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IMPACT OF PRODUCTIVE SAFETY NET PROGRAM ON
HOUSEHOLDS' WELFARE AND RESILIENCE TO
ENVIRONMENTAL SHOCKS IN RURAL ETHIOPIA: EVIDENCE
FROM PANEL DATA

CHERNET S. ABUYE

ADDIS ABABA, ETHIOPIA

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**Impact of Productive Safety Net Program on Households' Welfare and
Resilience to Environmental shocks in Rural Ethiopia: Evidence from Panel
Data**

Chernet S. Abuye

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Declaration

The author, undersigned, declares that this thesis is the author's original work, has not been presented for any degree in any other university and that all sources of materials used for the thesis have been dully acknowledged.

Declared by:

Name: Chernet S. Abuye

Signature: _____

Date: June, 2017

Confirmed by Advisor:

Name: Hailu Elias (PhD)

Signature: _____

Date: _____

Place and date of Submission: Addis Ababa University, June, 2017

Addis Ababa University

School of Graduate studies

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Signed by the examining committee:

Examiner _____ Signature_____ Date _____

Examiner _____ Signature_____ Date _____

Advisor _____ Signature_____ Date _____

Chair of Department of Graduate Program Coordinator

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Abstract

IMPACT OF PRODUCTIVE SAFETY NET PROGRAM ON HOUSEHOLDS' WELFARE AND RESILIENCE TO ENVIRONMENTAL SHOCKS IN RURAL ETHIOPIA: EVIDENCE FROM PANEL DATA

Chernet S. Abuye

From the analysis of IFPRI five round survey data from 2006 to 2014 this study has examined the impact of Productive Safety Net Program (PSNP) on Resilience to environmental shocks and Welfare of beneficiary households. In this study the analysis was made using Difference in Difference method of panel data analysis. This study has found Positive impact of PSNP on beneficiaries' Resilience to shock; measured using Food Gap, inconclusive impact of beneficiaries Welfare; measured using Per-capita expenditure and PSNP impact on Welfare of program participant has been concluded as Negative based on causal effect analysis of PSNP and households Welfare; using Asset Accumulation. This study has also recommended to measure program impact by classifying resilience effect of PSNP in to ex-ante analysis and ex-post analysis of shock resilience and indicates the potential effect of possible policy changes particularly policy issues related to the program such as payment size and PW involvements.

Key word: Resilience, Welfare, Environmental shock, Index, PSNP, Ethiopia

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Acronyms

Country Program Paper	CCP
Department for International Development	DFID
Difference in Difference	DiD
Direct Support	DS
Food Security Program	FSP
Index of Sustainable Economic Welfare	ISEW
Institution of Economic Growth	IEG
International Authority on Development	IGAD
Managing Environmental Resource to Enable Transition	MERET
Ministry of Agriculture	MoA
National Metrology Agency	NMA
Other Food Security Program	OFSP
Productive Safety Net Program	PSNP
Propensity Score Matching	PSM
Public work	PW
Social Safety Net	SSN
World Bank	WB
World Food Program	WFP

Chapter one: Introduction

This chapter presents background of the study, statement of the problem, general and specific objectives, significance and scope of the study; as well as operational definition of terms and key variables of the study. Finally, it presents organization of the thesis.

1.1 Background of the study

Ethiopia has been through chronic food insecurity in the past four decades: due to recurrent drought, land degradation, unpredictable climate change, poor and inadequate risk management strategies, population pressure and rain-feed subsistence agricultural practice with low investments and low expected output (World Bank, 2009).

Natural and human made shocks have led to the loss of lives of many, made many more displaced and left even more people for prolonged food insecurity. The manifestations as well as causes of land degradation are complicated; among these, unsustainable land use and inappropriate farming practices are probably the main causes (Bewuket Woldeamlak, 2009). In Ethiopia drought occurrence cycle renews itself every three to five years which makes it even worse (World Bank, 2011). In addition to World Bank (WB), National Metrology Agency (NMA) has indicated that among the natural hazards, drought is the most and cyclical problem of Ethiopia. In-fact, Ethiopia is one of the most drought exposed countries in Africa as have been indicated on the drought probability map (National Metrology Agency, 2007). Even though, drought is a global phenomenon, the consequence of drought in particular for developing nations like Ethiopia is severe (National Metrology Agency, 2007).

As a matter of fact, the effect of both natural and human made shocks have led to the loss of lives of many, made many more displaced and left even more people for prolonged food insecurity.

To overcome food insecurity problem, a lot has been done and is being done to reduce the severity of the impact of shock on Ethiopian economy. Provision of food aid for communities that suffer from food shortage has been done for more than thirty years. It was successful in saving lives and addressing hunger costing around 265 million dollar on average every year. However, the program could not break the relationship between poverty and factors causing food insecurity such as drought, falling productivity of land and some human made as well as other natural factors. Appreciating the problems of food aid program in 2003 the government of Ethiopia and donors came up with consensus which led them to bring a change in their food aid program and introduced what is known as Food Security Program (FSP) to reach those who are chronically in need for food aid and it shifted provision of food from emergency relief to predictable food aid (Government of Ethiopia, 2004).

The food Security Program was dominated by a program marked as Productive Safety Net Program (PSNP) drawing its beginning line in 2005 with the objective of reducing food insecurity by creating predictable flow of cash and/or food in either public work (PW) participation or direct support (DS). Labor intensive public work incorporates able body participants of PSNP that can entitle them to earn 6 birr/day or equivalently valued amount of food as of 2005 price (John Hoddinott et al., 2006). Direct support program involves in providing food or cash for those who cannot participate in physical work including children, senior citizens and disabled (FDRE, 2004).

The program addressed households who are identified as:

- chronically food insecure at least for three months within the previous three years and received food assistance;
- Those who suffered from severe losses of assets and failed to make themselves food secure in the last one or two years; and
- Those who have no family to support and did not involve in any type of social protection (World Bank, 2011).

According to the Department for International Development (DFID), in 2009, public work participating beneficiaries accounted for 86.1% of the social benefit of PSNP. As a principle, PSNP's public work component allocated social beneficiaries to work for 30 working days per year and it also incorporated other food security program (OFSP) such as credit, extension, irrigation and water harvest scheme (Hoddinott et al., 2009). Being the second largest social welfare receiving country in sub-Saharan Africa next to South Africa, the program was capable of reaching seven million people through public work (PW) and Direct Support (DS) with 500 million dollar annual budget. Participation of Ethiopian government in PSNP brought change in the course of the program scope and partnership with international aid providing organizations. By the newly developed program, the government and donors found out new achievement that underpin rural economic growth and environmental rehabilitation achieved through public work participation and meritocratic cash transfers. The program has allowed consumption smoothing and avoid asset depletion as well creation of productive and sustainable community asset

(Government of Ethiopia, 2014). This stimulates Resilience to both human made and natural shocks as well welfare due to treatment effect of the program on beneficiaries' Resilience.

According to different summits and report of different organizations, resilience has different definitions in different contexts. However, it can be defined as capacities of a system; community and/or society to with stand and recover from shocks. The three widely considered definitions of resilience are

1. *“The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner” (United Nations International Strategy for Disaster Reduction,2011)*
2. *“The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change” (Intergovernmental Panel on Climate Change,2011)*
3. *“The capacity of a system to absorb disturbance and reorganize itself while undergoing change” The Resilience Alliance” (Department for international development, 2011, p 6)*

Due to the absence of specified threshold there are no specified indicators to classify a given community as resilient or non-resilient. However, one way of identifying resilience level is to use universal indicators to compare resilience across communities. As per universal indicators, households are considered as resilient when they are capable of fulfilling the family's basic needs without any program intervention in both shock and normal period. On the other hand, we

can use composite and contextually specific indicators of resilience and using this indicator, a researcher can analyze in-particular how a given community's resilience status changes, what factors affect the resilience level in relation to specific condition and how this particular change affects overall resilience level (Drought Risk Reduction Action plan ____). Understanding the term resilience begins with determining the four elements of resilience which are the sum of context, disturbance, capacity and reaction that can help to develop framework and examine different types of resilience to determine resilience of what and resilience to what (DFID, 2011). Since, one of the researcher objective is to show the long run effect of PSNP on beneficiaries' Resilience to environmental shocks, the researcher in this study have considered Resilience as per the definition of DFID, (2011).

Following the 2011 summit, IGAD has run the project through a program called Drought resilience and sustainable initiatives which focused mainly on improving the livelihoods and enhancing resilience of drought-prone communities in the horn of Africa and the mandate to creating long term and medium term resilience to drought was given to IGAD in the meeting held in Nairobi 2011. The document of IGAD used to create drought resilience is an advanced copy of the Ethiopian program called country program paper (CPP)¹ for the drought resilience and sustainable initiatives. (Ministry of Agriculture, 2012)

¹ CPP was prepared by Natural resource management, early warning response and others and presented in Nairobi in 2012 by representatives from Ethiopian Environmental Protection and other ministries (Ministry of Agriculture, 2012).

Ever since, the transition of food aid program to PSNP believed to maintain productivity. PSNP has been expected to maintain productivity for extended period and enable beneficiaries to realize the potential of resilience for shortage of production caused by either natural phenomenon like El Nino or La Nina (dry hot or cooled rainy) or human caused disasters.

In a general sense, community level welfare maintenance conducted through addressing physical and material demand of beneficiaries in this study concern it particularly will point to PSNP eligible. Due to its intended effect of the program action known as PW and DS; In addition to resilience creation, it was intended to improve welfare of a given community being eligible to take the program.

Welfare can be taken as a synonymous to wellbeing or responding to what is considered as good for people's interest in provision of social service such as health care, housing, education, social work etc. From the perspective of social users as Paul described in his book "principles of social welfare" the role of social service has been seen as provision of welfare with different approaches (such as curative, developmental and protective). The protective (safety net) approach is the one which is intended and implemented to help household or community in resolving uncertainty or occurrence of shocks in relation to basic needs due to shocks, age, disability or poverty (Paul, 1998).

1.2 Statement of the problem

PSNP is the largest national Social Safety Net (SSN) program developed to withstand problems such as chronic food insecurity among the poor as a result of short term shocks resulting in food insecurity and asset depletion. PSNP was targeted to reduce the risk of disasters and climate related impacts incorporating Public work (PW) and Direct Support (DS). It is expected to boost climate change resilience, risk financing, enabling community to respond to shocks, and use methods that can help shock vulnerable community members to obtain the full benefits of consumption smoothing and asset protection.

Ethiopian Productive Safety Net Program is one of intensively studied research area as PhD dissertation and also for consultancy purpose. Most of these studies considered only one component of the program. Even though, they considered all economic, biophysical, social, and environmental aspect studies' prior did not address resilience to shock using the newly developed resilience measurement technique developed by Barrett and Constanas (2014); welfare impact of PSNP using Asset accumulation method and per-capita expenditure as measure of welfare. Among these studies the below listed are the o that should be summarized to show gaps:

Camilla Andersson et al., (2009) conducted a study entitled “Impacts of the Productive Safety Net Program in Ethiopia on Livestock and Tree Holdings of Rural Households” their major concern was studying PSNP impact in relation to environmental rehabilitation and asset depletion using Propensity score matching (PSM) method. However, it did not show the long run effect of the program.

Weldegebriel et al.,(2012) studied “Climate change adaption in Ethiopia; to what extent does social protection influence livelihood diversification” using propensity score matching method and the specified methodology influenced the findings and the researcher has recommended further study using quasi-experimental approach that can reduce the trade off due to methodology weakness’ used in his study. This study was conducted mainly to assess the effect of social protection effect on income diversification.

Guush B. et al., (2014) studied “Can social protection work in Africa? The impact of Ethiopia’s PSNP” using difference-in-difference (DID) method with an objective to analyze how effective households are to rehabilitate themselves after shock breakout (test either increment of asset or consumption happened as a result of a shock) among PSNP beneficiaries.

Conrad Murendi et al., (2011) studied “Drought impact and related risk management by small house hold farmers in developing country evidence from Awash river basin, Ethiopia” this study focused on the impact of drought, not how community and household are responding to it.

Carly Bishop and Dorta Hilhorst, (2010) studied “From food aid to food security: The case of the Safety Net policy in Ethiopia” Participant rule appraisal policy cycle model were used and their intended goal was to study how policy shift was taking place in Ethiopia.

World Bank evaluators assessed the PSNP from the perspective of the program objective, relevance, sustainability, efficiency and efficacy but not the impact of PSNP on any of the four components of resilience or welfare of households as a program effect. (World Bank, 2011).

Devereux and others have studied the impact of PSNP on asset building and welfare growth but it failed to capture other factors that affect asset building and welfare (Devereux et al., 2006). The Federal Democratic Republic of Ethiopia Ministry of Agriculture, (2014), also did not address Productive Safety Net program impact on resilience creation and welfare impact since their concern was to evaluate it from Environmental, Economic, Social and Bio-physical angle using panel data from secondary sources and recall survey data as baseline data only on PW water shade development.

Therefore, in line with these gaps in the literature, this study intends to examine how the amalgamations of the Productive Safety Net Program (PW and DS) add for household resilience to environmental shocks and welfare considering all the six climatic zones (Moist Dega, Moist Woina-Dega, Dry Woina Dega, Dry Kola, Moist Kolla, and Moist Bereha). Mainly this study is in advance of the cited studies.

This study tries to fill the gap in the literature in the following ways:

- ✓ In this study the Productive Safety Net Program effects of unobserved heterogeneity were eliminated since, the researcher used DiD to address the gap in assessing the impact of PSNP in previous studies.
- ✓ In this study the researcher used panel data from single source conducted for the same purpose rather than grasping from different secondary sources for the purpose of creating a panel data.
- ✓ Since, the researcher has studied PSNP after almost twelve years of operation there is an opportunity to address the long term impact of PSNP on resilience to Economic,

Biophysical, Social, and environmental shocks and that of welfare effect under different natural and human caused situations unlike studies conducted at the early stage of operation.

- ✓ The researcher has used newly developed resilience measure following Joanna B. Upton (2016) to measure resilience and conduct statistical analysis for each round.

1.3 Objective of the study

1.3.1 General objective

The general objective of this study was to assess the role of Productive Safety Net Program on improving resilience of households for environmental shocks and household welfare.

1.3.2 Specific objectives

Specifically, this research has intended to:

- I. generate households' shock index to Economic, Biophysical, Social, and Environmental shocks and Coping strategy index of PSNP beneficiary.
- II. identify the role of different PSNP pillars and their related magnitude to shock resilience and welfare maintenance at household level as a result of the program.
- III. provide externally valid analysis of PSNP impact on resilience capacity to shock and households' welfare.

- IV. indicate operational combination of PSNP pillars to shock resilience capacity and welfare creation at household level.
- V. measure resilience in terms of food gap as conceptualized by Joanna B. Upton et al., (2016)

1.4 Significance of the study

According to the World Bank (2009), Ethiopia has been making every effort to mitigate food security problems via different programs for more than forty years including the long lasting Food Security Program which finally turned in to PSNP in 2005. Therefore, the information that the author has generated from this study will have the following potential significances

- I. Measuring resilience by food gap is more reliable than asset accumulation. Since, price volatility of asset during shock is high and food gap is better indicator of households' environmental shock resilience. The researcher has measured resilience by food gap; thus it indicates new and more sustainable measure of PSNP impact on resilience.
- II. This study will serve as a stock of knowledge and source for similar future studies.
- III. It may serve as a source of convincing remarks for policy makers and stakeholders to deal with donors on the implementation for better achievement.

1.5 Scope of the study

This study has covered six climatic zones in Ethiopia which are Woredas of PSNP beneficiaries. Addressing all climatic zones is to ensure external validity of the PSNP impact assessment on outcomes for the case of Ethiopia. However, this study has address impact assessment of PSNP on resilience capacity to environmental shocks and welfare of households as program effect only.

1.6 Organization of the Study

This study is organized in six chapters including introduction to the study in the first chapter. Related literatures on PSNP, Resilience to environmental shocks and Welfare are briefed in chapter two. Method of data analysis is discussed in chapter three. The fourth chapter provides descriptive evidences on PSNP, Welfare and shock resilience variables. Chapter five presents statistical analysis and discussion of results. Conclusion and recommendation of the study is given in chapter six.

Chapter Two: Related Literature review

This chapter presents review of related literature. The first section reviews the theoretical literature and the second section present empirical review. Finally, an attempt was made to summarize the discussion of the literature.

2.1 Definition of concepts and terms

In this theoretical review of the literature, concepts such as social protection (safety net), Effect of social Security on households' Economic activity, Social safety Net in developing countries, Social safety Net in Ethiopia, Ethiopian PSNP fourth manual Program objectives, the concept of Resilience, Social protection and Resilience, challenges of resilience building in Ethiopia, the concept of Welfare, Social Protection and Welfare, Welfare in Developing Nations and other related issues are discussed.

2.1.1 Social protection (safety net)

Safety net can be considered as permanent social policy for the future rather than crisis reaction in the form of cash transfer, subsidy in wage, public work, subsidy for housing and energy as we can refer the early history of the then Soviet Union, Poland and Ukraine (Carly Bishop, 2010). Both private and public incentive involves provision of food and cash transfers to the poor and shock vulnerable community. Against livelihood risk to maintain the marginalized social status as well as right can be described as social protection with the overall protective objective. The concept of reducing vulnerability of the poor and marginalized groups from social and economic shocks was emerged in the late 1980s and early 1990s and was conceptualized as minimalist social assistance.

During the 1990s, as thinking on livelihood vulnerability to shock and multidimensional nature of poverty become more shaded and safety net were increasingly considered as sophisticated. Simultaneously, the dominating future of social protection began and concerns were on specifying what social protection can and should strive to achieve. The long-term and sustainable reductions of poverty are the two interconnected response. From the long-term concern of social protection aiming to reduce risk or protecting the poor against income and consumption shocks and also enable them to accumulate asset and invest. The provision of social protection in most low income countries left on the shoulder of government and international donors to alleviate consumption shock of economically inactive economic agents. Therefore, social protections drive public resource from economically productive investment to provision of food and cash which results less attention to social safety net in poverty reduction plan (Stephen Devereux and Rachel Sabates-Wheeler, 2004).

According to *ibid*, there have been some improvement on insurance protection, beneficiaries' engagement risky activities and investments that can result high return and also social protection potentially can mitigate policy change adverse effect (as Cited in Habtamu Ali, 2011).

2.1.2 Effect of social Security on households' Economic activity

Social security systems have two basic functions; which are, alleviating poverty by providing a safety net in time of natural and human made shock and maintaining income for individuals during periods of economic depreciation. Theoretically, social protection and economic developments must proceed together in a way carefully designed to benefit and protect vulnerable considering available resources. Social security is one of the government interventions which are believed to enhance economic development providing health services

that improve community health which is supposed to have impact on productivity (Pierre Plamondon, 2002).

2.1.3 Social safety Net in developing countries

The historical review of Institution of Economic Growth (IEG) on developing countries social safety net program covers more than 100 countries from Latin America, Sub-Sahara Africa, Central Asia, Eastern Asia, Southern Asia, and Europe. Due to the newly surging poverty reduction program most evidences are from Sub- Sahara Africa. According to the review of IEG majority of the protection program taken for the purpose of protection and promotion of human capital followed by un-conditional transfers and progress that can generate income. In some cases programs are combination of activities like Ethiopian which is compose of both DS and PW participation, Labor market program in Poland had both PW and wage subsidy in the form of conditional cash transfer and un-conditional cash transfers were as some designed as only as one way of intervention (IEG, 2011).

Across different dimension of program estimation evaluation of both final and intermediate outcome measures have takes place. Among this labor supply, school enrolment, risk coping behavior, consumption and physical growth are mainly considerable indicators (IEG, 2011).

Recent transformation of Socio-economic conditions have enforces the need for social inclusion, livelihood and resilience. Even though the global economic condition results economic transformation of developing countries still there are community and part of them under poverty trap. So as, to escape vulnerability of economic shocks and political crisis without social protection is unthinkable for those who are systematically un-able to afford basic needs and

vulnerable families facing the trap between immediate survival and irreversible damage to their welfare (Silva, 2012).

2.1.4 Social safety Net in Ethiopia

The early 21st century food aid programs were able to make people sustain the period of shock. But, the programs were not able to bring sustainable asset accumulation at household and community level. So that, it indicates the time was for the newly developed Ethiopian social security program of 2005. Where, policy arrangement with the objective of linking relief aid to social security and development. During this program implementation, the program has brought integrated food security known as PSNP along with voluntary settlement and other food security programs. The social assistant policy aimed at helping poor during structural and economic transformation called safety net; this program was also developed by World Bank as policy in order to mitigate asset depilation and harmful coping action of vulnerable. Even though, social safety net do have different forms to help the case of Ethiopia is directly to food security and is modeled after Bangladesh have launched similar program by integrating treatments (i.e., food-for-work and food aid) to secure chronically food insecure (Bishop, 2010).

2.1.4.1 Ethiopian PSNP fourth manual Program objective

Table 2.1 Presentation of the 4th PSNP manual policy objective and indicators

Policy and objectives	Indicators
Social protection policy Maintaining joyful economic and social well being, security and justice.	1. Proportion of safety net participant from total population found below poverty line. 2. Number of safety net beneficiaries in fee waivers and nutrition related condition.
Disaster risk management Its objective with the context of sustainable development is to reduce risk and impact of shocks via comprehensive and integrated disaster risk management.	1. Failing disaster withstanding asset sell by safety net beneficiaries than non participant under the same condition. 2. Reduction the number of children under malnutrition.
National Nutrition Program Improving nutritional status of women and Children.	Decline in stunting proportion

Adapter from MoA, 2014

2.1.4.2 Ethiopian PSNP fourth manual Program Goal

The fourth phase of PSNP program was developed with goals of creating resilience to shock, enhance livelihood and improve food security as well nutrition of rural household who are food insecure. The program was designed expecting too much contribution of PSNP in securing its objectives in alliance with other programs. The success fullness of PSNP in achieving program goal is assessed through one or more of the below mentioned as assessment indicator

- *Household dietary diversity*
- *Average value of asset holdings*
- *Number of different income sources*

The above indicators will be analyzed to allow comparisons between PSNP clients, control group (or counterfactual) and those who have exited the program (graduates). This will allow an impact assessment of the program on households participating in the program and the contribution of the program to achieve sustainable livelihood security furthermore, data will be disaggregated to assess the differing impacts by gender of household head and gender of the household member participating in livelihood enhancing activities (whether credit or livelihood transfer) (Ministry of Agriculture, 2014, pp 2-3).

