




Gender Gaps in Market Participation Among Individual and Joint Decision-Making Farm Households: Evidence from Southern Ethiopia

Girma Gezimu Gebre^{1,2}  · Hiroshi Isoda³ · Dil Bahadur Rahut⁴ · Yuichiro Amekawa⁵ · Hisako Nomura⁶

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Abstract

This paper analyzes market participation gaps among male, female, and joint decision-making households, and the factors influencing that gap, using data collected from 560 maize farm households in the Dawuro zone, southern Ethiopia. The results from the ordered probit analysis reveal that female and joint decision-making households were negatively associated with the probability of being a net seller, while being positively associated with being autarchic and net buyers. The decomposition results indicate clear market participation gaps in the net seller and net buyer positions between male and female decision-makers. The mean quantity gaps between males and females are more apparent in the net seller and net buyer positions. Between male and joint decision-makers, the mean quantity gaps are significant in the net seller and autarchic positions, while between female and joint decision-makers, it is significant in the net seller positions. In each market position, the quantity of gaps is unevenly distributed across the quantities of distribution, but the values increase as we approach higher levels of distribution. The gaps in the net seller and autarchic positions indicate that males are better positioned than females and that females are better positioned than joint decision-makers. Both endowment and return effects account for the quantity gaps. Thus, there is a need for policies to secure more equal access to productive resources for female and joint decision-making households and build their capacity to increase their resource returns.

Keywords Gender · Maize · Market participation · Decomposition models · Dawuro zone · Ethiopia

Résumé

Cet article analyse les écarts de participation au marché entre les hommes, les femmes et les ménages qui prennent les décisions de façon conjointe (les ménages

✉ Girma Gezimu Gebre
girma.gezimu@gmail.com

Extended author information available on the last page of the article



co-décideurs), ainsi que les facteurs qui influencent cet écart, en utilisant les données recueillies auprès de 560 ménages agricoles producteurs du maïs dans la zone de Dawuro, dans le sud de l'Éthiopie. Les résultats de l'analyse probit ordonnée révèlent que le fait d'être une femme et d'être un ménage co-décideur était négativement associés à la probabilité d'être un vendeur net, tout en étant positivement associé au fait de vivre en autarcie et d'être un acheteur net. Les résultats de la décomposition indiquent des écarts évidents de participation au marché entre les décideurs masculins et féminins dans les positions de vendeur net et d'acheteur net. Les écarts moyens entre les hommes et les femmes sont plus apparents dans les positions de vendeur net et d'acheteur net. Entre les hommes et les co-décideurs, les écarts moyens sont significatifs dans la position de vendeur net et la position autarcique, tandis qu'entre les femmes et les co-décideurs, l'écart est important dans la position de vendeur net. Dans chaque position commerciale, les écarts sont inégalement répartis entre les niveaux de distribution, mais la valeur de ces écarts augmente à mesure que nous approchons des niveaux de distribution plus élevés. Les écarts au niveau des positions de vendeur net et des positions autarciques indiquent que les hommes sont mieux positionnés que les femmes et que les femmes sont mieux placées que les co-décideurs. Ce sont les dotations de départ et les rendements qui expliquent les écarts. Ainsi, il est nécessaire de mettre en place des politiques garantissant un accès plus équitable aux ressources productives pour les femmes et les ménages co-décideurs et de renforcer leur capacité à accroître le rendement de leurs ressources.

Introduction

For agrarian households whose main activity is crop production, the ability to participate in agricultural markets, especially as net sellers of crop produce, is an indicator of the potential for achieving improved productivity and income. Participation in the market will help them to reduce poverty, increase food security, and enhance overall economic growth in the long run (Barrett 2008; Rios et al. 2009; Frelat et al. 2016; Ouedraogo 2019). Yet, their ability to participate in the market depends on various factors including transaction costs (Goetz 1992; Key et al. 2000; Alene et al. 2008), ownership of productive assets (Boughton et al. 2007), farm productivity (Rios et al. 2009), access to inputs and services (Gebremedhin et al. 2009), and output markets (de Janvry et al. 1991; Gebremedhin and Jaleta 2012). These factors under varying contexts exhibit a significant gender dimension (FAO 2011; World Bank 2012).

Cultural, social, and economic power structures may assign different productive and reproductive roles to men and women that affect their market participation (Wickramasinghe and Weinberger 2013). For example, women comprise about 43% of the agricultural labor force in developing countries (FAO 2011). However, women's agricultural productivity tends to be lower than men's because women have less access to productive resources such as education, land, labor, extension services, technology, and credit (Peterman et al. 2011; Ragasa et al. 2012; Quisumbing et al. 2014; Eerdewijk and Danielsen 2015). Such resource constraints result in women's lowered market participation (World Bank 2012; Fischer and Qaim 2012). Research on gender and development (e.g., World Bank 2001, 2012), and more specifically



on gender and agriculture (e.g., FAO 2011; Quisumbing et al. 2014), has found that reducing the gender gap could generate significant merits for the agrarian society such as an increase in agricultural productivity, poverty reduction, enhanced food security, and regional economic growth. However, the majority of extant studies on gender disparities focus on aspects of agricultural productivity and technology adoption (e.g., Peterman et al. 2011; Ragasa et al. 2012; Kassa et al. 2013; Aguilar et al. 2014; Oseni et al. 2015; Mukasa and Salami 2015; Slavchevska 2015; Ali et al. 2016) while paying limited attention to gender differences in market participation. Without clear links to markets, any productivity gains will be limited (Rios et al. 2009; Marennya et al. 2017; Ouedraogo 2019). Some of these studies show that the gender gap in agricultural productivity is due to a difference in access to productive resources and returns from these resources (e.g., Aguilar et al. 2014; Oseni et al. 2015; Mukasa and Salami 2015; Slavchevska 2015; Ali et al. 2016).

Likewise, studies on gender market participation by Marennya et al. (2015, 2017) in Ethiopia and Kenya suggest that the gaps are related to the gender difference in resource endowment and its effects on the returns. These studies are based on the unitary household model, which assumes that all the members of the household have a homogenous preference and an altruistic household head who would equally allocate resources to their household members (Lenjiso et al. 2016). Those studies use the sex of the household head as a gender indicator. In reality, however, male and female family members within a household can have different preferences and decision-making power, which, in turn, can affect the household decision-making. Hence, using headship as a gender indicator does not necessarily identify who actually makes agricultural production decisions in the household (Doss 2018). Such an analytical framing would make it difficult to illuminate the decision-making role of women within male-headed households and men within female-headed households (*ibid.*).

Based on specific cultural and social contexts, male and female family members collectively or independently make a range of decisions about what crop to produce and how much harvest is kept for home consumption and sale (Doss 2015). In Ethiopia, men and women living in the same household make these decisions either jointly or separately (Aregu et al. 2011). Particularly, among the Dawuro community of southern Ethiopia, men's and women's decision-making processes in production, consumption, and market participation are determined by their household power relations, i.e., decision-making status within the household depends on ownership and control of household resources. Men, typically the husband, control the productive resources in the household¹ and become the major decision-makers about production, amount of harvest kept for family consumption, and sale in the market, while women make such decisions in the absence of their male counterparts. However, men and women in resource-poor households jointly make these decisions, as found by Aregu et al. (2011).

¹ Extensive information and discussion about access and control of household resources of this study area is found in Gebre et al. (2019b).



In addition, the agricultural labor division plays a significant role in the household decision-making processes of the Dawuro community. As per Dawuro tradition, a strong physicality demanding agronomic activities such as plowing with oxen and planting are considered men's tasks, while women share other parts of the farming activities (e.g., weeding, harvesting, collecting, and selling in the market) with men, in addition to child care and other home tasks. As a result, men are primarily considered to be the farmers, while women are considered to be the helpers for men working on the farm. Because of such customary rules connected to the division of agricultural labor, men (husbands) in male-headed households control the ownership of the agricultural produce and become the major decision-makers regarding production, consumption, and market participation. In some male-headed households, where men are not physically able (e.g., due to age or health problems) to plow with oxen, these decisions are jointly made by women and men within the household.² For female-headed households living with adult sons, their sons plow with oxen while for those livings without adult sons, men from other households plow with oxen in the form of sharecropping³ on female headland. In the latter two cases, because of their household resource (e.g., land and oxen) ownership, women make the major decisions in production, consumption, and the amount of produce sent for sale in the market. In some female-headed households, where women are more aged, their adult sons make such decisions either jointly or independently, depending on their responsibilities in the household.

Indeed, given that agriculture is the primary source of income and source of food for agrarian households, their production and consumption decisions are intimately connected (Rangel 2012), and are correlated to their participation in markets (Aret-hun and Bhatta 2012). Hence, this study assumes that the person who makes production decisions also decides the amount of produce to be kept for home consumption or sale. Accordingly, the plot-level (production) decision-maker in the household is used as an analytical unit in this paper.

Using primary data collected from four maize growing districts in the Dawuro zone, southern Ethiopia, this paper seeks to identify the key drivers of gendered market participation. In doing so, it examines the gender gap in market participation and its causes by dividing sampled farm households into three categories: male, female, and joint decision-making households. As maize is the main staple crops in the study area, this paper focuses on market participation for maize.⁴

² In some male-headed households, where men (husbands) are much older than women (wives), women tend to control household resources and make separate decisions about household production, consumption, and market participation. They represent their husband in their household and community affairs and act as head.

³ In the case of sharecropping, the landowner makes the major decisions about production, but after harvest, the sharecrop owners divide the total amount of produce and make consumption and marketing decisions on the shared amount in their respective household.

⁴ Gender market participation varies by crop type. In order to confirm such variation in Ethiopia, Marenya et al. (2017) used household and agricultural production, and marketing data collected in 2010/11 from Ethiopia and estimated gender market participation for all crops, cereals, fruits and vegetables, and legumes separately. The results showed that gender gaps in market participation in other all crops are qualitatively close as in maize crop results.



The paper divides maize farmers' market participation into three agent categories: net buyers, self-sufficient (autarkic), and net sellers. It examines whether there are significant differences among men, women, and joint decision-making households regarding each of the agent categories of market participation. Specifically, it questions whether gender differences in a particular market participation category exist after controlling for other covariates. Our primary interest here lies in revealing whether a gender difference in access to resources and associated returns accounts for any gender difference in a particular market participation category across men, women, and joint decision-making households. Elucidation of such gender mechanisms will generate important policy implications for agricultural decision-making in Ethiopia and many other countries in the global South.

The case is worth investigating for several reasons. In terms of gender inequality, the gender gap in agriculture is wider in the southern parts of Ethiopia than that of the central and northern parts of the country (Aguilar et al. 2014). Among staples, maize is dominant in terms of the levels of production (30%) and the number of households involved (over 9.8 million) in Ethiopia (Central Statistical Agency 2019). In 2018, maize covered about 18.5% of the total cereal crop production area in the country (ibid.), accounting for 17–20% of the national per capita calorie intake (Abate et al. 2015). Maize is the major source of income and livelihood for smallholders and a source of food for residents in the Dawuro zone. Women in the Dawuro zone engage in maize production and marketing; however, their contributions are not clearly recognized.

The rest of the paper is organized as follows: section two provides “[Materials and Methods](#)”, section three presents “[Results and Discussion](#)”, and section four concludes the paper.

