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Abbreviations

5DE	Five Domains of Empowerment in Agriculture
AGP	Agricultural Growth Program
CSA	Central Statistics Agency
DHS	Demographic and Health Survey
EA	Enumeration Area
ENGINE	Empowering New Generations to Improve Nutrition and Economic Opportunities
FtF	Feed the Future
GRAD	Graduation with Resilience to Achieve Sustainable Development
haz06	height/length-for-age z-score
IFPRI	International Food Policy Research Institute
LMD	Livestock Market Development
OPHI	Oxford Poverty and Human Development Initiative
PRIME	Pastoralist Areas Resilience Improvement through Market Expansion
SNNP	Southern Nations, Nationalities, and People's (Region)
UN	The United Nations
USAID	United States for International Development
waz06	weight-for-age z-score
WEAI	Women's Empowerment in Agriculture Index
WHO	World Health Organization
whz06	weight-for-height z-score

Abstract

This paper examines the impact of women empowerment in agriculture on intra-gender nutritional outcomes of children below five years old. We use a two-round panel data from a baseline (6977 households in 2013) and midline (6696 households in 2015) survey of Women Empowerment in Agriculture Index (WEAI[1]) dataset collected by IFPRI, Central Statistics Agency of Ethiopia, and Addis Ababa University in the Feed-the-Future and non-Feed-the-Future zones in Ethiopia. The primary objective is to examine whether an empowered woman can influence the household decision and consequently better nutritional outcome for the household members. The allocation decision obviously is influenced by unobserved individual-specific effects such as child gender preference and community variables. We apply the correlated random effects panel model with instrumental variables method to estimate the impact of Women Empowerment in Agriculture on children nutrition outcomes (Wooldridge 2005; 2015; Elzinga and Gasperini, 2015). To identify which empowerment domain, have a larger effect on intra-gender child nutritional outcomes, we separately estimate the five disempowerment scores on child nutrition outcomes.

Our result confirms that women in the Feed the Future zone of intervention are more empowered than the ones in the non-Feed the Future intervention area. However, we find little evidence to suggest that the interaction between women empowerment in agriculture and gender dummy variables have a gender-biased effect on child nutrition outcomes. Similarly, child nutrition outcomes are improved by program interventions but with no bias to gender. The five domains of disempowerment score negatively correlate with child nutrition outcomes yet with no gender-biased effect.

1. Introduction

Women empowerment is vital given the role they play in poverty alleviation and nutrition outcomes. It is vital not only for their well-being but also their potential contribution to the overall economic development and improvements of nutrition and education of kids (Quisumbing and Maluccio, 2003; Malhotra and Schuler, 2005). According to Kabeer (1999), women empowerment is a process of making strategic life choices based on resources, agency, and achievements (wellbeing outcomes).

Recent studies on women empowerment used the Women Empowerment in Agriculture Index to understand women empowerment in agriculture. This index is an aggregate indicator that captures control over resources within the agricultural sector. The WEAI is an innovative initiative by USAID, IFPRI, and the Oxford Poverty and Human Development Initiative (OPHI) under the umbrella of 'Feed the Future (FtF)' with the goal of measuring women empowerment in agriculture. The WEAI is composed of two sub-indexes, namely the five domains of women's empowerment (5DE) and Gender Parity Index (GPI)).

In Ethiopia's context, the 5DEs refers to women's decisions over agricultural production; access to and decision-making power over productive resources;[2] control over the use of income; leadership in the community; and time. These 5DEs, in turn, are constructed from 10 indicators (see for example Malapit et al., 2015b; and Alkire et al., 2013 for a tabular presentation of the 5DE). The 5DE examines the extent women are empowered with respect to these domains, and the percentage of domains which are empowered for the disempowered ones. The Gender Parity Index (GPI) indicates the percentage of women with equal empowerment score as their men counterparts.

Women could achieve these empowerment indicators by interacting with their community at village level and beyond, and among household members within the household. As a result, the intra-household externality, especially adult men/primary male respondent versus adult female/primary female respondent interactions, play a crucial role in achieving the anticipated level of women empowerment in agriculture.

At the household level, spouses are the two economic agents that interact on matters pertaining to agriculture and resource allocation. We can call this interaction an intra-household externality which can be important in understanding intra-household welfare allocation between sexes. The level of women empowerment in agriculture can be influenced by this intra-household externality.

As the non-pooling of agricultural resources within the household creates a gender gap in control of agricultural inputs (for example, for production diversity). There is a link between women's control of resources and the allocation of resources to food (Udry et al., 1995; Peterman et al., 2014; Doss 2006). Sraboni et al. (2013) found that greater empowerment of women measured using WEAI confirms the existence of per adult-equivalent calorie availability and dietary diversity in Bangladesh. Similarly, Quisumbing (2003), confirmed that greater control of resources by women creates better children nutrition outcomes which are in line with the conclusion by Carlson and Wardlaw (1990) that maternal resources play a key role in child nutrition status than paternal resources do.

Although the direction of empowerment and nutrition outcomes linkage is ambiguous, i.e. due to its contextual aspect, it is confirmed that an increase in women's empowerment enables women to allocate more of the family's resources to food, and to food dietary diversity. Empowering women including women's participation in paid and unpaid work is considered as a strong determinant factor for resource access to the family and increased disposable income for consumption.

Feed the Future midline survey report by Bachewe et al. (2014) in Ethiopia indicates that there are small improvements of women empowerment in agriculture in the FtF Woredas of influence and so improvement in welfare and child nutrition. This report is based on the result using an average treatment effect on the treated and control technique.

The work is organized as follows: Section 1.1 describes the nutrition policy targets in Ethiopia. Section 1.2 is the problem statement of the study. The objective of the study is presented in section 1.3 followed by the statement of hypotheses and concepts on child growth trends then the theoretical model in section 3. Section 4 is methodology with subsections of 4.1, 4.2, and 4.3 for data description, identification strategy, econometric model, and summary of statistics respectively. Section 5 is empirical results followed by conclusion and policy implications in section 6.

Nutrition policy targets in Ethiopia

Majority of the people of a second populous African country with an annual population growth rate of 2.6% (Ringheim et al. 2009), Ethiopia, live in rural areas (82%) and are impoverished (according to UNDP's 2015 Human Development Index, Ethiopia is 174 out of 188 countries with 0.448 Human Development Index).

Malnourishment due to low access to clean water and sanitation, proper diet, and quality health services is the main contributor to high maternal, neonatal, and child mortality in the country. Though the country has commenced exercising rapid, sustained improvements in under-nutrition such as a steady reduction in stunting, and a decline in the percentage of underweight and wasted children, yet, many children in Ethiopia remains in a hazardous situation of malnutrition. The Government of Ethiopia in collaboration with various partners is working on multi-sectoral coordination to improve the nutrition of all children, pregnant and lactating women and their families (Ministry of Finance and Economic Development, 2010).

As a plan of action, the first national Growth and Transformation Plan (GTP I) was designed to achieve four comprehensive objectives: (i) maintaining at least an average real GDP growth rate of 11% per annum and attaining the Millennium Development Goals (MDGs) by 2014/1515; (ii) expanding access and ensuring the qualities of education and health services and achieve MDGs in the social sectors; (iii) establishing conditions for sustainable nation-building through the creation of stable democratic and developmental state; (iv) ensuring the sustainability of growth through maintaining macroeconomic stability.

In the second five years national plan, Growth and Transformation Plan II, the country's policy priority targets with respect to nutrition are clearly presented. That is, the plan sets to reduce the maternal mortality rate (MMR) from 420/100,000 live births in 2015 to 199/100,000 live births by 2020. Similarly, under-five child mortality rate and infant mortality rate are expected to decrease from 64/1000 live births in 2015 to 30/1000 live births by 2020 and from 44 in 2015 to 20 per 1000 live births by 2020 respectively (National Planning Commission, 2016).

Feed the Future in Ethiopia (FtF): The National Ministry of health involves various government sectors and non-governmental international aid actors to implement the GTP II. Among others, Feed the Future is one of the non-government international initiative engaged to play its role in improving the livelihood of citizens.

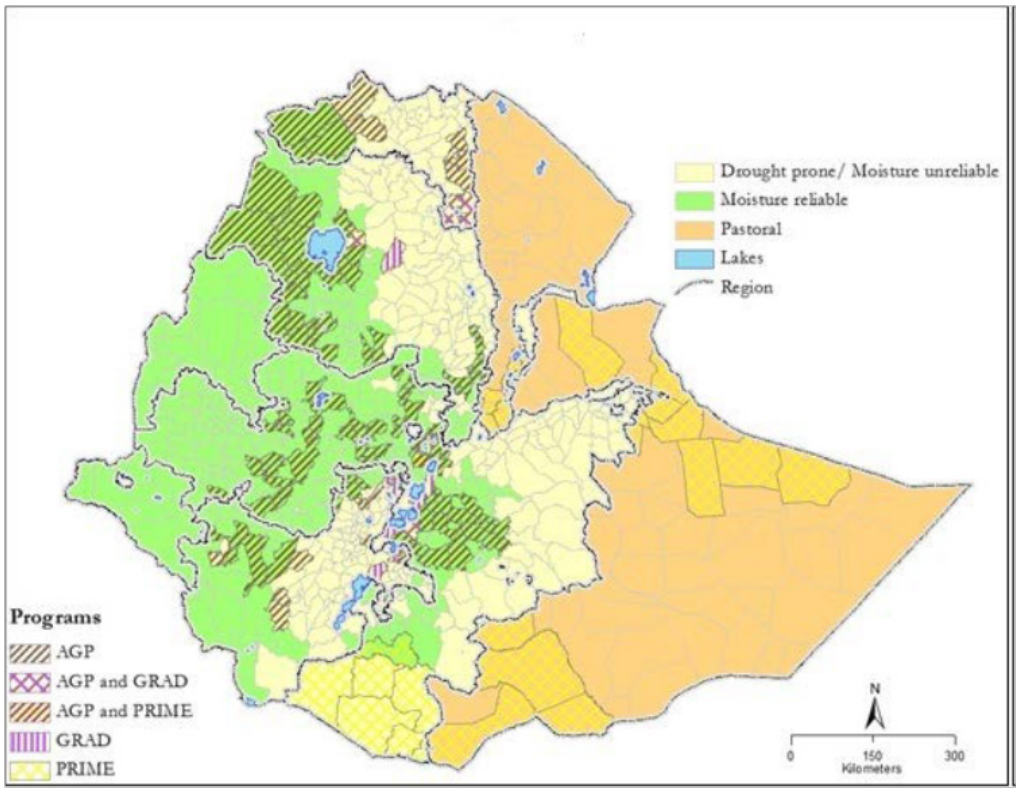
Feed the Future is the United States government's initiative to address global hunger which strives to address the root causes of global hunger by supporting countries to increasing their agricultural productivity to meet the demand for food, supporting and facilitating access to markets, and increasing incomes for the rural poor so they can meet their food and other needs.

