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Income Mobility of Rural Households: Are Female Headed Households Participating in Ethiopia's Economic Growth?

James Warner

Yalew Mekonnen

Markets, Trade, and Institutions Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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AUTHORS

James Warner (j.warner@cgiar.org) is a Research Coordinator in the Markets, Trade, and Institutions Division of the International Food Policy Research Institute, Addis Ababa, Ethiopia.

Yalew Mekonnen (yalew.mekonnen@cgiar.org) is a Research Officer in the Africa Regional Office (AFR) of the International Food Policy Research Institute, Addis Ababa, Ethiopia.

ABSTRACT

Over the last decade, Ethiopia has had one of the fastest growing economies in the world with annual growth rates averaging approximately 9.2% and 5.3% for the overall economy and the agricultural sector, respectively. Concomitant with this growth has been falling poverty rates and slightly rising inequality. While average growth has been strong, relatively little research has been performed on mobility within income quartiles, particularly among rural households. Using a panel of 1,899 households, taken from three rural household surveys carried out between 2012-2019, this paper explores the overall levels and trends of recent income mobility in rural Ethiopia. We conclude that female headed households, at the lower asset quartiles, are earning less income, marketing a smaller share of cereal crops, and experiencing less growth which, unlike comparable male headed households in lower quartiles, is leading to relative stagnation, and rising inequality. The implications for policymakers are important for improved targeting for pro-poor growth strategies as well as a better understanding of the heterogenous economic status of female headed households in rural Ethiopia more generally.

Keywords: Gender, female headed household, income mobility, quantile regression, Ethiopia

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1. BACKGROUND

Typical measures of a country's level of development focus on macroeconomic variables like gross domestic product (GDP) per capita or overall GDP growth. When microeconomic variables are used, methodologies tend to focus on poverty rates or poverty dynamics, usually depicted as the share, or changing share, of individuals or households that fall below a minimum welfare threshold. Unlike poverty dynamics, which typically compares households to a fixed threshold across periods, income mobility contrasts relative inter-household distributions of existing assets or income, over time. More generally, poverty dynamics focuses on absolute comparisons while income mobility is a relative measurement (Jenkins 2011). Given our large, nationally representative panel data set, we analyze, by sex-disaggregated head of household, income/asset mobility during this high growth period.

While Ethiopian GDP growth has been substantial over the past decade, averaging real growth of 9.2% per year, poverty rates declining from 30.4% to 25.6% over the same period, but inequality rose slightly (the Gini coefficient has increased from 0.37 to 0.38) during the decade (FDRE 2021). However, relative intra-generational rural income mobility is not as well known. This paper reviews relative asset/income endowments of a large panel of rural households across the 2012-2019 period. Our conclusion is that significant inequality exists, particularly for female headed households who are not participating in recent growth and they represent an increasingly vulnerable component of rural households because of their relative stagnation.

While both the absolute and relative level of household income/assets are critical for analyzing economic progress, Ethiopian poverty analysis has been the focus of significant research (NPC 2016, Sender 2019, Dercon et al. 2012, Dercon and Christiansen 2011, Woldehanna 2019, Jayamohan and Kitesa 2014, Dercon and Krishnan 2000). Less studied, within the Ethiopian context, is relative economic mobility between designated asset/income categories either in a single period or over time. For our purposes, relative inequality compares ordered categorical designations, measured by income/asset quartiles, and tracks the relative movement between these designated classes over time. Equality of opportunity, indirectly

measured by mobility, should be considered as a welfare indicator of a country's overall economic health. Alternatively, a lack of mobility indicates potential social problems if initial endowments predetermine little possibility of increased participation in economic growth and relative mobility over time.

Basic economic welfare of household can be measured by at least three types of quantitative assessments. These measurements include the absolute level of economic income/assets (frequently used for poverty rate determinations), the household's relative position of income/assets (e.g. Lorenz curves, Gini coefficients) and, economic mobility between designated economic classes (both inter- and intra-generational income analysis). The former two measurements are typically based on cross-sectional data analysis while the latter must have a dynamic component and is therefore less frequently analyzed because of the need for panel data. Our research tracks a panel of sex-disaggregated heads of household across three periods between 2012 and 2019 to explore the relative inequality and mobility of asset/income quartiles over this period. The result is a unique economic analysis regarding the relative economic mobility across Ethiopia's agricultural households during the last decade and reveals that disproportionally, poorer female headed households, contrary to their male headed counterparts, have not been participating in the economic transformation.

Income mobility analysis is concerned with measuring the extent of changes in economic status of individuals from one period to another (Blanden 2013) and is dynamic by nature, taking place in either intergenerational or intragenerational contexts. The measurement of intergenerational earnings mobility centers on the relationship between parents' permanent income and their child's permanent income, whereas an intragenerational focus on the income stability of a relative set of individuals or households.

A measure of income mobility, therefore, identifies how consistent the incomes of individuals/households have been over time and income instability may cause economic insecurity, changes in risk preferences, reduced perceived livelihood activities and other "defensive" positions which could reinforce low income earning and social dissatisfaction. However, most argue that mobility is a positive attribute, indicating economic opportunity over time. Therefore, measures of relative income mobility are useful complements to the traditional measures of mean income growth across households.

Some authors consider reasonable mobility as an equalizer of longer-term incomes (Krugman 1992, Jarvis and Jenkins 1998, Maasoumi 1998, Fields 2010, Shorrocks 1978, Chakravarty et al. 1985). Krugman (1992) states that an increase in income mobility tends to make the distribution of lifetime income more equal. Jarvis and Jenkins (1998) suggest that greater inequality at a point in time is more tolerable if accompanied by mobility, because mobility creates acceptable transitory variations in income. Finally, Maasoumi (1998) has written that mobility should be of greater concern to policymakers and analysts than other important measures of inequality and believes what matters is lifetime equity rather than contemporaneous equality. While mobility raises a more nuanced understanding the welfare economic participants, the importance for policymakers is relevant for tolerating a certain level of contemporaneous inequality. Overall, societies should move towards equality of opportunity, represented by reasonable levels of mobility, rather than just strict cross-sectional equality.

Little research exists about Ethiopian income mobility with only one recent published study focusing on intergenerational mobility, where the author concludes moderate to high levels of earnings persistence between generations (Haile 2018). High levels of initial inequality were found to lead to low levels of intergenerational mobility. Additionally, the author finds some gender disparity in mobility, with sons having a higher degree of mobility than daughters in terms of earnings.

The research presented here is based upon a set of three survey rounds collected in 2012, 2016 and 2019 with the unit of analysis being the household, disaggregated by sex of household head during a period of significant growth in Ethiopia's agricultural sector. Over the 2012-2019 period, data reveal increased crop productivity, falling rates of household poverty, increased market commercialization, among other positive economic outcomes. Specifically, we focus on mobility and concentrate on the variation of asset/income quartiles in three different time periods during the decade. We believe, that understanding income/asset mobility, of both male and female headed households, supplements our understanding of rural inequality.

Most research explores the absolute differences between male and female headed households but does not explore inter-household variations, of significant economic variables, across time. For example, when female headed households are disaggregated into asset quartiles, we find different welfare implications and

trends than their male counterparts. More generally, this paper explores disaggregated values of asset ownership, income, expenditures, and cereal crop marketing and finds some important differences. Most notably, separating into quartiles reveals that FHHs are not homogenous, have greater inequalities than MHHs, and are experiencing significantly different growth trajectories. For female headed households at the lower asset quartiles, our research indicates they are earning less income, marketing less percentages of cereal crops, and experiencing relatively less growth which, unlike comparable male headed households in lower quartiles, is leading to relative stagnation, greater inequality and a lack of commensurate economic growth. Careful policy targeting should be considered that both acknowledges the relative diversity of FHHs and specifically addresses these more disadvantaged households going forward.

The paper is divided into a total of six sections. Section Two discusses data and methods, Section Three provides descriptive analysis at the household head level, Section Four reviews income mobility, Section Five discuses econometric results and the final section concludes.

