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Does gender of the household head explain smallholder farmers' maize market positions? Evidence from Ethiopia

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Abstract: *This paper examines the market participation gaps and their causes between female headed households (FHHs) and male headed households (MHHs) in Ethiopia using an Oaxaca-Blinder decomposition approach. The results showed that structural/coefficient effects accounted for 74% (65%) of the differences between FHH and MHH in the net buyer (net seller) maize market positions. The gap between FHH and MHHs regarding quantities of maize sold was largely explained by endowment effects. The results imply that closing the observed market participation gaps will require policies that facilitate equal access for both FHHs and MHHs to resources and other supportive social networks.*

Keywords: Ethiopia, gender, market participation, ordered probit, endowment and return effect

JEL codes: Q12, Q18 Abstract.

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1. Introduction

For agrarian households, those whose primary activity is crop production, the ability to participate in agricultural markets especially as net sellers of crop produce is a strong indicator of the potential for achieving economic progress. Among these agrarian households are those that are headed by women, commonly referred to as female headed households (FHHs). Mostly without a spouse, they may not face the same intra-household gender issues that women in male headed households (MHHs) do. However, these FHHs face unique exogenous circumstances that make them of special interest for agricultural and rural development policy (Buvinic and Gupta 1997). Ensuring that women (in general) are not disadvantaged in agricultural development is both a human equality issue and therefore a fundamental development goal (Quisumbing 2014). For example, the literature shows that women, including those in female headed households tend to concentrate on food crop production (Mackenzie 1998; Heyer 2006). In addition, FHHs in rural areas also tend to be among the poorest rural households on average.

In many parts of Africa, there has been an increase in the proportion of FHHs. A report by IFAD and cited in FAO (2011) showed that 25-60% of rural households in eastern and southern Africa were headed by women. This range accounts for those that are *de jure* FHHs (those women household heads who not married, are widowed, divorced or separated) and those that are *de facto* FHHs (those women household heads with a male spouse who is away from home because of work or for other reasons). The reasons for the increase in FHHs generally are migration of men away from the rural areas to seek employment elsewhere, widowhood, divorce, separation and other forms of family disruption and fertility among young girls and women who are unmarried or without partners (Kassie, Ndirirtu and Stage 2014, FAO 2011). By some reports, the percentage of *de jure* FHHs in eastern and southern Africa is more than 60% of all FHHs (63% in Uganda and 70% in Malawi) according FAO (2011); (see also Chipande, 1987; Appleton, 1996; and Fuwa, 2000).

Both the general literature on gender and development (World Bank 2001; Quisumbing et al., 2014) as well as specific works on Africa (World Bank 2000; 2012) have argued that reducing gender disparities can be a powerful force for growth and poverty reduction in Africa. Past research has shown that women have less access to productive inputs (e.g. credit, land, technology, education), and women's lack of access to critical services like extension that are crucial for agricultural productivity (Quisumbing, 1995; World Bank, 2001; World Bank, 2013; Kassie et al. 2014; Quisumbing et al., 2014). Recent studies indicate that gender productivity gaps are caused by differences in resources and sometimes returns to those resources (Ndiritu et al., 2014; Aguilar et al., 2015; Kilic et al., 2013; Oseni et al. 2015 and Slavchevska, 2015). Given that agriculture is the main source of income in many developing countries, women's low productivity has implication on their market participation. Previous studies focus on understanding of gender technology and productivity gaps (e.g. Quisumbing, 1996, Peterman et al., 2011, and Horell and Krishnan, 2007), but with limited attention to gender market participation gap. Yet, without clear links to markets, any productivity gains will be limited and perhaps short lived. This paper is based on the need to expand the literature on gender differences beyond the analysis of productivity differentials to include analyses to deal with market access as a critical support for sustaining agricultural productivity through access to affordable inputs and technology and lucrative output markets. The literature on differential access to markets (or market participation) would provide a broader context within which to analyze gender complexities in the agriculture production continuum.

Using data from the main maize growing areas of Ethiopia, the objective of this paper is to understand the drivers of gendered market participation and examine market participation gap and its causes among FHHs and MHHs using the Oaxaca-Blinder decomposition method. We categorize maize market participation into three discrete categories of net sellers, net buyers or self-sufficient. As a discrete categorization of market participation may not provide adequate economic information, we also compare the quantities of maize sold among FHH and MHHs. For instance, being in a net seller position in staple crops markets may not necessarily be an advantage unless the volumes sold are large and prices lucrative enough to guarantee adequate incomes. Any household able to sell more than they buy are likely better integrated into markets and can generate more income than their neighbors who hardly sell any amounts , all else equal.

Finally, a net buying household can still have a reasonable food security situation or be non-poor conditional on having alternative crop and wage incomes. Generally, limited participation in markets may suggest a retreat into safety first, risk avoidance and consequently low income strategies attributable to poor integration of local food markets (Fafchamps, 1992 and Key, et al., 2000). Among those households who do not have other cash crops or wage earning opportunities, growing a sellable surplus of staple food crops remains an important income source. In situations where food markets are generally unreliable, households who are self-sufficient in their main staple crop through self-production can have a better food security outcome than a net buying household, all else equal. This paper focuses on market participation for maize, one of the major staple crops in Ethiopia. Maize accounts nearly 61% of all crop sales among FHHs and grown by 85 and 94% of FHH and MHHs respectively, the crop represents one of the most important sources of income and food in the study areas.

The contribution of this paper is to empirically analyze the extent to which FHH and MHHs exhibit differential participation in maize markets either as net buyers, net sellers or self-sufficient (autarchic)[1]. For example, do FHHs tend to be in a particular market participation categories different than their MHH counterparts after controlling for resources and other explanatory variables? Or given specific resource endowments associated with MHHs, and if FHHs were to attain similar endowments (as a counterfactual technique), will they retain their market participation positions or will their market participation positions change?

The answers to these two questions have important policy implications. For instance, empirical analysis may show that even after FHHs receive equal resource endowments, there still can remain disparities in gender market participation due to differences in returns (quality) to these resource endowments. The inequality is not only that women are disadvantaged in their access to resources, but also that the returns to their resources are low (World Bank, 2013). This

[1] In this paper we use the term autarchic not in the sense of total non-participation in maize markets , but in terms of buying and selling equal quantities of maize , including buying or selling zero amounts.

implies that although equal access to markets and resources is considered as a necessary condition for closing gender market participation gap, the "quality" of these markets and resources would be regarded as the sufficient condition. Identifying the relative contributions of these two issues (resource access on one hand and the quality of the resources on the other), is important to fully deal with observed gaps between FHH and MHHs as determined by exogenous factors amenable to policy intervention. Ours is a contribution towards filling this gap.

