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Participation of Farmers in Market Value Chains: A Tailored Antràs and Chor Positioning Indicator

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Participation of Farmers in Market Value Chains: A Tailored Antràs and Chor Positioning Indicator[*]

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Abstract

This study presents a micro-level indicator of farmers' positioning in the market chain, based on the conceptual framework outlined by Antràs and Chor (2013, 2018). The indicator considers the selling location of a farming household and its crop buyers. Using panel data from the World Bank's 'Living Standards Measurement Study: Integrated Surveys on Agriculture' for Ethiopia and Nigeria, this paper applies the proposed indicator empirically and showcases its superior performance in comparison to existing alternatives at the micro-level. Furthermore, by analyzing the dynamics of farmers' food and total consumption over time and controlling for various household and production characteristics, as well as potential confounding factors, this study shows that moving towards a downstream position in the market chain has a positive impact on farmers' food and total consumption levels. The results are validated through sensitivity analysis and robustness checks.

Keywords: Global value chains, economic development, market chain, farming households

JEL-Codes: Q12; O12; C23

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Introduction

The narrative of the effects of farmers' participation in global markets still needs to be clarified. A strand of the literature shows that smallholder farmers' participation in traditional markets has strong pro-poor outcomes due to a virtuous cycle of higher and more stable household income, higher consumption, greater food security, and improved nutrition (Bellemare, 2010; Montalbano et al., 2018). Another strand argues that market participation may be less beneficial to those who need help to realize the benefits of increased market orientation (von Braun, 1995; Sitko et al., 2014; Carletto et al., 2017). Nevertheless, despite the increased income and improved nutrition resulting from crop commercialization, not all farming households choose to commercialize their crops (Carletto et al., 2017). Specifically, smallholder farmers generally lack trust in markets and prefer to sell their crops to a local trader rather than to a more distant, institutional buyer (FAO, 2014). This is because when facing markets, they are more vulnerable to external shocks for two reasons: they are generally risk-averse regarding the prices of specific commodities (Bellemare et al., 2013), and they have little bargaining power.

Participation in market chains involves various activities necessary for delivering food production to customers, including trade (Kaplinsky & Morris, 2001). In development contexts, market participation is limited to lower-value activities, which restricts farmers' positioning to the backward stages of the market value chain (African Development Bank et al., 2014). Indeed, downward positioning in the market chain is associated with increased employment, better jobs, resources, governance, and food security (Minten et al., 2009; Cattaneo & Miroudot, 2013; Swinnen, 2014; Swinnen & Vandeplas, 2014). Antràs and Chor (2013) developed one of the main rationales behind positioning, building a model that establishes a dependence of downstream stages on those more distant or upstream, due to technological ordering in production. (i.e., stages closer to the end consumers) dependent on those more distant from the final demand or upstream ones. Nevertheless, the literature on how most upstream sectors is structured in value chains remains sparse.

This work aims to connect the two main strands of literature on value chain positioning: i) the trade one on firms, mainly focused on the industrial positioning of suppliers along the (local and global) chain, inspired by the positioning framework proposed by Antràs and Chor (2013; 2018) for firms along the supply chain and ii) the development one on farmers, mainly focused on the rural farmers' commercialization choices and their implied positioning along the (local and global) food supply chain (see, *inter alia*, Migose et al., 2018; Minten et al., 2018, Montalbano et al., 2018). Specifically, this work contributes to the strand of the literature on farmers' positioning by providing a stand-alone measure of upstreamness and downstreamness of rural farmers in market value chains inspired by that proposed by Antràs and Chor (2013) for firms' positioning along the supply chain. The adaptation of Antràs and Chor's (2013) framework to the analysis of the positioning of farmers requires some assumptions and is subject to several caveats. First, only one 'node' of the chain is considered, assuming that farmers can be seen as a distinct category of 'firms.' Farmers who engage in selling their crops to multiple buyers within the same crop value chain, particularly those who transport their produce beyond their local village or district for sale, are presumed to occupy a more advantageous position within the crop value chain. The relatively lower opportunity cost, which refers to the lower value of the forgone opportunity, is among the main reasons for accessing such selling outlets. Additionally, in accordance with Antràs and Chor's theory (2013) regarding supply chain integration, farmers who sell crops with lower price elasticities of demand are considered to have a higher likelihood of being vertically integrated into value chains. This reflects the higher stability of supply-demand relationships for crops with lower price elasticities.

The validity of the proposed positioning indicator for microanalyses is empirically tested using a large panel dataset on Ethiopian households provided by the World Bank "Living Standards Measurement Study" (LSMS-ISA). Ethiopia is chosen due to the presence of a well-established commodity exchange market that facilitates testing complex farmers' market chain structures. An equivalent empirical testing is provided within the framework of the LSMS-ISA data for Nigeria. Furthermore, an empirical mirroring analysis is applied to examine the causal relationship between farmers' food quantity and market positioning for sensitivity testing. Similar to those in the case of food and total consumption, these results confirm the literature that argues for the effects of market positioning on yields of food quantity. In all the empirical applications, the proposed indicator demonstrated superior performance compared to the conventional counterparts typically used in the empirical literature, namely geographical distance to the main market and market chain positioning as a categorical variable.

