating the treatment effect in equation (2) therefore, in what follows, we will focus on it. However, all the results can be easily extended to the treatment effect in equation (3).

Since only one of the potential outcomes is observed, the Conditional Independence Assumption, as defined by Imbens (2000), is assumed to be satisfied to identify the above defined average treatment effect:

$$Y_{it} \perp D_{it} | X_i, \quad \forall t \in \Im \tag{4}$$

The second important assumption for the identification of the treatment effect is the strict overlap assumption which can be defined considering the concept of Generalized Propensity Score (GPS) by Imbens (2000). The GPS is the conditional probability of receiving a treatment (in our paper only SCTP, only FISP or both SCTP and FISP received jointly) given the pre-treatment variables. It is defined as follow:

$$r(t, x) \equiv Pr[T_i = t | X_i = x] = E[D_{it}(T_i) | X_i = x] \tag{5}$$

The strict overalp assumption, often referred as the common-support condition, states that no value of the covariates can deterministically predict receipt (absence) of treatment. More formally:

$0 < \epsilon < Pr[T_i = t|X_i = x]$, for some $\epsilon > 0$, $\forall t \in \Im$ and $\forall x$ in the support of X.

Under these assumptions, treatment effects can be estimated through parametric regression. Using the definition of the observed outcome in equation (1), the regression model can be written as in equation (6):

$$Y_i = \sum_{t=0}^{K} \mu_t D_{it}(T_i) + \sum_{t=0}^{K} D_{it}(T_i)(X_i - \bar{X})'\alpha_t + \epsilon_i \tag{6}$$

The unconditional means μ_t and α_t are estimated by minimizing the objective function that is the sum of the squared residuals:

$$\min_{\tilde{\mu_t}, \tilde{\alpha_t}} \frac{1}{N} \sum_{i=1}^{N} \Big(Y_i - \sum_{t=0}^{K} \tilde{\mu_t} D_{it}(T_i) - \sum_{t=0}^{K} D_{it}(T_i)(X_i - \bar{X})'\tilde{\alpha_t} \Big)^2 \equiv \min_{\tilde{\mu_t}, \tilde{\alpha_t}} \frac{1}{N} \sum_{i=1}^{N} \tilde{\epsilon}_i^2 \tag{7}$$

Using the estimators $\hat{\mu_m^{reg}}$ and $\hat{\mu_l^{reg}}$ (where the superscript 'reg' refers to the regression method), τ_{ml} can be estimated as

$$\hat{\tau}_{ml}^{reg} = \hat{\mu}_m^{reg} - \hat{\mu}_l^{reg} \tag{8}$$

The second approach followed for our doubly robust estimation consists on constructing the propensity score weighting type estimators for the treatment effect parameters. Imbens (2000) shows that, as for the binary case, the unconditional means of the potential outcomes can be identified using GPS by weighting:

$$E\Big[\frac{Y_i D_{it}(T_i)}{r(t, X_i)}\Big] = E[Y_{it}] \tag{9}$$

Based on this identification result, the treatment effect estimator is given by

$$\hat{\tau}_{ml}^{we} = \frac{1}{N} \sum_{i=1}^{N} \frac{Y_i D_{im}(Ti)}{\hat{r}(m, X_i)} - \frac{1}{N} \sum_{i=1}^{N} \frac{Y_i D_{il}(T_i)}{\hat{r}(l, X_i)} \tag{10}$$

where $\hat{r}(t, X_i)$ is the estimated GPS and the superscript 'we' denotes the weighting method. To get doubly robust estimators for the treatment effect, we combine the weighted regression method with the weights related to the weighting identification. In practice, we estimate the regression model in equation (6) by a weighted least squares regression with the following minimization problem:

$$\min_{\tilde{\mu}_t, \tilde{\alpha}_t} \frac{1}{N} \sum_{i=1}^{N} \Big(\sum_{t=0}^{K} \frac{D_{it}(T_i)}{\hat{r}(t, X_i)} \Big) \Big(Y_i - \sum_{t=0}^{K} \tilde{\mu}_t D_{it}(T_i) - \sum_{t=0}^{K} D_{it}(T_i)(X_i - \bar{X})' \tilde{\alpha}_t \Big)^2 \quad (11)$$

The resulting estimators, $\hat{\mu}_t^{dr}$, are consistent for μ_t in three cases: 1) the conditional mean of Y_{it} is correctly specified; 2) the conditional mean of $D_{it}(T_i)$ is correctly specified; 3) both Y_{it} and $D_{it}(T_i)$ are correctly specified. Using $\hat{\mu}_m^{dr}$ and $\hat{\mu}_l^{dr}$ instead of the unweighted regression estimators $\hat{\mu}_m^{reg}$ and $\hat{\mu}_l^{reg}$, we are able to obtain doubly robust estimates of τ_{ml}:

$$\hat{\tau}_{ml}^{dr} = \hat{\mu}_m^{dr} - \hat{\mu}_l^{dr} \quad (12)$$

We estimated the standard errors using the asymptotic variance formula proposed by Uysal (2015). Following the arguments in Wooldridge (2007), Uysal (2015) derived the asymptotic distribution for the estimators of the treatment parameters in cases in which the GPS, $\hat{r}(t, X)$, is estimated by multinomial response model. This approach adapts particularly well to our case, since we estimated the GPS by multinomial logit regression, as it will be explained in the following section.

4.2 Data and regression analysis

This study is based on data collected from a seventeen-month evaluation (2013-2014) of a sample of households eligible to receive the SCTP, which also provided information about inclusion into the FISP. Data collection for this study and preliminary analysis were implemented by the Carolina Population Center at the University of North Carolina at Chapel Hill (UNC-CH) and the Centre for Social Research of the University of Malawi (CST UNIMA) (Handa et al. 2015b). The UNC-CH and CST UNIMA took advantage of an expansion in the SCTP to build an experimental "delay-entry" control group implemented in two stages, referred to as random selection and random assignment. In the first stage, in the districts of Salima and Mangochi four Traditional Authorities (TAs) were randomly selected by lottery (Ndidi and Maganga in Salima district and Mbwana Nyambi and Jalasi in Mangochi district). Thereafter, the MGCSW targeted eligible households and their corresponding Village Clusters (VCs). The selection of eligible households was done through a proxy means test and a community-based approach with oversight provided by the local District Commissioner's Office and the District Social Welfare Office. Overall, about 3,500 households were included in the study sample. Once the baseline survey was completed in July/August 2013, in the second stage, half of the VCs in the study sample were randomly assigned to a treatment group and entered the program immediately, while the other half served as a control group in order to measure the impact of the program and, were supposed to enter the program at the end of the evaluation period. The first follow-up survey was scheduled after twelve months from baseline when beneficiary households would have received eight to ten months of transfers. However, due to the delay in the start of the payment (May 2014), the follow-up was postponed until November 2014, at which time beneficiary households would have received five payments only (10 months' worth). These data have been already extensively analyzed by Handa et al. (2015b) and Asfaw et al. (2015), focusing exclusively on the stand-alone impact of the SCTP on a broad range of outcome variables that included household expenditure, food security, productive activities, labour supply among others.

With respect to the original sample, for this paper we selected a subsample in order to identify the stand-alone impact of the SCTP and FISP, their synergies, and the joint impact of FISP and SCTP when received jointly. We select 1,607 households (interviewed at both baseline and follow-up) that are divided into four groups: control households that neither received the SCTP nor the FISP (control group); households treated *exclusively* under the SCTP (treatment SCTP); households treated *exclusively* under the FISP (treatment FISP); and households treated under both programs simultaneously (treatment SCTP&FISP) (respectively, 38.33, 30.18, 14.87, and 16.6 per cent of the sample). We excluded from the sample the following categories of households: i) included in FISP in the previous two years but not in SCTP at follow-up (564); ii) included in FISP in the previous two years and in SCTP at follow-up (558); iii) included in FISP at baseline (340), included in FISP at baseline and in SCTP at follow-up (294).[3] This kind of selection has advantages and disadvantages. The exclusion of these four groups of households allows us to obtain a clean setting over which to estimate the impacts of the two programs. However, this selection procedure drastically reduces the sample size (from 3,363 to 1,607 households interviewed both at baseline and follow-up).[4] Potentially, it could also affect the randomized nature of the experiment, creating groups with different characteristics at baseline. Indeed, unlike the SCTP, access to FISP was not ran-

[3]These groups of households represent, respectively, 16.7, 16.6, 10.1 and 8.7 per cent of the original sample.

[4]Table A1 in the Appendix provides tests of differences between households excluded versus households included in the analysis of this paper. The group of households excluded from the study sample is relatively better off. This is not surprising since it includes households that received agricultural input subsidies already at baseline or in the previous two years.

domized in the evaluation design. In such a case, the identification of the programs' impact would be biased. In order to deal with this potential sample selection issue, we adopt the doubly robust estimation strategy by Uysal (2015) described in section 4.1 (combination of regression analysis and generalized propensity score weighting adjustment). Table A2 shows the unweighted tests of differences between the four groups included in the study sample. As suspected, the four groups show significant differences on a variety of baseline characteristics and economic indicators.