2. DATA AND METHODS

This paper uses the data from the Ethiopian Agricultural Commercialization Clusters (ACC) Surveys conducted by the International Food Policy Research Institute (IFPRI) in the four major regions of Ethiopia (Amhara, Tigray, Oromia and SNNP). Three survey rounds were conducted in 2012, 2016 and 2019. While 3,000 households were interviewed in 2012 and approximately 5,000 households were interviewed in the latter two periods. A panel of 1,899 households were interviewed over all three rounds. All three surveys randomly sampled households at the lowest administrative level (ie. kebele) and made no stratified distinction for the sex of the household head.

The survey questionnaire collected household level data including demographics, housing and assets, land ownership and use, crop inputs and labor use, crop production, storage and utilization, livestock ownership, sources of non-farm incomes, saving and credit, as well as food and non-food consumption expenditures. The aggregate consumption expenditure variable was determined by summing all direct survey questions related to consumption (excluding production inputs and labor) and imputing the value of own consumption of food based on local sale prices for the same commodities. The income variable was determined to be the sum of net income from crop production, livestock, wage income, and non-farm business income, where crop income is valued at local sale prices.

For our purposes here, simply summarizing and contrasting total household income would create a disproportionate emphasize on larger, typically male-headed, households. As is often used in this literature, adult-equivalence scales[1] are used to calculate income per adult-equivalent for inter-household comparisons (e.g. Ebert 1999).

A principal component analysis (PCA)[2] was performed on a set of consumer items identified in the questionnaire. While summary statistics do not have an intuitive interpretation, an index was created that

[1] Equivalence scales are determined by indexing the first household adult with a value of 1, every additional adult (14 years or older) 0.5, and every person under 14 years the index value of 0.3. The values are summed and then used as the denominator of the variable of interest.

[2] This type of analysis is commonly used for to obtain lower-dimensional data while preserving as much of the data's variation as possible.

weighted relative ownership, by asset quartile, which we feel depicts overall levels of asset ownership positively correlated to household welfare.

Most of this analysis relies on simple statistical analysis but two additional methodologies are outlined here for greater clarity. These two include transition probability matrices, which more formally evaluate inter-quartile stability, and quantile regression which disaggregates dependent variables in regression equations to determine if independent variables have differing impacts at these varying value categories.

Transition probability matrices evaluate the relative stability of categorical values aggregated into their designated nominal values across time. For example, if a unit of observation (i.e. household, person, firm, etc.) is placed into a specific quintile, the transition matrix evaluates the statistical stability of that designation over time. There are a variety of potential uses such as income or social mobility, inter-generational asset mobility and others. A typical quintile example, covering a single period change, is provided below (Nichols 2014).

$$s_t = M_1 s_{(t-1)}$$

Given that $s_{(t-1)}$ is the base designation of quintile values:

$$s_{(t-1)} \,\&\, s_{(t)} = (0.2;\ 0.2;\ 0.2;\ 0.2;\ 0.2)$$

and the quintile transition matrix

$$M_1 = \begin{pmatrix} a_{11} & \cdots & a_{15} \\ \vdots & \ddots & \vdots \\ a_{51} & \cdots & a_{55} \end{pmatrix}$$

where the elements of the matrix serve as the proportion of those units originally in quintile i that move to quintile j in the next period from one designated quintile to another.[3] For example, in the case of perfect immobility M_1 would be an identity matrix (the value of one in the diagonal ($a_{11}\ to\ a_{55}$). At the other

[3] Table 5 and 7 depict our data's M_1 transition matrices for both income and expenditure quartiles.

extreme of perfect mobility, the same diagonal values would be zero. The closer the diagonal values are to one, the less mobility is observed. Examples can be found in Tables 5 and 7 below.

A premise of this research is that different economically divided segments of female headed agricultural households are experiencing significantly different welfare outcomes. In order to explore this hypothesis more completely, quantile regression analysis is employed. Typical ordinary least squares (OLS) regression analysis evaluates the independent variables at the mean, while quantile regressions allow for distributional differences of the dependent variable to affect the estimated coefficients over different segments of the distribution (Baum 2013). In addition, while OLS minimizes the sum of squared errors $\sum_i e_i^2$, median regressions employ a least-absolute-deviations (LAD) error structure that minimize the absolute values of error $\sum_i |e_i|$ and therefore use a linear programming methodology to determine estimators that asymptotically approach a normal distribution for hypothesis testing. A basic quantile regression takes the form where errors are minimized with the following objective function:

$$Q(\beta_q) = \sum_{i:y_i \geq x_i'\beta}^{N} q\,|y_i - x_i'\beta_q\,| + \sum_{i:y_i < x_i'\beta}^{N} (1-q)\,|y_i - x_i'\beta_q\,|$$

The quantile equation depicted here minimizes the objective function $Q(\beta_q)$ and is estimated via the simplex method and not differentiated as is the case with OLS methodology. Asymmetric error penalties are assigned when the estimated equation underestimates the dependent variable via q weights, for q when $i: y_i \geq x_i'\beta$ and, conversely, overestimates the dependent variable via (1-q) when $i: y_i < x_i'\beta$. For relative ease of estimation, bootstrap errors are typically used (Baum 2013).

There are at least two major advantages to using quantile regression. The first involves efficiency of parameter estimates, which are improved over typical OLS estimates if the errors are significantly non-normal in distribution. The second, and more pertinent to our analysis, is the fact that quantitative regressions provide an enhanced data representation, allowing for the impact of covariates to vary over the distribution of the dependent variable of interest, and not merely evaluated at its conditional mean (Baum 2013). Consistent with our dependent variables graphed later, sampling variations can change rapidly over short interval of quantiles, especially at the extremes (Cade and Noon 2003).

3. DESCRIPTIVE ANALYSIS

Table 1 depicts general demographics, education and asset ownership of panel households by survey year and sex of household head. While there are some small changes in sex designation of households (i.e., divorce, widowed, etc.) we would expect stability of basic demographics across the panel as we trace the same households across time. For example, in all three rounds, about 84% of the households are male headed households (MHH) and 16% are female headed households (FHH). Typical national estimates for female headed households are approximately 20% (Kasa et al. 2019). Distinct differences exist between male and female headed households, with 18 of the 20 variables presented in Table 1 indicating statistically significant lower values for FHHs. On average, FHH have fewer household members, and the head is older, is far less educated, owns less farmland and has fewer assets than their male counterpart. More specifically, the typical FHH has four members as compared to six members for MHHs. By age distribution, FHHs have approximately one less child (age 14 or less) and one adult (14-60 years old), suggesting one less dependent and one less labor force participant in the FHH. As labor is a critical asset for subsistence agriculture, this has important implications for land use and lending/sharecropping out. In terms of education, a male head has an average of two to three more years of schooling than a female head, and male heads are five times more likely to be literate than female heads. For example, according to the 2019 survey, 50% of male household heads can read in any language, as compared to only 10% for female heads. The ownership of household mobile phones has increased rapidly from 2012 to 2019 for both male and female head households. In the 2012 survey year, only 29% and 34% of female and male headed households owned mobile phones but the relative percentages increased rapidly to 57% and 66%, by 2019. Importantly, the average FHH owns about 72% of the farmland of the average MHH (1.3 versus 1.8 hectares), and the figure is stable across the three periods. Household dietary diversity is slightly lower for FHHs in all three-survey periods as well, implying a lower-quality diet. General asset ownership is consistently, and significantly, lower for women headed households. Overall, Table 1 provides a general view of a less-educated, more resource-constrained FHH, which is consistent with findings from other Ethiopian

household surveys. Later analysis will explore variations within both FHH and MHH household categories, but simple averages are presented here.

