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Effects of gender and institutional support services on commercialisation of maize in Western Kenya

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ABSTRACT
This paper analyses the effects of gender and institutional support services on commercialisation patterns of maize by female-headed households (FHHs) and male-headed households (MHHs) in Western Kenya. Using primary household survey data from 297 maize farmers, we estimate a Tobit model and a treatment effect model to assess the determinants and gender-induced differences in commercialisation patterns, respectively. Results show that commercialisation levels of FHHs and MHHs were significantly and variably affected by institutional support services. The exogenous switching treatment effect model showed that the commercialisation intensity gap between MHHs and FHHs is explained by both observable and unobservable characteristics.

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1. Introduction

Women play major roles in agricultural food systems in Africa (IFPRI 2020). Women supply more than half of the agricultural labour force in sub-Saharan Africa (UN Women et al. 2018), and account for 60–80% of the total food production (FAO 2011). Despite women's contributions to the agricultural sector, there are persistent gender gaps in SSA. For instance, there is a 44% agricultural labour productivity gap between male and female managed plots in Malawi, with females being disadvantaged (Palacios-López and López 2015). Whereas in Uganda, Mugisha et al. (2019) found a 63% gender yield gap among ground nut producers, with plots managed by females realising less yields. A plethora of studies have highlighted gender inequalities that persist in the access, control, and use of productive assets such as land, labour, extension services, credit, education, and livestock (Djurfeldt 2017; FAO 2011; Quisumbing and Pandolfelli 2010).

Gender mainstreaming in agricultural value chains has attracted a lot of interest in research. For example, Mugisha et al. (2019) and Palacios-López and López (2015) focused on decomposing gender productivity gaps in Uganda and Malawi, respectively. Other studies have also focused on gender and food security (Stage, Kassie, and Ndiritu 2014), collective action (Fischer and Qaim 2012), and access to productive resources (Hill and Vigneri 2011). In Kenya, women form the largest share of the agricultural labour force, ranging from 42% to 65% (World Bank 2014), and they are extensively involved in rural economies and ensuring food and nutrition security. However, persistent gender inequalities limit women's contributions to agricultural development as well as associated benefits from agriculture (Lutomia et al. 2019). Compared to men, women farmers are mostly constrained with limited access to financial services, land, labour, agricultural markets, and extensions services (Diiro et al. 2018). For example, only 5% of land is owned by female farmers in Kenya (Young 2012). This is attributed to the patriarchal nature of the culture of land inheritance. Further, female-headed households (FHHs) in Kenya have lower incomes and asset value as opposed to their male counterparts. Women are also faced with time constraint

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due to active involvement in household chores, which negatively affect their access to agricultural extension services (Farnworth and Colverson 2015).

Reducing gender disparities in agriculture is consistent with global, regional, and national frameworks for ensuring sustainable development, agricultural growth, and food and nutrition security (IFPRI 2020). In Kenya, the national gender policy of 2011 calls on the government to integrate a gendered lens in its projects and plans so as to ensure benefits are equally received between men and women (Republic of Kenya 2011). Eliminating gender gaps in access to productive assets among women farmers is poised to increase their productivity up to 30%, which translates to a reduction of the rate of hunger by about 17% (FAO 2011). While assessing the cost of gender gaps in select countries in SSA, UN Women et al. (2018) found that closing the gender gap in agriculture would correspond with reducing poverty for about 80,000 and 238,000 people per year in Tanzania and Rwanda, respectively. It is also observed that closing the same gap in cash crop production can increase the gross domestic product of Malawi, Tanzania, and Uganda by more than $28million, $3million, and $8million, respectively (UN Women et al. 2015).

Despite the significant contributions that women play in the agricultural sector and development at large, women farmers exhibit low levels of market participation. This observation is highly linked to the gendered nature in access and use of productive resources (Hill and Vigneri 2011). Since commercialisation is hugely correlated with adoption of technology, poor adoption rates hinder women's participation in markets (Fischer and Qaim 2012). Participation in markets may also be defined by economic and cultural factors, with women always being disadvantaged. Economically, women farmers may face high transaction costs in their attempt to commercialise outputs, whereas culturally, they may be limited to producing crops that are majorly used for subsistence purposes (Orr et al. 2016). Thus, while focusing on the integration of women into markets it is important to concentrate on women-specific factors that hinder their participation in output markets (Oduol et al. 2013).