The rest of this paper is organized as follows. In the next section a literature review on the context of gender gaps in agriculture (especially regarding resource access and productivity) are presented to provide the context for market participation analysis. Section 3 outlines the conceptual framework for decomposing gender gaps generally. Section 4 provides a brief description of the country background, sampling and data collection. Section 5 presents the key results of the paper from descriptive statistics and the empirical models including the results from the decomposition analysis of market participation gaps between FHH and MHHs in the present sample.

2. Literature overview: female headed households in agriculture

The gender differences in resources which are responsible for the productivity gaps also extend to gaps in access to agricultural markets (Quisumbing et al. 2014). Reardon and Berdegue, (2006) concluded that farmers who manage to successfully participate in markets have larger farms, have more education, better access to information, and have the ability to hire-in labor. Given gender based division of labor in many rural societies, women tend to have limited economic opportunities beyond the home because they bear near total responsibility of household work and child care; tasks which men are generally not expected to do. Estimates show that women provide 85 to 90 percent of the time spent on household food processing and preparation across a wide range of countries (Fontana and Natalia, 2008; Jain, 1996). In areas where supply of natural resources are limited (e.g. water, firewood), women spend large amounts of their time in searching for and collecting water and firewood and in some cases women and girls provide 65% of all transportation needs for water, firewood and grain milling (Malmberg-Calvo 1994). This increased labor and time demand on women and the need to stay at home to perform these tasks, reduces the chances that they will participate in income earning opportunities in the wider economic sphere. This has greater implication on technology adoption and increasing agricultural productivity.

How do these gender driven division of labor and time expenditure patterns drive market participation? Given that the ability to participate in markets is determined by the size of the farm and other resources (Reardon and Berdegue, (2006)), women farmers who are smallholders can easily retreat into subsistence food production choices and related market participation strategies. They may concentrate on producing enough for household consumption perhaps foregoing choices that are riskier albeit more lucrative. These latter choices may require time and resources not readily available to FHHs. For example Hill and Vigneri (2011) found that the reduced participation of Ugandan women coffee farmers in distant and more lucrative markets could be explained by their producing small quantities of coffee and lack of their own bicycles. They also found that a major constraint facing women is their relative difficulty in accessing marketing channels that allow added value. By engaging in value adding distant marketing channels, male farmers received 7% more per kg of their coffee than women farmers. Crucially, for various reasons but chiefly related to extra time demands related to child care and other family and household care, women tend to be isolated from public spheres, they have greater time scarcity and the implied limited mobility reduces their access to markets (FAO, 1988).

The ability of men and women to effectively participate in agricultural markets is an important one. This is because a critical enabler of sustainable agricultural productivity is the economic and financial profitability of farm level intensification. Access to well organized markets that deliver inputs effectively and evacuate output remuneratively is important to open up opportunities for productivity and income growth among rural households. It is true that access to resources is at the heart of gender productivity differentials in agriculture as past research shows.

3. Conceptual and methodological framework

Gender differences in agriculture can also be studied in a similar framework as that found in the wage decomposition literature in the manner of Oaxaca-Blinder (OB) decomposition model. This point was made by Quisumbing (1996, p. 1587). Recently, a number of studies that use the OB decomposition approach are beginning to appear in the literature on gender differences in agriculture. Several recently published papers such as Aguilar et al. 2015; and Oseni et al. 2015 and Slavchevsca 2015 use the OB or related methods to study gender productivity differentials in Ethiopia, Malawi, Nigeria and Tanzania. Palacios Lopez-Lopez (2015) use an OB related decomposition approach in studying the impact of credit and labor market imperfections among male and female farmers in Malawi. Theoretically, if the survey instruments used to collect information on gender differences in agriculture were detailed enough, it would be possible to include "every factor" responsible for gender differences in outcomes of interest (Ndiritu, Kassie and Stage 2014). This level of detail is infeasible in practice. In OB lingo, observable resource endowment factors can be captured as "endowment" effects and another part can be explained by structural effects denoting the "returns" to the endowments (e.g. returns to land, inputs, agricultural extension etc).

Failure to distinguish between these effects could lead to missed opportunities in policy prescriptions meant to rectify gender differences. For example, if gender is simply an intercept shifter (and no more), then simply leveling the playing field with regard to resource access (and other enabling factors) will not rectify the gender gap in terms of productivity, technology adoption or market participation. If other factors come into play such that even if both male and female headed households have more or less same resource levels, there could still remain productivity and other differences. Then policy attention should go beyond simply increasing resource allocation to women or the relevant disadvantaged groups.

We used an OB[2] approach in this paper to first, decompose the market participation gap between FHH and MHHs to explain these gaps between FHH and MHHs with regard to being

[2] See Appendix A for an outline the basic conceptual framework of the OB decomposition framework used in this study.

net sellers, autarchic or net buyers[3]. The sex of the household head was the group variable used do divide the data into FHH and MHHs samples, and then we proceeded to decompose the gap between the two groups in terms of market position or quantity of maize sold. In the model to decompose the gap in the proportion of FHHs and MHHs in a particular market participation category, (e.g. proportion of FHHs vs MHHs who are net buyers, net sellers or autarchic) three binary probit models (one for each market position comparison) were used to predict market participation levels in a counterfactual process using the OB decomposition method. A second decomposition was done to explain the differences in quantity of maize sold by each type of household. The OB analysis in the quantity model was based on the ordinary least squares (OLS) regression of quantity of maize sold per household controlling for farm size, household size, other demographic variables, social networks, input use etc.

4. Country background and data sources

In Ethiopia women's involvement in agriculture is in production, post production marketing, food procurement and household nutrition. As per Mogues et al. (2009), despite these contributions there are perceptions that "women do not farm" even though there are numerous and important activities such as weeding, harvesting, postharvest handling activities such as storage and preservation of grain, home gardening, raising poultry, transportation of farm inputs from the homestead to the fields, and procuring water and firewood for household and farm uses which women are responsible for (EEA/EEPRI, 2006). The general pattern in Ethiopian agriculture is that there is a strong division of labor where some aspects of agricultural work such as ploughing are culturally regarded as tasks meant exclusively for men only (Gella and Tadele 2014). In regions dominated by teff production, men tend to provide the labor needed in most of the production activities and only weeding being regarded as women's task (Mogues et al. 2009).

In some southern areas of Ethiopia, most of the agricultural tasks (including weeding) devolve to men. However in the majority of cases, women predominate in the cultivation of vegetables in the proximity of the homestead. Therefore, in terms of agricultural incomes, women tend to sell vegetables and other "minor" crops. Major cash crops such as coffee or teff

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[3] In each market participation category the gap between FHH and MHH is necessarily a binary comparison. For example decomposing the gap as to why there are more MHHs who are net sellers or more FHHs who are net buyers?

are marketed by men in MHHs. Whenever women participate in the marketing of these crops, it is usually in small quantities. This is true regarding incomes from sale of large livestock (with the exception of poultry, eggs and milk), a fact consistent with observations across Africa (Mogues et al. 2009).