2.1.4.3 Ethiopian PSNP fourth manual expected outcome

The major expected PSNP outcome is “*Enhanced participation in improved rural safety net, livelihood and nutrition services by food secure female/male headed households*” (MoA, 2014, pp 3).

PSNP achievement in relation to intended outcomes highly depends on expanded scale of the program which is done to bring improved implementation, introduction of instruments and tools. In advance to maintain better implementation than the preceding phases this was considered as building blocks of the system in a broader good judgment (MoA, 2014).

Based on the objective and outcome of PSNP construction and implementation and the fundamental resilience context (i.e. Absorbent capacity, resolution capacity, adaptation capacity and transformation capacity) which is shortly described above and in detail on background of theoretical and empirical literature reviews the major concern of PSNP in one or other ways is to maintain livelihood and nutrition service of safety net program beneficiaries by improving food security of female/male headed household in the face of any shock that can extend its range from price shock to elongated drought with both direct and indirect effect of shocks.

From the concluding remark of Aboubeker G. Bouker and his colleagues study on factors affecting rural household resilience to food insecurity in Nigeria the result indicates that as their expectation asset and social safety net indicators have results the expected impact. This confirms the hypothesis that household owning more asset score highest level of resilience in addition to the study of Abubaker G. Boukary et al., they have also referred the work by Szabo et al., as confirming study of the hypothesis. Ceteris paribus the strength of being food insecure for the richest household is approximately 0.26 times lower, -0.06 and -0.03 for adaptive capacity and

climate change respectively and 0.05 for social safety net participants (Aboubeker G. Bouker et al., 2016).

2.1.5 The concept of Resilience

The conceptual concerns of resilience have captured attention of scholars. Since, it enable them to develop logical thinking about the system in situation where there is a growing probability of disaster and shock as well growing probability of individual vulnerability due to intensive socio-economic interdependency. In the context of rural vulnerability the systematic concern of resilience made its base on socio-ecological bases (natural resource and environmental); since, poor community and part of community heavily depends on natural resource and environment (Christopher Bene et al., 2012).

Therefore, resilience for such community practically as well conceptually cannot be seen without natural resource and environment. In general term, the remarkable and intuitive ideas of resilience become policy concern that enable policy makers, organizations and technocrats from different sectors to be around the table with unique objective of strengthen community resilience. This intermediary role of resilience is recognized capacity by different and most international development agencies and multilateral donors to create multilateral collaboration. (Christopher Bene et al., 2012). People and systems resilience in Africa requires leveraging knowledge, creativity and scholarship over all resilience of African network to keep warming, test and up grading innovation that strengthen potential and reduce vulnerability indicated by scientific resilience frame work for sub-Sahara Africa (Zewdie Brehanu, 2015).

Disaster resilience management need to direct systems which promote resilience during small disturbance, adaptation in time of great disturbance and transformability when conditions become unsustainable. The importance of linear interpretation does not seem useful to the implementation in multi-stressors nature vulnerability as it is to the conceptual interpretation. Indicating the fact that the occurrence of different shocks simultaneously affecting the system with different magnitude and intensity requiring either separated or integrated level of resilience more over it can have differentiated impact on household being in the same community.

So as, to build resilience need a very detailed concern to insure all the components (i.e., absorbent capacity, resolution, adaptive resilience and transformation resilience) together at individual level, household, community, regional etc this will enable us to see the three components as different values of resilience. Even though there is little understanding about the coping, adapting and transforming ability of different system with different level of complexity changes as well as multilevel linkage within an access at different scale. There have been and is different way of considering the three components so as some considered that there is tradeoff between short term coping and long term productivity and adaptation. Specially concerning climate change, some other also considered resilience far more from coping towards development and coping as a process of transformation with view of resilience as shock absorbing that can change the existing practice. But, also considering resilience as shock absorbing have constrained from transforming it to sustainable development.

Dealing with resilience is either or approach leads to emphasize only one aspect of resilience that ignores the interdependency between all components of resilience. Even-thought, there are certain conflicts and trade off. Taking the three dimensions of resilience as separated motives of

building resilience will kill out the chance on hand if we consider them as part of one rather than independent (Christopher Bene et al., 2012).

2.1.6 Social protection and Resilience

The absorbing capacity, coping capacity, adaptive capacity, transformative capacity being compiled with protection, prevention, promotion and transformative frame work is conceptual evidence that insure social protection introversion can have different types based on their objective and vulnerability type. With the objective of marginalized protective attachment protection through social policy effect by promoting social welfare program are usually based on short term intervention. Such as, provision of food and cash transfer to alleviate humanitarian crisis during shock period. Preventive action can be taken as social or disaster linked policy and safety net policy like that of productive safety net program intervention is to chop off vulnerability of certain community or household from particular shock being in line with protective and preventive action where the deal includes policy intervention to improve income and lively hood. Diversification of program with cash or asset transfers on other hand have problem to adders social justice using policy intervention addressed by transformative measures and this category will fail if have been separated and also overlapping implementation takes place (Christopher Bene et al., 2012).

2.1.7 Resilience as a General Remedy of policy problems

From the implication of different studies conducted by different scholars the concept of resilience has its own limitations such as:-

1. Conceptually resilience is complex and implementation requires the move that cuff-up all resource at hand due to difficulty of irrationalizing and /or measuring it. Therefore, there is a risk of making analytical framework when we try to adopt resilience approach.
2. The unspecified nature of resilience definition and their evolving nature.
3. Over complicated analysis and add up layer of complexity to assess the building nature of resilience to ass the role of social protection program in strengthen resilience of program participant.

Due to the above mentioned limitations we cannot take resilience as general remedy; on other hand there are also resilience theory concerns on how this concept of adapting resilience can be used in academic disciplines as specific concept, specified definitions and applications. Concerning resilience some of the limitations can be eliminated with molding the theories of resilience and supplementing them by other socially-grounded theories such as welfare. (Christopher Bene et al., 2012) One of policy makers' interests is to build resilience at community level by implementing many different projects. It is for this concern, we call resilience is mainly the concern of policy makers in association to coping strategy resilience building involves in providing social protection(PSNP), social transfers and pension programs (Quinn Bevnier et al., 2014).

2.1.8 Challenges of Resilience Building in Ethiopia

Regardless of PSNP positive program impact farmers and traders are still scratch mark of shock vulnerability that still kept the need for on time, full funded, and effective emergency relief. Furthermore, resilience building in Ethiopia challenged by poor infrastructure, logical short fall, limited connectivity, weak-institutional and human capacity. Management related problem and inadequate expertise are the blockages to the county's resilience building efforts in addition to occasional violence in the border areas. (Zewdie Birehanu, 2015)

2.1.9 The concept of Welfare

From the habitually mentioned policy science welfare economics is the dominant one that deals with policy recommendations. With the concern of policy makers' to evaluate policy in actual or simulated market with evidence from available data and reasonable model used empirically; Welfare economics in relation proposed welfare measure to be universally accepted it should have to satisfy three requisites

- 1 In measuring individual or homogenous group, welfare measure is expected to answer policy makers or evaluators objective.
- 2 From empirically estimated pillars of the program welfare measure can be calculated.
- 3 To assess the impact of a given policy welfare measure can be generalized to homogenous group of individuals or external validity² can be considered as stopping

² *External validity describes representative nature of experimental sample of the targeted population. The existence of external valid sample made sure that conclusion from semi experimental and experimental analysis will be extrapolated to population from which this population sample were drawn. (WB, 2011)*

stone for policy impact generalizations based on empirical evidence (Blackorby, C., D. Donaldson and D. Moloney 1984).

As a description of positive economics, it is humankind that have end rather than that of economics. This is human concern of addressing their need with the available scarce resources that will lead us to the search for efficient alternative arrangement and allocation of resources to address given want. The sensible procedure in welfare economics has appeared in a similar way to the choice system of individual and how different allocation and re-allocation can address this requisite of choice which is pronounced as choice criteria index of welfare (Archibald, 1959).

In welfare economics we test the assumption which is ethical and factual instead of conclusions, the ethical assumption involves in introspection and intuition similar to common usage definitions that insure wide acceptability. The intuitional notion of welfare sorts and formalized the widely accepted measure or index of welfare (G.C. Archibald, 1959).

2.1.10 Social Protection and Welfare

In assessing the role of Social Security to mitigate welfare consequences of economic shocks on average with different age, income, wealth and ability of agents this experiment was conducted in two steps.

Step-1 in each model, we calculate the welfare losses due to the exogenous wealth and unemployment shocks. The welfare lost due to the shocks considered as the constant fraction of per-period and future expected consumption (i.e. percent of expected future consumption) that an agent would be willing to sacrifice in order to not to live through the Great Recession.

Step-2 concerning DiD estimation, they calculated the difference in welfare losses a result of shocks between the two economies due to the Great Recession in each of the economy's role that Social Security plays in either mitigating or worsening the effects of the shocks (William B. Peterman and Kamila Sommer, 2016).

2.1.11 Average Social Security effect on Welfare

The comparing average welfare losses of agents living at the time of shocks in the benchmark and counterfactual economies. The benchmark model during recession average welfare for agents' at the time of the shocks face declining expected consumption. In the counterfactual model economy the reduction in average welfare is much larger as estimated consumption. The resulting difference in average welfare losses from the Great Recession between the benchmark and counterfactual economies suggests that Social Security will mitigate a non-trivial amount of welfare losses from this shock (Peterman, 2016).

Social Security effect on welfare due to Great Recession manifests itself through mitigates some of the average welfare losses by reducing agents' exposure to potential expected consumption losses as a result of declining wealth and labor earnings.

On the other hand model without Social Security, counterfactuals are expected to fund all of their post-retirement consumption with saving which are exposed to the shock. Comparing the two groups agents in the benchmark model are less vulnerable to shock. Considering Social Security exacerbating effect of welfare losses because of payroll tax effect on household budget constraints are worsened in an environment where household wealth and earnings dramatically fails. In relation to failing wealth and income William B. Peterman and Kamila Sommer have

examined which age, income, wealth and ability groups benefit the most from the mitigating effects of Social Security during the Great Recession and which loses most due to exacerbating effect of social security (Peterman, 2016).

Welfare effect of Social Security based on Age strata; its effect on welfare losses from the Great Recession on agents of different ages during shock period estimated effects on the broad age categories are agents who are in their prime working ages during shock, agents who are nearing retirement during shock and agents who are retired during shock in specified strata of (ages 20 to 50), (ages 50 to 70) and (ages 70+) respectively estimated Social Security effect exacerbates the adverse welfare effect of the Great Recession for younger agents aged between 20 and 50 with relatively small overall effect. However, estimated Social Security effect on older agents who are either near retirement or who have already retired exhibits mitigating effect on large amount of the welfare losses. On the other hand the effect of Social Security effect on welfare losses due to the Great Recession based on benchmarks' and counterfactuals' economic strata by average lifetime wealth, productivity, ability and labor income the overall estimation indicates similar result for each of the distributions. For the group of agents with greater lifetime wealth, incomes, ability or productivity in general suffer relatively larger welfare losses due to shocks than that of individuals with lower ability, lower income, and lower productivity to the other end of strata Social Security generally mitigates welfare losses for lower ability, lower income, poorer, and lower productivity agents (Peterman, 2016).

Therefore, according to William B. Peterman and Kamila Sommer study in 2016 Social security program is more effective in mitigating welfare loss as a result of shock program implementation in the ex-ante and post-ante shock to any group of agents depict the same positive effect without causing worsening effect on less vulnerable agents.

2.1.12 Welfare in Developing Nations

Welfare economics has potential to provide policy formulation to maximize social welfare as economics of economic policy. In the past twenty years welfare economics was through a big move to clean up its un-scientific elements such as inter personal utility comparison and value judgment. The new welfare economics known as Hiks-Kaldor driven from Parito, the other concept of social welfare function which is associated with Bergson and Samuelson considering conditions deduced by the two approaches of sufficiency in re-allocation to under developed economy. Examining relevancy of social welfare function of under developing economies as have been developed by Burgison and Samuelson who indicates social welfare is driven from the sum up of individual welfare in the community. To the contrary of social welfare-function construction it has little relevance to the extraordinary problems avoiding an under-developed economy. (N. C. Ray, 1954)

2.1.13 System of Welfare in Sub-Saharan Africa

The social security system in sub-Sahara Africa is very difficult to consider it as the traditional European security system especially considering the non-contributory system. However, social security system in sub-Sahara Africa contained complex arrangement in the formal of state system including international donors, humanitarian support, informal network and endogenous risk pooling mechanisms. The social security systems in sub-Sahara Africa have been through different attempts during and after the colonial system which extended match to import social security system. Most of social security in colonial Africa was built after the 2nd world war even though there was some active social security system in France colony through fund for social and economic development. The colonial development and welfare act in 1939 divert the colonialist

attention to build social security department. The post independent Africa social security system was invaded by large number of actors steeping in to various institutional setups. The postcolonial who stated with bigger objective finally realized that it was over whelming; which was indicated by failing per capital income in Sub- Sahara Africa (John M. Luiz, 2013).

2.2 Review of the literature on previous study

The second largest social work in sub-Saharan African country operating with 500 million USD annual budgets undertakes PW- PSNP and OFSP. As the joint program observation shows participants experience swift asset growth than the controlled one. According to the impact assessment by Gilligan et al., (2006), the result suggest that the joint program come out with better achievement keeping the size difference as constant. The benefit from PW-PSNP beneficiaries and PW beneficiaries defers considering not only OFSP and PW beneficiary deference but also among thus groups of beneficiaries receiving OFPS .This evaluation study, however, failed to decompose what contributes to success of the program (Gillingan et al., 2006).

2.2.1 Shock Impact and Risk Management in Developing countries

According to Conrald M. et al, research in Awash River Basin due to severe drought occurs which leads to significantly large decline on crop yield and livestock resulting high proportion of household food in secured and lengthened food unsecured duration. In the region drought periods are predicated to become more frequent causing more severe insecurity. In Awash River Basin the practice of ex-ante adaption in the practice of storage of livestock food, mixed cropping, rearing of drought resisting livestock, usage of short duration crop and soil and water conservation. This indicates the highly responding behavior of small household's economic agent in their crop and livestock management when they face risk of drought (Conrad Murendi et al., 2011).

The consequence of drought in the ex-ante period involves coping strategy such as sales of asset, informal network support, resilience of loan for consumption, and migration of households looking for salary job. According to this study regardless of the before and after drought management practice most of vulnerable households will not back to their initial point or level of consumption as a result of this to strength farmers potential to adoptee and cop with drought there should be enabling policy focusing on delivering production and conservation of livestock food, water and soil conservation practice, strengthening farmers access to formal financial credit, increasing access for metrological information and smoothing consumption during drought (Conrad et al., 2011).

From the study outcome of Fassil and his colleagues the occurrence of drought affects economy with crop failing, subsequent relief, famine and rehabilitation operation. The enveloping and long-draw out nature of the overall problem resulting from drought, failing crop yield and famine indicates elongated dilemma of underdevelopment and poverty. Certainly economic out comes will force on short term emergency survival rather than long-term development however any approach to the dilemma, emphasizing that the first step must be recognized the concern of relief effort is treating the symptom to create sustainability (Fasil G. et al., 1999).

2.2.2 Social Protection in Africa

Having empirical evidence from research by Guush et al which involves in analyzing Ethiopian PSNP impact to assess effectiveness of social protection in Africa they have found that program participant of PSNP range from a year providing tiny transfer to five year with total public work participant median payment of 18 birr. Researchers in this study have matched five year period with 2-5 years of transfer to get estimation result as the estimated difference on change of five year out come with one year payment will give us DID estimation of the program effect and

wide spreading drought. As the result from Guush et al study indicates that due to PSNP intervention food security increased by 1.29 months and reduces hunger session by one third which is statistically significant. Relatively livestock holding for five years participant increased by 0.38 Tropical Livestock Unite (TLU) than one year payment recipients. Their study also indicates that PSNP participation have no crowding out effect on privet transfer and very large joined effect of PSNP and other food security program evidencing 1.5 months increase in food security and by 0.99 TLU of livestock holding. In line with this result description the researchers participating in this in this paper developed different conclusion remarks on social security effectiveness in Africa which are with limited infrastructure and administration resources if the social-safety net program characterized by measurable impacts; Social-safety net program can be implemented. Moreover the program implementation if we can combine social- safety net program with agricultural productivity improving actions we can get larger intended and unintended but, large impact can be produced (Guush B. et al., 2014).

2.2.3 Relevance, Sustainability, Efficiency and Efficacy of Ethiopian PSNP

Objective

The consistency of government objective for safety net as proclaimed by article in plan for accelerated and sustainable development to end poverty (FDRE, 2005) and PSNP manual in (FRD, 2007) as well dialogs between government and Non Governmental organization (NGO's) about the reform to transform from relief to developmental oriented program which highly allied with world bank that makes objective and relevance classified as high (World Bank, 2011).

Intensively monitored provision of food and cash, inflation considering price and real wage as well level of benefit /wage with World Bank large intervention makes the project relevant design considerably sustainable. This project can be mentioned as example for its efficiency in terms of the cost of transforming the SNP to PSNP enabled the project to save almost 11 million USD every year. From the achievement that the project encountered efficiency is considered as sustainable and indicated that it can be most efficient. Level of efficacy is sustainable as it has classified measuring the success of the transformation from emergency provision of food to predictable food aid after 2005 the provision of food become more predictable even though there are some exceptional emergency cases. According to this report “there was progress towards decreasing the upward trend in food in security in 2005 and 2006 although progress was thwarted by the 2008 food price shock and a caseload of 7 millions remain in the PSNP in 2010”. The project was developed and implemented by government of Ethiopia in collaboration with different international organization including World Food Program (WFP) through the project known as Managing Environmental Resource to Enable Transition (MERET) were successful in creating opportunity to generate three kilo grams of wheat per day for those who are chronically face food in-security by involving in public work and direct support. (World Bank, 2011)

This program was also capable to create /build resilience for different shocks ranging from increasing food and fuel price to the distorting environmental and climate changes. MERET was implemented in chronically food unsecured districts Amhara, Dire Dawa, Southern Nations Nationality and peoples (SNNP) and Tigray regions mainly by government and community based selection of participants (World Food Program, 2012).

According to World Bank report PSNP was successful in achieving

Table 2.1 Summary of WB report

Variable	Ranking
PSNP objective relevancy	Highly relevant
PSNP Sustainability	Sustainable
PSNP efficiency	Substantial
PSNP efficacy	Substantial

Own develop from World Bank report, 2011

2.2.4 Effect of Social Security on Welfare

According to William B. Peterman and Kamila Sommer analysis of Social Security effect to mitigate welfare losses as a result of Great Recession has identified two possible mechanisms through which Social Security affects the welfare implications of the shock.

1. The program involves in reducing welfare losses by reducing agents' exposure to the wealth shock which dominates the Social Security mitigation effect on average welfare losses of agents during shock by the equivalent of 1.4 percent of expected lifetime consumptions.
2. Misrepresentation of payroll tax which funds Social Security to enhance during shock when agents tend to face tighter budgets constraints.

Even though, the strengths of the two channels vary across agents, their analysis on welfare losses based on age, income, wealth, and ability strata indicating Social Security is particularly effective in mitigating welfare effects of shock for agents who are poorer, lower ability, lower productive, or older during shock but, the effect of social security younger agents are the only group for which Social Security exacerbates the welfare losses due to the shock. However, its effect is small and a majority of it will be eliminated if government considered payroll taxes as exogenous variable to increase in response to macroeconomic conditions. Social Security in mitigating welfare losses for some of the most vulnerable demographic strata is significantly large, without considerable exacerbating effect on welfare consequences of the shock on other agents.

Exploring the welfare implications of Social Security program require to examine welfare implications of means-tested program in which beneficiaries receive smaller and unrelated compensation to their individual lifetime income to compensate shock this smaller-scale program intervention enables mitigates 0.7% of expected lifetime consumption indicating scope of Social Security program adjustment effect on mitigating the welfare effects and adverse effect in economic activity of vulnerable agents with much lower average long-run welfare costs. (Peterman et al., 2016)

Therefore, from the concluding remark of this analysis that Social Security is effective in providing insurance during shocks; the program effectiveness in mitigating the welfare losses due to shock for vulnerable agents. Social Security effect in the steady state is quite large compared to the mitigating benefits provided by the program during this type of a business cycle occurrence (Peterman et al., 2016).

2.2.5 Impact of PSNP in Asset Building and Shock Resilience

In response to elongated drought in the arable area of Kenya on the side of the traditional input supply program for donation purpose; DFID allying with Catholic relief service (CRS), Food and Agriculture Organization (FAO) and other local organizations launched food seed voucher and fair program for 35,000 households which contributes for crop diversification of farmers, socio ecological resilience and considered as cost effective mechanism to mitigate disaster impact as well effective in creating resilience in post ante concern of social safety net program.

Mark Davies's and his coworkers study in 2008 sighting the study by world Bank in 2004, United Nations Office for Disaster Risk Reduction (UNISDR) in 2004, Wisner 2004 and Taneer et al in 2006 they have provided evidence on that sells of asset among rural poor household considered as the common trend of coping strategy during climate change as well any shock so as effective and sustainable mechanism of disaster reduction is the one which focused on vulnerable rehabilitation in a way which can help them build asset that are potential to build resilience in changing climate (Mark Davies et al., 2008).

From the impact assessment of Guuesh on Ethiopian PSNP classifying beneficiaries in to different groups based on the duration of beneficiaries being in the program and taking the difference between only one year beneficiaries of transfer and five year program intervention beneficiaries to generate impact of PSNP using DiD methodology which shows the contradicting behave of program participant as public work to rising food price effect and wide spread drought effect. From the study outcome of Guuesh PSNP have improved food security by 1.29 months which can be evaluated with equivalent length of food gap reduction by one-third simultaneously it increases livestock holding by 0.38 TLU compared to one year only participant. But also the

joint impacts of PSNP and PFSP/HABP have increased 1.5 months and 0.99 TLU on food security and livestock holding respectively (Guuesh et al., 2014).