Further, Barrett (2008) observed that institutional barriers, such as poor access to services and inputs, unavailability of requisite infrastructure, fluctuation of prices, and poor linkages to markets, are the major causes of low commercialisation among smallholder farmers. Institutional support services refer to activities that support agricultural production and marketing. They include access to credit, transport, extension services, and a system of input supply among others (Onumah et al. 2014). Support services have multiplier effects across different subsectors of the economy. Services meant for producer organisations and agro-enterprises also help to stabilise market chains and create employment opportunities in the rural areas.

Previous literature on agricultural commercialisation (see e.g. Mihretie 2020; Sekyi, Abu, and Nkegbe 2020) greatly focused on the link between socio-economic factors and commercialisation, without a specific focus on variables that capture the effect of institutional support services on commercialisation. Further, none of these studies disaggregated their analysis by gender so as to offer context-specific solutions to different gender typologies.

Gaps in literature still exist on the role of gender in agricultural commercialisation. According to Djurfeldt (2017), previous gendered research has not focused on the role of gender dynamics on commercialisation patterns. This study seeks to fill these gaps by disaggregating the results by gender to improve our understanding on how different socio-economic variables affect commercialisation patterns between male-headed households (MHHs) and female-headed households (FHHs). This method improves on conventional commercialisation studies that assessed the effect of gender in a pooled regression with a gender binary variable included in the estimation. Disaggregating the results allows us to assume that institutional support services influencing commercialisation patterns among FHHs and MHHs do not have common slope coefficients (Stage, Kassie, and Ndiritu 2014). By addressing gender gaps in the level of agricultural commercialisation, we expand on the recent research by Osanya et al. (2020) that focused on factors influencing intrahousehold decisions about the use of income generated from agricultural sales, but neither did it focus on institutional support services nor decomposing the gaps relative to gender. Our study intends to fill this gap in the literature, as it will provide a greater understanding of gender-specific institutional factors that affect commercialisation, as well as illustrate the commercialisation differences attributed to both observable and unobservable factors.

The subsequent sections of this paper are organised as follows: section 2 provides a review of the literature. Section 3 describes the methodology. Discussions of the results are presented in section 4, while section 5 concludes.

2. Literature review

2.1. A review of commercialisation concepts and their relevance to livelihoods

Market participation encompasses a gradual transformation process from subsistence production to semi-commercial, then fully commercial production with a goal of increasing output and earning optimal profits (Pingali and Rosegrant 1995). Commercialisation is a shift from integrated farming systems to more specialised production. Market participation does not only involve the selling of farm outputs, instead, it entails efficient production, cost minimisation, and profit maximisation. This approach calls for optimal substitution of non-traded inputs with high quality purchased inputs and a shift to specialised production systems.

Research findings show the nexus between agricultural output market participation and welfare outcomes of smallholder farmers in East Africa, particularly Kenya (Krause, Faße, and Grote 2019; Ogutu and Qaim 2019). For instance, Ogutu and Qaim (2019) in their study, find that commercialisation reduced both income and multidimensional poverty among smallholder farmers in Kenya. Krause, Faße, and Grote (2019) find that commercialisation had a positive effect on the income and food security status of producers of African indigenous vegetables in Kenya.

These studies suggest that market participation improves livelihoods of smallholder farmers who are the most vulnerable actors in agrifood chains. However, it is important for market interventions that are meant to facilitate market access to be gendered.

