2018-03

Structural Transformation of African Agriculture and Rural Spaces

Do safety net transfers improve household diets and reduce undernutrition? Evidence from rural Ethiopia

Tagel Gebrehiwot
Carolina Castilla

partnership for economic policy
pep

Do safety net transfers improve household diets and reduce undernutrition? Evidence from rural Ethiopia

Abstract

In this paper we examine the impact of the Ethiopia's Productive Safety Net Program on household dietary diversity and child nutrition using both waves of the Ethiopian Socio-economic Survey. For identification, we use various methodologies. To estimate the effect of the program on household dietary diversity, we rely on the exogeneity of the change in the amount of money that kebeles (lowest administrative unit) have available to allocate among program beneficiaries, which depends on donor support. We present evidence that there is a discrete jump in the kebeles' allocated budget between 2012 and 2014. We use the change in the amount of PSNP transfers in each kebele as an instrument for the change in the amount of the transfer received by each household. For robustness, we confirm our results using generalized propensity score matching with a continuous treatment. We find no effect of an increase in the amount of money received by households in the form of PSNP transfers on household dietary diversity. To examine the effect of PSNP participation on long-term child nutrition we use a difference-in-difference approach. We use children aged 6 to 24 months in 2012 as a baseline. The treatment group is children in beneficiary households between the ages of 6 and 24 months in 2014 because they were not born during the 2012 round of the survey, and the control group were children in the same age range in non-beneficiary households. We find no effect on height-for-age regardless of age cohort, model specification, or methodology. Results indicate consistently that PSNP has not had the desired effect on household dietary diversity or child nutrition, suggesting that perhaps the transfers need to be paired with additional interventions such as information about nutrition.

Key words: Nutrition security, Dietary diversity, Impact, Continuous treatment, Dose-response function, Propensity Score Matching

Authors

Tagel Gebrehiwot
Research fellow, PhD,
Environment and Climate Research Center,
Ethiopian Development Research Institute,
Addis Ababa, Ethiopia

Carolina Castilla
Assistant professor in Economics,
Colgate University, Hamilton,
New York, USA

Acknowledgements

This working paper is based on the PEP-Structural Transformation of African Agriculture and Rural Spaces 'STAARS' Project-06, carried out with financial support from the Government of Canada through the International Development Research Centre (IDRC). Other partners of the STAARS consortium include the African Development Bank (AfDB), the African Economic Research Consortium (AERC), the CGIAR Research Program on Policies, Institutions and Markets (PIM), Cornell University and the World Bank. PEP receives core funding from the Department for International Development (DFID) of the United Kingdom (or UK Aid) and the IDRC.

The authors are greatly indebted to Mr Asmelash Haile Tsegay, at the World Bank Ethiopia Branch, for his immense support in preparing the data for this study. We thank the World Bank for making the Ethiopian Socio-economic Survey (ESS) data accessible for all. The opinions expressed herein are those of the authors.

Table of contents

Tables and figures

I. Introduction

Food and nutrition security remains Africa's most fundamental challenge. The Food and Agriculture Organization of the United Nations (FAO) report indicates that in Africa about 232.5 million people lacked economic and physical access to the food required to lead a healthy and productive life in 2014-16 (FAO, 2015). As in other Sub-Saharan Africa countries, food insecurity and malnutrition remain a critical issue in Ethiopia despite the implementation of several programs aimed at improving household food security. About 80% of the population reside in rural areas and subsist on agriculture. Many rural inhabitants cannot meet their basic needs and the country has a long history of receiving food aid (Gilligan, Hoddinot, & Taffesse, 2008). The 2014-2016 FAO assessment report estimated 31.6 million of the Ethiopian population are undernourished, indicating food shortage as a serious problem in the country (FAO, 2015).

Furthermore, Ethiopia's food production is highly vulnerable to the influence of adverse weather conditions as the economy is dependent on rain-fed agriculture. The incidence of recurrent drought has had an adverse effect on the rural population who depend mainly on agriculture for their livelihood. Currently, drought exacerbated by El Niño negatively affects the livelihoods of 15 million Ethiopians, as well as food security. As a result, child malnutrition is also among one of the most serious problems facing Ethiopia. According to the recent Ethiopian Demographic and Household Survey (DHS) report, 40%, 19% and 25% of children under the age of five had stunted growth, were wasted or were underweight in 2014, respectively (CSA, 2014).

There is a pressing need and commitment by the government to improve household food security in Ethiopia. Accordingly, different economic reform programs have been carried out since 2002 to improve the economy and eradicate rural poverty. The Food Security Program (FSP) (among others) was introduced to combat the persistent food insecurity problem in the country. The FSP combines a safety-net aimed at closing household food gaps and eliminating distress in asset sales. In 2005, the safety net component called the Productive Safety Net Program (PSNP) started, which is the cornerstone of the FSP. It is the second largest social protection program in sub-Saharan Africa, behind only South Africa (Debela, Shively, & Holden, 2014). The PSNP provides multi-annual transfers, such as food, cash or a combination of both, to chronically food insecure households. It provides direct income to poor households primarily through participation in public works, in addition to unconditioned direct support to poor households who are unable to participate in public works. The PSNP was first designed to solve the problem of chronic food insecurity and constant food emergencies with more predictable transfers, which it was hoped would also build resilience in poor communities. There was a conscious decision, however, not to address nutrition in the original PSNP, but to focus on food security and productive assets. Now, however, the new phase of PSNP has included nutrition, reflecting the growing demand for social safety nets to improve dietary diversity and child nutrition. In line with this, the 2006 version of Ethiopia's PSNP contains nutrition interventions for acutely malnourished children and mothers (EAS, 2013). Basically, the program is targeted towards the vulnerable and chronically food insecure population, and it has some of the characteristics of a nutrition-sensitive intervention. Thus, it addresses one of the underlying determinants of undernutrition through its provision of cash and food transfers (Berhane, Hoddinott, & Kumar, 2016).

Food or cash transfers are the main elements of the PSNP. The case for cash transfers schemes builds on Sen's (1981) analysis of 'entitlement to food'. He claims that restoring access to food through enhancing demand is a more effective response to food insecurity than food aid as cited in Sabates-Wheeler and Devereux (2010). Cash-based schemes offer greater choice of use of the transfer and can allow a greater diversity of food choice (FAO, 2012; Save the Children, 2012). Cash transfer programs relax household budget constraints and this in turn increases household ability to access food and improve the quantity, quality and diversity of food they consume (Alderman, Hoogeveen, & Rossi, 2006; Ruel & Alderman, 2013). Better access to food and greater dietary diversity could in return improve the nutritional status of resource poor rural households and children (Berhane *et al.*, 2016). Similarly, Ruel (2013) argued that cash transfers might increase dietary diversity since cash can be used to purchase any type of food available. Evidence in this context shows that cash transfers can be effective in improving household food availability and dietary diversity (Ruel & Alderman, 2013). In general, one would expect dietary diversity to increase with income. Melo, Abdul-Salam, Roberts, Gilbert, Matthews, Colen, Mary, and Gomez Y Paloma (2015) reveal income elasticities are much higher for animal sourced foods. Despite the many benefits of cash transfers, however, evidence of effects on child nutritional outcome is mixed (Leroy, Ruel, & Verhofstadt, 2009; Gaarder, Glassman, & Todd, 2010). Thus, the potential benefits of social safety nets, specifically cash transfers, on child nutrition and development are in need of further examination (Ruel & Alderman, 2013).

Studies on social safety nets and effects on dietary diversity and child nutrition outcomes among Ethiopian rural households are somewhat rare. However, there is ample literature evaluating the impact of Ethiopia's social protection program on outcomes other than dietary diversity (Quisumbing, 2003; Gilligan et al., 2008; Andersson, Mekonnen, & Stage, 2011; Coll-Black, Gilligan, Hoddinott, Kumar, Taffesse, & Wiseman, 2011; Hoddinott, Berhane, Daniel O. Gilligan, Kumar, & Taffesse, 2012; Debela et al., 2014; Berhane et al., 2016; Porter & Goyal, 2016). Quisumbing (2003) found that free distribution (FD) and food-for-work (FFW) had differing effects on child nutritional status, and the effects also varied depending on the gender of the child. Her results show that among younger children, FFW improved boys' weight-for-height relative to that of girls'. In contrast, FD had both a positive direct effect on weight-for-height for both older and younger children, and benefitted girls. Gilligan et al. (2008) present evidence that access to the PSNP increased household average calorie availability and reduced the likelihood of low caloric intake in households. Furthermore, they found those households who had access to the public works component of the PSNP and/or other food security programs (OFSP) were more likely to be food secure, and use improved agricultural technologies compared to non-PSNP beneficiaries.

Coll-Black *et al.* (2011) evaluated the targeting performance of the PSNP and their findings indicate that the PSNP has been able to target resources to the poorest. Debela *et al.* (2014) examined the link between Ethiopia's PSNP and short-run nutrition of children aged 5 years and younger, measured using weight-for-height. Their results indicate that PSNP increased weight-for-height, particularly of children in households who were able to leverage underemployed female labor. However, Debela *et al.* (2014) based their analysis on the short-run nutrition outcome indicator, Weight-for-Height Z-score (WHZ), which measures program impacts arising in the recent wake of PSNP enrollment. Recently, Berhane *et al.* (2016) examined the impact of the PSNP on children's nutritional status over the period 2008–2012. Their results indicate no evidence that the PSNP reduces either chronic under-nutrition (height-for-age z-scores, stunting) or acute under-nutrition (weight-for-height z-scores, wasting).

Other studies have examined the effect of PSNP on agricultural outcomes. Anderson et al. (2011) evaluate the impact of PSNP on rural households' livestock holdings and forest assets including trees by employing panel data. Their evidence suggests that participation in PSNP encourages households to increase investment in trees; however, there is no effect on protection of livestock in response to climate shocks or economic difficulties. In contrast, results from Hoddinott *et al*. (2012) indicated that high levels of participation in PSNP alone have no effect on agricultural input use or productivity. They do find that access to the OFSP/HABP program in addition to high levels of payments from the PSNP led to sizeable improvements in the use of fertilizer. Despite these research findings, there is still a dearth of evidence on the impact of Ethiopia's social safety net program on household and child nutritional outcomes. Filling this gap and obtaining a better understanding of Ethiopia's PSNP impact on dietary diversity and long-term nutrition outcomes of child malnutrition is therefore important in its own right. Thus, the question of whether PSNP cash transfers have an effect on household and children nutritional outcomes motivates the niche for this study.

In this paper, we investigate the impact of Ethiopia's PSNP on household dietary diversity and the nutritional status of children under the age of five. We further examined the effect of the program on child nutrition by exploiting the fact that stunting does not change after age 3. We draw on a group of children aged 3 to 5 in the first round as the control group, and those aged 3 or younger in the first round as the treatment group, and examine how their stunting changes as a result of repeated exposure to the program by the second round relative to themselves, and their same age group in the first round.

The findings reveal that the increase in PSNP transfers between 2012 and 2014 had no effect on household dietary diversity. Estimates for different household dietary indicators reveal that the effect of the change in the cash transfer received by the household is statistically and economically insignificant. This finding is robust to different identification strategies and inclusion of control variables that determine eligibility to become a PSNP beneficiary. Furthermore, our results indicate that participation in PSNP had no effect on child nutrition measured as height-for-age or probability of being stunted.

The contribution of this research to the literature is twofold. First, the results contribute to the impact evaluation of social protection through a new lens of inputs to food and household nutrition security, and child nutrition. Second, we identify the causal effect of Ethiopia's PSNP on household dietary diversity and child nutrition using the change in the amount of PSNP transfers in each *kebele (kebele* budget) as an instrument, which makes this study different from previous studies, specifically the Berhane *et al*. (2016) study on child nutrition. Hence, this study will help public officials and policy makers by providing important information about people's food and nutrient consumption patterns.

The paper is structured as follows: the next section gives a brief description of the program. We then outline the study setting, data, the food and nutrition security outcome indicator, and the data and estimation strategy. Finally, we present the empirical results and discussion followed by the conclusion.

II. Ethiopia's productive safety set program (PSNP)

In 2005, the Ethiopian government and a consortium of donors initiated a large-scale social safety net program called the Food Security Program (FSP). The FSP represented an important change in government strategy for addressing the recurring annual needs of its most food-insecure population and widespread poverty. The cornerstone of the FSP is the Productive Safety Net Program (PSNP), which is aimed at providing a long-term solution to the chronically food insecure households in the country (Debela et al., 2014). The goal of PSNP is to offer multi-annual transfers, such as food, cash or a combination of both to chronically food insecure households to break the cycle of food aid. Through these transfers, PSNP enables the rural poor to survive food deficit periods and prevent productive asset depletion while aiding them in meeting their basic food requirements and create assets (Bishop & Hilhorst, 2010; Hoddinott et al., 2012; Rodrigo, 2012; WFP, 2012; Weldegebriel & Prowse, 2013; Debela et al., 2014; Alpha & Gebreselassié, 2015).