Table 1. Sex-disaggregated Household Demographic Characteristics

	Sex of head of household					
	Female			Male		
	Survey Year			Survey Year		
Variables	2012	2016	2019	2012	2016	2019
Household size	**4.0**	**4.1**	**3.9**	5.8	6.0	5.9
Members 5 years and under	**0.4**	**0.4**	**0.3**	1.0	0.9	0.8
Members 6-14 years old	**1.2**	**1.1**	**1.0**	1.7	1.8	1.7
Members 14-59 years old	**2.1**	**2.2**	**2.1**	2.8	3.0	3.0
Members 60 years and above	0.3	0.4	0.4	0.3	0.4	0.4
Age of head (years)	**49**	**51**	52	45	48	50
Number of Dependents	**2.1**	**2.0**	**1.9**	3.1	3.2	3.1
Number of labor force	**1.9**	**2.0**	**1.9**	2.6	2.8	2.8
Dependency ratio	1.4	1.2	1.2	1.4	1.3	1.3
Education of head	**1.0**	**0.9**	**0.7**	3.5	3.7	2.8
Education of spouse	**0.3**	**0.2**	**0.2**	1.2	1.3	1.1
Maximum education in household	**5.6**	**5.8**	**5.9**	6.5	7.1	6.7
HH head can read	**14%**	**9%**	**10%**	51%	47%	51%
HH head can write	**14%**	**11%**	**10%**	50%	49%	51%
HH member can read	**77%**	**73%**	**77%**	84%	88%	91%
HH member can write	**76%**	**75%**	**78%**	83%	89%	91%
Household owns cell phone	29%	**46%**	**52%**	34%	57%	66%
Farmland owned (ha)	**1.3**	**1.4**	**1.3**	1.8	1.8	1.8
Household dietary diversity score	**5.6**	**5.6**	**5.6**	5.9	6.1	6.1
Asset index Tercile	**1.6**	**1.6**	**1.5**	2.2	2.2	2.1
Total observations	305	311	321	1594	1588	1578

Highlighted numbers indicate FHHs that have lower reported values than MHHs at the 99% level of significance.
Source: Analysis of ACC Surveys 2012, 2016, and 2019.

Table 2 outlines the regional distribution of female and male headed households and indicates that, consistent with other regional household data sets, female headed households are more common in Tigray than in the other three major regions. As expected from our panel data set, the figures are relatively consistent with a high of approximately 22% in Tigray and a low of 12% in Amhara. Overall, the share of FHHs rises approximately 1 percentage point, which is likely due to death or divorce of a male spouse. The total number of FHH increased from 305 to 321 over the three survey periods.

Table 2. Number of Male and Female Household Heads by Region

Region	Sex of head of household					
	Female			Male		
	Survey Year			Survey Year		
	2012	2016	2019	2012	2016	2019
	Percent					
Tigray	21.5%	22.0%	22.2%	78.5%	78.0%	77.8%
Amhara	12.1%	12.3%	13.1%	87.9%	87.7%	86.9%
Oromia	16.1%	17.1%	16.6%	83.9%	82.9%	83.4%
SNNP	15.1%	14.2%	16.5%	84.9%	85.8%	83.5%
Total (%'s)	16.1%	16.4%	16.9%	83.9%	83.6%	83.1%
Total Observations	305	311	321	1594	1588	1578

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

While average FHH land holdings are approximately 70% of MHH, female headed households are 3.5 times more likely to rent/sharecrop out some of their land. Literature on the subject tends to attribute this behavior to women's lack of assets/inputs (labor, oxen, monetary resources) (FAO 2019). As shown in Table 3, FHH sharecrop out more land than men, even though they own less total land. These are mostly sharecropping arrangements but renting for a cash payment is also undertaken. Although it is far less typical for FHHs, they do sharecrop in about 5% of their agriculture land. Compared to male headed households, female headed households also have less of a tendency to rent in, sharecrop in and/or borrow in farmland from others. Put simply, female headed households rent out a significant portion of their lands to male headed households who sharecrop the land. Overall, net sharecropping out for FHHs is a net reduction of 30% of their land and a net gain of about 7% for MHHs. Reviewing the total number of parcels (irrespective of land size), MHHs own an additional parcel but per capita ownership for MHHs is lower because of their larger average household size. Typical walking distances to parcels are about equal for male and female headed households at about 20 minutes for both.

Table 3. Farmland management by household head

Variables	Sex of head of household					
	Female			Male		
	Survey Year			Survey Year		
	2012	2016	2019	2012	2016	2019
Area of parcel in ha	1.4	1.5	1.7	2.2	2.2	2.3
Number of parcels	3.4	3.5	3.6	4.4	4.3	4.3
Number of parcels per HH member	1.1	1.2	1.2	0.9	0.8	0.9
Percentage managed by others	36	35	31	9	10	9
Percentage of land sharecropped in	5	6	5	17	16	16
Avg. distance from home to parcel (in minutes)	22	24	20	22	20	21

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

Agricultural cooperatives are established to provide a variety of benefits to members through distributing agricultural inputs, providing improved technologies, and encouraging farmers to produce high value crops. Table 4 presents sex-disaggregated percentage of household memberships, respondents' main reason to be a member and member's status in the cooperatives. From the 2012 survey round, 37% of women headed households were members of agricultural cooperatives and 47% of male head households were members. The number of cooperative members is relatively stable over the three survey periods for both men and women.

Of all reasons asked, both MHHs and FHHs list their top three reasons for being in a cooperative as access to specific inputs (either fertilizer or seed) as well as access to consumer goods. For both FHHs and MHHs, who are members of cooperatives, their primary reason to join is improved access to fertilizers. Access to consumer goods is slightly favored by women over men, while consumer goods and seeds is favored by MHHs.

Almost all female heads (97%) have simple membership status in their cooperatives. Female heads are less likely to have less management positions, and subsequently, feel less involved in decision-making. More specifically, more than half of the female heads interviewed don't feel involved in the cooperative's decisions, while around 40% of male heads report not being involved. The figures are relatively stable over the three sample periods. While there are some differences between the sex-disaggregated households, they

are not as different as might be expected and are likely the outcome of significant government efforts to get women to join cooperatives.

Table 4. Primary reason household heads join cooperatives

	Sex of head of household					
	Female			Male		
	Survey Year			Survey Year		
	2012	2016	2019	2012	2016	2019
	percent					
Member of Agricultural Cooperatives (Yes)	37	40	37	47	49	49
Reason for joining the cooperative						
Better access to fertilizer	35	35	36	38	44	47
Better access to consumer goods	29	25	37	17	20	21
Better access to seed	26	25	22	37	29	25
Assistance in selling crops	4	8	1	2	3	2
Share in profits of cooperative	4	2	3	2	2	2
Better access to other chemicals	2	3	1	3	1	1
Better access to credit	1	0	0	0	0	1
Status within the Cooperative						
Simple member	97	98	97	94	95	96
Member of a committee	1	1	3	5	3	3
Member of the management staff	2	1	0	1	1	1
Feel involved in cooperative decisions						
Yes, very much	9	8	6	12	11	14
Somewhat	31	40	42	50	49	47
Not at all	60	52	53	38	40	40

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

A basic statistical review of Ethiopian agricultural households, disaggregated by sex of the household head, reveals some fundamental regional, demographic, asset and income differences. The next section, Section 4, tracks a few principal economic variables across the panel period in order to provide insights into relative mobility by both male and female head of household.

4. INCOME MOBILITY OF SEX-DISAGGREGATED HOUSEHOLDS

This section focuses on dividing observations into equal-sized quartiles, focusing our attention on relative growth patterns as they relate to main welfare indicators such as asset ownership, real income and expenditure patterns of female and male headed households. The goal is to explore relative development patterns as they relate to both absolute and relative growth of both within and between sex-disaggregated households. Mobility within quartiles suggests, at least the possibility of relative growth or decline based on economic activity. Alternatively, a lack of inter-quartile mobility suggests limited economic possibilities and individuals merely maintaining their relative positions based on initial endowments.

In Ethiopia, the past two decades have seen primarily growth-emphasizing government initiatives such as the Agricultural Growth Program (AGP) and Agricultural Commercialization Clusters (ACC) which emphasizes intensive input use and increased adoption of high-value crops for greater marketing output. While most research covering the last decade in Ethiopia suggests relatively strong overall growth patterns, relative growth, based on inter-quantile mobility, especially for poorer female headed households, is not particularly encouraging. Poorer households exhibit relatively little inter-quartile mobility which indicates that those households in the poorest quartiles tend to remain there. Furthermore, these households are disproportionately not taking part in the overall growth transformation and are therefore suffering greater relative inequality as compared to those households in faster growing top asset quartiles. This raises the idea of reconsidering both the depth and breadth of growth and welfare enhancement for all rural households, during the last decade in Ethiopia.