In terms of resources access, women rarely inherit land and upon household formation bring little or no land to their names (Mogues et al. 2009). Even where progress in land titling is giving women more control, longstanding lack of access to labor, oxen and credit remain thereby dampening any gains in improved tenure security from titling because they cannot afford agricultural inputs for example. Women title holders often have to rent out their land to any available tenant without guarantees of high returns or ability to hold such tenants accountable (Bezabih and Holden 2009).

Sampling and data collection

This study is based on household- and agricultural production and marketing data collected in 2010/11 as part of a major research for development program in Ethiopia. The survey was carried in areas that have been established as the major maize-legume based farming regions in the country. These data were collected from five regions of Ethiopia contributing to the sample size as follows. Tigray (1.3%), Amhara (13.7%), Oromya (60.1%), Benshangul Gumuz (4.3%) and the SNNP[4] (20.6%). Typically multi-stage sampling methods were used to identify survey households. The survey was carried out in a total of 39 districts involving 2, 022 households randomly selected from peasant associations (PAs).

5. Results

5.1 Summary descriptive statistics

Table 1 reports the variables that were used in the ordered probit model. Generally FHHs appear to have less land, fewer livestock and other assets. Households were categorized into autarkic, net seller and net buyer categories. Female headed households appear to have distinctly less education as well. Nevertheless, FHHs appear to be less credit constrained. It is not possible

[4] Southern Nations, Nationalities and Peoples region

to explain this apparent advantage of FHHs from these data but it could relate to this being due to many female household heads (as may be true of women generally) that they have access to informal credit such as ROSCAs[5]. We however cannot confirm this from these data. Female household heads tended to be older but not by much. In terms of household size, FHHs tended to be smaller households compared to MHH.

<Table 1 here>

Table 1also shows that that 71% of the FHHs were *de jure.* Among MHHs, only 2.2% (not shown in table) had no spouse (for the same reasons as *de jure* FHHs). While it would be an important contribution to distinguish between the market participation of *de jure* and *de facto* FHHs, the numbers in each category are too few to enable the estimation of a three-level ordered probit model.

As shown in Table 2 maize is the predominant crop, not surprising because the sample was drawn from locations where maize was the main crop. From Table 2, 85% and 93% of FHH and MMHs grew maize and sell about 474 kg and 578 kg respectively. Maize accounts for 55% and 69% of all crop sales among FHH and MHHs respectively. Given that it is such a major crop, the ability to generate sellable surplus is an important source of crop income. This is relevant because an overwhelming majority of households self-report agricultural activities as the main occupation (Table 1). These factors lend weight to our choice of maize as a major crop of economic importance and whose market participation decisions are critical for the households in these areas covered by the

<Table 2>

5.2 Determinants of market positions

[5] Rotating Savings and Credit Associations

As a prelude to the OB decomposition, we fitted an ordered probit model (see section 1) whose object was to study the key demographic or community factors that might explain the placement of households into any of the categories. The ordered probit model whose results are reported in this section (section 5.2) is therefore distinct and separate from the three binary probit models used in determining differences in the proportions of FHH and MHH households within each market participation category (a binary process because the comparison is done within each sub-sample of net buyer, autarchic or net seller sub-samples one at a time).

The average marginal effects (AMEs) recovered from an ordered probit model (Table 3) show that larger household size was positively associated with being in the net buyer and autarchic categories. The same result is true for the age of the household head. Those households who reported crop and livestock farming as the main activity were more likely to be net sellers and autarchic. Larger farm size was associated with being in the net seller market categories for MHHs. Greater livestock ownership was positively associated with being in the net seller and negatively with being in the net buyer and autarchic market positions except for FHHs. More non-livestock assets were significantly and positively associated with a higher probability to be in the net seller and negative for net buyer market positions for MHHs. Consistent with higher numbers of MHH who reported credit constraints, the probability of being in a net seller market position was reduced with presence of credit constraint for MHH and no significant effect for FHHs and the probability for MHH being in a net buyer or autarchic position was positive with the presence of credit constraint. Lack of credit was associated with autarchic or bet buyer positions. Membership in farmer based organizations was significantly and positively associated with being in net seller market positions for MHHs and was significantly negative for net buyer positions for these households. Having friends or relatives in leadership positions in various organizations had positive effects on being in net seller positions and negatively associated with net buyer and autarchy positions for FHHs. Having relatives outside the village who the household could rely on for help was also positively associated with being in the net seller and negatively with being in net buyer positions for FHHs.

The general picture from the probit estimation results shows that asset levels (farm size, livestock ownership), social capital (membership in farmer organizations, availability of support networks) and human capital (family size, education) remain key predictors of ability to enter agricultural markets. The implication being that whenever financial markets are limited asset ownership is a key determinant of the ability to participate in markets. Extension systems that seek to strengthen human capital through farmer training are important and supporting informal network groups among farmers can contribute to their ability to enter agricultural markets.

<Table 3 here>

5.3 Decomposition of the gender market positions gap

The results from the decomposition model of the gaps between MHH and FHHs in the various market participation categories are reported in Table 4.[6] The results are reported with respect to FHHs because they represent the disadvantaged group as our literature review has shown and as per our working hypothesis in this paper. A clear difference was observed in the net buyer and net seller positions. The actual average probability of being a net buyer household among FHHs was more than twice that of the MHHs (Table 4). The decomposition results in Table 4 show that FHHs became less net buyers when their resource endowment had the *same returns* (coefficient effect) as those of MHHs, in which case their net buyer positions decreased by 10.2 percentage points (coefficient effect of -0.102), suggesting a slight improvement in autonomous maize supply situation. The endowment effect for net buyer position was small (-0.025) and not significant. The results suggest that where households are net buyers, it is the returns to resources rather than the resource endowments that seem to make FHHs have higher probability of being net buyers than MHHs. This probably arises from the fact that when comparing two households that are net buyers, these households may be equally struggling (having limited resources) to meet household needs. Overall about 74% of net buyer position gap is explained by the coefficient effects. The rest of the net buyer gap being attributable to endowments (18%) and interaction between endowments and coefficients (7.6%).

[6] These results are based on maize crop. However, because market participation may vary by crop type, we have estimated market participation for all crops, cereals, fruits and vegetables, and legumes separately. Results reported in supplementary tables (see table S3) are qualitatively close as in maize crop results.