2.2. Gender and agricultural commercialisation

Despite the fact that agricultural commercialisation is linked to positive welfare outcomes among smallholders, it is important to acknowledge that these gains may vary depending on various factors that are mediated by gender dynamics. Apart from the renowned production constraints, cultural and economic constraints could limit women to access markets (IFPRI 2020). Notably, Fischer and Qaim (2012) attributed low market participation among women to disparity in access and use of technology. The World Bank (2009) indicates that women are highly concentrated in rural and less developed markets due to limited access to productive resources. Markets in rural areas may be engulfed in high transaction costs that limit smallholder participation due to poor infrastructural support. Given their limited ownership of productive assets (Quisumbing and Pandolfelli 2010), female farmers may lack the capacity to participate in these markets. Women have a higher opportunity cost for marketing time in relation to other household responsibilities which limits their ability to participate in markets. Gebre et al. (2020) while decomposing gender gaps in market participation in Ethiopia, find that male farmers are better positioned than their female counterparts in both net sellers and autarchic positions.

The aforementioned patterns in this section clearly highlight gendered patterns in agricultural commercialisation. In addition to the usual production and marketing risks in agriculture, female farmers also face many gender-specific barriers in market access. Thus, integrating women into markets requires a systematic approach that seeks to understand the constraints and opportunities for women to participate in these markets (Oduol et al. 2013). Thus, in this study, we estimate separate equations for FHHs and MHHs so as to contextualise the gender-specific effect of institutional support services on commercialisation patterns.

3. Methodology

3.1. Data sources and sampling procedure

The current study is based on survey data collected from smallholder maize farmers in western Kenya. A multi-stage sampling technique was used to identify the farmers. First, three counties (Bungoma, Kakamega, and Trans-Nzoia) were purposively selected based on the relative importance of maize production and commercialisation in these counties. In the second stage, one sub-county was purposively selected from each county. Bungoma Central, Kiminini, and Lugari sub-counties were selected from Bungoma, Trans-nzoia, and Kakamega counties, respectively. These three sub-counties were selected due to their proximity to main agricultural markets. Third, with the help of sub-county agricultural offices, six administrative wards were randomly selected from these sub-counties (two in each sub-county), and four villages were randomly selected from each sub-county. The sampling formula of Cochran (1977) was applied to compute the sample size as shown below:

$$n = \frac{z^2 pq}{e^2} \tag{1}$$

where n is the sample size, Z is the desired confidence level, e is the desired level of precision, p is the maximum variance, and q is $1 - p$. The study used a confidence level of 95% and a 5% level of precision. The p was assumed to take the value of 0.5 since the variation level among maize smallholder farmers in Western Kenya was unknown. The required sample size is 385 farmers; however, due to budget limitation, a total of 301 farmers were interviewed.

This sample size was distributed across the three counties proportionate to the size of the populations in the sub-counties: 40% from Trans-Nzoia, 33% from Kakamega, and the rest from Bungoma County. This distribution was based on the 2009 census,[1] which was the current available statistic at the time of the survey. Using semi-structured questionnaires, household production and marketing data were collected. Four households were dropped in the analysis stage due to incomplete data; hence, a total of 297 households were included in the analysis. Finding FHHs was quite challenging as the majority of households in these regions were MHHs; however, with the help of administrative officers, we managed to interview 47 FHHs who were involved in maize production and commercialisation.

3.2. Analytical framework

This paper used an exogenous Tobit regression model in a counterfactual framework to understand the causal effect of gender on commercialisation intensity. Following APRA (2018), we measure the level of commercialisation using the volume of output sold in the market. However, to increase comparability across smallholders, we standardise this measurement by dividing it by the land size. Hence, we develop a commercialisation index defined by kilograms of maize sold per unit of land (acre). A Tobit model is appropriate because data of the dependent variable is censored.

Stage, Kassie, and Ndiritu (2014) argue that estimating a pooled regression with gender as an explanatory variable may not be sufficient in assessing the effect of gender on commercialisation intensity. The reason is that a generalised regression assumes that there are no differences in how a set of covariates affects MHHs and FHHs with regards to commercialisation levels. The Exogenous Switching Treatment Effect Regression (ESTER) model can estimate different equations for FHHs and MHHs – hence capturing the interaction between gender and other covariates.

