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Heterogeneous market participation channels and household welfare

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ABSTRACT

This paper uses panel data and qualitative interviews from southwestern Ghana to analyse farmers' heterogeneous oil palm marketing decisions and the effect on household welfare. We show that despite the supposed benefits that smallholders could derive from participation in global agribusiness value chains via formal contracts, such arrangements are rare although two of Ghana's 'big four' industrial oil palm companies are located in the study area. In the absence of formal contracts, farmers self-select into four main oil palm marketing channels (OPMCs). These OPMCs are associated with varying levels of welfare, with processing households and those connected to industrial companies by verbal contracts being better off. Furthermore, own-processing of palm fruits is shown to reduce gender gaps in household welfare. We also unearth community and household level factors that hamper or facilitate participation in remunerative OPMCs. These results have implications for development policy and practice related to inclusive agricultural commercialization.

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Introduction

The extant literature shows that smallholder participation in output markets has a positive impact on various dimensions of welfare Asfaw et al. (2012); Muriithi and Matz (2015). However, this literature is dominated by binary analysis of the impact of participation on outcomes (Arouna et al., 2021; Bellemare & Bloem, 2018; Chege et al., 2015; Meemken & Bellemare, 2020; Rao & Qaim, 2011). Even those papers that have examined the impact of particular marketing channels, such as linkage to supermarkets, on household income and poverty (Rao & Qaim, 2011) still tend to focus on structural differences between participants and nonparticipants.

Beyond these structural differences, however, the literature neither provides sufficient insight into the gamut of market participation channels in a given location, nor the individual- and household-level factors associated with participation in any chosen channel, and the possible differential welfare impacts. An analysis of a wider range of marketing channels and associated outcomes is necessary for the design of interventions that do not treat smallholder farmers as a homogenous group, but ensure that such interventions address the unique constraints associated with the various channel of market participation.

In this paper, we address this gap by examining heterogeneous marketing channels for smallholder oil palm farmers, asking why they self-select into varying marketing channels. We show that

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different oil palm marketing channels (OPMCs) yield different living standards due to differences associated with their characteristics such as the effect of participation on productivity, varying cost of transactions and output price. Furthermore, unlike most of the available studies, we accomplish our objectives using panel data that allows us to minimise endogeneity bias due to omitted heterogeneity.

Contract farming (CF) – an institutional arrangement or scheme that coordinates farmers to organise their production activities based on market signals – have been shown to have better livelihood outcomes for smallholder farmers in some cases (Arouna et al., 2021; Bellemare & Lim, 2018; Ruml & Qaim, 2020). However, a recent study reports high rates of dissatisfaction among smallholders with such arrangements owing to mistrust (Ruml & Qaim, 2021). Indeed, our study area (the southwestern oil palm belt of Ghana) is characterised by a relative absence of resource-providing contractual arrangements between farmers and companies, although two of the 'big four' oil palm estates (Benso Oil Palm Plantation [BOPP] and Norpalm Ghana Limited [NGL]) are present. The dominant relationship between farmers and BOPP in the Mpohor district and Norpalm in the Ahanta West district (both in the Western region) can be described as a simple verbal marketing contract (Dzanku et al., 2020). As we show in this paper, most of the resource-providing contract arrangements have collapsed under the weight of mistrust and high transaction cost of enforcing compliance to contract terms.

In the absence of contractual arrangements that could connect smallholders to markets and resolve constraints limiting their diversification into high-value downstream processing, the bargaining power of smallholders is diminished. This is partly due to the highly perishable nature of agricultural output such as oil palm fruits after harvest, which puts pressure on farmers to dispose of their Fresh Fruit Bunches (FFBs) immediately either through sales or own processing (i.e. vertical integration [VI)]. While providing a potentially lucrative alternative to CF, VI has the potential of being more gender-inclusive since artisanal processing and trading of oil palm in Ghana is dominated by women (Dzanku et al., 2020; Osei-Amponsah et al., 2012). Nonetheless, VI has its own entry barriers associated with initial capital requirements (Dzanku et al., 2020).

In light of the above, this paper addresses three specific research questions: (1) What OPMCs exist in the context of limited formal contractual arrangements? (2) Are the available OPMCs hierarchically ordered in terms of multidimensional welfare? (3) If some OPMCs yield higher welfare than others, then what factors promote or hinder participation in better remunerative channels? To answer these questions, we draw on a combination of qualitative and panel data collected from two oil palm producing districts in southwestern Ghana. We show that in the absence of formal contracts, farmers self-select into four main oil palm marketing channels (OPMCs). We find that these OPMCs are associated with varying levels of welfare, with processing households and those connected to industrial companies by verbal contracts being better off. We identify community and household-level factors associated with participation in different OPMCs and show the gendered impact of participation. For instance, we establish that own-processing of palm fruits reduces gender gaps in household welfare.

The next section provides a brief overview of oil palm production and marketing in Ghana. The following third section outlines the methods of the study including a conceptual framework, the data and key variables, and the econometric methods and identification strategies. The fourth section presents descriptive statistics and the results of the qualitative and econometric analyses. The final fifth section concludes and provides implications for the consideration of policy, development practice and further research.

Overview of oil palm production and marketing in Ghana

Oil palm (*Elaeis guineensis*), which is native to West Africa, is the most consumed vegetable oil crop in the world (FAO, 2022). In Ghana, two broad production and marketing arrangements can be identified based on the linkages between farmers and industrial estates: a formal resource-providing contract and

a verbal agreement. There are five large estates and a number of medium-scale companies who have their own oil palm plantations but also have various forms of production and marketing linkages with farmers. The five estates are: the previously mentioned BOPP and NGL, Ghana Oil Palm Development Corporation (GOPDC), Twifo Oil Palm Plantation (TOPP) and Juaben Oil Mills Limited (Asante, 2023). The first four are often referred to as Ghana's 'big four' oil palm estates.

Independent farmers without linkages to companies pick out palm fruits from their FFBs and sell to either market traders or artisanal palm oil mills within their communities. The palm oil produced from the artisanal mills is sold within Ghana or to traders from Togo and Nigeria. Some farmers also process their own fruits into oil palm for sale on the local market. The nature of linkages between farmers and oil palm companies vary depending on the company in question, but broadly fall into two categories: (a) indirect linkages whereby smallholders sell their FFBs to the industrial company mills through intermediaries without any contract whatsoever; and, (b) direct linkages through a variety of contractual (verbal or written) arrangements.

There are broadly two kinds of direct contractual linkages between smallholders and the companies. The first is the resource-providing written contract arrangements where a company provides input credit (including or excluding land) and technical advice, with farmers required to supply FFBs to the company. This arrangement includes: (a) the nucleus smallholder scheme where farmers cultivate part of the company's land and are obliged to sell FFBs exclusively to the company; and, (b) the contracted smallholder or 'outgrower scheme' where farmers operate their own farms and have a contract to supply FFBs to the company. The second is a simple verbal marketing contract (without any resource provision by the company). This second arrangement may involve a periodically determined fixed price and regular FFB pick-ups by the company at the farmgate. This arrangement simply offers a secure market for smallholders.

In Ghana and other West African countries, smallholders dominate the production of both oil palm FFBs and crude palm oil (CPO). The difference is stark when compared with production of the commodity in South East Asia. In Indonesia and Malaysia, estates produce between 50 and 60% of palm oil, whereas in Ghana, estates account for less than 14% of the output. Consequently, the estates rely heavily on FFB from smallholder farmers to supplement the harvests from their own plantation (Asante, 2018). However, formal contracts between estates and smallholder farmers are highly unstable and in recent times have become quite rare (Dzanku et al., 2020). In the absence of formal or verbal contracts with the estates, smallholders participate in alternative channels of market participation such as sale on local markets and own processing.

Methods

This section first presents a conceptual framework for guiding the analyses presented in the fourth section. It also describes the data, delineates the key variables used in the analyses, and presents the econometric models and identification strategies.

