THE ECONOMIC IMPACT OF PRODUCTIVE SAFETY NET PROGRAM ON POVERTY: MICROECONOMETRICS ANALYSIS, TIGRAI NATIONAL REGIONAL STATE, ETHIOPIA

YIBRAH HAGOS GEBRESILASSIE
Adigrat University, Ethiopia

Abstract

This paper aims at evaluating the impact of productive safety net program on poverty using primary data from randomly selected 600 households in central zone of Tigrai National Regional State, Ethiopia. Propensity Score Matching and Foster-Greer-Thorbecke were used to evaluate impact of the program and poverty, respectively. The paper revealed that the program has positive and significant effect on consumption, livestock holdings, and productive assets. Moreover, impact of the program on total consumption expenditure per adult equivalent was found to be positive and significant. Using total poverty line, poverty rate was lowest among program participants (30.33%) than non-participants (31.1%). Highest poverty rate was found among households headed by women (38.42%) while households headed by men (23.1%). The study also revealed that the program has positive and significant effect on poverty reduction and protecting productive assets. Finally, it was recommended that female headed program participants based programs should be provided to help boost their agricultural output and reduce endemic poverty.

1. Introduction

Recently, the global focus has been to given food security and poverty alleviation. This is being made in response to the increasing food insecurity and poverty in the world. The incidence of food insecurity and poverty is devastating particularly in the developing countries and in terms of food insecurity; 852 million people worldwide are still chronically underfed. In Africa, an estimated 200 million (27.4 percent) people are famished (Babatunde*et al*., 2007).

Eradicating extreme poverty and hunger is the first MDGs set by UN; this goal also has become the core development objective and agenda of the government of Ethiopia. The Plan for Accelerated and Sustained Development to End Poverty is Ethiopia's "guiding strategic framework". The key goal of PASDEP is to enable chronically food insecure households to

acquire sufficient assets and generate income to move out of food insecurity and improve their resilience to shocks. Similarly, the main focus of the government's agricultural development strategy is to ensure self-sufficiency in food production at household level (ERSFE, 2009).

Drought, environmental degradation, population pressure, limited access to services, shortage of farmland, lack of productive assets, low input and subsistence agricultural practices are the most prominent causes of food insecurity problems in rural areas of Ethiopia. Consequently, more than 38 percent of the rural households fall below the food poverty line and 15 percent of the rural population in Ethiopia reported that they experience a food gap of more than four months (MoARD, 2009).

Realizing the magnitude and severity of the food insecurity, and linked to the PASDEP, the government of Ethiopia launched a development strategy known as Productive Safety Net Program (PSNP) in 2005. The program is the largest social protection scheme in Africa outside of South Africa's social grants schemes. The PSNP delivers social transfers to chronically food insecure households, either through public work activities or as a direct support with three distinct objectives of smoothing food consumption, protecting household assets and building community assets (Devereux and Guenther, 2009). However, some studies conducted in Ethiopia were at early stage of the program (Gilligan *et al*, 2008). Moreover, some of these studies used qualitative analysis (Barnes, 2008 Devereux *et al*, 2006; & Rachel *et al*, 2006).

A survey regarding the impact of PSNP on poverty has not been yet evaluated, and remains untouched in the study areas. The Propensity Score Matching (PSM) and Foster-Greer-Thorbecke (FGT) were used to evaluate impact of theprogram and poverty, respectively.

1.2. Objective of the Study
The overall objective of this study is to evaluate the impact of Productive Safety Net Program (PSNP) on poverty. More specifically;

- To examine the impact of Productive Safety Net Program on consumption
- To examine the differentiated effect of the program on men and women
- To assess the magnitude of depth, gap and severity of poverty differentials between program participants and non- participants.

2. Methodology
2.1. Data and Procedure
To attain the stated objectives, mainly primary data was used. The primary data collection methods employed included both the use of structured and semi-structured type, focus group discussions and field observations to get information in-depth. Secondary data was also used to supplement the primary data using that was collected from various sources. A three-stage sampling procedure was implemented. In the first stage, the study area was selected based on PSNP coverage. In the second stage, five woredas (Districts) were selected randomly and finally, samples of 600 representative households were drawn on probability proportional to sample size. About 365 (60.8 percent) program participants and 235 (39.3 percent) non-participants were selected randomly using a systematic random sampling procedure.