In Ethiopia, USAID exerts its efforts to accelerate the FtF programs in 149 Woredas which include 3.58 million rural households and 16.8 million individuals. According to the FtF Ethiopia Strategy document, the main intervention programs supported by the USAID are Agricultural Growth Programme (AGP), Graduation with Resilience to Achieve Sustainable Development (GRAD), Pastoralist Areas Resilience Improvement through Market Expansion (PRIME), Empowering New Generations to Improve Nutrition and Economic Opportunities (ENGINE), and Livestock Market Development (LMD). These programs are mainly involved in the Institutional Strengthening and Development; Scaling up of best practices; Market and Agribusiness Development; Small Scale Agricultural Water Development and Management; and Small-Scale Market Infrastructure Development and Management. The programs in the FtF Woredas are indicated on the map of Ethiopia (national map), Figure 2, which indicates a considerable overlap of the programs in the Woredas. As it is on the map, AGP, GRAD, and PRIME are the main projects[3]. These programs are implemented mainly in five regions, namely, Tigrai, Amhara, Oromiya, Somali, and SNNP.

Because Women in Ethiopia own little independent decision making on most individual and family issues, FtF put goals to improve women empowerment in rural areas along with alleviating poverty.

Women empowerment in agriculture plays a key role in sustainably reducing global poverty and hunger via inclusive agricultural growth and improved nutritional status of women and children. Therefore, FtF deploys resources to reduce gender inequalities and enhance improvements in women's status as being critical for improvements in global food and nutrition security.

Figure 2: Feed the Future in Ethiopia



Source: Feed the Future (FtF) of Ethiopia – Midline report, 2015,

Problem statement

Children's nutritional status in Ethiopia is extremely disturbing though extensive efforts by government, NGOs and other stakeholders done to minimize malnutrition problem. One of the interventions to enhance child nutrition status is the empowering of a woman which is seen as one of the important factors to end malnutrition (Stevens et al. 2012; Ruel and Alderman 2013). The intervention priority on women empowerment emanates from the empirical evidence that confirms empowered women allocate household resources for the betterment of the family members (Quisumbing and Maluccio, 2003; Malhotra and Schuler, 2005). Whereas, many of this empirical evidence lack whether women empowerment equally enhances the nutrition of boys and

girls without disparity or not. This inquiry is potentially significant for Ethiopia as the country gives more attention to alleviating malnutrition. However, the evidence regarding the effect of women's empowerment on malnutrition is inconclusive and requires more research on it. Another important concern is the unavailability of nutrition indicators at an individual level. Usually, the per-capita expenditure is taken as a good proxy for individual welfare variable which is criticized for not considering individual heterogeneity in the analysis.

The lack of consistent evidence on whether women empowerment results in a homogenous effect on both gender's nutrition using individual-level nutrition indicators requires an alternative technique for analysis. Certain studies use child anthropometry as nutrition outcome variable while the challenge rests on how to find endogeneity free empowerment indicator. The question of household decision behavior when household level resources shock occurs also is imperative to address. Therefore, how do the decision-making agents in the household behave in the presence of empowered woman while shock occurs is one question not addressed that we know yet.

In summary, to the best of our knowledge, there is no paper that has estimated if the association between women empowerment and child nutrition enhances child wellbeing or not. In addition, how the decision-making household agents behave with resource scarcity during shocks and whether or not they make a gender-biased decision is still an area to be researched. The contribution of this paper is based on anthropometry and WEAI outcome variables and a predictor variable respectively to identify the effect of the association and nutrition contribution by gender.

Therefore, this paper seeks to answer the following research questions. (i) To what extent do women empowerment positively affect children's nutritional statuses in Ethiopia? (ii) How does women empowerment affect child nutrition? Does it create a gender-biased nutrition effect? (iii) What are the gender dynamics in decision making when resources are scarce especially during an environmental shock?

The contribution of this paper is the use of an innovative measure of women empowerment in Ethiopia to understand nutrition dynamics by gender within a household. This provides one of the first empirical evidence using the WEAI data and fills the knowledge gap on whether a change in women empowerment in agriculture results in gender-biased nutrition outcome. In addition to the result using the aggregate value of WEAI on nutrition, this paper goes further by separating the effect of the empowerment indicators/marginal effect of indicators on child nutrition which is important in targeted interventions that will encourage empowerment in specific resources for women that can maximize nutrition within the household. Beyond directly estimating the impact of changes in women empowerment in agriculture on child nutrition, indirect benefits of changes in women empowerment in agriculture including response to environmental shocks will be tested. Environmental shock variables are interacted with women empowerment in agriculture (i.e. WEAI) to examine how empowerment affects allocation behavior during livelihood fluctuations

Objective of the study

The general objective of the research is to examine the effect of women empowerment in agriculture on intra-gender children nutrition allocation with and without household level adverse environmental shocks. Particularly, the research aims to:

i Examine the association between women empowerment in agriculture and child nutrition.
ii Examine if women empowerment in agriculture has differential or child gender-biased nutrition effect within the household.

Statement of hypothesis

Based on the gaps from the empirical evidence, this research seeks to answer the question on if there is nutrition distribution between sexes, and impact of women empowerment in agriculture on individual child nutrition within the household given environmental shocks. During shock, households adapt by readjusting welfare distribution among household members; smooth consumption to share risk among the members. Men and women participate in the decision-making process including bargaining power with bargaining power represented by the level of women empowerment at the household level. The null hypotheses can be as:

i Women empowerment in agriculture index has no significant association with child nutrition.
ii Women empowerment in agriculture has differential or child gender-biased effect on nutrient allocation between boys and girls within the household.

2. Literature review

Concept of women empowerment

The agendas of feminist advocacy and official development priorities are the means for the mainstream development agenda which also inroads these goals into intrinsic grounds. Two understandable logic here. One, instead of adjusting between the competing claims with limited resources, policymakers may be influenced by the feminist goals in intrinsic terms to the indefinable territory of power and social injustice than focusing on the familiar conceptual territory of welfare, poverty, and efficiency. Second, there is also little effort by those who stand to gain from feminist advocacy to persuade those who set the agendas in major policy-making institutions (Razavi, 1997; Kabeer, 1999; Akter et al., 2017). These policy aspects lead to the concept of power, namely, women empowerment. But, no consensus on its definition and measurement is achieved in the literature. One of the well-known definitions of empowerment is by Kabeer (1999). Kabeer in her review paper known as 'Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment' defined 'power' as the ability to make choices which also means disempowerment is a denial of choice.

Although the concept of 'empowerment' varies across contexts, many of the definitions focus on the issues of gaining power and control over decisions and resources which determines quality of individual's life, i.e, empowerment is the capacity to realize choices into actions and desired outcomes (Narayan-Parker and Petesch , 2002; Akter et al., 2017). For instance, in a specific perspective, Alkire et al. (2013) defined empowerment in agriculture as one's ability to make decisions on matters related to agriculture as well as one's access to the material and social resources needed to carry out those decisions. In this regard, the Gender and Agriculture Research Network of the Consultative Group of International Agricultural Research (CGIAR) recommended two indicators to track and evaluate empowerment. These are i) Women control over productive resources such as land, livestock, water, forests, common property, seeds, fertilizers, machinery, financial assets, and the income from sales of the crop, livestock or forest products. ii) Women's decision-making power over time-use and income, and their decision-making power in groups and collective organizations.

It can be concluded that empowerment is a dynamic process of change in a sense those who have been denied the opportunity to make choices of their lives acquire such ability (Kabeer, 1999; Mahmud et.al., 2012).

As it is explained above, there are several defining elements which can be used to conceptualize empowerment. Agency, access to and control over resources, and the broader setting that characterizes the circumstances of a woman's life (such as marriage, living arrangements, household wealth, and characteristics of influential family members) shapes the opportunities and choices available to her (Kabeer, 1999; Kishor & Gupta, 2004; Mahmud et.al., 2012).

Measuring empowerment needs to consider several measurement issues which can be categorized into three basic aspects. Firstly, the empowerment process is not directly observable rather it can only be approximated using proxies or indicators. Second, empowerment is a multi-dimensional process. That is, gender inequality exists across different dimensions (social, economic, political, and psychological) and in various domains of women's lives. Third, in measuring empowerment, context is crucial. Which means the pathways of change vary from context to context, and even within the same context all women may not experience empowerment within the same dimensions (Kabeer, 1999; Kishor & Gupta, 2004; Mahmud et.al., 2012)

Bringing the concept of women empowerment to Ethiopia, society is characterized by a male-dominated which traditionally considers a woman in a lower status position that invites the agenda of women empowerment into the development agenda frontier. Taking many empowerment indicators such as agency, autonomy, resources control, decision-making on resources, on time-use and the outcome of the indicators such as education level, underage marriage, men are empowered than women (Lailulo et al., 2015).

Women empowerment and gender equity

It is commonly agreed that women's empowerment is vital because of its crucial role in the development agenda hence one of the UN's Sustainable Development Goals (SDGs) for the year 2030 is to achieve gender equality and empower all women and girls (UN, 2015). It is one of the key determining factors to achieve global food security. Because gender systems are diverse and complex, the nature and extent of gender inequity and the conditions necessary to empower women differ across contexts (Akter et al., 2017, Alkire et al., 2013).

In most parts of Africa, women are economically, culturally, socially, and politically disadvantaged. Institutional weaknesses, exclusion, and other barriers hinder women to access their rights in accessing opportunities, decision-making processes, and basic services. Therefore, empowering women is conceived as the result of gender equality while there are convincing arguments on whether gender equality is a result in itself (Onditi and Odera, 2017). On the other side, a significant section of the literature confirmed that gender equality and women's empowerment are mutually linked and mutually reinforcing and are both the direct goal and the desired ends.

In measuring empowerment and gender equity, there are commonly agreed domains or indicators by many researchers, namely, women's role and decision

making power in agricultural production, women's access to resources, women's access to and control over income, leadership, and membership in organizations, time and labor.

In this regard, an article titled 'Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia' by Akter et al. (2017), found that women have equal access to productive resources such as land and inputs, and greater control over household income than men which is consistent with findings on women empowerment in non-agricultural sector of Southeast Asia by (Mason and Smith, 2003; IFAD, 2013).

Other findings show that men and women in Sub-Saharan Africa grow different crops in demarcated plots while agricultural production is male-dominated in South Asia (Udry, 1996; Duflo, 2012; Akter et al., 2017).