Table 5. Asset Ownership by quartile and head of household

Female Headed Households (N=300)						Male Headed Households (N=1,599)					
	Overall		Between		Within		Overall		Between		Within
Assets	Freq.	%	Freq.	%	%	Assets	Freq.	%	Freq.	%	%
Poorest	331	36.8	174	58.0	63.4	Poorest	1232	25.7	751	47.0	54.7
2nd Quin.	191	21.2	147	49.0	43.3	2nd Quin.	1108	23.1	818	51.2	45.2
3rd Quin.	200	22.2	146	48.7	45.7	3rd Quin.	1224	25.5	875	54.7	46.6
Richest	178	19.8	116	38.7	51.2	Richest	1233	25.7	697	43.6	59.0
Total	900	100.0	583	194.3	51.5	Total	4797	100	3141	196.4	50.9

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

To better understand relative growth, tracking of intra-quartile asset and income mobility was performed and disaggregated at the level of sex of household head. Table 5 outlines asset panel data over the three data collection periods (2012, 2016 and 2019). The **overall** column sums all values for the three periods and depicts general distribution across the asset quartiles.[4] Consistent with the demographics review, FHHs are disproportionately more likely to be in the poorest quartile (331 observations out of the total 900 panel observations (there are, on average, 300 households across each of the three periods). A value of 25% (225 obs.) would be expected if FHHs were evenly distributed among the quartiles. Additionally, FHHs have fewer observations in higher quartiles (column values), suggesting skewed lower distributions with less assets. Male headed households are more evenly distributed throughout the four quartiles, dipping to no lower than 23% in the second lowest quartile. Given the relative asset levels depicted in Table 1, these values seem realistic.

The **between** column indicates how many FHHs and MHHs have been designated with that asset quartile category one or more times in any of the three periods. Somewhat strikingly, 58% of all FHH have been designated in the poorest quartile at least once in the three periods (174 out of 300 total FHH households). However, there is some mobility as about 49% of all FHHs have achieved second or third quartile asset status at least once and 39% have been evaluated as wealthy at least once. For MHHs, the numbers are more evenly distributed across the quartiles but generally favoring the middle two classes.

[4] For our proposes we performed principal component analysis (PCA) on a set of specific owned consumer items to determine general asset ownership. An index was created that weighted relative ownership by asset quartile.

For measuring relative quartile stability, the **within** percent measures the share of households remaining in the same quartile across the three periods. For example, in the FHH poorest quartile, of the 174 households in the poorest quartile, they are in that quartile about 1.9 times over the three periods (3 (periods)*.634=1.9). This suggests that if a FHH is in the bottom quartile there is a relatively high probability that they will remain in that quartile for at least one additional period. This inter-round quartile stability can be compared to a 0.75 categorization rate if asset quartiles were randomly distributed. In contrast, MHHs classified in the wealthiest quartile, approximately 44% achieved this status about 1.8 times in the three rounds. All of this indicates that the higher quartile designations favor MHHs over FHHs with some variation across the designations for both groups. Importantly for FHHs, there is significant stability for FHHs within the bottom asset quartile. The next section more formally measures asset quartile stability using transition probability matrices.

Table 6. Quartile Asset transition probability matrix by households

Asset Quartiles		Female Headed Households						Male Headed Households				
	∑(2016)+(2019) Values											
(2012) Values	Values	Lowest	2nd	3rd	Highest	Total		Lowest	2nd	3rd.	Highest	Total
Lowest	Freq.	**146**	55	24	8	233	Freq.	**417**	246	143	49	855
	%	**62.7**	23.6	10.3	3.4	100	%	**48.8**	28.8	16.7	5.7	100.0
2nd Quin.	Freq.	36	32	29	15	112	Freq.	201	214	205	91	711
	%	32.1	28.6	25.9	13.4	100	%	28.3	30.1	28.8	12.8	100.0
3rd Quin.	Freq.	21	35	45	35	136	Freq.	120	213	264	206	803
	%	15.4	25.7	33.1	25.7	100	%	14.9	26.5	32.9	25.7	100.0
Richest	Freq.	14	15	38	**52**	119	Freq.	50	91	207	**481**	829
	%	11.8	12.6	31.9	**43.7**	100	%	6.0	11.0	25.0	**58.0**	100.0
Total	Freq.	217	137	136	110	600	Freq.	788	764	819	827	3,198
	%	36.2	22.8	22.7	18.3	100	%	24.6	23.9	25.6	25.9	100.0

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

Transition probability matrices (Table 6) measure the extent to which respondent categorical variables maintain the same categorical designations across time. Rows reflect initial values (2012), and columns reflect the next period's value (2016 or 2019). Given that there are three periods, the total number of observations will be the summation of the latter two periods. For FHHs, the total number of observations is 600 reflecting 300 households from each of the second and third rounds. For our purposes, the matrix diagonals elements from upper left to lower right are of interest because they reflect the relative stability of

quartile designations across time. For example, of the 146 poorest FHHs identified in either 2012 or 2016, approximately 62.7% remained in the category for the next period, with 23.6% increasing to 2nd quartile status, 10.3% to third quartile and 3.4% to wealthiest quartile. While the richest quartile of FHHs has only one-third the number of the total number (146 vs. 52) in the poorest quartile, the stability of 43.7% should be noted. As contrast, a random distribution would suggest 25% of households in the next period. For MHHs, the wealthiest quartile was the most stable with 58% of the 829 households remaining in the highest quartile. Interestingly, the second most stable quartile for MHH is the poorest one, suggesting some stability at the extremes, which is consistent with other research findings (Woolard and Klasen 2005). The next section outlines income stability and then contrasts the relationship between assets and income. All of this is meant to track the relative stability of sex-disaggregated household heads' economic performance across the nine years, and three samples, of the study.

Table 75. Income by quartile and head of household

Female Headed Households						Male Headed Households					
	Overall		Between		Within		Overall		Between		Within
Income	Freq.	%	Freq.	%	%	Income	Freq.	%	Freq.	%	%
Poorest	**477**	**53.0**	**236**	**78.7**	**67.4**	Poorest	948	19.8	653	40.8	48.4
2nd Quin.	187	20.8	146	48.7	42.7	2nd Quin.	1238	25.8	895	56.0	46.1
3rd Quin.	133	14.8	105	35.0	42.2	3rd Quin.	1292	26.9	931	58.2	46.3
Richest	103	11.4	75	25.0	45.8	Richest	1319	27.5	811	50.7	54.2
Total (n = 300)	900	100	562	187.3	53.4	Total (n = 1599)	4797	100	3290	205.8	48.6

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

Given sex-disaggregated household size differences (Table 1—approximately 4 members for woman-headed and 6 for male-headed households) using income or expenditures at this household level would overestimate the relative differences between the two groups. In other words, incomes and expenditures are likely to be greater for male headed households because there are more members. Therefore, we adopted an equivalence scale index to make more accurate comparisons between the different size households (Ebert 1999). Results are depicted in several of the analyses, including quartile incomes, quartile expenditures,

transition probability matrices, Lorenz curves and quantile regressions. We choose not to adjust asset and marketed sales as they may only be affected indirectly by household size.

As depicted in Table 7, adjusted income quartiles are similar to asset quartiles with FHHs disproportionately comprising the lowest quartile and relative stability within that ranking. However, they are even more aggregated in the poorest income quartile with 79% of FHHs reported to be in the lowest income quartile for at least one period, with an average of two designations (67%) over the three periods. For MHHs, the number of observations generally increase the greater the income quartile. For MHH, half reported being in the top income quartile (811 of 1,599) with an average of 1.6 times in this category. The transition probability matrix for income is reviewed for additional insights.