Conceptual framework

The concept of 'welfare-enhancing market participation' (Barrett, 2008, p. 300) implies that not all channels of market participation yield similar welfare. Different OPMCs are associated with different producer prices. Similarly, each marketing channel comes with its own transaction cost such that not all channels are equally available to all smallholders. For instance, despite its documented benefits for both smallholders and processing companies, CF agreements often break down due to the perceived coercive nature of and dissatisfaction with some contracting arrangements (Dzanku et al., 2020; Ruml & Qaim, 2021; Vamuloh et al., 2020). This means that farmers' choice of marketing channel is determined by both utilitarian preferences and 'extra-economic variables' (Granovetter, 2018; Zafirovski, 1999). Therefore, to analyse the welfare impact of marketing channels, we adopt a modified transaction cost economics (TCE) framework that

accommodates the effect of non-economic factors such as trust between transacting partners. Based on TCE (Coase, 1937; Williamson, 1975), we assume that oil palm producers and buyers choose channels of exchange to minimize the cost of transactions.

Smallholders face varying transaction costs due, for example, to their spatial location relative to markets, and such costs increase in the presence of poor transportation and communication infrastructure and institutions. Under such circumstances, the marketing channel used by a smallholder is influenced not only by profitability, but the ability to overcome the transaction costs associated with the different channels. Therefore, when analyzing the choice of marketing channel, one must take into account channel-specific transaction attributes and the characteristics of market agents involved in the transactions (Williamson, 1985, 2005). In our study, channel-specific attributes such as vulnerability to opportunistic behaviour and spatial location of production relative to buyers matter because both factors affect the economic and social cost of transactions (Key et al., 2000). Smallholders also face high proportional transaction costs due to their limited ability to leverage-scale economies. This limitation may hinder their direct engagement with oil palm companies unless they can aggregate output across other smallholders through cooperatives.

We posit that farmer welfare is not only improved by higher average producer prices, which could depend on OPMC, but also by the distribution of returns from market participation over the production season. Factory-gate prices of FFBs are volatile, compared with crude palm oil (CPO), due to the high perishability of FFBs (Mehraban et al., 2021). This is more so during the bumper harvest season when large-scale processing companies have FFBs beyond processing capacity, resulting in huge losses to farmers, especially those without verbal contracting arrangements with the processing companies. VI becomes a safe haven for farmers, as it has the potential to reduce welfare losses by minimizing the variability of income from the oil palm production enterprise. This is because while FFBs are highly perishable and seasonal, CPO can be stored over a longer period.

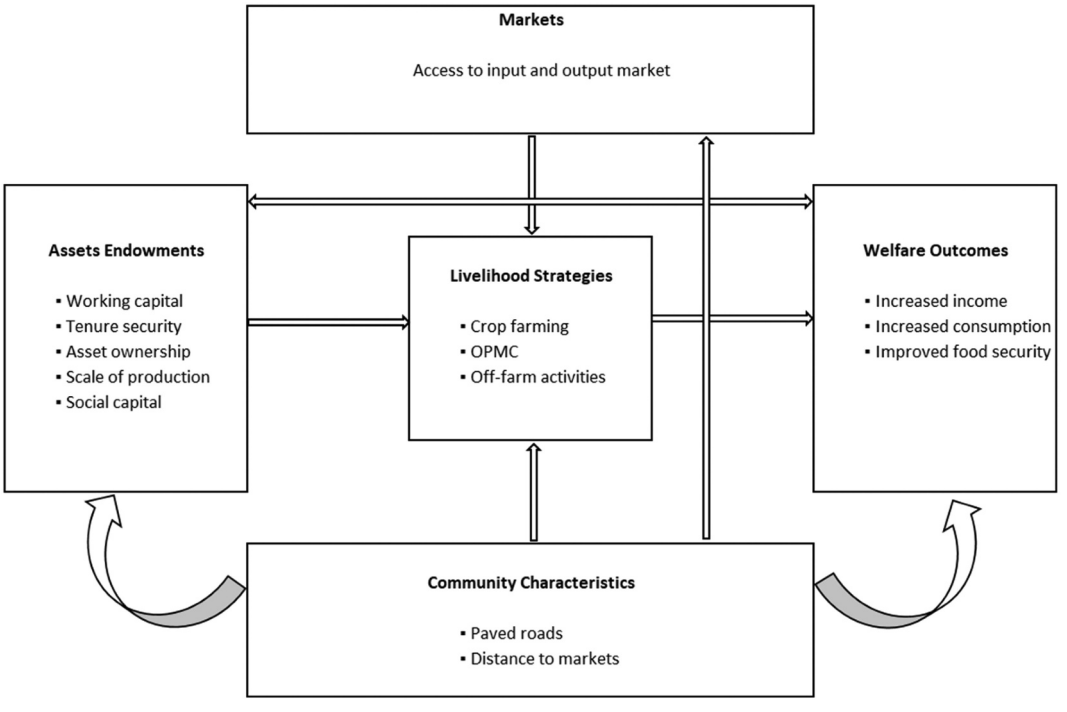

Figure 1. Analytical framework. Source: Adapted from Mmbando et al. (2017).

The empirical analysis is guided by the following propositions as illustrated in Figure 1. First, household characteristics shape oil palm producers' ability to participate in different OPMCs. Second, community characteristics such as infrastructure, the presence and size of local markets, and distance to industrial companies affect household participation in marketing channels such as CF and household level VI. The relationship between community characteristics and capacity to participate in some marketing channels is mediated by the characteristics of the household, including level of working capital, scale of production, tenure security, and asset ownership.

In short, households with the necessary resources can overcome the material obstacles imposed by their community's lack of necessary amenities. Household resources also translate into social capital by enabling well-resourced farmers to participate in costly collective action schemes (Takyiakwaa et al., 2021), thus allowing them to overcome the social obstacles of mistrust that plague CF schemes in Ghana (Ruml & Qaim, 2021).

Data

This study uses household-level panel survey and qualitative data collected from the Ahanta West and Mpohor Districts in southwestern Ghana. The districts were purposively selected based on the concentration of oil palm production involving smallholders, large-scale industrial oil palm companies (BOPP and NGL), and a medium scale company (B-BOVID). The two districts differ by the degree of oil palm concentration – participation and level of resource allocation to oil palm production is higher in Ahanta West than Mpohor.

The survey data was collected from 21 randomly sampled communities in the two districts. The list of communities was compiled in conjunction with the companies and the district agricultural offices. At the community level, we conducted a census of all households to construct a sample frame. Depending on household population size, we took a random draw of 10–60 households per community. This gave a sample size of 725 households for the baseline survey in December 2017.

Attrition rate during the follow-up survey in December 2019 was 8%. Our analysis is based on a balanced sample of 636 households after dropping households that did not cultivate any land or produce any oil palm. We show in the Online Appendix (Tables A1 and A2) that attrited and stayer households have similar characteristics and therefore our results are not significantly biased in the presence of attrition.

We subsequently carried out a qualitative study in April 2019 for deeper understanding of the quantitative findings that emerged after the baseline. We used a multistage purposive sampling approach to select five communities based on the dominant OPMC identified in the baseline data. In each community, five households were sampled and in-depth interviews were conducted with the household head and one other opposite-sex adult of the household. At the community level, we conducted in-depth interviews with farm labourers, palm fruit aggregators, and processors. We also conducted key informant interviews at the community level (with traditional leaders and local government councillors) and two focus group discussions per community (separately for males and females). At the district level, we carried out expert interviews with agricultural officers. Lastly, we interviewed management team members of BOPP, NGL and B-BOVID. Overall, we conducted 63 in-depth interviews, 11 key informant interviews, and 10 focus group discussions. The data was analysed using the thematic network approach for qualitative analysis (Attride Stirling, 2001)

Key variables

Our analysis relies heavily on two key variables: marketing channels and household welfare. We explain how these variables are measured below.

Marketing channels

Formal contracts with oil palm companies were extremely limited in our survey sample; only four farmers reported that they had such contracts. We identified four main OPMCs in the communities. The first is sales at the community spot market (marked below as Spot or SM) to retail-market women and artisanal mills. Smallholders who participate in the Spot channel harvest their FFBs piecemeal and then pick out the palm fruits for sale because they often have small farms and are therefore unable to aggregate a lot of FFBs at a time.

The second channel, which we mark below as Contract or MC, involves direct transactions between farmers and the companies on the basis of a verbal marketing contract. Although the contracts are verbal, as noted by Ruml and Qaim (2020), farmers see the arrangement as important for ensuring some level of price stability and a secure sales market. This is particularly important during the main harvest season when supply exceeds the processing capacity of company plants, and non-adherence to verbal contracts could prove costly as the industrial mills purchase FFBs only from farmers who have been faithful to past verbal contracts.