With overall plan of PSNP and contribution to policy perspective are concern of Social Protection Policy, the Disaster Risk Management (DRM) Policy, the National Nutrition Program (NNP) and the Climate Resilient Green Economy Policy (CRGE).

Considering PSNP manual following 2002/2003 drought, the Government of Ethiopia form Coalition with international organization to create Food Security which identified mechanisms that can enable vulnerable to break the cycle of emergency appeals to save their lives. Even though, it did little to protect household assets and comprehensively address food insecurity in Ethiopia the interaction of Ethiopian Government with international donors leads to number of initiatives including food and/or cash transfers for food insecure households in chronically food insecure woredas. Via interventions of PSNP annually prior to 2005 and other food security program (OFSP) which involves in providing productive asset from credit participation and invested in socio economic infrastructure aiming at building household assets and enable graduation from the program.

Following the two phases of the program implementation; the first two phases has shown significant expansion and some important improvements of the program design and implementation. Building phase four on the successes and lessons learned from previous phase of PSNP was expanded into Somali and Afar; were made in the timeliness of transfers and the quality of public works which shift from food to cash transfers. The OFSP was redesigned to build household's asset mainly through improved technical assistance, business planning and credit from both formal and informal institution. Through the process of participation in private

sector and strengthening marketing system the current Growth and transformation plan (GTP) by Government of Ethiopia (GoE) aiming at enhancing productivity and production of smallholder farmers and pastoralist which expands the amount of land with irrigation access and minimizing the number of households who are chronically food insecure.

From PSM evidence conducted by Camilla et al in 2009 which assess the impact of PSNP on tree and livestock holding of rural households according to their finding from livestock and tree model PSNP participation do have no statistically significant change in livestock holding and shows the negative impact of income shock on it. Even though, their analyses support the buffer, hypothesis shows the same positive magnitude of PSNP participation and income shock but, it is statistically in significant.

As we can see from tree holding model there is the same sign with livestock holding but, tree holding in comparison to non-participants in PSNP it shows significant incremental change for PSNP participants. To the contrary of livestock and income shock relationship from tree holding model change on tree holding on nonfarm is not affected by income shock indicating that income shock is statistically insignificant. The risk aversion being as the sign indicates have less reliability to be seen as safe alternative to crops and tree holding grow more on less risk-averse household. Even though PSNP participants hold more tree than non-participants; but, being program participant did not have impact on risk aversion (Camill et al., 2009).

Based on panel data from 2002-2007 in three surveys the researchers do have founded that; there was no indication for PSNP participants are involving in negative coping strategy in relation to livestock and tree holding. The researcher also seat possible interpretation for increasing PSNP participants' tree holding. PSNP participants have brought more skill in forestry and due to increasing wood price may have made tree holding more profitable but, farmers may face

constraint of land availability for crop once it has been used for tree planting while PSNP will cover the income gap with known and consistent income source will enable farmers to shift to tree holding and explains negative relationship between risk aversion tree holding (Camill et al., 2009).

Whereas their study did not generate being PSNP participants protects livestock during shock. During shock time households livestock holding declines while tree holding increases for two main reasons that are livestock may die due to drought, livestock are more liquid asset and if households harvest trees during shock they will replace it so as there will not be significant change on tree holding (Camill et al., 2009). In general the short run effect of PSNP was so far success full to increase tree holding but, does not work in a similar way for livestock holding.

The PSM evidence conducted by Zerihun and his correspondents on impact of PSNP on income diversification we can be in sighted with outcomes From 96 household analysis in data set the contribution of income to total household income are 45%,19% , 30% and 6% from farm activities, non-farm activities, public work and off- farm activity income respectively (Zerihun et al., 2012).

The contribution of non-farm income at national level is 6% in rural Ethiopia. This article have used score matching methods with

- Nearest neighbor matching:- matching to the close PS matching for each
- Radius matching and treatment unit the mean figure for the impact variable is used for a member of comparison unit with per defined radius

- Kernel matching :- each unit within the radius allocated a weight inversely proportional to the distance from treatment unit

Impacts of PSNP on non-farm income for PSNP participation have positive effect on off-farm income with a range of 21.6% to 39% at 5% level of significance. For radius matching PSNP participant income increase from seals of natural resources in arrange between 33.6% and 43.7% with 5% to 1% level of significance. For all matching method and On average the estimated impact of PSNP on farm income has negative sign with -36.5%,-37.2% and -44.7% decreasing impact for nearest neighborhood matching , radius matching and Kernel matching respectively with corresponding significance level of 5%,5% and 10% respectively (Zerihun et al., 2012).

According to Zerihun and his colleagues, there are expected two outcomes of PSNP which transform productive livelihood involving in producing households. Which shift from livelihood protection to helping households investing in productive venture and in a long term perspective considering the changing nature of shock. Specifying the need to incorporate risk in relation to climate change related risk in PSNP or other form of social protection program in Ethiopia. The social protection seems dealing with climate adaptation required more optimist income diversification than have been considered in analysis of zerihun and his colleagues (Zerihun et al., 2012).

In general Zerihun and his colleagues study on PSNP is effective in developing natural resource extraction but, the potential effort of PSNP cannot be effective nor have significant effect on income diversification of household.

After 18 months operation the study of Daniel O. Gilligan and his colleagues evidence from PSM on Ethiopian PSNP and other food security program, keeping in mind that its subjective nature to conflict due to short period of operation the analysis is temporary with recall survey to get comparison/ or non-participant data. With expected down ward bias due to deviation between planned and actual of the program the researchers found little evidence of program effect on participant who receives payment for participating in public work. The changes on outcome (asset) have declined to the opposite of PSNP objective; however, PSNP impact for those participants who receive alternative half of their intended transfers get improvement on their food security. The more significant positive impact of being participant were recorded when we consider both PSNP and other food security program together. Being program participant brought major effects which are more likely participants are food secured than non-participant, high investments in agricultural activity, borrow for productive purpose and participate in non-farming business as well there were no evidence on crowding out effect in labor supply of wage employments and private transfers. Even-though the growth of asset did not experience swift growth depending on the continued program participation in PSNP and other food security program participants' asset growth in the future (Gilligan et al., 2008).

As a summary of Daniel O. Gilligan and his colleague's study they have found that PSNP have little impact on average beneficiaries' asset growth and recommended that if PSNP transfer were done being integrated with agricultural support it will be more effective in maintaining food security and production in both farm and non- farm economic activities as well future asset growth.

From Devereux study particularly on PSNP beneficiaries' use of only food and only cash transfer beneficiaries use of food transfer out of 663 observation 88% of them consumes all food items they received as a program intervention. For either food only or food plus cash transfer only minority of participants sold 93% of their food generated from being PSNP participant and consume the remaining 7% the majority of food only participant household more likely to involve in selling food items received from the program with 11% and 6% of food only and both food and cash receiving agents respectively due to households motive to meet urgent non food needs.

On the other hand, use of PSNP beneficiaries of cash transfer in relative to food only beneficiaries used in much more diversified way based in classification by income level of households majority of beneficiary used 80% of their cash for staple food and other food takes 11% of it. Over half of program participant in the second income category used almost 59% of cash for grocery food and some 41% buy clothes, 29% used for health service, 15% for education, and 16% and 15% of beneficiaries used for debt and tax payment respectively as well closer to 8% and 1% of their cash invested in livestock and other business investments respectively. From the result we can generalize that across income inequality spending of cash transfers there is considerable striking difference between low income and high income inequality indicating that the spending on staple and other food spending were dominated by poorer groups but, the spending on groceries and cloth by all group of PSNP cash only beneficiaries are more or less show the same trend and across wealth group we can see better off in taking care of their social obligation in wealthier group than poor community group (S. Devereux et al., 2006).

Therefore according to Devereux et al. 2006 from the cross sectional evidence that cash only recipients are found with high current asset value than only food and both food and cash program recipients indicating that growth of welfare.

As Cary B. et al, 2010 evaluates the transition from food aid to food security: The case of the Safety Net policy in Ethiopia this study on PSNP provides evidence to show the linking reality to development through efficient provision of food aid to resolve food insecurity with crucial monitoring the practice of such programs and policy. Cary B et al also made indication to focus on how such policy translate to program and how to keep efficiency of implementation chain and Finally they comment to give more focus how the recruitments to be made keeping in mind that peoples for this program will be selected based on severity of the effect that they face not based on their political involvement (Cary B. et al., 2010).

PSNP 2nd public work impact assessment by Metaferia Consultancy engineering in 2013 the program was successful in degraded and bard land rehabilitation, reducing woman's burden of searching for water even though it is not for pastoralist area. Due to benefits from environmental rehabilitated land livestock and milk production has increased. It has brought high infrastructural development increases productivity due to knowledge sharing from PW and this study has recommended on time payment, provision of training that can build capacity of participants and revision of payment (MoA, 2013).

PSNP, phase 3 PW impact assessment in 2015 by SuDCA and Sobra land consulting association joint venture impact assessment of the program have demonstrated progress in access to Education, road, small scale irrigation, water supply and health post as of the program and recommended that there must be a very close supervision as any project to avoid low quality of layout, design and construction (MoA, 2015).

Social cash transfer eligible household in Malawi were not self sufficient even though they involves in agricultural activity. The rising food price and poor agricultural conditions which worsened food security that made households welfare in bad condition even if, government and Non-government have reached household in their program and food consumption. Social cash transfer program eligible where dependent on their relatives and community support at large. Even though, many household have credit constraint but, those who have the access to loan use the money for food consumption or health purpose.

In the concern of improving household consumption and maintaining general welfare especially in the face of shock, the role of cash transfer was very important. Households may become more self reliant and resilient if the program enhance their ability to invest in productive activities involving in both farm and non-farm activities (Kelly Kilburn and Sudhanshu Handa, 2015).

2.3 Summary and Conclusion of Literature Review

From the above both theoretical and empirical review of literatures that the researcher have tried to address most economic and geographic division of nation around the world from which some studies are conducted by the most leading international organization and some are conducted by individuals who have extensive exposure and experience in relation to PSNP. The impact of PSNP has achieved its objective from some perspective but, also it has lost its objective on some PSNP participants. The researchers in all the studies that the author have had reviewed recommended further studies to see the long run impact of PSNP as well with different method then they have used to control for sort of observed and un-observed effect to avoid potential source of bias. Therefore, this study will assess the impact of PSNP on Environmental shock resilience and households' welfare evidence from panel data with difference-in-difference method and the newly developed BC method.

Chapter Three: Methods of the Study

3.1 Source of Data and Data description

The researcher used panel data from 2006-2014 produced by International Food Policy Research Institute (IFPRI) in five rounds (2006 round-1, 2008 round-2, 2010 round-3, 2012 round-4 and 2014 round-5). The panel household survey of both beneficiaries and non-beneficiaries from the same economic agents, community and woreda survey using key informant interviews, focus group discussion and household case studies to generate qualitative studies was under taken. The longitudinal survey data collected at household and community level covered four regions: Tigray, Amhara, Oromiya and southern Nations, Nationalities and peoples region (SNNPR). To ensure balanced nature of data they have exerted considerable effort to create the same comparability over time-survey time, core questions and core team since 2006. (Alemayehu Seyoum, 2015)

The author used the same source as Guuesh et al., 2014 used to study impact of Ethiopian PSNP to prove whether social protection is working or not in Africa. The impact evaluation of PSNP on resilience and welfare will conduct.

Following the period July-August 2006, between late May-early July 2008, Jun- July 2010, 2012, and 2014 have been through bulk intervention in conducting survey to generate the first, second, third, fourth and fifth survey which produced the five round survey data respectively. Keeping structure and content of the questionnaire largely unchanged across survey rounds ensures that comparability of mean outcome changes are not due to change on types of questions used to produce this dataset.

The sampling was conducted based on randomly selected sample woredas from list of chronically food insecure woredas which were stratified by region covered with PSNP in 2006³ from which kebeles was randomly selected as Enumeration Area (EAs). In each EA, from separated list of beneficiaries and non beneficiaries, 15 and 10 household were selected respectively that yields a sample of 25 households per EA which produces 146 and 14.8 percent EA and attrition respectively. The sampling questionnaire was complimented by a questionnaire administered at community level covering topics related to location and access, water and electricity, education and health facility, service, migration, wage, production and marketing, food grain price ⁴ in the last year and PSNP operational aspect.

3.2 Descriptions of Variables and Expected sign

The empirical models that the author has designed to estimate the model has included socioeconomic factors. The model that the researcher has derived from empirical analysis on PSNP impacts by different individuals and organizations. It includes two dependent variables which are welfare and resilience. The independent variables explaining resilience and welfare included as explanatory variable are household head characteristics, different social, economic and natural shocks, Coping strategy index, and adaptive strategy index.

³ *Note that this design means that we exclude woredas that were added to the program after 2006 (Guush, 2014)*

⁴ *A price questionnaire obtained detailed information on current food prices (Guush, 2014)*

Table 3.1 Description of Dependent Variables

Dependent Variables					
Variables Name	Description	Type	Unit of measure	expected sign	
				Welfare	Resilience
Food gap	food gap: number of months	continuous	months		-
Total asset	Total real value of asset: birr	continues	Birr	+	+
Per capita expenditure	Per capita expenditure:	continues	birr per month	+	

Table 3.2 Description of Independent Variables

Independent Variables					
Variables Name	Description	Type	Unit of measure	expected sign	
				Welfare	Resilience
household characteristics					
Age	Age of household:	stratified	Years	+	+
Gender	household head sex:	dummy	1 = male 0=otherwise		
Marital status	household head marital status:	dummy	1= if married 0=otherwise	+	+
Literacy	heads education:	continuous	Years	+	+
household size	member of household:	continuous	Number	-	-
Asset					

land holding	household owned	continuous	hectare	+	+
	land size:				
TLU ⁵	household owned	continuous	weight	+	+
	livestock on SVY:				
production	real value household	continuous		+	+
asset	owned production				
	asset:				
Institutional setup					
extension office	there is extension office in the community:	dummy	1=if EP available 0=otherwise	+	+
electricity	electric power availability:	dummy	1=if EP available 0=otherwise	+	
Piped water	Availability of clean water:	dummy	1=if clean water 0=otherwise	+	
health post	Availability of health center:	dummy	1=if health center 0=otherwise	+	
primary school	Availability of primary school:	continuous	Kilometers	+	
Dist_nt	Distance from the nearest town:	continuous	kilometers	+	-

⁵ TLU equals 1 for cattle, horse, and mules, 0.15 for sheep and goats, 0.005 for poultry, 0.65 for donkeys, and 1.45 for camels (Ramakrishna and Demeke 2002 sighted by Guush 2014)

high school	distance from high school:	continuous	Kilometers	+	
Other					
Credit market	credit market participation:	dummy	1=if participant 0=otherwise	+	+
Off farm activity	participation in off-farm wage employment:	continuous	Birr	+	+
nonfarm activity	self-employee:	continuous	Birr	+	+
Dratio ⁶	Dependency ration:	continuous	number		-
Indices					
Shock index ⁷	Vulnerability to shock: continuous		number		-
CSI ⁸	Coping strategy index: continuous		number	-	+

Own compute base on Adapted from Aboubeker G. Bouker et al, 2016, MoA, 2014 and Paul Spicker, 1998

⁶ Dependency ratios is computed at household level which is equal to

$$Dratio = \frac{age\{(0 - 15) + above\ 60\}}{age(15 - 60)}$$

⁷ Shock index is calculated taking the ratio of shocks faced by PSNP beneficiary households to total variance or sum of eigenvalues.

⁸ Coping Strategy Index refers to the ratio of households coping strategy (sells of production asset, durable asset, livestock and land) to sum of eigenvalues.

3.3 Method of data analysis

In this section, readers can find brief discussion on the theory and application of DiD methodology, alternative method for impact evaluation, model specification and testes, modeling and justification for indicators of analysis.

3.3.1 Difference in Difference Method: Theory and application

Since, access to PSNP is delivered based on some criteria being PSNP cannot be considered as randomized. Therefore, in this study the researcher used DID method that will better mimic randomization and enable the author to get with and without comparison among participants of the program. With the availability of base line data researchers can estimate project, program or policy impact using DiD method. Assuming fixed effect un-observed heterogeneity and un-correlated with treatment over time. Which is weaker assumption of conditional independence and may make the outcome change for a comparable group of the control group (i.e., $E(Y_{1i} - Y_{0i} / T=0)$) as proportion counter factual which is equal to $(Y_{i1} - Y_{i0} / T = 1)$.

The regression framework for DiD can be specified as follows:

$$Y_{i1} = \alpha + \beta T_{i1}t + \rho T_{i1} + \gamma t + \varepsilon_{it} \quad \dots\dots\dots 3.1$$

The coefficient β on past program interaction between treatment variable (T_{i1}) and time ($t = 1 \dots T$) produces the average effect on program participants where the impact= β and variables T_{it} and t are included separately to take separate mean effect of being targeted and not targeted.

$$E[Y_1^T - Y_0^C / T_1 = 1] = (\alpha + DD + \rho + \gamma) - (\rho + \gamma)$$

$$E[Y_1^T - Y_0^C / T_1 = 0] = (\alpha + \gamma) - \alpha$$

DiD will be un-biased if and only if potential source of selection biases are additive and fixed

Basic assumption for reliable DiD analysis

1. The model is correctly specified
2. The error term is un-correlated with other variable in the equation

$$\text{Cov}(\varepsilon_{it}, t) = 0$$

$$\text{Cov}(\varepsilon_{it}, T_{it}) = 0$$

$$\text{Cov}(\varepsilon_{it}, T_{i1}t) = 0$$

3. Parallel- trend assumption which indicates that un-observed characteristics affecting program participation do not vary over time with treatment status. (Shahidur R. Khandker et al., 2010)

In this study the researcher has used five rounds panel data for analysis: keeping in mind that the effectiveness of using panel data highly depends on balanced nature of the data. The intension of using Difference-in-Difference (DiD) model with is to control unobserved behavior that can be potential source for heterogeneity (Vella and Verbeek, 1998). DiD is also in to handling missing data problem since it measures out come and covariates for both beneficiaries and control groups in both before and after treatment (Khandker et al., 2010).

Therefore, double D approach will enable the researcher to generate consistent estimate of PSNP effect on Environmental shock resilience and household's welfare of PSNP participants in Moist Dega, Moist Woina-Dega, Dry Woina Dega, Dry Kola, Moist Kolla, and Moist Bereha of Ethiopia.

$$Y_{it} = \beta_0 + \beta_1 T + \beta_2 P + \beta_3 (T * P) + \beta_4 X'_i + \varepsilon_{it} \dots\dots\dots 3.2$$

; where X is vector of other controlling variables

$$DD = \{ [E(Y_1/X, D = 1) - E(Y_0/X, D = 1)] - [E(Y_1/X, D = 0) - E(Y_0/X, D = 0)] \}$$

Where; D = 1, and D = 0 correspond to beneficiaries and control group, respectively

Table 3.3 Tabular Presentation of DiD methodology

	Treatment	Non-treatment
Before =0	$\beta_0 + \beta_1$	β_0
After =1	$\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4$	$\beta_0 + \beta_2 + \beta_4$
$DD = (\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4) - (\beta_0 + \beta_1) - (\beta_0 + \beta_1 + \beta_4) - \beta_0$ $= \beta_3$		

Computed from (Khandker et al., 2010)

In general, the impact of treatment can be derived from a comparison of treated with none treated for before and after the treatment period. The first difference avoids unobserved fixed effect and control for unobservable (time invariant) differences between individuals and the second difference compares treated with untreated individuals assuming that the time effect are common across treated and untreated individuals (Shahidur R. Khandker, 2010).

3.3.2 Principal Components Analysis

Principal component analysis (PCA) is the mechanism by which we can change large number of variables in to a smaller dimension. Using one of the statistical techniques involves in transforming “N” set of correlated variables to uncorrelated components/ indices. Keeping in mind that indices are linear weighted combinations of initial variables.

$$PC_1 = a_{11}x_{11} + a_{12}x_{12} + \dots + a_{1n}x_n$$

$$PC_1 = a_{m1}x_{m1} + a_{m2}x_{m2} + \dots + a_{mn}x_n \dots\dots\dots 3.3$$

Where, a_{mn} is weight of m^{th} PC of n^{th} variable

The eigenvector of the correlated matrix are weight of each principal component (PC) with descending order of possible value of variation total in original data. Were variations are subject to squared weight (i.e., $a_{11}^2 + a_{12}^2 + \dots + a_{1n}^2$) equal to unit. Considering that the sum of eigenvalues equal to initial data set quantity of variable $\frac{\mu_i}{n}$ represents proportion of total variation of data set PC explaining component1. The second component representing completely uncorrelated variation and explain additional variation which is less than the first component variation subject to the same constraint. Since, sub components are uncorrelated to the previous components that indicate us every component capture additional dimension in the data set even though the variation gets smaller and smaller as we pass to the next component (Seema Vyas and Lilani Kumaranay).

According to Seema and Lilani justification citing the work of McKezie 2003, that the situation under which distribution of variables vary across cases or households and are correlated. This, made the use of PCA more significant with higher weight given for those who have larger inequality of asset distribution across observations on the PCA and the vice versa (i.e., Zero standard deviation indicates no variation across household or will have zero weight on PCA and have little use in differentiating indices).

3.3.3 Fixed Effect and Random Effect Model

The structure of Fixed Effect (FE) and Random Effect (RE) model may restrict heterogeneity between units without full generality. Particularly are concerned with restricted constant slope of coefficients over unit and time. It allows the variation of coefficient's intercept by unit or time.

$$Y_{it} = X_{it}\beta_i + Z_{it}\delta + U_i + \epsilon_{it} \dots\dots\dots 3.4$$

Where X_{it} is $1 \times K$ vector varying over time and observation;

β_i is $1 \times k$ vector of coefficients on X_{it} , Z_{it} is $1 \times p$ vector time invariant variables that vary only over observation δ is $p \times 1$ vector of coefficient on U_i , Z_{it} is individual level effect and ϵ_{it} is disturbance term.

Random Effect (RE) indicates that U_i are uncorrelated with the regressors and individual level effects are simply parameterized as additional random disturbance. But, if U_i are correlated with regressors it is called FE. This indicates that the estimation strategy is to treat them like parameters or FE. Even though, including a parameter for every observation is not feasible. Since, it may result in infinite number of parameters in our large N (Christopher F. Baum, 2006).