Literature which deals on the correlation between women empowerment and food security also confirmed that women's significant effect on agricultural production decision-making is particular to crop type (Rahman, 2000; Sraboni et al., 2014; Clement et al., 2019). That is, empowered women, influence the household decision on vegetable harvest so retained for self-consumption while men have more control over rice production, fishing, and marketing of these products in Bangladesh.

Fathers' and mothers' empowerment in a study by (Malapit et al., 2019) titled 'Intrahousehold empowerment gaps in agriculture and children's well-being in Bangladesh' indicates different effects on investment in children: there is positive association between fathers' empowerment with younger children's nutrition and schooling; in addition to the importance of women empowerment for girls' education, it has also significant role in keeping older boys and girls in school.

Women empowerment and child nutrition

One of the reasons that put women empowerment at the frontier in the agenda of development is the issue of resources allocation decision-making in the household. There is always hot debate about who decides on child health and investments in children which are often influenced by gender inequalities on decision-making in the household. Family resources devoted to children is greater in families where resources are under control of women and in families where women play an important role in decision-making than in families in which women are less empowered so that play less decisive role (Thomas, 1990; Malapit et al., 2015).

In the issue of the link between women empowerment and child nutrition, there are different perspectives in the literature. A review of the association between women's autonomy and child nutritional status by Carlson et al. (2015) documented that maternal autonomy has a positive significant effect on child nutritional status. Another review by Cunningham et al. (2015) on Women's empowerment and child nutritional status in South Asia, a piece of review evidence in between the years of 1990 and 2012, showed that women's empowerment generally associates with child

anthropometry, but the findings are mixed. Explanations for the varied findings, according to them, are inter-study differences in population characteristics, settings or methods/conceptualizations of women's empowerment, and the specific domains studied. Besides, different women's empowerment domains may relate differently to child nutritional status.

A more comprehensive review by Pratley (2016) on women's empowerment and access to care and health status for mothers and children using 67 studies indicated that there was a significant association between women empowerment and maternal and child health outcomes with differences in magnitude and direction.

Evidence from a study by Malapit and Quisumbing (2015) in Ghana shows that women's empowerment is more strongly correlated with the quality of infant and young child feeding practices whereas weakly associated with child nutrition status. A similar study in Bangladesh shows that gender gaps in empowerment are only weakly linked to children's nutrition although empowerment discloses the significant difference in other parameters between boys and girls (Malapit et al., 2015).

As we have seen thus far, many of the study perspectives relied not on more two than empowerment indicators. Therefore, it might be good to summarize the pieces of evidence on this topic with some classifications.

The first strand is on woman's ability to access resources such as those control over a woman's mobility, access to information, or agency over agricultural decisions. A woman with better ability to decide and get access information and enough agency over agricultural decisions have a positive significant contribution to better household food security (Seymour, 2017; Sharaunga et al., 2016; Tsiboe et al., 2018, Santoso et al., 2019).

The second strand is on allocation of household resources for child nutrition, namely, material resource allocation, women's say on the allocation of their and other household members' time, women's decision making about childcare and child health, whether women can determine the activities (i.e., exercise, rest, socialization, health care) and material resources (i.e., good-quality food) that are optimal for their own health and nutrition status. A woman who owns these indicators influences decisions on food purchase and health care (Doan and Bisharat, 1990; Babu et al., 1993; Quisumbing and Maluccio, 2003; Porter, 2016)

The other group of women indicators lies in reproductive decisions. Evidence by Morgan and Niraula (1995), DeRose and Ezeh (2010), Abada and Tenkorang (2012) showed that an increase in women's decision-making power is associated with increased contraceptive use and with low pregnancy risks which result in good birth outcomes which in turn influences child nutrition outcomes.

From what we have reviewed, women empowerment has mixed result on child nutrition outcomes accompanied by various possible explanations for the varied evidence. In other terms, the correlation between women empowerment and child nutrition is dependent on which women empowerment indicator is considered, in what kind of population characteristics and contexts is the research done.

Child growth trends

Child growth refers to a measurable change in body size, physique, and body composition (Jurimae, T. and Jurimae, J., 2001; Beunen and Malina, 1996). Changes in stature and body mass are frequently used as markers of health and nutritional status of children. There are various methods to measure child growth trend among which anthropometry is one of the most applied ones which provides more information on the developmental process of children.

The growth pattern of a child is affected by a continuous interaction between the child's genes and environments such as the socioeconomic environment of the family and school as well as the ecological environment of the district and country.

Literature tries to classify child growth and development trends in different age categories. For example, Jurimae, T. and Jurimae, J., (2001) in their book entitled "Growth, Physical Activity, and Motor Development in Prepubertal Children" indicated that children can grow up in a normal process, where growth is organized in successive steps, or the growth process may be influenced by an individual variation due to genetic and/or environmental factors. In these steps till their adolescence (puberty), there are differences in sex organs but only minor differences in anthropometric characteristics between boys and girls: boys and girls have the same average statures and body masses provided that there are no external factors (Siervogel et al., 1991; Beunen and Malina, 1996).

Other evidence shows that, beyond the genetic effect, socioeconomic factors are attributed to the minor child growth variation. For instance, social classes matter for a weight-for-height indicator (see Eveleth et al., 1976). That is, in an industrialized countries, children in lower classes have the greater values of weight-for-height or obesity while the opposite works in developing countries: 'In the better-off populations of industrialized countries these latter differences are relatively small, while in developing countries the gap between well-off and poor is greater (the poor are thinner)'.

According to Eveleth et al. (1976), a child from birth to five years is at risk due to malnutrition and infections where malnutrition may begin during intra-uterine life after the first six months. This can result in growth variation between children or even gender.

Like the international evidence, gender child growth variation in Ethiopia depends mainly on the socioeconomic and environmental factors. The Ethiopian Demographic and Health survey 2016 report agrees to the international evidence on child growth variation (Demographic, 2016). According to this report, boys and girls anthropometric index, an index used to measure child growth, results indicate some variation between boys and girls below the age of five.

Looking at the height-for-age Z-score (stunting[4]), about 41.3% and 35.3% of boys and girls are stunted respectively. The result using weight-for-height z-score indicates 10.2% and 9.6% of boys and girls are wasted respectively. Similarly, the weight-for-age Z-score result indicates that 25.2% and 21.9% of boys and girls are underweight respectively. From these anthropometric measurement results, we observe that there are some growth variations between a boy and a girl in Ethiopia.

3. Theoretical model

As noted above, resources allocated among children are constrained by the availability of resources and other attributes including parent's child preferences. For instance, mother and father's influences on child welfare outcomes can differ (Chiappori 1988; Manser and Brown 1980), while allocations based on preferences involves bargaining between the agents who are responsible for the decision-making process (Agarwal 1997; Manser and Brown 1980; Chiappori 1988). To these aspects, researchers have generally adopted two conceptualizations known as unitary (Becker 1974; Thomas, 1994; Park, 2007) and non-unitary models (McElroy, 1990; McElroy & Horney, 1981) in understanding the correlates of child nutritional status while the unitary model is empirically invalidated (Lundberg, Pollak, and Wales, 1997).

Studies indicate that better bargaining power held by women is associated with improved welfare for every individual within the household than held by men (Haddad and Hoddinott 1994; Rubalcava et al 2004; Fafchamps et al., 2009; Maitra, 2004; Park, 2007). Therefore, to identify who has a higher influence on the family at a household level, it is crucial to identify power structure and its effect on the well-being of its members. The power structure scenarios can be a case where (i) the household is male-headed and the father can exercise most decisions; (ii) female-headed and mother exercises most of the decisions, and (iii) father and mother share the responsibility of decision-making. Therefore, bargaining power domains/indicators selection is at the center of discussion among researchers primarily because the concept of power or empowerment are subjective and contextual: subjective to use the best instrument that can have the best result on well-being.

For our simplicity, let us assume there are parents and children in a household: a mother (m), a father (f), and children (n) which are considered as the public to the parents. Simultaneously, we assume parents are the sole decision-makers in the household and not the children.

Now, let us denote C_j as a vector of consumer goods that do not affect child nutrition ($j = m,f$); as a vector of goods that affect child health; H is child nutrition status measured by anthropometric indicators; and X_j factors that determine the preferences of parent (exogenous factors): for instance, unearned individual income for j and her/his individual characteristics. Here, everyone j optimizes C_j that maximizes H. The simple household utility maximization problem (Becker, 1965; Rosenzweig and

Schultz, 1983; Strauss and Thomas, 1995; Mwabu, 2008; Kabubo-Mariara et al., 2009; Imai et al., R., 2014) is then:

$$\varphi_t U_{mt}(C_{mt}, q_t, H_{it}, X_{mt}) + (1-\varphi_t)U_{ft}(C_{ft}, q_t, H_{it}, X_{ft}) \quad (1)$$

where φ_t refers to the bargaining power of a woman (i.e. empowerment Index). Similarly, the nutrition/health production function for every child can also be defined as:

$$H_{it} = h(q_t, I_t, \varphi_t, X_{jt}) \quad (2)$$

Where *I* is a household's disposable income or the budget constraint which can be calculated as:

$$I_t = P_m C_{mt} + P_f C_{ft} + P_k q_{kt} \quad (3)$$

Where P_m P_f is the price of the private goods for the mother and the father respectively while the P_k is the shadow price of public goods (children in this case).

The reduced form child nutrition demand function derived from the maximization problem of (1) given (2) subject to (3) following Rosenzweig and Schultz (1983) and Mwabu (2008) is given as:

$$H_{it} = h(q_t, I_t, p_{mt}, p_{ft}, p_{kt}, X_{jt}, \varphi_t) \quad (4)$$

The bargaining power, φ_t, is the women empowerment index in agriculture. In the situation where the mother is likely empowered than the father in the sense that she value H_{it} than the father leads to a better nutritional outcome.

Beyond the direct correlation between nutrition and women empowerment, the point of interest here is to investigate the impact of empowerment on the distribution of resources/nutrients among household members. Every single rate of change in women empowerment index could result in an equal nutritional change of child (= a girl or a boy). Our null hypothesis is that women empowerment does not lead to differential changes in welfare within the household.

Adding the empowerment index into this maximization problem is assuming empowerment index, φ_t, as an exogenous variable. However, it might be endogenous in reality. For instance, the unobserved household decision-making on child health quality can affect the empowerment. Similarly, unobserved community support to women empowerment can equally contribute to child nutritional status. Therefore, we account for this concern in our implementation strategy in section (7) econometrically.