The PSNP provides direct income to poor households either as food or wages to those who are able to provide labor to public works projects. Households unable to work on public works receive unconditioned direct support in the form of cash or food (Sharp, Brown, & Teshome, 2006; USAID, 2012). The public works projects consist of activities to improve livelihoods, such as rehabilitating land and water resources, rural road construction and/or maintenance, and building schools and clinics (WFP, 2012). The program further aims at supporting the rural transformation process, encouraging smallholder farmers to participate in production and investment, and promote market development through improving smallholder farmers' purchasing power. The PSNP is a very large program, with over 7.7 million beneficiaries in close to 60% of the country (Furtado, & Hobson, 2011). The program operates in Tigray, Amhara, Oromia, SNNP, Afar, Somali, Dire Dawa, and Harare regions (WFP, 2012; Debela *et al.*, 2014).

The household selection process combines an administrative and community targeting approach and consists of two stages. First, a household is eligible to be a PSNP beneficiary if it is located in one of the chronically food insecure *woredas*; if it has faced continuous food shortages (at least three months of food gap or more per year in the last three years); if it suddenly became food insecure as a result of a severe loss of assets; or if it does not have adequate family support and other means of social protection, particularly in the case of female-headed, elderly-headed households, and those with orphans and members with disabilities. Furthermore, eligibility is determined by household's asset holdings (livestock and land holding) and income from agricultural and non-agricultural activities (Sharp et al., 2006; Slater, Ashley, Tefera, Buta, & Esubalew, 2006; Coll-Black et al., 2011; Rodrigo, 2012; Simons, 2016). Although there is some regional variation in the application of the program implementation manual, overall the guidelines were followed (Coll-Black *et al.*, 2011).

The administrative process for determining which households are included in PSNP beneficiary lists is an iterative process between the *woredas* and villages. First, the Community Food Security Task Force mobilizes the community for the participatory planning exercise used to identify chronically food-insecure households, and organizes a public meeting to discuss the proposed list of PSNP beneficiaries. At this stage, community members have the discretion to suggest the addition or removal of beneficiaries identified based on local knowledge (Coll-Black *et al.*, 2011; Simons, 2016). Secondly, this task force determines which households are eligible for the public works program versus the direct support program, and the Village Council approves the PSNP beneficiary list which is passed to the *woreda*. Finally, the District Food Security Task Force approves the plans it receives from the village councils at *woreda*-level, and, if there are any discrepancies, it gives additional direction to the village council, and other food security task force committees (Simons, 2016). Selected households are then registered as beneficiaries of the PSNP program and provided a guaranteed source of income for a consecutive five-year period.

III. Data and methods

3.1 The study setting

Ethiopia is the second largest country in sub-Saharan Africa located in the Horn of Africa. The majority of the populations (about 80%) reside in rural areas. Agriculture is the main sector of the economy and constitutes the basis of livelihood for the Ethiopian population. The sector constitutes about 40% of the regional gross domestic product. An overwhelming proportion of the population depends on subsistence rain-fed farming for survival. The country's agriculture largely depends on seasonal rainfall, which is characterized by a high coefficient of variation. As a result, the sector is highly exposed to changes in climate variability (Conway & Schipper, 2011). Over the past decades, the country has been overwhelmed by climate variability and associated droughts that resulted profound effects on the country's food production (Bewket & Conway, 2007; Araya, & Stroosnijder, 2011; Conway, & Schipper, 2011). Recurrent droughts form the major threat to rural livelihoods and food security in the country.

3.2 Data Source

We draw our data from the Ethiopian Socioeconomic Survey (ESS), a panel household survey collected every two years by the Central Statistical Agency (CSA) with the support of the Living Standards Measurement Surveys – Integrated Surveys in Agriculture (LSMS-ISA) project of the World Bank in all regions of Ethiopia. There are two waves available at this point. The first wave was conducted in 2011-2012 and comprised of 4,000 households in rural and small towns across Ethiopia. In the second wave, they re-interviewed most the households from the first wave and expanded it to include 1,500 urban households, comprising 5,262 households in 2014. The sampling design was representative at the national level, as well as for rural and urban areas. The study population is drawn from all areas of Ethiopia except for three zones and six zones of the Afar and Somalie regions, respectively.

The survey covers a wide range of topics, including household information on basic demographics; education; health (including anthropometric measurement for children); labour and time use; food consumption patterns and expenditure; household non-farm income; food security and shocks; safety nets; irrigation; crop harvest and utilization; livestock holdings, among other variables (ESS, 2013).

In this paper we focus on rural households. We excluded households in urban areas and those that had missing data for relevant variables, thus we are left with 3,797 households from the first round and 3,788 from the second. It is important to note that PSNP started in 2005, and thus we do not have data before the program was rolled out.

3.3 Methods

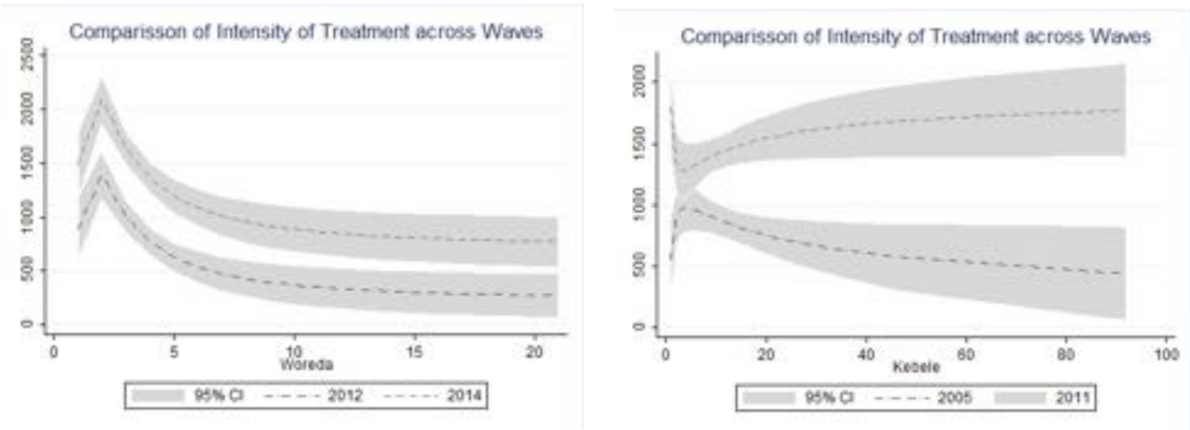
3.3.1 Empirical approach to estimate the effect of PSNP on dietary diversity

The ideal set up for evaluation of the effect of a transfer program, such as PSNP, on dietary diversity (or any other outcome) would imply collecting baseline data prior to the implementation of the program on outcome variables and determinants for eligibility (ideally for more than one round). Then either randomize assignment of beneficiary households or a staggered timing of implementation, followed by an end-line survey (or multiple rounds of post program data collection). Alternatively, one could use the thresholds on eligibility indicators to assign treatment and control groups, and evaluate the effect of the program. However, none of these approaches are feasible for the evaluation of PSNP. No baseline data was collected prior to the rollout of the program. Further, PSNP was not randomly assigned, therefore eligible and beneficiary households are more food insecure relative to those who are not enrolled in the program by design. Finally, the Community and Village Food Security task forces have discretion over who becomes a beneficiary. As a result, there is inconsistency in eligibility criterion applied across regions.

Our goal in this paper is to identify the effect of PSNP on dietary diversity and child nutrition. As discussed above, eligibility and assignment of PSNP was not random. We have two rounds of data, both of which are from after the program started and thus, we only observe what happens to program beneficiaries who are receiving transfers. Since we do not have counterfactual information, we cannot discuss what would happen to the same households had they not received the transfers. The empirical challenge then is that food insecurity can be caused by household unobservable characteristics which also lead them to become beneficiaries. Therefore, for identification purposes, we exploit variation in the amount of money individual households receive and the change in these amounts between waves I and II. Given these limitations, we focus our analysis on the change in dietary diversity as a result of repeated exposure to PSNP. To do this we follow two approaches. We show that the change in program transfers between 2012 and 2014 is exogenous and driven by the increase in donor support. This allows us to look at the intensive margin of the transfers by examining the effect of changes in the amount of the transfer between the two rounds among beneficiary households only. The identifying assumption is that changes in the amount of money beneficiary households receive across waves are exogenous. We show that the change in the amount can only come from changes to the budget the *kebele* receives, which is determined by donor support and not by household characteristics.

Using variation in changes in the budget would be problematic if the food security task force reallocates resources in such a way that *kebeles* that were receiving support no longer do, and those resources go to other *kebeles,* who are now relatively more food insecure. This is not the case as *kebeles* (and households) receiving support in wave I continued to receive support in wave II. The variation in the amount received by a household does not come from increases in the number of household members or hours worked in the public works program. Instead, if a household receives more money in 2014, it is because the *kebele's* budget devoted to the program expanded. In Figure 1, we show the results from using a fractional polynomial to fit the amount of money received by households over all eligible *woredas* (left) and *kebeles* (right) across waves. These estimates clearly indicate a discrete jump in the amounts distributed among eligible households in the same *woreda* or *kebele* across years.

Figure 1: Comparison of intensity of cash transfer across wave by *woreda* and *kebele*



The exogeneity of the change in *kebeles'* PSNP budget across years allows us to estimate the effect of PSNP on household dietary diversity. We first estimate the effect of a change the amount of the PSNP transfer received by an individual household on dietary diversity, using the change in the *kebele's* PSNP budget as an instrument for the amount received by each household in a particular *kebele*. We control for variables that influence both PSNP eligibility and dietary diversity. The regression specification is then:

$$(Y_{i,k,2014}^{d} - Y_{i,k,2012}^{d}) = \alpha_0 + \beta_1(T_{i,k,2014} - T_{i,k,2012}) + \gamma(X_{i,k,2014} - X_{i,k,2012}) + \Delta\varepsilon_{i,k,t}$$

Where $Y_{i,k,t}^{d}$ is the indicator of dietary diversity d in household i, in kebele k, in year t; $T_{i,k,t}$ is the amount of the transfer received in year t, by household i, in kebele k, and $X_{i,k,t}$ is a matrix of control variables including land and livestock holdings, household income from all sources, total household food and non-food expenditure, demographics, and indicators of drought and produce price shocks. The parameter β_1 then captures the effect of the change in the amount received by household i, in *kebele* k on dietary diversity. The reduced form equation of the change in the amount of the transfer received by each household is given by:

$$(T_{i,k,2014} - T_{i,k,2012}) = \pi_0 + \pi_1(B_{k,2014} - B_{k,2012}) + \theta(X_{i,k,2014} - X_{i,k,2012}) + \Delta\epsilon_{i,k,t}$$

Where $(B_{k,2014} - B_{k,2012})$ is the change in the PSNP budget of kebele k between 2012 and 2014.

We examine the robustness of the results using a propensity score matching approach with a continuous treatment. We use Hirano and Imbens' (2004) generalized propensity score (GPS) method. For a random sample of households, denoted by $i = 1,...,N$, the dose-response function is defined as the existence of a set of potential outcomes, $Y_i^d(t)$, the household dietary diversity. In our case, the continuous treatment is the change in the *kebeles*' budget allocated towards PSNP between 2012 and 2014, and is such that $t \quad T$ For each household i, $Y_i^d(t)$ given $t \quad T$, is the household level dose-response function. The continuous treatment T, is an interval $[t_0, t_1]$where t denotes the change in the *kebele's* PSNP budget. For each unit i, there is then a vector of covariates X_i, the level of the treatment received, $T_i \quad [t_0, t_1]$, and the potential outcome corresponding to the level of the treatment received, $Y_i^d = Y_i^d(t)$. We are interested in the identification of the average dose-response function, $E\left[\widehat{Y_i^d(t)}\right]$ which measures average dietary diversity in response to the treatment. The effect of the change in the *kebele's* PSNP budget (treatment) on dietary diversity is then estimated using the derivative of the dose-response function with respect to the treatment.

Following Hirano and Imbens (2004), the GPS, $r(t, X)$, is defined as the conditional probability of receiving treatment t given the covariates X,

$$R = r(t, X) = pr(T = t|X = x) \qquad (1)$$

Like the standard binary propensity score method, the main assumption in estimating the dose-response function is the weak unconfoundedness assumption, which requires the conditional independence of the potential outcome given each observed value of the treatment:

$$Y(t) \perp T|X \text{ for all } t \quad T \qquad (2)$$

As in the standard propensity score for a binary treatment, the GPS must also meet the balancing property. However, the GPS must be such that within strata with the same value of $r(t, X)$, the probability that $T = t$ does not depend on the value of the covariates, X. Thus, the GPS has the property that $X \perp 1\{T = t\}|r(t, X)$. Hirano and Imbens (2004) show that the balancing property combined with the weak unconfoundedness assumption imply assignment to treatment is exogenous conditional on the generalized propensity score.