Therefore, in a panel data analysis, if the individuals' models are correlated with other regressors FE models are consistent. If there is no correlation between individual effect and other regressors both models will be consistent but, it is only RE model is efficient.

3.3.4 Hausman Test to Specify Model

The Hausman test is used to decide whether fixed effect model or random effect model to be used in the panel data analysis. Since this test in analysis of data over time considered as model specification test it, is potential to give possibility of choosing model with null hypothesis. Random effect model is preferable and alternative hypothesis specifying the fixed effect as preferable model. Mainly the test will be undertaken to test the correlation between regressors' and the unique error term in the model. This test under its null hypothesis will specifies uncorrelated error term and explanatory variables. Estimate this "artificial regression" by least squares, and employ the usual t-test for the hypothesis of significance and the test will be an F-test of joint significance of the coefficients of included residuals when more than one variable is suspected.

$H_0: \delta = 0$ (*no correlation between unique error term and explanatory variables*)

$H_1: \delta \neq 0$ (*correlation between unique error term and explanatory variables*)

Or H_0 : *Random effect is preferred (there is no fixed time effect)*

H_1 : *fixed effect is preferred (there is fixed time effect)*

$$\text{Hausman} = \hat{\beta}_{RE} - \hat{\beta}_{FE}$$

(Chmelarova V., 2007 and Green, 2008)

3.4 Description of indicators used in the analysis

This section presents review of related literature. Which present justification on indicators based on theoretical as well empirical discussion and try to present reasons for the need of using different indicator of analysis based on facts.

3.4.1 Indicators of Resilience

Due to the continuous nature and absence of specified rules to measure resilience defining specifications to assess is mandatory in measuring value of alternative ways of building resilience for recurrent shocks. In priority to program beneficiary's evaluation of programs there must be dedication to assess intervention impact in a way that can intensively examine activity that has significant effect in response to potentially eligible group's interest in relation to impact of program. Impact assessment modeling of resilience should brief four major concepts

1. Context specification: - resilience measure in-particular must be in its local context and nature.
2. Shock-dependent: - resilience measure should have baseline assessment and shock dummy in particular to this study the occurrence of shock (1 if there occurs shock and 0 otherwise).
3. Robust indicator: - there should be explanatory variable for difference in level of resilience among different community and household.
4. Out-come oriented: - assessment of resilience must move beyond measuring out-put of program (discussion---

The two categories of disaster resilience modeling which are classified based on defining and measuring resilience level are

- I. Resilience modeling approach that can grasp and describe in system wide concerns which mostly applied by DFID, Technical assistant to non-governmental organizations (TANGO), practical actions, and others.
- II. Resilience model which is concerned in-particular to define and measure community level resilience characteristics used and designed by Food and Agricultural Organization (FAO), Oxfam, Tulan University and others.

In addition to the above two basic categories we have Community Based Resilience Analysis (CoBRA) model designing take some from mode that can describe and capture system wide approach and some from model that can enable researchers to define and measure resilience characteristics at community level; since it can be considered as hybrid of the two resilience modeling to have the best explanation and measure of resilience dedicated to beneficiaries interest from the intervention in addition to participatory and community based design of BoCRA (DRRAP__).

Identifying empirical evidence which shows factors contributing for, in which context and to which type of shock is essential to build resilience at a significant level such as household, community and national level. Following the work of Abubakar and his' friends developing resilience index based on principle components analysis need to include income, food expenditure, duration of grain holding and livestock holding measured in tropical livestock unit (TLU).

Table 3.4 Empirical description of variables explaining Resilience

Variables	Measurement Unites	Hypothesized relationship with resilience
Income	Household earning	Households' high income indicates greater level of resilience
Food expenditure	High food expenditure	Buying food in rural indicates lack of food production but, high expenditure indicates enhanced wealth level.
Farm size	The size of farm land during rainy season	The higher farm land the higher food production and high income level indicating higher food insecurity resilience
TLU	Number of livestock holding	Since livestock is the most liquidated asset higher number of livestock indicates better resilience capacity
Stock	Stock duration of grain	The long lasting stock of grain in store indicates households capacity of resilience to food shortage

Adapted from Aboubeker G. Bouker et al, 2016

The principle component analysis indicates that the higher resilience index value the more the household are resilient and the vice versa holds. With the algebraic notation of resilience index representing household i:

$$R_i = F(A_i, CSI_i, SSN_i, CC_i)$$

Where R_i is resilience

A_i is asset at time t

AC_i Is adaptive capacity of households'

SSN_i Represent social safety net and

CC_i Climate change the index using principle component analysis will resolve the latent variable nature of resilience unlike A_i, AC_i and SSN_i (Aboubeker G. Bouker et al, 2016) .

From the articulation of the program objective at the level of policy objective, program goal and program outcome PSNP plays significant role but the role varies across levels. Concerning policy objectives PSNP was assessed as playing major role from the perspective of program goal PSNP has played great role in relation to other interventions and PSNP impact assessment was and will be conducted through its regular impact assessments. The program outcome on the other hand is within the PSNP's ability to deliver

$$CSI = (IFA, AB, AST, S)$$

Where:

CSI is coping strategy index. CSI is one of the sophisticated measures of food security that can help us in monitoring and indicating the extent of food insecurity which can be used for program oriented decision making. CSI as well have been used to measure the impact of program interventions including food aid and household food insecurity indicator (Daniel M. and Richard C. 2008).

IFA is income and food access measured in terms of expenditure per capital

AB is access for basic service measured in terms of distance form irrigation canal

AST is asset measured in terms of agricultural tools, Agricultural Wealth Index, Wealth Index, land and number of cattle (such as agricultural equipment, and non agricultural equipment)

S is sensitivity of hh vulnerability to shock measured using proportion of income from shock mitigation activity (FAO, 2011)

Considering the contribution of social protection to asset building through conditional and un conditional cash transfers, microcredit and direct provision of livestock throughout the design and implementation of “reducing vulnerability to climate change”(RVCC)⁹ project improves asset commutating capacity that directly improve income level and proved to be resilient during climate change (Davies et al., 2008).

Beginning with evidence of 2010 crisis during post harvest and difficult food period of Nigeria in December and April respectively Anderson and Philip illustrate the evolution of food insecurity. According to their finding to appreciate dynamic nature of food security analysis researchers need to do it in intra annual periodicity that can allow entirety of program dimension. Besides, as Anderson and Philip describe on their conclusion the relation between the food insecurity and food systems is inversely proportional. Keeping in mind that, the population of the agricultural and agro-pastoral systems is most vulnerable than the pastoral systems. Regardless of the intra-annual variability, coping strategy index analysis has demonstrated that the Tahoua found with most of the strategies and the most vulnerable with fewer coping strategies. In the coming evaluation of food security should integrated vulnerability and resilience with coping strategy since different coping strategies are fundamental to analyze food security (Andres Ludovic and Philippe Lebailly,).

Measuring resilience in-terms of food gap with inversely related magnitude (i.e., resilience declines as food gap increase) is reliable in assessing PSNP impact on resilience than measuring it in-terms of asset accumulation effect of the program; since volatility of asset price mainly the

⁹ For Reducing Vulnerability to Climate Change (RVCC) project detail see Mark Davies et al, (2008), “Adaptive Social Protection: Synergies for Poverty Reduction”, IDS volume 39 number 4, institution of development studies for more detail.

failing value of asset in birr due to any shock effect which can be considered as direct or indirect effect on asset eg. The falling effect on cattle price from average 10,000birr for an oxen to 600 birr for an oxen of Borena farmers during the 2017 drought which exposed over 5.6 million people for food insecurity (VoA and FBC, January, 2017).

Therefore, based on newly developed measure of Barrett and Constaz applied by Joanna B. Upton et al., 2016, responding to statement of FAO the continuous nature and absence of specified rules to measure resilience defining specifications to assess is mandatory in measuring value of alternative conduct of building resilience for repeated shocks. In priority to program beneficiary's evaluation of programs there must be dedication to assess intervention impact. In a way that can intensively examine activity that has significant effect in response to potential eligible group's interest in relation to impact of program. Impact assessment modeling of resilience should brief four major concepts as the researcher has reviewed on section 2.1.5.

$$R_{it} = \beta_0 + \beta_1 PSNP_{i1} + \beta_2 Period_{it} + \beta_3 (PSNP_{i1} * Period_{it}) + \beta_4 SI + \beta_5 CSI_j + \varepsilon_{it}$$

Where R_{it} is Resilience of household at time t in terms of asset holding and food gape. Adapted from the study of Guuesh, 2014; Aboubeker G. Bouker et al., 2016; Daniel M. and Richard C. 2008 and Mark Davies et al., 2008 the researcher have take variables and used method of Joanna B. Upton, 2016.

Where i; represents household

t; time

T_{i1} ; Post ante program treatment variable

ε_{it} ; The error term this is defined above

3.4.2 Indicators of Welfare

From the mostly mentioned policy science welfare economics is the dominate one that deals with policy recommendations in policy makers' concern to evaluate policy in actual or simulated market (Blackorby et al., 1984).

Hitherto index, calculation of sustainable economic welfare which is developed for United State of America by Daly and Cobb in 1996, Sweden by Jackson and Stymme in 1996, Scotland by Moffatt and Wilson in 1994 and Austria by Stockhammer et al. in 1997 have served as baseline analysis for Poland index calculation. Taking the critics of Cobb and Daly into consideration Poland's index calculation was implemented. The need for index of sustainable economic welfare (ISEW) arises from the critics of Gross Domestic Product (GDP) to capture indicators of either current welfare or capacity to provide non-declining future of welfare. Since, GDP did not capture household labor value, the welfare effect of income inequality and environmental degradation which caused loss of welfare and miss leading consideration of defense expenditure as contribution for welfare. The need for ISEW mainly concerned with comparison of social, environmental and economic aspect of sustainable welfare which are

Table 3.5 Empirical description of Welfare indicators

Environmental component	Social component	Economic component
- Pollution	- Distribution of income	- Consumption
- Long-run		- Capital growth
environmental		
degradation		

Computed from (Robert P. Wicz and Jerzy S. Zynki, 2006)

Even though there exists number of supporting argument on ISEW, Genuine program indicator (GPI) and related index it need continues and robust improvement that can contribute for broader acceptability. Moreover, the growing need for standard technique for welfare comparison of different nations brought the concern to index development. Keeping in mind the critic on ISEW with different assumption about weighting of income distribution, depletion of nonrenewable resources, including the effect of human capital, long run environmental damage and technical progress there will be different view about social welfare and sustainability.

Assumption of welfare index

1. Components of economic welfare index for represented period were calculated in current price as have been used by Daly and Coob.
2. Component index represented in a form of streams and apply the same method as have been calculated Stockhammer et al.
3. Selection of index component based on their importance for welfare level in relation to the economy.
4. Whenever there is the need to include missing data to the construction of complete time serious perturbation will be used. (Robert P. Wicz and Jerzy S. Zynki, 2006)

Considering over time modification on Index of Sustainable Economic Welfare (ISEW) Roberrrt and Jerzy in 2006 calculate and assess ISEW of Poland for the year 1990-2003 based on the shape of curvature and change on index value they have analyzed Poland's sustainable economic welfare. The distributional in equality index indicating welfare and welfare disparity within the society and population growth measures ISEW per capita. As the result of the analysis Poland

have had faced the lowest ISEW in 1990 which show growing trend in 1992 and slow down in 1997 and also moderate tendency recorded in 2000.

For ISEW stagnation the additive effect of commuting and road accident, long term environmental damage, consumer expenditure durability, net international position change, non renewable resource depletion moreover, the declining ISEW were arises from growing welfare in equality. ISEW and GDP per capita of Poland in the same period analysis shows contradicting outcomes which finally lead to conclusion keeping the assumption and the method of computing sustainable economic welfare index is recommended than computing GDP. In general, to the contrary of traditional positive economic indicators analysis for the case of Poland in 1990's the outcomes recommends careful revision on some social and economic problems which seem unsustainable in analyzing the ongoing economy as well negative trends require deep discussion of analysis (Robrt P. Wicz and Jerzy S. Zynki, 2006).

As a constitute of welfare, Welfare policy in a material form included level of money, goods and services received as income program participant in measuring household welfare. This definition of welfare was driven assuming the level of income which is directly associated with level of consumption. In addition to this less common approach of welfare measurement is derived from the level of asset. Since, considering preliminary asset theory suggest that asset may have certain effect on welfare in-terms of providing stability, creates orientation about the future, stimulating human capital development, enables household to take risk, increase social power and political participation as well enhancing the welfare of off spring (Michael Sharnden, 1999).

According to Michel Sharnden (1999) he has suggested that it is to be considered as high-quality and effective approach if researchers derived household welfare from accumulation of asset and percapita expenditure on consumption.

$$w_{it} = \theta_i + \theta_1 PSNP_{i1} + \theta_2 Period_{it} + \theta_3 (PSNP_{i1} * Period_{it}) + \varepsilon_{it}$$

W_i ; Welfare of household at time t measured in terms of asset holding and per-capita expenditure
(Adapted form study of Blackorby et al., 1984: Michael Sharnden, 1990 and Robrt P. Wicz and Jerzy S. Zynki, 2006)

Where i; represents household

t; time

W_i ; Welfare of household at time t in terms of asset holding and per-capita expenditure

Ti1; post ante program treatment variable

ε_{it} ; the error term which is defined above

Chapter Four: PSNP, households' Resilience to Environmental shocks and Welfare: Descriptive Evidence

In this chapter, the researcher has explored the impact of Productive Safety Net program on households' resilience to Environmental shocks and households' welfare using panel data from 2006 to 2014 produced by International Food Policy Research Institute in five rounds. Before discussing regression result the author present descriptive statistics of variables used in this study.

The variables in this study are classified in to four extinguished categories: household characteristics, asset, institutional setup, indices and other relevant variables. The first category includes characteristics of households such as age, sex and marital status, level of education, household size and dependency ratio. Size of land holding, livestock owned and real value of household production asset are classified under the second category. Availability of extension office, access to electric power, piped water, distance from health center, high school attendance, primary school attendance, participation in credit market, participation in off-farming, wage employments and self employments are in the third category. The fourth category includes vulnerability to shock index and Coping Strategy Index.

4.1 Descriptive Statistics of Coping Strategy Index analysis

Table 4.1 and 4.2 below, shows the correlation among preferred variables by households as a means to over passing shocks satisfying their food demand and emergency needs as well mean values and frequency of observation respectively.

Table 4.1 Presentation of CS variables correlation

	Var. definition	Disell	Disell	Disell	Disell	disren~d	disren~y	d~k_food	disell
prd~d	Sells of production asset for food	1							
prd~y	Sells of production asset for emergency	0.47	1						
dur~d	Sells of durable asset for food	0.45	0.39	1					
dur~y	Sells of durable asset for emergency	0.31	0.39	0.56	1				
la~d	Rent/sells of land for food	0.12	0.17	0.21	0.13	1			
la~y	Rent/sells of land for emergency	0.16	0.21	0.15	0.14	0.60	1		
lvs~d	Sells of livestock for food	0.03	0.03	0.04	0.05	0.001	-0.02	1	
lvs~y	Sells of livestock for emergency	0.08	0.10	0.10	0.11	0.04	0.05	0.53	1

As we can see from coping strategy descriptive analysis, households' involvement in selling the same kind of asset for the same purpose is highly correlated than selling different asset type for different purpose. That is, as the first column shows the correlation between sells of production asset for food purpose with itself is a unit indicates exact correlation. Whereas, the correlation between sells of production asset for food purpose with sells of production asset for emergency need, sells of durable asset for food purpose, sells of durable asset for emergency need, sells/rent of land for food need, sells/ rent of land for emergency purpose, sells of livestock for food need and sells of livestock for emergency purpose are less than a unit and vary due to the variation of purpose and types of asset preferred by households. Also, selling the same asset type for different purpose is highly correlated than selling different asset type for the same purpose (i.e., for food purpose or emergency need). Even though, there is large difference in measure of variance but, it would make theoretical sense to analyze the covariance matrix of the variables since they are in commensurable units.

Table 4.2 Frequency and average of CS variables

Variable	Variable Definition	Obs	Mean	Std. Dev.	Min	Max
disell_prd~d	Sells of production asset for food	2370	0.021	0.143	0	1
disell_prd~y	Sells of production asset for emergency	2304	0.014	0.120	0	1
disell_dur~d	Sells of durable asset for food	2304	0.017	0.132	0	1
disell_dur~y	Sells of durable asset for emergency	2304	0.013	0.113	0	1
disrent_la~d	Rent/sells of land for food	2301	0.041	0.198	0	1
disrent_la~y	Rent/sells of land for emergency	2304	0.034	0.183	0	1
disell_lvs~d	Sells of livestock for food	2304	0.461	0.498	0	1
disell_lvs~y	Sells of livestock for emergency	2303	0.275	0.446	0	1

In the analysis of the covariance, sells of livestock asset for both food and emergency need have dominated the covariance analysis with average values 0.461. Since, livestock holding in the rural community are considered as the most liquidated asset (Deveruex, 2006). Indicating that, more than 46.1 percent and 27.5 percent of households' most preferred commodity type to maintain food demand and emergency situations than any other asset type respectively.

From appendix A1a, There are two panels in the Principal Component Analysis (PCA) which contains Eigenvalues of correlation matrix in a descending value of possible variation from original data subject to squared weight equal to one and the corresponding Eigenvectors respectively. The sum of Eigenvalues over variance of the original variables in the analysis gives us the total variance of variables from original data. Due to the need of analyzing correlation matrix, the variables are standardized and have a unit variance with a total variance of about 8 units. The variance of the principal component is explained in-terms of Eigenvalues. Having a variance of 2.58 explaining 32.27%, 1.52 explaining 18.97% and 19.9% of total variance in the first, second and third principal component respectively with uncorrelated nature of the principal components. Considering the correlation between the first and second components as zero (i.e., $\text{Cov}(\text{comp1}, \text{comp2})=0$) explaining 51.24% of total variance. Indicating that they have represented different information, zero unexplained variance and $\text{Rho}=0$.

Appendix A1b indicates, the first four components of the PCA explains 77.5% of the total variance denoting the first four largest eigenvalues. The first positive definite component having similar magnitude approximately has the same size of loading over all variables except that of livestock sells for food. That can be interpreted as over all coping strategy preference of individuals. The second component has both positive and negative loading. Indicating that positive coping for the most liquidated assets on hand and negative for less liquidated assets (i.e.,

Land) relative to other assets as well based on their CS needs. The preference of households for coping strategy by selling productive asset to cope food shortage and emergency do have different magnitude. Indicating that, households are sensitive to sell productive asset for emergency than for food. That can be, Due to legal issues and high value of willingness to accept (WTA) and fear of losing ownership right (Kahneman et al., 1990). This indicates us that sensitivity of coping strategy differed based on liquidity nature of asset on hand. In a similar way the third principal component differentiate coping strategy sensitivity based on the composite or types of asset considered as one category indicating negative loading on productive asset and durable assets and positive loading for land and livestock.

Table 4.3a and 4.3b below show the statistically computed variance of variables from the original data stratified by components and presenting in different equations.

Table 4.3 a Explained variance by components

Components	Eigenvalue	Proportion	SE_Prop	Cumulative	SE_Cum	Bias
Comp1	2.58	0.32	0.007	0.32	0.007	0.004255
Comp2	1.51	0.19	0.005	0.51	0.0064	0.005636
Comp3	1.35	0.17	0.004	0.68	0.0049	-0.00477
Comp4	0.75	0.09	0.003	0.77	0.0038	0.000394
Comp5	0.56	0.07	0.002	0.84	0.003	0.000089
Comp6	0.46	0.06	0.002	0.90	0.0022	0.000268
Comp7	0.42	0.05	0.002	0.95	0.0013	-0.00315
Comp8	0.35	0.04	0.001	1	0	-0.00272

Table 4.3 b Explained coefficient and Eigenvalues by components

	Coef.	Std. Err.	P>z	[95% Conf.Interval]	
Eigenvalues					
Comp1	2.58	0.076	0	2.432574	2.730898
Comp2	1.52	0.044	0	1.431356	1.603933
Comp1					
disell_prdAsset_food	0.42	0.014	0	0.392434	0.448125
disell_prdAsset_emrgcy	0.44	0.013	0	0.413656	0.464527
disell_durAsset_food	0.47	0.012	0	0.444263	0.493308
disell_durAsset_emrgcy	0.43	0.014	0	0.403251	0.458448
disrent_land_food	0.30	0.022	0	0.262092	0.348982
disrent_land_emrgcy	0.31	0.023	0	0.265597	0.352193
disell_lvstk_food	0.09	0.027	0.001	0.041654	0.151345
disell_lvstk_emrgcy	0.16	0.027	0	0.111642	0.217546
Comp2					
disell_prdAsset_food	-0.014	0.053	0.787	-0.11791	0.089361
disell_prdAsset_emrgcy	-0.024	0.043	0.562	-0.10888	0.059175
disell_durAsset_food	-0.008	0.051	0.876	-0.10777	0.091887
disell_durAsset_emrgcy	0.037	0.054	0.493	-0.06914	0.143439
disrent_land_food	-0.266	0.106	0.012	-0.47567	-0.05759
disrent_land_emrgcy	-0.269	0.106	0.011	-0.47739	-0.06249
disell_lvstk_food	0.668	0.043	0	0.583246	0.754259
disell_lvstk_emrgcy	0.637	0.046	0	0.546848	0.728367

From principal component variance analysis, we have equations of all variables replaced with component 1 up to component 8 based on sizes of eigenvalues. Representing all variables preferred by households as coping strategy and Eigenvalues respectively under the first column. Where, Eigenvalues and equations named comp1 which is the first principal component as household's preference to sell production asset to maintain their shock exposure and second equations respectively and so on. Therefore, we can interpret the PCA reports results as Eigenvalues 2.58 with standard error 0.076 taking stability in to consideration.

$$(1) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disell_prdAsset_emrgcy}} = 0$$

$$(2) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disell_durAsset_food}} = 0$$

$$(3) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disell_durAsset_emrgcy}} = 0$$

$$(4) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disrent_land_food}} = 0$$

$$(5) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disrent_land_emrgcy}} = 0$$

$$(6) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disell_lvstk_food}} = 0$$

$$(7) - [\text{Comp1}]_{\text{disell_prdAsset_food}} + [\text{Comp1}]_{\text{disell_lvstk_emrgcy}} = 0$$

$$\chi^2(7) = 150.45 \quad \text{Prob} > \chi^2 = 0.0000$$

Testing coefficient for equation com1, using eq (comp1) which is, the first principal component. Equal command specifies that the coefficients are equal to each other instead of testing that the coefficients are zero. Since, the principal components are normalized to one PCA will gives us more rational hypothesis.