The third channel involves indirect sales to companies through an intermediary called a buying agent, marked below as Agent or BA. Such intermediaries facilitate marketing in an environment of high risk and uncertainty. In our context, the cost of reaching individual farmers who undertake piecemeal harvesting is prohibitive for both the companies and some farmers because of the high cost of transactions driven by distance between the parties. The Agent aggregates FFBs from several smallholders and sells either directly to a company or through a company-registered agency called third party buyers.

The fourth channel is the VI or Process channel, which involves smallholder oil palm farmers who avoid selling palm fruits altogether and instead process most of their own fruits into mainly red palm oil for the local food market. With volatile FFB prices and investment constraints in processing, an important decision for smallholders is whether to sell palm fruits to industrial companies and other buyers or to process their own fruits.

Household welfare

Welfare is a multidimensional concept and improvement in one dimension may not necessarily mean improvement in other dimensions (Dzanku, 2015). Therefore, we used three measures – household per capita net income, an asset index following Filmer and Pritchett (2001),[1] and household food insecurity – to estimate the effect of the OPMCs on welfare. The food insecurity indicator measures the incidence of inadequate access to food throughout the year by asking a female adult household member to identify the months for which there was not enough food for the household. A household is identified as seasonally food insecure (SFI) if there is at least a month of inadequate food.

Econometric analysis

Our econometric analysis first seeks to answer the question of whether the observed marketing channels are hierarchically ordered in welfare terms, after which the question of which factors promote or hinder channel selection follows. The welfare effect of an OPMC is analysed by specifying

$$welf_{k,it} = \delta_1 Agent_{it} + \delta_2 Spot_{it} + \delta_3 Process_{it} + \mathbf{x}_{it}\beta + c_i + u_{it}, \quad (1)$$

where $welf_{k,it}$ is the kth welfare measure for household i in year t; $Agent_{it}$, $Spot_{it}$, and $Process_{it}$ are the marketing channels each of which takes on the value one for participation and zero otherwise, meaning that $Contract_{it}$ is the reference channel. The vector of all other controls is contained in $\mathbf{x}_{it}$; c_i is the time-constant household-specific unobserved effect or heterogeneity that is allowed to be correlated with the explanatory variables; and u_{it} are the idiosyncratic disturbances, which vary across households and time. In essence, c_i represents

an omitted variable in the absence of panel data, rendering estimates using cross-sectional data biased.

Since households may not select at random into the OPMCs, the estimates of δ_1, δ_2 and δ_3 may be biased measures of the welfare effects of the channels because of potential endogeneity arising from self-selection, omitted heterogeneity and reverse causality. For instance, ex-ante wealthy households may self-select into better remunerative OPMCs, meaning that one cannot identify a true welfare effect of channel choice. One way of addressing this problem is to apply the multinomial endogenous switching regressions (MESR) approach. However, with panel data that allows us to model both 'heterogeneity endogeneity' and 'idiosyncratic endogeneity' (Lin & Wooldridge, 2019), we apply the MESR approach via a control function method (CFM) rather than joint maximum simulated likelihood.

Panel data allow us to address endogeneity due to omitted heterogeneity by allowing correlation between c_i and the OPMCs (and the other covariates) through the application of the fixed effects (FE) estimator or the CRE approach. Endogeneity due to time-varying unobserved factors (idiosyncratic endogeneity) may remain, however. Therefore, in addition to the FE or CRE estimates, we apply a CFM by estimating a multinomial logit model for the choice of marketing channel for each time period in the first stage and thereafter obtain inverse Mills ratios, which we then enter as additional regressors in the welfare equations to minimize selection bias akin to Blundell and Powell (2004) and Heckman (1979). The first stage estimation includes four variables that act as instruments for selection into an OPMC: distance to an industrial oil palm estate, and the proportion of households in the village that participate in each of the four OPMC less one (Meemken & Bellemare, 2020).

We specify the selection correction equation in the correlated random effects framework to allow us to include geographic units (village-fixed effects) and a rich set of observed characteristics that adjust for self-selection. This approach helps to further minimize the possible bias in estimating the welfare effects due to the influence of spatial heterogeneity in selection into an OPMC (Maertens & Swinnen, 2009; Meemken & Bellemare, 2020). The endogeneity adjusted model is

$$welf_{K,it} = \sum_{k=1}^{4-1} \delta_k OPMC_{it} + \mathbf{x}_{it}\beta' + \mathbf{h}_i\gamma' + \boldsymbol{IM}_{it}\varphi' + \overline{\mathbf{x}}_i\pi' + \overline{\boldsymbol{IM}}_i\theta' + u_{it} \tag{2}$$

where $OPMC_{it}$ represent the marketing channel indicator variable; $\mathbf{h}_i$ is the matrix of time-constant covariates including community fixed effects; IM_i is the matrix of inverse Mills ratios; $\overline{\mathbf{x}}_i$ and $\overline{\boldsymbol{IM}}_i$ are the time-averages of the respective variables that allow correlation with unobserved heterogeneity.

The above procedure is in essence what the MESR approach accomplishes (Deb & Trivedi, 2006). With panel data, however, CFM allows more flexibility and computational ease. We bootstrap the standard errors with 1,000 draws because of the two-step nature of the procedure.

Second, we use regression analysis for identifying the drivers of farmers' choice of OPMC. Let the utility of household i from choosing channel j at time t, and a vector of covariates associated with the choice be U_{ijt} and $\mathbf{x}_{it}$, respectively. Also, let α_{ij} be oil palm producer i's household-specific and time-constant heterogeneity. We can then write our structural model as:

$$U_{ijt} = \beta_j'\mathbf{x}_{it} + c_{ij} + \varepsilon_{ijt}, t = 1, 2; j = 1, 2, \ldots 4; i = 1, \ldots, N. \tag{3}$$

To allow modelling the choice probabilities via multinomial logit, the following assumptions apply: choices are independent, α_{ij} is normally distributed and independent over time, and ε_{ijt} is independently, identically extreme value distributed. Conditional on the random effect (α_{ij}), the probability that oil palm producer i chooses OPMC j at time t is

$$Prob_{ijt}|\alpha_{i1}, \ldots, \alpha_{i4} = \frac{\exp\left(\beta_j'\mathbf{x_{it}} + \alpha_{ij}\right)}{\sum_{j=1}^{4}\exp\left(\beta_j'\mathbf{x_{it}} + \alpha_{ij}\right)}. \tag{4}$$

The model is identified by setting the coefficient vector of one of the marketing channels and one of the random effects to zero.

In the empirical application, we need to choose between allowing the random effects to be freely correlated, independent, or the same across the utility function. In essence, the latter two options produce a restricted model while the first is unrestricted. Therefore, we empirically tested these options and used the one that best fits our data. We also include time-averages of a subset of variables contained in $\mathbf{x}_{it}$ to allow correlation between the explanatory variables and household-specific unobserved heterogeneity.

Based on our conceptual framework, $\mathbf{x}_{it}$ contains household characteristics (household type, composition, and socioeconomic characteristics), farm characteristics (land holding, scale of production, and crop diversification), as well as community and institutional characteristics (distance to nearest industrial oil palm company, access to paved roads, availability of semi-mechanized processing mill, and a daily market in the community).

Results and discussion

This section first presents descriptive analysis from the survey data, followed by insights from the qualitative study on the precarity of livelihoods and the fragility of marketing contracts. The rest of the section presents the regression results on marketing channels and household welfare, (including heterogeneous effect analysis), and then the analysis of factors that determine marketing channel participation.