2.2. Method of data analysis

The collected data were subjected to both descriptive statistics and econometrics analysis such as Foster, Greer and Thorbecke (FGT) index and Propensity Score Matching (PSM) to measure poverty and impact of the Productive Safety Net Program (PSNP), respectively.

2.2.1. Impact Analysis

Choosing an appropriate model and analytical technique depends on the type of variable under consideration (Gebrehiwot, 2008). Here, the dependent variable of interest (program participation) is binary that takes a value of 1 and 0. Assessing the impact of any intervention requires making an inference about the outcomes that would have been observed for program participants had they not have participated. The appropriate evaluation of the impact of the program requires identifying the average treatment effect on the treated (ATT) defined as the difference in the outcome variables between the treated households and their counterfactual. Counterfactual refers to what would have happened to the outcome of program participants had they not have participated (Rosenbaum and Rubin, 1983; Becker, S., and Ichino, A. 2002 and Gilligan *et al.*, 2008). According to Rosenbaum and Rubin (1983), let Y^{PSNP} be the outcome of the PSNP participants and $Y^{non-PSNP}$ outcome of the non-participants. For each household, only Y^{PSNP} or $Y^{non-PSNP}$ is observed, which leads to a missing data problem. In estimating the propensity score, the dependent variable used was participation in the PSNP and let Di denotes the participation indicator equalling 1 with probability of π if the household is program participant and 0 with probability of 1-π otherwise. Let X_i denotes a vector of observed individual characteristics used as conditioning variables. Propensity Score Matching (PSM) technique was used which looks like as follow:

$$ATT_{PSM} = E_{P(X)}\{E(Y^{PSNP}|D=1, P(X)) - E(Y^{non-PSNP}|D=1, P(X))\} \quad [1]$$

The perception is that two individual households with the same probability of participation will show up in the participants and non-participants samples in equal proportions on the basis of propensity scores.

2.2.2. Poverty Analysis

The poverty situation of the program participants and non-participants was analyzed using the expenditure approach, the one developed by Foster, Greer, and Thorbecke (1984) known as FGT Index which is commonly applied for poverty analysis. A separate food and total poverty lines were developed for the study area using the Cost of Basic-Need approach (CBN) as proposed by Revallion and Bidani (1994). The three measures of poverty in the FGT index were employed of which the Head Count Index (P_0) which depicts number of population who are poor, Poverty Gap Index (P_1) which measures the extent to which individuals fall below the poverty line (the poverty gaps) as a proportion of the poverty line and Poverty Severity Index (P_2) that demonstrates not only the poverty gap but also the inequality among the poor (WBI, 2005). Let Z is the poverty line, Y_i is the actual expenditure (per adult equivalent) of individuals below the poverty line, n is number of people, q is the number of poor people normally those below the poverty threshold, α is poverty aversion parameter andis a value given (0, 1, or 2) to determine the degree to which the measure is sensitive to the degree of deprivation for theses below the poverty line and higher values of α shows greater weight is placed on the poorest section of the society. Then, the FGT or $P\alpha$ is given by:

$$P_\alpha (Z, Y) = \frac{1}{n} \sum_{i=1}^{q} \left[\frac{Z - Y_i}{Z} \right]^\alpha \qquad [2]$$

Therefore, if the value of α =0, theFGT or the Pα becomes the Head Count Index (P_0), when α = 1, Pα is the Poverty Gap Index (P_1) and α =2, Pα becomes the poverty severity index.

The Cost- of- Basic-Needs (CBN) approach was employed to estimate the poverty line for the 2010 collected data. Ravallion and Bidani (1994), and Dercon and Krishnan (1996, 2000) provided further information on the construction of the poverty line, including the details of the food basket and its sensitivity to different sources of data on prices used to value the food basket. Individual expenditures have historically been shown to be correlated with income level. The consumption expenditure approach was used to estimate the poverty line; accordingly, the food poverty line was 235 per month (2820 per year) per adult equivalent Ethiopian Birr. Once the food poverty line computed, the total poverty line was derived by taking the average food share of the first lower (first quartile) proportion of the population (WBI, 2005) which resulted in a total poverty line (TPL) of 330 per month (3960 per year) per adult equivalent Ethiopian Birr.