In the first stage, we use the Normal distribution to model the change in the natural logarithm of the *kebele's* budget from 2012 to 2014 (T_i) given the covariates:

$$ln(T_i)|X_i \sim N(\delta_0 + \beta' X_i, \sigma^2) \quad (3)$$

We estimate the parameters δ_0, β' by maximum likelihood. The GPS is obtained as the fitted values of the likelihood function:

$$\hat{R}_i = \frac{1}{\sqrt{2\pi\hat{\sigma}^2}} e^{-\left[\frac{\left(ln(T_i) - \hat{\delta}_0 - \hat{\beta}' X_i\right)^2}{2\hat{\sigma}^2}\right]} \quad (4)$$

In the second stage, we estimate the conditional expectation of household dietary diversity for each indicator by ordinary least squares using a quadratic function of the observed treatment (T_i) and the estimated GPS ($\hat{R}_i$) (Hirano, & Imbens, 2004).

$$E[Y_i^d | T_i, R_i] = \alpha_0 + \alpha_1 T_i + \alpha_2 T_i^2 + \alpha_3 R_i + \alpha_4 R_i^2 + \alpha_5 T_i \times R_i \quad (5)$$

Finally, given the estimated parameters in (5), we estimate the potential outcome, or dose-response, at each treatment level t:

$$E[\widehat{Y_i^d(t)}] = \frac{1}{N}\sum_{i=1}^{N}(\hat{\alpha}_0 + \hat{\alpha}_1 T_i + \hat{\alpha}_2 T_i^2 + \hat{\alpha}_3 \hat{R}_i + \hat{\alpha}_4 \hat{R}_i^2 + \hat{\alpha}_5 T_i \times \hat{R}_i) \quad (6)$$

To examine whether participation in the social safety net (PSNP) impacts long-term nutritional status of children, we used a different estimation strategy. WHO reports that for children aged 2-3 years and older, low height-for-age indicates failure to grow or stunting (WHO, 2006). This indicates that by ages 2-3 stunting is irreversible. We use this fact to estimate a difference-in-difference model of the effect of PSNP participation on stunting. We observe children aged 2 or above, for both PSNP beneficiary households and non-eligible households in both waves. Children who were 2 or above in 2012 have attained a long-term status of being stunted or non-stunted measured by HAZ, thus PSNP over the next 2 years would have had no effect on the HAZ of these children. Therefore, we used these children as the baseline group for both PSNP and non-PSNP households: children who were 2 or above in 2014, and who were thus within the age-range in 2012 in which improved nutrition could have impacted long-term outcomes. The treatment group was then comprised of children aged 2 or above in PSNP participant households in 2014, and children in the same age-range in non-participant households formed the control group. We then constructed a pseudopanel consisting of two different pooled cross sections of children, aged 2 to 5, across waves among PSNP and non-PSNP participant households to estimate the following regression:

$$haz_{c,i,k} = \beta_0 + \beta_2 T_{i,k} + \beta_2 t_t + \beta_3 T_{i,k} \times t_t + \gamma X_{i,k,t} + \varepsilon_{i,k,t} \quad (7)$$

Where $haz_{c,i,k}$ is the child's height-for-age in household *i*, in kebele *k*; $T_{i,k,t}$ is a dummy variable equal to 1 if household *i*, in kebele *k*, is a PSNP participant, and zero otherwise; t_t is a dummy variable equal to 1 in 2014, and zero in 2012; and $X_{i,k,t}$ is a matrix of household control variables including land and livestock holdings, household income from all sources, total household food and non-food expenditure, demographics, and indicators of drought and produce price shocks. The difference-in-difference estimate of the effect of PSNP participation is β_3. This parameter captures the ATT, aka the average effect of PSNP participation on children HAZ.

3.4 The food and nutrition security outcome indicator

In the nutritional sciences literature, several indicators are available that can be used to measure nutrition based impact assessments (Babatunde & Qaim, 2010; Nguyen & Winters, 2011). Hoddinott and Yohannes (2002), in their 10-country analysis, showed a strong association between household dietary diversity and per capita consumption and energy availability, which is a proxy for food security. It has been proven that dietary diversity is positively associated with the key pillars of food security (access, availability and utilization) (Styen, Nel, Nantel, Kennedy & Labadarios, 2006; Hillbrunner & Egan, 2008). Thus, dietary diversity is considered a measure of a household's capacity to access a variety of food groups at the household level. Within this context, evaluations of cash transfer programs using dietary diversity as an indicator of adequate dietary intake and food security are increasing (Bailey & Hedlund, 2012). In these studies, dietary diversity is defined as the number of different foods or food groups consumed over a given reference period (Ruel, 2002).

Different methods are available to measure dietary diversity. In the nutritional literature, the food variety score and the dietary diversity scores are the two indicators most commonly used (Kant, Schatzkin, Harris, Ziegler & Block, 1993; Swindale & Bilinsky, 2006; FAO, 2011b). In order to capture differences in the nutrition content of the food items consumed, we use dietary per adult equivalent nutrient intake of calories, protein and iron separately, and construct the dietary diversity[1] score, which is one of the most direct indicators related to food and nutrition security (Hoddinott & Skoufias, 2004; Gilligan & Hoddinott, 2007), using the Simpson index. The Simpson index of food diversity measures household access to a variety of foods. It is also a proxy for the nutritional adequacy of individual diets (Ruel, 2003).

The dietary diversity score is derived based on seven food groups that include 26 food items. Total consumption was determined by summing consumption levels collected for 26 food items and 7 food groups, during 7 days. The physical quantities of food consumed by a household were converted into calories, protein and iron intake adjusted for household age and sex composition intake using the national food composition table compiled by the Ethiopian Health and Nutrition Research Institute (EHNRI, 2000).

We also used anthropometric measures to assess children's nutritional status. The most commonly used anthropometric measures are height-for-age and weight-for-height. For these measures to be useful they have to be compared to corresponding measures for a well-nourished and healthy reference population of children. In order to standardize the three measures of child under-nutrition, they are typically transformed into z-scores using the WHO growth standards (WHO, 2006) referred to as height-for-age z-scores (HAZ) and weight-for-height z-scores (WHZ). Children with height-for-age z-scores (HAZ) less than –2 from the median of the reference population are regarded as stunted or chronically malnourished, while those with HAZ less than –3 are considered as severely stunted (CSA, 2014; Bastagli, Hagen-Zanker, Harman, Barca, Sturge & Schmidt, 2016). Similarly, children with weight-for-height z-scores (WHZ) less than –2 were regarded as wasted or acutely malnourished. Wasting, by contrast, reflects acute malnutrition and it may be the result of a more recent insufficient food intake (Bastagli *et al.*, 2016).

In this study, we focused on the height-for-age z-score (HAZ) outcome indicator to measure the effect of Ethiopia's PSNP on child nutrition. According to the World Health Organization, stunting of children under 2 to 3 years of age indicates a continuous process

[1] Dietary diversity refers to nutrient adequacy, defined as a diet that meets the minimum requirements for energy and all essential nutrients. The basis for using dietary diversity as an outcome indicator for dietary quality stems mainly from a concern associated to nutrient insufficiency and the recognition of the significance of improving food and food group diversity to ensure nutrient adequacy.

of failing to grow, while for children over 2 to 3 years old it indicates failure to grow. Therefore, height-for-age represents long-term effects of malnutrition and it is not sensitive to short-term changes in dietary intake (CSA, 2014).

3.5 Definition of covariates

Definitions of explanatory variables are shown in Table A in the Appendix. The existing literature examines many other determinants of dietary and nutrition outcomes, including gender, gender of household head, education, the age of the household head, and household size, food-related expenditures, and non-agricultural income (Rogers, 1996; Quisumbing, Brown, Haddad & Meizen-Ruth, 1998; Thiele & Weiss, 2003; Gronau & Hamermesh, 2008; Taruvinga, Muchenje & Mushunje, 2013; Tankari & Badiane, 2015). We also include several measures that could potentially influence the outcome variable, household dietary diversity, and the selection of household into program participation. Land and livestock holdings are among the criteria's considered for program eligibility. We use the amount of cultivated land by a household to control for farm size, which may explain much of the underlying difference in household wealth and food security status. Farm size is also expected to influence household diet diversity (Oyarzun, Borja, Sherwood & Parra, 2013). Furthermore, in order to control for the wealth effect on household nutrition, we included the number of livestock owned by a household aggregated in terms of tropical livestock units (TLU). The agriculture related shocks that affect household nutrition are captured by the two most common stressors: food price shocks and drought (see Table A in the Appendix).

IV. Results

4.1 Descriptive statistics

4.1.1 Basic summary statistics for PSNP member and non-member household heads

The Ethiopian socio-economic survey consists of about 3,776 farm households during the years 2011-2012 and 2014. About 24% of the households surveyed participate in the social protection scheme of the PSNP. This section looks at some descriptive statistics of food consumption, nutritional outcomes and some variables of interest. Using LSMS data, we examine household level of food consumption, calorie, protein and iron intake, using headship characteristics and regional differences. Basic socio-economic characteristics of the rural households are presented in Table B in the Appendix. On average 75% of household heads in both surveys were male, and the remaining 25% were female headed (see Table B).

Table 1 reports statistics of per adult equivalent consumption of calorie, protein and iron; and degree of dietary diversity measured by dietary diversity score. The average per capita calorie consumption for the sample households was around 2262 kcal. However, 67% of the sample households consumed less than 2,200 Kcal. There were differences in reported consumption of various food groups between the first and second rounds of survey. There was a 13.4% increase in the average daily per capita calorie consumption among PSNP member households between 2011-2012 and 2014.

Based on the dietary diversity measured as a simple count of food groups that households consumed over the last 7 days, and the Food and Agriculture Organization's classification of food consumption, consumption of less than 3 food groups, 4 to 5 food groups, and greater or equal to 6 food groups are considered as poor, medium and high dietary diversity respectively (FAO, 2007). The mean dietary for all households is 4.7 in both rounds, indicating that on average, every household consumed almost 5 different food groups in the 7-day period preceding the survey. Therefore, households in the survey exhibit, on average, medium dietary diversity. The results further show that female heads of households enjoy relatively higher levels of calorie consumption per day, protein and iron intake per day in both rounds of the survey compared to their male-headed counterparts.

Table 1: Household dietary intake and food diversity across years

	2011/12			2014			
	Full sample	Male	Female	Full sample	Male	Female	Total
Calorie intake per adult equivalent, Kcal per day	2145.8	2105.6	2296.9	2378.70	2336.3	2507.8	2204.05
Protein intake per adult equivalent, gm per day	60.25	59.3	63.5	62.36	61.6	64.7	61.30
Iron intake per adult equivalent, mg per day	18.65	18.8	19.0	17.8	17.8	17.9	17.8
Household Dietary diversity score (HDDS)	4.7	4.45	4.75	4.6	4.43	4.68	
Number of observations	3,797	2,854	943	3,788	2,802	986	

The main differences between the two groups of households, in particular, were observed with respect to household size, size of cultivated land and owned livestock. As compared to non-participant heads of households, PSNP participant heads of households had smaller amounts of land and relatively larger families, while they had relatively better livestock ownership (see Table 2). Given the targeting of PSNP, this is not surprising; PSNP member households have smaller farms than non-PSNP member households. Furthermore, Table 2 indicates that there were significant differences between PSNP participants and non-participants on the main household dietary diversity outcome indicators. In both waves, non-participants had higher dietary diversity measured in terms of the Simpson index compared to PSNP participants, which is expected given the goal of eligibility criteria of the PSNP. However, the average Simpson index values for all outcome indicators were less than 0.40 in both rounds of the survey, indicating that rural farm households exhibited a lower level of food diversity.