Descriptives

Figure 2 shows the sample distribution of oil palm producing households by the marketing channels. At baseline (2017), about 58% of households sold their palm fruits to industrial companies either directly via marketing contracts (≈20%) or through buying agents (≈38%); the rest sold their fruits in the community spot market (≈29%) or processed into red palm oil (≈12%). However, there is considerable time dynamics in the choice of channel (see Table A3, in the Online

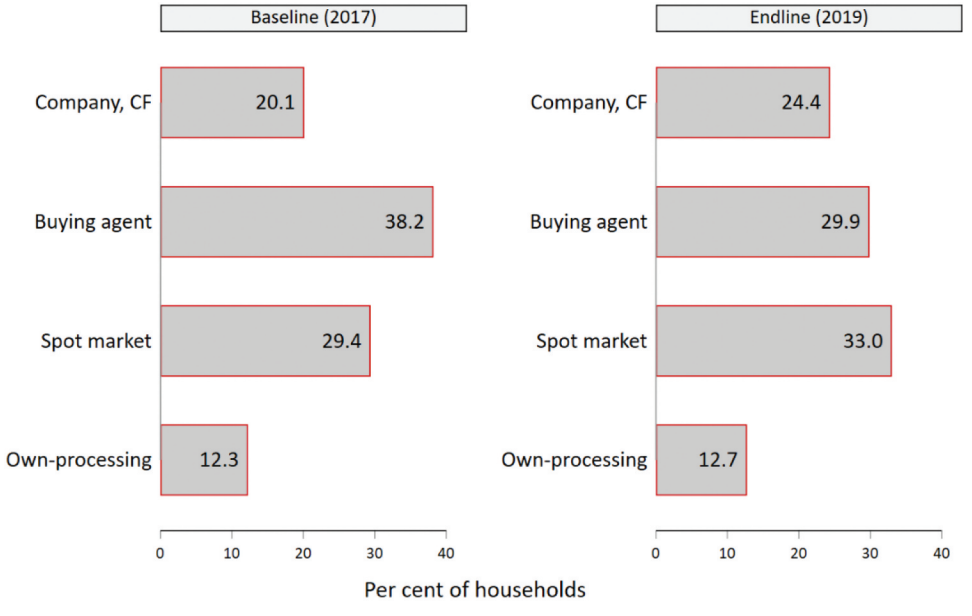

Figure 2. Oil palm marketing channels.

Appendix), meaning that households are not always stuck in a particular marketing outlet. Two years hence, participation in both the contract and spot market channels increased by roughly four percentage points while sales to companies via agents dropped by about eight percentage points. Own-processing remained about the same as baseline proportions.

Table 1 presents the average characteristics of the overall sample as well as the marketing channels, and shows that the null hypothesis that the characteristics of households are similar across the channels is rejected at the 0.05 level for 22/30 (73%) of the variables. The following are highlights of what the descriptive analysis suggests. In general, a higher percentage of females (relative to males) are found in the spot and processing channels. All farm characteristics differ significantly (p-value = 0) across the channels. For instance, contract participants have the largest average farmland and mean quantity of fruits harvested.

In theory, price is an important determinant of the choice of marketing channel. Those who sold to industrial companies through contracts received 13% higher prices than the sample average, and about 10% higher than those who sold to the same companies through buying agents. Except for transfers and wage employment income participation, all reported income and wealth variables differ significantly (p-value = 0) across the channels. Processing households have the highest mean per capita income, followed by marketing contract households. However, contract households are the wealthiest in composite assets, followed by processing households. About 43% of households reported that they did not have enough food during some month(s) of the year. However, this differs significantly by marketing channel: food insecurity incidence is lowest among processing

Table 1. Mean summary characteristics, by marketing channel.

	Total	Contract	Agent	Spot	Process	Joint test
Variables	n = 1272	n = 283	n = 433	n = 397	n = 159	p-val.
Household characteristics						
Percent female-headed household	19.4	15.2	18.5	23.2	20.1	0.069
Age of household head	52.4	52.9	51.9	52.1	53.4	0.527
Mean age of adult household members	43.5	43.4	43.4	43.3	44.4	0.820
Household size	4.3	4.3	4.3	4.2	4.5	0.655
Number of dependants	1.6	1.6	1.7	1.6	1.8	0.400
Number of working-age members	2.7	2.7	2.7	2.6	2.7	0.911
Dependency ratio (%)	73.4	67.9	74.8	73.2	79.5	0.545
Ratio of female to male adults	1.2	1.1	1.2	1.3	1.3	0.012
Head's years of schooling	7.7	8.6	7.5	7.1	8.0	0.001
Female adults mean years of schooling	5.9	6.6	5.5	5.8	5.7	0.005
Male adults mean years of schooling	8.9	9.5	8.6	8.5	9.2	0.001
Farm and marketing characteristics						
Farmland (ha)	3.3	4.3	3.0	2.7	3.7	0.000
Oil palm farmland (ha)	2.2	2.7	2.0	1.8	2.4	0.000
Quantity of palm fruit harvested (t)	9.4	15.2	7.6	7.3	9.3	0.000
Oil palm yield (t/ha)	5.1	6.8	4.1	5.0	4.9	0.000
Oil palm fruit producer price (US$/t)	68.6	77.4	70.7	63.1	61.4	0.000
Transport cost of marketing oil palm (US$/t)	4.7	10.9	4.2	1.4	—	0.000
Length of transaction relationship (years)	7.8	9.3	7.3	7.7	7.2	0.000
Other non-food cash crop producer (%)	32.5	44.2	29.6	24.2	40.2	0.000
Income, wealth & welfare						
Real per capita income (PPP US$)	1410	1993	1175	1014	2003	0.000
Received transfer income (%)	28.0	27.6	25.6	31.7	25.8	0.225
Received wage employment income (%)	14.0	13.4	11.1	16.4	17.0	0.104
Livestock (cow equivalent)	1.9	2.5	1.7	1.6	2.6	0.000
Normalized composite asset index (0–1)	0.37	0.44	0.36	0.34	0.40	0.000
Experienced seasonal food insecurity (%)	43.1	35.7	51.7	46.1	25.2	0.000
Community characteristics						
Community has daily market (%)	20.2	19.4	10.9	33.2	14.5	0.000
Community accessible by all-weather road (%)	37.6	48.8	37.0	28.7	41.5	0.000
Community has oil palm processing mill (%)	34.7	33.9	26.8	34.5	58.5	0.000
Distance to industrial mill (km)	17.8	9.4	15.1	25.3	21.5	0.000

These summary statistics are based on the pooled sample.

households (≈25%) and highest among agent households (≈52%). Lastly, all community characteristics show significant differences across the channels.

Precarious livelihoods and the fragility of marketing contracts

Using the qualitative data, we address the first research question by interrogating the role of trust across the different OPMCs in Ahanta West and Mpohor. We observe that hardships brought on by material deprivation can undermine the ability of poor farmers to nurture and maintain trust. Indeed, the survey data shows that material wealth and trust are generally positively correlated (Figure 3). Mistrust in turn serves as an obstacle to long-term transactional relations (Asante, 2018; Granovetter, 2018; Portes, 1998).

Thus, even though social relations in the study communities were cordial, economic transactions at the community level were marred by the practice of farmers side-selling in violation of verbal contracts, on the one hand, and rigging sharp practices like scale-rigging by agents or aggregators, on the other. As such, farmers were unable to convert the 'social goodwill' inherent in their social relations into 'social capital' that may support their economic activities.

Mistrust is reproduced in transactions between smallholders and the estates, making contractual relations extremely tenuous. Resource-providing contracts are all but absent in our sample because, as reported by a manager of one of the industrial firms, side selling is common:

> Even if you give them [farmers] help by advancing fertilizer to them, when it comes to selling to you so that you will make the deduction, they'll go and sell it to your competitor so that they will dodge the deduction. (Key informant interview, BOPP, 15 April 2019)

Thus, a combination of material deprivation and the desire to avoid repayment for inputs, leads to the rampant violation of contracts or informal agreements, especially among the poorest farmers.