Materials and Methods

Study Area

The study area for this research is the Dawuro zone located in Southern Nations, Nationalities, and Peoples' Region (SNNPR) in Ethiopia (Fig. 1). The majority of the Dawuro people (91%) live in rural areas (Negashi 2019), and their livelihood is based on a mixed crop-livestock production system. The Dawuro zone is one of the major crop production areas in the country, and the principal crops produced in Dawuro include ensete (*Ensete ventricosum*), teff (*Eragrostis tef*), maize, sorghum, wheat, barley, coffee, beans, peas, spices, vegetables, tubers, and fruits. The Dawuro zone has ample potentials for crop production, but farm productivity is very low because of inefficient traditional means of production, dependence on natural rainfall, and poor market access, making the livelihood of farm households stagnant (Abebe 2014).



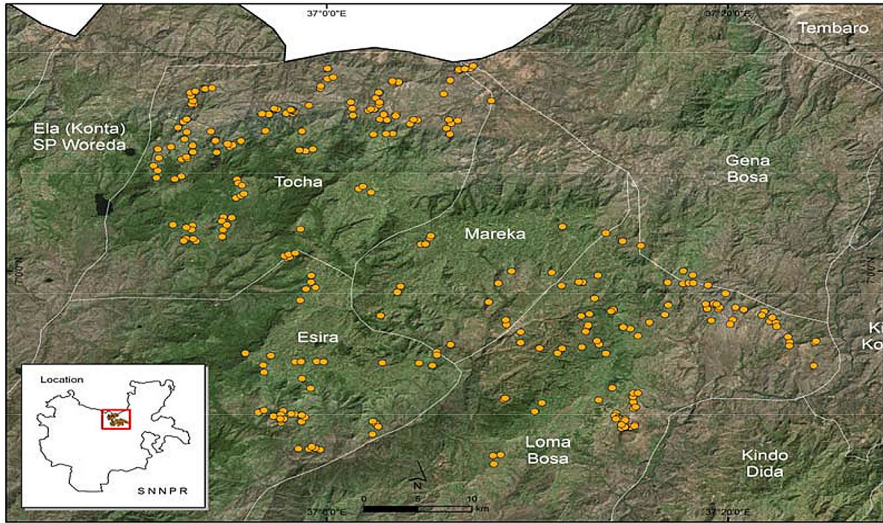


Fig. 1 Map of the study area (Dawuro zone) in the SNNPR of the Ethiopia. *Source* Author's sketch using GPS data (2018)

Sampling and Data Collection

This study draws on household maize production and marketing data collected from the Dawuro zone during April–June 2018. Multi-stage purposive sampling techniques based on the probability proportional to size⁵ were used to select districts, *kebeles*, and households in the Dawuro zone. In the first stage, four districts, namely ‘Loma Bosa (including current Disa district)’, ‘Mareka’, ‘Esara’, and ‘Tocha (parts of the current Tarcha zuriya and Kachi districts)’, were selected based on their maize production potentials. In the second stage, 6–8 *kebeles*⁶ growing maize were selected from each district, and in the final stage, on average, 20 maize grower households were selected from each *kebele* for the survey. Accordingly, a sample of 560 smallholder maize producers was obtained for the survey. This was done with the assistance of agricultural development agents (DA)⁷ who keep in constant contact with the farm households in each *kebele*. In all sampled households, maize

⁵ Probability proportional to size sampling is a variant of stratified sampling which is used when the sampling process is done in multiple stages. It can also be called ‘unequal probability sampling’ because one actually increases the odds that a subject will be chosen in the sample based on its size. The advantage of using this approach is that it helps reduce the standard error and bias by increasing the likelihood that a sampling unit from a larger population will be chosen over a sampling unit from a smaller population, thereby obviating the need for sample weighting (Marennya et al. 2017).

⁶ Kebele is the smallest administrative unit next to Woreda (district) in Ethiopia.

⁷ DA in Ethiopia is also known as “extension agent” who graduated from the Agricultural Technical and Vocational Education Training College and is working at the kebele level. Three DA agents are assigned to each kebele to provide effective extension services for farmers in the areas of crop and livestock production and natural resource management (Gebre et al. 2019a).



production took place at the household level and one or two family members (mostly a husband, wife, or adult son) within the household made maize production decisions either independently or jointly. As a cultural norm in the study area, a wife and husband in the same household typically did not have separate maize farms. Depending on the type of household, the person most responsible (either a husband, wife, or adult son) for maize production was selected and interviewed using a semi-structured questionnaire.

The selected respondent was asked about individual, household, and plot-level characteristics and institutional environment. The questionnaire also captured data on the total stock of the maize produce in the household, amounts transferred from the previous production and harvested from current productions, amounts contributed from aid programs, used for seed, kept for home consumption, and sold in the market.⁸ Respondent were also asked more specific questions about maize production, consumption, and market participation such as who makes decisions in the household about the size of the plot to allocate for maize production, variety choice, fertilizer use, planting, harvesting, collecting, amount of harvest kept for home consumption and sale in the market. Moreover, an additional family member⁹ was separately asked some supplemental questions such as who makes decisions in the household about maize production, consumption, and market participation. This is because the information collected from a single respondent may not clearly show intra-household gender dynamics.¹⁰ All responses indicated that decisions about maize production, consumption, and market participation were made by either men, women, or jointly. In a few cases, males and females from the same households gave different answers for the same questions. In such cases, both respondents were jointly asked about who makes decisions about maize production, consumption, and market participation in the household. In this way, they reached a common response. Finally, the collected responses were clustered in groups divided into male, female, or joint decision-making households.

Conceptual Frameworks

Many studies (e.g., Goetz 1992; Key et al. 2000; Alene et al. 2008; Abafita et al. 2016) treat the decision-making of agrarian households on market participation as

⁸ Data on maize stock transferred from the previous production and harvested from current production were to define the level of household maize production. Data on the amount of harvest kept for home consumption and used for seed were to define the level of household maize consumption by their own production. The amount received from the aid program was deducted to indicate their market participation status. There are no data on the amount contributed from and to other households or individuals in the form of gifts. Sampled respondents reported that they did not give or receive maize in the form of a gift or kind of payment.

⁹ When the main (first) respondent was a man, the woman was asked supplemental questions to confirm the realities of the man's response and vice versa.

¹⁰ Our approach to collecting data from males and females within the household was based on the recommendations in a study by Marenja et al. (2017) in Ethiopia. This approach helped us to understand details about the complexities of intra-household gender dynamics of the sampled households.



a two-stage process involving: (i) the decision to participate in the market; and (ii) the decision of how much to sell. These studies differ, however, as to whether households make these decisions sequentially (Goetz 1992) or simultaneously (Key et al. 2000). Some studies (e.g., Burke et al. 2015; Lifeyo 2017) argue that the decision to participate in the market may be driven by more structurally differentiated processes than the decision to grow crops, in particular for less commonly produced crops. They may include the initial decision of whether or not to produce in the market participation process, and hence require the treatment of market participation as a three-stage process. In our study, the decision on whether to participate in maize production does not lend itself to this kind of consideration because all sampled households were maize growers, and it is the most commonly produced staple crop in the study area. Following Key et al. (2000), Boughton et al. (2007), Alene et al. (2008), and Barrett (2008), we assume that the maize farm households' market participation is heterogeneous because they face differential transaction costs due to their household and farm-specific characteristics as well as other institutional factors such as access to extension services, credit, and markets. Hence, in the first stage, the maize farm households are assumed to decide whether to participate in the market as net buyers of maize, self-sufficient (autarchic), or net sellers of maize. Then, in the second stage, the amount of maize to be sold is determined. The households who buy more maize than they sell are considered to be net buyers, and those who sell more than they buy are regarded as net sellers. Those who decide to consume the total amount of their maize produce or those who end up selling and buying an equal amount of maize are treated as self-sufficient or autarchic.¹¹

Methodological Frameworks

An ordered probit model is estimated to examine whether a gender gap in a particular market participation category remains after controlling for other covariates because the outcome variables (net buyers, autarchic, and net sellers) are logically ordered. The coefficient estimates from the ordered probit model simply gives the direction of explanatory variables on the outcome variables. It does not represent the actual magnitude of change associated with explanatory variables. Thus, the marginal effects of each explanatory variable on the probabilities are discussed in this paper.

The Blinder–Oaxaca (B–O) decomposition method (Blinder 1973; Oaxaca 1973) was employed to investigate how gender differences in access to resources and returns from the mobilization of the resources contribute to the gender gap in a particular market participation category among men, women, and joint decision-making households. This approach is used to decompose the average market participation gap between two selected gender groups with regard to net buyers, autarchic, or net sellers. The second decomposition is done to explain the average gender gap in the quantities of maize sold by the households of each gender-based category. The outcome variables for the market participation and the quantity sold are discrete and

¹¹ Following Marenya et al. (2017), we use the term autarchic not in the sense of total nonparticipation in maize markets, but in terms of buying and selling an equal amount of maize including no amount.



continuous, respectively. Thus, we used the B–O decomposition approach applicable to linear and nonlinear models. In case the linear model is considered for simplification, the amount of maize sold will be an outcome variable, and the B–O decomposition will be based on the linear model. The standard linear regression equation modeling the relationship between the outcome variable (Y) and a set of predictors (X) for two comparable groups of a household is given as

$$Y_{ig} = \beta_g X_{ig} + \varepsilon_{ig}, \quad E(\varepsilon_{ig}) = 0, \quad (1)$$

where Y is the natural log of the value of outcome variable, i represents net buyer, autarchic or net seller maize farm households, g represents the gender group, such as male or female group, X_{ig} is a vector of average values of observable characteristics, β_g is a vector of coefficient estimates for gender g (including an intercept), and ε_{ig} is the gender-specific random error term assumed to be independently and identically distributed with mean zero and variance σ^2 . The rationale behind the B–O decomposition approach is therefore to show how much of the average quantity gap between two groups (e.g., male and female groups). Following Daymont and Andrisani (1984) and Jann (2008), the mean gender gap of the quantity sold by two groups can be written as

$$\begin{aligned} \text{Gap} = \bar{Y}_m - \bar{Y}_f &= \underbrace{\left\{ (\bar{X}_m - \bar{X}_f) \beta_f \right\}}_{\text{Endowment effect (E)}} + \underbrace{\left\{ \bar{X}_f (\beta_m - \beta_f) \right\}}_{\text{Coefficient effect (C)}} \\ &+ \underbrace{\left\{ (\bar{X}_m - \bar{X}_f) (\beta_m - \beta_f) \right\}}_{\text{Interaction effect (CE)}} = E + C + CE, \end{aligned} \quad (2)$$

where \bar{Y}_m and \bar{Y}_f denote the average value of the quantity sold by male and female decision-making groups, \bar{X} is a vector of average values of observable characteristics, and β is a vector of coefficient estimates for male or female group.

Equation (2) is a ‘threefold’ decomposition where the mean gender gap is divided into three components. The first component is the portion of the gap that is due to the gender differences in observable characteristics (called the “endowment effect”). The second component, the “structural or return effect”, is the part of the gap emanating from differences in the coefficients of the observable characteristics. And the third, the “interaction effect”, is the portion of gap attributable to the joint effects of both observable characteristics and their estimated coefficients. Thus, gender differences in maize market participation can be explained by these three factors.