Table 2: Summary statistics for the whole sample

	2011/12			**2013/14**		
Variable	Non-participant	Participant	t-test	Non-participant	Participant	t-test
Explanatory variable						
Age of household head	43.2	46.6	-6.66***	44.8	47.7	-5.23***
Household size	4.9	5.0	-1.20	5.2	5.0	1.53
Land holding size	0.51	0.39	4.05***	0.82	0.44	9.78***
Livestock ownership in TLU	2.4	3.5	-6.82***	3.1	3.6	-3.00
Food expenditure	180.52	187.12	-0.179	142.94	129.01	1.569
Non-food expenditure	2498.53	1626.22	1.723	3335.79	2186.9	5.277***
Dependent family members	2.35	2.39	-0.619	2.99	3.12	-1.853
Non- agricultural income	2875.34	1797.68	1.592	4673.23	2487.61	1.10
Income transfer	408.84	494.39	-0.823	524.08	548.18	-0.188
Non-agricultural labor worked per week	19.46	19.69	-0.158	9.30	5.66	3.36**
Outcome indicators						
Food Calorie intake	0.407	0.355	7.19***	0.405	0.353	6.55***
Protein intake	0.434	0.323	14.55***	0.424	0.325	11.94***
Iron intake	0.400	0.338	8.44***	0.396	0.343	6.59***
Household dietary diversity score	4.810	4.280	11.46***	4.745	4.140	11.97**
Number of observations	2,805	947		3,013	775	

Note: * p<0.05, ** p<0.01 and *** p<0.001

The summary statistics further revealed that PSNP participating households received on average 1,402.78 and 1,584.11 Ethiopian Birr cash transfers in 2011 to 2012 and 2014, respectively. This indicates a 13% increase in cash transfer.

4.1.2 Summary statistics for children under five years of age

In this section, we will briefly discuss the summary statistics of the nutrition outcomes of children under five years of age. We generated z-score values for height-for age, weight-for-height, and weight-for-age of child nutritional status using the WHO (2006) child growth standard measurement. In the 2011 to 2012 and 2014 survey rounds, anthropometric data were obtained for all children living in the household who were aged from 6 months to 5 years. Of the 3,797 and 3,788 rural households covered by the LSMS survey in waves 1 and 2, we obtained anthropometric data for 1,771 and 1,651 children in the corresponding age range.

Among our sample, we observe that about 42.8% of children under five years of age were stunted, and 26.3% were severely stunted. The impacts of nutrition deficiency during the first three years are likely to leave an enduring mark on the child's z-score. In light of this, we looked at the level of stunting for different age groups and we observed that in the younger group of children (aged less than 24 months) less children were stunted compared to the older children (aged between 24 to 60 months). The results further reveal that, on average, 11% of children under age five had signs of wasting. By examining the dynamics of stunting over the given period, the mean height-for-age z-score slightly improved between 2011 to 2012 and 2014, and the proportion of children stunted declined from 45.3% in 2011 to 2012 to 42.8% in 2014 (see Table 3). These values are somewhat higher than the mean values reported by Berhane *et al.* (2016), -1.81 for 2012.

Table 3: Mean values of height-for-age, stunting, weight-for-height, and wasting, by survey round (N_1 =1,771 & N_2=1,656)

	Height-for age		Weight-for height	
	Mean score	Per cent stunted	Mean score	Per cent wasted
2011/12	-2.02	45.3	-0.21	11.0
Less than 24	-1.99	6	0.00	3.0
24-59 months	-2.04	20	-0.25	8.1

2014	-2.18	42.8	-0.39	11.3
Less than 24	-2.25	7.9	-0.08	2
24-59 months	-2.15	33.8	-0.44	9.2

Table 4 presents summary statistics on child nutrition outcome indicators comparing children from households participating in the PSNP to non-member households by survey rounds. Long-term nutritional status, HAZ, worsened in both groups between 2011 to 2012 and 2014, declining from -0.402 in 2011 to 2012 to –2.04 in 2014. With regards to the proportion of children who were stunted within households that were PSNP members and non-members, we found children in PSNP member households were slightly more likely to be stunted (43%) than children in non-PSNP households (41.7%) in 2014. There were significant difference in the mean value for height-for-age z-scores between children (in both age groups) in PSNP member households and non-PSNP households in 2011 to 2012, however, the prevalence of stunting worsened among children in PSNP households in 2014. Table 4 further indicates that, in general, under-nutrition in PSNP households was slightly higher than among children living in non-PSNP households. The prevalence of wasting in both age groups was higher among PSNP member households than among children in non-PSNP households.

Table 4: Summary of child nutrition outcome indicators by membership in PSNP and across years

Outcome variable	Year	Full sample	Non members	Members	t-test
Height-for-age (HAZ)	2011/2	-0.402	-1.127	1.763	-2.756
	Stunting		-4.202	-4.537	1.14
	Less than 24m		-4.974	-5.682	0.766
	24-59m		-3.954	-4.261	1.133
N		1,775	1,330	445	
	2014	-2.036	-1.976	-2.272	0.733
	Stunting		-4.707	-4.896	0.394
	Less than 24m		-5.709	-5.962	-0.013
	24-59m		-4.460	-4.674	0.438
N		1,664	1,325	339	
Weight-for-height (WHZ)	2011/2	0.182	0.294	-0.162	1.41
	Wasting		-3.432	-3.697	0.861
	Less than 24m		-3.408	-4.627	2.182
	24-59m		-3.443	-3.454	0.029
	2014	-0.383	-0.348	-0.516	1.07
	Wasting		-3.847	-2.955	-1.970
	Less than 24m		-3.991	-3.002	-1.241
	24-59m		-3.814	-2.936	-1.612
Weight-for-age (WAZ)	2011/2	-0.976	-0.917	-1.152	1.28
	Underweight		-3.035	-3.017	-0.165
	Less than 24m		-3.121	-3.354	1.023
	24-59m		-3.001	-2.934	-0.593

2014	-1.160	-1.109	-1.357	2.15
Underweight		-3.021	-2.923	-0.628
Less than 24m		-3.64	-3.129	-1.236
24-59m		-2.932	-2.857	-0.451

4.2 Empirical results on dietary diversity

In the previous section, we showed that the change in the *kebele* budget allocated towards PSNP was exogenous to both household and *kebele* characteristics. We first used the change in the *kebele* PSNP budget as an instrument for the change in household transfers between 2012 and 2014 to estimate its effect on dietary diversity. The results from this approach are presented in Table 5. Panel (a) contains the results using a 2SLS approach, while Panel (b) contains results from a reduced form (IV) where we included the change in the *kebele* budget directly into the dietary diversity equation. The first stage results show that the change in the *kebele* budget is a strong instrument, with a significant F-value of 16.610.

Regardless of the approach, there was no effect of the change in the amount of PSNP transfers on dietary diversity, iron, calorie or protein intake. The result is robust to the inclusion of various control variables. A change in the household head's age and the household non-food expenditure positively influenced the dietary diversity score. Our findings further show that a change in livestock holdings significantly decreased the dietary diversity score by 0.047.

Table 5: Effect of PSNP Transfers on Dietary Diversity, 2SLS

	Panel (a): Two-State Least Squares				Panel (b): Reduced Form IV			
Dependent Variable	Dietary Diversity Score	Iron Intake	Caloric Intake	Protein Intake	Dietary Diversity Score	Iron Intake	Caloric Intake	Protein Intake
No Controls:								
Change in ln(HH PSNP Transfer)	-0.152	0.008	0.003	0.007	-0.061	0.003	0.001	0.003
	[0.286]	[0.046]	[0.004]	[0.049]	[0.113]	[0.019]	[0.002]	[0.020]
With Controls:								
Change in ln(HH PSNP Transfer)	-0.184	0.005	-0.001	0.001	-0.071	0.002	-0.000	0.001
	[0.289]	[0.048]	[0.002]	[0.051]	[0.112]	[0.019]	[0.001]	[0.020]
Age Household Head	0.000***	-0.000	-0.000***	-0.000	0.000***	-0.000	-0.000***	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Livestock Holdings (TLU)	-0.047***	-0.002	0.000**	-0.002	-0.050***	-0.002	0.000**	-0.002
	[0.016]	[0.003]	[0.000]	[0.003]	[0.015]	[0.003]	[0.000]	[0.003]
Land Holdings (Ha)	-0.134	-0.036	0.000	-0.021	-0.196	-0.035	-0.000	-0.020
	[0.190]	[0.032]	[0.001]	[0.034]	[0.169]	[0.029]	[0.001]	[0.031]
Employment Income	-0.000	-0.000	0.000	0.000	-0.000	-0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Food Expenditure	0.000*	0.000**	0.000	0.000**	0.000*	0.000**	0.000	0.000**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Non-food Expenditure	0.000***	-0.000	-0.000	0.000	0.000***	-0.000	-0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Income Transfers	0.000	0.000	-0.000	0.000	0.000	0.000	-0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
No. HH members PSNP	-0.034	-0.005	0.001	-0.005	-0.029	-0.005	0.001	-0.005
	[0.069]	[0.011]	[0.001]	[0.012]	[0.067]	[0.011]	[0.001]	[0.012]
Non-Ag. Labor p/week	0.001	-0.000	-0.000	-0.000	0.001	-0.000	-0.000	-0.000
	[0.002]	[0.000]	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]	[0.000]
Drought	-0.090	0.018	-0.002***	0.008	-0.097	0.018	-0.002***	0.008
	[0.109]	[0.018]	[0.001]	[0.019]	[0.108]	[0.018]	[0.001]	[0.019]
First Stage								
Change in ln(Kebele Budget)	16.610***							
N	449	449	449	449	449	449	449	449
R-squared	0.048	0.025	0.689	0.019	0.088	0.019	0.690	0.018

Note: Standard errors in brackets.

We examine the robustness of these results using propensity score matching from Hirano and Imbens (2004) with a continuous treatment. First, we present evidence that the balancing property holds. In the continuous treatment case, Hirano and Imbens (2004) suggest using blocking by ranges of the treatment. Block 1 includes PSNP beneficiary households whose change in the log of the amount of the PSNP transfer was below -0.5, block 2 ranges from -0.5 and 1, block 3 from 1 to 2, and block 4 for changes greater than 2. In Table 6, we show the mean differences in the covariates and test whether this difference is significantly different from the rest of the groups combined (Kluve, Schneider, Uhlendorff & Zhao, 2007). In the left panel, we include the tests for the balancing property using the change in household PSNP transfers between 2013 and 2014 as the treatment, while in the right panel we use the change in the *kebele* PSNP budget. The results indicate that the balancing property after adjusting for the propensity score was satisfied for all covariates with the household transfer treatment, and in most covariates using the *kebele* budget.

Table 6: Test of Balancing Property

	Treatment: ln(Household PSNP Transfer)				Treatment: ln(Kebele Budget)		
	(-4 , -0.5]	(-0.5 , 1]	(1 , 2]	(2 , 4)	(-4 , -0.5]	(-0.5 , 1]	(1 , 4)
Age Household Head	4.462	-6.889	5.051	3.697	3.869	-4.761	4.399
	(0.505)	(-1.006)	(0.675)	(0.242)	(0.336)	(-0.627)	(0.507)
Livestock Holdings (TLU)	0.048	-0.024	0.063	-0.049	0.261***	-0.248***	0.029
	(0.817)	(-0.438)	(0.696)	(-0.433)	(3.276)	(-3.504)	(0.165)
Land Holdings (Ha)	-0.006	-0.000	-0.000	0.004	0.012*	-0.009	0.003
	(-1.146)	(-0.027)	(-0.097)	(0.477)	(1.655)	(-1.428)	(0.262)
Employment Income	62.42	-116.0	92.709	144.7	136.7	-125.55	93.607
	(0.542)	(-1.189)	(0.564)	(0.672)	(1.062)	(-1.015)	(0.296)
Food Expenditure	7.527	-9.747	6.067	8.386	8.249	-10.145	6.418
	(1.057)	(-1.734)	(0.836)	(0.676)	(0.882)	(-1.293)	(0.466)
Non-food Expenditure	-22.05	18.647	8.304	-31.16	3.519	-18.533	32.471
	(-1.122)	(1.1582)	(0.352)	(-0.892)	(0.143)	(-0.882)	(0.720)
Income Transfers	10.23	3.513	16.187	-86.221	60.59	-59.022 *	23.017
	(0.296)	(0.130)	(0.560)	(-1.464)	(1.647)	(-1.794)	(0.266)
No. HH members PSNP	-0.006	0.005	-0.006	-0.000	0.012	-0.013	0.002
	(-0.607)	(0.616)	(-0.514)	(-0.001)	(0.986)	(-1.277)	(0.112)
Number of Dependents	0.001	0.005	-0.014	0.015	0.019	-0.008	-0.035
	(0.123)	(0.489)	(-0.777)	(0.640)	(1.110)	(-0.569)	(-0.779)
Non-Ag. Labor p/week	-0.018	-0.213	-0.303	0.386	-0.363	-0.392	1.775*
	(-0.043)	(-0.620)	(-0.596)	(0.514)	(-0.709)	(-0.876)	(1.724)
Drought	-0.003	-0.005	0.010	0.000	0.001	-0.003	0.011
	(-0.670)	(-1.109)	(1.337)	(0.036)	(0.182)	(-0.575)	(0.770)
N	114	236	76	25	114	236	101

Note: Differences in means reported, with t-statistics for the equality of the mean in parenthesis. Each comparison contrasts units in a given treatment category versus the rest of the treatment categories. * p<0.10, ** p<0.05, *** p<0.01

In Table 7, we present results of the estimation of the generalized propensity score via maximum likelihood. The results indicate that conditional on being a PSNP beneficiary, none of the eligibility variables correlated with the change in the amount of the household's PSNP transfer. The second column contains the results using the change in the *kebele* budget as the treatment. Results indicate that both household landholdings and having experienced a drought increased the change in the *kebele* budget. These results are not surprising because we are not modeling eligibility into the program, but rather changes in the amount received by households between 2012 and 2014.