4.2 Descriptive Statistics of Shock Index analysis

Table 4.4 and 4.5 below, shows the correlation among shock types as variables by households indicating shock vulnerability as well mean values and frequency of observation respectively.

Table 4.4 Presentation of SI variables correlation

	Flood	Erosio n	Frost	pestCro p	pestSto r	pestLv s	Inputs	inputP r	Output	Husbd z	Wifedz	Othrdz
Flood	1											
Erosion	0.42	1										
Frost	0.34	0.267	1									
pestCrop	0.22	0.272	0.23	1								
pestStor	0.15	0.250	0.16	0.23	1							
pestLvs	0.06	0.150	0.05	0.25	0.21	1						
Inputs	0.18	0.182	0.24	0.20	0.23	0.11	1					
inputPr	0.17	0.194	0.16	0.25	0.22	0.29	0.32	1				
Output	0.25	0.265	0.22	0.28	0.28	0.16	0.29	0.27	1			
Husbdz	0.03	0.043	0.04	0.03	0.03	0.03	0.00	0.04	0.05	1		
Wifedz	0.02	-0.011	-0.01	0.01	0.04	0.04	-0.01	0.02	-0.00	-0.00	1	
Othrdz	-0.01	0.000	0.00	-0.00	-0.01	0.02	0.07	0.03	-0.01	-0.00	-0.00	1
Husbill	0.02	0.021	0.08	0.04	0.09	0.03	0.12	0.09	0.11	0.02	-0.00	0.04
Wifeill	0.03	0.015	0.03	0.03	0.00	0.06	0.14	0.08	0.05	0.02	0.08	0.10
Othrill	0.04	0.008	0.08	0.07	0.00	0.01	0.13	0.06	0.06	0.03	-0.00	0.09
Divorce	0.03	0.013	0.00	0.07	0.03	0.00	0.04	0.02	0.08	-0.00	0.08	-0.00
DummySho ck	0.34	0.287	0.38	0.36	0.18	0.34	0.39	0.52	0.25	0.11	0.08	0.16
Husbill	Wifeill	Othrill	divorce	Dummy_~k								
Husbill	1											
Wifeill	0.19	1										
Othrill	0.16	0.24	1									
Divorce	0.03	0.02	0.06	1								

From descriptive analysis of shock index principal component, the correlation within the same shock and among different shock have the same magnitude with different loading (probability of shock occurrence) except shock denoted as other shocks. Table 4.3 also indicates the higher correlation between shocks of flood, erosion and frost. Which used to imply the high probability to occur when one shock have been faced by households. Such as, the occurrence of flood increases probability to face shock of erosion and frost. In this analysis, covariance matrix of variables gives theoretical sense to analyze when we use commensurable unit. Since, it has a dummy for all shock types.

Table 4.5 Frequency and average of SI variables

Variable	Variable Definition	Obs	Mean	Std. Dev.	Min	Max
Flood	Flood	2637	0.04	0.21	0	1
Erosion	Erosion	2637	0.03	0.18	0	1
Frost	Frost	2637	0.06	0.24	0	1
pestCrop	Pest of diseases before harvest	2637	0.05	0.22	0	1
pestStor	Pest or diseases brought store loss	2637	0.01	0.12	0	1
pestLvs	Pest or disease that affect livestock	2637	0.05	0.21	0	1
Inputs	Lack of access to input	2637	0.06	0.24	0	1
inputPr	Large increase in price of input	2637	0.10	0.30	0	1
Output	Large decrees in price of out put	2637	0.03	0.16	0	1
Husbdz	Husband death	2637	0.00	0.07	0	1
Wifedz	Wife death	2637	0.00	0.05	0	1
Othrdz	Other death	2637	0.01	0.10	0	1
Husbill	Husband ill	2637	0.01	0.13	0	1

Wifeill	Wife ill	2637	0.02	0.14	0	1
Othrill	Other ill	2637	0.01	0.12	0	1
Divorce	Divorce	2637	0.01	0.07	0	1
Dummy_	Occurrences of any shock other	3093	0.25	0.43	0	1
Shock	than listed in this data seat					

From the summary statistics, the average probability of shock occurrence on households has been indicated to be 0.046, 0.034, 0.061, 0.05, for flood, erosion, frost, pest crop respectively. The covariance analysis in this study dominated by shock of large increase in input price and occurrence of any shock other than shocks controlled in the study. Followed by frost, lack of access to input, pest or disease affecting crops before harvest, flood and pest or disease affecting livestock respectively are the most dominating covariance.

From Appendix A2a, the descriptive PCA have two panels containing Eigenvalues of correlated matrix in descending value. Possible variation from original data subject to weighted square value equal to one with corresponding eigenvectors respectively based the size of eigenvalues. Where, total variance from original variables indicated by sum of Eigenvalues. Due to the need to analyze correlation matrix the variables are standardized and have unit variance with total variance of about 17 units. The variance of the principal components explained in-terms of Eigenvalues.

Having variance of 3.42 explaining 20.09%, 1.50 explaining 8.85% and 1.18 explaining 6.98% of total variance in the first, second and third principal component respectively with uncorrelated nature of principal components. Considering the correlation between the first and second

components as zero (i.e., $\text{Cov}(\text{comp1}, \text{comp2})=0$) explaining 28.94% of total variance. Indicating that they have represented different information, zero unexplained variance and $\text{Rho}=0$.

As appendix A2b, the first eight components of the PC analysis explain 65.04% of total variance. The first component having similar magnitude approximately has the same size of loading over all variables except that of death shock and divorce. That can be interpreted as over all indifference of individuals' vulnerability to shock. The second component has both positive and negative magnitude of loading values. Indicating that a positive component of a higher and lower shock index. This indicates that vulnerability for shock differed based on shock type which can be predicted before its occurrences (i.e., Flood, erosion, frost.....which can be predicted base on metrological data and wife death, husband death, wife ill, husband ill....which cannot be predicted). In the second panel which have the leading eight components only 50 percent of all components information explaining 64.21 percent and left the remaining unexplained. Where variables weight sum of squares unaccounted in the deleted component measured in eigenvalues equal to 35.79 percent of all information with zero unexplained information.

Table 4.6a Explained variance by components

Components	Eigenvalue	Proportion	SE_Prop	Cumulative	SE_Cum	Bias
Comp1	3.42	0.20	0.0046	0.20	0.0046	0.0072
Comp2	1.50	0.08	0.0023	0.28	0.0046	0.01105
Comp3	1.18	0.07	0.0019	0.36	0.0044	0.01617
Comp4	1.08	0.06	0.0017	0.42	0.0043	0.01787

Comp5	1.03	0.06	0.0016	0.48	0.0041	0.02522
Comp6	1.01	0.06	0.0016	0.54	0.0038	-0.0156
Comp7	0.94	0.05	0.0015	0.59	0.0036	0.00077
Comp8	0.88	0.05	0.0014	0.65	0.0033	0.00842
Comp9	0.86	0.05	0.0014	0.70	0.0031	-0.0094
Comp10	0.82	0.05	0.0013	0.75	0.0028	-0.008
Comp11	0.76	0.04	0.0012	0.79	0.0025	-0.007
Comp12	0.70	0.04	0.0011	0.83	0.0022	0.0068
Comp13	0.69	0.04	0.0011	0.87	0.0018	-0.0196
Comp14	0.64	0.04	0.001	0.91	0.0015	-0.0102
Comp15	0.59	0.03	0.001	0.94	0.0011	-0.0094
Comp16	0.55	0.03	0.0009	0.98	0.0005	-0.0111
Comp17	0.32	0.01	0.0005	1	0	-0.0033

Table 4.6b Explained coefficient and Eigenvalues by components

	Coef.	Std. Err.	Z	P>z	[95%Conf. Interval]
Eigenvalues					
Comp1	3.42	0.09	36.31	0	3.231356 3.600097
Comp2	1.50	0.04	36.31	0	1.423532 1.585976
Comp1					
Flood	0.28	0.01	22.74	0	0.261272 0.310561
Erosion	0.29	0.01	23.78	0	0.269575 0.318004

Frost	0.28	0.01	23.45	0	0.261679	0.30941
pestCrop	0.31	0.01	26.87	0	0.283872	0.328544
pestStor	0.25	0.01	20.14	0	0.230811	0.280585
pestLvs	0.23	0.01	17.48	0	0.206957	0.259221
Inputs	0.31	0.01	27.31	0	0.287515	0.331974
inputPr	0.33	0.01	30.1	0	0.309917	0.353085
Output	0.31	0.01	26.95	0	0.284824	0.329499
Husbdz	0.06	0.01	4.16	0	0.032596	0.090577
Wifedz	0.03	0.01	2.06	0.039	0.001511	0.060579
Othrdz	0.05	0.01	3.45	0.001	0.02275	0.082641
Husbill	0.13	0.01	9.08	0	0.105981	0.164321
Wifeill	0.12	0.02	7.93	0	0.093291	0.154575
Othrill	0.12	0.02	7.94	0	0.092066	0.15245
Divorce	0.06	0.01	4.34	0	0.035471	0.093878
Dummy_Shock	0.42	0.01	48.5	0	0.403094	0.437044
Comp2						
Flood	-0.23	0.04	-5.94	0	-0.31527	-0.15888
Erosion	-0.29	0.03	-9.92	0	-0.35313	-0.23663
Frost	-0.12	0.04	-3.08	0.002	-0.202	-0.04491
pestCrop	-0.14	0.02	-4.91	0	-0.19491	-0.08368
pestStor	-0.17	0.03	-4.87	0	-0.2433	-0.10365
pestLvs	-0.01	0.05	-0.34	0.735	-0.11777	0.083121
Inputs	0.11	0.03	3.87	0	0.055919	0.170407

inputPr	0.04	0.03	1.08	0.281	-0.03118	0.10735
Output	-0.12	0.03	-4.29	0	-0.18159	-0.06775
Husbdz	0.02	0.05	0.53	0.596	-0.0674	0.117445
Wifedz	0.09	0.05	1.78	0.075	-0.0095	0.196017
Othrdz	0.31	0.04	7.72	0	0.236948	0.398287
Husbill	0.36	0.03	10.12	0	0.292681	0.433212
Wifeill	0.51	0.02	20.15	0	0.465865	0.566283
Othrill	0.46	0.03	14.29	0	0.398501	0.525209
Divorce	0.09	0.05	1.91	0.056	-0.00253	0.191291
Dummy_Shock	0.17	0.02	8.33	0	0.135775	0.219311

From principal component variance analysis, table 4.6a represents all shock types denoted by component 1 up to component 17. We get out put organized in different equations where, Eigenvalues and equations named comp1 which is the first principal component. The first component representing Eigenvalue of flood shock as first and second equations called comp2 stands for Eigenvalue of erosion respectively and so on. From the PC analysis report we can interpret the results as Eigenvalue 3.42 with standard error .09 taking stability in to consideration.

$$(1) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{erosion}} = 0$$

$$(5) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{pestLvs}} = 0$$

$$(2) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{frost}} = 0$$

$$(6) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{inputs}} = 0$$

$$(3) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{pestCrop}} = 0$$

$$(7) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{inputPr}} = 0$$

$$(4) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{pestStor}} = 0$$

$$(8) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{output}} = 0$$

$$(9) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{husbdz}} = 0$$

$$(13) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{wifeill}} = 0$$

$$(10) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{wifedz}} = 0$$

$$(14) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{othrill}} = 0$$

$$(11) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{othrdz}} = 0$$

$$(15) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{divorce}} = 0$$

$$(12) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{husbill}} = 0$$

$$(16) - [\text{Comp1}]_{\text{flood}} + [\text{Comp1}]_{\text{DumShock}} = 0$$

$$\chi^2(16) = 1959.24 \quad \text{Prob} > \chi^2 = 0.0000$$

Testing coefficient for equation com1, using eq (comp1) which is, the first principal component. Equal command specifies that the coefficients are equal to each other instead of testing that the coefficients are zero. Since, principal components are normalized to one. This will enable PCA to give us more rational hypothesis.

4.3 Descriptive Statistics Variables used in the regression

Under this section descriptive statistics of variables used in the analysis are described by its overall variance separating in to between and within variance, statistical significance indicators and average values.

4.3.1 Descriptive Statistics of Dependent Variables used in the regression

Table 4.7 below shows the mean and standard deviations of the dependent variables. It also shows whether the within and between variation are zero or different from zero by breaking the overall variation in to the between and within variation.

Table 4.7 Mean and Standard Deviations of the Dependent Variables

Variable	Var. defn. and measurement unit		Mean	Std. Dev.	Min	Max	Observations
Fgap	Food gap measured in	Overall	1.93	2.46	0	12	N = 3093
	number of months per	Between		1.55	0	6.4	n = 637
	year	Within		1.92	-4.06	11.33	T-bar = 4.8
Intotv~l	Total Real value of asset	Overall	6.58	4.02	-0.30	12.86	N = 3093
	measured in birr at 2014	Between		2.70	0.01	11.65	n = 637
	price	Within		2.96	-2.61	15.36	T-bar = 4.8
Lnpcexp	Per capita expenditure	Overall	5.82	0.69	3.19	8.82	N = 2366
	measured in months per	Between		0.51	4.24	7.84	n = 637
	year	Within		0.53	3.68	7.61	T-bar = 3.7

The table 4.7 shows that, the average food gap in months is 1.933 indicating mean values of variables which take the value of both the largest and smallest point in the analysis with minimum of zero month and maximum of 12 months. The overall deviation is the compiled variation of variables between individuals and overtime at the same household. Food gap, scores over all variation of 2.46 unite and almost the same deviation unit across id and over time. But, 1.92unit within deviation indicates the changing trend in food gap of household and give hint to study the causal effect of program. The natural logarithm of total real value of asset distribution on average scores is 6.58 with overall deviation of 4.02 and minimum of -0.30 and maximum 12.86. Asset accumulation across ID deviation scores of 2.70 and over time deviation of 2.93 units. It indicates the change of asset accumulation by households over time and to study its causal effect. Among independent variables log of per-capita expenditure per month's average

expenditure is 5.82 units with 3.19 and 8.8 unit minimum and maximum scores respectively with no significant deviation across individuals as well over time. But, the within variation of per-capita expenditure of households indicated the possibility to analyzes causal effect of program. Since, it's within effect is different from zero.

4.3.2 Descriptive Statistics of household Asset Variables used in the regression

Table 4.8 below shows average value and deviation across ID and aver time decomposing the overall variation of variables explaining household asset holding. The table also indicates the minimum and maximum values of household asset holding indicator variables.

Table 4.8 Mean and Standard Deviations of Asset variables

Variable	Var. defn. and unite of measurement		Mean	Std. Dev.	Min	Max	Observations
Land	Land in hectares	Overall	1.25	1.18	0	15.00	N = 2373
		Between		0.98	0.07	15.00	n = 637
		Within		0.86	-2.22	11.82	T-bar = 3.72
tlu_svy	Number of livestock owned in Tropical livestock Unites	Overall	4.55	5.37	0	80.01	N = 2316
		Between		4.16	0	36.07	n = 637
		Within		2.99	-24.37	48.48	T-bar = 3.63
lnvpro~l	Log of productive asset measured in birr at 2014 price.	Overall	5.84	1.11	-0.90	10.38	N = 2259
		Between		0.96	1.14	8.51	n = 630
		Within		0.69	1.16	10.15	T-bar = 3.58

With 1.26 hectare average land holding and overall deviation of 1.18 with zero and 15.02 hectare registered as minimum and maximum holding respectively. Land holding variation among different households score 0.98 and 0.86 variation over time for the same household. The within variation is different from zero indicating the effect of land on dependent variables over time. The average household holding of livestock in TLU is 4.55 with overall variation 5.37 unit taking minimum and maximum score of Zero and 80.01 respectively. 2.99 unit within variation indicates household's livestock holding over time and proven the need to study its effect on dependent variables as explanatory variable. The average holding of production assets is 5.84 units with overall deviation of 1.11. As well -0.9 and 10.4 minimum and maximum values respectively. Indicate significant deviations on between and within variation and need to asses correlation between dependent and explanatory variables.

4.3.3 Descriptive Statistics of household Demographic characteristics Variables used in the regression

Table 4.9 shows, the average value of household demographic characteristics with the overall variation and separating it in to within and between variation indicating the difference between households and change over time.

Table 4.9 Mean and Standard Deviations of the Households Demography Variables

Variable	Var. defn. and measu. unit		Mean	Std. Dev.	Min	Max	Observations
Hhsize	Number of household	Overall	5.23	2.13	1	12	N = 2374
	members	Between		1.98	1	11	n = 637
		Within		0.96	0.48	9.73	T-bar = 3.72
head_age	Age of household head	Overall	49.49	14.81	16	98	N = 2374
		Between		13.94	23.4	90	n = 637
		Within		5.8546	11.29	84.29	T-bar = 3.72
Eduhead	Education of household	Overall	0.98	2.28	0	16	N = 2374
	head in years of school	Between		2.28	0	14	n = 637
	attendant.	Within		0.91	-6.01	13.78	T-bar = 3.72
Marital	Marital status of household	Overall	1.89	1.51	1	9	N = 2371
	head	Between		1.22	1	6	n = 637
		Within		0.93	-2.10	5.89	T-bar = 3.72
Dratio	Dependency ration	Overall	1.34	0.97	0	7	N = 2247
	measured by taking the	Between		0.76	0	6	n = 622
	ration of productive	Within		0.66	-1.05	6.09	T-bar = 3.61
	household members to						
	dependents						
Malehead	Mal head	Overall	0.73	0.44	0	1	N = 2375
		Between		0.41	0	1	n = 637
		Within		0.16	-0.06	1.53	T-bar = 3.72

From presentation of table 4.9, the average household size is 5 with a minimum of 1 and a maximum of 12 members. Where, the largest deviation scored across households and the smallest change over time for the same household. The age of household head varies between individuals compared to the same id over time with average of 49.5 years and 16 and 98 as minimum and maximum age respectively. Average score of household head education level hits on 0.984 with 0 year and 16 years of education as minimum and maximum respectively. In which the largest variations driven across individuals than overtime individuals' progress. The average dependency ratio is 1.345 with a variation within and between households are almost the same (0.76 and 0.66) respectively.

4.3.4 Descriptive Statistics of household Institutional Variables used in the regression

Table 4.10 below present descriptive statistics of institutional variables, SI and CSI average and deviation over time plus across households surveyed in five rounds.

Table 4.10 Mean and Standard Deviations of the Institutional Variables

Variable	Var. defn. and meas. unit		Mean	Std. Dev.	Min	Max	Observations
extYN	Extension office	Overall	0.92	0.27	0	1	N = 2581
	in woreda (1 = yes; 0 otherwise)	Between		0.11	0.6	1	n = 637
		Within		0.24	0.12	1.31	T-bar = 4.05
dist_nt	Distance from	Overall	11.19	8.09	0	33.5	N = 2620
	the nearest	Between		8.09	0	33.5	n = 524
	office in	Within		0	11.19	11.19	T = 5

Kilometers							
electr~y	Availability of	Overall	0.18	0.38	0	1	N = 2716
	electric in	Between		0.19	0	0.75	n = 637
	woreda (1 = yes; 0 otherwise) a	Within		0.33	-0.56	0.98	T-bar = 4.26
pipd~r	Availability of	Overall	0.50	0.50	0	1	N = 2689
	pipd water in	Between		0.25	0	1	n = 637
	woreda (1 = yes; 0 otherwise)	Within		0.44	-0.29	1.30	T-bar = 4.22
primsc~2	Primary school	Overall	0.54	0.49	0	1	N = 2755
	availability in	Between		0.40	0	1	n = 637
	woreda (1 = yes; 0 otherwise)	Within		0.30	-0.25	1.29	T-bar = 4.32
highsc~1	High school	Overall	0.05	0.23	0	1	N = 2755
	availability in	Between		0.09	0	0.25	n = 637
	(1 = yes; 0 otherwise)	Within		0.21	-0.19	0.85	T-bar = 4.32
health~t	Health center	Overall	0.90	0.29	0	1	N = 2755
	availability in	Between		0.20	0.2	1	n = 637
	Woreda (1 = yes; 0 otherwise)	Within		0.21	0.10	1.70	T-bar = 4.32
dummyC~H	Household has	Overall	0.29	0.45	0	1	N = 3093
	access to credit	Between		0.27	0	1	n = 637
	woreda (1 = yes; 0 otherwise)	Within		0.37	-0.50	1.09	T-bar = 4.85

lnGtra~d	Household	Overall	5.90	1.58	-0.75	10.22	N = 354
	received	Between		1.55	-0.75	10.22	n = 274
	remittance (1 = yes; 0 otherwise)	Within		0.63	3.65	8.27	T-bar = 1.29
dum_Of~m	Off farming	Overall	0.13	0.34	0	1	N = 3093
	participation in	Between		0.19	0	1	n = 637
	woreda (1 = yes; 0 otherwise)	Within		0.28	-0.66	0.93	T-bar = 4.85
dum_No~s	Non farming	Overall	0.09	0.29	0	1	N = 3093
	participation in	Between		0.18	0	1	n = 637
	woreda (1 = yes; 0 otherwise)	Within		0.24	-0.70	0.89	T-bar = 4.85
shock_~x	Shock index	Overall	0.05	0.09	0	0.64	N = 2637
	measured in	Between		0.04	0	0.23	n = 615
	fraction	Within		0.07	-0.18	0.56	T-bar = 4.2
CSI	Coping strategy	Overall	0.12	0.13	0	1	N = 2298
	Index measured	Between		0.08	0	0.5	n = 637
	in number	Within		0.10	-0.34	0.67	T-bar = 3.60

The average distance from the nearest town in kilometer is 11.19 with the minimum of 0 kilometer and maximum of 33.5 kilometer. Have the same overall variation with between variation equal to 8.1 and 0 within variation which indicates no change on distance over time. And recommend dropping it from the list of variables for analysis of program effect. Since, it does indicate zero change on households over time. The average values of dummy variables are 0.29, 0.13, 0.96, 0.06 and 0.11 for credit dummy, off farm dummy, dummy of non-farm

business, shock index dummy and CSI respectively. The overall variation and within variations are 0.5 and 0.37. It shows that, the major deviation is the over time interest of households to take credit than variation across individuals at the same period. It indicates the need to assess impact of credit on households over time due to its rising trend over time and deviation across households. The within score of off-farm participation accounts 0.28 unit with indicative analysis for further study on its change over time. standard deviation 5.73, 1.56, -0.75 and 9.61 are figures generated from stata computation indicating average transfer, the overall variation with minimum and maximum unites received from relatives and informal networks respectively. 0.09, 0.06 and 0.12 are averages of non-farm activities, shock index and coping strategy index respectively. Within variation of non-farm participation of households show change over time scoring 0.24 that indicates the need to assess the causal effect of it as regressor's variable.