4. Methodology

Data

We use a two-round panel data from a baseline (6977 households in 2013) and midline (6696 households in 2015) survey of WEAI dataset collected by IFPRI, Central Statistics Agency of Ethiopia, and Addis Ababa University, in Ethiopia. The survey has an attrition rate of 4% with data collected from both empowerment intervention area known as the 'zone of influence' and an area without empowerment intervention. In the survey, the following questions were elicited: household demographics; dwelling characteristics; household consumption expenditure; household hunger scale; role in household decision-making around production and income generation; women's dietary diversity and anthropometry; child anthropometry and infant and young child feeding; employment; agricultural productivity and input use; crop utilization; agricultural extension; technology and information networks; livestock ownership and income from livestock and livestock products; shocks; non-farm income and business activities – own business activities; off-farm employment; credit; trust; control and agency; household assets (Non-Land); transfers, gifts and remittances; aspects of market supply and access and farm productivity are the main modules among others.

Among these modules, one module is designed and administered to collect information on the 10 empowerment indicators required to calculate the WEAI and consists of anthropometry measurements for women, and for children below 6 years old. The outcome variables are child nutrition in terms of Z-score in reference to the World Health Organization (WHO) population standard calculated using the anthropometry measurement for children below six years old. We calculate our key predictor WEAI and women's dietary diversity score as is described in section 6.2 and section 6.3.

Identification strategy

Variables identification

In Table 1, we present full description of our variables of interest. The outcome variable of interest is child nutrition measured using anthropometric indicators and

child dietary diversity (Minimum Adequate Dietary Adequacy) scores. We take into consideration that the z-score of a child, the result of dietary diversity, consuming nutrient-rich food types, and other child-rearing practices, is a good child nutrition/welfare outcome indicator.

Table 1: Describing the nutrition outcome and interaction variables

Nutrition outcome variables[1]	**Acronomy**	**Description**
Weight-for-age Z-score(waz06)	waz06	It tells how many standard deviations child nutrition is from world health organization population references
Length/height-for-age Z-score(haz06)	haz06	It tells how many standard deviations child nutrition is from world health organization population references
Weight-for-length/height Z-score (whz06)	whz06	It tells how many standard deviations child nutrition is from world health organization population references
Child Dietary Diversity Score	CDDS	Child nutrition outcome calculated using FANTA[6] guideline
Interaction variables		
Female#not in the FtF Woreda#WEAI	FNFWE	Female in the non-Feed the Future Woreda interacted WEAI
Female#in the FtF Woreda#WEAI	FFWE	Female in the Feed the Future Woreda interacted with WEAI
Male#in the FtF Woreda#WEAI	MFWE	Male in the Feed the Future Woreda interacted with WEAI
Female#shockdummy	Female_ shockdummy	Female with shock index
Male#shockdummy	Male_shockdummy	Male with shock index
Male#WDDS	Male_WDDS	Male dummy interacted with Women dietary diversity
Female#prudction input	FPID	Female respondent feels decides on production input
Male# production input	MPID	Male respondent feels makes decision on production input
Female#ownership	FOWNA	Female feels ownership on assets
Male# ownership	MOWNA	Male feels ownership on assets
Female#rightdispo	FRDISPO	Female feels she has the right of asset disposal
Male#rightdispo	MRDISPO	Male feels she has the right of asset disposal
Female#crdit	FCREDIT	Female with access to credit
Male#crdit	MCREDIT	Male with access to credit
Female#Decisio_income	FDINCOME	Female with access to income decision
Male#Decisio_income	MDINCOME	Male with access on income decision

continued next page

Table 1 Continued

Nutrition outcome variables	Acronomy	Description
Female#Aut_agri	FAAGRI	Female with autonomy in agri production
Male#Aut_agri	MAAGRI	Male with autonomy in agri production
Female#Group	FGROUP	Female with access to group membership
Male#Group	MGROUP	Male with access to group membership
Female#speack_public	Fspeack_p	Female with access to speak in public
Malee#speack_public	Mspeack_p	Male with access to speak in public
Female#leisure	FLEISURE	Female with access to leisure
Male#leisure	MLEISURE	Male with access to leisure

The anthropometric measures, namely weight-for-age z-score, Length/height-for-age z-score, and Weight-for-length/height z-score, will be regressed separately on women empowerment in agriculture (Onis 2006), women's dietary diversity score and other covariates.

The panel nature of our data set will help us control for potential endogeneity in the data that does not vary over time while variables such as average women empowerment in agriculture by districts will serve as an instrument that can be used to correct for potential unobservable that may be changing over time. Women empowerment in agriculture is expected to have a positive correlation with changes in the outcome variables.

Equally interesting is that empowerment can result in bias on resource allocation decisions (Eveleth et al., 1976). We assume that an empowered mother may allocate more resources to daughters and fathers to sons or vice versa. Interacted variable between change in women empowerment in agriculture and child gender dummy is included in the analysis to check if the marginal change on women empowerment in agriculture gives a gender-biased marginal change in child nutrition outcome.

In addition to the aggregate women empowerment in agriculture, the individual empowerment inadequacy scores for both indicators are traced against child nutrition so that it enables us to identify which indicator affects child nutrition more.

Inadequacy score is the percentage of domains in which the woman lacks adequate achievements while the WEAI score is the weighted sum of the country- or regional level 5DE and GPI (Alkire et al., 2013). In other terms, the inadequacy score is the lack of adequate achievements on the ten indicators at an individual level while WEAI is at the country or regional level.

Calculating women empowerment in agriculture index

According to Alkire et al. (2013), there are two ways to construct 5DE[7]. The first focuses on the percentage of empowered women and adequacies among the disempowered, and the second focuses on the percentage of disempowered women and the

percentage of domains in short of adequate achievements (For detail calculation steps using the second approach , see Alkire et al., 2013; Malapit et al., 2015).

Equally important is that a mother's nutrition is positively correlated with child nutrition and our point of interest is to identify if a mother's nutrition influence child nutrition differently depending on gender.

To estimate the parent's allocation decision behavior during tough times due to climate variability, we include the interaction of child gender and environmental shock dummy variables in our estimation. Variables in Table 1 are the main variables of interest in our estimations.

The relative inequality measure, gender parity index (GPI) score, which is a measure of inequality in 5DE profiles between the primary adult male and female in each household is included in the WEAI.

Table 2: The Domains used to compute the Women's Empowerment in Agriculture Index (WEAI)

Domain	Indicator	Definition	Weight
Production	Decision on Production	Sole or joint decision-making over food and farming, livestock, fisheries	1/10
	Autonomy in Production	Autonomy in agricultural production, e.g., what inputs to buy, what crop and what livestock to raise	1/10
Resources	Ownership of assets	Sole or joint ownership of major household assets	1/15
	Asset disposal and acquisition	Does the woman participate in decisions to buy, sell or transfer assets?	1/15
	Access to and decisions on credit	Access to credit and participation in decisions concerning credits	1/15
Income	Control over the use of income	Sole or joint control over income and expenditure	1/5
Leadership	Group membership	Is woman an active member in at least one economic or social group, e.g. agricultural marketing	1/10
	Speak in public	Is woman comfortable speaking in public concerning various issues, such as intervening in a family dispute	1/10
Time	Workload	Allocation of time to productive and domestic tasks.	1/10
	Leisure	Satisfaction with the time available for leisure	1/10

Source: Alkire et al. (2013)

The WEAI of a woman is within the range of zero (0%) and a hundred percent (100%) where an individual who has achieved 'adequacy' in eighty percent or more of the weighted

indicators are empowered (Alkire et al., 2013; Malapit et al., 2015). Table 1 shows the domain, their indicators and weight given to each indicator.

Women's dietary diversity score

To examine the association between child nutrition and women dietary diversity, we calculate the women's dietary diversity score (WDDS) which measures individual nutritional quality of the diet: the probability of micronutrient adequacy of the diet so that food groups included to calculate the score are directed towards determining this purpose (see FANTA indicator guideline by Swindale and Bilinsky, 2006). Women dietary diversity scores are positively correlated with socioeconomic status and household welfare share and food security (Hoddinot and Yohannes, 2002; Kennedy et al., 2011). To make nutrition comparison between child genders, we interact with the WDDS variable and gender of a child to identify if the effect of WDDS on child nutrition within the household varies based on child gender.

Following FAO's guidelines for measuring household and individual dietary diversity, nine food-groups were created and defined as Starchy staples; Dark green leafy vegetables; another vitamin A-rich fruits and vegetables; Other fruits and vegetables; Organ meat; Meat and fish; Eggs; Legumes, nuts and seeds; and Milk and milk products. Each woman of reproductive age (15-49 years) in the household were asked to recall if they consumed the food items which are included in our contextual food-groups.

Econometric model

In what follows, the econometric technique to address the motivational questions we raised in the statement section is presented. We examine the effect of women's empowerment in agricultural on child welfare outcomes where child welfare outcomes are measured via child nutrition outcomes. On top of this, the other point of interest is to estimate if women empowerment in agriculture creates a gender-biased effect on child nutrition. The women empowerment in agriculture with a positive effect on women's dietary diversity, measured with a dietary diversity score, helps in harnessing child nutrition. In addition to the two motives, we examined how women's dietary diversity affects child nutrition.

In estimating the rate of change of an outcome variable on the rate of change of explanatory variables in two-wave panel models, correlated random effects panel model can be applied. Following Wooldridge (2005 & 2015) and Elzinga and Gasperini (2015), expressed explicitly as:

$$H_{it} = \beta_0 + \beta_1 X_{jt} + \beta_2 Z_{it} + \beta_3 \varphi_t + \varepsilon_{it} \tag{9}$$

where β_0, β_1, β_2, and β_3 are parameters and H_{it} is the child nutrition outcome, the dependent variable for the i^{th} child within the household at the time, t, and X_{jt} factors

that determine the preferences of the parent *j* (exogenous factors): for instance, unearned individual income for j and her/his individual characteristics. Z_{it} captures time-variant, and time-invariant covariates, and ε_{it} is error term at time *t*. Here, H_{it} represents the z-scores and child dietary diversity score at which these scores considered as excellent child-level welfare indicators: child-level nutrition outcomes are a good proxy for child welfare used to examine welfare sharing among children within the household. $\varepsilon_{it} = \upsilon_i + u_{it}$ where the correlated random effects (CRE) panel model controls the unobserved effect (heterogeneity), υ_i, problem. β_1, and β_2 measures the average partial effects of the time-variant and time-invariant explanatory variables respectively.

Average partial effects are heterogeneous as they can vary dramatically with the underlying observed or unobserved covariates; they fail to reflect the entire variety of the heterogeneous effects. Therefore, interpreting average partial effects in the correlated random effects panel model using the causal effect is incomplete.