Table 7: Estimation of the generalized propensity score

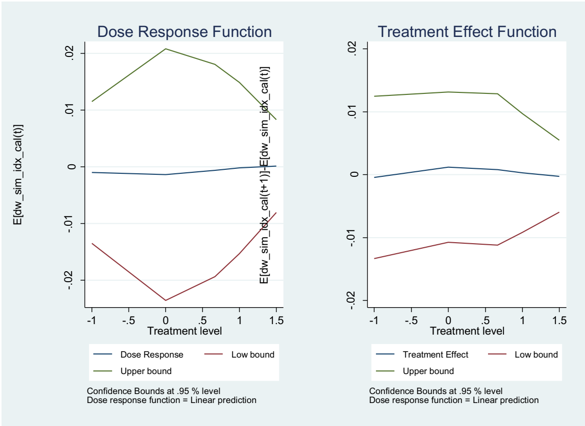
	Treatment: ln(Household PSNP Transfer)	Treatment: ln(Kebele Budget)
Age Household Head	0.001	0.003
	[0.003]	[0.002]
Livestock Holdings (TLU)	-0.014	0.005
	[0.012]	[0.005]
Land Holdings (Ha)	0.088	0.175***
	[0.128]	[0.061]
Employment Income	-0.000	-0.000
	[0.000]	[0.000]
Food Expenditure	0.000	0.000
	[0.000]	[0.000]
Non-food Expenditure	-0.000	0.000
	[0.000]	[0.000]
Income Transfers	0.000	-0.000
	[0.000]	[0.000]
No. HH members PSNP	0.016	-0.054
	[0.072]	[0.034]
Non-Ag. Labor p/week	-0.001	-0.001
	[0.002]	[0.001]
Drought	0.010	0.147**
	[0.128]	[0.061]
N	450	450

Note: Standard errors in brackets.

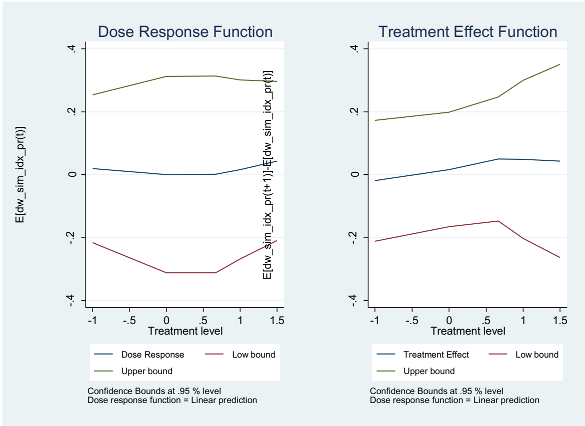
Once the generalized propensity score is estimated, the next step towards the estimation of the dose response function is to regress household level dietary diversity on the observed treatment and the generalized propensity score. Following Hirano and Imbens (2004), we use a quadratic specification. Figure 2 presents the estimated dose-response function and the treatment effects for the four household dietary diversity indicators. As the figures show, the dose-response functions for all outcome variables considered have more or less similar shapes, and the effect of the change in the transfer received by the household is statistically equal to zero. These results further confirm that there is no relationship between the change in the amount of the PSNP transfer and household level dietary diversity, regardless of the indicator chosen.

Figure 2: Estimates of the Dose-Response Function and Treatment Effects on Dietary Diversity

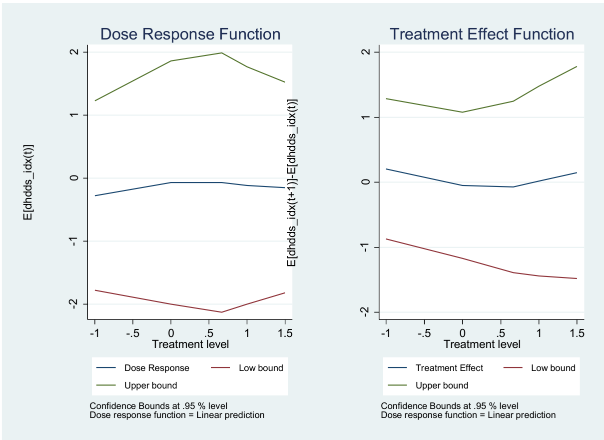
(a) Caloric Intake



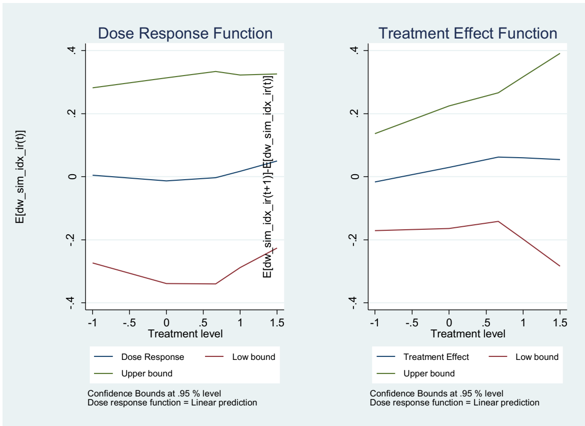
(b) Protein Intake



(c) Iron Intake



(d) Household Dietary Diversity Score



4.3 Empirical results on children's nutritional status

The results from the difference-in-difference model of the effect of PSNP participation on stunting are presented in Table 8. In columns (1) and (2), we compare children between 2 and 5 years old, while in columns (3) and (4), we restrict the sample to 3 to 5 year olds. Regardless of the sample or specification, the PSNP had no effect on long term nutrition measured as height-for-age. In the right-hand panel, we estimate the effect of PSNP participation on height-for-age of children 6 to 24 months and 6 to 30 months of age. In particular, children of ages 6 to 24 months were not born in the first round of the survey (2012), thus allowing us to isolate the effect of the increase in household transfers on child nutrition. Further, parents under severe income constraints may have had to choose between their younger and older children when they made food allocation decisions. Parents may think it is a better investment to devote the additional transfers to their younger children, as they are more likely to respond to improved nutrition. Our results suggest PSNP participation had no effect on height-for-age of children between 6 and 24 months of age, and these are robust to expanding the sample to include children up to 30 months of age, and the inclusion of additional controls.

Table 8: Diff-in-Diff Estimates of Child Height-for-Age

Dep. Variable: Height-for-Age Z-Score	Child Age [24 - 60] months		Child Age [36 - 60] months		Child Age [6 - 24] months		Child Age [6 - 30] months	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
PSNP Participant HH	-0.030	-0.215	0.120	-0.055	0.344	0.602	0.338	0.561
	[0.195]	[0.226]	[0.232]	[0.271]	[0.427]	[0.511]	[0.315]	[0.380]
t (=1 if 2014)	-0.068	-0.016	-0.087	-0.051	-0.298	-0.467*	-0.261	-0.361*
	[0.141]	[0.165]	[0.147]	[0.172]	[0.246]	[0.258]	[0.180]	[0.189]
PSNP Participant X t	-0.088	0.041	-0.091	0.033	-0.496	-0.289	-0.454	-0.397
	[0.291]	[0.336]	[0.292]	[0.340]	[0.615]	[0.620]	[0.451]	[0.451]
Age Household Head	-	0.004	-	0.003	-	-0.005	-	-0.008
		[0.005]		[0.006]		[0.010]		[0.007]
Livestock Holdings (TLU)	-	0.033*	-	0.044**	-	0.026	-	0.022
		[0.018]		[0.020]		[0.033]		[0.024]
Land Holdings (Ha)	-	-0.072	-	-0.095	-	0.225*	-	0.111
		[0.071]		[0.086]		[0.132]		[0.093]
Employment Income	-	0.000	-	0.000	-	0.000	-	0.000
		[0.000]		[0.000]		[0.000]		[0.000]
Food Expenditure	-	0.000	-	0.000	-	-0.000	-	0.000
		[0.000]		[0.000]		[0.000]		[0.000]
Non-food Expenditure	-	0.000	-	0.000	-	-0.000	-	0.000
		[0.000]		[0.000]		[0.000]		[0.000]
Income Transfers	-	0.000***	-	0.000**	-	0.000**	-	0.000***
		[0.000]		[0.000]		[0.000]		[0.000]
No. HH members PSNP	-	-0.159	-	-0.160	-	-0.175	-	-0.111
		[0.154]		[0.175]		[0.304]		[0.239]
Non-Ag. Labor p/week	-	0.002	-	0.002	-	0.005	-	0.003
		[0.002]		[0.003]		[0.004]		[0.003]
Drought	-	-0.078	-	0.063	-	0.075	-	-0.051
		[0.190]		[0.224]		[0.368]		[0.266]
N	3119	3114	2052	2048	1404	1399	2382	2376
R-squared	0.000	0.018	0.001	0.020	0.003	0.040	0.002	0.029

Note: Standard errors in brackets. Wave 2 PSNP participants restricted to children in households that were participants during wave I. * p<0.10, ** p<0.05, *** p<0.01

In Table 9, we present the results of the intensive margin of PSNP participation on child height-for-age. For this, we restrict the sample to include only children in PSNP participant households and estimate equation (7) using the amount of the transfer received by the household (*kebele*) instead of an indicator of participation as the treatment (T). For the most part, these results confirm that PSNP has no effect on long term nutrition measured by height-for-age (or stunting), although a priori we expected participation in the PSNP to improve children's nutritional status due to the increase in household income, as noted by Glewwe and Miguel (2007). The exceptions correspond to columns (1), (2), (7) and (8) where there was a statistically significant decrease of 0.02 standard deviations in height-for-age for each additional thousand Ethiopian birr increase in the *kebele* PSNP budget. The average *kebele* PSNP budget is about 46,500 thousand birr, therefore, evaluating the effect at the average would result in a 0.92 standard deviation decrease in height-for-age in the group aged 24 to 60 months, and over a one standard deviation decrease in 6 to 36 months old.

Table 9: Results Effect of *Kebele* budget changes on children nutritional status

Dep. Variable: Height-for-Age Z-Score	Child Age [24 - 60] months		Child Age [36 - 60] months		Child Age [6 - 24] months		Child Age [6 - 36] months	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Amount of PSNP Transfer	0.493	0.445	0.313	0.315	0.255	-0.213	0.513	0.296
	[0.507]	[0.523]	[0.635]	[0.649]	[0.912]	[1.012]	[0.637]	[0.674]
t (=1 if 2014)	0.013**	0.016**	0.012	0.015	0.022*	0.018	0.022**	0.020**
	[0.006]	[0.008]	[0.008]	[0.009]	[0.013]	[0.015]	[0.009]	[0.010]
PSNP Transfer X t	-0.026**	-0.025**	-0.022	-0.020	-0.027	-0.022	-0.032**	-0.032**
	[0.010]	[0.010]	[0.012]	[0.013]	[0.018]	[0.019]	[0.013]	[0.013]
Age Household Head	-	0.007	-	-0.003	-	-0.030	-	-0.003
		[0.014]		[0.017]		[0.028]		[0.018]
Livestock Holdings (TLU)	-	0.012	-	0.037	-	0.044	-	0.003
		[0.035]		[0.043]		[0.069]		[0.046]
Land Holdings (Ha)	-	-0.332	-	-0.378	-	-0.733	-	-0.570
		[0.309]		[0.402]		[0.641]		[0.400]
Employment Income	-	0.000	-	-0.000	-	0.000	-	0.000
		[0.000]		[0.000]		[0.000]		[0.000]
Food Expenditure	-	0.000	-	0.000	-	-0.000	-	-0.000
		[0.000]		[0.000]		[0.000]		[0.000]
Non-food Expenditure	-	0.001	-	0.000	-	0.000	-	0.001*
		[0.000]		[0.000]		[0.001]		[0.000]
Income Transfers	-	0.000	-	0.000	-	0.000***	-	0.000***
		[0.000]		[0.000]		[0.000]		[0.000]
No. HH members PSNP	-	0.063	-	0.195	-	0.073	-	-0.053
		[0.208]		[0.253]		[0.365]		[0.260]
Non-Ag. Labor p/week	-	-0.006	-	-0.000	-	0.002	-	-0.005
		[0.006]		[0.007]		[0.011]		[0.007]
Drought	-	-0.349	-	-0.622	-	0.213	-	0.223
		[0.359]		[0.438]		[0.654]		[0.453]
N	473	472	318	318	224	224	379	378
R-squared	0.020	0.076	0.014	0.101	0.022	0.128	0.027	0.112

Notes: Standard errors in brackets. * p<0.10, ** p<0.05, *** p<0.01

As a robustness check, we use standard propensity score matching to estimate the effect of PSNP on child nutrition outcomes. Tables 10 and Table 11 present results of the average treatment effects for the whole sample and impacts by gender among PSNP members, respectively. The findings show that there is no proof that participation in the PSNP program had any impact on child under-nutrition as measured by height-for-age and weight-for-height z-scores (or stunting and wasting). The average treatment effect on the treated (ATT) for height-for-age z scores was negative, but not significant. This indicates that the average HAZ for children living in PSNP member households is lower suggesting PSNP did not have any significant impact on reducing the prevalence of stunting on children of participant households, compared to children in non-PSNP households (Table 10). However, when we decomposed the impact by child age, we found that the PSNP had a positive impact on the prevalence of stunting for those children who were 2 years or older in 2014, indicating an improvement in nutrition. Columns (2) and (3) in Table 10 contain results for the treatment effects of PSNP member households across boys and girls. The findings reveal no significant effect of the PSNP on girls' or boys' height-for-age. While not statistically significant, the negative sign of the ATT indicates that the average HAZ for girls in member households was higher than boys'. However, boys aged of 24 to 59 months were better-off in the prevalence of stunting relative to girls in PSNP member households. The results further reveal that there is no evidence that PSNP improved under-nutrition as measured by weight-for-height or wasting. However, a positive impact on the prevalence of wasting was observed among children aged 24 to 59 months.