Therefore, the tabular presentation above indicates us that distance from the nearest town will be dropped from fixed effect analysis. Since, variables having zero within standard deviation and coefficient of variables with too small within standard deviation will be classified as variable which are not well identified. As a result it will describe nothing about change over time in panel data (Christopher F. Baum, 2006).

4.4 Testing for Time Fixed Effect

Through appendix A3a to A3c presentation, the F-test of food gap in months, real value of asset accumulation at 2014 price and per-capita expenditure per months at different degrees of freedom suggest the use of fixed effect model to analyze the panel data. Since, $\text{Prob} > F = 0.0000$ which is below 0.05 as stated in the Hausman test.

Therefore, F-test in our study rejects the null hypothesis that coefficients for all years under this study are jointly equal to zero. This indicates that fixed effects models are needed in this study.

As expected from different point estimates generated from RE estimator, the null hypothesis which states that the RE estimator is consistent is soundly rejected for food gap analysis and real asset holding after dropping program effect value greater than 1^{10} . In the same way, the Hausman test result failed to reject the null hypothesis which indicates efficiency of using RE model to analyze per-capita expenditure. Individual effects are correlated with the regressors' and the command also indicates difficulty of positive definite covariance matrix. Large chi-square indicates that estimation of the equation with regress yielded inconsistent result.

Therefore, from both the Hausman test and F-test, we conclude that the use of fixed effects model is consistent modeling for food gap while the random effect model found to be appropriate for per-capita expenditure.

¹⁰ to extract only categorical variables to make Hausman test statistically computable

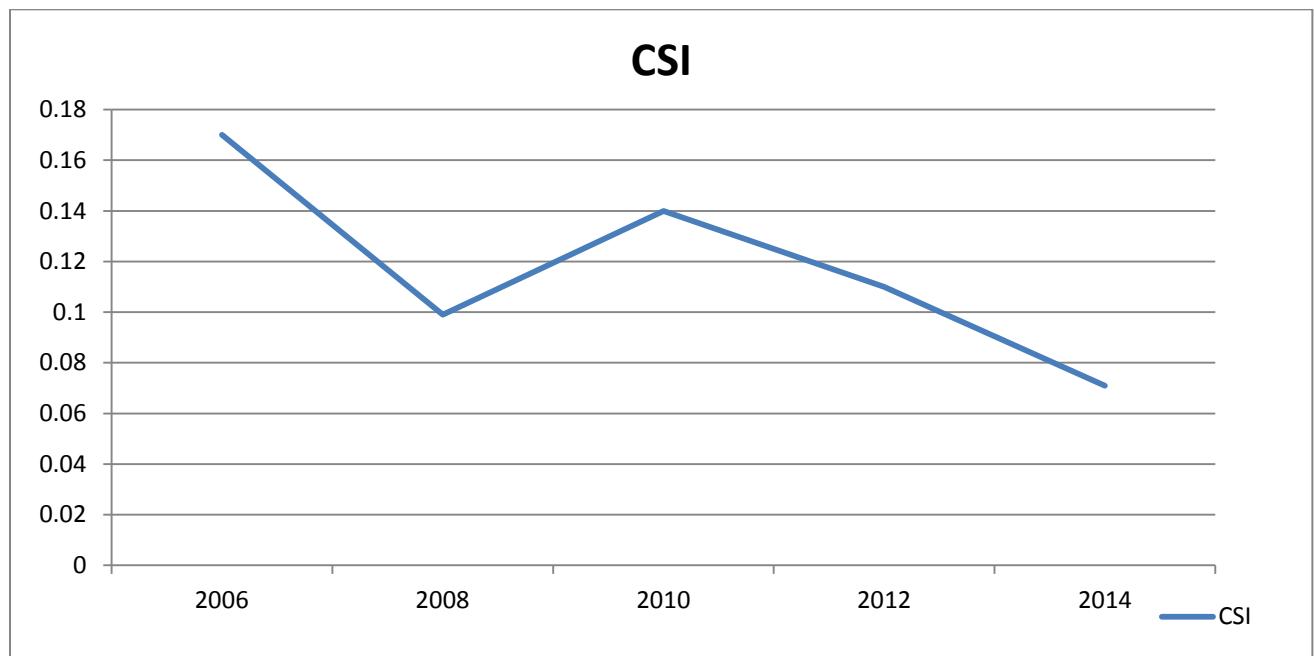
Chapter Five: Econometric analysis

5.1 The link between PSNP and Coping Strategy Index

Figure 5.1 below present, the average trend of households' coping strategy index analysis over each round of survey from 2006 to 2014 based on principal components analysis and indication to other food security indicators.

CSI analysis is done following Mohamed's and his correspondents' study, which stated that households with lowest CSI are classified as food secured than households using any of coping strategies. This used to denote that households with consecutive and increasing CSI are under deteriorating food security situation. On the other hand, households with falling trend of average CSI are considered as households in trend of improving food security. (Mohamed Ziace, 2013)

Fig 5.1 Average CSI of PSNP participant households by year



As we can see it from the graphic presentation of the CSI, in 2006 after a year were the program has began to work CSI was approximately 0.17 which has declined to 0.099 in 2008. The declining trend of CSI between the two surveys indicates an improvement of food security in relative to the preceding survey round. As the CSI computation shows, the highest value household's CSI indicate that they have used the most assets as strategies to with stand shocks.

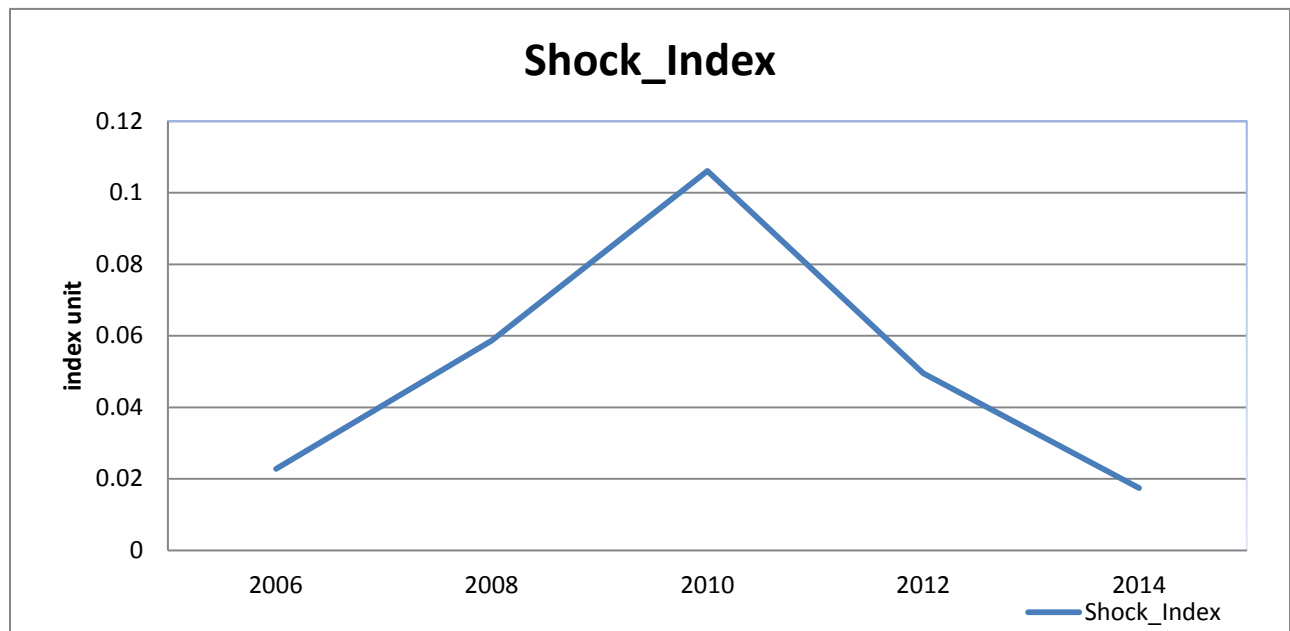
The 2010 CSI registered 0.045 units higher than 2008 and reached 0.144 indicating most awful food unsecured status of households. Possibly that has been registered due to the 2009 drought which surpassed only by historic drought of 1984 (Ellen Vist et al., 2012). The year between the third and fifth round survey can be considered as most successful in reducing food security problem as indicated by falling CSI. Under which households strive to maintain food security via sells of asset reach the ever lowest point after 2009 drought until the very recent survey of 2014. Evaluating CSI as of 2014 indicates that sells of productive assets, durable assets, land and livestock for both emergency and food purpose have reached the lowest score ever in this panel indicating households under PSNP coverage food security status is getting well again than ever.

The CSI in this study has shown the characteristics stated by Daniel M. and Richard C. on CSI (2008) field method manual second edition. This manual states that CSI has correlation with other determinants of food security such as income, food budget and asset. The relations between CSI and the indicators have been tested with over fourteen studies. According to findings of Daniel and Richard, an increase on measuring unit of the CSI directly will indicates us the falling trend on measuring unit of other determinants of food security. Such as income, food budget, and asset unit will fall. In a situation where the score of CSI are fallen other determinant of food security will increase (as expected) with percent of expenditure devoted to food. This theoretical statement is satisfied in this study finding.

5.2 The link between PSNP and Shock Index Analysis

Figure 5.2 below, gives graphic analysis of households' shock vulnerability based on principal component analysis of seventeen shock occurrence from dummy variables evidence. It also indicates average trend of occurrences.

Fig 5.2 Average SI of PSNP participant households by year



The shock index analysis indicates households' vulnerability to different shock types dominated by Environmental shocks including dummy of any shocks other than mentioned in this analysis data set which took the largest Eigenvalues and Eigenvector (weight) of all shocks mentioned separately as dummy variable in the panel. According to 2006 and 2008 interview, households' shock index was registered as 0.023 and 0.058 respectively. Indicate high and increasing probability of shock vulnerability of households at increasing rate of vulnerability to different

shocks over time. The 2010 index of shock under this panel is the pick point registered at 0.11 units indicating the worst shock vulnerability of households under this survey.

This can be justified as a result of the second largest drought in 2009 after 1984 as stated by Ellen Vasst in 2012. The 2012 survey indicates relatively lower vulnerability of households for shock and the index reaches at 0.49 which is even lower than 2008. Vulnerability during the fifth round in 2014 shows falling trend of household's shock index at decreasing rate and scored at 0.17 above the 2006 vulnerability. Households' vulnerability has declining trend but it is still subspecies for its falling slop.

5.3 Econometric Result Analysis

The result analysis using ("*t*-test"), will takes manual differences in variable of outcomes in this case "food gap in months", "log of real value of total asset at 2014 price" and "log of percapita expenditure in months" labeled as food gape in month, asset accumulation over time and percapita expenditure in months respectively. It also compares "food gap", "log of real value of total asset" and "log of percapita expenditure" for PSNP both DS and PW participants and nonparticipants. In real meaning, it creates a second difference of "food gap", "log of real value of total asset" and "log of percapita expenditure" for those beneficiaries (PSNPany_PW_DS_benef=yes) and those counter factual (PSNPany_PW_DS_benef=No). This second difference gives the estimate of the PSNP beneficiaries' impact on food gap in months, asset accumulation and percapita expenditure in months respectively but, it does not explain correlation.

5.3.1 Resilience Analysis

5.3.1.1 The link between PSNP and Resilience Analysis in-terms of Food Gap

Figure 5.3 and table 5.1 presentations below, shows average trend of food gape in months from 2006 to 2014 based on DiD analysis taking the manual difference between program participant and counterfactuals. Following the work of Joanna B. Upton, 2016 in Northern Kenya applying the methodology developed by Barrett and Conostas, 2014 which involves computing the difference on each round.

Fig.5.3 Average trend of food gap for PSNP participant households by year

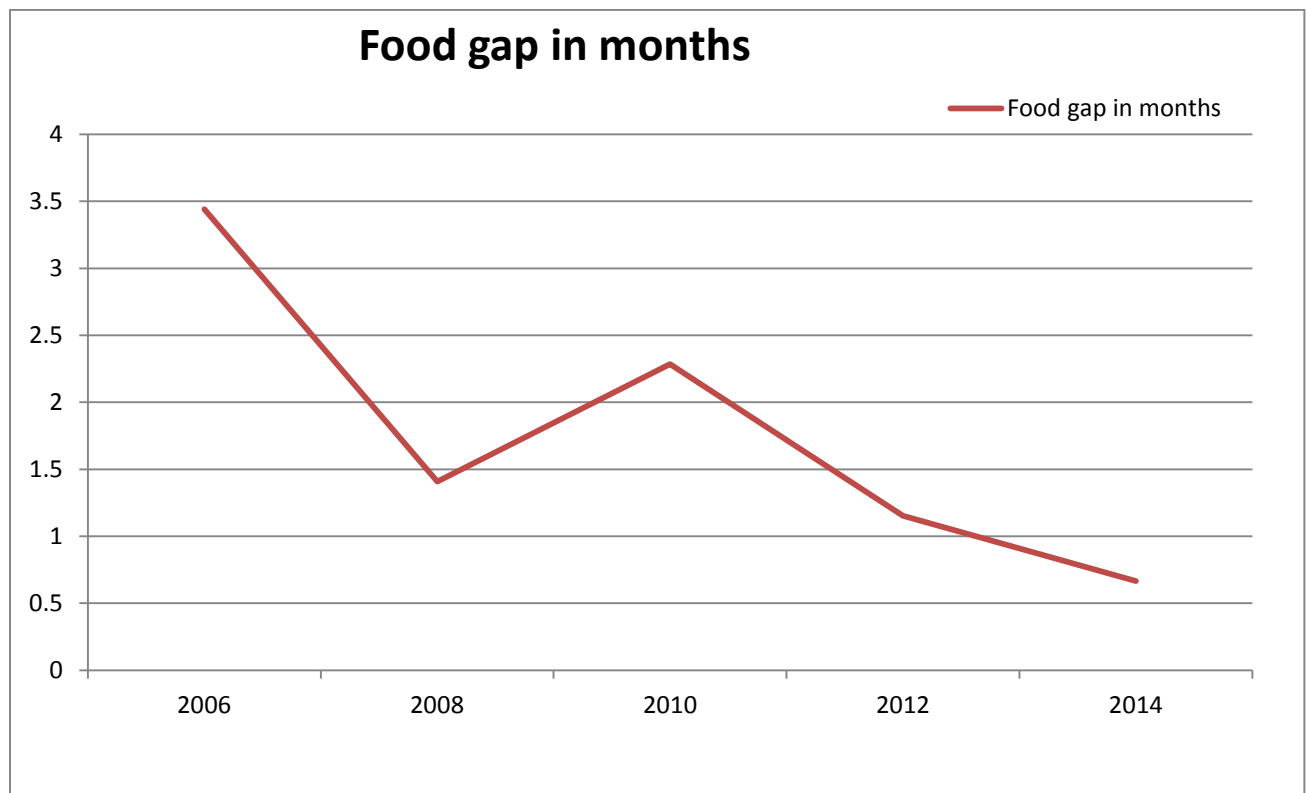


Table 5.1 Resilience Analysis of households using food gap (Std. Err. adjusted for 637 clusters in ID)

Robust					
Fgap	Coef.	Std. Err.	T	[95% Conf. Interval]	
Year	0.0042	0.03	0.14	-0.056	0.064
PSNPany_PW_DS_benef	2.37***	0.31	7.73	1.770	2.976
PSNPeff	-0.43***	0.07	-5.67	-0.576	-0.279
_cons	1.58***	0.09	16.13	1.392	1.778
sigma_u	1.38				
sigma_e	2.11				
Rho	0.30	(fraction of variance due to u_i)			

*, **, *** indicates level of significance at 10%, 5% and 1% respectively

The manual difference result from A5a to A5e and A6 presents, in 2006 indicates us that food gap of PSNP both DS and PW (PSNPany_PW_DS_benef) participants were 3.44 months assuming equal variance which is significant at 95 percent confidence interval. The second round analysis result shows that program beneficiaries' food gap become 1.24 months which is lower than 2006 by 2.12 months which is 66.6 Days and this impact is significant at 95 percent confidence interval. Indicating the growing households' resilience covered with the program. In 2010 food gap have been reached 2.28 months which is higher than 2008 by 1.04 months. The rising food gap according to Barrett and Conostas considered as estimated falling trend on resilience keeping the inverse relation between food gap and program effect: the rising in food gap is due to 2009 drought. Even though food gap is higher but, it is still below the 2006 by 1.54 months which is immediate after implementation of PSNP in 2005. In 2012 the mean food gap reaches 1.15 months for PSNP participants' assessed against the food gap in 2010. The food gap of PSNP participants in the fifth round in 2014 have reached 0.66 months estimated at 95 percent confidence interval.

The overall evaluation of food gap in 2014 survey against 2006 in five rounds, evidence from IFPRI panel indicates that PSNP participant who has been in the program for nine years food gap has declined by about 2.8 months (i.e., 84 days) from 2006. Keeping in mind that curtailing effect of PSNP on food gap was not smoothly falling, rather it also experienced expanding trend as has been shown in 2010 household survey due to the second severe famine after 1984 until 2014. Under the overall evaluation of PSNP impact on rural households' resilience, the up and down in maintaining resilience can insure that resilience of households did not attain its transforming state of shock vulnerable households. The fixed effect regression result indicates us that 30.17 percent of variation is due to variance across panel or round and program's negative effect on food gap (i.e., reducing effect) have confirmed the PSNP effect on Resilience to Environmental shocks is positive and significant.

5.3.2 Welfare Analysis

Figure 5.4, table 5.2a, 5.2b and A3c below shows, the average trend of households' asset holding from panel analysis of PSNP impact on asset holding of each survey round and program effect as overall analysis indicator.

5.3.2.1 The link between PSNP and Welfare Analysis in-terms of Asset Accumulation

Fig. 5.4 Average trend of Asset holding for PSNP participant households by year

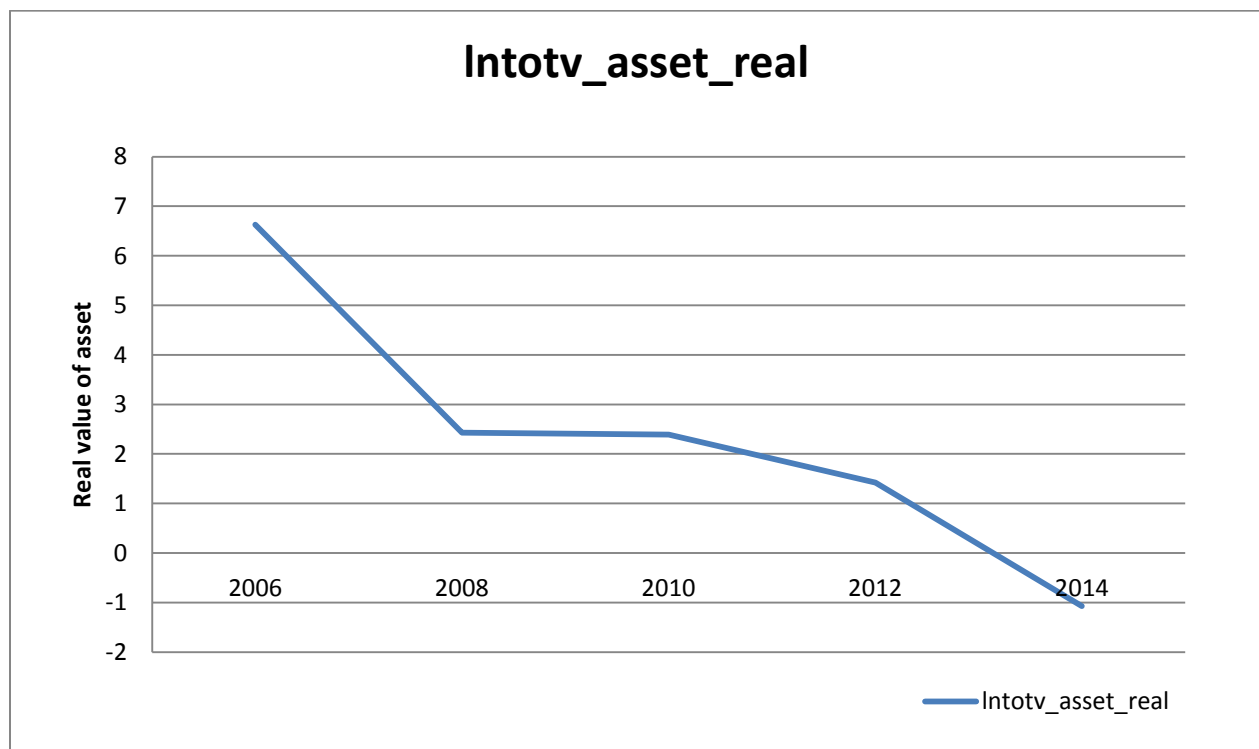


Table 5.2a Households Welfare Analysis of using Asset holding

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
No	2053	5.75	0.09	4.46	5.554162	5.940539
Yes	1040	8.23	0.06	2.14	8.098091	8.359108
Combined	3093	6.58	0.07	4.02	6.440007	6.7233
Diff		-2.48	0.15		-2.76808	-2.19442

Table 5.2b household Asset holding Analysis taking 2006 as base year

DIFFERENCE IN DIFFERENCES ESTIMATION

	Base line			follow up			
Outcome	Control	Treated	Diff(BL)	Control	Treated	Diff(FU)	DIFF-IN-DIFF
Variable							
Intotv_ass~l	1.17	8.47	7.31	2.74	8.40	5.66	-1.65
Std. Error	0.19	0.14	0.24	0.15	0.10	0.18	0.07
t	6.04	58.98	30.35	18.57	80.43	31.30	-23.65
P>t	0	0	0.00***	0	0	0.00***	0.00***

*, **, *** indicates level of significance at 10%, 5% and 1% respectively

From figure 5.4 presentation, using the manual difference of asset value hold by households it shows the log of real asset value were 7.31 percent higher than the value of households own asset in 2008 by 5.66 units at 2014 price. Even-though their asset holding is higher than counterfactuals; this figure clearly shows the diminishing trend of asset accumulated by PSNP beneficiary households. Relatively the most effective period to show PSNP optimistic effect on asset holding is the time between 2008 and 2010. Since, it was able to reduce tumbling effect of 2009 drought and this particular survey analysis pretend in the same way as Camilla et al., 2009 did on asset holding effect of PSNP.