The GPS were estimated via a multinomial logit regression using data at baseline, as in equation (13).

$$Pr[T_i = t] = f(\xi + \theta X_i) \tag{13}$$

The variable $Pr[T_i = t]$ represents the probability of being included in one of the four groups (control, treatment SCTP, treatment FISP, treatment SCTP&FISP). This is modeled as a function of a vector of control variables (X_i) which includes household size and demographic composition, characteristics of the household head, proxies of wealth (total land owned, agricultural assets, labour constraints and livestock owned), distance to the markets and district fixed effect. The GPS weights allowed to "rebalance" the sample. Indeed, Table 1 shows that, with only one exception, the four groups are identical at baseline. Equation (14) presents the regression equivalent of difference-in-difference with covariates and weighting based on GPS.

$$\begin{gathered} Y_{i,d} = \zeta + \alpha D2014_i + \beta_1 SCTP_{i,d} + \beta_2 (D2014_i * SCTP_{i,d}) + \gamma_1 FISP_{i,d} + \\ \gamma_2 (D2014_i * FISP_{i,d}) + \gamma_3 SCTP_{i,d} \& FISP_{i,d} + \delta (D2014_i * SCTP_{i,d} \& FISP_{i,d}) + \\ \sum \beta X_i + \mu_{i,d} \end{gathered} \tag{14}$$

$Y_{i,d}$ represents the main outcome variables. $SCTP$ and $FISP$ are indicator variables for, respectively, *exclusive* assignment to the social cash transfers and to the farm input subsidy program. $SCTP\&FISP$ is an indicator variable for assignment to both, the social cash transfers and the farm input subsidy program. $D2014$ represents the survey year and is equal to 1 at follow-up, zero otherwise. X is the set of household characteristics and controls at community level. μ is an error term.

The parameters of interest are the coefficients β_2, γ_2 and δ which are, respectively, the average treatment effect estimates of the SCTP for households treated only by SCTP, the effect of FISP for households treated only by FISP, and the estimate of the joint impact of SCTP and FISP for households treated by both programs. These parameters allow to estimate the synergies between the two programs, as well as their complementarity. In particular, the difference between δ (joint impact of

SCTP and FISP when a household receives both), β_2 (stand-alone impact of SCTP) and γ_2 (stand-alone impact of FISP), i.e. δ-β_2-γ_2, measures the complementarity between the $SCTP$ and $FISP$. The difference between δ and β_2 measures the incremental impact of $FISP$ on $SCTP$. The difference between δ and γ_2 measures the incremental impact of $SCTP$ on $FISP$. Note that $SCTP$, $FISP$ and $SCTP\&FISP$ represent mutually exclusive groups. $SCTP$ takes value one if the household is treated exclusively under SCTP, zero otherwise. $FISP$ takes value one if the household is treated exclusively under FISP, zero otherwise. $SCTP\&FISP$ takes value one if the household is treated under both SCTP and FISP, zero otherwise (i.e. none of the programs is received, only STCP, only FISP). This variable does not represent an interaction between $SCTP$ and $FISP$. It represents a completely different group of households. For this reason, the stand-alone impacts of SCTP and FISP are, respectively, simply β_2 and γ_2, and the joint impact of SCTP and FISP is δ. See also Gertler et al. 2011.

5 Results of the standalone and combined impacts of SCTP and FISP

We begin this section by presenting four figures related to two main indicators of the demand side and the production side that are likely to be affected by the SCTP and FISP, namely total household expenditure and total value of agricultural production, by treatment group. Figures 1 and 2 show kernel densities of total household consumption at baseline and follow-up. While at baseline there are not significant differences among the distributions, at follow up the distributions of expenditure for the $SCTP$ and for the $SCTP\&FISP$ groups, almost coincidentally, shifted significantly to the right. This suggests that without controlling for potential confounding factors, the SCTP contributes to an increase in household expenditure. The SCTP and FISP seem to go in the same direction, but most of the change in expenditure is due to the effect of the SCTP. In other words, the FISP seems to contribute weakly to the increase in expenditure.

We replicate the same kind of exercise for the value of production. Figures 3 and 4 show kernel densities of the value of production at baseline and follow-up. As for household expenditure, there are not significant differences among the distributions at baseline. However, at follow-up, the distributions of value of production (maize, groundnuts, pigeon pea, nkhwani, rice, cotton, sorghum) for the $FISP$ and especially $SCTP\&FISP$ groups significantly shifted to the right, meaning that the combination of FISP and SCTP increases the value of production. As opposed to total expenditure, here the effect seems to be driven mainly by the implementation of FISP.

The following sub-sections describe and discuss the main findings on a large set of outcomes, namely household expenditure and food security and their intermediate outcomes including productive activities (agricultural production and input use), and livestock (ownership and expenditure). All estimates are doubly robust: they include a large set of control variables, namely, baseline head of household's characteristics, household demographic composition and size, a vector of contemporaneous cluster level prices, a set of exogenous shocks, and district fixed effect, and are adjusted with the GPS weighting. Confidence intervals consider heteroskedasticity robust standard errors clustered at the community level.

5.1 Household expenditure

Figure 5 provides a graphical representation of the estimated stand-alone impact of SCTP and FISP, the joint impact of the two programs and their synergy on household expenditure. The thick horizontal bars represent the estimated coefficients, while the thin horizontal bars show the confidence interval. The figure shows, from the left to the right, 1) the stand-alone impact of SCTP, 2) the stand-alone impact of FISP, 3) their sum, and 4) (in red) the joint impact of SCTP and FISP when the households benefit from both simultaneously. The difference between 4 and 3 represents the precise measure of complementarity between the two interventions $(\delta - \beta_2 - \gamma_2)$.

The figure shows that the stand-alone impact of SCTP on total household expenditure is positive and significant but the stand alone impact of FISP is positive but not statistically significant. The joint impact is positive and significant and it is greater than the sum of the stand-alone impacts of the SCTP and FISP. Overall, the estimates for total household expenditure confirm and strengthen the main message of Figure 2: there are positive synergies when households participate in both programmes. Table 2 provides the doubly robust estimates of the impacts on total expenditure. In addition to the findings shown in Figure 5, Table 2 shows estimates of the incremental impacts of SCTP on FISP and the incremental effect of FISP on SCTP. While the former is positive and statistically significant, the latter is positive but not significant. Moreover, the analysis by labor constraints suggests that the stand-alone impact of SCTP and FISP are larger for households defined as labor constrained but synergies take place only for households defined as labor unconstrained, but not for the other group.

Table 3 shows the effect on several expenditure items (food, alcohol, health, education, clothing and footwear, housing and utilities, furnishing and transport). The results for food expenditure are similar to those for total expenditure. Indeed, the stand-alone impact of SCTP is positive and significant, the stand-alone impact of FISP is positive but not statistically significant, and the joint impact is positive and significant. Looking at the estimates of other consumption items, the results are more heterogeneous. In particular, we find that there are synergies between SCTP and FISP for expenditure on health and education, but not for the other consumption items. Most of the increase in expenditure is due to SCTP. The stand-alone impact of FISP is significant only for expenditure on housing and utilities but the joint impact of the two programs run simultaneously is always positive and significant, with the only exceptions of the items "alcohol" and "transport". Looking at these results, we need to bear in mind that FISP does not provide direct cash to treated households. The impact of FISP on these expenditures may be due to i) FISP producing both a substitution and an income effects (i.e. it is likely to release liquidity used for agricultural inputs (fertilizers and/or seeds)); and ii) the vouchers provided to FISP-beneficiaries being exchanged for cash. The analysis by labor constraints suggest that the SCTP and FISP are complementary instruments in increasing expenditure on food, health, education, housing and furnishing only for households defined as labour unconstrained.

5.2 Food security

We consider several proxies of food security (see Table 4). First, we analyze a question included in the survey that asks respondents whether they worry that the household will not have enough food.[5] Second, we consider the number of meals consumed per day in the household. Interestingly, while the stand-alone impact of SCTP on food security is positive and significant, the stand-alone impact of FISP is statistically significant only for the first indicator. Finally, as a proxy of food security we consider daily per capita caloric intake calculated using kilocalories per gram of edible portions of specific foods, multiplied by the quantity (in grams) of specific foods eaten. These kilo-calorie figures were summed up within the household, and then divided by the number of household members and the days per week to receive daily per capita figures. As for the other food security indicator, we find that the SCTP allows to increase caloric intake, especially from purchased food, but the stand-alone contribution of FISP is not significant. Overall, the estimates of the joint impact suggest that the two interventions improved food security, but positive synergies seem to take place only for the number of meals per day and only for households defined as labor unconstrained.

[5]Note that the results for the variable "Worry that household will not have enough food" need to be read differently. In this case, a negative and significant coefficient means that SCTP and FISP improve food security since they contribute to reduce the concern of not having enough food.

5.3 Agricultural production, agricultural inputs and assets and livestock

Figure 6 provides a graphical representation of the estimated stand-alone impact of SCTP and FISP, the joint impact and their synergy on value of production, controlling for a large set of confounding factors at household and community levels. The estimates confirm and strengthen the main message of Figure 4: the joint impact is positive and significant and there are positive synergies when households participate in both programmes in increasing the value of production. The figure also shows that most of the increase in the value of production is due to the FISP. Indeed, while the stand-alone impact of FISP is big in size, positive and significant, the coefficient of SCTP is small in size and insignificant. Table 5 provides additional information of the incremental effect of SCTP on FISP and the incremental effect of FISP on SCTP. The results show strong synergies between the two interventions since the incremental effect of each program on the other is positive and statistically significant. Moreover, the heterogeneity analysis suggests that the stand-alone impacts of SCTP and FISP are larger for labor unconstrained households but positive synergies take place more for households defined as labor constrained. This is an important result: the combination of a social protection program and an agricultural development intervention generates more synergies in agricultural production for the most disadvantaged households.