As a remedy for this problem, we use the instrumental variable technique with the correlated random-effects model to detect the average change in nutrition to women empowerment index when the change in nutrition to women empowerment varies among children exposed to the same[8] empowerment index level (Heckman and Vytlacil, 1998). In this setting, we identify that community-level effect on child nutrition and women empowerment, i.e. community can contribute to child nutrition and at the same time to empowerment. Therefore, average village-level women empowerment in agriculture is used as an instrument for the aggregate women empowerment in agriculture such that it is correlated with individual women empowerment in agriculture but once controlled for has no impact on the outcome of interest.

Summary statistics

Table 3 presents our summary statistics result about the score of child nutrition outcomes by gender. Based on the anthropometric results, the summary result indicates the relative standing of a child nutrition outcomes within our statistical dataset. Accordingly, close to 50 % of both male and female children are stunted[9]. Similarly, about 11% of both male and female children are wasting[10].

Prevalence of underweight is between 10 and 25% for both male and female children. In Table 4, we show the mean of the inadequacy count and inadequacy of Women Empowerment Indicators by household type.

As can be seen, the inadequacy score[11] is slightly smaller in the households where the household head is male above 34 years old; and is female between 13-34 years old.

Table 3: Summary Statistics of Child Nutrition in terms of z-scores (Percentile report)

Sex		N	mean	sd	p5	p10	p25	p50	p75	p95	p99
girl	waz06	2199	-1.116	1.334	-3.28	-2.82	-1.98	-1.14	-.27	1.11	2.37
	haz06	2199	-1.747	2.038	-4.87	-4.22	-3.17	-1.9	-.55	1.94	3.96
	whz06	2199	-.134	1.647	-2.85	-2.06	-1.13	-.19	.83	2.73	4.39
boy	waz06	2148	-1.198	1.377	-3.4	-2.93	-2.045	-1.23	-.33	1.15	2.29
	haz06	2148	-1.771	2.043	-4.88	-4.22	-3.18	-1.98	-.64	1.92	4.32
	whz06	2148	-.288	1.658	-3.18	-2.39	-1.21	-.305	.71	2.51	4.05
Total	waz06	4347	-1.156	1.356	-3.34	-2.87	-2.03	-1.17	-.31	1.12	2.3
	haz06	4347	-1.759	2.040	-4.87	-4.22	-3.18	-1.93	-.59	1.93	4.01
	whz06	4347	-.210	1.654	-3.02	-2.24	-1.17	-.25	.78	2.61	4.24

Source: Result extract from data analysis, 2019

Table 4: Mean of the Inadequacy of Women Empowerment Indicators by Household Type

Indicators\HH Head Type	Male (Age> 34)	Male (Age13-34)	Female (Age>34)	Female (Age13-34)	Total
Inadequacy Count	0.357	0.374	0.368	0.353	0.364
Input-dec-domain	0.015	0.020	0.016	0.018	0.016
Ownership	0.006	0.011	0.010	0.016	0.009
Right-agri	0.006	0.011	0.010	0.016	0.008
Credit decision	0.051	0.058	0.052	0.055	0.052
Income-decision	0.025	0.021	0.024	0.029	0.025
Autonomy in Agri	0.021	0.025	0.019	0.023	0.021
Group membership	0.025	0.023	0.024	0.022	0.024
Speak public	0.055	0.057	0.059	0.052	0.057
leisure	0.078	0.077	0.074	0.08	0.076

Source: Result extract from data analysis, 2019

Households, where their head is a male between 13-34 years old and female above 34 years old, have higher inadequacy count.

According to the FtF midline report 2015 in Ethiopia, the pictorial presentation of the contribution of five domains for empowerment are described in Appendix B. Production, resources income leadership and leisure time contribution in the FtF zone are 12%, 19%, 7%, 34%, and 28% respectively while in the non_FtF zone they are 11%, 18%, 7%, 35%, and 29% respectively.

5. Empirical results

The women empowerment vs. nutrition outcomes

In what follows we present the result of the Correlated Random Effect Panel model with the instrumental variable method. Table 5 columns 1, 2 and 3 presents results of z-scores, on child anthropometry[12] (waz06 haz06 and whz06) using the WHO 2006 child nutrition standard reference while column 4 presents the child dietary diversity score (CDDS) calculated from nine food groups.

For the purpose of instrument validation, we regress the aggregate women empowerment in agriculture index (WEAI_c) on the village level average women empowerment in agriculture index (see the result on Table D in the Appendix). Specifically, the Wu-Hausman Test for Endogeneity is manually estimated using the t-statistic on linear predicted residual in the outcome of interest regression (see in Table D in the Appendix). This is the test of the null that WEAI_c is exogenous. We reject the null that WEAI_c is exogenous, so we run our correlated random effects with instrumental variables estimation technique. This test is robust to serial correlation and heteroskedasticity (Wooldridge, 2012; Wooldridge, 2013).

Incorporating the village level average women empowerment index in the regression, we examine our hypothesis which pursues to answer whether women empowerment in agriculture affects child nutrition outcomes (that is, weight-for-age Z-score (waz06), height-for-age Z-score (haz06), weight-for-height Z-score (whz06), and CDDS[13]) or not. If so, does its effect vary with child sex or not? We traced women empowerment in agriculture and the women empowerment inadequacy indicators on child nutrition outcomes.

The result indicates that the endogenous variable, women empowerment in agriculture, has a positive correlation at a 5% level of significance. A unit change in women empowerment in agriculture results in a large change in weight-for-age Z-score (waz06). It also has an ambiguous correlation with CDDS which correlates negatively at a 1% level of significance with a large coefficient. In terms of the inadequacy score variable, we find statistically significant (significant at 1%) negative correlation between the inadequacy score and waz06. According to Alkire et al. (2013), inadequacy score (Inadequacy Count in Table 5) measures the inadequate achievements of the woman in every 10 empowerment indicators (hereafter indicators). A unit increase in the inadequacy score reduces weight-for-age Z-score (waz06) by about 32%. Similarly,

inadequacy score has negative significant effects on the child dietary diversity and height-for-age Z-score (haz06) at one percent level of significance, that is, a unit increase in the inadequacy score results in a decrease in child dietary diversity score and haz06 by above 35 and 67% respectively which goes in line with Smith et al. (2003), Park (2007), Sraboni et al. (2013), and Lundberg et al. (1997) results, but differs from findings by Zereyesus et al. (2017) in northern Ghana and Imai et al. (2014). Unlike the previous nutrition outcomes, inadequacy score has no effect on the Weight-for-length/height Z-score (whz06). A possible explanation for why the effect of inadequacy score and women empowerment in agriculture on child nutrition outcome varies may be due to the reason that inadequacy score is lack of achievements at an individual level while the latter is an aggregate one (i.e. it is an aggregate of 5DE and GPI) (Alkire et al., 2013; Malapit et al., 2015).

The interaction variable of child sex dummy (one if a child is male, zero otherwise), dummy if the household is in the area of FtF Woredas (one if the household is in the influence Woredas and participates in the agricultural interventions by FtF, zero otherwise), and women empowerment in agriculture variables examined on the nutrition outcomes indicates different results based on gender and whether the household adopts the FtF development interventions (See Table 1 for the full description of the variables).

Looking at the waz06, the result for a girl in the non-FtF (FNFWE) indicates that girls are worse off than boys in the same area. The women empowerment in agriculture negatively correlates with a girl‘s waz06 in the FtF Woredas at 1% level of significance while it shows positive significant relation with haz06 and child dietary diversity score. Boys in the FtF Woredas are better off than girls in Length/height-for-age z-score and child dietary diversity score at 10% and 1% level of significance respectively this result is consistent with the findings by Malapit et al., (2015).

The FtF of Ethiopia midline report in 2015 concluded that the FtF has no statistically significant impact on Length/height-for-age z-score and Weight-for-length/height z-score nutrition outcomes. That is, even though there exists change in women empowerment in agriculture between the baseline and midline surveys and between the non-FtF and FtF Woredas, there is no significant FtF impact on these nutrition outcomes at which our result of Weight-for-length/height z-score is in line with. What is interesting here is that the interaction variable has varied effects on child dietary diversity (CDDS) and anthropometric nutrition outcomes. The explanation for these differences might be that women empowerment in agriculture might have an immediate influence on food distribution while these anthropometric nutrition outcomes are gradual so that it might be too early to examine the impact of women empowerment in agriculture on child anthropometric results.

Child nutrition outcomes and Women’s Dietary Diversity Score (WDDS) have a positive correlation but not significant with waz06 and haz06 while it indicates an insignificant inverse correlation with child dietary diversity and weight-for-length (wha06). We interacted WDDS and child gender to trace its effect on child nutrition outcomes.

Table 5: Correlated Random Effects model with IV (WEAI with interaction)

	(Model 1)	(Model 2)	(Model 3)	(Model 4)
VARIABLES	**Weight-for-age z-score**	**Length/height-for-age z-score**	**Weight-for-length/height z-score**	**Child Dietary Diversity Score**
WEAI	8.216**	1.034	83.590	-11.123***
	(4.043)	(5.548)	(93.945)	(2.294)
Age of a child	-0.026**	0.045***	6.393***	-0.147***
	(0.011)	(0.016)	(0.227)	(0.003)
Gender	-13.692***	-11.559*	33.521	-6.709***
	(4.393)	(6.619)	(106.233)	(2.592)
WDDS	0.036*	0.014	0.184	0.351***
	(0.020)	(0.030)	(0.495)	(0.010)
Household type = 1, Female - Age > 34	-0.006	-0.086	2.049	-0.015
	(0.078)	(0.119)	(1.838)	(0.034)
Household type = 2, Male - Age 13-34	0.102**	-0.050	1.192	0.017
	(0.051)	(0.077)	(1.191)	(0.024)
Household type = 3, Female - Age 13-34	-0.008	-0.120	-0.070	-0.058
	(0.086)	(0.131)	(2.023)	(0.041)
Household size	0.024**	0.019	0.702**	-0.021***
	(0.011)	(0.018)	(0.279)	(0.005)
Inadequacy Count	-0.324***	-0.675***	0.357	-0.358***
	(0.116)	(0.175)	(2.713)	(0.056)
FNFWE	-16.939***	0.144	39.421	0.043
	(5.457)	(0.098)	(131.911)	(0.031)
FFWE	-16.802***	14.272*	40.772	8.324***
	(5.455)	(8.222)	(131.905)	(3.217)
MFWE	0.059	14.344*	-0.099	8.381***
	(0.066)	(8.223)	(1.540)	(3.218)
Female#shockdummy	0.261**	0.068	-1.374	0.175**
	(0.123)	(0.186)	(3.099)	(0.077)
Male#shockdummy	-0.279**	-0.482**	0.673	-0.076
	(0.135)	(0.204)	(3.135)	(0.077)
Male#WDDS	0.019	0.062	-0.656	-0.021
	(0.028)	(0.042)	(0.685)	(0.014)
Constant	5.628*	-2.804	-106.103	10.217***
	(2.964)	(4.467)	(74.857)	(1.846)
Observations	6,263	6,263	9,359	15,762
Number of unique_id	5,266	5,266	7,237	11,710

Source: Result extract from data analysis, 2019; Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

We accept our null hypothesis on the correlation between child dietary diversity and the interaction variable, that is, our result indicates that the interaction variable is statistically insignificant in both the nutrition outcomes.