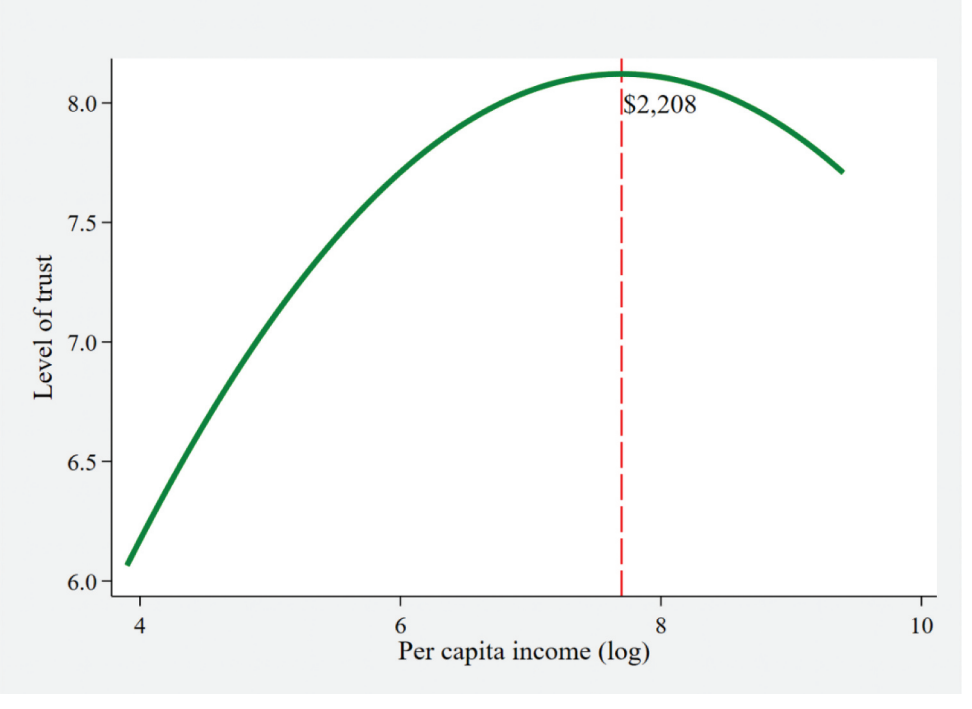

Figure 3. Relationship between trust (number of years producer sells to the same buyer) and income.

Even collective efforts by individual farmers to overcome the transactional cost of access to industrial companies are not immune to the corroding effects of mistrust and often end up collapsing. Relations often get so acrimonious in some groups that some farmers would rather sell to agents than collaborate with their colleagues to participate in joint-contracts with companies. After leaving one such joint arrangement, a respondent said that at the moment:

> I just handle my farming activities myself and sell my palm fruits to the agents after harvest and then I am done. I do not have other engagement with anyone aside that. (Male HH, Adum Dominase, 18 April 2019)

The result is a paradoxical situation where farmers are enmeshed in dense social relations but are at the same time isolated when taking consequential economic decisions.

In the next section, we use insights from the qualitative analysis to quantitatively examine the welfare differences of participation in the various marketing channels and then identify correlations of participation in better remunerative channels.

Marketing channels and household welfare

Does it matter (in welfare terms) which marketing channel a producer uses? We show that answering this question appropriately requires: (a) adjusting the regression results for both heterogeneity and idiosyncratic endogeneity, particularly when income is used as the welfare indicator; and (b) using multiple welfare indicators to provide a better understanding of which dimension is influenced by the choice of marketing channel. Table 2 reports estimate that account for only heterogeneity endogeneity (columns 1, 3 & 5), and both heterogeneity and idiosyncratic endogeneity (columns 2, 4 & 6). Joint tests of the selection correction terms show that the null hypothesis of idiosyncratic exogeneity cannot be rejected in any of the welfare equations except per capita income. The Online Appendix presents detailed instrumental variable analysis (Table A4) as well as alternative estimates of the effect of the OPMCs on welfare using the inverse-probability-weighted regression adjustment (IPWRA) procedure. Comparing the results that adjust for neither heterogeneity endogeneity nor idiosyncratic endogeneity (Online Appendix Table A5) and those that do (Tables 2 and 3) show the importance of addressing the research question using panel data. Columns (2), (4) and (6) of Table 2 reports the results of the IPWRA procedure. The following are the main regression results.

Given the general results from the received literature, one could expect marketing contracts to be the most rewarding in terms of material wellbeing. Figure 4 plots the cumulative distribution function (CDF) of per capita income by the marketing channels, showing that the CDF of the households that participated in the contract and processing channels are strongly shifted to the right of those using the agent and spot market channels. This suggests that the contract and processing groups were better off in the income dimension of welfare.

Indeed, without further scrutiny, one would erroneously conclude that the contract and processing channels yield higher income than the other channels (Table A5). However, after accounting for heterogeneity endogeneity using the panel data, we find no significant income differences between the marketing channels (Tables 2 and 3). The asset and food (in)security measures, however, tell a consistent story about the superiority of the contract and processing channels relative to the agent and spot channels, even after adjusting for heterogeneity endogeneity (and selection bias). To get a better sense of the magnitude of the channel choice effect in the composite welfare equation, we divided the point estimates by the cash transfer coefficient (0.00031).[2] The results show that, compared with marketing contracts, using the agent and spot market channels reduce welfare by about $952 and $1,135, respectively. This is corroborated by a respondent in the qualitative study who asserted that after bypassing the buying agents to sell directly to the companies, ‘our living standard has improved a little’ (Female HH, Adum Dominase, 18 April 2019). We also found that processing yielded higher asset wealth than the Spot channel but not the Agent channel.

Table 2. Welfare regression showing the impact of the marketing channels.

	Income		Asset index		Food insecurity	
	CRE	CFM	CRE	CFM	CRE	CFM
Buying agent vs. contract	−0.147	−0.166	−0.295**	−0.237*	0.110***	0.104**
	(0.137)	(0.137)	(0.123)	(0.129)	(0.040)	(0.041)
Spot market vs. contract	−0.194	−0.243	−0.352**	−0.351**	0.094**	0.088*
	(0.144)	(0.149)	(0.140)	(0.148)	(0.043)	(0.047)
Processing vs. contract	0.041	−0.082	0.022	−0.003	−0.105**	−0.109**
	(0.197)	(0.199)	(0.172)	(0.177)	(0.048)	(0.052)
Female headed household	0.057	0.080	−0.295*	−0.252	0.129***	0.122**
	(0.105)	(0.163)	(0.164)	(0.375)	(0.047)	(0.055)
Age of household head	0.018**	0.026*	0.001	0.005	0.002**	0.003*
	(0.009)	(0.015)	(0.010)	(0.025)	(0.001)	(0.001)
No. of female adults	−0.140***	−0.196***	0.137**	0.086	−0.017	−0.016
	(0.035)	(0.056)	(0.056)	(0.115)	(0.015)	(0.019)
No. of male adults	−0.102***	−0.112**	0.171***	0.138	0.018	0.019
	(0.032)	(0.051)	(0.054)	(0.128)	(0.018)	(0.020)
Dependency ratio	−0.000	−0.001	0.001*	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Primary school	0.205	0.147	0.341**	0.328	0.034	0.036
	(0.156)	(0.202)	(0.158)	(0.323)	(0.046)	(0.055)
Pre-high school	0.541***	0.644***	0.761***	0.955*	0.010	0.010
	(0.181)	(0.242)	(0.209)	(0.563)	(0.052)	(0.062)
High school & above	0.757***	0.858***	1.084***	1.297*	0.004	0.008
	(0.219)	(0.305)	(0.281)	(0.784)	(0.072)	(0.088)
Adult female school years	−0.004	0.008	−0.014	−0.018	−0.007*	−0.008
	(0.008)	(0.014)	(0.021)	(0.033)	(0.004)	(0.005)
Adult male school years	−0.001	−0.005	−0.054**	−0.064	−0.011**	−0.010
	(0.011)	(0.020)	(0.023)	(0.054)	(0.005)	(0.007)
Livestock (cow equiv.)	0.051***	0.035**	0.014	0.007	−0.007	−0.005
	(0.008)	(0.016)	(0.014)	(0.031)	(0.004)	(0.007)
Land per capita	0.098***	0.121***	−0.146**	−0.233	−0.014	−0.012
	(0.031)	(0.042)	(0.072)	(0.200)	(0.010)	(0.014)
Cash crops aside oil palm	0.206***	−0.031	0.099	−0.118	0.041	0.056
	(0.080)	(0.167)	(0.125)	(0.351)	(0.038)	(0.071)
Cash transfers	0.002***	0.001**	0.001	0.000	−0.000	−0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Distance to capital	−0.022	−0.024	−0.076***	−0.084***	0.001	0.001
	(0.019)	(0.020)	(0.027)	(0.032)	(0.011)	(0.011)
All-weather road	0.172***	0.039	0.091	−0.060	−0.066**	−0.060
	(0.060)	(0.117)	(0.082)	(0.192)	(0.029)	(0.043)
2019 vs 2017	0.129**	0.080	−0.059	−0.161	−0.101***	−0.094***
	(0.055)	(0.076)	(0.063)	(0.136)	(0.025)	(0.030)
Inverse Mills Ratio 1		−0.010		−0.057		0.006
		(0.020)		(0.047)		(0.009)
Inverse Mills Ratio 2		−0.005		−0.057		0.010
		(0.032)		(0.093)		(0.015)
Inverse Mills Ratio 3		0.101***		0.086		−0.001
		(0.039)		(0.135)		(0.018)
Observations	1,272	1,272	1,272	1,272	1,272	1,272
R-squared	0.319		0.326	0.326	0.137	0.137
Exogeneity test p-values		0.010		0.610		0.843

Standard errors (in parentheses) are clustered at the household level. ***Significant at 1%, **Significant at 5%, *Significant at 10%.