Table 8. Quartile Income transition probability matrix by households

Income Quartiles		**Female Headed Households**						**Male Headed Households**				
		∑(2016)+(2019) Values										
(2012) Values		Lowest	2nd	3rd	Highest	Total		Lowest	2nd	3rd	Highest	Total
Lowest Inc.	Freq.	174	54	24	18	270	Freq.	242	225	105	71	643
	%	64.4	20	8.9	6.7	100	%	**37.6**	35	16.3	11	100
2nd Inc.	Freq.	57	25	34	14	130	Freq.	181	265	255	124	825
	%	43.9	19.2	26.2	10.8	100	%	21.9	**32.1**	30.9	15	100
3rd Inc.	Freq.	37	20	23	21	101	Freq.	117	217	277	248	859
	%	36.6	19.8	22.8	20.8	100	%	13.6	25.3	**32.3**	28.9	100
Highest Inc.	Freq.	29	20	22	28	99	Freq.	77	123	227	444	871
	%	29.3	20.2	22.2	28.3	100	%	8.8	14.1	26.1	**50**	100
Total	Freq.	297	119	103	81	600	Freq.	617	830	864	887	3,198
	%	50	19.8	17.2	13.5	100	%	19.3	26.0	27.0	27.7	100

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

According to the transition probability matrix for income (Table 8 above), the poorest income quartiles for women are even more stable than asset quartiles. Of the 174 FHHs in the poorest income quartile, identified in either 2012 or 2016, approximately 64.4% remained in the category for the next period, with 20.0% increasing to second quartile status, 8.9% to third quartile and 6.7% to the wealthiest quartile (see first row of Table 8-*Female Headed Households*). While the richest quartile of FHHs has only a little more than one-third of the total number in the poorest quartile (99 versus 270), the relative stability of 28.3%, for the highest income quartile, should be noted. In terms of inter-quartile stability, the wealthiest quartile was the most stable with 50% of the 444 MHH households remaining in the highest quartile in subsequent periods.

Interestingly, and similar to the asset analysis, the second most stable category for MHHs is the poorest quartile, suggesting again, relative stability at the extremes. Overall, the stability of the poorest income quartile for FHHs suggests relative stagnation in this income class.

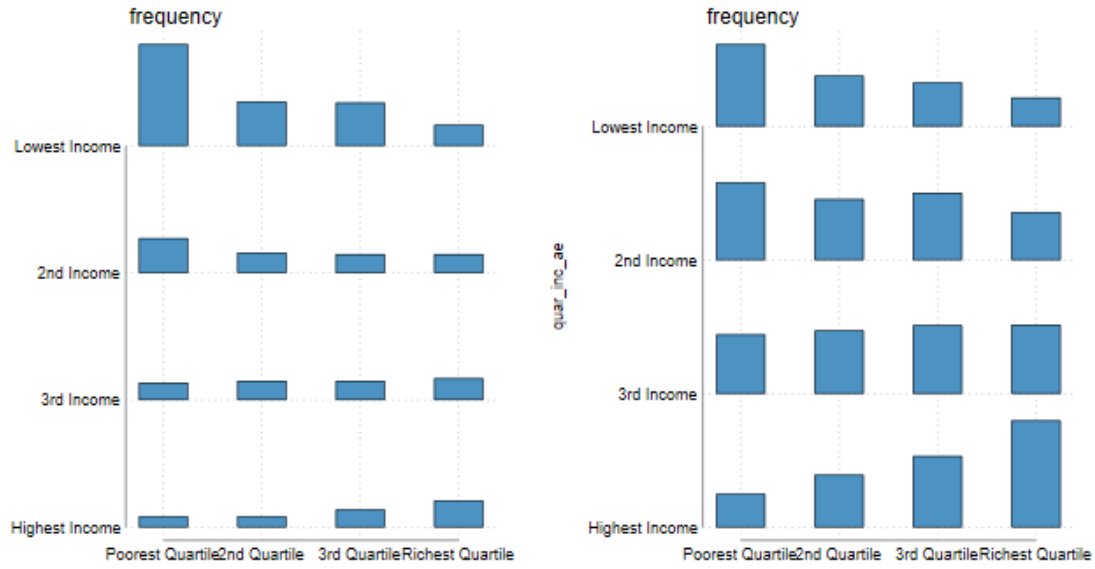
Finally, as would be expected, the relationship between asset and income quartiles is relatively consistent (Table 9). Importantly, about 23% of all FHH observations across the panel indicate that they are in both the lowest asset quartile and the lowest income quartiles. For comparisons sake, if the values were randomly distributed across all categories, the average number of households would be 6.3%. That indicates that the share of households that are in both the poorest income group and the lowest asset category is approximately 4 times what would be expected with a random distribution. However, there is some variation of FHH asset ownership relative to the lowest income quartile. Interestingly, and suggestive of further research, FHHs report being in the lowest income quartile with some notable variation in asset ownership status. About 47% of all FHH observations are in the bottom income quartile compared to only 21% for MHHs. The most common category for MHHs is the highest income and asset quintile with 10.9%. The results of Table 9 are depicted visually in Figure 1. The relative weighting of female headed households in the lowest income/asset quartiles (22.7%) disproportionately reduces the relative weighting of the remaining asset/income potential possibilities. For male headed households, the largest category is the highest asset/income category, followed by the lowest asset/income category. Given that MHHs are more evenly distributed, the blue weighted frequency bars are more equal for MHHs over FHHs.

Table 9. Contrasting asset and income quartiles

Assets	Female Headed Household					Male Headed Household				
	Lowest Income	2nd Income	3rd Income	Highest Income	Total	Lowest Income	2nd Income	3rd Income	Highest Income	Total
Poorest Quintile	22.7	7.8	3.9	2.4	36.8	8.4	7.9	6.0	3.4	25.7
2nd Quintile	9.9	4.6	4.3	2.4	21.2	5.2	6.2	6.4	5.4	23.1
3rd Quintile	9.7	4.2	4.3	4	22.2	4.5	6.8	7	7.3	25.5
Richest Quintile	4.7	4.2	4.9	6	19.8	2.9	4.9	7	10.9	25.7
Total	46.9	20.8	17.4	14.9	100	20.9	25.8	26.4	26.9	100

Source: Analysis of ACC Surveys 2012, 2016, and 2019.

Figure 1. Contrasting asset and income quartiles, FHH (left panel) & MHH (right panel)



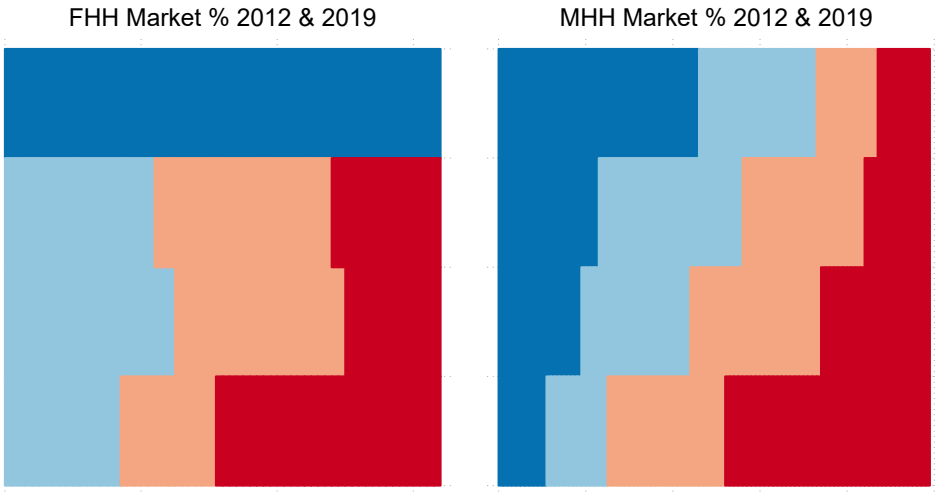
Source: Analysis of ACC Surveys 2012 and 2019.

Finally, transition probability color plots are used in Figure 2 to visualize some additional data reflecting the relative stability among quartiles related to crop marketing. These color plots aggregate the initial quartiles by rows and then measure the change over the period by colors ranging from blue (lowest quartile) to red (highest). For example, a solid darker blue row along the top row indicates the relative stability in the same quartile (lowest asset quartile remaining the lowest). This data is compiled in a somewhat different manner than the transition matrices above, as quantiles are taken at the sex-disaggregated level separately, rather than aggregated by all households as was performed above.