Table 10: PSM estimates of PSNP program impacts on child nutritional status, 2014

Outcome variable	All children	Boys	Girls
Height-for-age Z-score	-0.533	-0.118	-0.911
	(0.712)	(0.479)	(1.328)
Stunting	0.098	-0.193	0.423
	(0.648)	(0.869)	(0.969)
Less than 24 months	-0.421	-1.37	0.314
	(1.801)	(2.289)	(1.875)
24 - 59 months	0.298	0.127	0.502
	(0.670)	(0.924)	(0.978)
Sample size	688	339	349

Notes: Standard errors in parentheses; ** $p<0.05$

Table 11 presents results for the treatment effects of PSNP member households across boys and girls. The findings reveal that the average treatment effect on the treated (ATT) was negative, though not significant, for HAZ and WAZ outcome indicators. This indicates that girls under 5 years of age were better-off in HAZ and WAZ compared to boys in PSNP member households, suggesting that average HAZ and WAZ for girls in member households was higher than their male counterparts. However, boys aged 24 to 59 months were better-off in the prevalence of stunting relative to girls in PSNP member households.

Table 11: PSNP program impacts on child nutritional status by child sex (boys=1 & girls=0)

Outcome variable	Treated	Std. error
Height for age z score	-0.185	0.576
Stunting	0.101	1.084
Less than 24 months	-0.464	1.798
24- 59 months	0.318	1.115

We also further examined the effect of the gender of the household head on child nutritional status in PSNP households, and we find evidence that this was an important factor in impacting child malnutrition. The findings show that PSNP participation and households headed by females had a positive significant impact on children who were acutely malnourished or wasting ($p<0.05$).

In general, the estimates show that there is no evidence of Ethiopia's PSNP impact on child nutritional status. The estimates further indicate that nutrition outcomes of children under 5 years of age have not been responsive to PSNP participation, even though the analysis was disaggregated to the first 1,000 critical days of life, where most of the impairments in growth occur.

V. Discussion

Social safety nets have been shown to improve household food availability to chronically poor households and to shock victims. The descriptive results revealed that the average per capita calorie consumption for the sample households was about 2,262 kcal, which is almost equal to average daily per capita calorie requirement needed to maintain a healthy life. Furthermore, a 13.4% increase in the average daily per capita calorie consumption among PSNP member households was observed between 2011 to 2012 and 2014 suggesting a positive program effect on household food insecurity. This is in line with findings from Jones *et al*. (2010) that participation in the PSNP program increased the quantity of household food consumption. Gilligan *et al*., (2013) also reported that having access to either cash or food transfers resulted in a significant increase in daily calorie intake per capita. Berhane *et al*. (2011) showed statistically significant impacts of the PSNP on households' food security and consumption status. Garcia and Moore (2012) also reported positive impacts of the unconditional cash transfer programs on food consumption.

The summary of results on the mean dietary diversity for all households (measured as a simple count of food groups that households consumed over the last 7 days) was 4.7 in both rounds. This indicates that, on average, households in the survey exhibited medium dietary diversity based on Food and Agriculture Organization's classification of food consumption, in which the consumption of 4 to 5 food groups are considered as medium dietary diversity (FAO, 2007). The results from the simple count measure (HDDS) further shows that female-headed households had slightly higher dietary diversity, or were more likely to consume more varied diets when compared to male-headed households. In line with this, Rogers (1996) and Taruvinga et al. (2013) noted that female heads of households had a higher likelihood of attaining a high dietary diversity compared to their male counterparts. This could be indicative of the role women could play in improving the variety and quality of food consumed by the households if empowered and given more resources such as cash transfers.

The summary statistics also indicated that about 42.8% of children under age five were stunted, and 26.3% were severely stunted indicating the existence of chronic malnutrition in the country. This figure is slightly higher than the national average reported by the 2014 Demographic and Household Survey, which found 40% and 19% were stunted and severely stunted, respectively (CSA, 2014). Looking at the proportion of children who were stunted within households that were PSNP members and non-members, our results indicate that, in general, under-nutrition in PSNP households was slightly higher than among children living in non-PSNP households. This is consistent with the findings of the 2014 Ethiopian Demographic and Household Survey (CSA, 2014) and Berhane *et al.* (2016). On the other hand, our findings show that children living in PSNP households exhibited higher WHZ than children in non-PSNP households. This is in contrast to the findings of Debela *et al*. (2014).

The empirical results on the effect of PSNP cash transfers on household dietary diversity indicate no effect of the change in the amount of PSNP transfers on dietary diversity, iron, calorie or protein intake, regardless of the approach used. This result is robust to the inclusion of various control variables. A change in the household head's age and the household non-food expenditure positively influenced the dietary diversity score. However, this finding is in contrast with those of Thiele and Weiss (2003) and Tankari and Badiane (2015) who noted age of household head to have a significant and non-linear relationship with food diversity. Torheim *et al*. (2004) also showed that the number of food items consumed decreased with age, except for green leaves. Thorne-Lyman *et al*. (2009) reported positive and significant correlations between dietary diversity and per capita non-grain food expenditure in Bangladesh. Our results further show that a change in livestock holdings significantly decreases the dietary diversity score by 0.047. This is in contrast with the findings of Megersa *et al*. (2014) who reported dietary diversity varied highly significantly with per capita livestock holdings in Borana, Ethiopia. However, this study focuses on the role of livestock diversification and household food security which involves a different approach from other studies. Ferro-Luzzi *et al*. (2001) also similarly reported that an increase in per capita livestock holdings was linked to improved dietary diversity in Ethiopia. However, this was before the PSNP program was available in which households were eligible to participate based on their livestock holdings.

The findings from the estimated dose-response function and the treatment effects for the four household dietary diversity indicators considered, further confirm that there was no relationship between the change in the amount of the PSNP transfer and household level dietary diversity, regardless of the indicator chosen. Similarly, MacAuslan and Schofield (2011) found that the food security cash transfer program in urban Nairobi did not substantially increase dietary diversity. This is in line with the findings of Merttens *et al*. (2013) who found that Kenya's Hunger Safety Net Program (HNSP) had no impact on dietary diversity after two years of intervention. However, this is in contrast to the findings of Yablonski and Woldehanna (2008) who reported social transfers enabled poor people to access more and better quality food in Ethiopia. Hidrobo *et al*. (2012) similarly found that cash transfers improved dietary diversity of households in northern Ecuador. Similarly, households in Malawi experienced improvements in dietary diversity due to cash transfers compared to non-intervention households (Miller, Tsoka & Reichert, 2008). Mascie-Taylor *et al*. (2010) also noted that the cash-for-work program in Bangladeshi led to a greater quantity and variety of food.

The findings on the impacts of participation in PSNP on long-term nutritional status of children reveal that PSNP participation had no effect on height-for-age of children between 6 and 24 months of age, and these are robust when expanding the sample to include children up to 30 months of age, and the inclusion of additional controls. The difference-in-difference results further confirm that PSNP had no effect on long term nutrition as measured by height-for-age (or stunting), though we a priori expected participation in the PSNP would be able to improve children's nutritional status due to the increase in household income, as noted by Glewwe and Miguel (2007).

Furthermore, evaluating the effect at the average *kebele* PSNP budget resulted in a 0.92 standard deviation decrease in height-for-age in the group aged 24 to 60 months old, and over a one standard deviation decrease in 6 to 36 months old. It is possible that the decrease in long term nutrition was caused by the severe drought that occurred between the two survey years. While we controlled for whether the household faced a drought, we were unable to account for heterogeneity in the severity of drought across households. There were also different factors that are external to the PSNP and beyond simple access to food that could have affected child nutrition, and participation in the PSNP by itself may be insufficient to compensate for these factors. Consistent with our findings, Evans *et al*. (2014) and Ferré and Sharif (2014) found that a conditional cash transfer did not have any significant effect on the incidence of stunting in Tanzania and Bangladesh, respectively. Similarly, Merttens *et al*. (2013) found that Kenya's Hunger Safety Net Program (HSNP) did not have a significant impact on child nutrition.

The findings from standard propensity score matching also consistently show no proof that participation in the PSNP program had any impact on child under-nutrition, as measured by height-for-age and weight-for-height z-scores (or stunting and wasting). The results further reveal that there is no evidence that the PSNP improved under-nutrition, as measured by weight-for-height or wasting. Similarly, Berhane *et al*. (2016) found that PSNP participation did not have any effect on children under nutrition as measured by height-for-age and weight-for-height z scores, or stunting and wasting in Ethiopia. Similarly, Gilligan *et al*. (2013) reported that food and cash transfers did not reduce the prevalence of stunting or wasting among children aged 6 to 35 months in Karamoja, Uganda. Also, Leroy *et al*. (2008) did not find a statistically significant impact for Mexico's PAL in improving the HAZ of urban children up to the age of two.

However, decomposing the impact by age, the results show that the PSNP had a positive impact on the prevalence of stunting for those children who were 2 years or older in 2014, indicating an improvement in nutrition. This is consistent with the findings of Porter and Goyal (2016) who noted evidence of improvements in nutritional outcomes (HAZ) due to the PSNP, for children aged 3 to 5 years in Ethiopia. Hoddinott and Bassett (2008) also found significant improvements in children's height for age in Mexico and Nicaragua, and Fiszbein and Schady (2009) note that cash transfer programs in Mexico, Nicaragua and South Africa demonstrated significant improvements in children's height-for-age. Similarly, a positive impact on the prevalence of wasting was observed among children aged 24 to 59 months. This is consistent with the findings of Debela *et al*. (2014) who reported that average weight-for-age z scores for children living in PSNP member households were higher than they would have been if the marginal return to their characteristics had been the same as for non-members. Quisumbing (2003) also found that the food-for-work program had a positive direct impact on the weight-for-height of younger children in low asset households in rural Ethiopia. Ferré and Sharif (2014) also noted a significant improvement in the incidence of wasting among children aged 10 to 22 months in Bangladesh.

The findings on the differential impact of PSNP participation across boys and girls reveal that girls under age of 5 years were better-off in HAZ compared to boys, suggesting that average HAZ for girls in PSNP member households was higher than their male counterparts. However, boys aged 24 to 59 months were better-off in the prevalence of stunting relative to girls in PSNP member households. The findings also provide evidence that PSNP participation and households headed by females had a positive significant impact on acutely malnourished or wasting children ($p<0.05$), indicating the importance of the gender of the household head with regards to child malnutrition. This is consistent with the findings of van den Bold *et al*. (2013) who suggested a positive relationship between women's empowerment and improved nutritional status. However, our study did not find strong significant evidence of household head gender being an important factor in impacting child nutrition, particularly on the prevalence of stunting and being underweight. The existing evidence on social safety net programs, specifically cash transfers and women's empowerment, is generally heterogeneous (Van de Bold, Quisumbing & Gillespie, 2013). Thus, in order to determine whether gender of a PSNP participant's household head affects children's nutritional outcomes, a longer-term follow up is required.