The ESTER model can be specified as follows:

$$\begin{cases} C_m = X_m\beta_m + \mu_m & if\ G = 1 \\ C_f = X_f\beta_f + \mu_f & if\ G = 0 \end{cases} \tag{2}$$

where *C* indicates the commercialisation intensity of the two gender groups. Subscript *m* and *f* show MHHs and FHHs, respectively; *G* is the gender variable which is equal to 0 for FHHs and 1 for MHHs; the two *x* vectors are vectors for farm, household, and location characteristics that affect commercialisation intensity; β refers to the parameters to be estimated; and the two μs are the error terms. We use Equation (2) to estimate the counterfactual commercialisation intensity for each group, that is, what the commercialisation intensity levels of MHHs would have been if the coefficients on their institutional support services had been synonymous with the coefficients of the institutional support services on FHHs, and vice versa. We estimate the counterfactual and actual scenarios of the commercialisation intensity of both groups:

$$E(C_m|G = 1) = X_m\beta_m \tag{3a}$$

$$E(C_f|G = 0) = X_f\beta_f \tag{3b}$$

$$E(C_f|G = 1) = X_m\beta_f \tag{3c}$$

$$E(C_m|G = 0) = X_f\beta_m \tag{3d}$$

where *E* is the expected operator for expected probabilities of commercialisation intensity for FHHs and MHHs. Equations (3a) and (3b) represent the actual commercialisation intensity levels for MHHs and FHHs, respectively, while equations (3c) and (3d) are their respective counterfactual expected commercialisation intensity. By the help of these conditional expectations, the outcome differences of commercialisation intensity are obtained.

If the characteristics of MHHs had the same coefficients as the characteristics of FHHs, then the gender effect on MHHs' commercialisation intensity (*MHHsCI*) would be obtained by subtracting equations (3a) and (3c), as shown:

$$MHHsCI = E(C_m|G = 1) - E(C_f|G = 1) = X_m(\beta_m - \beta_f) \tag{4}$$

Consequently, the gender effect on FHHs' commercialisation intensity (*FHHsCI*) if the coefficients of their characteristics were synonymous with the coefficients of the characteristics of MHHs will be given by the difference between equations (3d) and (3b):

$$FHHsCI = E(C_m|G = 0) - E(C_f|G = 0) = X_f(\beta_m - \beta_f) \tag{5}$$

The parameters *MHHsCI* and *FHHsCI* show the commercialisation intensity gain/loss that MHHs would have if they had the same characteristics as they do now, but the same coefficients that the characteristics of FHHs have, and the commercialisation intensity gain/loss that FHHs would have if they had similar characteristics as they do now, but the same coefficients to the characteristics of MHHs, respectively. In Equations (4 and 5), MHHs (FHHs) have their returns to characteristics switched with those of FHHs (MHHs) as a counterfactual mechanism. These equations are similar to the average treatment effect on the untreated (ATU) and on the treated (ATT).

It is likely that MHHs and FHHs will have different commercialisation intensity levels even if they have the same coefficients to their respective observed characteristics or even if they have the same observed characteristics. In practice, MHHs may be more commercialised as opposed to their female counterparts due to other endogenous characteristics that affect commercialisation. This can be tested by estimating the heterogeneity effects. This can be shown by subtracting equations (3a) and (3d) for MHHs and (3c) and (3b) for FHHs, as illustrated below:

$$BH_m = E(C_m|G = 1) - E(C_m|G = 0) \quad (6)$$

$$BH_f = E(C_f|G = 1) - E(C_f|G = 0) \quad (7)$$

4. Results and discussions

4.1. Descriptive statistics

Table 1 shows different socio-economic characteristics of the households by gender and significant differences between female-headed households (FHHs) and male-headed households (MHHs). The result shows that 83% of the respondents were MHHs and the rest were FHHs. The main reason for having a small sample size for FHHs is because the study went beyond the gender of the respondent and focused on the gender of the decision maker; thus, fewer FHHs in the study area.

The mean difference of land size under production by MHHs and FHHs was 0.71 acres and it was statistically significant at 1%. This result suggests that males had larger maize farms than their female counterparts, which is consistent with evidence by Marenya et al. (2015), indicating that despite women's contribution to agricultural production, they have limited access to land. Table 1 also shows that men applied more quantities of farm inputs (fertilisers and seed) compared to women. This finding is consistent with Larson et al. (2015) who found that FHHs were less likely to purchase fertiliser than MHHs. The mean wealth index (proxied by household asset index) for men was higher than women, indicating that men were wealthier than women. The difference in wealth index could explain the differences in input use by men and women.