However, when the outcome variable is binary and is estimated using nonlinear model, any form similar to Eq. (2) or the standard B–O decomposition technique may not be appropriate. Because for the nonlinear equation, $Y_{ig} = \Phi(X_{ig} \beta_g)$, the conditional expectations, \bar{Y}_{ig} , may not equal $\Phi(\bar{X}_{ig} \beta_g)$. An extension of the B–O decomposition method which performs a decomposition that uses estimates from a logit or probit model was first described in Fairlie (1999) and expanded in Fairlie (2005). The decomposition for a nonlinear equation for the average probability of being net buyer, autarchic or net seller in the market, $\bar{M} = \Phi(X\beta)$, can be expressed as



$$\begin{aligned}
 \text{Gap} = \bar{M}_m - \bar{M}_f = & \underbrace{\left\{ \frac{1}{N_m} \sum_{i=1}^{N_m} \Phi(X_{im}\beta_f) - \frac{1}{N_f} \sum_{i=1}^{N_f} \Phi(X_{if}\beta_f) \right\}}_{\text{Endowment effect (E)}} + \underbrace{\left\{ \frac{1}{N_f} \sum_{i=1}^{N_f} \Phi(X_{if}\beta_m) - \frac{1}{N_f} \sum_{i=1}^{N_f} \Phi(X_{if}\beta_f) \right\}}_{\text{Coefficient effect (C)}} \\
 & + \underbrace{\left\{ \frac{1}{N_m} \sum_{i=1}^{N_m} \Phi(X_{im}\beta_m) - \frac{1}{N_m} \sum_{i=1}^{N_m} \Phi(X_{im}\beta_f) \right\}}_{\text{Interaction effect (CE)}} + \underbrace{\left\{ \frac{1}{N_f} \sum_{i=1}^{N_f} \Phi(X_{if}\beta_m) - \frac{1}{N_f} \sum_{i=1}^{N_f} \Phi(X_{if}\beta_f) \right\}}_{\text{Interaction effect (CE)}}
 \end{aligned} \tag{3}$$

where \bar{M}_m and \bar{M}_f denote the average probability of being net buyers, autarchic or net sellers by male and female decision-making groups, N_g is the sample size of gender g , and Φ is the cumulative normal distribution function from the probit distribution. Similar to Eqs. (2), Eq. (3) is a ‘threefold’ decomposition where the mean gender gap in market participation is divided into three components.¹² The decomposition of nonlinear model (Eq. 3) shares the problems of the standard B–O decomposition (Eqs. 2), such as a potential sensitivity of the results with respect to the choice of the reference group and the specification of the regression model (Sinning et al. 2008).

Since the B–O model is formulated to decompose the mean outcome difference between the two groups, we decompose one group from the viewpoint of the other group. For example, the decompositions shown in Eqs. (2) and (3) are formulated from the perspective of female decision-makers. That is, the group differences in the predictors are weighted by the coefficients of female decision-makers (β_f) to determine the endowment effects. The endowment effects measure the expected change in the female’s mean outcome if a female has male predictor levels. Similarly, for the effects of the coefficients, the differences are weighted by female decision-makers’ predictor (X_{if}) levels. The coefficient effect measures the expected change in female’s mean outcome if a female had male coefficients. A positive value of the return effect will imply that male decision-makers have a structural advantage over female decision-makers with regard to the specific covariates, while a negative value indicates a female structural advantage. The same reason holds for the other components in Eqs. (2) and (3). Alternatively, we could have used male group coefficient (β_m) and predictor (X_{im}) levels as weights to determine gender differences between male and female groups due to levels of the endowment and its return effects, respectively. This alternative method of calculating the decomposition often provides different estimates.¹³

¹² Fairlie (2005) expanded a nonlinear equation that performs the decomposition for logit or probit model in a ‘twofold’ decomposition, while Sinning et al. (2008) provided it in a ‘threefold’ decomposition following Daymont and Andrisani (1984) extension of the B–O decomposition. Thus, we included the third component (interaction effect) in Eq. (3).

¹³ Oaxaca and Ransom (1994) have suggested to use the reference group which corresponds to the pooled sample of both groups. However, we considered female decision-making household as a reference group for male decision-making and joint decision-making household for female decision-making. Between male and joint comparison, joint decision-makings are a reference group. Decision to choose a reference group in this paper was based on empirical studies on gender and agriculture in Ethiopia and elsewhere. For example, females may be less likely to sell maize not only because they have less access to land but also they have access to land of less quality or to extension advice.



Equation (2) provides the contribution of the gender gap in the quantities sold due to gender differences in the full set of included variables and in the specific variables. Equation (3) provides the contribution of the gender gap in market participation due to gender differences in the entire set of included variables; however, identifying the contribution of the gender gap in market participation due to the gender differences in specific variables are not as straightforward. The contribution of each variable to the gender gap in market participation is equal to the change in the average predicted probability from replacing the female group distribution with the male group distribution of that variable while holding the distributions of the other variable constant.¹⁴ To estimate the contribution of each variable to the gender gap using the nonlinear decomposition method requires the sample sizes of two groups to be equal (Fairlie 2005), i.e., one-to-one matching of female and male observations. Thus, we used an equal sample size for two groups to calculate the contributions of individual variables to the gender gap in the probability of market participation.

To decompose the gender gap between groups in a particular market participation category (e.g., proportion of female and male decision-making households who are net buyers, autarchic or net sellers), three binary probit models (one for each market position comparison) are used to predict market participation levels using nonlinear decomposition techniques.

The standard B–O decomposition produces the average quantity of the maize sold between each gender group. It is important, however, to compute the gender gap in the quantity sold at different points of distribution. The Recentered Influence Function (RIF) method developed by Firpo et al. (2009) allows us to decompose the gender market differences in terms of the quantity sold for distributional statistics other than mean. RIF is an unconditional quantile regression procedure which gives rise to the standard linear B–O decomposition at each specified points of the quantity distribution. The influence function measures the effect on distributional statistics of small changes in the underlying distribution. We use the RIF to identify differences by gender at various quantiles of the quantity-sold-distribution.

Similar to the standard B–O decomposition Eq. (2), the RIF regression involves the estimation of simple linear regression. However, the difference is that the dependent variable Y is now replaced by the RIF distributional statistics of interest. Consider $IF(y;v)$, the influence function corresponding to an observed quantity sold y for the distributional statistics of interest $v(F_Y)$. Fortin et al. (2011) defined the RIF as $RIF(y;v) = v(F_Y) + IF(y;v)$, so that it aggregates back to the statistics of interest ($\int RIF(y;v) \cdot \partial F(y) = v(F_Y)$). In the case of the quantiles q_τ of the unconditional marginal distribution $F(y)$, the recentered function of influence, $RIF(y;q_\tau)$, is defined as follows:

$$RIF(y;q_\tau) = q_\tau + IF(y;q_\tau) = q_\tau + \frac{\tau - I(y \leq q_\tau)}{f_y(q_\tau)}, \quad (4)$$

¹⁴ Unlike in the linear case, the independent contribution of one variable depends on the value of the other variable included in the model. This implies that the choice of a variable (the order of switching the distributions) is potentially important in calculating its contribution to the gender gap in market participation.



where q_τ is the population τ -quantile of the unconditional distribution of y ; $\frac{\tau-1(Y \leq q_\tau)}{f_y(q_\tau)}$ is the influence function; $I(y \leq q_\tau)$ is an indicator function; and $f_y(q_\tau)$ is the density of the marginal distribution of y .

The RIF for a quantile is simply an indicator variable $I(y \leq q_\tau)$ for whether the value of the outcome variable, y , is smaller or equal to q_τ . In the case of quantiles, the RIF function, $RIF(y; q_\tau)$, may be estimated empirically by means of a local inversion following calculation of the dummy variable $I(y \leq q_\tau)$, the estimation of the quantile of the sample q_τ , and the estimation by means of kernel density functions of the corresponding density function f_y evaluated in q_τ . The estimated coefficients of RIF regression may be interpreted as the partial effect of an increase in the average value of the covariates in the distribution quantile (Firpo et al. 2009), so that subsequently a standard B–O decomposition, as expressed in Eq. (2), could be developed for the quantiles of the quantity-sold-distribution based on the regression results.

However, that the standard B–O decomposition would yield consistent results only if the actual conditional expectations of the RIF function hold the linearity assumption, implying that standard B–O decomposition results based on nonlinear regression may be biased because of standard error misspecification (Barsky et al. 2002).¹⁵ For that reason, Fortin et al. (2011) suggest a two-stage procedure to perform B–O type of decomposition on distributional statistics. The first stage consists of following the Di Nardo et al. (1996) reweighting procedure to account for potential nonlinearity in the true conditional expectation of the RIF function. This reweighting procedure generates counterfactual observations that result if individual samples in the female decision-making group had the same distribution of observable characteristics as individual samples in the male decision-making group, and if it is based on the weights estimated via a probit model.¹⁶ Having estimated the RIF regressions for female decision-makers, male decision-makers, and the counterfactual quantity-sold-distribution on the reweighted sample, in a second stage a B–O type (reweighted-regression) decomposition analysis can be performed on the reweighted data for any unconditional quantile (τ) of the quantity-sold-distributions:

$$\text{Total gap} = \Delta_0^\tau = \frac{(\bar{X}_f^C \beta_{\tau,f}^C - \bar{X}_f \beta_{\tau,f}) + (\bar{X}_m \beta_{\tau,m} - \bar{X}_f^C \beta_{\tau,f}^C)}{\text{Endowment effect} \quad \text{Coefficient effect}}, \tag{5}$$

where superscript C stands for the reweighted sample estimates: \bar{X}_m and \bar{X}_f are the average value of the observable characteristics for the male and female groups.¹⁷

¹⁵ If the model was truly linear, the specification error term would be equal to zero (Fortin et al.(2011)

¹⁶ We used probit model to estimates the reweighted B–O decomposition as described in Firpo et al. (2018). In estimating the probit model, the same explanatory variables are used as Eq. (2). However, in Table 5, we only report the overall gaps across quantity distribution points in order to save space in the paper.

¹⁷ There are several STATA (the software we use) routines for the B–O decomposition. For the mean quantity Eq. (2), we use STATA `oaxaca` command by Jann (2008), for the market participation (probit) Eq. (3) we use `nldecompose` and for RIF decomposition (quantity distribution) Eq. (5) we use `oaxaca_rif`.



The portions of the gap due to the endowment (explained) and coefficient (unexplained) effects can be further decomposed as

$$\text{Endowment Effect} = \left(\overline{X}_f^C - \overline{X}_f \right) \beta_{\tau,f} + \overline{X}_f^C \left(\beta_{\tau,f}^C - \beta_{\tau,f} \right) \quad (6)$$

$$\text{Coefficient Effect} = \overline{X}_m \left(\beta_{\tau,m} - \beta_{\tau,f}^C \right) + \left(\overline{X}_m - \overline{X}_f^C \right) \beta_{\tau,f}^C \quad (7)$$

The reweighted-regression decomposition is similar to the standard B–O decomposition except for two small differences. The first difference is that the endowment effect consists of a standard error $\left(\overline{X}_f^C - \overline{X}_f \right) \beta_{\tau,f}$ plus the specification error $\overline{X}_f^C \left(\beta_{\tau,f}^C - \beta_{\tau,f} \right)$. The second difference is that the coefficient effect is based on a comparison between $\beta_{\tau,m}$ and the weighted estimate $\beta_{\tau,f}^C$ instead of the usual unweighted estimate $\beta_{\tau,f}$. The RIF procedure computes the portion of gender differences in the quantity-sold-distribution into the ‘twofold’ decomposition (endowment and return effects).