We test the nutrition outcomes versus household environmental shocks[14] interacted with gender dummy. The result of this dataset shows a positive significant effect on a girl (Female#shockdummy) waz06 and child dietary diversity score. Consistent with our expectation, the interaction between the environmental shock index and male (Male#shockdummy) affects boys' waz06 and haz06 significantly and inversely but had no significant effect on other nutrition outcomes. Child age indicates an inverse correlation with both the nutrition outcomes which is consistent with the empirical literature.

There is no significant difference in child nutrition outcomes in households with female-headed above 34 years old except the negative coefficients for Length/height-for-age Z-score and child dietary diversity. A child in between 13-34 years old male-headed household is better in Weight-for-length/height Z-score than a child in a household led by a male above 34 years old.

Empowerment indicators and child nutrition outcomes

Table 6 similarly presents the Correlated Random Effects Panel Model results of nutrition outcomes versus the inadequacy of the 10 women empowerment indicators, namely, decision on production, autonomy in production, ownership of assets, asset disposal and acquisition, access to and decisions on credit, control over use of income, group membership, speak in public, workload and leisure. As can be seen in Table 6, the result for the interaction variable of inadequacy score indicator in speaking in public (Fspeack_p, Mspeack_p) with child gender negatively affects both genders but at a different level of significance. Its inverse association with weight-for-age z-score is at 1% level of significance and 5% for a girl (Fspeack_p) and a boy (Mspeack_p) respectively. In a similar way, this interaction variable and Length/height-for-age Z-score are negatively correlated at 10% and 5% level of significance for female (Fspeack_p) and male (Fspeack_p) child respectively while the rest of the inadequacy indicators do not have a significant correlation with weight-for-age z-score, Length/height-for-age Z-score. Both results in weight-for-age Z-score, Length/height-for-age Z-score with the interaction variable supports the evidence by Smith et al. (2003), Park (2007), Sraboni et al. (2013), and Lundberg et al. (1997).

Looking at the association between weight-for-length (whz06) and the 10 inadequacy indicators, we find that inadequacy in input in production decisions have a negative effect at 5 and 1% level of significance for girls (FPID) and boys (MPID) respectively. Similarly, inadequacy in income decision (MDINCOME) if the child is a boy and autonomy in agriculture (FAAGRI) if the child is a girl has a significant effect on this nutrition outcome. Inadequacies in speaking in public (Mspeack_p), group membership (MGROUP) and autonomy in agriculture (MAAGRI) negatively affect male

children dietary diversity while inadequacy in group membership (FGROUP) is the only variable that negatively and significantly affects female child dietary diversity score. Inadequacies in small asset ownership, autonomy in production, access to and decisions on credit, control over the use of income, workload and leisure variables interacted with child gender dummy have no significant effect on any of the nutrition outcomes.

Table 6: Correlated Random Effects model using inadequacy in empowerment (Result with Women empowerment inadequacy Scores with gender interactions)

VARIABLES	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Weight-for-age z-score	Length/ height-for-age z-score	Weight-for-length/height z-score	Child Dietary Diversity Score
Child Age	-0.025**	0.045**	-0.042***	0.147***
	(0.012)	(0.017)	(0.014)	(0.010)
Inadequacy Count	-0.315**	-0.518**	-0.007	-0.961***
	(0.148)	(0.219)	(0.178)	(0.123)
FPID	-1.174	0.640	-2.280**	-0.595
	(0.862)	(1.274)	(1.039)	(0.718)
MPID	-1.187	1.495	-2.773***	-1.304*
	(0.848)	(1.253)	(1.024)	(0.710)
FOWNA	1.368	2.868	-0.368	0.688
	(2.071)	(3.059)	(2.494)	(1.724)
MOWNA	3.201	3.527	2.048	-0.732
	(2.192)	(3.237)	(2.634)	(1.817)
FRDISPO	0.819	1.002	0.255	-0.285
	(2.182)	(3.222)	(2.630)	(1.821)
MRDISPO	-1.997	-2.151	-1.616	0.628
	(2.331)	(3.442)	(2.803)	(1.935)
FCREDIT	-0.195	1.562	-1.391	-0.644
	(0.944)	(1.393)	(1.134)	(0.782)
MCREDIT	0.032	0.498	-0.468	0.915
	(0.953)	(1.407)	(1.146)	(0.791)
FDINCOME	0.268	-0.263	0.589	0.137
	(0.495)	(0.731)	(0.597)	(0.413)
MDINCOME	0.308	-1.009	1.155**	0.481
	(0.482)	(0.711)	(0.581)	(0.402)
FAAGRI	1.017	0.090	1.353*	0.211
	(0.653)	(0.965)	(0.787)	(0.545)

Continued next page

Table 6 Continued

VARIABLES	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Weight-for-age z-score	Length/ height-for-age z-score	Weight-for-length/height z-score	Child Dietary Diversity Score
MAAGRI	0.694	0.808	0.660	-1.689***
	(0.650)	(0.960)	(0.782)	(0.541)
FGROUP	0.398	-0.404	0.788	-1.958***
	(0.615)	(0.909)	(0.741)	(0.513)
MGROUP	-0.382	-1.467	0.557	-1.725***
	(0.630)	(0.930)	(0.759)	(0.525)
Fspeack_p	-1.440***	-1.479*	-0.734	-0.662
	(0.530)	(0.782)	(0.637)	(0.440)
Mspeack_p	-1.168**	-1.941**	-0.085	-1.556***
	(0.535)	(0.790)	(0.644)	(0.445)
Constant	-1.150***	-1.778***	-0.327	1.702***
	(0.201)	(0.296)	(0.243)	(0.169)
Observations	6,035	6,035	6,035	6,035
Number of unique_id	5,043	5,043	5,043	5,043

Source: Result extract from data analysis, 2019; Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Marginal effects results

To disaggregate by how much the nutrition outcomes differ due to the change in women empowerment in agriculture for those who are living in the FtF Woredas depending on child gender, we apply 'margins[15] with the contrast' command which is also usually taken as an option to estimate treatment effects[16] in certain policy interventions.

'Margins' is used after our regression adjustment, that is, after the correlated random effects panel with instrumental variables model, to predict our nutrition outcomes controlling for treatment status and other characteristics[17].

Table 7 presents the predictive margins and contrast of predictive margins of women empowerment in agriculture on weight-for-age z-score, weight-for-height, length/height-for-age z-scores and child dietary diversity scores based on child gender.

Taking weight-for-age z-score, as it is indicated in the table, change in women empowerment in agriculture results has an insignificant discrepancy with 1.1496 and 1.0828 predictive margins for girls and boys respectively with a -0.0668 contrast of predictive margins with 95% confidence intervals.

Table 7: Predictive margins and contras of predictive margins with 95% CIs

Models	Predictive Margins with 95% CIs				Contras of predictive margins with 95% CIs	
	(1) Sex	(2) argin	(3) z	(4) P>|z|	(5) Contrast (girl vs boy)	(6) Std. Err.
Weight-for-age z-score	girl	1.149	0.82	0.411	-0.0668	0.03730
	boy	1.082	0.78	0.438		
Weight-for-height z-score	girl	1.687	0.96	0.336	-0.1274	0.0453
	boy	1.560	0.89	0.373		
Length/height-for-age z-score	girl	-0.931	-0.42	0.675	-0.0223	0.0575
	boy	-0.953	-0.43	0.668		
child dietary diversity score	girl	-1.711	-1.41	0.158	-0.0757	0.0272
	boy	-1.7871	-1.47	0.140		

Source: Result extract from data analysis, 2018

Similarly, a unit change in women empowerment in agriculture has no significant effect on the Weight-for-height z-score of a child with no gender-wise discrepancy. Change in women empowerment in agriculture also has no differential effect between boys' and girls' Length/height-for-age z-score, child dietary diversity score.

The impact of a unit change in women empowerment in agriculture on these nutrition outcomes is measured using the contrast of predictive margins. In Table 7, the marginal effects of women empowerment in agriculture on both nutrition outcomes are presented in column 5.

The estimated contrast of -0.0668 indicates an average change of Weight-for-age z-score of a boy due to a unit change of women empowerment in agriculture which does not significantly differ from that of a girl. This marginal effect result like the correlated random effect result again went in contradiction with the findings by Thomas (1990), Lundberg et al. (1997), and Sraboni et al. (2013).

These estimated contrasts are called the average treatment effect (ATE). Conceptually, we predicted the child nutrition outcome of a child taking a child gender as a discriminatory factor. In other words, this contrast of predictive margins is a difference-in-differences estimate for each women empowerment in agriculture level on the nutrition outcome is displayed. We can conclude that women empowerment in a household does not cause nutrition disparity between boys and girl kids.

6. Conclusions and policy recommendations

Our estimation using the Correlated Random Effect Panel model with the instrumental variable method is to examine the effect of women empowerment on child nutrition outcomes where nutrition outcomes are among the excellent welfare indicators at an individual level in rural Ethiopia. The reason behind why women empowerment is used as a predictor to nutrition outcomes, as we explain in section one, is that an empowered woman plays a key role in the development and, food and nutrition security agendas and thereby reduces gender inequalities.

The descriptive result in Table 3 shows that close to 50% of both male and female children are stunting. The summary of weight-for-age indicates about 11% of both male and female children are wasting while the prevalence of underweight is in between 10 and 25% for both male and female children. This descriptive result is evidence that confirms the existence of severe malnutrition in the nation.

The correlated random effects panel with instrumental variables model estimation in Table 5 indicates that inadequacy score affects child nutrition outcomes differently. An inverse significant correlation between inadequacy score with both length/height-for-age z-score and child dietary diversity indicates that the more inadequate the woman is in women's empowerment indicators the less nutritious is the child while it shows no significant causal effect on both weight-for-age and length/height-for-age.