In general, the estimates on PSNP participation and children nutritional outcome show that there is no evidence of Ethiopia's PSNP impact on child nutritional status. The findings further indicate that nutrition outcomes of children under age of 5 years have not been responsive to PSNP participation, even though the analysis was disaggregated to the first 1000 critical days of life, where most of the impairments in growth happen. This finding is in line with the recent literature on the impact of social protection schemes, specifically cash transfer programs, which report no conclusive evidence of a positive impact on child nutrition, and the pathways of impact are not clearly understood (Hoddinott & Wiesmann, 2010; Van de Bold et al., 2013; Owusu-Addo & Cross, 2014). The lack of effect may be attributed to time of exposure in PSNP. It is possible that the two year time period between the rounds of survey may not be sufficient to capture impacts in child anthropometric measures as stunting, in particular, requires long-term interventions from the time of birth in order for any changes to be observed. The effect of the amount of time that participants were exposed to the treatment is reflected by Ferré and Sharif (2014) as a possible reason why effects on stunting and being underweight were not found in Bangladesh's Shombhob. The effect of time of exposure to cash transfers on child anthropometric indicators was also tested in the context of transfers in Mexico and Ecuador (Bastagli *et al.*, 2016). Similarly, Fernald *et al*. (2008), Agüero *et al*.(2009), and Leroy *et al*. (2009) suggested that children who were exposed to a cash transfer program for a longer duration, had better nutritional outcomes.

Furthermore, for social protection schemes like Ethiopia's PSNP, which for the majority of participants involve working in a public work program, there are potential threats to finding effects. Participation in public work reduces the parents' time which can be devoted to childcare, which in turn may harm children nutritional status (Berhane *et al.*, 2016). As noted by Porter and Goyal (2016), increased household income may not be translated into improved child nutrition without conditionality on child inputs. There are also factors external to the PSNP that affect child nutrition beyond simple access to food, in which case participation in the PSNP by itself is insufficient in improving nutrition outcomes. The FAO (2011a) report also shows that transfers are appropriate when markets are functioning and food is available. However, markets in rural Ethiopia are very thin or even missing, and there are high rates of reliance on own production (Hoddinott, Headey & Dereje, 2015). Hence, even if incomes of poor households have increased, it is not evident that they can buy more animal sourced foods for their kids, especially if there is a drought. Another possible explanation might be the attention given to social protection interventions, such as PSNP cash transfers, in tackling child malnutrition are not sufficient. A similar argument was put forward by Gavrilovic and Jones (2012). Thus, more effort is required to design a social protection program that is nutrition sensitive. Pairing cash transfers with nutrition education interventions that promote awareness of the importance of dietary diversity and the nutritional needs of children would increase the positive effects of the PSNP.

However, like all studies, ours is not without limitations. First, we did not have baseline data on outcome variables and determinants for eligibility before the program was rolled out and this limited our ability to observe the real result of the program on household dietary diversity and children's nutritional outcomes. Second, we did not attempt to examine the size or magnitude of cash transfer as a share of total household income, which is critical to the effectiveness of the program in improving household consumption. This is mainly because the data from wave 1 did not have household level agricultural production. Thus, we were not able to construct total household income and examine whether the increase in cash transfers as a share of income were large enough to substantially increase demand for nutrient rich foods. Furthermore, price movements also influenced the amount of food that can be purchased by a household which was not examined in this study. Thus, these limitations should be kept in mind when evaluating the conclusions of our study.

VI. Conclusions

Safety net programs aim to help vulnerable and chronically food insecure households maintain an adequate level of food consumption, improve food security, and protect them from depleting their productive assets. Ethiopia's Productive Safety Net Program has been effective in improving household food security (Gilligan et al. 2009; Berhane et al. 2015). However, there is little work exploring the effect of PSNP on household and children's nutritional status. In this paper, we presented consistent robust evidence that the large-scale social protection scheme, the PSNP, has no effect on household dietary diversity or children's height-for-age in participating households using the Ethiopian Socio-economic Survey panel data collected in 2011 to 2012 and 2014.

The first outcome of interest is household dietary diversity because it is one of the most direct indicators related to adequate dietary intake, food access and food security. Accordingly, a household dietary diversity index was constructed using the Simpson index of food diversity, which is based on seven food groups and twenty six food items. The use of a Simpson Index instead of the count measure has the advantage of being comparable across different cultures. Furthermore, we examined indices of intake of specific items such as protein, iron, and calories. We exploited the exogenous increase in the *kebele* PSNP budget to identify the effect of the change in the amount of money households received in transfers between 2012 and 2014 on the change in dietary diversity. We used three different approaches to identify this effect: two-stage least squares, reduced form IV, and generalized propensity score matching using a continuous treatment. The results indicate the increase in PSNP transfers between 2012 and 2014 had no effect on household dietary diversity. Estimates for different household dietary indicators reveal that the effect of the change in the cash transfer received by the household was statistically and economically insignificant. This finding is robust to different identification strategies and the inclusion of control variables that determine eligibility to become a PSNP beneficiary.

We next examined the effect of PSNP participation and increased transfers on children's nutrition. We focused on height-for-age, which reflects long-term under nutrition. Among children aged 2 to 5, a height-for-age z-score of 2 standard deviations below the mean or worse indicates the child is stunted, and by that age it is irreversible. To identify the effect of PSNP participation on children height-for-age and stunting we used a difference-in-difference approach. We used children between 2 and 5 years of age in 2012 as a baseline because by then they have achieved long-term failure to grow. The treatment group comprised of children aged 2 to 5 in 2014 in PSNP participant households. While changes in height-for-age take time, two years of additional transfers among children who were not born, or who were under the age of 2 to 3 in 2012, had the potential to make a considerable impact on reducing the prevalence of stunting. The results indicate that participation in PSNP had no effect on child nutrition measured as height-for-age or probability of being stunted. We further estimated the effect of the increase in the amount of the PSNP transfers on long term nutrition of children in PSNP participant households. Consistent with the aforementioned results on participation, we found no statistically or economically significant effects of the amount of the transfers received by households on children's height-for-age.

In sum, the paper concludes that, there is no evidence that Ethiopia's Productive Safety Net Program has had any impact on household dietary diversity or children's long-term nutrition on participating households. Thus, based on the results of the study, a more concerted effort is required in designing the social protection program, PSNP, in a more nutrition-sensitive way, specifically integrating strong nutrition goals and effective implementation of interventions to achieve them. Rigorous enlightenment programs on nutrition and promoting awareness on the importance of consuming variety of foods, and child growth is necessary to increase the nutrition impact of PSNP.

References

Agüero, J., Carter, M.R., & Woolard, I. (2009). The Impact of Unconditional Cash Transfers on Nutrition: The South African Child Support Grant. International Poverty Research Center Working Paper.

Alderman, H., Hoogeveen, H., Rossi, M. (2006). Reducing child malnutrition in Tanzania combined effects of income growth and program interventions. Economics and Human Biology, 4(1), 1-23.

Alpha, A., Gebreselassié, S. (2015). Governing Food and Nutrition Security in Food-Importing and Aid-Recipient Countries: Burkina Faso and Ethiopia. Food Secure Working paper no. 34 November 2015.

Andersson, C., Mekonnen, A., Stage, J. (2011). Impacts of the productive safety net program in Ethiopia on livestock and tree holdings of rural households. Journal of Development Economics, 94(1), 190-126.

Araya, A., Stroosnijder, L. (2011). Assessing drought risk and irrigation need in northern Ethiopia. Agricultural and Forest Meteorology, 151, 425-436.

Babatunde, R.O., Qaim, M. (2010). Impact of off-farm income on food security and nutrition in Nigeria. Food Policy, 35, 303 - 311.

Bailey, S., Hedlund, K. (2012). The impact of cash transfers on nutrition in emergency and transitional contexts: A review of evidence. Humanitarian Policy Group, Overseas Development Institute, London, United Kingdom.

Bastagli, F., Hagen-Zanker, J., Harman, L., Barca, V., Sturge, G., Schmidt, T. (2016). Cash transfers: what does the evidence say? A rigorous review of programme impact and of the role of design and implementation features.

Berhane, G., Hoddinott, J., Kumar, N. (2016). The impact of Ethiopia's Productive Safety Net Programme on the nutritional status of children: 2008-2012. ESSP Working Paper 99. The International Food Policy Research Institute (IFPRI).

Berhane, G., Hoddinott, J., Kumar, N., Taffesse, A.S. (2011). The impact of Ethiopia's Productive Safety Nets and Household Asser Building Program: 2006-2010. Technical report, International Food Policy Research Institute.

Bewket, W., Conway, D. (2007). A note on the temporal and spatial variability of rainfall in the drought-prone Amhara region of Ethiopia. International Journal of Climatology, 27, 1467–1477.

Bishop, C., Hilhorst, D. (2010). From food aid to food security: the case of the Safety Net policy in Ethiopia. Journal of Modern African Studies, 48(2), 181-202

Coll-Black, S., Gilligan, D.O., Hoddinott, J., Kumar, N., Taffesse, A.L., Wiseman, W. (2011). Targeting Food Security Interventions When "Everyone is Poor": The Case of Ethiopia's Productive Safety Net Programme. ESSP II Working Paper 24, International Food Policy Research Institute.

Conway, D., Schipper, E.L.F. (2011). Adaptation to climate change in Africa: Challenges and opportunities identified from Ethiopia. Global Environmental Change, 21(1), 227-237.

CSA (2014). Ethiopia Mini Demographic and Health Survey. Central Statistical Agency (CSA) Addis Ababa, Ethiopia.

Debela, B.L., Shively, G., Holden, S.T. (2014). Does Ethiopia's Productive Safety Net Program Improve Child Nutrition? Norwegian University of Life Sciences (NMBU), Centre for Land Tenure Studies Working Paper 01/14.

EAS (2013). Report on Integration of Nutrition into Agriculture and Health in Ethiopia. Ethiopian Academy of Sciences (EAS), Addis Abeba, Ethiopia.

EHNRI (2000). Food Consumption Table for Use in Ethiopia. Ethiopia Health and Nutrition Research Institute (EHNRI), Part III, Addis Ababa, Ethiopia.

Evans, D.K., Hauslade, S., Kosec, K., Reese, N. (2014). Community-based conditional cash transfers in Tanzania: results from a randomized trial. World Bank Study. Washington, DC: World Bank. Journal of Development Effectiveness, pp. 103-129.

FAO (2007). Guidelines for measuring household and individual dietary diversity. Nutrition and Consumer Protection Division with support from the EC/FAO Food Security Information for Action Programme and the Food and Nutrition Technical Assistance (FANTA) Project, Rome, Italy.

FAO (2011a). Guide for Policy and Programmatic Actions at Country Level to Address High Food Prices. FAO, Rome.

FAO (2011b). Guidelines for Measuring Household and Individual Dietary Diversity, Food and Agriculture Organization (FOA), Rome.

FAO (2012). Social Protection and Nutrition.

FAO (2015). The State of Food Insecurity in the World. Food and Agriculture Organization of the United Nations, Rome.

Fernald, L.C., Gertler, P.J., Neufeld, L.M. (2008). Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's Oportunidades. The Lancet, 371(9615), 828-837.

Ferré, C., Sharif, I. (2014). Can conditional cash transfers improve education and nutrition outcomes for poor children in Bangladesh? Evidence from a pilot project. World Bank Policy Research Working Paper 7077. Washington, DC: World Bank.

Ferro-Luzzi, A., Morris, S.S., Taffesse, S., Demissie, T., D'Amato, M. (2001). Seasonal undernutrition in rural Ethiopia. Magnitude, correlates and functional significance. IFPRI Research Report 118. Washington, D.C.

Fiszbein, A., Schady, N. (2009). Conditional cash Transfers: reducing present and future poverty. a world Bank policy research report. Washington DC: World Bank.

Furtado, X., Hobson, M. (2011). From aid effectiveness to development effectiveness in Ethiopia: A national review with case studies. An input to the 4th High Level Forum on Aid Effectiveness (HLF4), Busan, Republic of Korea, November 29 - December 1, 2011.

Gaarder, M.M., Glassman, A., Todd, J.E. (2010). Conditional cash transfers and health: unpacking the causal chain. Journal of Development Effectiveness, 2(1), 6-50.

Garcia, M., Moore, C. (2012). The Cash Dividend: The Rise of Cash Transfer Programs in SubSaharan Africa. World Bank.

Gavrilovic, M., Jones, N. (2012). Realising the nutrition potential of social protection: progress and challenges.

Gilligan, D.O., Hoddinot, J., Taffesse, A.S. (2008). The Impact of Ethiopia's Productive Safety Net Programme and its Linkages. Washington: IFPRI.

Gilligan, D.O., Hoddinott, J. (2007). Is there persistence in the impact of emergency food aid? Evidence on consumption, food security, and assets in rural Ethiopia. American Journal of Agricultural Economics, 89(2), 225-242.