When welfare is measured by year-round food access or the lack thereof, the results show that the average probability of experiencing seasonal food shortage was about 11 and 9% points higher for Agent and Spot market households, respectively, than it was for contract participating households. Own-processing in particular is superior to all other channels in reducing the likelihood of seasonal food insecurity – the probability of seasonal food insecurity is about 10, 20 and 22% points less among processing households than contract, spot, and agent households, respectively. Why does own-processing have such an important food insecurity reduction advantage? As we have argued, this is because palm fruit harvests are seasonal and output is perishable, and so is the

Table 3. Welfare effects of marketing channels with alternative selection bias correction methods.

	Per capita income (log)		Asset index		Food insecurity (binary)	
	CFM	IPWRA	CFM	IPWRA	CRE	IPWRA
Agent vs. Contract	−0.17	−0.16	−0.24*	−0.46***	0.11***	0.11***
	(0.14)	(0.20)	(0.13)	(0.14)	(0.04)	(0.04)
Spot vs. Contract	−0.24	−0.09	−0.35**	−0.51***	0.09**	0.10**
	(0.15)	(0.21)	(0.15)	(0.15)	(0.04)	(0.04)
Processing vs. Contract	−0.08	−0.00	−0.00	−0.23	−0.10**	−0.10**
	(0.20)	(0.33)	(0.18)	(0.18)	(0.05)	(0.05)
Agent vs. Spot	0.08	−0.07	0.11	0.05	0.02	0.01
	(0.11)	(0.14)	(0.10)	(0.11)	(0.04)	(0.04)
Processing vs. Agent	0.08	0.15	0.23	0.24	−0.22***	−0.20***
	(0.17)	(0.29)	(0.15)	(0.15)	(0.05)	(0.04)
Processing vs. Spot	0.16	0.09	0.35**	0.29*	−0.20***	−0.19***
	(0.17)	(0.29)	(0.15)	(0.15)	(0.04)	(0.05)
Observations	1272	1272	1272	1272	1272	1272

Standard errors (in parentheses) are clustered at the household level. ***Significant at 1%, **Significant at 5%, *Significant at 10%.

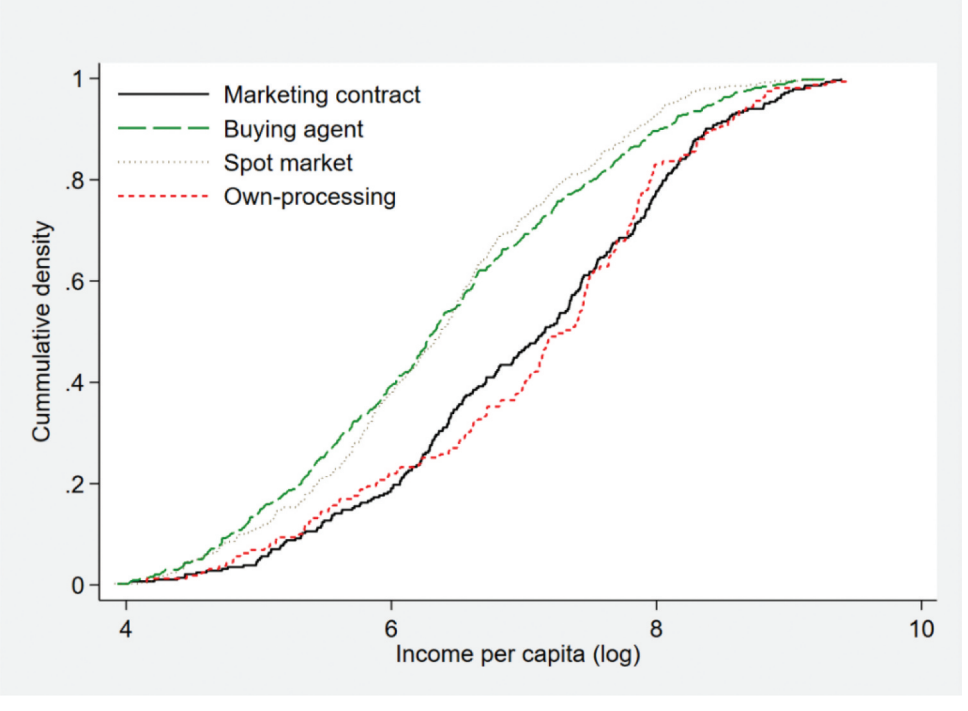

Figure 4. Distribution of income by marketing channels.

income derived from fresh fruit sales. Processing on the other hand allows storage which makes it possible for consumption smoothing.

The qualitative data shows that welfare premium is an important motivation for farmers who switch from the agent or spot market to VI:

> We realized we were not getting much from selling so we switched to processing our palm oil after we realized that farmers in Ahuntomanu (a nearby town) were benefiting from processing their oil. (Male HH, Butre, 23 April 2019)

Next, we explore heterogeneity analysis of the effect of the OPMCs on welfare.

Welfare impact heterogeneity analysis

We explore heterogeneous effects by selected community and household characteristics. We find that the welfare impacts of the marketing channels differ across selected variables in some cases and that the welfare of participants within a channel differs over selected characteristics (Figures A1-A12 in the Online Appendix). First, we consider effect heterogeneity by market access (measured by distance to the district capital and nature of roads). Figure A1 displays the food insecurity-market access slopes, and suggests that the relationship varies by marketing channel. The differences in the probability of food insecurity between the spot channel on the one hand and contract and own-processing channels on the other hand fall with distance to market, turning statistically insignificant after about 30 km and 46 km, respectively (Figures A2 and A4). Thus, beyond some distance thresholds, selling in the spot market does not yield inferior welfare relative to processing and marketing contracts. Additionally, good roads tend to attenuate the welfare premium of marketing contracts and own-processing over the other channels (Figures A4 and A5). Good roads are particularly important for improving welfare among those using the agent channel (Figure A6).

Second, turning to heterogeneity by household characteristics (Figure A7), the overall mean result that contract and processing households are wealthier in assets holds among male-headed households (MHHs) but not female-headed households (FHHs). Also, recall from the overall mean impact estimates that FHHs were significantly more food insecure than MHHs. However, results from the heterogeneity analysis show that this holds for all channels except own-processing for which there is no significant gender gap (Figure 5). Figure A8 also shows that, relative to marketing contracts, own-processing has a significantly larger food insecurity-reducing effect among FHHs. These results suggest that own-processing is more gender-inclusive than the other channels. We also observe that educational attainment does not induce a significant asset-based impact

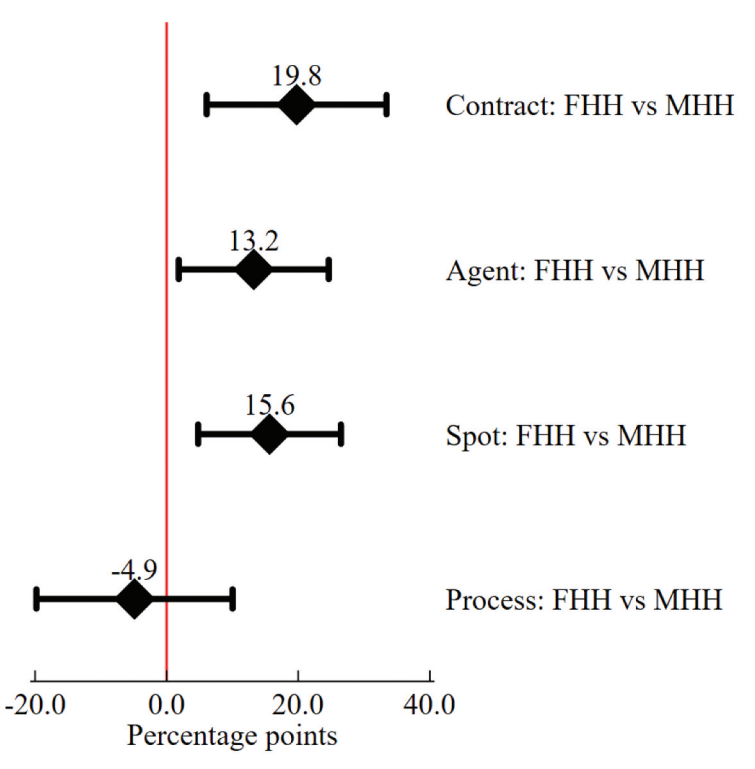

Figure 5. Gendered food insecurity, by marketing channels.

heterogeneity of the marketing channels (Figure A9), and that marketing contracts yield no food security benefits among the less educated (Figure A10).