The impact of the variable interaction between women empowerment in agriculture, FtF dummy, and gender dummy on both height-for-age, length/height-for-age, weight-for-length/height z-score is statistically insignificant but with a negative coefficient. We find that the same variable interaction has significant effect on child dietary diversity score when the child is a boy in both the non-FtF Woreda and in the FtF Woreda while there is no significant influence of this interacted variable on child dietary diversity score when the child is a girl in both the non-FtF Woreda and in the FtF Woreda. The reason for the negative relationship between the interacted variable and the nutrition outcomes measured using anthropometric indicators might be that empowerment increases the burden of agency and other household responsibilities other than child caregiving in the household so that the more the woman is empowered the less is the child is nutritious. Our result also finds that environmental shocks dummy has no significant effect on all the child nutrition outcomes. Except for child dietary diversity score (for both girls and boys), women dietary diversity does not affect the other nutrition outcomes in our consideration.

The correlated random effects panel models with estimation using the inadequacy of women empowerment indicators in Table 6 in summary shows that all the inadequacy indicators, namely, control over use of income (inadequacy on decision making over the use of income), inadequacy in-group membership of a woman, inadequacy in input in production decisions, inadequacy in group membership, inadequacy in speaking in public, inadequacies in small asset ownership, autonomy in production, access to and decisions on credit, control over use of income, workload and leisure variables have varied effect on the nutrition outcomes. The result in our marginal analysis shows that a unit change due to a unit change in women empowerment in agriculture that does not create gender differential significant effect on the nutrition of children. The estimated contrast -0.0668 is the average marginal change of both boys' and girls' nutrition due to a unit change of WEAI.

From the findings we have seen thus far, we can conclude that women empowerment in agriculture is gradual so its effect on the nutrition outcomes. A possible explanation for this can be that the time interval of baseline and mid-term surveys might not be enough time duration to observe the gradual effect of women empowerment in agriculture on nutrition outcomes measured using anthropometry which also invites to wait for the project completion thought our result indicates a tendency of some change when the project completes. Whereas, an interesting finding is the impact of women empowerment in agriculture on child dietary diversity in the FtF and non-FtF Woreda: the marginal effect of women empowerment in agriculture on nutrition outcomes varies with project intervention. This differential effect on nutrition invites policy attention that promote women empowerment in agriculture so that it will have a positive significant effect on nutrition for both boys and girls equally.

Inadequacies in woman's group membership, i.e., adequate if individual is part of at least one group has negative effect on weight-for-age and length/height-for-age z-scores, and positive effect on child dietary diversity while inadequacies in speaking in public (adequate if comfortable speaking in public in at least one context) negatively affects length/height-for-age z-score. Similarly, inadequacies in input in production decisions (adequate if there are at least two domains in which an individual has some input in decisions) negatively affects weight-for-height Z-score for both boys and girls.

The results of inadequacy indicators versus nutrition outcomes give a clue to policymakers where their priority of attention should be. Therefore, policies should be in a way to encourage and promote women to achieve the adequacy levels that have a negative significant effect, to call some, women's input in production decisions, women's group membership, and speaking in public, on nutrition outcomes of children. In general, women empowerment in agriculture shows the tendency for positive contribution on both genders' nutrition and more works should be intensified by the government and NGOs working in the project area. On top of this, awareness creation programs about the impact of women empowerment should be provided to the community, husbands and other household members so that they encourage women to actively participate in the matter the household pertains.

Notes

1. WEAI is an innovative initiative by USAID, IFPRI, and the Oxford Poverty and Human Development Initiative (OPHI) under the umbrella of 'Feed the Future (FtF)' with the goal of measuring women empowerment in agriculture. WEAI is composed of two sub-indexes, namely the five domains of women's empowerment (5DE) and Gender Parity Index (GPI)).

2. Land ownership is one of the determining factors for individuals to participate in the decision-making process. According to Bezu and Holden (2014), youth in Ethiopia, especially women, get land access mainly from inheritance. In the empowerment questionnaire/module, it administers if the respondent owns agricultural land (parcel) or not.

3. ENGINE and LMD are other programs which also run overlapping with the other programs.

4. Stunting is a measure of linear growth retardation and cumulative growth deficits. Children whose height-for-age Z-score is below minus two standard deviations (-2 SD) from the median of the reference population are considered short for their age (stunted), or chronically undernourished. Children who are below minus three standard deviations (-3 SD) are considered severely stunted (Demographic, C.E., 2016).

5. child nutrition calculated using anthropometric indicators

6. FANTA is an abbreviation for Food and Nutrition Technical assistance

7. According to Alkire et al (2013) and Malapit et al (2015), the production domain have two indicators namely input in productive decisions and autonomy indecision with each 1/10 weight. Second domain is resources with three indicators, i.e. ownership of land and assets; decisions regarding the purchase, sale, or transfer of land and assets; and access to and decisions about credit each of them with 1/15 weight. The third domain is income which concerns sole or joint control over the use of income and expenditure with1/15 weight. Leadership is the fourth domain The fourth domain concerns leadership in the community measured by membership in economic or social groups and comfort speaking in public each of them with 1/10 weight. The final domain is 'time' which concerns about workload and leisure where each of them are with 1/10 weight.

8. WEAI level is the same at least for children with in a household.

9. Stunting, or low height for age (haz06 in this case), is caused by long-term insufficient nutrient intake and frequent infections.

10. Wasting, or low weight for height (whz06 in this case), is a strong predictor of mortality among children under five. It is usually the result of acute significant food shortage and/or disease.

11. Inadequacy score is calculated as as c_i=w_1 I_1i+w_2 I_2i+⊠+w_d I_di where I_di=1 where if person i has an inadequate achievement in indicator and = 0 otherwise and is the weight attached to indicator with . (Alkire et. Al, 2013)

12. Each child's anthropometric measurements were compared to the 2006 WHO child growth standards reference for his/her age and sex to compute haz06, whz06, and waz06 (WHO 2006).

13. See the full meaning of weight-for-age Z-score (waz06), height-for-age Z-score (haz06), weight-for-height Z-score (whz06), and CDDS and other explanatory variables in Table 1

14. Household level environmental shock refers to the dummy if one or more of drought, too much rain or flood, or erosion risk occurs.

15. According to Jann (2013) 'Margins' refers to the margins of responses, i.e. it is computed from predictions from a model while manipulating the values of the covariates. It is first derivative of the response with respect to the covariate in our case (Stata, A., 2015; Jann 2013).

16. A treatment effect represents a change in an outcome variable due a change in a particular covariate, all other remain the same.

17. Here we assume the conditional independence assumption is met because "the conditional independence assumption implies that we have enough variables in our dataset so that once we control for them in our regression model, the outcomes one would obtain with and without treatment are independent of how treatment status is determined" (Stata, A., 2015).

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Appendix

Table A: Summary statistics

VARIABLES	(1)	(2)	(3)	(4)	(5)
	mean	sd	n	min	max
Ftf dummy	0.684	0.465	0.465	0	1
Child Age	3.091	1.263	1.263	0	5
WEAI	0.820	0.0165	0.0165	0.806	0.839
Length/height-for-age Z-score(haz06)	-1.820	1.941	1.941	-6	5.910
Weight-for-age Z-score(waz06)	-1.218	1.324	1.324	-5.860	4.990
Weight-for-height Z-score(whz06)	-0.241	1.607	1.607	-4.990	4.980
Women dietary diversity	1.821	1.191	1.191	0	8
Child dietary diversity	1.736	1.202	1.202	0	9
Household size	5.472	1.543	1.543	1	12
Shock dummy	0.496	0.500	0.500	0	1
Number of children 5<age<19	6.027	2.542	2.542	0	10
Number of women in the HH	5.023	2.192	2.192	0	12
Number of men in the HH	4.890	2.337	2.337	0	14
Son/daughter: Relationship with primary respondent	0.966	0.181	0.181	0	1
Gender	0.504	0.500	0.500	0	1
Household type	1.383	1.002	1.002	0	3
Has some input in decisions or feels can make decisions in at least two domains	0.0142	0.0349	0.0349	0	0.100
Adequate if self-joint owns AT LEAST two small assets (chicken, farming)	0.00818	0.0219	0.0219	0	0.0667
Jointly has AT LEAST ONE right in AT LEAST ONE agricultural asset the household owns	0.00752	0.0211	0.0211	0	0.0667
Jointly makes AT LEAST ONE decision regarding AT LEAST ONE source of credit	0.0509	0.0283	0.0283	0	0.0667
Has some input in income deci or feels can make deci AND not only minor HH expend	0.0221	0.0627	0.0627	0	0.200
AUTONOMY IN PRODUCTION: Has RAI above one in at least on production activity	0.0178	0.0383	0.0383	0	0.100

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Table A Continued

VARIABLES	(1)	(2)	(3)	(4)	(5)
	mean	sd	n	min	max
Group membership: Adequate if individual is part of AT LEAST ONE group	0.0218	0.0413	0.0413	0	0.100
SPEAK IN PUBLIC: Adequate if comfortable speaking in public in AT LEAST ONE	0.0588	0.0492	0.0492	0	0.100
Adequate if does not express any level of dissatisfaction with the amount of leisure	0.0753	0.0431	0.0431	0	0.100
Number of girl kids in the HH	2.024	1.552	1.552	0	8
Number of boy kids	1.113	1.078	1.078	0	6

Source: Author's result, 2019

Table B: Correlated Random Effects model with IV (WEAI with interaction)