<<<Table 4>>>

For net seller position, the endowment effects would make FHHs more probable to be net sellers by 3.9 percentage points but this result is not significant. The return effect are however large and significant. The net seller gap between FHH and MHHs is reduced by 10.8 percentage points (coefficient effect of 0.108) when FHHs are assigned the coefficients of MHHs. This means that if given MHHs coefficients, the gap between the two households would decrease by 65.2% (see Table 4). When endowments are equalized, about 23% of the net seller gap may be closed, with 11.4% of the net seller gap being attributable to interaction effects between coefficient and return effects. Both the net buyer and net seller results show that equalizing resources does not eliminate the gender gap in these two market positions between FHH and MHHs and that return effects are overwhelmingly responsible for the maize market positions gap.

In the probability of being autarchic, both the endowment and coefficient effects were not significant. The sign of the estimated endowment effect suggests that FHHs would be less autarchic if given the endowments of the MHHs but less autarchic with MHH endowments and the returns effects would make them more probable to be autarchic. The reason can be attributable to the small (2 percent points) and insignificant raw difference between MHH and FHH with regard to being self-sufficient[7].

Table 5 reports the variables that were significant in explaining the market participation gap in the net seller position[8]. The results indicate that family size, time taken to reach the nearest market by foot, farm size and fertilizer application rates contributed to coefficient effect portion of the gap between MHH and FHH in the net seller position. The credit constraint contribution to the returns effects was favorable to FHHs. This arises from the fact that FHHs

[7] Compare that to the statistically significant -13.8 and 16.5 point differences in the net buyer and net seller positions respectively.

[8] For brevity and to conserve space, this table reports variable contributions for only the net seller gap results. This is because no variable had a statistically significant contribution to any of the three (endowment, coefficient or interaction) effects in the net buyer and autarchy gaps. As reported in this table, the above reported five variables significantly contributed to coefficient effects in the net seller gap, (although even in the net seller gap, these variables were not significant in the endowment and interaction effects).

were slightly less credit constrained than MHHs (50% compared to 63% for MHHs). So the observed levels of credit constraint favors FHHs contributing to reducing the net seller gap portion of the coefficient effects. Therefore human capital (labor) availability in larger households, market access (proximity of markets), farm size (assets) and access to inputs were factors that significantly contributed to the structural differences between FHH and MHH in terms of the ability to be net sellers of maize.

<<<Table 5>>>

Table 6 reports the decomposition results for the quantities of maize sold by the household in each market participation category. In this case endowment effects significantly explain the differences between FHH and MHHs in the net buyer and autarchic samples. The coefficient effect estimates were not significant[9]. In this estimation, the OB decomposition shows that only the endowment effects were statistically significant in their contribution to the gap between FHH and MHHs regarding amount of maize sold. Given the negative and significant interaction effects it implies that endowment effects account for more than 100% of the gap in amount of maize sold between FHH and MHHs in the net buyer and autarchic samples. This result contrasts with those of the discrete market participation decomposition where the main significant effects were the coefficient (structural effects). This is understandable because the quantity models capture the ability to generate enough sellable maize. Other than factors such technical agronomic knowhow or market networks etc., the differences in this regard are likely to be borne out of differences in input use, land size and resources necessary to generate sellable quantities of maize.

<<Table 6>>

The detailed decomposition results in Table 7 appear to confirm the general thrust of the results in Table 6. The variables presented in Table 7 contributed to the widening of the gaps

[9] As a robustness check, we implemented similar OB decompositions using probit models for market participation and OLS for quantities of different crop groups than maize (all crops, cereals as a group, legumes and fruits and vegetables. The results which are placed in the Supplementary Materials at the end of the manuscript and are qualitatively similar to those for maize. Coefficient effects (where significant) were more important in the market participation probit models and endowment effects dominated in the quantity equations. An exception was the case of legumes where FHHs had a slight advantage over MHHs and the negative and significant endowment effect confirmed this (see Supplementary materials).

between FHH and MHHs in terms of quantities of maize sold. The results suggest that variables that reflect social capital (membership in farmers' organizations), family labor (family size), human capital (education of the household head), market access (walking minutes to the nearest market) contributed to the endowments gap. Similarly asset endowments (farm size, amount of livestock and farm equipment and household durables) and credit access contributed to the endowment effects.

Notably, the variables that contributed to widening the endowment portion of the gap in quantities sold mostly reduced the portion of the gap due to coefficient effects. This could go suggest that FHHs had some structural advantages in the quantities of maize sold. This is consistent with the results in Table 6 showing that coefficient effects were largely insignificant in contributing the gap in maize sales between the two types of households. This suggests that if resources were to be equalized, FHHs would at a minimum, sell as much as the MHHs. This is because the results under the coefficients effects column in Table 7 suggest a structural advantage for FHHs. The crucial and policy relevant differences are rooted in the lower endowments (inputs, labor, and social capital) among FHHs compared to MHHs.

Qualitatively similar findings have been observed in the literature on the gender productivity gaps. The thrust of this literature is that once access to resources are controlled for, productivity differences between male and female farmers diminish or are eliminated (Quisumbing, 1996). In the mid-seventies, Moock (1976) using a sex dummy variable showed that in western Kenya, male farmers were not more productive than their female counterparts after controlling for observables. Oladeebo and Fajuyigbe (2007) in a study in Osun State, Nigeria, found that female rice farmers were more technically efficient than their male counterparts. Aly and Shields (2010) respectively find no productivity differences by sex of the household head. In Zimbabwe, Horrell and Krishnan (2007) found no productivity differences between male and female headed households.

<<Table 7>>

6 Conclusions and policy implications

Determinants of the gender differences in agricultural productivity have received more empirical attention than pre-production aspects of market participation. This paper analyzed the factors that may underlie differences in maize market participation based on the gender of the household head using data from Ethiopia. In particular we sought to identify the treatment effects of being a male headed household by using Oaxaca-Blinder decomposition to determine the effect of the sex of the household head as determined by differences in demographics (e.g. educational attainment), resources (e.g. farm size), market access (travel time to market) and social networks (number of relatives that they could rely on). As a major crop in the study area, accounting for nearly 55% (69%) of all crop sales among FHHs (MHHs) and grown by 85% (93%) of all FHH (MHHs) respectively, maize represents one of the most important sources of income and food in the study area.

The results showed that larger family sizes and lack of credit were significantly associated with being in net buyer positions. Among FHHs, ownership of more livestock was positively and significantly associated with the net seller and negatively with being in the net buyer. Similar effects were found for more non-livestock assets which were significantly and positively associated with a higher probability to be in the net seller and negative for net buyer market positions for MHHs. The central role of assets, credit, social capital indicators and assets underscore the apparent reason why FHHs fare less well compared to MHHs in market access and participation. This is because FHHs were consistently shown to have less access to these enablers of market participation.