Finally, we show temporal impact heterogeneity of the marketing channels (Figures A11 and A12). Although the main results showed an overall reduction in food insecurity over time, Figure A11 shows that this was true for all OPMCs except the agent channel. The evidence further suggests that the food insecurity reduction effect of the contract channel (relative to agent and spot) widened significantly over time (Figure A12).

The following caveat must be borne in mind when interpreting these impact heterogeneity results. First, our results could be driven by inadequate statistical power due to the relatively small sub-group sample sizes for heterogeneity analysis. Second, since we have not applied multiple testing adjustment procedures, these results should be taken as exploratory.

In the next section, we examine the factors that promote or hinder participation in the high-return marketing channels (marketing contracts and processing).

What factors determine channel participation?

We asked smallholder farmers directly what their main reasons for choice of marketing channel were. Figure A12 in the Online Appendix graphs their responses. Cash flow, prompt payments and proximity to an industrial company were the two most important reasons for their choice. Table 4 reports parameter estimates from the random parameters multinomial logit (RPML) model, which answers the research question of what factors determine the choice of marketing channel. We note that allowing the random effects to be freely correlated rather than fixed fits the data better as shown by the Likelihood Ratio Test results (Table 4). We grouped the potential drivers of channel choice into four main categories: household characteristics, resources, farm production and price, and community factors. We report the average marginal effects of each variable in Table 5.

First, on household characteristics, the presence of adult females is the most dominant driver of channel selection – an additional female adult increases the likelihood of choosing all other channels relative to marketing contracts; it also decreases the likelihood of using the Agent and Spot market channels relative to processing. The latter finding could be expected because women are known to dominate the oil palm processing space in Ghana (Osei-Amponsah et al., 2012). The probability of processing is not significantly different from zero between households who have no female adult present and those who have only one female adult, but processing probability rises significantly by about four percentage points with two female adults (t-stat = 2.24).

Second, turning to household resources, land has no effect on channel choice, but livestock wealth significantly increases the likelihood of choosing the better remunerative channels (i.e. marketing contract and processing) – the sale of livestock helps overcome transportation and processing cost constraints. It seems that using the agent channel is driven by necessity rather than accumulation – if a household received cash transfer, their probability of using the agent channel decreases by about seven percentage points while their probability of processing goes up by three percentage points (Table 5). As demonstrated above using the qualitative data, farmers who have the means to overcome the entry barriers associated with marketing contracts or VI prefer to bypass the Agents and Spot market channels.

Third, all the farm production and price variables have statistically significant impact on choice of marketing channel. Consistent with the qualitative findings, and as could be expected based on transaction cost economies, scale of production is a key determinant of channel choice – an increase in the quantity of fruits produced significantly (at the 1% level) decreases that likelihood of choosing all other channels relative to marketing contracts; it also increases the likelihood of selling through agents rather than processing or selling at community Spot markets. These results are to be expected because fixed cost of transportation to industrial companies makes such transactions worthwhile only when quantity of output increases. For

Table 4. Drivers of marketing channel choice (RPML with correlated parameters).

Variables	Agent *vs.* Contract	Spot *vs.* Contract	Process *vs.* Contract	Agent *vs.* Process	Spot *vs.* Process	Spot *vs.* Agent
Household characteristics:						
Female headed household	0.347	0.556	0.480	0.145	0.294	0.573
	(0.408)	(0.510)	(0.667)	(0.640)	(0.606)	(0.542)
Age of household head	0.013	0.007	0.018	−0.008	−0.015	−0.015
	(0.013)	(0.015)	(0.019)	(0.017)	(0.016)	(0.015)
No. of female adults	0.293**	0.577***	0.873***	−0.730***	−0.471**	0.578***
	(0.143)	(0.181)	(0.232)	(0.227)	(0.214)	(0.198)
No. of male adults	0.303*	0.247	0.187	0.242	0.175	−0.050
	(0.161)	(0.204)	(0.276)	(0.270)	(0.262)	(0.212)
Head's years of schooling	0.009	0.005	0.080	−0.112**	−0.113**	−0.027
	(0.036)	(0.045)	(0.057)	(0.054)	(0.051)	(0.047)
Adult average school years	−0.068*	0.011	−0.033	−0.005	0.071	0.200***
	(0.041)	(0.052)	(0.064)	(0.061)	(0.058)	(0.057)
Household resources:						
Land available	−0.002	−0.009	0.026	−0.020	−0.030	−0.026
	(0.028)	(0.038)	(0.047)	(0.047)	(0.046)	(0.044)
Livestock (cow equivalent)	−0.172***	−0.204***	0.055	−0.338***	−0.373***	−0.186**
	(0.044)	(0.057)	(0.059)	(0.068)	(0.068)	(0.077)
Cash transfers	0.086	0.635*	0.248	0.060	0.584	1.483***
	(0.297)	(0.384)	(0.514)	(0.509)	(0.483)	(0.440)
Farm production & price:						
Quantity of palm fruits	−0.123***	−0.163***	−0.178***	0.075***	0.037*	−0.125***
	(0.014)	(0.017)	−(0.021)	(0.020)	(0.019)	(0.022)
Lagged fruit price (US$/ton)	−0.107***	−0.213***	−0.293***	0.216***	0.123***	−0.228***
	(0.014)	(0.017)	(0.022)	(0.023)	(0.021)	(0.024)
Cash crops aside oil palm	−0.509	−0.003	1.369**	−2.519***	−2.059***	0.734
	(0.350)	(0.443)	(0.558)	(0.561)	(0.523)	(0.497)
Community level factors:						
Distance to company	0.468***	0.732***	0.755***	−0.252***	−0.027	0.614***
	(0.045)	(0.050)	(0.052)	(0.026)	(0.018)	(0.055)
Daily market in community	1.518***	5.246***	2.660***	0.338	3.718***	9.241***
	(0.422)	(0.532)	(0.691)	(0.669)	(0.620)	(0.871)
All-weather road	−0.262	−0.258	1.124**	−1.704***	−1.759***	−0.381
	(0.278)	(0.359)	(0.461)	(0.467)	(0.445)	(0.406)
Community has a mill	−0.742**	1.278***	5.092***	−6.882***	−5.228***	2.951***
	(0.304)	(0.408)	(0.550)	(0.650)	(0.606)	(0.487)
High oil palm zone	1.052***	2.491***	2.969***	−2.819***	−1.456***	3.550***
	(0.363)	(0.466)	(0.586)	(0.596)	(0.565)	(0.578)
2019 vs 2017	−0.193	−0.003	−0.072	−0.127	0.064	0.190
	(0.138)	(0.174)	(0.218)	(0.206)	(0.198)	(0.184)
Means of Random Effects						
α_1	5.279***					
	(0.317)					
α_2	6.254***					
	(0.359)					
α_3	5.226***					
	(0.340)					
Observations	1,272					
Log likelihood	−1206.94					
McFadden's LRI	0.283					

RPML denotes random parameters multinomial logit. The estimates are from simulation based on 200 Halton draws. Household cluster robust standard errors are in parentheses; *Significant at 10%, **Significant at 5%, ***Significant at 1%. The estimates include time averages of three time-varying covariates. Likelihood Ratio Test statistic comparing the correlated random constant model with the fixed parameters and common random constant model: $\chi^2 = 15.082$, p-value = 0.001; $\chi^2 = 8.023$, p-value = 0.018.

instance, the difference in the probability of choosing marketing contracts between the lowest production quintile (averaging about 1.0 t of fruits) and the third quintile (average of 5.5 t) is 30% points (t-stat = 10.29); the difference between the lowest and highest quintile (about 28.3 t of fruit) is 50% points (t-stat = 22.29).