In Figure 2, FHH are divided into equal marketed share of crop quartiles and then contrasted to their relative values in 2019. Stability would be indicated by the designated color for that row and relative mobility would be captured by changes in colors. Somewhat strikingly, the bottom quartile of FHHs is fully stable indicating no change in crop market sales over the 2012 and 2019 survey periods. Closer analysis reveals zero sales over the entire seven-year period for this select group of FHHs and may indicate a source of why inter-quartile mobility is low for this group. While more research is necessary, targeted policy needs to explore ways for this disadvantaged group to attain increased mobility to higher income quartiles. MHHs

reveal at least some mobility between all four categories with relatively more stability in the lowest and highest quartiles.

Figure 2. Marketed Percentage 2012 to 2019



Source: Analysis of ACC Surveys 2012 and 2019

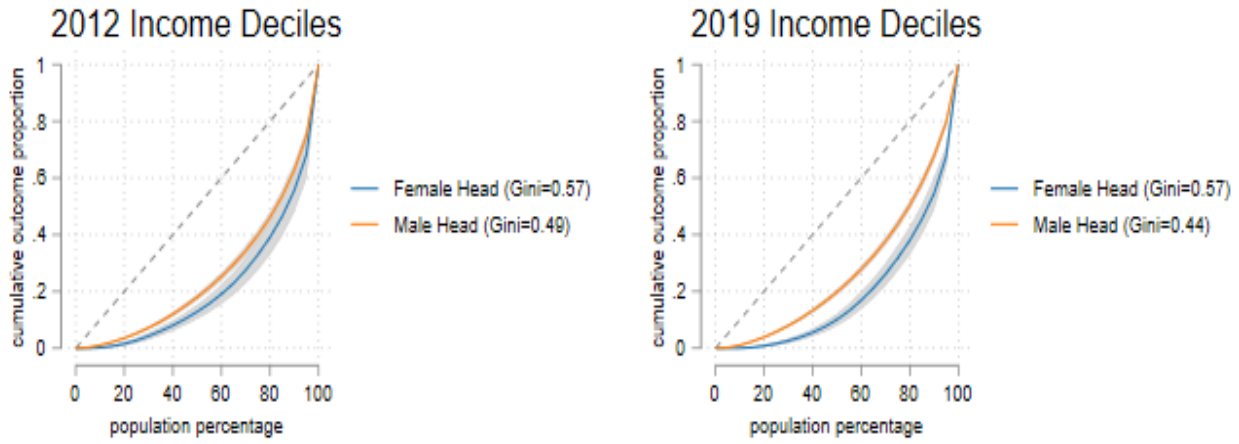
For purposes of elucidating baseline and trend analysis of inequality, we use standard Lorenz curves. Pictured below are income and expenditure, adjusted by adult equivalent, Lorenz curves for rural sex-disaggregated households in Ethiopia between 2012 and 2019 survey periods. The data suggests that the overall income distribution has improved slightly over the period, led by male headed households. However, contrary to the overall trend, female headed households, which exhibited greater inequality in 2012 relative to their male counterparts and has remained high over the seven years.[5] The picture for expenditures is better than income inequality in 2012 but inequality expenditure trends are increasing over the study period. World Bank data indicates the national Gini coefficient of per capita expenditure inequality was 0.35 Gini in 2012, rising to 0.39 in 2015[6] which is consistent with our figures here. Other

[5] The underlying adult equivalent income distribution for FHHs reveals large inequalities, particularly at the lower end. Unlike MHHs, approximately 10% of FHHs reported earning zero income consistently across the 2012 and 2019 period.

[6] The figures are not exactly comparable to the World Bank's as they are national estimates and not just rural households. However, the rising trend, particularly for expenditures, is consistent with our data (https://www.ceicdata.com/en/ethiopia/poverty/et-gini-coefficient-gini-index-world-bank-estimate).

Ethiopian research and government documents support our Gini coefficients as well (e.g. Debebe and Zekarias 2020, FDRE, 2021).

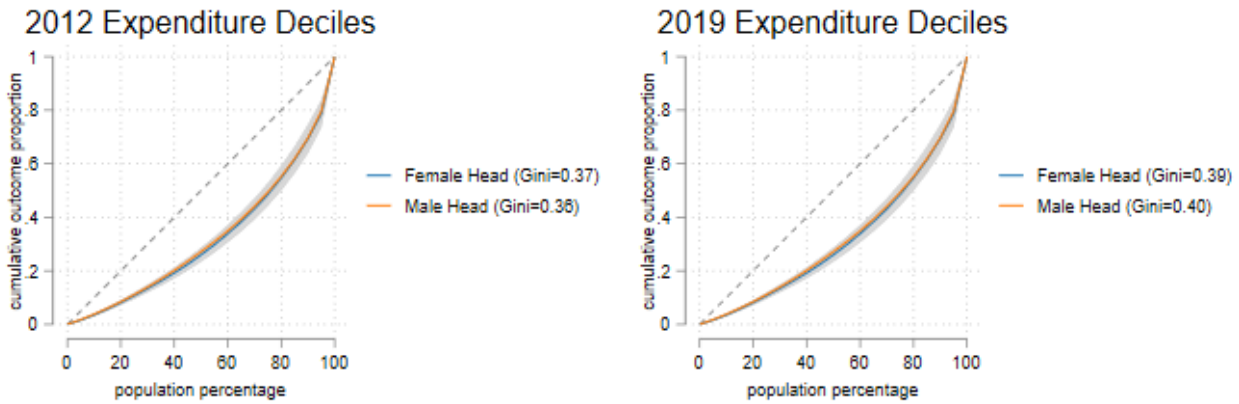
Figure 3. 2012 and 2019 Lorenz income curves by household head



Source: Analysis of ACC Surveys 2012 and 2019.

Income data is divided into deciles and mapped by sex of household head in Figure 3. Based on 2012 income, the bottom 60% of female headed households' control only about 20% of income and the top 20% receive about 60% of income with approximately the same distribution in 2019. On the other hand, male headed households are less unequal in 2012 and improved somewhat in 2019. In conclusion, these income Lorenz curves suggest significant rural inequality and indicate that female headed households are not a homogenous group, as sometimes intimated in policy documents, with even greater inequality than MHH that has persisted over the last decade.

Figure 4. 2012 and 2019 Lorenz expenditure curves by household head



Source: Analysis of ACC Surveys 2012 and 2019.

Expenditure Gini coefficients (Figure 4) are lower than income Gini coefficients, which have several potential explanations (e.g. income smoothing). As before, Gini coefficients are higher for FHH and in the case of expenditures, the coefficients are increasing which indicates increased relative inequality over the survey period.

The purpose of this section is to review asset ownership and income stability/mobility between female and male headed households and trends over our survey period. Ideally, a longer period should be used in order to better track medium-term trends, but this analysis does provide evidence of relative stagnation for FHHs within the lowest income and expenditure quartiles. Income and expenditure inequality for MHHs is lower and declining, at least for income, while FHHs have higher inequalities that are steady or are rising slightly. The next section reviews what variables contribute to some of our variables of interest and how they might vary over disaggregated quartiles.

5. ECONOMETRIC ANALYSIS

The previous sections demonstrated several basic statistical differences between disaggregated quartiles of measures of well-being for male and female headed households and depicted some important economic differences and trends of variables. The indicators of well-being were real income per adult-equivalent, real expenditures per adult-equivalent and asset ownership. This section also considers these variables but incorporates quantile regression analysis which allows for control variables to better isolate whether there are significant differences between sex-disaggregated households at the 25th, 50th, and 75th percentiles (the quartile borders). Overall, the results support our previous finding that there are many important cross sectional and time trend differences between male and female led households. Most coefficients are significant and of the expected sign and vary between percentiles in important ways. Considering our primary variable of interest, female household head, the variable demonstrates statistical differences which support our general thesis and relative use of quantile regressions.

As outlined in Section 2, quantile regression estimates[7] an equation to predict a certain percentile of the dependent variable as a function of the independent variables. If there are differences between these groups, then independent variables influence the dependent variable via different segregated values which renders quantile regressions as a more suitable form of regression analysis.