VARIABLES	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Weight-for-age Z-score	Length/ height-for-age Z-score	Weight-for-length/height Z-score	Child Dietary Diversity Score
WEAI	8.216**	1.034	83.590	-11.123***
	(4.043)	(5.548)	(93.945)	(2.294)
Age of a child	-0.026**	0.045***	6.393***	-0.147***
	(0.011)	(0.016)	(0.227)	(0.003)
Gender	-13.692***	-11.559*	33.521	-6.709***
	(4.393)	(6.619)	(106.233)	(2.592)
WDDS	0.036*	0.014	0.184	0.351***
	(0.020)	(0.030)	(0.495)	(0.010)
Number of women in the HH	0.004	0.028**	-0.299	-0.002
	(0.009)	(0.014)	(0.216)	(0.004)
Primary respondent's age	0.002	-0.003	0.063	0.002**
	(0.002)	(0.003)	(0.057)	(0.001)
Household type = 1, Female - Age > 34	-0.006	-0.086	2.049	-0.015
	(0.078)	(0.119)	(1.838)	(0.034)
Household type = 2, Male - Age 13-34	0.102**	-0.050	1.192	0.017
	(0.051)	(0.077)	(1.191)	(0.024)
Household type = 3, Female - Age 13-34	-0.008	-0.120	-0.070	-0.058
	(0.086)	(0.131)	(2.023)	(0.041)
Household size	0.024**	0.019	0.702**	-0.021***
	(0.011)	(0.018)	(0.279)	(0.005)

continued next page

Table B Continued

VARIABLES	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Weight-for-age Z-score	Length/ height-for-age Z-score	Weight-for-length/height Z-score	Child Dietary Diversity Score
Relationship to primary respondent (son/daughter)	-0.217**	-0.221	4.738**	-0.028
	(0.091)	(0.137)	(2.207)	(0.041)
Inadequacy Count	-0.324***	-0.675***	0.357	-0.358***
	(0.116)	(0.175)	(2.713)	(0.056)
FNFWE	-16.939***	0.144	39.421	0.043
	(5.457)	(0.098)	(131.911)	(0.031)
FFWE	-16.802***	14.272*	40.772	8.324***
	(5.455)	(8.222)	(131.905)	(3.217)
MFWE	0.059	14.344*	-0.099	8.381***
	(0.066)	(8.223)	(1.540)	(3.218)
Female#shockdummy	0.261**	0.068	-1.374	0.175**
	(0.123)	(0.186)	(3.099)	(0.077)
Male#shockdummy	-0.279**	-0.482**	0.673	-0.076
	(0.135)	(0.204)	(3.135)	(0.077)
Regionvar = 1, Tigray	-0.294***	-0.036	-6.494***	0.061*
	(0.064)	(0.098)	(1.556)	(0.033)
Regionvar = 2, Oromiya	0.296***	0.251***	-1.319	0.145***
	(0.048)	(0.073)	(1.134)	(0.023)
Regionvar = 3, SNNP	0.331***	0.322***	-6.007***	0.154***
	(0.053)	(0.081)	(1.269)	(0.026)
Regionvar = 4, somale	-0.177**	0.297***	-7.732***	-0.042
	(0.075)	(0.113)	(1.790)	(0.038)
DepRatio_c	0.025	0.021	0.121	0.003
	(0.019)	(0.029)	(0.457)	(0.009)
Male#WDDS	0.019	0.062	-0.656	-0.021
	(0.028)	(0.042)	(0.685)	(0.014)
Constant	5.628*	-2.804	-106.103	10.217***
	(2.964)	(4.467)	(74.857)	(1.846)
Observations	6,263	6,263	9,359	15,762
Number of unique_id	5,266	5,266	7,237	11,710

Source: Result extract from data analysis, 2019; Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table C: Correlated Random Effects model using inadequacy in empowerment (Result with Women empowerment inadequacy Scores with gender interactions)

VARIABLES	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Weight-for-age Z-score	Length/ height-for-age Z-score	Weight-for-length/height Z-score	Child Dietary Diversity Score
Child Age	-0.025**	0.045**	-0.042***	0.147***
	(0.012)	(0.017)	(0.014)	(0.010)
Number of women in the HH	0.005	0.032**	-0.015	0.008
	(0.009)	(0.014)	(0.011)	(0.008)
Primary respondent's age	0.0002	-0.003	0.003	-0.001
	(0.002)	(0.003)	(0.003)	(0.002)
Household type = 1, Female - Age > 34	0.068	-0.045	0.140	-0.018
	(0.082)	(0.121)	(0.099)	(0.069)
Household type = 2, Male - Age 13-34	0.121**	-0.047	0.233***	0.053
	(0.053)	(0.079)	(0.064)	(0.044)
Household type = 3, Female - Age 13-34	0.065	-0.047	0.144	0.118
	(0.093)	(0.138)	(0.112)	(0.077)
Household size	0.031**	0.024	0.025*	0.008
	(0.012)	(0.018)	(0.015)	(0.010)
Relationship to primary respondent	-0.235**	-0.256*	-0.133	-0.096
	(0.094)	(0.139)	(0.114)	(0.079)
Inadequacy Count	-0.315**	-0.518**	-0.007	-0.961***
	(0.148)	(0.219)	(0.178)	(0.123)
FPID	-1.174	0.640	-2.280**	-0.595
	(0.862)	(1.274)	(1.039)	(0.718)
MPID	-1.187	1.495	-2.773***	-1.304*
	(0.848)	(1.253)	(1.024)	(0.710)
FOWNA	1.368	2.868	-0.368	0.688
	(2.071)	(3.059)	(2.494)	(1.724)
MOWNA	3.201	3.527	2.048	-0.732
	(2.192)	(3.237)	(2.634)	(1.817)
FRDISPO	0.819	1.002	0.255	-0.285
	(2.182)	(3.222)	(2.630)	(1.821)
MRDISPO	-1.997	-2.151	-1.616	0.628
	(2.331)	(3.442)	(2.803)	(1.935)
FCREDIT	-0.195	1.562	-1.391	-0.644
	(0.944)	(1.393)	(1.134)	(0.782)
MCREDIT	0.032	0.498	-0.468	0.915
	(0.953)	(1.407)	(1.146)	(0.791)

continued next page

Table C Continued

VARIABLES	(Model 1)	(Model 2)	(Model 3)	(Model 4)
	Weight-for-age Z-score	Length/ height-for-age Z-score	Weight-for-length/height Z-score	Child Dietary Diversity Score
FDINCOME	0.268	-0.263	0.589	0.137
	(0.495)	(0.731)	(0.597)	(0.413)
MDINCOME	0.308	-1.009	1.155**	0.481
	(0.482)	(0.711)	(0.581)	(0.402)
FAAGRI	1.017	0.090	1.353*	0.211
	(0.653)	(0.965)	(0.787)	(0.545)
MAAGRI	0.694	0.808	0.660	-1.689***
	(0.650)	(0.960)	(0.782)	(0.541)
FGROUP	0.398	-0.404	0.788	-1.958***
	(0.615)	(0.909)	(0.741)	(0.513)
MGROUP	-0.382	-1.467	0.557	-1.725***
	(0.630)	(0.930)	(0.759)	(0.525)
Fspeack_p	-1.440***	-1.479*	-0.734	-0.662
	(0.530)	(0.782)	(0.637)	(0.440)
Mspeack_p	-1.168**	-1.941**	-0.085	-1.556***
	(0.535)	(0.790)	(0.644)	(0.445)
FLEISURE	0.964	0.677	0.797	0.216
	(0.598)	(0.884)	(0.720)	(0.498)
MLEISURE	0.304	0.124	0.452	-0.074
	(0.615)	(0.908)	(0.740)	(0.511)
Female#shockdummy	0.021	0.117*	-0.035	0.417***
	(0.046)	(0.069)	(0.059)	(0.042)
Male#no_shockdummy	-0.009	0.183	-0.191	0.040
	(0.115)	(0.171)	(0.140)	(0.097)
Male#shockdummy	0.002	0.212	-0.201	0.421***
	(0.114)	(0.169)	(0.138)	(0.096)
DepRatio_c	0.026	0.035	0.008	-0.045***
	(0.020)	(0.029)	(0.024)	(0.016)
Mean child age	0.006	-0.023	0.030	-0.029**
	(0.015)	(0.023)	(0.019)	(0.013)
Constant	-1.150***	-1.778***	-0.327	1.702***
	(0.201)	(0.296)	(0.243)	(0.169)
Observations	6,035	6,035	6,035	6,035
Number of unique_id	5,043	5,043	5,043	5,043

Source: Result extract from data analysis, 2019; Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table D: Results for endogeneity test

VARIABLES	(M1)		(M2)
	Weight-for-age Z-score		WEAI_c
Residual	24.436**	Village level Mean of WEAI	2.19000***
	(11.808)		(0.35004)
Age (in years) of the child from the household roster	-0.034***		0.00218***
	(0.013)		(0.00015)
Number of women in the HH	0.004	Gender	-0.00013
	(0.009)		(0.00050)
Primary respondent's age	0.002	WDDS attached to a child	0.00364***
	(0.003)		(0.00019)
Household type = 1, Female - Age > 34	-0.007		
	(0.087)		
Household type = 2, Male - Age 13-34	0.089*		
	(0.052)		
Household type = 3, Female - Age 13-34	-0.012		
	(0.089)		
Household size	0.016		-0.00045***
	(0.012)		(0.00012)
Inadequacy Count	-0.309***		
	(0.119)		
0b.gender#0b.ftf_dummy#c.WEAI_c	-24.959*		
	(15.139)		
0b.gender#1.ftf_dummy#c.WEAI_c	-24.846		
	(15.143)		
1.gender#0b.ftf_dummy#c.WEAI_c	-25.076*		
	(15.144)		
1.gender#1.ftf_dummy#c.WEAI_c	-25.025*		
	(15.145)		
0b.gender#c.shock	-0.009		
	(0.169)		
1.gender#c.shock	0.015		
	(0.169)		
0b.gender#c.WDDS_C	0.077*		
	(0.043)		

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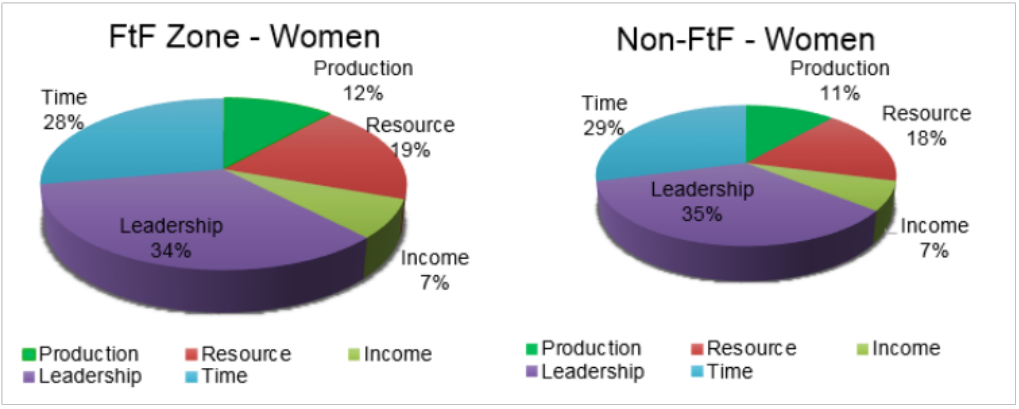
Table D Continued

VARIABLES	(M1)		(M2)
	Weight-for-age Z-score		WEAI_c
1.gender#c.WDDS_C	0.100**		
	(0.042)		
Constant	16.951		-0.98751***
	(11.885)		(0.28799)
Observations	6,248		6,321
Number of unique_id	5,257		5,323

Source: Researcher's estimation, 2019, Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 1: Contribution of Each of the 5Ds to Disempowerment of Women



Source: Feed the Future (FtF) of Ethiopia – Midline Report, 2015

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