Table 6 shows the results for production of several crops. FISP positively affects the percentage of households engaged in maize production and also the quantity produced, especially for labor constrained households. The stand-alone impact of SCTP is not statistically significant but the joint effect on participation is significant for the most disadvantaged group of households. For the production of this crop synergies are also taking place. Indeed, the incremental impact of FISP on SCTP on participation of labor constrained households is highly significant. The effect for labor unconstrained household is weak probably because the overwhelming majority of households is already engaged in farming activities ("ceiling effect"). As for the production of groundnut, we find that the stand-alone impact of FISP is positive and significant for both indicators (percentage of household engaged and quantity produced) but the joint impact is significant only for the latter. Interestingly, we find that, the estimate of complementarity is negative, meaning that, for this outcome variable (percentage of labor unconstrained households involved in grandnut production), the two interventions seem to act as substitutes rather than complements. A similar result is obtained for the quantity of pigeon pea produced.

As for the results on agricultural inputs, as expected, FISP significantly increases the percentage of users and quantity of chemical fertilizers used, and increases the percentage of users of improved or hybrid seeds (see Table 7). Overall, the joint impact is positive and significant only for chemical fertilizers and the synergies between the two programs seem to be weak. Finally, in Tables 8 and 9 we looked at whether SCTP and FISP had any impact on household expenditure for livestock and whether the ownership of chicken, sheep or goats, ducks and pigs increased. Overall the results suggest that the stand-alone impacts of SCTP and FISP are positive and significant, and the two programs are complementary instruments for increasing ownership of livestock and expenditure on livestock. Indeed, the SCTP directly affects expenditure for livestock providing immediate cash to beneficiaries households. The positive impact of FISP on these expenditures may be due to two reasons: FISP it is likely to ease liquidity used for agricultural inputs the vouchers provided to FISP-beneficiaries being exchanged for cash. The results by labor constraints are striking: the incremental impact of FISP on SCTP, the incremental impact of SCTP on FISP, and the complementarity are stronger for labor constrained households.

6 Conclusions

This paper contributes to the literature on anti-poverty program evaluation by shedding light on the interplay between the SCTP and the FISP in Malawi. We take advantage of data collected from a seventeen-month evaluation of a sample of households eligible to receive the SCTP, which also provided information about inclusion into the FISP. We adopt a doubly robust estimation method which combines regression modeling and GPS weighting.

Although both programs are considered two instruments for poverty reduction and food security they have not been coordinated in implementation. This raises the question of whether multiple dipping in a social protection program and an agricultural development program creates positive synergies or, on the contrary, it constitutes an inefficient use of resources compared to targeting different households for different programs. The analysis shows that there are synergies between SCTP and FISP in increasing expenditure, the value of agricultural production, agricultural activities and livestock, and weakly, in improving food security. More specifically, we find that SCTP and FISP are complementary instruments in increasing total household expenditure and expenditure on food, health and education, and in increasing the value of production, production of crops, and livestock. Furthermore, the heterogeneity analysis based on labor constraints shows that positive synergies between SCTP and FISP in increasing household expenditures are stronger for labor unconstrained households. On the contrary, the synergies between the two interventions in increasing the value of production, production activities and livestock are stronger for labor constrained households.

Two features of this study need to be born in mind when interpreting the results. First, given the required eligibility for inclusion into the SCTP, our sample is representative of the lower income quantile of the population in Malawi. The SCTP explicitly targeted to ultra-poor households, defined as households unable to meet the most basic urgent needs, including food and essential non-food items, and labour-constrained households. Second, in this study we do not consider any indirect benefits (such as spillover effects on the local economy), nor the implied costs of the two programs. This is purely a study on the direct stand-alone impact, joint impact and synergies between the two programs.

Despite these two potential limitations, our analysis shows that for the poorest households in Malawi there are positive synergies taking place between SCTP and FISP. Two factors may well explain this result (Gavrilovic et al., 2016). First, neither FISP nor SCTP alone can address all constraints faced by poor rural households: the combination of the two interventions can be more effective in tackling hunger and poverty than stand-alone programs. Second, overlapping between FISP and SCTP allows to avoid potential harm. Indeed, certain agricultural policies can inadvertently be unfavourable to small family farmers (Deininger et al., 2011 cited in Gollin, 2014). By the same token, social protection interventions might also inadvertently have negative impacts on agriculture (Devereux, 2009; Bundy et al., 2009; Sumberg and Sabates-Wheeler, 2011).

To conclude, the evidence showed here suggests that coordinated agricultural and social protection intervention programs, such as FISP and SCTP can have positive medium and long term effect, supporting poor households in breaking out the cycle of disadvantage and preventing the transmission of poverty across generations. On one hand, the SCTP provides liquidity and certainty for poor households and small family farmers, allowing them to invest in agriculture, invest in human capital development and better manage risks. On the other hand, FISP can also promote growth in the productivity of small family farmers, by addressing structural constraints that limit access to inputs, financial and advisory services and markets. In addition, as documented by Thome et al. (2015), coordination between FISP and SCTP can also better promote local economic growth, increasing employment opportunity in the agricultural sector, increasing food availability and keeping staple food prices low, with benefits for poor net food buyers (Gavrilovic et al., 2016).

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Figures

Figure 1: Kernel density of total household expenditure at baseline by treatment groups – real values in log

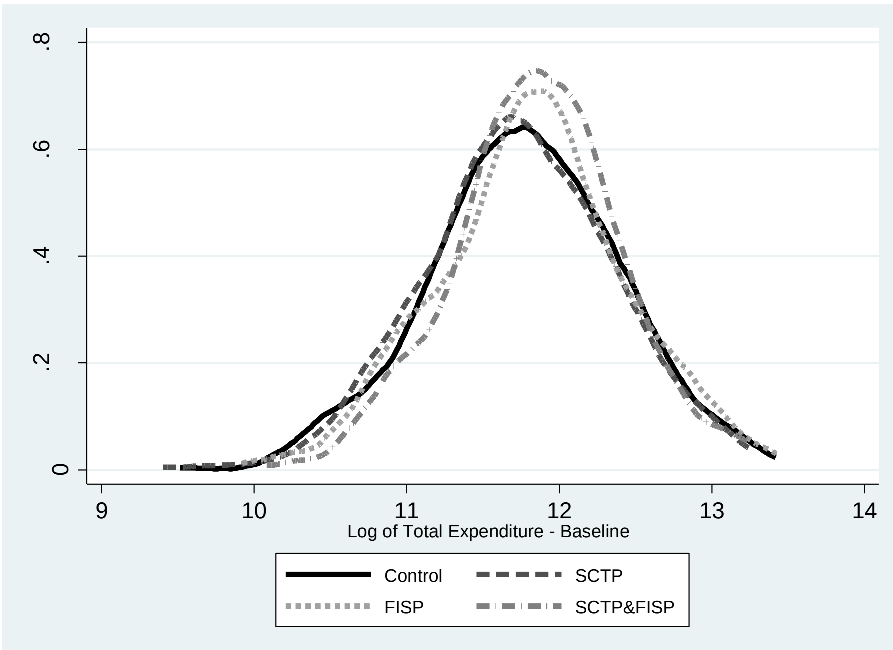


Figure 2: Kernel density of total household expenditure at follow up by treatment groups – real values in log

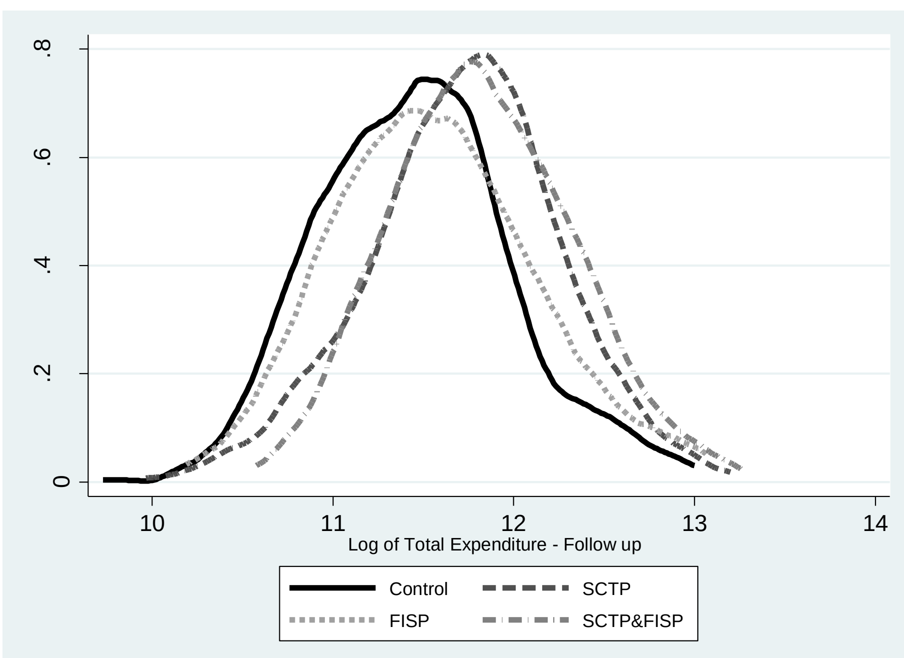


Figure 3: Kernel density of value of production at baseline by treatment groups – real values in log