The results showed that FHHs were more than twice as likely to be net buyers of maize compared to MHHs. Additionally; MHHs were more likely to be net sellers than FHHs by a 16.5-point margin. After equalizing resource endowments, the net buyer (net seller) participation gaps between FHHs and MHHs would be substantially reduced by approx. 74% (65%). Approx. another 26% (35%) remained to be explained by coefficient and interaction effects. The gaps in the various market participation categories (net buyer, autarchic, net seller) were significantly accounted for by coefficient/structural effects. Household size, number of relatives who could offer help in times of need, total livestock owned and whether the household perceived credit constraint contributed to these gaps in the maize market positions.

Different from the market positions, the gaps in the amounts of maize sold were largely explained by endowment effects. Household size, years of education of the household head, farm size and being a member of a farmer group were the major variables that contributed significantly to the endowment effects in the equation explaining the differences in the quantity of maize sold between FHH and MHHs. Notably the decomposition results of the gaps in the quantities of maize sold between the two types of households showed that differences in resources and endowments were the key contributors to the gaps in maize sales in the two types of households. There were indications that FHHs may in fact have some structural advantages and that the returns to the endowments in determining maize quantities sold would be higher among FHHs. This phenomenon has been alluded to in the productivity literature that show no productivity differences and sometimes higher productivity among women farmers once endowments and resources are equalized.

The results imply that where they exist, closing the gaps between the two household types in market participation will require a two pronged approach. First, there is an apparent need for policy to pay attention to closing structural differences that give MHHs an apparent advantage in the initial discrete decision to participate in maize markets. Second ensuring equal access to resources between these two household groups was confirmed. In either case, the effects of education of household head, farm size and membership in farmer groups in explaining these gaps call for special attention to FHHs in terms positive policy interventions and investments in rural advisory services and extension as a medium of education, encouraging land reforms to give women more access to land and strengthening farmer groups among women.

While our study has contributed to the analysis of the differences between FHH and MHHs as two distinct demographic groups and while we have provided empirical results that can inform policy action or debate and to point to needs for future research, one limitation of our results is that we use aggregated household level data. This places limits on the scope for more detailed gender analysis of market participation. We suggest that future studies on market participation should be based on intra-household sex disaggregated data (and if possible at plot level). This is in line with recognition that gender differences are most apparent in the dynamics of intra-household relations, resource distribution and decision making. Secondly, where the amount of data allows, there is need to disaggregate the Oaxaca-blinder decomposition results reported here by *de facto* and *de jure* households.

Appendix A

A.1 Conceptual Framework for Oaxaca-Blinder (OB) decomposition

We use the Oaxaca decomposition framework (Oaxaca 1973), to explain the observed differences in market participation between FHH and MHHs into that part which is due to group differences in the magnitudes of the endowments and differences in the effectiveness these endowments. For example, female household heads may be less likely to sell maize not only because they have less access to land but also because they have access to land of less quality or to extension advice (Jalan and Ravallion 2003; Wagstaff and Nguyen 2003). Using the case of amount of maize sold[10], and designating this as *Q*, we compare the two household types. Let *Q* be explained by a vector of determinants, *x*. The basic data generating process (regression equation) modelling the relationship between *Q* and *x* is given as follows:

$$Q_i = \begin{cases} \beta_1 x_i + \varepsilon_1 \ \ if\ MHH \\ \beta_0 x_i + \varepsilon_0 \ if\ FHH \end{cases} \qquad (1)$$

For the purposes of illustration consider a situation where the two household types are being compared in terms of only two variables x_1 and x_2. The market participation gap $(Q_a - Q_b)$ is given as follows:

$$Q_1 - Q_0 = (\beta_0^1 - \beta_0^0) + (\beta_1^1 x_{a1} - \beta_0^1 x_{b1}) + (\beta_{12} x_{12} - \beta_{02} x_{02})$$

$$= D_0 + D_1 + D_2$$

The gap in this case is composed of three parts, so that D0 are differences emanating from the intercept, D1 are differences arising from differences in β_{i1} and x_{i1} and D2 which are differences

[10] The same principles apply in the determining the market position gap. In the market position gap the variable Q would be the proportion of FHH and MHH in the various market participation categories

in β_{i2} and x_{i2}. The two variables x_1 and x_2 could be farm size and off farm income respectively so that D_1 measures the market participation gap due to differences in farm size and the effects of farm size and D_2 would measure the portion of the gap due to differences in off farm income and the effects of off farm income. The Oaxaca-Blinder (OB) decomposition seeks to determine how much of the overall gap or the gap specific to any one of the covariates is attributable to either differences in the explanatory variables themselves or the $x's$ (the explained component, levels, or endowments effects) or differences in the coefficients the β'_s (the coefficient or returns effects) (Jann 2008). The outcome, Q variable (quantity of maize or beans sold by the household) is predicted by a set of covariates *x*, the central question in this study is how much of the mean outcome difference; *Gap* (eq. A1) is accounted for by geographic differences in the covariates.

$$Gap = E(Q_1) - E(Q_0) \quad \text{(A1)}$$

The $E(Q_j)$ derives from the regression model below

$$Q_j = Z_j'\beta_j + \epsilon_j, \qquad E(\epsilon_j) = 0, j \in \{0,1\} \quad \text{(A2)}$$

Z is a vector of explanatory variables and a constant, β is a set of coefficients and ϵ is the error term. The difference in the mean outcome between group *A* and *B* is the difference in the prediction (linear in our case) at the group specific means of the regressors. This is denoted as follows:

$$Gap = E(Q_1) - E(Q_0) = E(Q_1)'\beta_1 - E(Q_0)'\beta_0 \quad \text{(A3)}$$

Since

$E(Q_1) - E(Z'_j\beta_j + \epsilon_j) = E(Z'_j\beta_j) + E(\in_j) = E(Z_j)'\beta_j$, recall that from the Gauss-Marcov assumption, $E(\beta_j) = \beta_j$ and $E(\in_j) = 0$.

We decompose the contribution of geographic differences to the overall differences we observe between FHH and MHHs into the different components. This can be seen by rearranging eq. A3 similarly to Jann (2008).

$$Gap = [E(Z_1) - E(Z_0)]'\beta_0 + E(Z_0)'(\beta_1 - \beta_0) + [E(Z_1) - E(Z_0)]'\big((\beta_1 - \beta_0)\big) \quad \text{(A4)}$$

In fact as Eq. 4 shows there are three components into which Gap can be broken. So that the first part $[E(Z_1) - E(Z_0)]'\beta_0$, is the portion of G that is attributable to household differences arising from their characteristics (broadly "endowments effects"). The second component $E(Z_0)'(\beta_1 - \beta_0)$ is the part attributable to the differences in the "slopes" or "coefficients" (the "returns effects") and $[E(Z_1) - E(Z_0)]'\big((\beta_1 - \beta_0)\big)$ is the third component which is the portion of *G* attributable to the joint (interaction) effects of both endowment and coefficient effects.