The most widely used poverty indices: the head count index (P_0), the aggregate poverty gap or poverty gap index (P_1) and poverty severity index (P_2) was employed. The head count index measures the share of the population whose consumption is below the poverty line (the share of the population that cannot afford to buy a basic basket of goods). The poverty gap index measures the extent of the poor (living below the poverty line) how far away from the poverty line and the poverty severity index measures not only the gap but also the inequality among the poor (a higher weight is placed on those households further away from the poverty line).

3.   Results and Discussion
3.1. Impact of the Productive Safety Net Program
The impact indicators used in this study were assets and consumption expenditure. Consumption is here measured as per adult equivalent, which is food consumption per-adult equivalent, non-food consumption and total consumption expenditure (food and non-food) per-adult equivalent.

3.1.1. Family size
Out of the total sample respondents, 69 percent of them were male headed households and the remaining 31 percent female headed households whose livelihoods are based on farming activities. About 82 percent of the sample respondents were illiterate while 18 percent of them were literate. Male-headed households participated more relative to the female-headed households in the study area. Out of the total male-headed household respondents, 65 percent were from the PSNP participants. Only 35 percent of the female-headed households were PSNP participants out of the total female-headed sample.

There was statistical significant (at 1 percent) mean percentage difference between male-headed and female-headed households in PSNP participation. This result was in line with the study done by Gilligan *et al*. (2008) whose findings on the PSNP indicated that participants in the public work were more likely to come from male-headed households with married head.Family size and program participation have positive relationship. On average, program participants (6) have a bit larger family size than the non-participants (5). The combined average family size for sample respondents was six persons per household. The mean

difference in family size between program participants and non-participants was statistically significant (at 5 percent). The result revealed that households with higher male adults were participating more in the program than those who have less male adults. Thus, the mean difference of male adults between program participants and non- participants was positive. Statistically, this was found to be significant at less than 1 percent level of significance.

3.1.2. Age of the household
The mean age of the sample household heads was found to be 49 years. The mean age of program participants and non- participants were 49 and 48 years, respectively. On average, the cultivated landholding size of the sample respondents was about 0.45 hectare.

3.1.3. Land holding size
The average cultivated landholding size for program participants was 0.35 hectare whereas that of the non- participants was 0.38 hectare. Thus, the mean difference of the landholding between program participants and non- participants was found to be not statistically significant.

3.1.4. Livestock holding
The average number of livestock owned by the sample respondents prior to the program intervention (productive safety net program) was converted into tropical livestock unit (TLU) and this was used as lagged variable in matching technique. On average, the sample respondents have had about 3.7 while the program participants and the non- participants have 3.5 and 3.3 TLU, respectively. Prior to the program intervention, however, the mean difference in terms of TLU between the program participants and non- participants was found to be not statistically significant.

Currently, on average, program participants and non-participants have 4.5 and 2.5 TLU, respectively. The result revealed that on average the TLU of the program participants have increased from 3.5 to 4.5 while that of the non- participants have decreased from 3.3 to 2.5. After program intervention, the average size of TLU for program participants has increased by one fold while that of the non-participants has declined by 0.8. Statistically, this was found to be significant. Oxen are important assets and were treated separately; on average the sample respondents have about 1 TLU. The mean oxen TLU for the program participants and non- participants were 1.16 and 0.67, respectively.

4.   Econometric Analysis of Welfare Effects (Impact of PSNP on Assets)
4.1 Impact on Livestock holdings
The average the TLU of the program participants has increased from 3.5 to 4.5 TLU while that of the non- participants have decreased 3.3 to 2.5 TLU. After the program intervention (productive safety net program), the average size of program participants has increased while that of the non- participants has declined. The mean difference in terms of TLU between program participants and non- participants was found to be positive and statistically, significant at 1 percent level of significance.