Results and Discussion

Descriptive Results

Table 1 provides the summary statistics of the variables of our interest. Of the surveyed households, 45% were net sellers, while 26 and 29% were autarchic and net buyers, respectively. Of the male decision-making households, 48% were net sellers, 27% autarchic, and 25% net buyers. Of the female decision-making households, 41, 25, and 34% were net sellers, autarchic, and net buyers, respectively, while these numbers were 43, 26, and 31%, respectively, for joint decision-making households. There are statistically significant differences between male and female decision-making households in the categories of net sellers and net buyers.

Males headed about 73% of the surveyed households, with 27% headed by females. In terms of gender-based decision-making, about 43, 21, and 36% were male, female, and joint decision-making households, respectively. Among male-headed households, 57 and 41% were male and joint decision-making households, respectively, while the remaining 2% had female decision-makers. Of the female-headed households, 72 and 23% had female or joint decision-makers, respectively, while the remaining 5% had male decision-maker. This indicates that females in male-headed households and males in female-headed households were independently or jointly making decisions on maize market participation. This tells us that studies using the headship as the sole gender criteria fail to capture the actual patterns of gender heterogeneity in decision-making for agricultural market participation in Ethiopia. Notably, however, either a male or female independently, not jointly, is the dominant decision-maker for maize market participation in male and female-headed households, respectively. This might be linked to the social status of



Table 1 Descriptive statistics of mean differences by the gender of decision-makers in the household. *Source* Own survey results (2018)

Variables	Whole sample			Mean difference		
	Male[1]	Female [2]	Joint [3]	[1]-[2]	[1]-[3]	[2]-[3]
Outcome variables						
Maize net sellers	0.45	0.48	0.43	0.07*	0.05	-0.02
Maize autarchic	0.26	0.27	0.26	0.02	0.01	-0.01
Maize net buyers	0.29	0.25	0.31	-0.09**	-0.06	0.03
Independent variables						
Female-headed household	0.27	0.05	0.23	-0.67***	-0.18***	0.49***
Male-headed household	0.73	0.57	0.41	0.55***	0.16***	-0.39***
Number of children in the household (≤ 15 years)	2.12	2.32	2.00	0.21	0.32	0.11
Number of adult males in the household (> 15 years)	2.18	2.16	2.05	0.16	0.11	-0.05
Number of adult females in the household (> 15 years)	1.90	2.00	1.90	0.15	0.10	-0.05
Age of head in years	42.61	42.40	43.50	1.20	-1.10	-2.30**
Education of the household head in years	3.43	3.10	3.02	-0.53	0.08	0.61
Number of oxen owned	1.55	1.67	1.50	0.15**	0.17**	0.20
Livestock owned in Total Livestock Unit (TLU)	6.03	6.50	6.00	0.70**	0.50*	-0.20
Maize productivity (ton/ha)	2.44	2.69	2.18	0.45***	0.51***	0.06
Total landholding in hectares	1.58	1.67	1.50	0.15**	0.17**	0.20
Size of the land planted with maize in hectares	0.82	0.96	0.78	0.06**	0.18***	0.12***
Maize farming experience in years	16.49	16.19	15.22	3.37***	0.97	4.34***
Improved maize seed (1 = yes)	0.65	0.68	0.65	0.05	0.03	-0.02
Access to credit service (1 = yes)	0.38	0.40	0.33	0.05	0.07	0.02
Contact with extension agent (1 = yes)	0.78	0.80	0.78	0.04	0.02	-0.02
Participation in farmer training (1 = yes)	0.73	0.72	0.75	0.02	0.03	-0.05
Participation in social activities (1 = yes)	0.66	0.70	0.68	0.07	0.02	-0.05
Distance from market in km	10.88	10.63	10.90	-0.71**	-0.27**	0.44**



Table 1 (continued)

Variables	Whole sample	Male[1]	Female [2]	Joint [3]	Mean difference		
					[1]-[2]	[1]-[3]	[2]-[3]
Access to market information (1 = yes)	0.71	0.70	0.67	0.75	0.03	- 0.05	- 0.08
Access to off-farm income (1 = yes)	0.08	0.05	0.07	0.12	- 0.02*	- 0.07**	- 0.05***
Other crops sale (1 = yes)	0.58	0.54	0.35	0.76	0.19***	- 0.22***	- 0.41***
Observations	560	240	118	202			

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



the major household decision-maker as the head of household, who tends to have greater asset ownership than other family members, and who accordingly commands prominent decision-making power in the household (Deere et al. 2009).

Compared to male decision-making households, female and joint decision-makers owned smaller numbers of oxen and livestock in TLU,¹⁸ less total household land and land planted to maize and had lower average maize productivity.¹⁹ Compared to female decision-maker household heads, the joint decision-maker heads were older but had fewer years of experience in maize production. Moreover, they had less land planted with maize compared to female decision-makers. The lower resourced status of joint decision-making is consistent with what Aregu et al. (2011) found in Ethiopia. The results also show that joint decision-makers relied more on off-farm incomes and sale of other crops than male or female decision-making households. This indicates that men and women within joint decision-making households engaged more in causal labor or wage work (ibid.) and grew a more diverse set of crops per plot as part of their livelihood strategies.

Econometric Results

Factors Affecting the Market Positions

This subsection shows the results of the maximum likelihood ordered probit regression that examines the probability of household positions in the market. All the selected explanatory variables are included in the estimation model except productivity. Although productivity is a significant determinant of market participation, it is highly likely to be endogenous, as indicated by the previous studies (e.g., Rios et al. 2009; Kondo 2019). Therefore, the variables included in the model are considered to be good candidates to replace productivity and to avoid an omitted variable bias in the model estimation. We estimated pooled and separate samples to examine the gender effect on the probability of household positions in the market. In both estimations, the model is significant at a 1% level, showing that the explanatory variables taken together explain the maize market position of households. In the pooled sample estimation, we included the sex of female and joint decision-makers as gender indicator variables, while male decision-makers were the reference category.

¹⁸ Tropical Livestock Units refers to livestock numbers converted to a common unit (Harvest Choice 2015). Conversion factors are cattle=0.7, sheep=0.1, goats=0.1, pigs=0.2, and chicken=0.01.

¹⁹ As there are strong linkages between productivity (or volume of the production) and volume sold in the market (Gebremedhin and Jaleta 2012; Kondo 2019), we have estimated the average maize productivity across three market participation strata. Results show that the average maize productivity for net sellers is 3.12 ton/ha, while self-sufficient and net buyers produce 1.91 and 1.44 ton/ha, respectively. These results indicate that net suppliers, in general, have higher maize productivity than self-sufficient and net buyers in the market. FAO (2011) analysis shows that households with higher levels of productive resources such as land, labor, technology, and training are more capable of increasing their agricultural productivity. In our study, the average maize productivity in male decision-making households was 2.69 ton/ha, while female and joint decision-makers were 2.24 and 2.18 ton/ha, respectively. Higher maize productivity in male decision-makers indicates greater access to resources compared to female and joint decision-makers, as observed from summary statistics in Table 1.



The included gender variables are significant at a 1% probability level, implying that controlling other covariates, the placement of households into any of the market positions is strongly explained by the sex of female and joint decision-makers in the household. Table 2 presents the average marginal effect recovered from the ordered probit model. The pooled sample estimate shows that the sex of female and joint decision-makers in the households are negatively associated with the probability of being net sellers while positively associated with the autarchic and net buyers. This might be linked to their decreased access to resources and lower productivity compared to male decision-making households (Table 1). Greater numbers of adult males, higher educational levels of the head, more oxen, larger sizes of landholding and land planted with maize, use of improved maize seed, and contact with extension agents were positively associated with being in the net seller categories while negatively associated with being autarchic or net buyers. On the other hand, access to market information and off-farm incomes were negatively and positively associated with autarchic positions for the households, respectively.

Regarding the gender-based decision-making regression, additional numbers of adult males, more oxen owned, greater size of landholding and land planted to maize, and use of improved maize seed increased the probability of being net sellers while decreasing the probability of being autarchic or net buyers in all the kinds of households (male, female, and joint decision-makers). Contact with extension agents increased the probability of being net sellers and decreased the probability of being autarchic or net buyers in male decision-makers. Participation in farmer training increased the probability of being net sellers while decreasing the probability of being net buyers in female decision-making households. An increase in the age of the household head increased the probability of being a net seller while reducing the probability of being autarchic or a net buyer in joint decision-making households. Access to credit services had a negative association with the probability of net selling among female decision-making households, implying that they tended to divert loaned money to off-farm activities or other agricultural production rather than investing in the maize sector. For joint decision-making households, additional numbers of adult females, participation in social events, and access to off-farm income were negatively associated with the probability of being net sellers while positively related to autarchic and net buyer positions. The possible implication for the negative relationship between the number of adult females and the probability of net selling is that as females dominate in gender-egalitarian joint decision-making households, more resources are allocated for home consumption than for selling. This is because, first, joint decision-makers have access to fewer resources, and second, women are more cautious about their family consumption than male family members, as is confirmed by the existing literature. Besides, these households may spend more of their off-farm incomes on home consumption or other productive activities than investing in maize production.