As is common in the Oaxaca-Blinder decomposition literature the effects are estimated from the point of view of one group, in this case the reference group is FHH. The differences in the endowments are weighted by the coefficients of FHHs to calculate the endowment effects. The endowment effect is the expected change in FHH's mean outcome if FHH had MHH endowment levels (weighted by FHH's estimated coefficients). The second effect therefore is the expected change in FHH's market outcome if FHHs had MHH's coefficients (weighted by FHH endowments).

The estimation procedure for the outcome variable depends on what model is appropriate for estimating the coefficients. In the case of quantity of maize sold, estimation of β_1 and β_0 can be done via least squares[11] so that $\hat{\beta}_1$ and $\hat{\beta}_0$will the estimates of β_1 and β_0 respectively and in case of the discrete market partipcation, we use the ordered probit model. The means computed by household type ($\widetilde{Q_1}$ and $\widetilde{Q_0}$) are used as the estimates for $E(Q_1)$ and $E(Q_0)$ respectively. Eq. A4 can therefore be written as eq. A5 below

There are two groups of households from two different counties, A and B.

$$\widehat{Gap} = \bar{Q}_1 - \bar{Q}_0 = (\bar{Z}_1 - \bar{Z}_0)'\hat{\beta}_0 + \bar{Z}'_0\left(\hat{\beta}_1 - \hat{\beta}_0\right) + (\bar{Z}_1 - \bar{Z}_0)'\left(\hat{\beta}_1 - \hat{\beta}_0\right) \qquad \text{(A5)}$$

A.2. Important assumptions about Oaxaca-blinder decomposition:

There are a three important assumptions behind the OB decomposition that are necessary to support and understand the results. According to Fortin, Limieux and Firpo (2010) these can be summarized as the existence of a simple counterfactual implying the absence of general equilibrium effects, overlapping support and ignorability. We outline these in turn.

Simple counterfactual means that for each group it is possible to construct alternative states of the world for each group such that for FHH and MHH, the counterfactual market participation satisfies this condition that the counterfactual market participation equations for FHHs is $M_C = f_1(\ldots)$ and the counterfactual market participation for MHHs is $M_C = f_0(\ldots)$ and that no third counterfactual state of the world exists for FHH and MHHs (this is rather obvious in our case but may not be apparent where the groups being compared may have less rigid categorizations). This only holds when no general equilibrium effects exist (Fortin, Limieux and Firpo, 2010)

Overlapping support: This assumption ensures that none of the observed factors or anything in the error terms explain selection into one of the groups being compared. In the present case this means that the arguments in the two market participation equations (for FHH and MHHs are the same). This assumes that we have the same process of market participation determination obtains for FHH and MHHs.

[11] There are several STATA (the software we use) routines for the OB decomposition. For the quantity equations we use the STATA **oaxaca** command by Jann (2008) and for the ordered probit equations we use **nldecompose**.

Ignorability (conditional independence): This is the equivalent of unconfoundedness in program evaluation and enables the identification of the treatment effect parameter. Formally, for, $g = 0, 1$ let (D_g, X, ε) be jointly distributed. For all $x \in X: \varepsilon$ meaning that $D_g \perp \varepsilon \mid X$. The ignorability assumption allows us to disentangle two important effects. The differences associated with the return to observable characteristics where all else equal, only the levels of the observable X's are different between FHH and MHHs. Similarly, it allows for the estimation of the returns to the X's in cases where, all else equal, only the returns to the X's are different between the two groups.

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Table 1: Variable descriptive statistics among MHH, *de facto* FHHs and *de jure* FHHs in Ethiopia[A]

Variable	MHH N=1882	ALL FHH N=138	*de facto* FHHs N=40	*de jure* FHHs N=98
Maize net buyer (proportion of households)	0.11	0.25	0.29	0.21
Maize autarchic (proportion of households)	0.30	0.33	0.24	0.42
Maize net sellers proportion of households)	0.57	0.41	0.45	0.37
Household size (persons)	6.75	5.37	5.98	4.76
Age of household head (years)	42.22	42.94	39.35	46.52
Years of education of household head	3.07	1.41	2.33	0.48
Proportion whose main occupation is own-farming	0.97	0.71	0.80	0.62
Proportion whose main occupation is salaried employment	0.006	0.03	0.03	0.03
Proportion whose main occupation is casual labor	0.024	0.27	0.18	0.35
Walking minutes to nearest major market	46.56	61.87	71.80	51.94
Farm size in ha	2.46	1.98	2.33	1.62
TLUs of livestock owned	5.96	5.07	5.96	4.18
Value of non-livestock assets owned (US$)	205.47	116.04	164.21	67.87
Credit constrained (yes=1)	0.63	0.50	0.48	0.51
Member of a farmer-based organization	0.17	0.17	0.23	0.10
Number of years in current village	36.33	32.11	33.48	30.74
Relatives outside the village who can provide assistance when needed (number)	6.29	5.77	5.40	6.14
Non-relatives outside the village who can provide assistance when needed (number)	4.99	3.69	4.55	2.82
Number of people in influential positions known	0.55	0.44	0.48	0.39
Number of agricultural crop traders known to respondent	4.27	2.58	2.53	2.63
Fertilizer application rate per ha	181.09	135.35	143.69	127.01
Proportion adopting improved maize (hybrids or OPVs[B])	0.93	0.88	0.85	0.91

[A]In subsequent analysis we pool both the de jure and de factor subsamples. Largely because of the small sample size of the de facto FHHs

[B]Open pollinated varieties

Table 2: Main crops sold and percent of households growing them

	FHHs (N=138)				MHHs (N=1882)			
Variable	Mean sales (kg/ha)	Std. Dev.	% of all crop sales	% growing	Mean	Std. Dev.	% of all crop sales	% growing
Maize	474.1	234.8	54.5	84.9	577.6	133.9	69.4	93.4
Common Beans	41.3	93.8	4.8	25.9	37.9	117.6	4.5	25.8
Ground nuts	5.5	39.9	0.6	3.6	4.3	32.2	0.5	3.5
White teff	40.7	130.3	4.7	20.5	43.0	105.2	5.2	27.2
Bread wheat	43.5	128.4	5.0	18.7	32.3	112.1	3.9	16.9
Barley	15.8	53.3	1.8	11.5	19.8	86.0	2.4	13.3
Sorghum	47.6	191.1	5.5	19.9	74.2	182.3	8.9	30.7
Finger millet	16.3	83.3	1.9	9.0	39.9	187.4	4.8	17.6
Banana	0.7	9.3	0.1	0.6	3.3	31.1	0.4	3.3
Fruits and vegetables	59.1	188.8	6.8	22.9	81.4	370.0	9.8	33.7
Non-staple cash crops	22.1	241.3	2.5	4.2	22.4	203.7	2.7	6.2