The FHHs harvested less kilograms of maize as compared to MHHs. On average MHHs had 800 kgs more of harvested maize as compared to FHHs. This result supports the finding that men were 44% more productive than women in Malawi (Palacios-López and López 2015). This productivity gap can be attributed to differential access to and use of productive resources and support services by male and female farmers (Palacios-López and López 2015). The result indicates that 61% of men participated in the market whereas the 55% of women participated in the market. This finding suggests that men are more commercialised in maize production compared to women. This finding concurs with Fischer and Qaim (2012) who found that female farmers exhibited low levels of commercialisation.

Table 1. Socio-economic characteristics of households by gender.

Variable	FHHs ($n = 47$)	MHHs ($n = 249$)	Pooled sample ($n = 296$)	Significant differences (p-value)
Average land under maize production (acres)	1.21[b]	2.00[a]	1.80	0.001***
Average maize harvested (kgs/year)	1100.20[b]	1901.60[a]	1771.20	0.004***
Average quantity of seeds used (kgs)	10.00[b]	16.20[a]	15.20	0.002***
Average quantity of fertiliser used (kgs)	84.10[b]	160.50[a]	148.00	0.002***
Average maize sold (kgs)	332.60[b]	1139.70[a]	1008.30	0.001***
Years of formal schooling of the household head	7.70[b]	9.30[a]	9.10	0.010***
Dependence ratio	6[b]	7[a]	6	0.151
Wealth index	11.2[b]	14[a]	13.6	0.003***
Average distance to the nearest market (km)	3.7[b]	4.8[a]	4.6	0.005***
Market participation (% of farmers who sold)	55.00[b]	61.00[a]	60.00	0.400
Access to market information (% Yes)	85.00[b]	88.00[a]	88.00	0.660
Membership in development groups (% Yes)	75.50[a]	62.00[b]	64.00	0.070*
Access to extension services (% Yes)	63.30[b]	74.60[a]	72.80	0.100*
Access to credit (% Yes)	50.00[a]	46.40[b]	46.80	0.743

Notes: ***, **, * significance levels at 1%, 5%, and 10%, respectively. The superscripts a and b denote statistical differences in ascending order of magnitude.
Source: Survey Data (2017).

Regarding membership in development groups, the proportion of women who were members in development groups was higher compared to men. A reason for collective action may be due to supporting one another, increased access to credit, forming table banking platforms, and information sharing. About three quarters of MHHs had access to extension services as compared to the FHHs. This means that women have poor access to new production methods and training; hence, they will have low rates of technology adoption leading to low yields.

In terms of credit access, FHHs had a higher access as compared to their male counterparts. These results are contrary to the observations of Palacios-López and López (2015) who found credit market imperfections to affect FHHs more than MHHs. This can be explained by a higher rate of women in development groups than men. Further analyses of the results showed that the majority of groups are used for savings and credit purposes.

4.2. Determinants of men and women intensity of commercialisation

This section presents the results of an exogenous switching treatment regression of a Tobit model. The F-statistics for both men's and women's models were statistically significant at 1% (Table 2). This result shows that the explanatory variables included in the models jointly affect the intensity of commercialisation among men and women. The result shows that men's membership in development groups did not affect their intensity of commercialisation, whereas in the case of women, membership in development groups positively and significantly influenced their intensity of commercialisation. This result implies that women's membership in development groups tends to increase their intensity of commercialisation.

The coefficient of household asset index for men was not statistically significant (Table 2). However, the household asset index shows a positive significant effect on women's intensity of commercialisation, suggesting that women who have more assets are more likely to intensify their commercialisation. Asset index is a proxy for wealth status of the household. Wealthy households are expected to have a higher access to productive resources as compared to their non-wealthy counterparts. Similar insights are shown by Siziba et al. (2011) who found that increased access to resources by wealthy households acts as an incentive to commercialise agriculture.