Table 2 Ordered probit average marginal effects of the factors affecting maize market position by the gender of decision-makers in the household. *Source* Own survey results (2018)

Variables	Whole sample (N = 560)				Male (N = 240)				Female (N = 118)				Joint (N = 202)			
	Net seller	Autarchic	Net buyer	Net seller	Autarchic	Net buyer	Net seller	Autarchic	Net Buyer	Net seller	Autarchic	Net Buyer	Net seller	Autarchic	Net Buyer	
Female decision-makers	-0.187*** (0.054)	0.029*** (0.009)	0.157*** (0.052)	-	-	-	-	-	-	-	-	-	-	-	-	
Joint decision-makers	-0.168*** (0.053)	0.037*** (0.012)	0.131*** (0.044)	-	-	-	-	-	-	-	-	-	-	-	-	
Children	-0.002 (0.014)	0.005 (0.003)	0.001 (0.010)	0.012 (0.026)	-0.006 (0.014)	-0.005 (0.011)	0.012 (0.031)	-0.002 (0.006)	-0.010 (0.025)	0.001 (0.023)	-0.003 (0.005)	-0.001 (0.018)	-	-	-	
Adult male	0.035** (0.018)	-0.009* (0.005)	-0.026** (0.013)	0.033* (0.029)	-0.018 (0.016)	-0.014 (0.013)	0.001** (0.042)	-0.001 (0.007)	-0.001 (0.034)	0.083** (0.033)	-0.019* (0.010)	-0.064** (0.026)	-	-	-	
Adult female	-0.033 (0.023)	0.009 (0.006)	0.024 (0.016)	-0.003 (0.037)	0.002 (0.020)	0.002 (0.018)	-0.021 (0.051)	0.003 (0.009)	0.017 (0.041)	-0.111** (0.042)	0.025* (0.013)	0.085** (0.033)	-	-	-	
Age of head	0.002* (0.002)	-0.007 (0.006)	-0.001 (0.001)	-0.003 (0.004)	0.002 (0.002)	0.002 (0.005)	-0.001 (0.004)	0.002 (0.008)	0.001 (0.003)	0.008** (0.003)	-0.002* (0.001)	-0.006** (0.003)	-	-	-	
Education of head	0.013** (0.006)	-0.003** (0.001)	-0.009** (0.004)	0.006 (0.009)	-0.004 (0.005)	-0.003 (0.004)	0.015 (0.016)	-0.003 (0.003)	-0.012 (0.013)	0.013 (0.010)	-0.003 (0.056)	-0.010 (0.008)	-	-	-	
Oxen	0.135*** (0.033)	-0.036*** (0.011)	-0.099*** (0.0240)	0.207*** (0.063)	-0.113*** (0.040)	-0.093*** (0.030)	0.187*** (0.079)	-0.034 (0.025)	-0.152** (0.063)	0.106** (0.053)	-0.024 (0.015)	-0.082** (0.041)	-	-	-	
Livestock in TLU	0.012 (0.008)	-0.003 (0.002)	-0.009 (0.006)	0.020 (0.016)	-0.011 (0.009)	-0.009 (0.007)	-0.018 (0.019)	0.002 (0.005)	0.014 (0.015)	0.034** (0.014)	-0.007* (0.004)	-0.026** (0.011)	-	-	-	
Landholding	0.141*** (0.028)	-0.037*** (0.010)	-0.103*** (0.020)	0.248*** (0.053)	-0.136*** (0.038)	-0.111*** (0.026)	0.342*** (0.092)	-0.108 (0.056)	-0.278*** (0.070)	0.052* (0.042)	-0.011 (0.010)	-0.040 (0.033)	-	-	-	
Land planted with maize	0.028** (0.054)	-0.007** (0.014)	-0.020** (0.039)	0.022** (0.109)	-0.012 (0.060)	-0.09 (0.049)	0.074* (0.126)	-0.021 (0.039)	-0.061 (0.102)	0.048** (0.082)	-0.256* (0.127)	-0.022** (0.063)	-	-	-	
Maize farming experience	0.001 (0.002)	-0.003 (0.005)	-0.001 (0.001)	0.003 (0.004)	-0.002 (0.003)	-0.001 (0.002)	0.007 (0.005)	-0.002 (0.001)	-0.005 (0.004)	-0.008 (0.003)	0.002 (0.008)	0.006 (0.002)	-	-	-	



Table 2 (continued)

Variables	Whole sample (N = 560)				Male (N = 240)				Female (N = 118)				Joint (N = 202)			
	Net seller	Autarchic	Net buyer	Autarchic	Net seller	Autarchic	Net buyer	Autarchic	Net seller	Autarchic	Net Buyer	Autarchic	Net seller	Autarchic	Net Buyer	Autarchic
Improved maize seed	0.273*** (0.046)	-0.050*** (0.013)	-0.222*** (0.042)	-0.174*** (0.041)	0.358*** (0.069)	-0.065 (0.079)	-0.183*** (0.047)	-0.043 (0.031)	0.244*** (0.136)	-0.043 (0.031)	-0.219* (0.132)	-0.024 (0.015)	0.194*** (0.093)	-0.024 (0.015)	-0.169* (0.091)	-0.024 (0.015)
Credit	0.023 (0.047)	-0.006 (0.013)	-0.017 (0.034)	-0.065 (0.046)	0.116 (0.079)	-0.050 (0.033)	-0.050 (0.053)	0.020 (0.021)	-0.211*** (0.102)	0.020 (0.021)	0.191* (0.099)	-0.006 (0.018)	0.026 (0.078)	-0.006 (0.018)	-0.020 (0.060)	-0.006 (0.018)
Contact with extension agents	0.104** (0.051)	-0.022** (0.009)	-0.082* (0.043)	-0.086** (0.035)	0.184** (0.083)	-0.097* (0.053)	-0.097* (0.053)	0.018 (0.044)	-0.074 (0.140)	0.018 (0.044)	0.057 (0.102)	-0.013 (0.013)	0.074 (0.086)	-0.013 (0.013)	-0.061 (0.074)	-0.013 (0.013)
Participation in farmer training	0.062 (0.055)	-0.014 (0.012)	-0.047 (0.044)	0.042 (0.060)	-0.073 (0.090)	0.030 (0.038)	0.030 (0.038)	-0.045 (0.029)	0.248** (0.31)	-0.045 (0.029)	-0.222* (0.130)	-0.019 (0.016)	0.104 (0.099)	-0.019 (0.016)	-0.085 (0.021)	-0.019 (0.016)
Participation in social events	-0.052 (0.045)	0.014 (0.013)	0.037 (0.031)	0.016 (0.040)	-0.029 (0.072)	0.013 (0.032)	0.013 (0.032)	-0.020 (0.024)	0.063 (0.104)	-0.020 (0.024)	-0.053 (0.089)	0.050* (0.030)	-0.176** (0.081)	0.050* (0.030)	0.126** (0.054)	0.050* (0.030)
Distance from market	-0.004 (0.003)	0.001 (0.001)	0.003 (0.002)	0.001 (0.004)	-0.001 (0.008)	0.001 (0.003)	0.001 (0.003)	0.001 (0.004)	-0.002 (0.015)	0.001 (0.004)	0.001 (0.012)	0.001 (0.005)	-0.006 (0.005)	0.001 (0.005)	0.005 (0.004)	0.001 (0.005)
Market information	0.075 (0.050)	-0.017* (0.010)	-0.058 (0.0403)	-0.044 (0.038)	0.084 (0.074)	-0.039 (0.036)	-0.039 (0.036)	0.017 (0.046)	-0.101 (0.148)	0.017 (0.046)	0.077 (0.106)	-0.019 (0.012)	0.144 (0.092)	-0.019 (0.012)	-0.124 (0.089)	-0.019 (0.012)
Off-farm income	-0.100 (0.072)	0.019** (0.009)	0.080 (0.064)	-0.013 (0.071)	0.024 (0.124)	-0.010 (0.052)	-0.010 (0.052)	0.010 (0.043)	-0.033 (0.204)	0.010 (0.043)	0.027 (0.177)	0.008* (0.026)	-0.199** (0.105)	0.008* (0.026)	0.190** (0.125)	0.008* (0.026)
Other crops sell	-0.037 (0.048)	0.010 (0.013)	0.027 (0.034)	0.072 (0.047)	-0.131 (0.083)	0.058 (0.037)	0.058 (0.037)	0.008 (0.029)	-0.075 (0.112)	0.008 (0.029)	0.063 (0.097)	-0.003 (0.019)	0.014 (0.091)	-0.003 (0.019)	-0.011 (0.072)	-0.003 (0.019)

***, **, and * denote level of significance at 1%, 5%, and 10%, respectively. Standard Errors are given in parentheses



Table 3 Probit model Blinder–Oaxaca decomposition of maize market position gaps among male, female, and joint decision-makers

(A) Male vs. female	Net sellers			Autarchic			Net buyers		
Male	0.479			0.267			0.247		
Female	0.406			0.254			0.339		
Mean gender gap	0.073*			0.013			− 0.092**		
	Endow- ment effects	Coefficient effects	Interaction effects	Endow- ment effects	Coefficient effects	Interaction effects	Endow- ment effects	Coefficient effects	Interaction effects
Aggregate decomposition	− 0.032 (0.057)	0.175** (0.076)	− 0.070 (0.070)	0.070 (0.075)	− 0.020 (0.059)	− 0.037 (0.085)	0.036 (0.064)	− 0.186*** (0.046)	0.058 (0.071)
Share of the gender gap	− 43.83%	239.72%	− 95.89%	538.45%	− 153.84%	− 284.61%	− 39.13%	202.17%	− 63.04%
Detailed decomposition									
Improved seed	− 0.021 (0.017)	− 0.044 (0.098)	0.006 (0.013)	0.015 (0.015)	0.238** (0.098)	− 0.032 (0.023)	− 0.005 (0.012)	0.194*** (0.093)	0.026 (0.020)
Credit	− 0.013 (0.011)	− 0.69*** (0.036)	0.020 (0.016)	0.007 (0.009)	− 0.039 (0.035)	0.011 (0.012)	0.006 (0.009)	0.029 (0.033)	− 0.008 (0.011)
Participation in farmer training	0.048** (0.025)	0.254*** (0.096)	− 0.063** (0.030)	− 0.0027 (0.021)	0.185** (0.094)	0.046* (0.027)	− 0.020 (0.021)	0.068* (0.087)	0.017 (0.022)
Market information	0.023 (0.021)	− 0.086** (0.089)	− 0.037 (0.025)	0.022 (0.020)	− 0.221 (0.114)	0.041 (0.025)	0.001 (0.019)	− 0.022 (0.109)	− 0.004 (0.020)
(B) Male vs joint	Net sellers			Autarchic			Net buyers		
Male	0.479			0.267			0.247		
Joint	0.425			0.252			0.310		
Mean gender gap	0.054			0.015			− 0.063		
	Endowment effects	Coefficient effects	Interaction effects	Endow- ment effects	Coefficient effects	Interaction effects	Endow- ment effects	Coefficient effects	Interaction effects
Aggregate decomposition	− 0.101* (0.058)	0.179*** (0.052)	− 0.024 (0.059)	0.103** (0.045)	− 0.044 (0.058)	− 0.044 (0.062) − 0.044 (0.062)	− 0.017 (0.039)	− 0.128*** (0.040)	0.082* (0.048)
Share of the gender gap	− 187.03%	331.48%	− 44.45%	686.66%	− 293.33%	− 293.33%	26.98%	203.17%	− 130.15%
Detailed decomposition									
Adult male	0.019* (0.012)	− 0.058 (0.064)	− 0.013 (0.015)	0.011 (0.012)	− 0.046 (0.069)	− 0.010 (0.016)	− 0.030** (0.014)	0.105* (0.063)	0.024 (0.015)
Adult female	− 0.004 (0.007)	0.087 (0.081)	0.003 (0.005)	− 0.002 (0.002)	0.075 (0.087)	0.002 (0.004)	0.005 (0.007)	− 0.163** (0.079)	− 0.005 (0.008)
Age of head	− 0.002 (0.005)	− 0.322* (0.183)	0.003 (0.007)	− 0.002 (0.012)	0.105 (0.194)	0.008 (0.002)	0.001 (0.005)	0.216 (0.174)	− 0.001 (0.005)



Table 3 (continued)