4.2.   Impact on productive asset
All asset categories have been valued in Ethiopian Birr based on their current prices as reported by each sample respondents, but deflated. The result indicated that the value of the productive assets at their prices (but deflated) was higher for program participants than non-participants. The difference in the mean value of the productive assets between program participants and non- participants was positive and statistically significant (at 5 percent and at

10 percent using radius and kernel, respectively), but it was significant based on nearest neighbor matching estimators.

4.3. Impact on durable and household goods

The impact of the PSNP on the value of the durable goods was positive and statistically significant (at 10 percent). This indicated that the program participants were able to protect their durable goods as a result of the program's intervention. The mean value of the durable goods was found to be positive and statistically significant (at 5 percent). The impact of the PSNP on household goods was found to be positive and statistically significant (at 1 percent). A study conducted by Devereux *et al*. (2006) indicated that the impact of the program on assets protection has positive and significant effect (at 10 percent). In terms of asset protection, non-participants had more likely to experience decrease in their asset-holding than program participants.

Table 1 – ATT Estimation Results of the Impact of Productive Safety Net Program on Assets

Outcome variables	Estimators	No. of PSNP participants	No. of non-PSNP participants	ATT	t-values
Livestock	Nearest Neighbor	332	123	1.966	3.490∗∗∗
	Kernel	210	143	1.845	10.375∗∗∗
	Radius	212	143	2.012	8.647∗∗∗
Productive asset	Nearest Neighbor	218	123	31.397	1.031
	Kernel	218	143	35.609	1.661∗
	Radius	218	143	38.324	2.357∗∗
Durable goods	Nearest Neighbor	218	123	34.518	2.154∗∗
	Kernel	218	143	36.075	2.329∗∗
	Radius	218	143	33.882	2.059∗∗
Household goods	Nearest Neighbor	218	123	89.321	3.627∗∗∗
	Kernel	218	143	80.196	3.744∗∗∗
	Radius	218	143	70.202	3.292∗∗∗

Significant differences are indicated with: * $p<0.05$ (5 percent level), ** $p<0.01$(10 percent level), *** $p<0.001$ (1 percent level) and standard errors are bootstrapped.

4.4. Impact of Productive Safety Net Program on Consumption

Consumption expenditure was used as impact indicator while evaluating impact of the program (Productive Safety Net Program, PSNP), and it was computed as per adult equivalent consumption expenditure.

4.4.1. Impact on consumption expenditure

The result of this study revealed that on average, program participants consumed more food items as compared to the non-participants. The difference in the mean value of food consumption per adult equivalent between program participants and the non- participants was found to be positive and statistically significant (at1 percent). Therefore, the overwhelming majority of program participants participating in the PSNP consumed more food items. A study conducted by Gilligan *et al*. (2008) found that positive impact on per capita food expenditure and this was statistically significant (at1 percent) for program participants. Thus, program participants were more likely to consume more food as compared to the non-participants. The estimated non-food household consumption expenditure per adult equivalent was positive, but it was not statistically significant. The total (food and non-food) consumption expenditure per adult equivalent for program participants was found to be higher as compared to that of the non- participants. The estimated results indicated that the mean total consumption expenditure per adult equivalent for program participants was positive and

statistically significant (at 1 percent). The principal results of the study on consumption expenditure showed that the program intervention (productive safety net program) enabled program participants to increase household consumption expenditure very considerably. A study conducted by Devereux *et al.* (2006) noted that 75 percent of program participants have been reported that they consumed more food of better quality and Barnes (2008) also noted that the PSNP had positive and statistically significant (at1 percent) impact on household consumption expenditure.

Table 2 – ATT Estimation Results of Impact of PSNP on Household Consumption

Outcome variable	Matching method	No of PSNP participants	No of PSNP non-participants	ATT	t-values
Food consumption	Nearest Neighbor	332	123	1254.59	6.960***
	Kernel	218	143	1061.25	8.144***
	Radius	218	143	1070.22	9.227***
Non-food consumption	Nearest Neighbor	218	123	9.50	0.127
	Kernel	218	143	30.98	0.620
	Radius	218	143	31.04	1.011
Total consumption	Nearest Neighbor	218	123	305.75	3.753***
	Kernel	218	143	242.72	4.072***
	Radius	218	143	241.50	5.303***

Significant differences are indicated with: * p<0.05 (5 percent level), ** p<0.01(10 percent level), *** p<0.001 (1 percent level) and standard errors are bootstrapped.