Table 3: Ordered probit Average Marginal Effects of factors affecting participation in maize markets among male and female headed households in Ethiopia (Dependent variable: 1= net buyers, 2=autarchic and 3=net sellers)

	MHH (N=1882)			FHH (140)		
VARIABLES	Net sellers	Autarchic	Net sellers	Net sellers	Autarchic	Net sellers
Household size (persons)	0.001	0.002	-0.003	0.102***	-0.014	-0.089***
	(0.002)	(0.003)	(0.005)	(0.025)	(0.012)	(0.025)
Age of household head (years)	-0.000	-0.000	0.000	0.008	-0.001	-0.007
	(0.001)	(0.001)	(0.001)	(0.005)	(0.001)	(0.004)
Years of education of household head	0.001	0.001	-0.003	-0.025	0.003	0.022
	(0.002)	(0.002)	(0.003)	(0.019)	(0.004)	(0.017)
Salaried employment (c,f, farming)	0.014	0.016	-0.031	Not estimated	Not estimated	Not estimated
	(0.088)	(0.089)	(0.178)	Not estimated	Not estimated	Not estimated
Non-farm self-employment (c,f, farming)	-0.102***	-0.375***	0.477***	0.113	-0.029	-0.084
	(0.007)	(0.019)	(0.019)	(0.336)	(0.128)	(0.209)
Casual laborer (c,f, farming)	-0.020	-0.028	0.047	0.009	-0.001	-0.008
	(0.025)	(0.039)	(0.065)	(0.070)	(0.009)	(0.061)
Walking minutes to nearest major market	0.000**	0.000**	-0.001**	0.001	-0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Farm size in ha	-0.011***	-0.014***	0.025***	0.040	-0.005	-0.035
	(0.003)	(0.004)	(0.007)	(0.040)	(0.007)	(0.035)
TLUs of livestock owned	-0.007***	-0.008***	0.015***	-0.038***	0.005	0.033***
	(0.001)	(0.001)	(0.003)	(0.010)	(0.005)	(0.009)
Value of non-livestock assets owned ($)	-0.00002	-0.00003	0.00005	-0.0003	0.00005	0.0003
	(0.000002)	(0.00002)	(0.00003)	(0.0004)	(0.0001)	(0.0003)
Credit constrained (yes=1)	0.003	0.003	-0.006	0.159*	-0.022	-0.138*
	(0.011)	(0.014)	(0.025)	(0.084)	(0.022)	(0.074)
Member of a farmer-based organization	-0.043***	-0.052***	0.095***	-0.149	0.020	0.129
	(0.014)	(0.017)	(0.031)	(0.150)	(0.029)	(0.127)
Number of years living in current village	0.003***	0.003***	-0.006***	-0.005	0.001	0.005
	(0.001)	(0.001)	(0.001)	(0.004)	(0.001)	(0.003)
Relatives outside the village who can assist when needed (number)	0.0002	0.0003	-0.001	-0.010	0.001	0.009
	(0.001)	(0.001)	(0.001)	(0.007)	(0.002)	(0.006)
Friends/relatives in leadership positions	-0.055***	-0.067***	0.123***	-0.178**	0.024	0.154**
	(0.010)	(0.012)	(0.021)	(0.070)	(0.023)	(0.061)
Fertilizer application rate (kg/ha)	-0.000004	-0.000005	0.000008	0.0001	-0.000009	-0.0001
	(0.000007)	(0.000009)	(0.00002)	(0.0001)	(0.00001)	(0.0001)
Planted improved maize (yes=1)	-0.043*	-0.052*	0.095*	-0.252**	0.034	0.218**
	(0.023)	(0.028)	(0.050)	(0.119)	(0.033)	(0.105)
Number of non- relatives who could be relied on	0.000	0.000	-0.000	-0.021*	0.003	0.019*

	(0.001)	(0.001)	(0.001)	(0.013)	(0.003)	(0.011)
Number of traders outside village know to household head	-0.002*	-0.002*	0.004*	0.009	-0.001	-0.008
	(0.001)	(0.001)	(0.002)	(0.012)	(0.002)	(0.010)
Observations	1,607	1,607	1,607	80	80	80

Table 4: Probit model Oaxaca-Blinder[A] decomposition of maize market position differences between male and female headed households in Ethiopia

	Net buyer	**Self-sufficient**	**Net seller**
MHH	0.114	0.302	0.572
FHH	0.252	0.326	0.407
Difference	-0.138***	-0.024	0.165***
Characteristics	-0.025	-0.009	0.039
	(0.055)	(0.055)	(0.062)
Coefficients	-0.102**	0.004	0.108***
	(0.043)	(0.045)	(0.039)
Interaction	-0.010	-0.020	0.019
	(0.055)	(0.055)	(0.061)
	(0.039)	(0.042)	(0.039)
Percent Characteristics	0.180	0.354	0.234
	(0.439)	(6.140)	(0.414)
Percent Coefficients	0.744***	-0.179	0.652***
	(0.166)	(3.375)	(0.131)
Percent Interaction	0.076	0.825	0.114
	(0.461)	(4.893)	(0.429)

Standard errors in parentheses *** p<0.01, ** p<0.05

Table 5: Variables contributing to net seller[A] market position gaps

	Individual variable contributions[B]		
VARIABLES	Endowment effects	Coefficient effects	Interaction effects
Family size	-0.141	0.336***	0.232
	(0.152)	(0.122)	(0.665)
Walking minutes to nearest major market	0.025	0.129**	0.047
	(0.025)	(0.055)	(0.145)
Farm size in ha	0.074	0.123*	-0.088
	(0.072)	(0.070)	(0.275)
Credit constrained (yes=1)	-0.023	-0.101**	0.037
	(0.023)	(0.048)	(0.115)
Fertilizer application rate (kg/ha)	-0.009	0.077*	0.012
	(0.015)	(0.045)	(0.038)

[A] For brevity and to conserve space, this table reports variable contributions for only the net seller gap results. This is because no variable had a statistically significant contribution to any of the three (endowment, coefficient or interaction) effects in the net buyer and autarchy gaps. As reported in this table, the above reported five variables significantly contributed to coefficient effects in the net seller gap, (although even in the net seller gap, these variables were not significant in the endowment and interaction effects).