	Endowment effects	Coefficient effects	Interaction effects	Endowment effects	Coefficient effects	Interaction effects	Endowment effects	Coefficient effects	Interaction effects
Oxen	-0.013 (0.012)	0.127 (0.094)	-0.022 (0.019)	-0.013 (0.013)	-0.148 (0.100)	0.026 (0.020)	0.026* (0.016)	0.021 (0.090)	-0.003 (0.016)
Livestock in TLU	-0.025 (0.016)	-0.232*** (0.084)	0.032 (0.020)	0.015 (0.012)	0.150* (0.077)	-0.021 (0.016)	0.010 (0.011)	0.081 (0.083)	-0.011 (0.013)
Maize farming experience	0.005 (0.004)	0.168*** (0.070)	-0.010 (0.011)	-0.005 (0.006)	-0.182** (0.069)	0.011 (0.012)	0.008 (0.003)	0.013 (0.065)	-0.008 (0.004)
Improved seed	-0.028*** (0.015)	-0.006 (0.073)	0.001 (0.016)	0.011 (0.013)	0.188** (0.061)	-0.041** (0.020)	0.016 (0.014)	-0.182** (0.073)	0.040* (0.019)
Participation in social events	0.011 (0.009)	0.120** (0.057)	-0.010 (0.009)	-0.008 (0.007)	-0.090 (0.055)	0.008 (0.008)	-0.003 (0.004)	-0.021 (0.055)	0.002 (0.005)
Market information	-0.016* (0.024)	-0.055 (0.078)	0.010 (0.015)	-0.013 (0.013)	-0.023 (0.068)	0.005 (0.015)	0.010 (0.013)	0.084 (0.078)	-0.015 (0.015)
(C) Female vs joint			Net sellers			Autarchic			Net buyers
Female			0.406			0.254			0.339
Joint			0.425			0.252			0.310
Mean gender gap			-0.019			0.002			0.029
	Endowment effects	Coefficient effects	Interaction effects	Endowment effects	Coefficient effects	Interaction effects	Endowment effects	Coefficient effects	Interaction effects
Aggregate decomposition	-0.022 (0.052)	-0.045 (0.105)	0.048 (0.102)	0.005 (0.015)	0.014 (0.013)	-0.017 (0.026)	-0.043 (0.053)	-0.018 (0.084)	0.090 (0.103)
Share of the gender gap	115.79%	236.84%	-252.63%	250%	700%	-850. %	-148.27%	-62.08%	310.34%
Detailed decomposition									
Adult male	0.021* (0.013)	0.102 (0.084)	-0.025 (0.022)	0.012 (0.013)	-0.006 (0.085)	-0.001 (0.021)	-0.033** (0.016)	0.108 (0.084)	-0.026 (0.022)
Livestock in TLU	-0.029* (0.016)	-0.246** (0.125)	0.038 (0.025)	0.016 (0.013)	0.214* (0.126)	-0.033 (0.024)	0.012 (0.012)	0.031 (0.125)	-0.011 (0.019)
Land planted with maize	0.013 (0.010)	-0.120 (0.111)	-0.016 (0.017)	0.005 (0.008)	-0.110 (0.112)	-0.014 (0.017)	0.008 (0.009)	-0.231** (0.111)	0.030 (0.023)
Distance from market	0.031 (0.021)	-0.007 (0.192)	0.028 (0.075)	0.007 (0.023)	0.220 (0.189)	-0.086 (0.074)	-0.038* (0.023)	-0.213 (0.187)	0.083 (0.073)
Participation in social events	-0.001 (0.009)	0.176** (0.079)	0.002 (0.013)	0.001 (0.007)	-0.136** (0.079)	-0.001 (0.010)	0.004 (0.008)	-0.024 (0.075)	-0.029 (0.021)



Table 3 (continued)

	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coef- ficient effects	Interaction effects
Market infor- mation	0.009 (0.007)	- 0.253* (0.123)	- 0.001 (0.014)	- 0.005 (0.004)	0.191 (0.124)	0.011 (0.008)	- 0.006 (0.003)	0.093 (0.116)	0.069 (0.050)

***, **, and * denote level of significance at 1%, 5%, and 10%, respectively. Standard errors are given in parentheses. Only significant variables are reported for the detailed decompositions in the table

Decomposition of the gender Market Position Gap

Table 3 presents the results from the B–O decomposition model with regard to the gap between male and female, male and joint, and female and joint decision-making groups in each of the market positions.

Block A in Table 3 shows the decomposition results of the market position gap between male and female decision-making households. Here, a significant difference in the net seller and net buyer positions between male and female decision-making households is observed. The results show that the actual mean probability among female decision-making households of being net sellers are 7.3% lower, and 9.2% higher for being net buyers than male decision-making households. These results are in line with the findings of Marenya et al. (2017).

Regarding the gender gap of being in the net seller position, the coefficient effect is significant, while the endowment and interaction effects are not. The result suggests that if women had the same returns from their resource endowments as male decision-making households, their net selling position would increase by 17.5% (coefficient effect of 0.175), potentially even closing the existing gender gap (7.3%) in the net seller position. In aggregate, 239.72% of the net seller position gap is explained by the coefficient effects, whereas the rest of the gap is attributed to endowment (43.83%) and interaction effects (95.89%). Access to credit and market information contributes to the coefficient effect portion of the gap, while participation in farmer training contributes to all endowment, coefficient, and interaction effects. The results suggest that female decision-makers would benefit more from the returns of credit services and market information; however, they benefit less from participating in farmer trainings in the net seller position compared to their male counterparts.

For the net buyer position, the coefficient effect suggests that female decision-makers would benefit more from returns on resource endowments than their male counterparts. This implies that if females had male's return on resources, their net buying gap would decrease by 18.6%, helping to close the existing gender gap (9.2%) in the net buyer position. However, overall, 202.17% of the net buyer position gap is explained by the coefficient effects, whereas the rest is owed to endowment (39.13%) and joint interaction effects (63.04%). Use of improved maize seed and participation in farmer trainings significantly contribute to the widening



of the coefficient effect portion of the gap between males and females in the net buyers' position.

Block B in Table 3 shows the market position gap between male and joint decision-making households. For the net seller position, the observed gender gap, while statistically nonsignificant, is significantly attributed to the endowment and coefficient effects. For the net buyer position, it is mainly attributed to the coefficient and interaction effects.

For the net sellers' position, the endowment effect suggests that compared to male decision-making households, the joint decision-making households would benefit more from their resource endowments, while the coefficient effect suggests that they would have a structural disadvantage related to the returns on their resource endowments. Detailed decomposition results indicate that the number of adult males in the household, use of improved maize seed, and market information significantly contribute to the endowment portion of the gap, while the age of household head, number of livestock owned, experience in maize farming, and participation in social events contribute to the coefficient portion of the gap.

For the autarchic position, the aggregate decomposition results suggest that the joint decision-making households would benefit less from resource endowments than male decision-makers. The portion of the gap explained by the coefficient effect in this position is not significant. However, the detailed decomposition results indicate that the number of livestock owned, experience in maize farming, and the use of improved maize seeds are the significant drivers for the portion of the gap contributed by coefficient effects.

With regard to the probability of being net buyers, the coefficient and interaction effects are significant, while the endowment effect is not. The coefficient effect suggests that joint decision-making households would benefit more from their endowment returns than male decision-making households. The positive and significant interaction effect suggests that the return effects account for more than 70% of the gap between male and joint decision-making households in the net buyer position. The gap is significantly derived by the availability of adult male and female laborers in the household, and the use of improved maize seeds.

Block C of Table 3 shows the results of the market position gap between female and joint decision-making households. The aggregate decomposition results indicate no significant gaps explained by any of the decomposition effects (endowment, coefficient, and interaction). However, the detailed decomposition results indicate that the availability of adult males, the number livestock owned, land planted with maize, distance from market, participation in social events, and access to market information are the main drivers of the existing gaps.

Decomposition of the Mean Gender Gap in the Quantity of Maize Sold

Table 4 presents the average quantities of maize sold by male, female, and joint decision-making households in each market participation category. Block A in Table 4 reports the mean quantities of maize sold by male and female decision-makers. The actual mean gaps in quantities of maize sold by the net seller, autarchic, and net buyer households are 4.7, 17.6, and 19.5%, respectively. The gaps are significant in



Table 4 OLS model Blinder–Oaxaca decomposition of quantities sold gaps among male, female, and joint decision-makers

(A) Male vs. female	Net sellers			Autarchic			Net buyers		
Male	2.356 (0.296)***			0.622 (0.105)***			0.377 (0.053)***		
Female	2.309 (0.441)***			0.446 (0.102)***			0.572 (0.108)***		
Mean gender gap	0.047 (0.532)			0.176 (0.169) *			– 0.195 (0.120)**		
	Endow- ment effects	Coef- ficient effects	Interaction effects	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coefficient effects	Interac- tion effects
Aggregate decomposition	– 0.206 (0.653)	0.370 (0.675)	– 0.117 (0.606)	– 0.021 (0.029)	0.308** (0.204)	– 0.111 (0.168)	– 0.016 (0.306)	– 0.132** (0.164)	– 0.047 (0.329)
Share of the gender gap	– 438.30%	787.23%	– 248.93%	– 11.94%	175%	– 63.06%	8.20%	67.70%	24.10%
Detailed decomposition									
Adult female	0.227 (0.210)	– 0.568*** (0.188)	– 0.452 (0.321)	– 0.012 (0.015)	– 0.007 (0.139)	0.024 (0.009)	0.002 (0.009)	– 0.086 (0.254)	0.002 (0.012)
Landholding	– 0.013 (0.103)	0.094 (0.110)	0.072 (0.140)	0.001 (0.066)	0.049** (0.230)	– 0.099 (0.089)	0.105 (0.086)	0.387** (0.266)	– 0.099 (0.089)
Improved seed	0.187 (0.230)	0.058** (0.201)	– 0.340 (0.287)	– 0.551 (0.123)	0.023** (0.034)	0.425 (0.173)	0.082 (0.143)	0.121 (0.230)	– 0.079 (0.152)
Distance from market	– 0.350 (0.243)	0.483** (0.241)	0.391 (0.276)	0.004 (0.026)	0.094 (0.152)	– 0.020 (0.033)	0.050 (0.073)	– 0.237 (0.314)	– 0.055 (0.077)
Credit	– 0.224 (0.240)	0.555** (0.392)	0.387 (0.247)	– 0.072 (0.104)	0.421**x (0.104)	0.032 (0.108)	– 0.062 (0.040)	0.035 (0.104)	– 0.012 (0.037)
Off-farm income	– 0.013 (0.052)	0.055 (0.191)	0.013 (0.058)	– 0.013 (0.100)	– 0.026 (0.096)	– 0.030 (0.109)	– 0.051 (0.060)	0.114** (0.075)	0.065 (0.075)
(B) Male vs joint	Net sellers			Autarchic			Net buyers		
Male	2.356 (0.296)***			0.622 (0.121)***			0.377 (0.053)***		
Joint	1.895 (0.223)***			0.215 (0.018)***			0.462 (0.124)***		
Mean gender gap	0.461 (0.371)**			0.407 (0.101)**			– 0.085 (0.135)		
	Endow- ment effects	Coef- ficient effects	Interaction effects	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coefficient effects	Interac- tion effects
Aggregate decomposition	0.697** (0.345)	0.306 (0.552)	– 0.542 (0.562)	– 0.043* (0.032)	0.481** (0.284)	– 0.031 (0.269)	0.518** (0.158)	– 0.098 (0.224)	– 0.505 (0.318)
Share of the gender gap	151.20%	66.37%	– 117.57%	– 10.56%	118.18%	– 7.62%	– 609.41%	115.29%	594.12%
Detailed decomposition									
Adult female	0.016 (0.034)	– 0.048** (0.842)	– 0.115 (0.148)	0.003 (0.008)	– 0.244 (0.230)	– 0.031 (0.037)	0.016 (0.030)	– 0.004 (0.268)	0.005 (0.030)