To better understand the principal variables, we graph the distributions of real income per adult-equivalent, real expenditures per adult-equivalent, and marketed percentage of cereal crops.[8,9] The three variables are meant to capture a household's relative participation in general economic activity and serve as proxies for welfare that can be used to track relative economic progress across time. Figures 5 and 6 display the three

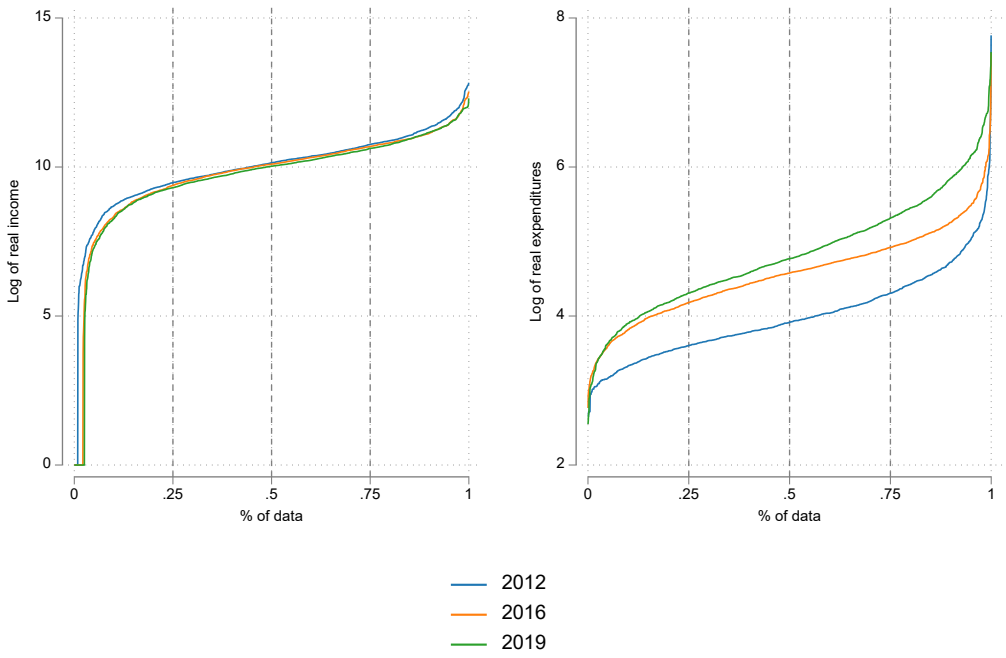
[7] Given the relative size of our overall sample, the data could have been disaggregated into smaller categories than quartiles. However, the relatively small FHH distinction, particularly at higher quartiles, restricted the disaggregation to only quarters to maintain relatively robust estimations.

[8] Marketed percentage of cereal crops refers to the gradual increase in the percentage share of output sold and is a key component of the process of agricultural transformation. It is widely assumed that shifting from low-value staple food crops to higher-value commercial crops raises farm household income and is measured by increasing market share percentage. We assume that increase households' commercialization, emanating from the relative increase in cash crop production and market access, improves the economic welfare of farming households.

[9] Asset ownership was not chosen as a dependent variable for at least two reasons, including relative "stickiness" of the PCA analysis that prevented easy segmentations into quartiles and a concern for causality as asset ownership may have relative joint causality issues with income and expenditures.

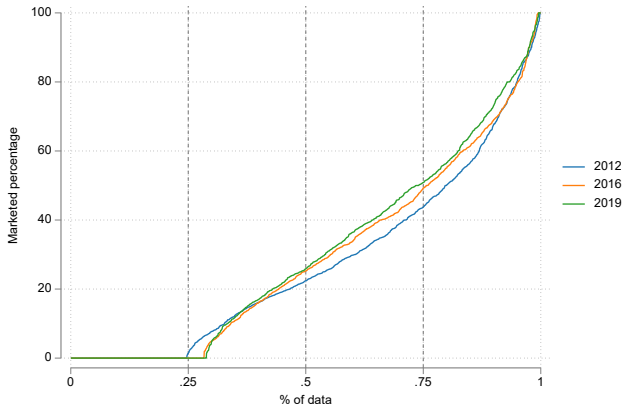
dependent variables' distributions over the three survey periods. Interestingly, the values of logged real income (Figure 5, left panel) are stable across the three survey periods and suggest that real incomes did not increasing dramatically. Over the three periods, the bottom quartile (25%) indicates rapidly increasing intra-quartile income that rises steadily over the two middle quartiles and then more sharply in the last quartile. This is typical of logged income values. As would be expected, expenditure quartiles are more stable than income and likely reflect spending needs that occur irrespective of income, especially at low or no incomes (e.g. negative savings). There is evidence of real expenditure increases over the period that seems to favor lower quartiles between 2012 and 2016 and then higher quartiles from 2016 to 2019. Figure 6 depicts the relative changes of cereal marketed percentages. The bottom quartile indicates that about 25% of all households across the three survey periods did not market crops, with a slight decrease of marketed percentage over time. The top quartile consistently markets between 40 and 100% of their crops.

Figure 5. Quantile distribution of real income (left panel) and real expenditures (right panel)



Source: Analysis of ACC Surveys 2012, 2016, and 2019.

Figure 6. Quantile distribution of percentage cereal crop marketed



Source: Analysis of ACC Surveys 2012, 2016, and 2019.

We focus on determinants of total income, logged in real terms, generated at the household level (Table 10). As the information is presented in a cross-section format over the three time periods, the amount of potential analysis is extensive. More specifically, because there are three percentiles (25th, 50th, and 75th) that mark the quartile borders, we have estimated a total of nine regression coefficients for each variable. General findings of the control variables are first discussed, to provide general support to the model, and then we concentrate on our coefficients of primary interest, the female-headed household designation.

Overall, the estimated coefficients are generally consistent with what would be expected from variables related to predicting total income in a smallholder rural agricultural household. Several variables are positively related to income, including head's education, mobile phone ownership, farm size, oxen owned and fertilizer, while the age of the household head is negatively related to income. Additionally, farm size contributes more to income in the higher percentiles. How fertilizer use contributes to income is remarkably consistent across quartiles and years. Our regressions indicate that fertilizer use is increasingly contributing to real income over the three periods and falling at higher intra-quartiles, suggesting larger fertilizer use and lower marginal contribution to income at higher incomes. Quartile coefficients are visually presented in Figure 7 and are contrasted to an OLS model's coefficients to determine if quantile coefficients are significantly different from the OLS regression coefficient.