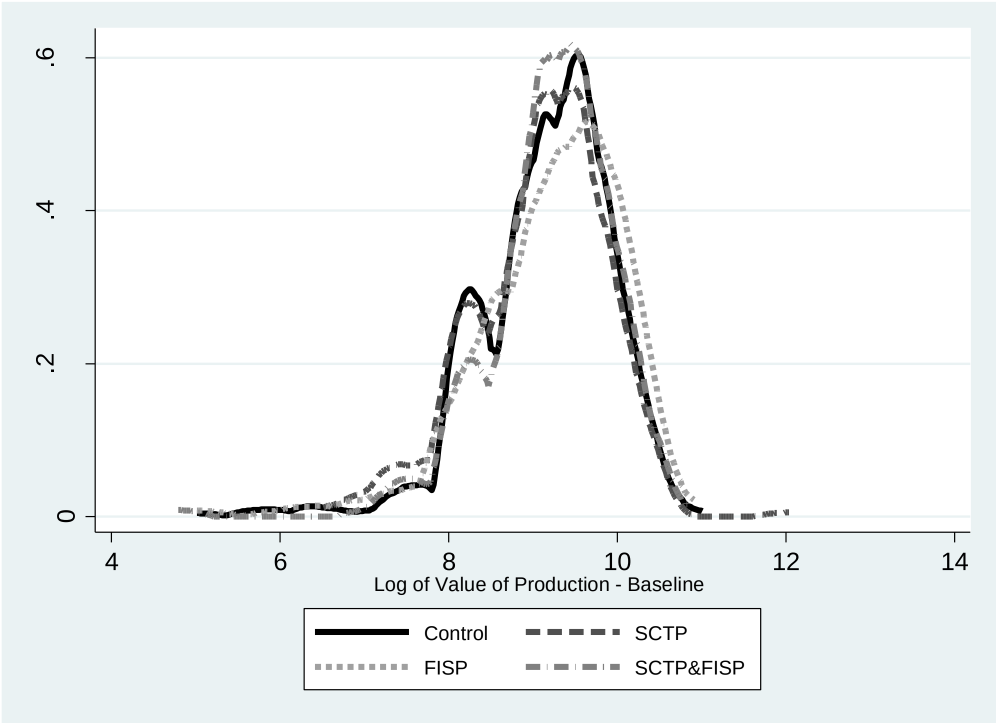


Figure 4: Kernel density of value of production at follow up by treatment groups – real values in log

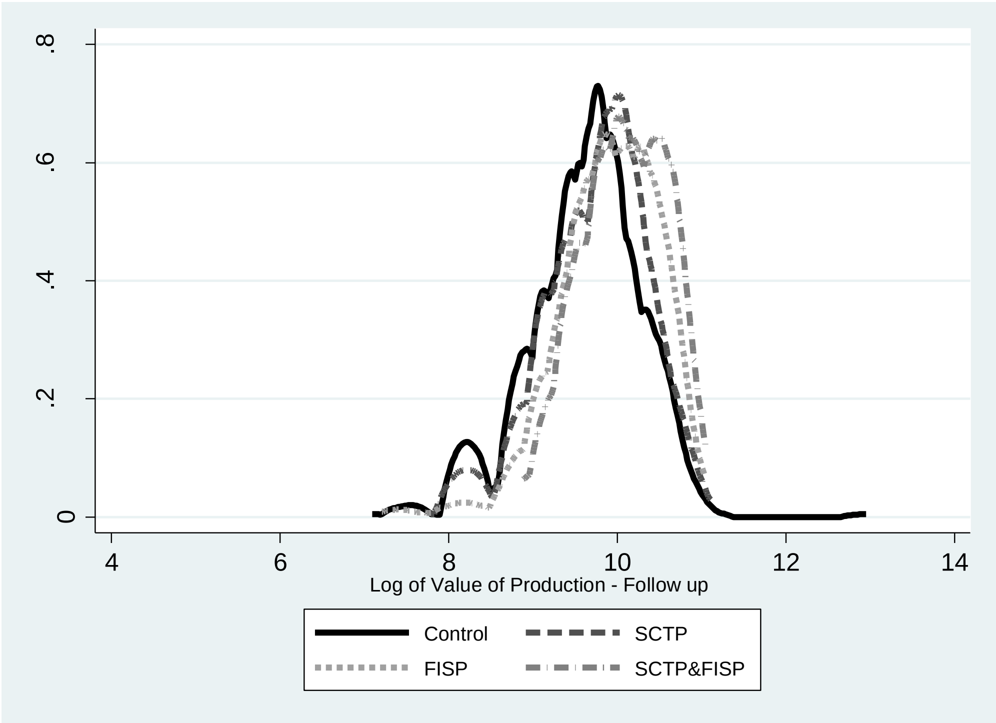
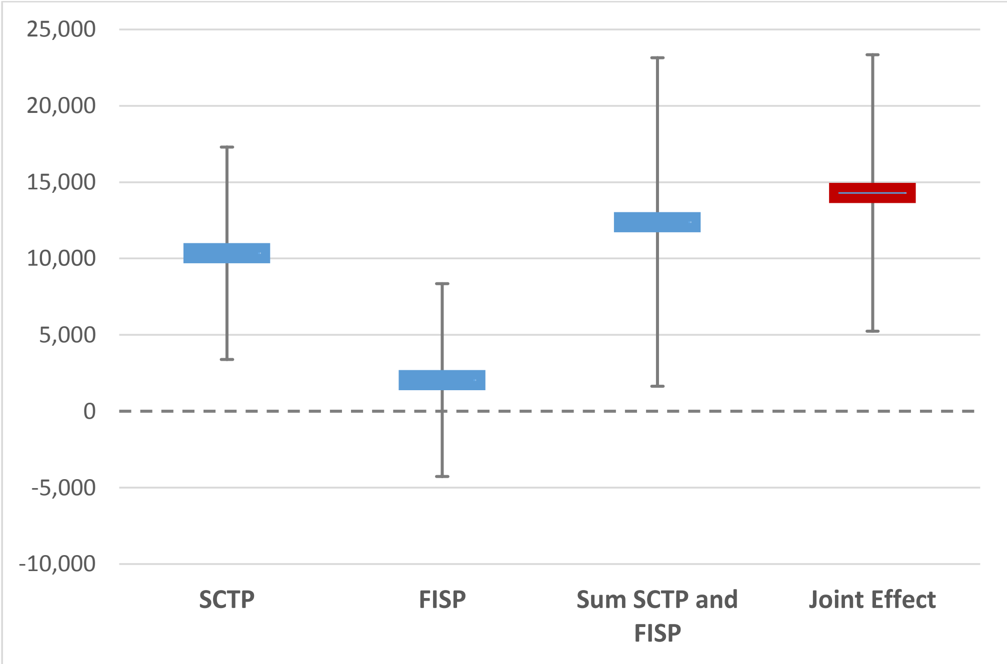
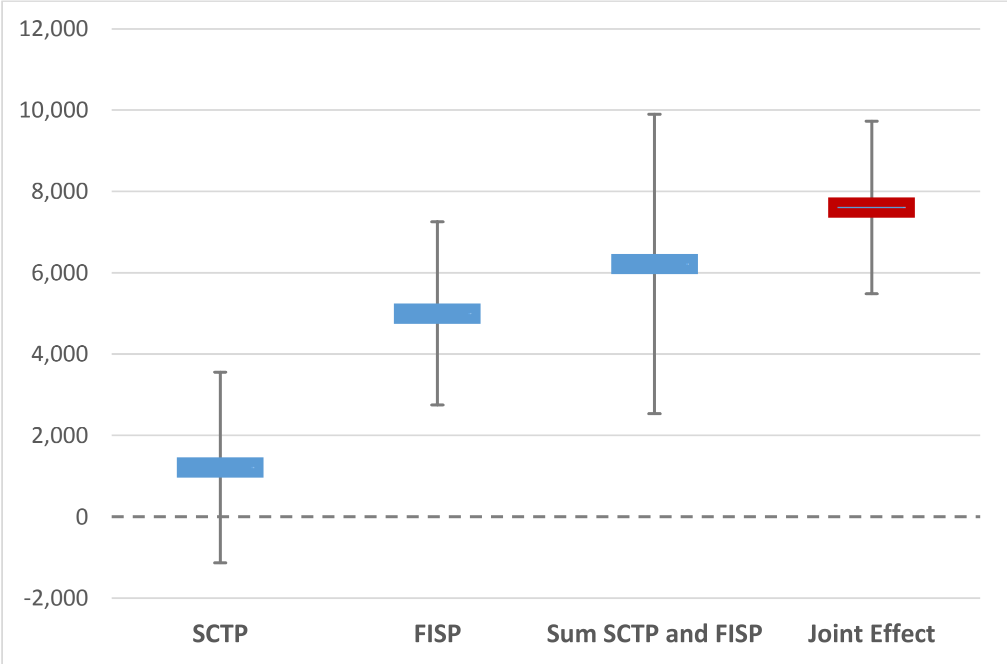


Figure 5: Impact on household expenditure per capita– MWK real values



Note: the y axis shows the range of the estimated coefficients. The thick horizontal bars represent the estimated coefficients, while the thin horizontal bars show the confidence interval.

Figure 6: Impact on value of production – MWK real values



Note: the y axis shows the range of the estimated coefficients. The thick horizontal bars represent the estimated coefficients, while the thin horizontal bars show the confidence interval.