5. Econometric Analysis of Poverty

5.1. Poverty Line (TL)

The incidence of poverty was analyzed using the total poverty line (330 per month or 3960 per year per adult equivalent Ethiopian Birr) and then food poverty line of 235 per month or 2820 Ethiopian Birr per year per adult equivalent. Accordingly, 30.33 percent of the respondents were living below the poverty line with poverty gap index of 6.6 percent and poverty severity index of 2.77 percent. Ahferom (30.33 %) and Merebleke (25.55%), with poverty gap and severity index level (2% and 0.55%) and (1.85% and 0.45%) were the leading woredas (Districts) in this zone with their high and low level of poverty, respectively.

Table 3 – Incidence of Poverty by Woreda (Districts)

Woreda (District)	Poverty Estimates			Total Poverty line
	P_0	P_1	P_2	
Geter Adwa	0.351(0.038)	0.052(0.009)	0.013(0.003)	330
Ahferom	0.313(0.031)	0.054(0.008)	0.016(0.003)	330
Kola Temben	0.346(0.036)	0.049(0.008)	0.013(0.003)	330
Merebleke	0.320(0.036)	0.025(0.009)	0.007(0.003)	330
LailayMachew	0.308(0.042)	0.077(0.014)	0.029(0.008)	330
Population	0.328(0.008)	0.084(0.003)	0.031(0.001)	330

Values in brackets are standard deviations

5.2. Poverty and gender of the household

About 30 percent of the female headed households were found to be below the poverty line with poverty gap index of 7.3 percent and severity index rate of 2.6 percent. Male headed

households had 0.23 level of poverty head count index with poverty gap index of 0.062 and squared poverty gap index of 0.028. Thus, the incidence of poverty was higher in female headed households than their counter part.

Table 4 – Incidence of poverty by gender

Sex of the household head	Poverty Estimates			t-statistics
	P_0	P_1	P_2	
Female	0.301(0.0021)	0.073(0.0051)	0.026(0.0023)	
Male	0.231(0.0076)	0.062(0.0025)	0.028(0.0011)	0.004***
Population	0.233(0.0046)	0.061(0.0031)	0.026(0.0010)	

***Significant at 1% & values in parenthesis are standard deviation

5.3. Poverty and education

As most studies have indicated, education has positive and significant impact on poverty. Highest level of poverty of 35.55 percent (head count index) was observed in illiterate households; accompanied by high level of poverty gap index 9 percent and severity index of 1.65 percent.

5.4. Poverty and family size

Significant numbers of research works carried out to express the relationship between poverty and family size revealed that there is an inverse relationship between households' size and that of poverty status of the household. A household who have a larger family size has the higher probability of falling into poverty (Esubalew, 2006). The average family size of the sample respondents was 5.66 per household. Whereas the average family size of the program participants was 5.33 per household while that of the non-program participants was 4.85 per household.

   As the family size of the household increased, the incidence of poverty also increased. About 6.3 percent of the households that had a family size of 2-3 were living below the poverty line with income short fall of 3 percent and poverty severity index of 1.1 percent. About 12.8 percent of the households with family size of 4-5 were living below the poverty line with poverty gap index of 4.12 percent and poverty severity index of 1.88 percent. Thus, as has been indicated by most empirical literatures, the level of poverty had increased directly with an increment of family size of the households.

5.5. Poverty and Productive Safety Net Program

The program participants were 60.8 percent (n=365) while the remaining 39.3 percent (n=235) were non- participants, but eligible. The result revealed that the poverty level of the program participants was lower than that of the non-participants. The results also indicated that 30.33 percent of the program participants and 31.11 percent of the non-participants were found to be living below the total poverty line. Furthermore, the poverty severity index was lower for the program participants.