Table 4 (continued)

	Endow- ment effects	Coef- ficient effects	Interaction effects	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coefficient effects	Interac- tion effects
Adult male	0.023 (0.072)	-0.452 (0.622)	-0.081 (0.119)	-0.005 (0.007)	0.035 (0.222)	0.003 (0.019)	0.142 (0.098)	-0.389*** (0.205)	-0.178* (0.107)
Educa- tion of head	-0.007 (0.026)	0.431 (0.392)	0.043 (0.071)	0.002 (0.004)	0.208** (0.116)	0.031 (0.050)	-0.010 (0.022)	0.042 (0.097)	0.007 (0.021)
Oxen	-0.007 (0.123)	-0.892 (0.140)	0.188 (0.250)	0.002 (0.005)	0.506* (0.305)	-0.050 (0.057)	-0.117 (0.093)	-0.389* (0.241)	0.137 (0.103)
Livestock in TLU	0.128 (0.118)	0.775 (0.850)	-0.145 (0.173)	-0.008 (0.001)	-0.551** (0.293)	-0.015 (0.062)	0.182** (0.110)	0.701** (0.313)	-0.205 (0.122)
Credit	-0.082 (0.089)	0.877** (0.368)	0.134 (0.146)	-0.018 (0.003)	0.253** (0.137)	-0.041 (0.060)	0.048 (0.044)	0.155 (0.103)	-0.067 (0.056)
Exten- sion	0.037 (0.065)	-0.547** (0.919)	-0.056 (0.099)	0.003 (0.007)	-0.109 (0.236)	-0.006 (0.018)	0.066 (0.055)	0.374** (0.206)	-0.090 (0.067)
Distance from market	0.301** (0.133)	0.757* (0.016)	-0.385 (0.253)	-0.011 (0.014)	0.450 (0.459)	-0.137 (0.145)	0.166 (0.093)	0.411 (0.298)	-0.152 (0.114)
(C) Female vs joint									
	Net sellers			Autarchic			Net buyers		
Female	2.309 (0.441)***			0.466 (0.102)***			0.572 (0.108)***		
Joint	1.895 (0.223)***			0.215 (0.018)***			0.462 (0.124)***		
Mean gender gap	0.414 (0.636)**			0.231 (0.080)			-0.110 (0.165)		
	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coef- ficient effects	Interaction effects
Aggregate decom- position	0.622** (0.369)	-0.323 (0.318)	0.115 (0.272)	0.124 (0.058)	-0.098 (0.102)	0.205 (0.245)	0.340 (0.263)	-0.012 (0.423)	-0.218 (0.478)
Share of the gender gap	150.24%	-78.02%	27.78%	53.68%	-42.42%	88.74%	-309.09%	10.90%	198.19%
Detailed decom- position									
Adult male	0.028 (0.086)	0.962 (0.867)	0.207 (0.215)	0.0131176 (0.027)	0.089 (0.342)	-0.185 (0.122)	0.128 (0.094)	-0.452** (0.242)	-0.185 (0.122)
Educa- tion of head	-0.010 (0.034)	-0.540 (0.557)	-0.069 (0.118)	-0.016 (0.038)	0.732** (0.139)	-0.097 (0.168)	-0.019 (0.036)	0.158 (0.132)	0.057 (0.064)
Livestock in TLU	0.222 (0.183)	0.825 (0.524)	-0.268 (0.498)	0.098 (0.134)	0.105 (0.123)	-0.027 (0.294)	0.019 (0.052)	0.791** (0.487)	-0.091 (0.132)
Credit	0.171** (0.121)	0.060 (0.519)	-0.019 (0.166)	0.007 (0.066)	0.099 (0.188)	-0.006 (0.011)	0.015 (0.032)	0.114 (0.139)	-0.016 (0.036)
Land- hold- ing	-0.101 (0.115)	-0.716 (0.330)	0.128 (0.247)	0.008** (0.132)	-0.272 (0.543)	0.061 (0.351)	-0.280 (0.191)	-0.690 (0.461)	0.282 (0.211)
Distance from market	0.441** (0.170)	-0.924 (0.639)	0.626 (0.550)	-0.004 (0.018)	-0.124 (0.274)	0.005 (0.024)	0.220** (0.118)	-0.429 (0.317)	-0.429 (0.317)



Table 4 (continued)

	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coef- ficient effects	Interac- tion effects	Endow- ment effects	Coef- ficient effects	Interaction effects
Improved seed	0.014 (0.039)	- 0.739 (0.472)	0.024 (0.074)	- 0.047 (0.061)	0.149** (0.505)	- 0.259 (0.687)	0.007 (0.029)	- 0.097 (0.314)	0.014 (0.050)
Market infor- mation	0.042 (0.068)	0.127** (0.554)	- 0.147 (0.225)	- 0.008 (0.030)	- 0.156 (0.466)	- 0.005 (0.149)	- 0.011 (0.041)	0.500 (0.354)	0.0194 (0.067)

***, **, and * denote level of significance at 1%, 5%, and 10%, respectively. Standard Errors are given in parentheses. Only significant variables are reported for the detailed decompositions in the table

the autarchic and net buyer categories, with higher average quantities sold by males over females in the autarchic category and vice versa in the net buyer category. In the autarchic category, the gap is significantly explained by the coefficient effect, suggesting that females have structural disadvantages compared to male decision-makers for returns on their resource endowment. The size of landholding, use of improved maize seed, and access to credit are the significant contributing factors for female structural disadvantages in the autarchic category. In the net buyers' category, the coefficient effect implies that the female has structural advantages over their male counterparts for returns to resources. However, returns from landholding and off-farm income would favor male decision-making households to recover from their structural disadvantage.

Block B in Table 4 presents the mean quantity gaps between male and joint decision-makers. It shows that the mean quantity gaps in the net sellers, autarchic, and net buyer categories are 46.1, 40.7, and 8.5%, respectively. The gaps are significant in the net seller and autarchic categories, with the higher average quantities sold by males over joint decision-makers in both categories. In the net seller category, the result of the endowment effect suggests that joint decision-making households would benefit less from their resource endowments than male decision-makers. Distance from the market contributes to the widening of the gap for joint decision-making households in the net seller category.

In the autarchic category, both endowment and coefficient effects significantly account for the mean gap between male and joint decision-making households. The endowment effects suggest that joint decision-making households would benefit more from their resource endowments, while coefficient effects indicate that they have structural disadvantages on their resources return. The education level of the head, the number of oxen owned, and access to credit services play a significant role to aggravate the structural disadvantage of joint decision-making households in the autarchic category. However, the number of livestock in TLU would contribute to closing the gap caused by their structural disadvantage.

In the net buyer category, the endowment effect significantly explains the average gap of the quantity sold between male and joint decision-makers. It suggests that the joint decision-makers would benefit less from their resource endowments than male decision-makers in the net buyer position. The number of livestock in TLU



significantly contributes to widening the endowment and coefficient portions of the quantity gap in this position.

Block C in Table 4 presents the mean quantity gaps between female and joint decision-making households. The total mean gaps in the quantities sold by net sellers, autarchic, and net buyers between female and joint decision-making groups are 41.4, 23.1, and 11.0%, respectively. The gaps are significant in the net seller category with females showing a higher average quantity sold over joint decision-making households. This gap is significantly explained by the endowment effects, which suggests that joint decision-makers would benefit less from resource endowments. Access to credit services and distance from the market play a significant role in the widening of the gap caused by the endowment effect in the net seller category. In the autarchic and net buyer categories, no significant aggregate decomposition effects nor any gender gaps are observed between female and joint decision-makers.

Gender Gaps Across the Quantities-Sold-Distribution-Percentile Comparison

The gender market participation gaps discussed in the preceding section is computed by comparing mean gender gaps. This approach could mask the heterogeneity of gender market participation gaps across different economic strata of agricultural households (in terms of the quantities of maize sold). To reveal the gender gaps from a class perspective, Table 5 presents the decomposition results of gender gaps across designated percentile distributions (i.e., 10, 30, 50, and 80) of maize sold in male, female, and joint decision-making households. Overall, irrespective of the gender group, the gender gap is almost unevenly distributed across all the 4 percentile divisions of the maize-sold-distribution.

Table 5 (block A) provides the decomposition of quantities of the maize-sold-distribution between male and female decision-making households. Gender gaps at the 80 percentiles of each market position (i.e., net sellers, autarchic, and net buyers) are significant. Men sold larger quantities than women at this percentile point of net sellers and autarchic positions, while women sold larger quantities in the net buyer position. The results suggest that the significant quantity gaps in the net seller and autarchic positions would be explained by females' structural disadvantages, while in the net buyer position it would be explained by their structural advantages.

Table 5 (block B) provides decomposition results of the quantity-sold-distributions between male and joint decision-making households. The net seller position shows the significant gender gap at the highest level of quantities distribution (80 percentile). This gap is significantly explained by the joint decision-making household's endowment and structural effects. The autarchic position shows significant gender gaps at the 10 and 80 percentiles, in both of which male decision-making households show more quantities than joint decision-making households. The net buyer position has significant gender gaps in all the four percentile divisions with the 10, 30, and 50 percentiles showing more quantities for joint decision-making households and the 80 percentiles more quantities for male decision-making households. The results imply that the gender gaps across quantities distribution points in the net buyer position are mainly explained by joint decision-makers structural effects.