Table 5. Average partial effects (average probability) of channel choice (per cent).

	Contract		Agent		Spot		Process	
Variables	Prob.	t-stat	Prob.	t-stat	Prob.	t-stat	Prob.	t-stat
Female headed household	−2.13	0.92	0.20	0.07	1.89	0.64	−0.00	0.01
Age of household head	−0.10	1.05	0.12	1.13	−0.06	0.76	0.02	0.82
No. of female adults	−1.93	2.30	−0.67	0.53	1.92	1.89	0.69	2.16
No. of male adults	−1.77	1.87	2.09	1.50	−0.21	0.19	−0.11	0.28
Head's years of schooling	−0.06	0.28	0.06	0.18	−0.13	0.52	0.13	1.75
Adult average school years	0.37	1.54	−0.96	2.71	0.64	2.23	−0.05	0.57
Land available	0.01	0.07	0.03	0.11	−0.10	0.42	0.06	0.87
Livestock (cow equivalent)	1.02	4.06	−0.79	1.72	−0.67	1.72	0.43	4.16
Cash transfers	−0.79	0.45	−3.63	1.31	4.85	2.10	−0.43	0.63
Quantity of palm fruits	0.75	13.3	−0.34	3.00	−0.36	3.55	−0.06	1.98
Lagged palm fruit price (US$/ton)	0.70	10.6	0.26	2.79	−0.76	9.98	−0.20	5.01
Cash crops aside oil palm	2.73	1.27	−7.14	2.24	1.45	0.56	2.97	3.02
Distance to company	−2.94	15.4	0.51	2.38	2.22	18.8	0.21	4.88
Daily market in community	−10.2	6.41	−24.4	8.12	37.6	12.9	−3.00	4.44
All-weather road	1.46	0.88	−2.03	0.78	−2.10	0.97	2.67	3.32
Community has an artisanal mill	3.11	1.70	20.8	7.70	9.90	3.94	7.78	5.24
High concentration oil palm zone	−7.51	3.30	−5.41	1.60	11.3	4.30	1.63	2.34
2019 vs 2017	1.06	1.31	−2.47	2.06	1.47	1.51	−0.05	0.18

The partial effects are computed after the RPML model by averaging over sample observations using the Delta Method.

Palm fruit price enters the model as a lagged variable, showing that an increase in a previous season's mean price significantly (at the 1% level) increases the likelihood of choosing to sell to a company (either directly through marketing contracts or indirectly though agents) relative to the other channels. As with quantity, producers are willing to bear the cost of transactions involved in selling to companies at a given price. For example, a US$10/tonne increase in previous season's price is predicted to increase the average probability of selling through contracts and buying agents by about seven and three percentage points, respectively, but decreases the probability of using the spot and processing channels by about eight and two percentage points, respectively (Table 5).

Fourth, community-level factors are major drivers of channel choice. As could be expected, due to the cost of transportation, increasing the distance from communities to the industrial companies significantly (at the 1% level) increases the likelihood of choosing the other three channels over contracts. For every kilometre away from an industrial company, the mean probability of contract sales falls by about three percentage points (t-stat = 15.4) and the probability of selling at the Spot market increases by about two percentage points (t-stat = 18.8). The difference in the probability of selling to companies directly through contracts is 11% points less at the second quintile distance to a company (10.9 km) than at the lowest quintile (5.8 km); the difference is 31% points lower at the highest quintile (30.1 km). When a community is further away, selling to a company occurs mainly through buying agents, but the likelihood that a producer will sell through Agents (relative to processing their own fruits) falls significantly with distance.

When there is a daily market in the community, all else held constant, the likelihood of selling through all other channels rather than contracts falls and spot market sales dominate. The probabilities of selling through contracts and Agents are 10 and 24% points less, respectively, in the presence of community daily markets; the mean probability of spot market sales is about 38% points higher when daily markets exist in the community than where there are no daily markets.

The key community-level drivers of processing are access to an all-weather road and the availability of an artisanal processing mill in the community. Demand for palm oil, the main output from palm fruit processing, comes from major towns and cities outside the communities. Either traders come from these locations to buy the palm oil or processors must transport the oil to the major demand areas, which is why access to good roads matter for processing incentive, all other

factors remaining the same. The average probability of processing is about three percentage points higher in communities accessible via all-weather roads (Table 5).

Traditional methods of processing palm oil are labour intensive, which is why the availability of processing equipment in a community raises the likelihood of processing significantly (at the 1% level). The probability of processing is about eight percentage points higher (t-stat = 5.24) in communities with semi-mechanised milling equipment; the presence of mills also decreases the probability of using the agent channel by a large magnitude (about 21% points, t-stat = 7.70).

Conclusion and implications

Contract farming, as an important aspect of agricultural commercialization, has been proposed as a viable pathway to poverty reduction for the agrarian poor. Although an industrial crop such as oil palm could have the potential to foster mutually beneficial contract farming arrangements between producers and industrial companies, formal contractual relations between smallholders and processing companies are rare. This is in spite of the fact that two of Ghana's 'big four' industrial oil palm companies are present in the southwestern oil palm belt where we conducted our study. In the absence of formal contracts, farmers self-select into four main marketing channels: (1) selling directly to companies (with verbal contracts); (2) selling to companies through agents; (3) selling on the open market; and (4) smallholder VI (own-processing).

We have demonstrated in this article that farmers' marketing decisions have important livelihood implications, with households involved in smallholder VI and direct sales to industrial companies being significantly better off. The composite welfare premiums associated with marketing contracts relative to the agent and spot market channels are economically nontrivial. Additionally, the Agent and Spot market channels are associated with greater seasonal food insecurity relative to own-processing. Importantly, we show that smallholder VI in the oil palm sub-sector has the potential to reduce gender gaps in food insecurity and poverty. This finding contributes to answering the question of 'which pathways to agricultural commercialisation are the most gender inclusive and effective in reducing poverty and improving food security'[3]. Furthermore, we found significant heterogeneity in the welfare effects of the various channels of market participation, particularly with respect to factors such as market access (distance and road infrastructure).

Our results show that the use of less remunerative channels is driven by household and community level deprivation, including liquidity constraint, poor yields, limited access to mechanized processing equipment and poor road infrastructure. Yet, collective arrangements, such as pooling resources to transport harvests to company mills frequently break down because of the inability of poorer farmers to uphold their side of the agreements. As such, the poorest farmers who stood to benefit the most from collective action were unable to participate in such arrangements.

Our findings have a number of policy and rural development practice implications, particularly for inclusive agricultural commercialization. Since direct sales to industrial companies and own-processing were the most welfare-enhancing, policy interventions could encourage farmers to self-select into these channels by relaxing entry constraints. This could be achieved through a quasi-state agency – such as the recently established Tree Crop Development Authority – that regulates the market for FFBs and enforces contracts. Further, engagements between smallholders and industrial processing companies could be enhanced by accelerating rural infrastructure development – particularly improved roads – which could substantially reduce the cost of transactions. Finally, policy interventions designed to improve access to mechanized processing facilities to boost processing by smallholders would enhance household welfare, particularly among women because ease of access to palm fruit processing reduces welfare-related gender gaps significantly.

Notes

1 We use principal components analysis to derive the weights for household consumer durable assets (mattresses, cooking stoves, radios, televisions, mobile phones, fridges, bicycles, motorcycles and car/trucks), household dwelling characteristics (type of roof, wall and floor of housing, access to decent toilet, type of cooking fuel, and access to water).
2 We follow Finan et al. (2005) in using this approach that makes the coefficients in the welfare index equation intuitively interpretable.
3 The research from which this article emerged as part of a broader research agenda that was aimed at answering the research question: 'Which pathways to agricultural commercialisation are the most effective in empowering women, reducing rural poverty and improving food and nutrition security in Sub-Saharan Africa?' See https://www.future-agricultures.org/apra/.

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