Gilligan, D.O., Margolies, A., Quiñones, E., Roy, S. (2013). Impact evaluation of cash and food transfers at Early Childhood Development centres in Karamoja, Uganda. Final impact report. Washington, DC: IFPRI.

Glewwe, P., Miguel, E.A. (2007). The impact of child health and nutrition on education in less developed countries. Handbook of Development Economics, 4, 3561-3606.

Gronau, R., Hamermesh, D. (2008). The demand for variety: a household production perspective. The Review of Economics and Statistics, 90(3), 562-572.

Hidrobo, M., Hoddinott, J., Peterman, A., Margolies, A., Moreira, V. (2012). Cash, food or vouchers? Evidence from a randomized experiment in northern Ecuador. Discussion Paper 1234. Washington, DC: IFPRI.

Hillbrunner, C., Egan, R. (2008). Seasonality, Household food Security and nutritional Status in Dinajpur, Bangladesh. Food and Nutrition Bulletin, 29(3), 221-231.

Hirano, K., Imbens, G.W. (2004). The Propensity Score with Continuous Treatments.

Hoddinott, J., Bassett, L. (2008). Conditional Cash Transfer Programs and Nutrition in Latin America: Assessment of Impacts and Strategies for Improvement.

Hoddinott, J., Berhane, G., Daniel O. Gilligan, D.O., Kumar, N., Taffesse, A.S. (2012). The Impact of Ethiopia's Productive Safety Net Programme and Related Transfers on Agricultural Productivity. Journal of African Economies, 21, 761-786.

Hoddinott, J., Headey, D., Dereje, M. (2015). Cows, missing milk markets and nutrition in rural Ethiopia. The Journal of Development Studies, 51(8), 958-975.

Hoddinott, J., Skoufias, E. (2004). The impact of PROGRESA on food consumption. Economic Development and Cultural Change, 53(1), 37-61.

Hoddinott, J., Wiesmann, D. (2010). The Impact of Conditional Cash Transfer Programs on Food Consumption. In: Adato, M., Hoddinott, J. (Eds.), In: Conditional Cash Transfers in Latin America: A Magic Bullet to Reduce Poverty? Johns Hopkins University Press, Baltimore.

Hoddinott, J., Yohannes, Y. (2002). Dietary Diversity as Food Secuirty Indicator. Food Consumption and Nutrition Division, International Food Policy Research Institute (IFPRI), Washington, D.C. U.S.A.

Jones, N., Tafere, Y., Woldehanna, T. (2010). Gendered risks, poverty and vulnerability in Ethiopia: To what extent is the Productive Safety Net Programme (PSNP) making a difference? London: Overseas Development Institute.

Kant, A.K., Schatzkin, A., Harris, T.B., Ziegler, R.G., Block, G. (1993). Dietary diversity and subsequent mortality in the First National Health and Nutrition Examination Survey. The Americal Journal of Clinical Nutrition, 57(3), 434-440.

Kluve, J., Schneider, H., Uhlendorff, A., Zhao, Z. (2007). Evaluating Continuous Training Programs Using the Generalized Propensity Score. IZA Discussion Paper No. 3255.

Leroy, J.L., García-Guerra, A., García, R., Dominguez, C., Rivera, J., Neufeld, L.M. (2008). The Oportunidades program increases the linear growth of children enrolled at young ages in urban Mexico. Journal of Nutrition, 138(4), 793-798.

Leroy, J.L., Ruel, M., Verhofstadt, E. (2009). The impact of conditional cash transfer programmes on child nutrition: a review of evidence using a programme theory framework. Journal of Development Effectiveness, 1(2), 103-129.

MacAuslan, I., Schofield, L.L. (2011). Evaluation of Concern Kenya's Korogocho Emergency and Food Security Cash Transfer Initiative, Final Report . Concern Worldwide and Oxford Policy Management.

Mascie-Taylor, C.G.N., Marks, M.K., Goto, R., Islam, R. (2010). Impact of a cash-for-work program on food consumption and nutrition among women and children facing food insecurity in rural Bangladesh. Bull World Health Organ 88, 854-860.

Megersa, B., Markemann, A., Angassa, A., Zárate, A.V. (2014). The role of livestock diversification in ensuring household food security under a changing climate in Borana, Ethiopia. Food Security, 6(1), 15-28.

Melo, P.C., Abdul-Salam, Y., Roberts, D., Gilbert, A., Matthews, R., Colen, L., Mary, S., Gomez Y Paloma, S. (2015). Income Elasticities of Food Demand in Africa: A Meta-Analysis. EUR 27650 EN; doi:10.2791/661366.

Merttens, F., Hurrell, A., Marzi, M., Attah, R., Farhat, M., Kardan, A., MacAuslan, I. (2013). Kenya hunger safety net programme monitoring and evaluation component impact evaluation final report: 2009 to 2012. Oxford: Oxford Policy Management.

Miller, C., Tsoka, M., Reichert, K. (2008). Impact Evaluation of the Mchinji Social Cash Transfer. Government of Malawi, UNICEF and USAID.

Nguyen, M., C., Winters, P. (2011). The impact of migration on food consumption patterns: The case of Vietnam. Food Policy, 36, 71-87.

Owusu-Addo, E., Cross, R. (2014). The impact of conditional cash transfers on child health in low- and middle-income countries: a systematic review. International Journal of Public Health, 59(4), 609 - 618.

Oyarzun, P.J., Borja, R.M., Sherwood, S., Parra, V. (2013). Making sense of agrobiodiversity, diet, and intensification of smallholder family farming in the highland Andes of Ecuador. Ecology of Food and Nutrition, 52(6), 515-541.

Porter, C., Goyal, R. (2016). Social protection for all ages? Impacts of Ethiopia s Productive Safety Net Program on child nutrition. Social Science & Medicine, 159, 92-99.

Quisumbing, A., Brown, L., Haddad, L., Meizen-Ruth, D. (1998). The importance of gender issues for environmentally and socially sustainable rural development", in Lutz, E. (Ed.), Agriculture and the environment: Perspectives on sustainable rural development, The World Bank, Washington, DC, USA.

Quisumbing, A.R. (2003). Food aid and child nutrition in rural Ethiopia. World Development, 31(7), 1309-1324.

Rodrigo, M.F. (2012). Impact Evaluation of the Productive Safety Nets Program in Ethiopia.

Rogers, B.L. (1996). The implications of female household headship for food consumption and nutritional status in the Dominican Republic. World Development, 24(1), 113-128.

Ruel, M. (2002). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. FCND Discussion Paper No. 140. Washington, DC: International Food Policy Research Institute.

Ruel, M.T. (2003). Operationalizing Dietary Diversity: A Review of Measurement Issues and Research Priorities. Journal of Nutrition, 133, 3911S-3926S.

Ruel, M.T., Alderman, H. (2013). Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? The Lancet, 382(9891), 536-551.

Sabates-Wheeler, R., Devereux, S. (2010). Cash Transfers and High Food Prices: Explaining Outcomes on Ethiopia’s Productive Safety Net Programme. Working Paper 004, Future Agricultures.

Save the Children (2012). A Chance to Grow: How Social Protection Can Tackle Child Malnutrition and Promote Economic Opportunities.

Sen, A. (1981). Poverty and Famine: An Essay on Entitlement and Deprivation. Oxford, UK: Clarendon Press.

Sharp, K., Brown, T., Teshome, A. (2006). Targeting Ethiopia's Productive Safety Net Programme (psnp). Overseas Development Institute.

Simons, A.M. (2016). What is the Optimal Locus of Control for Social Assistance Programs? Evidence from the Productive Safety Net Programme in Ethiopia. ESSP Working Paper 86, IFPRI

Slater, R., Ashley, S., Tefera, M., Buta, M., Esubalew, D. (2006). PSNP policy, programme and institutional linkages.

Styen, N.P., Nel, J.H., Nantel, G., Kennedy, G., Labadarios, D. (2006). Food Variety and Dietary Diversity Scores in children: are they good indicators of dietary adequacy. Public Health Nutrition, 9(5), 644-650.

Swindale, A., Bilinsky, P. (2006). Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). Washington, D.C.: FHI 360/FANTA.

Tankari, M.R., Badiane, O. (2015). Determinants of households’ food diversity demand in Uganda. International Conference of Agricultural Economists. August 8-14, Milan, Italy.

Taruvinga, A., Muchenje, V., Mushunje, A. (2013). Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa. International Journal of Development and Sustainability, 2(4), 2233-22472.

Thiele, S., Weiss, C. (2003). Consumer demand for food diversity: evidence for Germany. Food Policy, 28, 99-115.

Thorne-Lyman, A.L., Valpiani, N., Sun, K., Semba, R.D., Klotz, C.L., Kraemer, K., Akhter, N., de Pee, S., Moench-Pfanner, R., Sari, M., Bloem, M.W. (2009). Household Dietary Diversity and Food Expenditures Are Closely Linked in Rural Bangladesh, Increasing the Risk of Malnutrition Due to the Financial Crisis. The Journal of Nutrition, 182S-188S.

Torheim, L.E., Ouattara, F., Diarra, M.M., Thiam, F.D., Barikmo, I., Hatloy, A., Oshaug, A. (2004). Nutrient adequacy and dietary diversity in rural Mali: association and determinants. European Journal of Clinical Nutrition, 58, 594-604.

USAID (2012). Ethiopia's Productive Safety Net and Household Asset Building Programs (2006–10): A Synthesis of Findings. 1300 Pennsylvania Avenue, NW; Washington, DC 20523, USA.

Van de Bold, M., Quisumbing, A.R., Gillespie, S. (2013). Women's Empowerment and Nutrition: An Evidence Review. IFPRI Discussion Paper 01294, International Food Policy Research Institute (IFPRI): Washington, DC.

Weldegebriel, Z., Prowse, M.P. (2013). Climate change adaptation in Ethiopia: to what extent does social protection influence livelihood diversification? Development Policy Review, 31(S2), 35-56.

WFP (2012). Ethiopia Productive Safety Net Programme (PSNP). Quik Facts 2012.

WHO (2006). WHO Child Growth Standards: Length/Height-for-Age, Weight-for-Age, Weight-for-Length, Weight-for-Height, and Body Mass Index-for-Age: Methods and Development. WHO (World Health Organization), Geneva.

Yablonski, J., Woldehanna, T. (2008). Impacts of social protection programmes in Ethiopia on child work and education. Young Lives Policy Brief 6.

Appendix

Table A: Variables used in the specification of the outcome regression model

Variable	Type	Measurement
Dependent variable, Treated	Dummy	1 if yes-participants of PSNP, 0 otherwise
Outcomes		
Food Calorie intake	Continuous	
Protein intake	Continuous	
Iron intake	Continuous	
Household dietary diversity score	Continuous	
Explanatory variable		
Sex of household head	Dummy	1 if head is male, 0 otherwise
Age of household head	Continuous	Age of the household head in years
Land holding size	Continuous	Hectare
Livestock ownership in TLU	Continuous	Tropical Livestock Unit
Food expenditure	Continuous	Ethiopian Birr
Non-food expenditure	Continuous	Ethiopia Birr
Household members working in PSNP	Continuous	Number of household members participating in PSNP
Dependent family members	Continuous	Number of children under 15 years age
Non- agricultural income	Continuous	Ethiopian Birr
Income transfer	Continuous	Ethiopian Birr
Non-agricultural labor worked per week	Continuous	Number of days worked
Price shock	Dummy	1 if yes, 0 otherwise
Drought shock	Dummy	1 if yes, 0 otherwise

Table B: Household composition across survey rounds

Characteristics	2011/12	2014
Household headship		
Male	75.1	74.1
Female	24.9	25.9
Household size		
3 & less	31.4	28.1
4-6	44.2	45.7
7-9	21.4	22.9
10-12	2.6	3.0
13 & Above	0.4	0.3
Mean size of households	4.9	5.2
Age		
20-30	18.2	13.8
31-40	26.5	26.8
41-50	21.2	22.7
51-60	14.1	15.7
Above 60	20.0	21.0
Mean age of households	44.0	45.4
Literacy		
Illiterate	59.5	59.4
Literate	40.5	40.6
Land holding		
0.5 ha & less	51.2	43.6
0.51-1.0 ha	22.2	23.4
1.1-2.0 ha	17.6	21.2
2.1-3.0 ha	5.5	7.4
3.1-4.0 ha	1.7	2.3
4.1-5.0 ha	0.7	0.8
Above 5 ha	1.1	1.3
Mean land holding size	0.48	0.75
Livestock holding		
2 TLU & less	57.2	48.4
2.1 - 4 TLU	20.3	24.4
4.1 – 6 TLU	11.1	12.0
Above 6 TLU	11.4	15.2
Mean livestock holding	2.5	3.1
Number observations	3,797	3,788