Table 5 Blinder–Oaxaca RIF decomposition of quantities of maize-sold-distribution among male, female, and joint decision-makers

(A) Male vs female	10th percentile		30th percentile		50th percentile		80th percentile	
Net sellers								
Male	0.517 (0.059)***		0.675 (0.158)***		1.103 (0.192)***		4.150 (0.703)***	
Female	0.256 (0.219)		0.583 (0.314)*		1.200 (0.373)***		3.757 (0.728)***	
Gender gap	0.261 (0.227)		0.092 (0.352)		− 0.097 (0.420)		0.393 (0.012)**	
	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained
Aggregate decomposition	− 0.202 (0.265)	0.463 (0.361)	− 0.794* (0.442)	0.886 (0.563)	− 0.055 (0.587)	− 0.042 (0.650)	− 0.425 (0.132)	0.818*** (0.306)
Share of the gender gap	− 77.9%	177.9%	− 863.04%	963.04%	56.70%	43.30	− 108.14%	208.14%
Autarchic								
Male	0.192 (0.006)***		0.119 (0.064)*		0.282 (0.064)***		0.808 (0.108)***	
Female	0.191 (0.007)***		0.245 (0.064)***		0.361 (0.068)***		0.491 (0.093)***	
Gender gap	0.001 (0.010)		− 0.126 (0.091)		− 0.079 (0.094)		0.317 (0.142)**	
	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained
Aggregate decomposition	− 0.002 (0.007)	0.003 (0.012)	− 0.065 (0.063)	− 0.061 (0.102)	− 0.095 (0.068)	0.016 (0.100)	− 0.027 (0.096)	0.344** (0.149)
Share of the gender gap	− 200%	300%	51.58%	48.42%	120.25%	− 20.25%	− 8.51%	108.51%
Net buyers								
Male	0.145 (0.003)***		0.154 (0.030)***		0.227 (0.029)***		0.528 (0.092)***	
Female	0.147 (0.021)***		0.213 (0.047)***		0.350 (0.097)***		0.896 (0.061)***	
Gender gap	− 0.002 (0.023)		− 0.059 (0.056)		− 0.123 (0.102)		− 0.368 (0.110)***	
	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained	Explained	Unexplained
Aggregate decomposition	− 0.002 (0.013)	0.000 (0.027)	0.027 (0.034)	− 0.086 (0.062)	0.077 (0.090)	− 0.200 (0.134)	− 0.023 (0.062)	− 0.345*** (0.113)
Share of the gender gap	100.00%	0.00%	− 45.76%	145.76%	− 62.60%	162.60%	6.25%	93.75%
(B) Male vs joint								
	10th percentile		30th percentile		50th percentile		80th percentile	
Net sellers								
Male	0.517 (0.059)***		0.675 (0.158)***		1.103 (0.192)***		4.150 (0.703)***	
Joint	0.498 (0.107)***		0.672 (0.185)***		1.105 (0.208)***		3.773 (0.541)***	
Gender gap	0.019 (0.122)		0.003 (0.244)		− 0.002 (0.283)		0.377 (0.887)**	



Table 5 (continued)

	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Aggregate decomposition	0.282* (0.150)	- 0.263** (0.126)	0.492** (0.296)	- 0.489 (0.338)	0.977 (0.304)	- 0.979 (0.372)	0.952*** (0.694)	- 0.575*** (0.952)
Share of the gender gap	1,484.21%	- 1,384.21%	16,400%	- 16,300%	- 48,850%	48,950%	252.52%	152.52%
Autarchic								
Male	0.192 (0.007)***		0.118 (0.070)*		0.281 (0.070)***		0.808 (0.116)***	
Joint	0.150 (0.019)***		0.127 (0.044)**		0.192 (0.041)***		0.288 (0.045)***	
Gender gap	0.042 (0.020)**		- 0.009 (0.083)		0.089 (0.082)		0.520 (0.125)***	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Aggregate decomposition	- 0.043 (0.038)	0.085* (0.047)	- 0.127* (0.072)	0.118 (0.099)	- 0.142** (0.069)	0.231** (0.096)	- 0.163** (0.075)	0.683 (0.137)
Share of the gender gap	- 102.38%	202.38%	1,411.11%	- 1,311.11%	- 159.55%	259.55%	- 31.34%	131.34%
Net buyers								
Male	0.145 (0.004)***		0.153 (0.033)***		0.227 (0.033)***		0.528 (0.100)***	
Joint	0.194 (0.013)***		0.224 (0.013)***		0.255 (0.016)***		0.298 (0.027)***	
Gender gap	- 0.049 (0.013)***		- 0.071 (0.036)**		- 0.028 (0.037)**		0.230 (0.103)**	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Aggregate decomposition	0.009 (0.019)	- 0.058*** (0.020)	0.010 (0.026)	- 0.081** (0.044)	0.011 (0.037)	- 0.039** (0.054)	0.009 (0.066)	0.221*** (0.121)
Share of the gender gap	- 18.36%	118.36%	- 14.08%	114.08%	- 39.28%	139.28%	3.91%	96.09%
(C) Female vs joint								
Net sellers		10th percentile	30th percentile	50th percentile	80th percentile			
Female		0.492 (0.101)***	0.661 (0.174)***	1.100 (0.197)***	3.773 (0.535)***			
Joint		0.253 (0.207)***	0.584 (0.295)**	1.200 (0.362)***	3.764 (0.704)**			
Gender gap		0.239 (0.230)**	0.077 (0.343)	- 0.10 (0.412)	0.009 (0.884)			



Table 5 (continued)

	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained	Explained	Unexplained
Aggregate decomposition	- 0.689** (0.409)	0.928** (0.546)	- 1.003** (0.511)	1.080* (0.622)	0.147 (0.803)	- 0.247 (0.849)	- 1.414 (0.655)	1.423 (0.626)
Share of the gender gap	- 288.28%	388.28%	- 1,302.59%	1,402.59%	- 147%	247%	- 15,711%	15,811%
Autarchic								
Female	0.156 (0.004)***		0.222 (0.032)***		0.280 (0.034)***		0.489 (0.113)***	
Joint	0.128 (0.009)***		0.166 (0.018)***		0.196 (0.017)***		0.241 (0.019)***	
Gender gap	0.028 (0.010)***		0.056 (0.037)		0.084 (0.038)**		0.248 (0.115)**	
	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained	Explained	Unexplained
Aggregate decomposition	- 0.025 (0.021)	0.053** (0.028)	- 0.047 (0.033)	0.103** (0.050)	- 0.043 (0.031)	0.127*** (0.049)	- 0.036 (0.031)	0.284** (0.115)
Share of the gender gap	- 89.28%	189.2805	- 83.92%	183.92%	- 51.19%	151.19%	- 14.51%	114.51%
Net buyers								
Female	0.198 (0.003)***		0.207 (0.004)***		0.216 (0.004)***		0.297 (0.037)***	
Joint	0.126 (0.013)***		0.205 (0.024)***		0.350 (0.340)***		0.974 (0.018)***	
Gender gap	0.072 (0.014)***		0.002 (0.024)		- 0.134 (0.340)		- 0.677 (0.041)***	
	Explained	Unex- plained	Explained	Unex- plained	Explained	Unex- plained	Explained	Unexplained
Aggregate decomposition	- 0.082 (0.052)	0.154*** (0.058)	- 0.026 (0.086)	0.028 (0.091)	- 0.654 (0.244)	0.520 (0.313)	- 0.021 (0.052)	- 0.656*** (0.062)
Share of the gender gap	- 113.88%	213.88%	- 1,300%	1,400%	488.05%	- 388.05%	3.10%	96.90%

***, **, and * denote level of significance at 1%, 5%, and 10%, respectively. Standard Errors are given in parentheses. We only report the overall gaps across quantity distribution points in order to save space in the paper.

Table 5 (block C) provides a decomposition of the quantity-sold-distributions between female and joint decision-making households. The results show a significant gender gap at the lowest level of quantities distribution (10 percentile) in the net seller category. This is significantly explained by joint decision-makers endowment and structural effects. Moreover, the results indicate significant gender gaps at the 10, 50, and 80 percentiles for the autarchic position and at 10 and 80 percentiles for the net buyer position. All of them show larger quantities for females over joint decision-making households except at the 80 percentiles of net buyers. The results



suggest that the larger quantities sold by females would be explained by joint decision-makers' structural disadvantages over female decision-makers.

Conclusion and Policy Implications

Studies on gender differences in agricultural productivity and technology adoption have received more attention than those on gender differences in market participation in developing regions. Using data collected from maize farm households in the Dawuro zone, southern Ethiopia, this study has analyzed gender-based differences in market participation by dividing sampled households into three gender-based decision-making categories: male, female, and joint.

From the ordered probit analysis, we found a significant aggregate gender difference in the probability of market participation within sampled households. Thus, after controlling other covariates, the placement of households into any of the maize market positions is significantly explained by having female or joint decision-makers. The results suggest that female and joint decision-makers are more negatively associated with the probability of net selling, while more positively associated with the autarchic and net buyer market positions compared to male decision-making households. These results could be related to their decreased access to productive resources such as landholding, lower maize productivity, fewer number of oxen, and livestock units owned, observed from the descriptive results.

From the decomposition results, we found significant market participation gaps between male and female decision-making households in the net seller and net buyer positions. Meanwhile, their average gaps in the volume sold are significant in the autarchic and net buyer positions. The quantity distribution gaps are significant at the highest level of quantities distribution (80 percentile) in all the market categories (net sellers, autarchic, and net buyers). In all the significant gender gaps of market participation for mean and percentile decompositions, the male scored higher than the female in the net seller and autarchic categories because of the female's structural disadvantages. Women scored higher in the net buyer category due to their structural advantages. Overall, the results from the comparison between males and females suggest that higher market participation would lead to larger quantity supply. However, the gender gaps tend to widen with both gender groups selling larger quantities at the quantity's distribution line. This is due to the differences in returns from their respective resource endowments.

In the comparisons between male and joint decision-makers, no significant market participation gaps are observed. However, the aggregate decomposition results suggest that the endowments and its return effects would explain the existing gaps. The mean gaps of the amount sold are significant in the net seller and autarchic positions, with higher means of males observed in both categories. The quantity distribution gaps are significant at the 80 percentile for the net seller categories. For the autarchic category, the gaps are significant at 10 and 80 percentiles, while for the net buyers, it is significant in all the estimated percentile divisions (10, 30, 50, and 80). In the net seller and autarchic categories, both the



endowment and its returns effects would explain the gaps, while in the net buyers only return effects would explain the gaps across the distribution points.

From the comparison between female and joint decision-making households, no clear market participation gaps are observed. However, the mean quantity gaps are significant in the net seller category, with females showing a higher mean due to their endowment advantage over joint decision-makers. The quantity distribution results show that the gender gap is significant at the lowest percentile point (10) in the net seller category. For the autarchic category, the gaps are significant at 10, 50, and 80 percentiles and at 10 and 80 percentiles for the net buyer category. All the other gaps, except at the 80 percentile in the net buyer category, show larger quantities for females over joint decision-makers due to the joint decision-makers' structural disadvantage.

Overall, all the significant gaps in the net seller and autarchic positions, except some gaps in the net buyer positions, indicate that males are better positioned than females and that females are better positioned than joint decision-makers. Both endowment and return effects would explain the gender gaps between different gender groups across the distribution points. The size of landholding, use of improved maize seed, farm labor, number of oxen owned and livestock in TLU, participation in farmer trainings, access to credit, and market information are significantly contributed to the endowment and return effects portion of the gaps between male, female, and joint decision-making households. Hence, there is a need for policies that not only ensure more equal access to productive resources, but also build capacity for female and joint decision-making farm households to increase their return on resources at different economic strata of agricultural market participation.

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Compliance with Ethical Standards

Conflict of interest All authors have not conflict of interest on this paper.

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Affiliations

Girma Gezimu Gebre^{1,2}  · **Hiroshi Isoda**³ · **Dil Bahadur Rahut**⁴ · **Yuichiro Amekawa**⁵ · **Hisako Nomura**⁶

Hiroshi Isoda
isodah@agr.kyushu-u.ac.jp

Dil Bahadur Rahut
D.RAHUT@cgiar.org

Hisako Nomura
hnomura@agr.kyushu-u.ac.jp

¹ Department of Agricultural and Resource Economics, Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Fukuoka, Japan

² Department of Agricultural Economics, Aksum University, Aksum, Ethiopia

³ Faculty of Agriculture, Kyushu University, Fukuoka, Japan

⁴ International Maize and Wheat Improvement Center (CIMMYT), El Batan, Mexico

⁵ College of International Relations, Ritsumeikan University, Kyoto, Japan

⁶ Center for Promotion of International Education and Research, Faculty of Agriculture, Kyushu University, Fukuoka, Japan