Table 6: OLS Oaxaca-Blinder decomposition of quantities of maize sold

	Net buyer	Autarchic	Net seller
MHH	580.694***	447.919***	704.073***
	(30.95)	(17.84)	(17.05)
FHH	515.972***	335.075***	571.102***
	(71.60)	(53.37)	(107.66)
Raw difference	64.722	112.844	132.971
	(91.23)	(88.53)	(89.01)
Endowment effects	732.526**	744.396**	70.889
	(322.39)	(295.80)	(135.44)
Coefficient effects	-54.475	23.439	116.049
	(68.32)	(88.65)	(78.32)
Interaction effects	-613.329*	-654.991**	-53.967
	(325.88)	(292.23)	(134.45)
Percent Characteristics	11.318	6.597	0.533
	(90.22)	(18.88)	(8.29)
Percent Coefficients	-0.842	0.208	0.873
	(10.08)	(1.92)	(4.54)
Percent Interaction	-9.476	-5.804	-0.406
	(80.26)	(17.07)	(12.61)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

[A]In this table, we only report variable contributions in cases where the estimated contribution was statistically significant

Table 7. Oaxaca-blinder estimates of Individual variable contributions to quantity of maize sold by market position

	Individual variable contributions to:		
	Endowment effects	Coefficient effects	Interaction effects
		Net buyer	
Family size	279.533*** (83.48)	-626.002*** (177.29)	-184.518*** (68.25)
TLUs of livestock owned		406.892*** (123.12)	
Relatives outside the village who can assist when needed (number)	195.145** (76.08)	-155.523** (61.61)	-159.885** (70.89)
Planted improved maize (yes=1)		612.542** (305.95)	
		Autarchic	
Farm size (ha)	228.416*** (69.50)	-354.919*** (102.07)	-228.398*** (70.35)
TLUs of livestock owned	17.024 (19.40)	164.179** (80.96)	27.188 (27.02)
Credit constrained (yes=1)		-127.949* (74.47)	
Member of a farmer-based organization	43.809* (26.14)		
		Net seller	
Family size	259.441** (108.62)	-298.773* (179.42)	-178.623* (108.47)
Walking minutes to nearest major market		-150.823* (80.08)	
TLUs of livestock owned		-273.751*** (94.38)	
Credit constrained (yes=1)	-165.160*** (58.41)	-215.808*** (69.41)	152.203*** (56.89)
Fertilizer application rate (kg/ha)		176.705*** (63.46)	

Appendix

Important assumptions about Oaxaca-blinder decomposition:

There are a five important assumptions behind the OB decomposition that are necessary to support and understand the results. According to Fortin, Limieux and Firpo (2010) outline these as the existence of a simple counterfactual implying the absence of general equilibrium effects, ignorability, effects and overlapping support (the same process of outcome determination holds for both groups. For the benefit of our reader, we outline these in turn.

Simple counterfactual means that for each group it is possible to construct alternative states of the world for each group such that for FHH and MHH, the counterfactual market participation satisfies this condition that the counterfactual market participation equations for FHHs is $M_C = f_1(\ldots)$ and the counterfactual market participation for MHHs is $M_C = f_0(\ldots)$ and that no third counterfactual state of the world exists for FHH and MHHs (this is rather obvious in our case but may not be apparent where the groups being compared may have less rigid categorizations). This only holds when no general equilibrium effects exist (Fortin, Limieux and Firpo, 2010)

Overlapping support: This assumption ensures that none of the observed factors or anything in the error terms explain selection into one of the groups being compared. In the present case this means that the arguments in the two market participation equations (for FHH and MHHs are the same). This assumes that we have the same process of market participation determination obtains for FHH and MHHs.

Ignobility (conditional independence): This is the equivalent of unconfoundedness in program evaluation and enables the identification of the treatment effect parameter. Formally, for, $g = 0, 1$ let (D_g, X, ε) be jointly distributed. For all $x \in X: \varepsilon$ meaning that $D_g \perp \varepsilon \mid X$. The ignorability assumption allows us to disentangle two important effects. The differences associated with the return to observable characteristics where all else equal, only the levels of the observable X's are different between FHH and MHHs. Similarly, it allows for the estimation of the returns to the X's in cases where, all else equal, only the returns to the X's are different between the two groups.

Supplementary Materials

S1 Ordered probit Oaxaca-Blinder probit decomposition of market participation gap

	Overall	Family size (persons)	Non-relatives outside village who can provide support in time of need	Total livestock (TLU)	Credit constraint
MHH	2.424***				
	(0.017)				
FHH	1.925***				
	(0.089)				
Difference	0.499***				
	(0.090)				
Endowments	0.081	-0.365***	0.127*		
	(0.194)	(0.114)	(0.070)		
Coefficients	0.468***	1.027***	-0.145*	-0.299**	0.225*
	(0.094)	(0.309)	(0.078)	(0.127)	(0.136)
Interaction	-0.049	0.358***	-0.127*		
	(0.196)	(0.114)	(0.070)		

Table S2: Probit model Oaxaca-Blinder decomposition of market position differences between male and female headed households in Ethiopia (dependent variable =1 if household sold any positive amount, 0 otherwise)

Variable	All crops	Cereals	Legumes	Fruits and vegetables
MHH				
FHH				
raw	0.008	0.015	-0.017	0.063
	(0.041)	(0.043)	(0.034)	(0.040)
Characteristics	-0.004	-0.041	0.138***	0.029
	(0.064)	(0.055)	(0.051)	(0.042)
Coefficients	0.022	0.032	-0.045	0.001
	(0.044)	(0.046)	(0.034)	(0.039)
Interaction	-0.010	0.024	-0.110**	0.033
	(0.066)	(0.059)	(0.053)	(0.042)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table S3: OLS Oaxaca-Blinder decomposition of quantities of crops sold

Variable	All Crops	Cereals	Maize	Legumes	Fruits and vegetables
MHH	1,048.648***	966.343***	751.188***	82.305***	336.052***
	(24.007)	(17.878)	(13.805)	(15.148)	(60.906)
FHH	865.245***	781.193***	617.631***	84.051***	197.759***
	(88.446)	(76.517)	(60.843)	(23.364)	(72.938)
Raw difference	183.403**	185.149**	133.556**	-1.746	138.293
	(91.646)	(78.578)	(62.390)	(27.845)	(95.024)
Endowment effects	529.711***	422.473***	380.788***	107.238***	230.177**
	(106.838)	(92.470)	(74.097)	(29.950)	(89.951)
Coefficient effects	-36.284	31.699	22.445	-67.983**	-7.189
	(79.005)	(68.903)	(56.573)	(33.571)	(112.754)
Interaction effects	-310.024***	-269.023***	-269.677***	-41.002	-84.695
	(95.582)	(83.989)	(69.054)	(35.769)	(107.783)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1