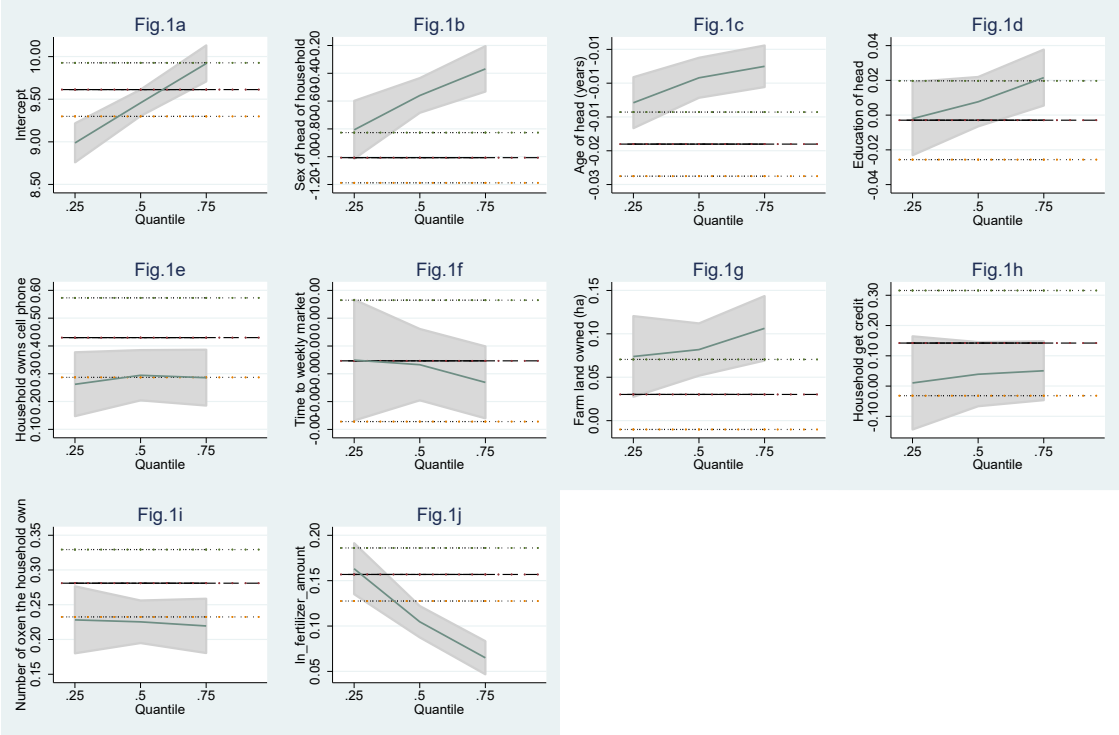
In regards to the female household coefficients, we note several important findings that include, firstly, all the coefficients are negative, eight out of nine are statistically significant, and suggest that FHHs earn less income, over all income quartiles. Secondly, and important to our cross-sectional analysis, coefficients are generally falling as the inter-quartile range increases, suggesting that FHHs, relative to MHHs, have more disparate incomes at lower quartiles and relatively more equal income at the higher quartiles. This is consistent with the annual income Lorenz curves depicted earlier (Figure 3). The differences between FHH coefficients at the 25th and 50th percentiles are statistically significant for the 2016 and 2019 surveys. It should be noted that there is statistical significance between 50% and 75% for 2019 only. Thirdly, all quantile coefficients are becoming more negative over time (e.g. bottom quartile -0.34 in 2012 to -0.81 in 2019), while the top quartile is becoming more negative at a slower rate which also supports rising FHH inequality over time. Put another way, the deteriorating coefficient values (increasingly negative), especially over time in the lower percentiles, suggests poorer female-headed households may not be participating in Ethiopia's growth and should be an issue for policy consideration. Overall, Table 10 depicts that FHHs consistently earn less income than MHHs, and contrary to what might be expected, the coefficient is relatively greater in the lowest quartile, with the situation worsening for FHHs. This is especially problematic given that many important control variables are included in the models.

Table 10 Simultaneous regression round 1 thru 3—Total real income

	Total income(adj.)2012	Total income(adj.)2016	Total income(adj.)2019
q25			
Female household head	**-0.34*** **	**-0.60*** **	**-0.81*** **
Age of head (years)	-0.01***	-0.02***	-0.01***
Education of head	0.03***	0.02**	-0.00
Mobile phone ownership	0.36***	0.22***	0.26***
Time to weekly market	-0.00	-0.00	-0.00
Farmland owned (ha)	0.05***	0.07***	0.07***
Household get credit	0.03	0.22***	0.01
Oxen Owned	0.16***	0.18***	0.23***
Ln fertilizer use	0.06***	0.08***	0.16***
Constant	8.26***	8.51***	8.99***
q50			
Female household head	**-0.21*** **	**-0.17**	**-0.56*** **
Age of head (years)	-0.01***	-0.01***	-0.01***
Education of head	0.02***	0.02***	0.01
Mobile phone ownership	0.26***	0.19***	0.29***
Time to weekly market	-0.00	-0.00*	-0.00
Farmland owned (ha)	0.05**	0.07***	0.08***
Household get credit	0.03	0.10**	0.04
Oxen Owned	0.15***	0.18***	0.23***
Ln fertilizer use	0.04***	0.06***	0.10***
Constant	8.86***	8.92***	9.46***
q75			
Female household head	**-0.17** **	**-0.20*** **	**-0.37*** **
Age of head (years)	-0.01***	-0.01***	-0.01***
Education of head	0.01*	0.01**	0.02**
Mobile phone ownership	0.41***	0.14***	0.29***
Time to weekly market	0.00	-0.00***	-0.00*
Farmland owned (ha)	0.06***	0.10***	0.11***
Household get credit	0.08	0.07	0.05
Oxen Owned	0.13***	0.10***	0.22***
Ln fertilizer use	0.02	0.06***	0.07***
Constant	9.44***	9.45***	9.92***
Observations	1899	1897	1883

Source: Analysis of ACC Surveys 2012, 2016, and 2019, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 7. Income-independent coefficient values by quartile (2019)



Source: Analysis of 2019 ACC Survey.

Figure 7 is separated into 10 separate graphs that illustrate the quantile coefficients, and their OLS estimates, of the 2019 total income regression equation (far right column of Table 10) and is meant to serve as an illustrative example for all the regressions. Of particular interest here is Fig. 1b that contrasts the three coefficients generated in the 2019 quantile regression for female head of household and the value of the OLS estimate depicted by the black solid line (with dashed lines serving as 95% confidence intervals). The quartile points depict a gradual increase in the coefficient (less negative) that, for all quartiles, is outside the 95% confidence bounds and therefore, suggests support for using the quantile regression methodology. In addition, most of the other quantile coefficients exceed the confidence bounds of the OLS coefficients, further supporting the quantile regression methodology.

6. CONCLUSION

While there is growing awareness of the importance of married women in rural Ethiopia, data collection is only recently being incorporated into larger survey design.[10] If there is a gender component in Ethiopian rural household research, the research tends to focus on the absolute differences between male and female headed households using cross-sectional data. Few Ethiopian studies have analyzed either relative inter-household variations or trends over time. This study attempts to be innovative by disaggregating, using important economic variables, quartile values at the sex-disaggregated household level and to track different trajectories of both male- and female-headed households over the last decade.

Separating households into quartiles reveals that FHHs are not a homogenous category, having greater income and expenditure inequalities than MHH, and experiencing significantly different growth trajectories. Separating FHHs into quartiles also reveals important distinctions at both the lowest and highest quartiles. Our research indicates that female headed households at the lower asset quartiles are earning less income, marketing a smaller share of their cereal crop production, and experiencing less growth which, unlike comparable male headed households in lower quartiles, is leading to relative stagnation, greater inequality and a lack of economic mobility. Of particular note was the bottom quartile of FHHs who have not marketed any cereal crops across the three sample periods. This segment of FHHs needs additional research and may need careful targeting for improved growth prospects. At the highest quartile, FHHs appear to be performing relatively well and seem to be approaching the growth experience of typical MHHs but there is need for further exploration here as well. These results have important policy implications for enhanced targeting of rural households.

The most recent major Ethiopian policy document, *Ten Years Development Plan—A Pathway to Prosperity,* adopts a more humanist approach to the country's economic development, linked to the United Nations' Sustainable Development Goals (UN-SDGs), where the idea that *prosperity should be defined in terms of*

[10] This is reflected in the ACC survey rounds which omitted a sex-disaggregated household component in 2012 but was then included in 2016 and 2019.

the overall human and institutional capability [whereby] … every citizen would be able to satisfy their basic needs and aspirations (FDRE 2021). This laudable goal needs several multifaceted indicators to measure relative progress, which seems, at least to us, to include intertemporal income mobility. A major aspect of developing these strategies is to carefully review women's roles, relative economic participation in the economy and trends that are developing over time. Beyond merely targeting women, policymakers should consider further disaggregating households, by income or other relevant welfare measures, to better track mobility. Using quantile regression analysis, this research reveals some stagnant growth trajectories that indicate all households, and particularly lower quartile female headed households, are not participating in Ethiopia's recent GDP growth. If policymakers are going to further develop pro-growth strategies, then more detailed analysis, on several aspects of this study, seems warranted.

Overall, this research suggests that quantile analysis, disaggregated by sex of the household head, is a useful approach for understanding how different segments of Ethiopia's rural sector are experiencing growth over past decades. Using this type of analysis also has implications for Ethiopia's relatively more recent interest in focusing more on humanist growth objectives over just growth.

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