Tables

Table 1: Anova test for difference between groups of intervention: control, SCT, FISP, SCT+FISP (weights adjusted)

	C	SCT	FISP	SCT&FISP	F-test	P-value>F
single head of hh	0.748	0.730	0.751	0.740	0.18	0.9117
female head of hh	0.851	0.838	0.820	0.837	0.49	0.692
age of head of hh	54.495	54.161	55.087	54.719	0.15	0.927
num members in the hh	4.633	4.633	4.454	4.544	0.59	0.618
num members in the hh: 0-5 years old	0.783	0.769	0.728	0.771	0.27	0.846
num members in the hh: 6-12 years old	1.250	1.256	1.162	1.195	0.74	0.527
num members in the hh: 13-17 years old	0.905	0.905	0.873	0.891	0.11	0.956
num members in the hh: 18-64 years old	1.178	1.196	1.195	1.170	0.07	0.976
num members in the hh: >=65 years old	0.517	0.508	0.496	0.517	0.12	0.951
num orphans in the hh	1.099	1.084	1.019	1.035	0.23	0.874
yrs of education head of hh	1.272	1.296	1.245	1.385	0.28	0.840
hh severely labor constrained	0.456	0.449	0.473	0.463	0.17	0.914
hh consumption - total	164515	154514	163867	160597	0.56	0.639
hh consumption - food and beverages	127622	118177	124934	125508	0.75	0.523
Household owns or cultivates land	0.919	0.932	0.937	0.933	0.4	0.754
Total plot area operated within hh	1.210	1.238	1.220	1.247	0.13	0.944
HH has plot that is irrigated	0.045	0.045	0.051	0.066	0.76	0.515
HH applies chemical fertilizer	0.276	0.270	0.353	0.424	9.59	0.000
HH applies organic fertilizer	0.278	0.265	0.315	0.329	1.72	0.161
HH uses pesticides	0.015	0.030	0.040	0.030	1.5	0.212
HH uses improved or hybrid seed	0.283	0.271	0.328	0.348	2.51	0.057
HH planted maize	0.872	0.872	0.877	0.884	0.12	0.951
HH planted groundnut	0.094	0.091	0.089	0.136	2.23	0.083
HH planted pigeon pea	0.098	0.111	0.068	0.115	2.14	0.094
Value of production	9506	9143	9571	9831	0.35	0.786
HH owns hand hoe	0.813	0.814	0.837	0.855	1.18	0.317
HH owns axe	0.100	0.081	0.093	0.100	0.37	0.771
HH owns panga knife	0.192	0.226	0.242	0.217	1.02	0.383
HH owns sickle	0.126	0.128	0.107	0.085	1.6	0.187
HH owns chickens now	0.126	0.128	0.107	0.085	1.6	0.187
HH owns goat or a sheep now	0.064	0.054	0.051	0.083	1.38	0.246
Total HH Expenditure for livestock	87.79	97.95	43.83	80.277	0.86	0.462
Total HH livestock sales	275.48	321.27	119.46	293.949	1.63	0.180
obs	616	485	239	267		

Table 2: Impact on total expenditure per capita – real values

	All		Labor unconstrained		Labor constrained	
		Baseline Mean		Baseline Mean		Baseline Mean
SCT*d2014	10348.555**	40384.55	5093.74	32691.30	15220.805**	49843.35
	[2.44]		[0.96]		[2.76]	
FISP*d2014	2041.03	44615.69	-3590.39	39623.17	7957.69	50181.21
	[0.53]		[-0.68]		[1.53]	
Joint impact SCT&FISP	14290.270**	44988.36	14443.217*	35532.26	11709.515**	55976.07
	[2.59]		[1.97]		[2.39]	
Incremental impact of FISP on SCT	3941.715		9349.475*		-3511.29	
	[1.01]		[1.80]		[-0.75]	
Incremental impact of SCT on FISP	12249.25**		18033.6**		3751.827	
	[2.03]		[2.50]		[0.57]	
Complementarity	1900.69		12939.86*		-11468.98	
	[0.34]		[1.80]		[-1.72]	

Table 3: Impact on expenditure per capita by items - real values

	All	Labor unconstrained	Labor constrained
Food per capita			
SCTP*d2014	6013.45	1377.53	10058.494**
	[1.63]	[0.29]	[2.2]
FISP*d2014	1834.64	-2976.59	6723.04
	[0.54]	[-0.63]	[1.45]
Joint Impact SCTP&FISP	8117.414*	7650.87	6774.536*
	[1.83]	[1.18]	[1.67]
Incremental impact of FISP on SCTP	2103.96	6273.344	-3283.958
	[0.65]	[1.38]	[-0.72]
Incremental impact of SCT on FISP	6282.779	10627.46*	51.4941
	[1.38]	[1.79]	[0.01]
Complementarity	269.3276	9249.934	-10007
	[0.06]	[1.43]	[-1.62]
Health per capita			
SCTP*d2014	515.10	441.73	545.76
	[1.45]	[1.21]	[0.93]
FISP*d2014	-391.02	-172.20	-857.66
	[-0.62]	[-0.37]	[-0.63]
Joint impact SCTP&FISP	1219.446**	1428.233**	624.29
	[2.73]	[2.38]	[1.25]
Incremental impact of FISP on SCTP	704.3511	986.5052	78.52
	[1.56]	[1.61]	[0.12]
Incremental impact of SCTP on FISP	1610.465**	1600.429**	1481.94
	[2.04]	[2.16]	[1.09]
Complementarity	1095.37	1158.701	936.18
	[1.36]	[1.48]	[0.61]
Education per capita			
SCTP*d2014	225.755***	-22.35	474.719***
	[2.94]	[-0.16]	[3.78]
FISP*d2014	-72.27	-241.111*	100.19
	[-1.09]	[-1.84]	[0.94]
Joint impact SCTP&FISP	360.351***	263.51	401.553**
	[3.29]	[1.39]	[2.49]
Incremental impact of FISP on SCTP	134.5952	285.8555	-73.1667
	[1.11]	[1.54]	[-0.54]
Incremental impact of SCTP on FISP	432.6177***	504.6155**	301.3672*
	[3.84]	[2.42]	[1.85]
Complementarity	206.8622	526.9664**	-173.3522
	[1.52]	[2.21]	[-1.02]
Clothing and foot. Per capita			
SCTP*d2014	962.313***	946.165***	906.557***
	[7.00]	[4.98]	[4.5]
FISP*d2014	187.030***	57.49	395.723***
	[3.05]	[0.57]	[2.95]
Joint impact SCTP&FISP	902.583***	1047.960***	659.761***
	[6.34]	[5.67]	[3.56]
Incremental impact of FISP on SCTP	-59.730	101.795	-246.796
	[-0.42]	[0.44]	[-1.37]
Incremental effect of SCTP on FISP	715.553***	990.476***	264.038
	[4.70]	[5.17]	[1.07]
Complementarity	-246.760	44.310	-642.519
	[-1.53]	[0.17]	[-2.84]

Impact on expenditure per capita by items - real values (cont'd)

	All	Labor unconstrained	Labor constrained
Alc/Tobacco			
SCTP*d2014	904.796*	1073.079*	1152.33
	[1.84]	[1.9]	[1.47]
FISP*d2014	-639.47	-1409.77	268.39
	[-1.45]	[-1.42]	[0.93]
Joint impact SCT&FISP	1264.42	1317.242*	1283.34
	[1.68]	[1.88]	[1.56]
Incremental impact of FISP on SCTP	359.628	244.163	131.0163
	[0.43]	[0.53]	[0.13]
Incremental impact of SCTP on FISP	1903.891*	2727.009*	1014.958
	[1.83]	[1.85]	[1.36]
Complementarity	999.0956	1653.93	-137.3696
	[1.05]	[1.54]	[-0.12]
Housing/Utilities			
SCTP*d2014	263.03	113.83	381.86
	[1.12]	[0.58]	[0.93]
FISP*d2014	262.71	362.361*	269.74
	[1.39]	[1.87]	[0.59]
Joint impact SCT&FISP	551.983**	637.101**	472.44
	[1.97]	[2.16]	[1.18]
Incremental impact of FISP on SCTP	288.95	523.268**	90.57807
	[1.10]	[2.47]	[0.19]
Incremental impact of SCTP on FISP	289.27	274.74	202.6946
	[0.87]	[0.85]	[0.36]
Complementarity	26.24	160.91	-179.1656
	[0.08]	[0.57]	[-0.30]
Furnishings			
SCTP*d2014	514.225***	314.10	821.313***
	[3.97]	[1.55]	[4.66]
FISP*d2014	53.89	-15.64	257.12
	[0.27]	[-0.08]	[1.19]
Joint impact SCT&FISP	686.711***	762.469***	584.281***
	[4.43]	[3.21]	[2.88]
Incremental impact of FISP on SCTP	172.49	448.3676*	-237.03
	[1.23]	[1.70]	[-1.11]
Incremental impact of SCTP on FISP	632.820**	778.11**	327.1653
	[2.74]	[2.81]	[1.4]
Complementarity	118.60	464.01	-494.1479
	[0.48]	[1.44]	[-1.69]
Transport			
SCTP*d2014	441.010**	444.09	403.254**
	[1.97]	[1.1]	[2.28]
FISP*d2014	351.38	616.15	66.10
	[1.34]	[1.17]	[0.29]
Joint impact SCT&FISP	463.75	681.59	126.02
	[1.59]	[1.58]	[0.66]
Incremental impact of FISP on SCTP	22.74	237.50	-277.23
	[0.07]	[0.41]	[-1.68]
Incremental impact of SCTP on FISP	112.3689	65.44	59.93
	[0.40]	[0.13]	[0.29]
Complementarity	-328.64	-378.65	-343.33
	[-0.74]	[-0.45]	[-1.15]

Impact on expenditure per capita by items - real values (cont'd)