The result indicates that PSNP both PW and DS program participation reduces beneficiary's real asset holding value at 2014 price and significant at one percent level of significance. This indicates that 45.5 percent of variation is due to change across panel which can be interpreted as increasing asset changes over time on the same participant and registered as progressive trend of households asset accumulation due to program participation. But, this test does not indicate the causal relation among outcomes and program pillars based on FE analysis which has the same magnitude with that of simple DiD.

5.3.2.2 The link between PSNP and Welfare analysis in-terms of pre-capita expenditure in months

According to figure 5.5, table 5.3a and 5.3b Presentation, it shows the average trend of PSNP participants' natural logarithm of per-capita expenditure in months over five round survey produced by IFPRI. The trend analysis has been generated based on DiD method of panel data analysis.

Fig 5.5 Average trend of per-capita expenditure for PSNP participants by year

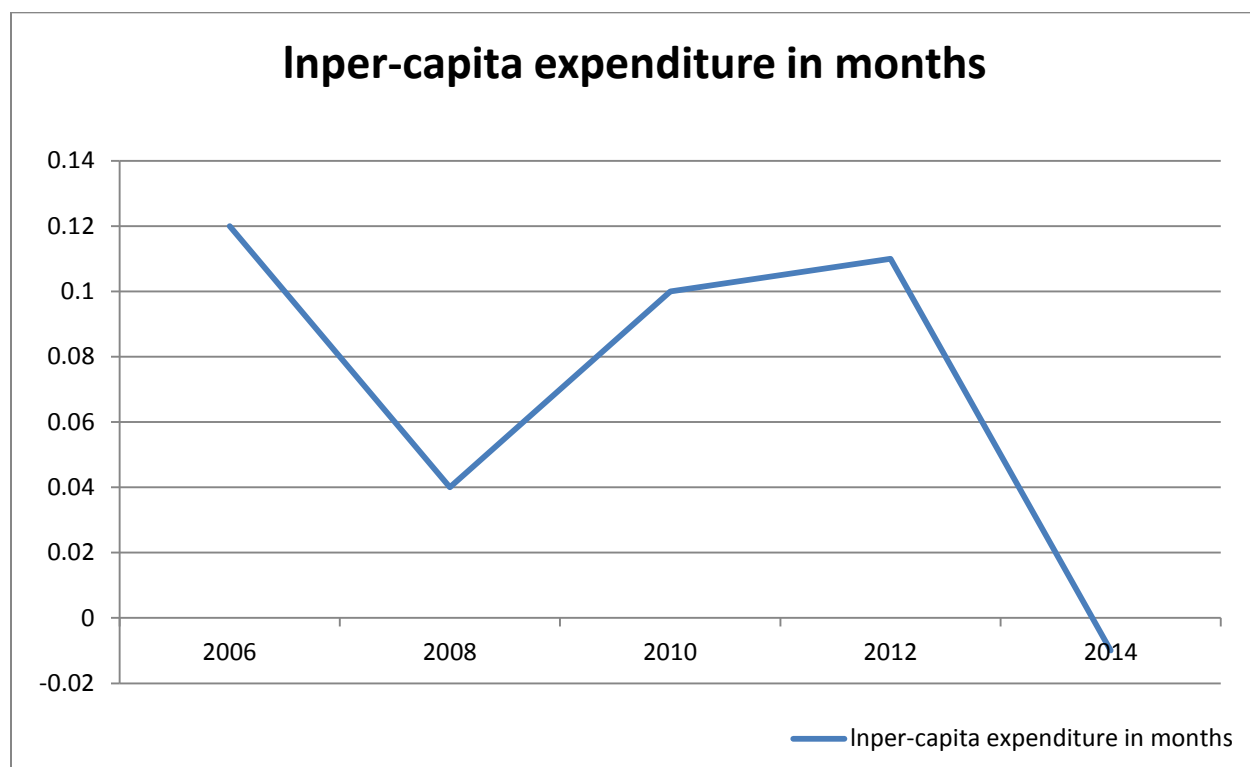


Table 5.3a Households Welfare Analysis using per-capita expenditure

	Base line			follow up			
Outcome Variable	Control	Treated	Diff(BL)	Control	Treated	Diff(FU)	DIFF-IN-DIFF
Lnpcexp	5.23	5.24	0.01	5.41	5.409	-0.002	-0.012
Std. Error	0.05	0.05	0.07	0.038	0.037	0.052	0.02
T	104.44	107.38	0.16	144.21	147.73	-0.03	-0.65
P>t	0.00	0.00	0.87	0	0.000	0.975	0.516

*, **, *** indicates level of significance at 10%, 5% and 1% respectively

Table 5.3b Households Welfare Analysis of using per-capita expenditure

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.Interval]	
No	1329	5.85	0.019	0.714	5.812748	5.889624
Yes	1037	5.78	0.020	0.656	5.74617	5.826153
Combined	2366	5.82	0.014	0.690	5.794865	5.850507
Diff		0.065	0.028		0.009004	0.121045

As we can see from the result, participant's per-capita expenditure is still lower by 6.5 percent compared to non participants and the result is not different from zero. The overall natural logarithm of percapita expenditure of PSNP both PW and DS participants in month was declined by 7.59 percent comparing the 2008 percapita expenditure with that of 2006. On the other hand,

the 2010 percapita expenditure have increased by 5.84 percent from the 2008 round. The 2012 survey shows increasing per-capita expenditure which is about 0.36 percent. This increase in per-capita expenditure can be rated as increasing per-capita comparing incremental to previous survey. But, the final round in 2014 shows 12.2 percent decline in household's percapita expenditure evaluated from 2012 per-capita expenditure in months. The overall PSNP DiD analysis indicates negative impact of program on beneficiaries' percapita expenditure per month. Even-though it is statistically insignificant; according to Aboubeker G. Bouker et al., 2016 the result have expected outcome effect of PSNP on beneficiaries' Welfare. This result shows conflicting and insignificant effect to that of welfare analysis using asset as indicator with two-sample t test with equal variances of PSNP on percapita expenditure when compared to non beneficiaries. It indicates 27.7 percent of variation is due to individual effect.

5.4 Econometric Analysis for Other Controlling Variables

Due to difficulty of measuring welfare and resilience of households' by their percapita expenditure, accumulation of asset and Food gap we need to include household's demographic characteristics effect, Economic indicators such as off-farm activities and non-farm participation. Controlling for dummy of credit access, institutional setups such as extension office health center as welfare indicators and shock vulnerability with their preference to mitigate shocks. (Camilla et al., 2009 and Zewedie et al., 2015)

Conducting simple DiD is don based on the assumption of keeping other covariance constant over time. But, if the assumption of all things remain constant is being violated the need to conduct the analysis controlling for other variables effect on outcome will help us to get the net effect of program on participants of program. As a result the regression model will be extended and includes other covariates that may affect the outcomes of interest. (Shahidur R. Khandker et al., 2010)

5.4.1 Resilience in-terms of Food Gap Analysis for Other Controlling Variables

Table 5.4 presentation of food gap analysis below shows that 92 percent of variation over time explained by individual specific effect and non-idiosyncratic nature of individual variation indicated by very high chi-square. For the change in food gap, the treatment effect is positive and statistically insignificant where as the program effect or the treatment effect over time is negative, have the same magnitude as expected and described in table 3.1 and significant at one percent level of significance. One of the food security program components PSNP cash payments

only has significant and negative effect on change of food gap as a result of safety net program indicates reducing effect of cash payment on program participants' food gap in months. Effects of some institutional set ups and demographic characteristics of households have significant and reducing effect such as access to truck, piped water, household head education level, number of females in household and health post at 5 percent and 1 percent level of significance have been registered in this analysis.

Table 5.4 Average trend of food gap for PSNP participant households by year for other controlling variables with robust standard error

Food gap	Coef.	t	P>t
Year	0.27 (0.33)	0.81	0.424
PSNP both PW and DS beneficiaries	0.94 (3.18)	0.30	0.770
Program effect	-1.62*** (0.53)	-3.04	0.005
Livestock owned	-0.42** (0.18)	-2.36	0.025
PSNP PW beneficiaries	3.90 (2.8)	1.39	0.174
PSNP DS beneficiaries	1.78 (2.41)	0.74	0.467
Land	-0.23 (0.34)	-0.69	0.494
Household size	0.55 (0.45)	1.23	0.227
Number of female in household	-1.80*** (0.6)	-2.97	0.006
Male head	3.18** (1.63)	1.95	0.061
Extension office	-1.09 (1.32)	-0.83	0.415

Access to truck	-1.55*** (0.54)	-2.84	0.008
Electricity	2.61 (1.67)	1.57	0.127
Piped water	-2.41*** (0.85)	-2.83	0.008
High school	-4.63 (3.25)	-1.43	0.165
Health post	-2.96** (1.15)	-2.58	0.015
Household education level	-0.57** (0.24)	-2.36	0.025
Dummy Credit HH	-0.43 (0.62)	-0.70	0.488
Dummy Off farm participation	2.53*** (0.85)	2.98	0.006
Dummy of Non-farm business participation	1.05 (0.77)	1.37	0.182
Marital status	0.25 (0.21)	1.22	0.234
Dependency ratio	1.15*** (0.3)	3.91	0.001
Shock index	-4.45 (2.92)	-1.53	0.138
Ln Growth trans received	0.13 (0.22)	0.60	0.551
CSI	-3.23 (2.67)	-1.21	0.236
head_age2	0.00052 (0.0045)	-1.15	0.260
Cash payment only beneficiaries	-3.40** (1.23)	-2.75	0.010
_cons	11.47*** (3.42)	3.35	0.002

*, **, *** indicates level of significance at 10%, 5% and 1% respectively; standard error in parentheses. Values in the parenthesis are robust standard errors.

5.4.2 Welfare Analysis in-terms of Asset Accumulation and Per-capita Expenditure for Other Controlling Variables

Table 5.5a and 5.5b below presents households' Welfare analysis controlling for demographic characteristics, institutional setup and indices of Environmental shocks vulnerability and coping strategy.

Table 5.5a Welfare analysis in-terms of Asset holding

Robust				
Intotv_asset_real	Coef.	t	[95% Conf. Interval]	
Year	0.44*** (0.1469)	2.98	0.15	0.73
PSNPany_PW_DS_benef	1.72** (0.763)	2.25	0.21	3.22
PSNPeff	-0.39** (0.164)	-2.40	-0.71	-0.07
tlu_svy	0.22*** (0.0639)	3.45	0.09	0.35
PSNP_PW_benef	-0.40 (0.40837)	-0.98	-1.20	0.40
PSNP_DS_benef	0.10 (0.33748)	0.30	-0.56	0.76
Invlvstk_svy_real	0.31*** (0.1109)	2.76	0.08	0.52
Land	-0.13 (0.1501)	-0.90	-0.43	0.16
Hhsize	0.10 (0.0929)	1.13	-0.07	0.29
head_age2	-0.00018 (9.97 E-05)	-1.76	-0.00037	2.06E-05
extYN	-1.04 (0.6343)	-1.64	-2.29	0.21
Electricity	0.03 (0.521)	0.06	-0.99	1.06
pipewater	0.18 (0.179)	0.99	-0.17	0.53
primschool2	-0.43 (0.3438)	-1.25	-1.11	0.25
Healthpost	0.16 (0.543)	0.31	-0.90	1.23
Eduthead	0.06 (0.06418)	0.92	-0.06	0.18
dummyCredit_HH	0.02 (0.177)	0.11	-0.33	0.37
highschool1	-1.14** (0.539)	-2.12	-2.20	-0.08
dum_Off_farm	-0.49** (0.242)	-2.02	-0.96	-0.01
dum_Non_farm_bus	0.000456 (0.175)	0.00	-0.34	0.34
lnreal_income_rev	0.03 (0.031)	0.87	-0.03	0.08

Marital	0.08 (0.0455)	1.76	-0.00976	0.17
Dratio	-0.08 (0.079)	-0.98	-0.23	0.08
shock_index	-0.39256 (1.076)	-0.36	-2.51	1.73
CSI	-0.46 (0.723)	-0.64	-1.89	0.96
lnGtrans_received	-0.05 (0.087)	-0.59	-0.22	0.12
_cons	5.97*** (1.398)	4.27	3.22	8.73
sigma_u	1.38			
sigma_e	0.60			
Rho	0.84152	(fraction of variance due to u_i)		

*, **, *** indicates level of significance at 10%, 5% and 1% respectively

From the above table analysis made for other controlling variables which are potential variables to affect program effect on outcome; the effect of PSNP on asset holding of households under the program are negative. The overall evaluation of welfare using program effect on households asset holding indicates, that PSNP as social safety net program is not effective in maintaining welfare at list as long as it is measured in terms of asset holding. Even though, social safety net programs are implemented to maintain welfare of participants at household or community level. (Christopher Bene et al., 2012)

Table 5.5b Welfare analysis of households' in-terms of per-capita expenditure in months with robust standard error

Ln per-capita expenditure	Coef.	z
Year	0.223***	5.28
	-0.042	
PSNP PW and DS beneficiaries	0.085	0.2
	-0.416	
Program effect	-0.077	-1.43
	-0.054	
Livestock owned by households	0.019***	4.18
	-0.005	
PSNP PW beneficiaries	0.188	0.52
	-0.360	
PSNP DS beneficiaries	-0.052	-0.15
	-0.343	
Ln livestock in survey year value	0.038	1.19
	-0.032	
Land	0.006	0.18
	-0.033	
Household size	-0.098***	-5.62
	-0.017	
Head_age2	-3.67E-06	-0.16
	-2.27E-05	
Extension office	-0.342**	-2.04
	-0.167	
Electricity	0.067	0.72
	-0.093	
Piped water	0.004	0.06
	-0.063	

primschool2	0.005	0.06
	-0.087	
Health post	-0.014	-0.13
	-0.110	
Education level of house head	0.034**	2.32
	-0.014	
Dummy Credit household	-0.031	-0.53
	-0.058	
highschool1	-0.427	-1.24
	-0.441	
Dummy Off-farm	-0.059	-0.87
	-0.068	
Dummy of Non-farm business	0.018	0.21
	-0.085	
Ln real income households generate in YEAR	0.004	0.45
	-0.010	
Marital status	0.019	0.89
	-0.021	
Dependency ratio	-0.032	-1.11
	-0.028	
shock index	-0.305	-0.94
	-0.324	
CSI	-0.085	-0.35
	-0.243	
ln Growth trans received	0.054***	2.7
	-0.020	
_cons	5.422***	18.98
	-0.285	

*, **, *** indicates level of significance at 10%, 5% and 1% respectively; standard error in parentheses. Values in the parenthesis are robust standard error

The over-all analysis of households' per-capita expenditure in months for other controlling variables effect on it indicates that, the program impact appears to be negative and insignificant. The magnitude of this PSNP pillar has come out as have not been expected on the null-hypothesis specified on table 3.1. Tropical livestock unit, household head educational level and transfer received have positive and significant contribution to change for per-capita expenditure in months. Whereas existence of extension office for potentially unexplained reason appear to have negative effect at 5 percent level of significance having different sign than expected.

Chapter Six: Conclusion and Recommendation

This chapter presents Conclusion and Recommendation based on the result of the study.

6.1 Conclusion

Food security program impact assessment has been conducted extensive from South America to Asia and from Middle East to Africa. Among food security program PSNP is one of the biggest programs in Africa and Ethiopia is among the nations having very large share of food security programs.

In this paper, we have implemented both descriptive and regression analysis to assess the impacts of Ethiopian Productive Safety Net Program on rural household's resilience to shocks and welfare using panel data of five rounds from 2006 to 2014 generated by IFPRI. The author used the DiD model for asset analysis, Food Gap analysis; and percapita expenditure analysis based on the result from the Hausman's test.

Compared to many comparable prior studies, this study has made improvements for quite a few reasons including the fact that the researcher has used data of five rounds from the same center and for the same purpose as well applying new method and different methods of analysis.

As have been stated on general and specific objectives of this study, the analysis of coping strategy index and shock index has been conducted to explorer vulnerability of households participating in the Productive Safety Net program for more than twelve years. Following the study of Daniel M. and Richard C. (2008), the researcher has developed Shock Index of environmental shocks and Coping Strategy Index to examine the dynamics of food security and vulnerability among participants of PSNP. Using Principal Component Analysis from both CSI

and SI examination, different shock occurrences have been indicated as getting better situation of households' vulnerability. Even though the trends of vulnerability differ across rounds of survey but, it is not more than change on incremental rate of household's vulnerability indicated by change in slope of Index.

As a second step of this study objective, resilience analysis has been conducted base on the very recently developed measure of resilience which came up with solution of measuring food security. Specifying it as BC denoting Barrett and Constanas (2014) and as it has been empirically shown by panel data analysis in the case of Northern Kenya, the newly developed theory focused explicitly on the stochastic dynamics of well being determined at multiple scale of analysis. According to BC, developed following FAO's 1999 definition of resilience development it defined as ability of households to avoid poverty in the face of various shocks and stressors. It indicates that the unit will be resilient whenever the mitigation capacity of households last over long time (Joanna B. Upton, 2016).

The PSNP impact analysis indicates that PSNP has reduced participant households' food gap. As the theoretical concern of BC (2014) indicates the falling trend in food gap can be interpreted as resilience indicators of shocks dominated by environmental disturbance.

Therefore, PSNP participants' resilience has increased and in overall evaluation the program is effective in improving households' resilience in the face of different shocks. This is found to be consistent in both analysis of without controlling other variables and under the analysis conducted for other controlling variables effect.

Since the theory of per-capita expenditure analysis for rural household by Aboubeker G. Bouker et al., 2016 indicates that even though buying food in rural point towards lack of food production but, high expenditure indicates enhanced wealth level.

As the study conclusion of Deverux et al., 2006 indicates that most of PSNP beneficiaries are chronically faced food insecurity and consume the entire food item they received at home. Very small proportions of beneficiaries were selling some proportion of food and made the large proportion for home consumption. In a surprising manner only food beneficiaries are twice as much of both food and cash beneficiaries to involve in such practices. This is most probably is to meet their other demands. Participants of PSNP receiving cash transfer in more diversified way than food ration beneficiaries. Very few households have used their cash transfer to purchase livestock and invested in their business.

Therefore, PSNP impact analysis on households' welfare in-terms of percapita expenditure indicates that PSNP has an expected positive effect on welfare. Devereux et al., 2006 analysis shows most of the rural population's per-capita expenditure goes to consumption good. Since, PSNP beneficiaries' payments made in food items the failing per-capita expenditure will be interpreted as indicator of rising households' welfare. But, the coefficients were statistically insignificant and are not different from zero. It indicates inconclusive nature of PSNP impact on Welfare in-terms of per-capita expenditure.

The demonstration of PSNP impact assessment using the DiD method on asset holding which is the summation of most liquidated and non-liquidated asset types indicates the negative impact of program on beneficiaries. The negative program effect on welfare analysis using asset holding

expenditure have been indicated in both analysis conducted controlling other variable effect and without controlling households demographic, institutional and vulnerability indicator indices.

As summary conclusion of the general impact assessment of PSNP on households Resilience to both human made and natural shocks and Welfare in rural Ethiopia generating evidence from panel data analysis of households who have been in the program for twelve years, five round survey starting from 2006 to 2014 shows that:

- i. CSI and SI analysis shows very sharp rising and falling trends indicating households' vulnerability to environmental shocks and food insecurity. But, after 2012 the evidence from households' PCA indicates that shock index and CSI analysis shows decreasing index of households shock vulnerability and food insecurity at decreasing rate that can be considered as a smooth probability of rising shock vulnerability and food insecurity of households under the program. Since, the year between 2012 and 2014 point toward the rising slope difference between the two analyses.
- ii. Ethiopian Productive Safety Net Program has increasing effect on Resilience of program eligible households. In this case PSNP in Ethiopia have met the program expected outcome as have been stated on the fourth manual developed by the Government of Ethiopia in 2014.
- iii. Ethiopian Productive Safety Net Program has inconclusive or can be pronounced as statistically insignificant but, negative effect on households' welfare analyzed in-terms of natural log of per-capita expenditure.

- iv. In contradiction to the finding of Government of Ethiopia in (2004EC), O.gilligan et al (2006) and William B. Peterman and Kamila Sommer study in (2016); Ethiopian Productive Safety Net Program has statistically significant reducing effect on beneficiary households' Welfare analyzed in terms of Asset holding unlike the objective of social safety net programs.

6.2 Recommendation

As has been described on objective of this thesis, the researcher has intended to assess the role of different PSNP interrelation and their related magnitude to shock resilience and welfare maintenance of households as a result of program effect only. To magnify the impact of PSNP on both Resilience to environmental shocks and Welfare of eligible households to promote food security in rural Ethiopia this study have endow with the following options to be taken care in both policy implications of PSNP pillars and Evaluation Methods:

- Measuring Resilience to environmental shocks in-terms of food gap is considerable and effective than measuring it in-terms of asset accumulation. Since, price of the most liquidated rural asset price dramatically fail as we shown in Borena Zone (VOA and FBC, 2017). So as it is recommended to measure program impact by classifying resilience effect of PSNP in to shock ex-ante analysis and ex-post analysis.
- Controlling the sharp disrupting shock vulnerability needs, strongly tie-up environmental rehabilitation programs with PSNP are needed. This attempt is made mainly to restore the environment into an acceptable standard that is as close as possible to its base line environmental state. The rehabilitation objective can be addressed in different ways and mechanisms such as ensuring stability and reducing risk of erosion, pollution and returning the disturbed area to an acceptable post mining state by providing households with predictable income as PSNP did. This requires managerial criteria such as

- 1 Limiting traffic until vegetation is self-sustaining

2 Damages by erosion will be rehabilitated as well erosion control will be maintained

3 Unhealthy plants need to be medicated and should be removed if necessary

● CSI and SI should be studied on monthly or quarterly collected panel data to see more detailed trend of environmental shocks effect than sharp rising and falling trend after occurrences of events.