   Based on the level of food poverty, there was statistically significant (at 5 percent) difference between the two groups (participants and non-participants). The head count indices were 0.37 and 0.191 for program participants and non-participant households, respectively. The poverty gap index was lower for the program participants (0.023) than that of the program non-participants (0.043). And the poverty severity of the program participants (0.012) was 1.9% lower than the non-participants (0.031).

Table 5 – Level of Poverty by program participation

Variable	Total Poverty Estimates			TPL	Food Poverty Estimates			FPL
	P_0	P_1	P_2		P_0	P_1	P_2	
Participants	0.3033	0.066	0.025	**330**	0.370	0.045	0.021	**235**
Non-Participants	0.3110	0.059	0.022	**330**	0.391	0.051	0.026	**235**
Population	0.30615	0.0624	0.025	**330**	0.383	0.053	0.020	**235**
	Pearson chi2(1) = 0.3432 Pr = 0.411[N]				Pearson chi2(1) = 4.111 Pr = 0.015**			

**Significant at 5% and N = non-significant

5.6. *Food poverty*

About 235 Ethiopian Birr measured in per adult equivalent was used as food poverty line, accordingly, 30.6 percent of the households were found to be below the food poverty line with income gap of 6.24 percent and squared poverty gap index of 2.1 percent. As depicted in table 2 below, the level of food poverty incidence varied from Woreda (District) to Woreda (District). The highest food poverty head count index (0.217) was recorded in Geter Adwa and the least was observed in TahitayMachew (0.111). In addition, the poverty gap (0.034) was higher in Geter Adwa and the least was observed in MerebLeke (0.003).

Table 6 – Food Poverty by Woredalevel

Woreda	Food Poverty Estimates			Food Poverty Line
	P_0	P_1	P_2	
Geter Adwa	0.217(0.031)	0.034(0.013)	0.012(0.002)	235
Ahferom	0.157(0.021)	0.015(0.004)	0.006(0.003)	235
Kola Temben	0.126(0.022)	0.014(0.004)	0.005(0.003)	235
LailayMachew	0.134(0.030)	0.028(0.014)	0.011(0.011)	235
MerebLeke	0.215(0.012)	0.003(0.002)	0.001(0.001)	235
Population	0.125(0.004)	0.024(0.001)	0.013(0.001)	235

Source: Author's own survey computation

6. Conclusion and Recommendations
6.1. *Conclusion*

The study specifically revealed that the Productive Safety Net Program (PSNP) intervention has enabled the program participants to retain their assets holdings. The program participants, as a result of the program's intervention, have increased their livestock holdings. The program participants owned more livestock in terms of TLU, than the non-participants. The study revealed that the program has positive and statistically significant impact on productive assets, durable goods, and household goods. Positive and statistically significant results were obtained for food consumption per adult equivalent and total consumption per adult equivalent (at 1 percent).

Based on the level of food poverty, there was statistically significant difference between the two groups (participants and non-participants). The head count indexes were 0.37 and 0.191 for program participants and non-participant households, respectively. The poverty gap index was lower for the program participants (0.023) than that of the program non-participants (0.043). And the poverty severity of the program participants (0.012) was 1.9% lower than the non-participants (0.031). Furthermore, the poverty severity index was lower

for program participants. Generally, findings this study revealed that the impact of the Productive Safety Net Program (PSNP) has positive and statistically significant effect on poverty reduction through increasing households' overall family consumption expenditure and in protecting assets of the rural households.

6.2. Recommendations

Based on the above findings of the study, the following recommendations are made:

o The government should encourage the program participants to re-orient on commercialized dairy and fattening livestock development activities in order to reduce the problem of food insecurity and to improve their income sources.

o Every member of the program participants should be fully targeted into the program so that improved their food insecurity problems and to ensure self-food sufficiency (the program should be individual focused than household based).

o In order to target all the eligible ones, the government should consider reducing the duration of benefits from the program (reducing the duration of program benefits) so as to increase the number of participants within the budget constraints. Thus, the researcher recommends reducing program participation period from five to four years with series follow ups.

o Most of the program participants were male-headed households relative to the female-headed households. Hence, the program should able to include more female-headed households or at least in the same proportion as that of the male-headed households.

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