	All	Labor unconstrained	Labor constrained
Communication			
SCTP*d2014	53.835	81.204	30.842
	[1.59]	[1.37]	[0.86]
FISP*d2014	12.697	32.083	2.322
	[0.49]	[0.59]	[0.07]
Joint impact SCT&FISP	78.583	116.432	19.666
	[1.6]	[1.44]	[0.37]
Incremental impact of FISP on SCTP	24.748	35.229	-11.176
	[0.45]	[0.42]	[-0.25]
Incremental impact of SCTP on FISP	65.886	84.349	17.344
	[1.25]	[1.03]	[0.27]
Complementarity	12.051	3.145	-13.499
	[0.19]	[0.03]	[-0.24]
Recreation			
SCTP*d2014	-1.08	1.63	-2.57
	[-0.46]	[0.28]	[-1.19]
FISP*d2014	-4.43	-9.90	0.51
	[-1.36]	[-1.67]	[0.28]
Joint impact SCT&FISP	-11.38	-13.79	-7.53
	[-1.65]	[-1.31]	[-1.37]
Incremental impact of FISP on SCTP	-10.30	-15.4121	-4.96
	[-1.35]	[-1.03]	[-1.24]
Incremental impact of SCTP on FISP	-6.95	-3.89	-8.05
	[-0.90]	[-0.35]	[-1.26]
Complementarity	-5.87	-5.52	-5.48
	[-0.69]	[-0.37]	[-1.09]
Hotels and restaurants			
SCTP*d2014	265.650**	227.408*	239.05
	[2.17]	[1.68]	[-1.25]
FISP*d2014	216.315*	52.07	398.202*
	[1.76]	[0.35]	[1.74]
Joint impact SCT&FISP	121.09	77.29	209.70
	[0.63]	[0.45]	[0.66]
Incremental impact of FISP on SCTP	-144.56	-150.12	-29.3
	[-0.69]	[-0.69]	[-0.09]
Incremental impact of SCTP on FISP	-95.22086	25.22	-188.50
	[-0.43]	[0.13]	[-0.53]
Complementarity	-360.871	-202.19	-427.6
	[-1.39]	[-0.76]	[-1.07]
Miscellaneous			
SCTP*d2014	190.47	95.33	209.19
	[1.5]	[0.68]	[1.4]
FISP*d2014	229.550***	114.67	334.014**
	[2.84]	[1.33]	[2.66]
Joint impact SCT&FISP	535.310***	474.311**	561.454***
	[3.54]	[2.22]	[3.2]
Incremental impact of FISP on SCTP	344.841**	378.98	352.2612*
	[2.91]	[1.62]	[1.84]
Incremental impact of SCTP on FISP	305.76**	359.65	227.4401
	[2.21]	[1.61]	[1.45]
Complementarity	115.29	264.32	18.24706
	[0.82]	[1.04]	[0.08]

Table 4: Impact on food security

	All	Labor unconstrained	Labor constrained
Worry about lack of food			
SCTP*d2014	-0.091**	-0.095**	-0.084
	[-2.17]	[-2.12]	[-1.57]
FISP*d2014	-0.046	-0.070**	0.002
	[-1.51]	[-2.28]	[0.04]
Joint impact SCT&FISP	-0.076	-0.109*	-0.043
	[-1.68]	[-1.72]	[-0.76]
Incremental impact of FISP on SCTP	0.015	-0.014	0.04
	[0.58]	[-0.29]	[0.72]
Incremental impact of SCTP on FISP	-0.030	-0.039	-0.045
	[-0.70]	[-0.62]	[-0.59]
Complementarity	0.06	0.056	0.038
	[1.56]	[0.92]	[0.44]
Number of meals per day			
SCTP*d2014	0.226***	0.174**	0.278***
	[3.51]	[2.36]	[3.03]
FISP*d2014	0.054	-0.016	0.131
	[0.92]	[-0.13]	[1.57]
Joint impact SCT&FISP	0.244***	0.226**	0.237***
	[3.25]	[2.17]	[2.88]
Incremental impact of FISP on SCTP	0.018	0.05	-0.04
	[0.3]	[0.64]	[-0.42]
Incremental impact of SCTP on FISP	0.190**	0.241**	0.11
	[2.79]	[2.04]	[0.87]
Complementarity	-0.036	0.07	-0.17
	[-0.42]	[0.46]	[-1.34
Caloric intake in the past 7 days			
SCTP*d2014	187.382**	119.382	280.131**
	[2.13]	[1.24]	[2.24]
FISP*d2014	-12.874	-57.596	63.059
	[-0.29]	[-0.70]	[0.74]
Joint impact SCT&FISP	188.926	175.909	267.392**
	[1.40]	[1.03]	[2.14]
Incremental impact of FISP on SCTP	1.54	56.53	-75.80
	[0.01]	[0.4]	[-0.51]
Incremental impact of SCTP on FISP	201.80	233.50	-12.74
	[1.43]	[1.26]	[-0.11]
Complementarity	14.42	114.12	-75.80
	[0.12]	[0.71]	[1.54]
Caloric intake from purchased food			
SCTP*d2014	181.329**	90.501	345.121***
	[2.23]	[0.93]	[4.32]
FISP*d2014	54.114	0.919	128.241
	[0.82]	[0.01]	[1.47]
Joint impact SCT&FISP	211.552**	163.367	294.328***
	[2.09]	[1.49]	[2.79]
Incremental impact of FISP on SCTP	30.22	72.87	-50.79
	[0.42]	[1]	[-0.55]
Incremental impact of SCTP on FISP	157.44	162.45	166.087
	[1.58]	[1.39]	[1.58]
Complementarity	-23.89	71.95	-179.03
	[0.24]	[0.65]	[-1.44]
Caloric intake from produced food			
SCTP*d2014	-41.163	-18.085	-77.454
	[-0.71]	[-0.29]	[-1.33]
FISP*d2014	-6.951	-6.514	-21.837
	[-0.38]	[-0.26]	[-1.03]
Joint impact SCT&FISP	-29.016	4.027	-63.326
	[-0.52]	[0.08]	[-0.90]
Incremental impact of FISP on SCTP	12.147	22.112	14.128
	[0.78]	[0.90]	[0.48]
Incremental impact of SCTP on FISP	-22.066	10.541	-41.489
	[-0.41]	[0.21]	[-0.63]
Complementarity	19.098	28.626	35.965
	[0.84]	[0.84]	[1]
Caloric intake from gifts			
SCTP*d2014	-4.915	-2.845	-7.85
	[-1.29]	[-0.81]	[-1.68]
FISP*d2014	3.677*	1.431	6.655***
	[1.78]	[0.50]	[3.04]
Joint impact SCT&FISP	-1.503	-1.061	-1.84
	[-0.37]	[-0.26]	[-0.39]
Incremental impact of FISP on SCTP	3.412*	1.784	6.010***
	[1.73]	[0.58]	[2.96]
Incremental impact of SCTP on FISP	-5.180	-2.492	-8.495
	[-1.18]	[-0.50]	[-1.91]
Complementarity	-0.265	0.353	-0.645
	[-0.1]	[0.09]	[-0.23]

Table 5: Impact on value of production – real values

	All		Labor unconstrained		Labor constrained	
		Baseline Mean		Baseline Mean		Baseline Mean
SCTP*d2014	1215.245	9143.033	2338.955	10501.45	-170.595	7472.863
	(0.85)		[1.66]		[-0.07]	
FISP*d2014	5001.897***	9570.896	5874.043***	11169.23	2682.042	7789.116
	(3.64)		[5.24]		[1.03]	
Joint impact SCTP&FISP	7609.484***	9830.867	7774.090***	11101.51	7060.743***	8354.416
	(5.88)		[5.63]		[3.78]	
Incremental impact of FISP on SCTP	6394.239***		5435.135***		7231.338***	
	(6.93)		[3.67]		[4.06]	
Incremental impact of SCT on FISP	2607.587*		1900.047		4378.7*	
	(1.70)		[1.28]		[1.9]	
Complementarity	1392.342		-438.909		4549.295	
	(0.86)		[-0.26]		[1.38]	