● Promoting insurance company to provide agricultural insurance when production faller occurs due to environmental shock has reduced its consequence.

● As Seema and Lilani, 2006 indicates, the dummy variable analysis are suspected for Truncation or clumping¹¹ effect; so as to resolve the problem researchers should conduct their analysis with data set in a more specified truncation than dummy variables.

● Even-though it is statistically insignificant, as the resilience analysis in this study indicates and other study Bapu Vaitla (2012) made on the case of Tigray and Oxfam (2010) indicates credit availability have positive contribution to increase households resilience to shock. Therefore, it is advisable to focus on availability of credit to households in a manner that can enable beneficiaries to invest in non farming practice. Since, non farming practice has positive impact on resilience.

¹¹ Truncation or clumping effect refers to the problem of considering observation being in a small group of cluster e.g considering households taking credit service using dummy even-though it have large variance of amount of money. (Seema and Lilani, 2006)

- Considering this study and Munir Ahmad and Umar Farooq (2012), payments in both kind and cash are very small and un-adjusted for inflationary and identification of eligible households made considering the transitory nature of poverty and low human capital and access to productive asset. Therefore, PSNP implementation needs to focus on reducing Dependency ratio, and CSI; increasing school attendance, households head education level, health post accessibility moreover making the transfer in terms of cash have pro-motive effect.
- The inconclusive contribution of some variables due to statistically insignificant coefficients for un-justified reasons should be studied; above all, the contribution of land holding should be studied.

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Appendices

A1a: PCA of households coping preference of all components during shock

Principal components/correlation No. of obs = 2298

Trace = 8

Number of comp. = 8

Rotation: (unrotated = principal) Rho = 1.000

Component	Eigenvalue	Difference	Proportion	Cumulative
-----------	------------	------------	------------	------------

-----+-----

Comp1	2.58174	1.06409	0.3227	0.3227
-------	---------	---------	--------	--------

Comp2	1.51764	.163706	0.1897	0.5124
-------	---------	---------	--------	--------

Comp3	1.35394	.604442	0.1692	0.6817
-------	---------	---------	--------	--------

Comp4	.749497	.184163	0.0937	0.7754
-------	---------	---------	--------	--------

Comp5	.565334	.103227	0.0707	0.8460
-------	---------	---------	--------	--------

Comp6	.462107	.0399888	0.0578	0.9038
-------	---------	----------	--------	--------

Comp7	.422118	.0744949	0.0528	0.9565
-------	---------	----------	--------	--------

Comp8	.347623	.00	0.0435	1.0000
-------	---------	-----	--------	--------

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Unexplained
-----+-----+-----									
disell_prd~d	0.4203	-0.0143	-0.2519	0.5616	0.5198	-0.1009	0.3045	0.2668	0
disell_prd~y	0.4391	-0.0249	-0.1872	0.4458	-0.6616	0.1760	-0.3056	-0.1037	0
disell_dur~d	0.4688	-0.0079	-0.2450	-0.3684	0.4004	0.0201	-0.3921	-0.5196	0
disell_dur~y	0.4308	0.0371	-0.2613	-0.5813	-0.2909	-0.0156	0.4195	0.3821	0
disrent_la~d	0.3055	-0.2666	0.5774	-0.0953	0.1464	0.1763	-0.4215	0.5127	0
disrent_la~y	0.3089	-0.2699	0.5730	0.0497	-0.1031	-0.1420	0.4913	-0.4783	0
disell_lvs~d	0.0965	0.6688	0.2294	0.0202	0.0964	0.6668	0.1748	-0.0774	0
disell_lvs~y	0.1646	0.6376	0.2427	0.0192	-0.0758	-0.6800	-0.1860	0.0663	0

A1b: PCA of households coping preference of the first four components during shock

Principal components/correlation No. of obs = 2298

Trace = 8

Number of comp. = 4

Rotation: (unrotated = principal) Rho = 0.7754

Component	Eigenvalue	Difference	Proportion	Cumulative
-----------	------------	------------	------------	------------

-----+-----

Comp1	2.58174	1.06409	0.3227	0.3227
-------	---------	---------	--------	--------

Comp2	1.51764	.163706	0.1897	0.5124
-------	---------	---------	--------	--------

Comp3	1.35394	.604442	0.1692	0.6817
-------	---------	---------	--------	--------

Comp4	.749497	.184163	0.0937	0.7754
-------	---------	---------	--------	--------

Comp5	.565334	.103227	0.0707	0.8460
-------	---------	---------	--------	--------

Comp6	.462107	.0399888	0.0578	0.9038
-------	---------	----------	--------	--------

Comp7	.422118	.0744949	0.0528	0.9565
-------	---------	----------	--------	--------

Comp8	.347623	.000	0.0435	1.0000
-------	---------	------	--------	--------

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
----------	-------	-------	-------	-------	-------------

-----+-----+-----

disell_prd~d	0.4203	-0.0143	-0.2519	0.5616	.2214
--------------	--------	---------	---------	--------	-------

disell_prd~y	0.4391	-0.0249	-0.1872	0.4458	.3049
--------------	--------	---------	---------	--------	-------

disell_dur~d	0.4688	-0.0079	-0.2450	-0.3684	.2496
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disell_dur~y	0.4308	0.0371	-0.2613	-0.5813	.173
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disrent_la~d	0.3055	-0.2666	0.5774	-0.0953	.1929
disrent_la~y	0.3089	-0.2699	0.5730	0.0497	.1968
disell_lvs~d	0.0965	0.6688	0.2294	0.0202	.2257
disell_lvs~y	0.1646	0.6376	0.2427	0.0192	.233

A2a: PCA of households Shock Index

Principal components/correlation	Num. of obs =	2637		Trace	=	17
	Number of comp. =	17	Rotation: (unrotated = principal)	Rho	=	1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.41573	1.91097	0.2009	0.2009
Comp2	1.50475	.31691	0.0885	0.2894
Comp3	1.18784	.103845	0.0699	0.3593
Comp4	1.084	.0565732	0.0638	0.4231
Comp5	1.02743	.0175271	0.0604	0.4835
Comp6	1.0099	.0655916	0.0594	0.5429

Comp7	.944307	.0610873	0.0555	0.5985
Comp8	.883219	.024201	0.0520	0.6504
Comp9	.859018	.0423523	0.0505	0.7010
Comp10	.816666	.0500994	0.0480	0.7490
Comp11	.766567	.0633046	0.0451	0.7941
Comp12	.703262	.0128554	0.0414	0.8355
Comp13	.690407	.0478694	0.0406	0.8761
Comp14	.642537	.0496999	0.0378	0.9139
Comp15	.592837	.0448205	0.0349	0.9487
Comp16	.548017	.224499	0.0322	0.9810
Comp17	.323518	.0	.0190	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Comp10
flood	0.2859	-0.2371	-0.3912	0.1742	0.2253	0.0122	-0.0981	-0.0498	0.0819	0.1025
Erosion	0.2938	-0.2949	-0.2209	0.0625	0.1288	0.0145	-0.0963	0.0912	0.3518	0.0873
frost	0.2855	-0.1235	-0.3949	0.0384	0.1072	0.0175	-0.0631	-0.1007	-0.2795	0.1035
pestCrop	0.3062	-0.1393	0.1278	0.0462	-0.0110	-0.0211	0.1372	-0.2073	0.3176	0.0161
pestStor	0.2557	-0.1735	0.2094	-0.0233	-0.3221	-0.0546	-0.1752	0.4884	0.1972	-0.1664
pestLvs	0.2331	-0.0173	0.5510	-0.1884	0.1155	0.0688	0.0066	-0.2083	0.2842	0.1940
inputs	0.3097	0.1132	-0.0487	-0.1245	-0.1234	-0.2187	0.0375	0.1098	-0.4415	-0.3705
inputPr	0.3315	0.0381	0.3032	-0.1933	0.0547	-0.0181	0.0701	-0.1799	-0.3480	-0.0160
output	0.3072	-0.1247	-0.0030	0.0297	-0.3380	-0.0566	0.0481	0.2034	0.0455	-0.2347
husbdz	0.0616	0.0250	-0.0406	-0.0625	-0.0070	0.9283	0.2273	0.2108	-0.0678	-0.1065
wifedz	0.0310	0.0933	0.3079	0.5979	0.3127	0.1042	-0.4998	0.1796	-0.1543	-0.1307
othrdz	0.0527	0.3176	-0.0505	-0.2440	0.5257	-0.2098	0.2577	0.6080	0.1338	0.1104
husbill	0.1352	0.3629	-0.1118	-0.0484	-0.4582	0.0569	-0.2745	0.1499	-0.0528	0.6632
wifeill	0.1239	0.5161	-0.0653	0.0679	0.0254	0.0540	-0.2790	-0.1295	0.2209	-0.1610
othrill	0.1223	0.4619	-0.2316	0.0745	-0.1064	0.0033	0.1314	-0.2328	0.3415	-0.3738
divorce	0.0647	0.0944	0.1065	0.6624	-0.1563	-0.1147	0.6127	0.0707	-0.0460	0.2021
DummyShock	0.4201	0.1775	0.0574	-0.0133	0.2256	0.0620	0.0713	-0.1533	-0.1902	0.1613

Variable	Comp11	Comp12	Comp13	Comp14	Comp15	Comp16	Comp17	Unexplained
flood	-0.2369	0.1224	0.1948	0.0410	0.0433	-0.6822	0.1430	0
Erosion	-0.2898	0.1977	0.0684	-0.2738	0.1303	0.6233	0.0106	0
frost	0.4293	-0.0069	-0.3725	0.4176	-0.1443	0.2412	0.2335	0
pestCrop	0.3718	-0.5762	-0.1198	-0.4397	-0.0005	-0.1230	0.1093	0
pestStor	0.1797	0.3713	-0.3117	-0.0630	-0.3055	-0.2068	-0.1008	0
pestLvs	-0.0076	0.1961	-0.0835	0.4303	0.4010	-0.0399	0.1825	0
inputs	-0.0870	0.0323	-0.1604	-0.2369	0.5976	-0.0400	0.1248	0
inputPr	-0.1785	0.1221	0.2976	-0.1791	-0.5261	0.0840	0.3823	0
output	-0.1686	-0.4592	0.3872	0.5005	-0.0337	0.1023	-0.1403	0
husbdz	-0.0189	-0.0273	-0.0323	-0.0546	0.0669	-0.0238	0.0777	0
wifedz	0.2014	-0.0702	0.2035	-0.0230	0.0914	0.0767	0.0686	0
othrdz	0.0845	-0.1335	0.0654	0.0481	-0.0407	-0.0098	0.1195	0
husbill	0.0850	-0.0385	0.1794	-0.1175	0.1231	-0.0080	0.1080	0
wifeill	-0.4743	-0.2162	-0.4635	0.0673	-0.1964	-0.0089	0.0824	0
othrill	0.3628	0.3486	0.3394	0.0258	0.0067	0.0371	0.0533	0
divorce	-0.1557	0.1139	-0.1636	0.0366	-0.0156	0.0296	0.0969	0
Dummy Shock	0.0324	0.0670	-0.0166	-0.0417	-0.0522	-0.0205	-0.7952	0

A2b: PCA of households Shock Index of first eight components

Principal components/correlation Num. of obs = 2637

Trace = 17

Number of comp. = 8

Rotation: (unrotated = principal)

Rho = 0.6504

Component	Eigenvalue	Difference	Proportion	Cumulative
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Comp1	3.41573	1.91097	0.2009	0.2009
Comp2	1.50475	.31691	0.0885	0.2894
Comp3	1.18784	.103845	0.0699	0.3593
Comp4	1.084	.0565732	0.0638	0.4231
Comp5	1.02743	.0175271	0.0604	0.4835
Comp6	1.0099	.0655916	0.0594	0.5429
Comp7	.944307	.0610873	0.0555	0.5985
Comp8	.883219	.024201	0.0520	0.6504
Comp9	.859018	.0423523	0.0505	0.7010
Comp10	.816666	.0500994	0.0480	0.7490
Comp11	.766567	.0633046	0.0451	0.7941
Comp12	.703262	.0128554	0.0414	0.8355
Comp13	.690407	.0478694	0.0406	0.8761

Comp14	.642537	.0496999	0.0378	0.9139
Comp15	.592837	.0448205	0.0349	0.9487
Comp16	.548017	.224499	0.0322	0.9810
Comp17	.323518	.0000	0.0190	1.0000

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Unexplained
-----+-----+-----									
flood	0.2859	-0.2371	-0.3912	0.1742	0.2253	0.0122	-0.0981	-0.0498	.3579
erosion	0.2938	-0.2949	-0.2209	0.0625	0.1288	0.0145	-0.0963	0.0912	.4788
frost	0.2855	-0.1235	-0.3949	0.0384	0.1072	0.0175	-0.0631	-0.1007	.4869
pestCrop	0.3062	-0.1393	0.1278	0.0462	-0.0110	-0.0211	0.1372	-0.2073	.5725
pestStor	0.2557	-0.1735	0.2094	-0.0233	-0.3221	-0.0546	-0.1752	0.4884	.3295
pestLvs	0.2331	-0.0173	0.5510	-0.1884	0.1155	0.0688	0.0066	-0.2083	.3579
inputs	0.3097	0.1132	-0.0487	-0.1245	-0.1234	-0.2187	0.0375	0.1098	.5575
inputPr	0.3315	0.0381	0.3032	-0.1933	0.0547	-0.0181	0.0701	-0.1799	.4361
output	0.3072	-0.1247	-0.0030	0.0297	-0.3380	-0.0566	0.0481	0.2034	.494
husbdz	0.0616	0.0250	-0.0406	-0.0625	-0.0070	0.9283	0.2273	0.2108	.02156

wifedz	0.0310	0.0933	0.3079	0.5979	0.3127	0.1042	-0.4998	0.1796	.1076
othrdz	0.0527	0.3176	-0.0505	-0.2440	0.5257	-0.2098	0.2577	0.6080	.05344
husbill	0.1352	0.3629	-0.1118	-0.0484	-0.4582	0.0569	-0.2745	0.1499	.412
wifeill	0.1239	0.5161	-0.0653	0.0679	0.0254	0.0540	-0.2790	-0.1295	.4448
othrill	0.1223	0.4619	-0.2316	0.0745	-0.1064	0.0033	0.1314	-0.2328	.4824
divorce	0.0647	0.0944	0.1065	0.6624	-0.1563	-0.1147	0.6127	0.0707	.08586
Dummy									
_Shock	0.4201	0.1775	0.0574	-0.0133	0.2256	0.0620	0.0713	-0.1533	.264

A3a: Food Gap Test for Time Fixed Effect

Fixed effects (within) regres	Number of obs	=	3093	corr(u_i, Xb) = 0.1952	Prob > F	=	0.000
Group variable: ID	Number of groups	=	637				
R-sq: within = 0.0517	Obs per group: min =		1				
between = 0.2253		avg =	4.9				
overall = 0.1152		max =	5				
	F(5,2451)	=	26.70				

Fgap	Coef.	Std. Err.	t	[95% Conf.Interval]	
PSNPany_PW_DS_benef	1.010386***	0.122719	8.23	0.769742	1.251029
Year					
2	0.329792***	0.120023	2.75	0.094434	0.56515
3	0.16543	0.119989	1.38	-0.06986	0.40072
4	-0.67485***	0.12049	-5.60	-0.91112	-0.43858
5	-0.23767**	0.120982	-1.96	-0.4749	-0.00043
_cons	1.677026***	0.092774	18.08	1.495102	1.858949
sigma_u	1.416198				
sigma_e	2.102785				
Rho	0.312045	(fraction of variance due to u_i)			

F test that all $u_i=0$: $F(636, 2451) = 2.02$ Prob > F = 0.0000

*, **, *** indicates level of significance at 10%, 5% and 1% respectively

A3b: Real Asset Accumulation Test for Time Fixed Effect

Intotv_asset_real	Coef.	Std. Err.	t	[95% Conf. Interval]	
PSNPany_PW_DS_benef	1.640527	0.162689***	10.08	1.321504	1.959549
Year					
2	2.011492	0.159116***	12.64	1.699477	2.323507
3	2.55235	0.15907***	16.05	2.240424	2.864275
4	3.342641	0.159734***	20.93	3.029413	3.655868
5	4.387	0.160387***	27.35	4.072492	4.701507
_cons	3.557688	0.122991***	28.93	3.316511	3.798865
sigma_u	2.560396				
sigma_e	2.787673				
Rho	0.45758	(fraction of variance due to u_i)			

Fixed-effects (within) regr No. of obs = 3093Group

variable: ID No. of groups = 637R-sq: within = 0.2975 Obs per group: min = 1between = 0.1133 avg = 4.9 overall = 0.2094 max = 5 F(5,2451) = 207.61corr(u_i, Xb) = 0.0454 Prob > F = 0.0000

F test that all u_i=0: F(636, 2451) = 4.09 Prob > F = 0.0000

A3c: log of Percapita Expenditure Test for Time Fixed Effect

Fixed-effects (within) reg Number of obs = 2366 R-sq: within = 0.2288 Obs per group: min = 1 Group variable: ID Number of groups = 637 between = 0.0694 avg = 3.7

overall = 0.1633

max = 5

F(5,1724) = 102.27

corr(u_i, Xb) = 0.0179

Prob > F = 0.0000

Lnpcexp	Coef.	Std. Err.	t	[95% Conf.Interval]	
PSNPany_PW_DS_benef	-0.04406	0.035857	-1.23	-0.11439	0.026267
Year					
2	-0.24182	0.043608***	-5.55	-0.32734	-0.15629
3	0.291022	0.043532***	6.69	0.205642	0.376403
4	0.364864	0.042843***	8.52	0.280834	0.448894
5	0.493426	0.04237***	11.65	0.410325	0.576528
_cons	5.619369	0.039348***	142.81	5.542194	5.696544
sigma_u	0.494012				
sigma_e	0.5532				
Rho	0.44366	(fraction of variance due to u_i)			

F test that all u_i=0: F(636, 2451) = 4.09 Prob > F = 0.0000

*, **, *** indicates level of significance at 10%, 5% and 1% respectively

A4 Hausman test

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
year	.0041831	.0273007	-.0231176	.0082335
PSNPany_PW~f	2.373544	3.142682	-.7691385	.1250146
PSNPeff	-.4281759	-.5237745	.0955986	.0239385

b = consistent under Ho and Ha; obtained from xtreg

$$\chi^2(3) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

B = inconsistent under Ha, efficient under

$$= 34.40$$

Ho; obtained from xtreg

$$\text{Prob} > \chi^2 = 0.0000 \quad (V_b-V_B \text{ is not positive definite})$$

Test: Ho: difference in coefficients not systematic

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
PSNPany_PW~f	.8944561	2.511204	-1.616748	.3053982

b = consistent under Ho and Ha; obtained from xtreg

Test: Ho: difference in coefficients not systematic

B = inconsistent under Ha, efficient under

Ho; obtained from xtreg

$$\chi^2(1) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

= 28.03

Prob>chi2 = 0.0000

—— Coefficients ——				
	(b)	(B)	(b-B)	$\sqrt{\text{diag}(V_b - V_B)}$
	fe	re	Difference	S.E.
PSNPany_PW~f	-.3723859	-.3173394	-.0550465	.0570528

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under

$$\chi^2(1) = (b-B)'[(V_b - V_B)^{-1}](b-B)$$

Ho; obtained from xtreg

= 0.93

Test: Ho: difference in coefficients not systematic

Prob>chi2 = 0.3346

A5 a Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	426	0.92723	0.107307	2.214787	0.716312	1.138148
1	188	4.367021	0.264508	3.626754	3.845218	4.888825
Combined	614	1.980456	0.127179	3.151365	1.730697	2.230215
Diff		-3.43979	0.238596		-3.90836	-2.97122

A5 b

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
0	444	1.934685	0.113797	2.397848	1.711036 2.158333
1	171	3.175439	0.192992	2.523696	2.794469 3.556408
Combined	615	2.279675	0.100578	2.494259	2.082156 2.477194
Diff		-1.24075	0.219009		-1.67085 -0.81066

A5 c

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.Interval]
0	436	1.463303	0.096725	2.019681	1.273196 1.65341
1	179	3.748603	0.222523	2.977148	3.309482 4.187725
Combined	615	2.128455	0.103113	2.557117	1.925959 2.330952
Diff		-2.2853	0.207585		-2.69297 -1.87764

A5 d

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.Interval]
0	380	0.947368	0.090169	1.757718	0.770074 1.124663
1	232	2.099138	0.129642	1.974644	1.843707 2.354569
Combined	612	1.383987	0.07779	1.924416	1.231219 1.536755
Diff		-1.15177	0.153545		-1.45331 -0.85023

A5 e

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.Interval]	
0	367	1.607629	0.093628	1.793658	1.423513	1.791746
1	270	2.274074	0.121813	2.001596	2.034245	2.513903
Combined	637	1.89011	0.075744	1.911693	1.741371	2.038849
Diff		-0.66644	0.151099		-0.96316	-0.36973

A6 Difference in difference analysis of Food gap

DIFFERENCE IN DIFFERENCES ESTIMATION							
Outcome Variable	BASE LINE			FOLLOW UP			DIFF-IN-DIFF
	Control	Treated	Diff (BL)	Control	Treated	Diff (FU)	
fgap	1.280	4.705	3.425	1.316	4.180	2.864	-0.561
Std. Error	0.114	0.241	0.267	0.085	0.184	0.203	0.069
t	11.24	19.49	12.83	15.48	22.69	14.12	-8.09
P> t	0.000	0.000	0.000***	0.000	0.000	0.000***	0.000***

* Means and Standard Errors are estimated by linear regression

**Robust Std. Errors

Inference: * p<0.01; ** p<0.05; * p<0.1