Table 2. Tobit model results on determinants of commercialisation intensity for MHHs and FHHs.

	MHHs		FHHs	
Variable	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.
Membership in development groups	0.12	0.12	0.65**	0.31
Total seeds and fertiliser used	0.03	0.13	0.08	0.21
Household asset index	0.01	0.02	0.11**	0.05
Total land under maize (acres)	−0.12	0.17	0.55	0.39
Total maize harvested (kgs)	0.63***	0.24	0.25	0.36
Years of formal schooling	0.00	0.02	0.08**	0.03
Access to extension services	0.04	0.14	−0.44	0.27
Number of dependants	−0.04**	0.02	−0.20***	0.06
Number of traders known	−0.17**	0.08	−0.16	0.18
Access to credit	−0.02	0.12	0.10	0.33
Bungoma county	0.15	0.14	−0.25	0.35
Kakamega county	−0.14	0.17	0.30	0.28
Constant	−2.29	1.11	−1.09	2.42
$n = 249$			$n = 47$	
$F(12, 237) = 10.24$			$F(12, 35) = 4.72$	
Prob $> F = 0.0000$			Prob $> F = 0.0002$	
Pseudo $R^2 = 0.19$			Pseudo $R^2 = 0.34$	
94 left-censored observations			21 left-censored observations	
155 uncensored observations			26 uncensored observations	

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

The total maize harvested had a positive impact on MHHs' levels of commercialisation. Higher output rates enable surplus production among farmers. In the current study, a one kilogram increase in the amount of maize harvested increased the intensity of commercialisation by 49% for MHHs. This variable had no significant effect on FHHs.

While the level of education, which was measured in years of formal schooling completed, had no effect on the intensity of commercialisation among MHHs, it positively and significantly influenced the level of commercialisation of FHHs. This is probably because educated FHHs are more likely to be trained and informed on better agricultural methods that are necessary for the production of marketable surplus.

The number of dependants and the commercialisation intensity of FHHs were negatively and significantly related. An increase in the number of people who depended on the household for food decreased the commercialisation level for FHHs by 20%. A plausible explanation for this could be that households only participate in markets if they produce more than they can consume. A higher dependency ratio leads to greater levels of consumption at the household level – hence low levels of commercialisation.

Surprisingly, the number of traders known decreased the commercialisation intensity among MHHs by 17%. This result is expected if the farmers have to incur the information cost of knowing the traders. However, there appear to be no such observations for FHHs since this variable has an insignificant effect on the level of commercialisation among FHHs.

4.3. Gender gaps in commercialisation

The results in Table 3 show the effect of gender on the commercialisation intensity levels of MHHs and FHHs in both actual and counterfactual conditions. The dependent variable is the natural log of the kilograms of maize sold per acre.

The conditional level of commercialisation intensity was estimated from the coefficients of the ESTER model. When we compare the actual or observed level of commercialisation between MHHs and FHHs, cells (*a* and *b*) respectively, we observe that MHHs have relatively higher (81.28 kgs) commercialisation intensity as opposed to their female counterparts (44.67 kgs) (*taking antilogs*). However, this direct comparison alone is not sufficient to allow us to examine the impact of gender on commercialisation intensity between MHHs and FHHs because these two groups have different socio-economic, demographic, and farm characteristics and environments, as seen from the descriptive results in Table 1. To control for inherent differences between MHHs and FHHs, we estimate counterfactual commercialisation intensity levels for each group. We sought to answer the question, what would be the commercialisation intensity of FHHs if, with their observed characteristics, they were accorded the same environment as their male counterparts and vice versa. This is observed when we compare values in cells (a) and (c) for MHHs and (b) and (d) for FHHs, that is, actual and counterfactual figures in Table 3. The results show that if FHHs' observed characteristics had the same coefficients as the characteristics of MHHs, the commercialisation intensity would increase from 44.67 kgs (*antilog of 1.65*) to 100 kgs (*antilog of 2.00*), which exhibits a gap of 2.24 kgs of maize (*antilog of 0.35 in Table 3*). On the contrary, the study did not find any significant change in actual and counterfactual values of the MHHs. Notably, the results suggest that with

Table 3. Conditional, treatment, and heterogeneity effects of gender on commercialisation intensity.