Table 6: Impact on crop production

	% of households engaged in:			Quantity produced		
	All	Labor unconstrained	Labor constrained	All	Labor unconstrained	Labor constrained
Maize production						
SCTP*d2014	-0.001	-0.004	-0.008	18.767	19.641	12.244
	[-0.03]	[-0.19]	[-0.15]	[1.22]	[1.29]	[0.52]
FISP*d2014	0.067**	0.014	0.112**	65.581***	61.179***	61.037***
	[2.48]	[0.72]	[2.52]	[6.42]	[5.97]	[4.49]
Joint impact SCTP&FISP	0.033	0.003	0.081	81.418***	76.181***	82.667***
	[0.98]	[0.10]	[1.64]	[4.32]	[3.70]	[4.28]
Incremental impact of FISP on SCTP	0.034	0.007	0.089	62.651***	56.540***	70.423***
	[1.52]	[0.28]	[2.99]	[5.40]	[3.29]	[4.08]
Incremental impact of SCTP on FISP	-0.034	-0.011	-0.031	15.837	15.002	21.629
	[-0.94]	[-0.39]	[-0.56]	[0.78]	[0.70]	[0.97]
Complementarity	-0.033	-0.007	-0.023	-2.93	-4.639	9.386
	[-0.94]	[-0.22]	[-0.4]	[-0.19]	[-0.25]	[0.43]
Grandnut production						
SCTP*d2014	0.090*	0.089	0.088	7.954**	8.654 7.076*	
	[1.86]	[1.44]	[1.54]	[2.23]	[1.68]	[2.01]
FISP*d2014	0.082***	0.096**	0.082**	7.861**	6.145	9.508**
	[4.04]	[2.42]	[2.37]	[2.33]	[1.25]	[2.16]
Joint impact SCT&FISP	0.105**	0.105*	0.100*	9.038**	9.372**	8.112**
	[2.14]	[1.74]	[1.99]	[2.38]	[2.19]	[2.21]
Incremental impact of FISP on SCTP	0.015	0.017	0.012	1.084	0.718	1.035
	[0.34]	[0.31]	[0.19]	[0.47]	[0.27]	[0.24]
Incremental impact of SCTP on FISP	0.022	0.009	0.018	1.177	3.227	-1.397
	[0.45]	[0.14]	[0.3]	[0.25]	[0.60]	[-0.25]
Complementarity	-0.067	-0.079	-0.069	-6.777	-5.428	-8.472
	[-1.43]	[-1.2]	[-0.95]	[-1.63]	[-0.98]	[-1.39]
Pigeon pea production						
SCTP*d2014	0.016	0.102**	-0.109	1.506	2.648	-0.09
	[0.30]	[2.05]	[-1.57]	[0.85]	[1.25]	[-0.06]
FISP*d2014	0.094**	0.095**	0.071	3.706***	3.916**	3.039**
	[2.23]	[2.33]	[1.18]	[2.85]	[2.43]	[2.31]
Joint impact SCT&FISP	0.001	0.027	-0.035	1.929	1.405	2.28
	[0.01]	[0.49]	[-0.64]	[1.30]	[0.82]	[1.13]
Incremental impact of FISP on SCTP	-0.015	-0.074**	0.074	0.424	-1.243	2.37
	[-0.86]	[-2.49]	[2.16]	[0.41]	[-0.76]	[1.40]
Incremental impact of SCTP on FISP	-0.094	-0.067	-0.105	-1.776	-2.511	-0.759
	[-1.56]	[-1.04]	[-1.58]	[-0.97]	[-1.15]	[-0.34]
Complementarity	-0.110**	-0.169***	0.004	-3.282**	-5.159**	-0.669
	[-2.48]	[-3.18]	[0.05]	[-2.14]	[-2.40]	[-0.32]
Nkhwani production						
SCTP*d2014	-0.086*	-0.122*	-0.069	-0.954	-2.396	0.366
	[-1.89]	[-1.95]	[-1.52]	[-0.66]	[-1.28]	[0.25]
FISP*d2014	0.001	-0.043	0.06	1.849	0.339	3.651***
	[0.03]	[-0.86]	[1.06]	[1.45]	[0.19]	[2.81]
Joint impact SCTP&FISP	-0.07	-0.104	-0.057	-0.3	-2.457	1.856
	[-1.28]	[-1.39]	[-1.36]	[-0.19]	[-1.26]	[1.19]
Incremental impact of FISP on SCTP	0.015	0.018	0.012	0.653	-0.061	1.489
	[0.57]	[0.42]	[0.38]	[0.90]	[-0.09]	[1.14]
Incremental impact of SCTP on FISP	-0.072	-0.061	-0.117*	-2.149	-2.796	-1.795
	[-1.28]	[-0.86]	[-1.77]	[-1.44]	[-1.53]	[-0.96]
Complementarity	0.014	0.061	-0.048	-1.195	-0.399	-2.162
	[0.26]	[0.95]	[0.69]	[-0.79]	[-0.22]	[-1.16]
Rice production						
SCTP*d2014	-0.034	-0.025	-0.045	-2.551	-1.567	-2.568
	[-0.80]	[-0.45]	[-1.07]	[-0.86]	[-0.45]	[-0.80]
FISP*d2014	0.01	0.011	0.003	-0.451	-1.754	0.294
	[0.33]	[0.34]	[0.08]	[-0.20]	[-0.89]	[0.13]
Joint impact SCTP&FISP	-0.038	-0.061	0.004	-4.577	-5.850*	-1.894
	[-0.94]	[-1.20]	[0.10]	[-1.54]	[-1.91]	[-0.67]
Incremental impact of FISP on SCTP	-0.004	-0.035	0.049	-2.026	-4.283	0.674
	[-0.11]	[-0.65]	[1.32]	[-0.87]	[-1.39]	[0.34]
Incremental impact of SCTP on FISP	-0.049	-0.072	0.001	-4.126	-4.096	-2.188
	[-1.18]	[-1.27]	[0.02]	[-1.03]	[-1.04]	[-0.61]
Complementarity	-0.015	-0.047	0.045	-1.575	-2.529	0.38
	[-0.3]	[-0.75]	[0.77]	[-0.53]	[-0.77]	[0.14]

Table 7: Impact on agricultural input

	% of households which use:			Quantity used		
	All	Labor unconstrained	Labor constrained	All	Labor unconstrained	Labor constrained
Chemical fertilizers						
SCTP*d2014	0.058	-0.004	0.096	2.378	1.171	2.305
	[0.85]	[-0.04]	[1.01]	[0.99]	[0.34]	[0.65]
FISP*d2014	0.472***	0.354***	0.562***	21.638***	15.819***	26.205***
	[7.95]	[3.55]	[13.88]	[7.80]	[3.57]	[7.93]
Joint impact SCTP&FISP	0.338***	0.284***	0.435***	21.952***	21.792***	22.380***
	[5.03]	[3.78]	[4.17]	[7.46]	[6.20]	[4.96]
Incremental impact of FISP on SCTP	0.279***	0.288**	0.339**	19.574***	20.621***	20.075***
	[4.04]	[2.97]	[2.82]	[5.49]	[4.08]	[3.8]
Incremental impact of SCTP on FISP	-0.134**	-0.07	-0.127	0.314	5.972	-3.825
	[-2.12]	[-0.89]	[-1.26]	[0.10]	[1.51]	[-0.9]
Complementarity	-0.192**	-0.066	-0.223*	-2.063	4.802	-6.13
	[-2.09]	[-0.49]	[-1.75]	[-0.47]	[0.77]	[-1]
Organic ferlizers				Value		
SCTP*d2014	0.046	-0.009	0.122	213.131*	207.302	208.637*
	[0.64]	[-0.09]	[1.50]	[1.92]	[1.38]	[1.79]
FISP*d2014	-0.082	-0.072	-0.083	-201.953**	-178.551*	-221.040***
	[-1.35]	[-0.85]	[-1.46]	[-2.65]	[-1.81]	[-2.81]
Joint impact SCTP&FISP	-0.069	-0.158	0.077	114.853	91.057	162.463
	[-0.75]	[-1.32]	[0.94]	[0.93]	[0.56]	[1.39]
Incremental impact of FISP on SCTP	-0.115	-0.149	-0.045	-98.278	-116.246	-46.175
	[-1.81]	[-1.36]	[-0.70]	[-1.04]	[0.65]	[-0.63]
Incremental impact of SCTP on FISP	0.013	-0.086	0.160*	316.806***	269.607**	383.503***
	[0.16]	[-0.81]	[1.86]	[2.94]	[1.96]	[3.38]
Complementarity	-0.033	-0.077	0.038	103.675	62.305	174.866*
	[-0.36]	[-0.53]	[0.46]	[0.86]	[0.31]	[1.77]
Pesticides						
SCTP*d2014	-0.004	-0.02	0.012			
	[-0.25]	[-0.74]	[0.95]			
FISP*d2014	-0.01	-0.023	0.001			
	[-0.74]	[-1.16]	[0.06]			
Joint impact SCTP&FISP	0.031	-0.004	0.062**			
	[1.60]	[-0.15]	[2.68]			
Incremental impact of FISP on SCTP	0.035**	0.015	0.051*			
	[2.39]	[0.54]	[1.94]			
Incremental impact of SCTP on FISP	0.041**	0.019	0.062**			
	[2.46]	[0.77]	[2.33]			
Complementarity	0.045**	0.039	0.05			
	[2.36]	[1.21]	[1.61]			
Improved or hybrid seeds						
SCTP*d2014	0.05	-0.021	0.118*			
	[1.04]	[-0.36]	[1.67]			
FISP*d2014	0.125***	0.121*	0.136*			
	[3.32]	[1.96]	[1.98]			
Joint impact SCTP&FISP	0.115	0.087	0.171*			
	[1.49]	[1.01]	[1.93]			
Incremental impact of FISP on SCTP	0.065	0.108	0.053			
	[0.83]	[1.13]	[0.76]			
Incremental impact of SCTP on FISP	-0.01	-0.034	0.035			
	[-0.11]	[-0.31]	[0.37]			
Complementarity	-0.06	-0.013	-0.083			
	[-0.67]	[-0.11]	[-0.82]			

Table 8: Impact on livestock expenditures and sales

	Expenses			Sales		
	All	Labor unconstrained	Labor constrained	All	Labor unconstrained	Labor constrained
SCTP*d2014	1172.647***	1395.706***	761.950***	-78.668	-44.992	-247.801
	[5.95]	[6.07]	[2.83]	[-0.54]	[-0.18]	[-1.23]
FISP*d2014	232.985***	493.282***	32.287	57.964	231.508	62.384
	[2.96]	[3.66]	[0.28]	[0.37]	[0.76]	[0.27]
Joint impact SCTP&FISP	1688.574***	1478.082***	1997.143***	395.800*	383.684	335.607
	[5.89]	[3.92]	[6.19]	[1.98]	[1.05]	[1.06]
Incremental impact of FISP on SCTP	515.926*	82.3756	1235.193***	474.468**	428.676	583.408
	[1.82]	[0.2]	[4.68]	[2.03]	[1.08]	[1.57]
Incremental impact of SCTP on FISP	1455.59***	984.800**	1964.855***	337.836*	152.176	273.224
	[5.04]	[2.52]	[5.33]	[1.7]	[0.5]	[0.8]
Complementarity	282.941	-410.906	1202.906***	416.505	197.167	521.024
	[0.99]	[-0.94]	[3.83]	[1.50]	[0.43]	[1.17]

Table 9: Impact on livestock

	% of households which own:			Quantity		
	All	Labor unconstrained	Labor constrained	All	Labor unconstrained	Labor constrained
Chicken						
SCTP*d2014	0.196***	0.150***	0.236***	0.931***	0.698**	1.365***
	[3.81]	[2.77]	[3.20]	[3.03]	[2.62]	[3.04]
FISP*d2014	0.103***	0.134**	0.029	0.276*	0.408	-0.067
	[2.80]	[2.29]	[0.77]	[1.96]	[1.34]	[-0.31]
Joint impact SCTP&FISP	0.244***	0.230***	0.263**	1.677***	1.511***	1.828***
	[4.31]	[4.54]	[2.72]	[3.90]	[4.19]	[3.03]
Incremental impact of FISP on SCTP	0.047**	0.080*	0.027	0.746*	0.814**	0.463
	[2.32]	[1.81]	[0.46]	[1.90]	[2.68]	[0.98]
Incremental impact of SCTP on FISP	0.141**	0.095	0.234**	1.400***	1.104**	1.894**
	[2.56]	[1.43]	[2.13]	[3.29]	[2.39]	[2.85]
Complementarity	-0.055	-0.054	-0.002	0.469	0.406	0.529
	[-1.35]	[-0.71]	[-0.03]	[1.20]	[1.06]	[1.08]
Goats and sheeps						
SCTP*d2014	0.108***	0.114***	0.075*	0.145	0.263*	0.03
	[3.99]	[2.99]	[1.91]	[1.36]	[1.84]	[0.35]
FISP*d2014	0.062*	0.099	0.025	0.145	0.294	0.021
	[2.01]	[1.53]	[0.59]	[1.30]	[1.46]	[0.19]
Joint impact SCTP&FISP	0.238***	0.185***	0.300***	0.694***	0.758***	0.452***
	[5.79]	[3.75]	[5.93]	[3.93]	[2.99]	[4.18]
Incremental impact of FISP on SCTP	0.131***	0.071	0.226***	0.549**	0.495**	0.422***
	[4.31]	[1.44]	[6.35]	[2.96]	[2.15]	[4.87]
Incremental impact of SCTP on FISP	0.176***	0.086	0.276***	0.549**	0.464*	0.431***
	[3.70]	[1.24]	[4.48]	[2.89]	[1.73]	[3.60]
Complementarity	0.069*	-0.028	0.201***	0.404*	0.201	0 .401**
	[1.71]	[-0.34]	[3.44]	[1.86]	[0.68]	[2.91
Pigeons, doves or ducks						
SCTP*d2014	0.007	0.006	0.001	0.136*	0.263**	-0.083
	[0.48]	[0.37]	[0.06]	[1.71]	[2.33]	[-0.83]
FISP*d2014	-0.005	-0.006	-0.006	0.065	0.143	-0.045
	[-0.38]	[-0.27]	[-0.34]	[1.21]	[1.20]	[-0.63]
Joint impact SCTP&FISP	0.060**	0.064*	0.052*	0.280**	0.336**	0.238*
	[2.55]	[1.84]	[1.71]	[2.74]	[2.09]	[1.80]
Incremental impact of FISP on SCTP	0.053*	0.058*	0.051	0.144	0.072	0.320*
	[1.91]	[1.7]	[1.28]	[1.15]	[0.45]	[1.67]
Incremental impact of SCTP on FISP	0.064**	0.070*	0.057*	0.215**	0.192	0.283*
	[2.65]	[1.9]	[1.7]	[2.12]	[1.32]	[1.81]
Complementarity	0.057*	0.064	0.056	0.079	-0.071	0.365*
	[1.89]	[1.5]	[1.31]	[0.58]	[-0.38]	[1.73]

Table A1: Test for difference between groups included in the analysis and groups excluded

	Excluded	Included	F-test	P-value>F
single head of hh	0.665	0.750	28.78	0.0000
female head of hh	0.827	0.854	4.51	0.034
age of head of hh	60.021	55.583	43.230	0.000
num members in the hh	4.543	4.528	0.03	0.857
num members in the hh 0-5 years old	0.600	0.747	22.23	0.000
num members in the hh 6-12 years old	1.153	1.218	3.06	0.080
num members in the hh 13-17 years old	0.948	0.898	2.28	0.131
num members in the hh 18-64 years old	1.193	1.126	3.56	0.059
num members in the hh >=65 years old	0.649	0.538	24.72	0.000
num orphans in the hh	0.864	1.014	8.37	0.004
yrs of education head of hh	0.994	1.157	4.89	0.027
hh severely labor constrained	0.472	0.471	0.01	0.926
hh consumption - total	189278	158799	55.62	0.000
hh consumption - food and beverages	147563	123545	55.21	0.000
Household owns or cultivates land	0.991	0.919	112.79	0.000
Total plot area operated within hh	1.454	1.177	65.41	0.000
HH has plot that is irrigated	0.046	0.051	0.37	0.543
HH applies chemical fertilizer	0.947	0.323	2546.7	0.000
HH applies organic fertilizer	0.226	0.267	7.37	0.007
HH uses pesticides	0.026	0.019	1.65	0.199
HH uses improved or hybrid seed	0.511	0.269	217.16	0.000
HH planted maize	0.979	0.869	158.97	0.000
HH planted groundnut	0.236	0.122	74.26	0.000
HH planted pigeonpea	0.264	0.136	85.55	0.000
Value of production	16412	10010	371	0.000
HH owns hand hoe	0.922	0.814	89.57	0.000
HH owns axe	0.166	0.103	28.98	0.000
HH owns panga knife	0.258	0.203	14.14	0.000
HH owns sickle	0.218	0.145	29.39	0.000
HH owns chickens now	0.189	0.120	30.74	0.000
HH owns goat or a sheep now	0.131	0.067	37.93	0.000
Total HH Expenditure for livestock	82.11	65.63	1.23	0.268
Total HH livestock sales	494.32	246.00	16.48	0.000
obs	1756	1607		

Table A2: Anova test for difference between groups of intervention: control, SCT, FISP, SCT+FISP (no weights adjusted)

	C	SCT	FISP	SCT&FISP	F-test	P-value>F
single head of hh	0.760	0.749	0.748	0.730	0.32	0.8097
female head of hh	0.870	0.839	0.857	0.846	0.7	6 0.514
age of head of hh	53.160	54.294	58.477	60.199	9.93	0.000
num members in the hh	4.620	4.487	4.565	4.391	0.74	0.525
num members in the hh 0-5 years old	0.822	0.798	0.596	0.636	5.13	0.002
num members in the hh 6-12 years old	1.568	1.418	1.619	1.439	2.27	0.079
num members in the hh 13-17 years old	0.581	0.624	0.658	0.612	0.61	0.608
num members in the hh 18-64 years old	1.164	1.115	1.049	0.971	2.83	0.057
num members in the hh >=65 years old	0.485	0.533	0.643	0.733	12.22	0.000
num orphans in the hh	1.030	1.026	0.955	1.009	0.14	0.937
yrs of education head of hh	1.149	1.246	1.273	0.925	1.57	0.195
hh severely labor constrained	0.438	0.461	0.534	0.500	2.51	0.057
hh consumption - total	157874	150568	171136	164813	1.41	0.238
hh consumption - food and beverages	122880	117391	130279	130018	1.89	0.129
Household owns or cultivates land	0.916	0.910	0.933	0.927	0.47	0.702
Total plot area operated within hh	1.199	1.080	1.276	1.220	2.89	0.034
HH has plot that is irrigated	0.049	0.047	0.047	0.063	0.41	0.747
HH applies chemical fertilizer	0.279	0.278	0.370	0.448	11.2	0.000
HH applies organic fertilizer	0.274	0.222	0.279	0.319	3.22	0.022
HH uses pesticides	0.013	0.021	0.020	0.027	0.8	0.494
HH uses improved or hybrid seed	0.279	0.232	0.271	0.311	2.15	0.092
HH planted maize	0.873	0.863	0.850	0.890	0.69	0.559
HH planted groundnut	0.100	0.111	0.118	0.187	4.92	0.002
HH planted pigeonpea	0.131	0.139	0.115	0.157	0.72	0.541
Value of production	9906.08	9154.94	10737.91	11100.21	2.98	0.030
HH owns hand hoe	0.818	0.778	0.814	0.870	7.97	0.000
HH owns axe	0.096	0.079	0.106	0.152	13.01	0.000
HH owns panga knife	0.192	0.201	0.195	0.235	4.28	0.005
HH owns sickle	0.156	0.125	0.110	0.189	10.7	0.000
HH owns chickens now	0.133	0.117	0.115	0.102	7.85	0.000
HH owns goat or a sheep now	0.074	0.046	0.069	0.090	22.19	0.000
Total HH Expenditure for livestock	90.12	49.37	43.69	63.720	47.69	0.000
Total HH livestock sales	266.64	238.49	170.20	280.338	1.43	0.231
obs	616	485	239	267		