Household type	Actual	Counterfactual	Treatment effect
MHHs	(a) 1.91	(c)1.94	−0.03 (0.059)
FHHs	(b) 1.65	(d) 2.00	−0.35 (0.104)***
Heterogeneity effects	BH_m −0.09 (0.108)$a - d$	BH_f 0.29 (0.177)*$c - b$	TH 0.32

Notes: Cells (a), (b), (c), and (d) represent the actual outcome and counterfactual outcomes, respectively. ***, **, and * denote significance levels at 1%, 5%, and 10%, respectively. TH – transitory heterogeneity; the commercialisation intensity units are in natural logs.

women being accorded a similar working environment as men, the CI gap between FHHs and MHHs would also generally decrease from 0.26 (*1.91–1.65*) – 1.82 kgs – to 0.09 (*2.0–1.91*) – 1.23 kgs.

However, the base heterogeneity results (BH_f) indicate that, even if we gave MHHs the same observable characteristics as FHHs, the remaining unobservable differences caused by gender would make MHHs have a higher commercialisation intensity than the FHHs. The transitory heterogeneity cell (*TH*) implies that, when a household is picked at random, there will always be a commercialisation intensity gap of 2.09 kgs in favour of MHHs (*antilog of 0.32 in cell TH in Table 1*).

These results show that both observable and unobservable differences affecting women are important in explaining the difference in commercialisation intensity between the two gender groups.

5. Conclusions and policy implications

Using recent household survey data from maize farmers in Kenya, this paper sought to find out if there were any differences in factors affecting commercialisation levels between MHHs and FHHs. Further, we estimate a Tobit Exogenous Switching Treatment Effect Regression model to analyse the effect of gender of the household head on commercialisation intensity. Results from both descriptive and econometric analysis demonstrate that FHHs are disadvantaged in access to productive resources; farm-, household-, and location-specific factors variably affected FHHs and MHHs; and FHHs exhibit low levels of commercialisation. Whereas the amount of maize harvested, the number of traders known, and access to credit significantly influenced MHHs' level of commercialisation, FHHs were significantly influenced by household asset index, years of formal schooling, and dependency ratio.

Analysis of the effect of gender on commercialisation intensity confirmed that, generally, FHHs are likely to be less commercialised than MHHs. We further find that this pattern can be explained by both observable and unobservable characteristics. From the ESTER model, we are able to show that when we compare FHHs under actual and counterfactual conditions where their coefficients are allowed to have the same returns as the coefficients of MHHs, FHHs perform better. Further, using heterogeneity effects, we are able to show that even when all the observable effects are considered, FHHs still have a lower level of commercialisation intensity because of the gender gap that influences their ability to utilise those characteristics. These results indicate that in addition to differences in observed characteristics, there are also gender-specific factors that make FHHs less commercialised in comparison to MHHs.

The main implication of these results is the observable differences in factors that define commercialisation intensity levels; policy interventions can be instrumental to correct these differential opportunities. Given that there are unobservable differences caused by the gender gap that affect commercialisation patterns, policy should go beyond the observed characteristics and focus on reforms that are socially oriented to eliminate unobservable disparities between MHHs and FHHs. For instance, access to land, which is a key resource in agricultural production, is highly gendered. One way that policy can tap into this is by creating platforms where women can invest in land as a group, thus giving them the ability to produce for the market in instances where they cannot own land due to societal norms.

With regard to the household asset index, policies should be centred on building FHHs' asset base. Further, extension policies can target FHHs to improve their capacity in production methods and commercialisation opportunities, for instance, training on good agricultural practices and commercial orientation can be directed to women's groups to ensure direct involvement of women. With respect to the dependency ratio, policy could focus on creating more income-generating activities for FHHs so as to break the vicious cycle of dependency.

Note

1. https://www.knbs.or.ke/?wpdmpro=single-and-grouped-ages-in-years-by-county-and-district.

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Data availability statement

The data that support the findings of this study can be obtained from the authors on request.

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