In summary, this study addresses two key questions: "How do farmers position themselves within the crop market chain?" and "Does improved market chain positioning lead to higher consumption levels?" To answer these questions, the research introduces a novel micro-level measure of farmers' positioning in the market chain, drawing inspiration from the conceptual framework put forth by Antràs and Chor (2013, 2018). This measure considers factors such as the selling location and the buyers involved. Furthermore, the study applies this indicator empirically and finds that changes in market chain positioning have a positive impact on farmers' food and total consumption levels. The results are robust and supported by sensitivity testing and robustness checks.

The remainder of the paper is arranged as follows. Sections 2 describes the literature supporting the study and the theoretical framework. Section 3 presents the proposed indicator for market positioning at the micro-level. Section 4 analyzes the structure of crop value chains in the Ethiopian market. Section 5 exemplifies the empirical approach. Section 6 illustrates the data and reports descriptive statistics. Section 7 presents and discusses the empirical strategy and the results. Section 8 concludes the paper.

2. Literature Review

Agricultural commercialization has long been viewed as an effective strategy to reduce poverty in rural areas (de Janvry & Sadoulet, 2006; von Braun & Kennedy, 1994). Specifically, commercialization is broadly believed to influence rural households' nutritional status positively (von Braun & Kennedy, 1994). Smallholder farmers who enter the market via agricultural commercialization transition from self-subsistence agriculture to growing specific crops for sale (van Asselt & Useche, 2022). In addition, better market positioning facilitates specialization and technology adoption, leading to higher yields. This additional income from agricultural commercialization, market participation, and better market positioning enables smallholders to purchase adequate and healthy calories in the market, improving their nutrition (van Asselt & Useche, 2022).

Scholars agree that the way farmers participate in the market affects their food consumption. However, participation can take various forms and the literature is divided between those claiming a positive effect of vertical commercialization and those claiming a negative effect. For instance, Bellemare and Novak (2017) argue that farmers involved in contract farming experience a reduction of low-producing cycles. In contrast, Kirk et al. (2018) claim that income growth arising from the intensification of crops with low nutrients hampers the consumption of more nutritious food.

Market participation and positioning are affected by access costs and risk preferences (Jensen, 2010; Key et al., 2000; Svensson & Yanagizawa, 2009). Scholars controlling for such factors have long confirmed the positive effects on food security of better marketing choices and crop yields (Ochieng et al., 2016; Montalbano et al., 2018). Sustained agricultural productivity growth requires farmers to achieve greater crop response from fertilizer use by implementing a higher degree of knowledge about soil management and agronomy (Jayne et al., 2019). In this context, international agricultural trade may affect production constraints while influencing land-use patterns, land intensification, and deforestation (Minten et al., 2007). Smallholder farmers also face additional competitive bottlenecks that limit their involvement—low productivity, lack of standards compliance, and high transaction costs (Montalbano et al., 2015).

Nevertheless, cash-crop adoption has the potential to translate in-kind income to cash income (Kennedy & von Braun, 1995), which can, in turn, be used to purchase diversified goods and services (Pingali & Rosegrant, 1995; Romer, 1993). Vertical market integration is particularly relevant in developing economies characterized by market fragmentation, inadequate contract-enforcement mechanisms, and unstable political environments (Fackler & Goodwin, 2001). In these contexts, what drives market positioning is the type of crop buyer.

When selling their crops, farmers interact with intermediaries and large processing and retailing firms or directly with the state and parastatals that manage assembly markets. In competitive systems, spatial arbitrage lowers price differences across the market to the level of transaction costs (Fafchamps, 1992). However, this situation is rare in developing regions where various sources of imperfect spatial-price transmission affect the vertical transmission of prices (such as market power, transport and marketing costs, government intervention, or asymmetric information) affect vertical price transmission (Meyer & Cramon-Taubadel, 2004). Thus, agricultural markets tend to be oligopolistic or oligopsonistic (Kikuchi et al., 2016; Muratori, 2016; Sexton, 2013; Swinnen & Vandeplas, 2014).

Within this debate, the dominant narrative considers intermediaries as non-competitive rent extractors (Montalbano, et al., 2018). Market intermediaries (also called "briefcase" or "bicycle" traders) tend to decrease producer margins while increasing food prices for consumers (Coulter & Pouton, 2001). However, recent empirical studies highlight mostly positive effects from the role of intermediaries on smallholder farmers who are included in contract schemes (Barrett et al., 2012; Bellemare, 2010; Bellemare & Novak, 2017) and high-value export chains (Minten et al., 2009; Subervie & Vagneron, 2013).

The literature also focuses on the links between global and local value chains, attributing the effects on food consumption and productivity of farmers' participation in the former to the connection with the latter. On the one hand, according to Ríos Guayasamín et al. (2016), value chains have the tendency to highlight shortcomings in local traditional systems and reinforce the existing farmers' markets. On the other hand, the links between global value chains (GVCs) and local value chains can create competition for land, labor, and other resources (Feyaerts et al., 2020). Producers complying with standards minimize the risk of being excluded from value chains; they do not necessarily receive higher prices than those supplying noncertified products (Gebreeyesus, 2015).

Global market standards for product characteristics reduce transaction costs within the chain by reducing information asymmetries between buyers and suppliers (Montalbano et al., 2018). Contracts checking for quality production with local suppliers in developing countries specify conditions for delivery and production processes and include the provision of inputs, credit, technology, and management advice (Minten et al., 2009). In this respect, better market positioning is associated with increasing employment, better-remunerated jobs, better use of resources, and food security (Cattaneo & Miroudot, 2013; Swinnen, 2014).

For local farmers, local value chain markets may perform better than GVCs (Wegerif & Martucci, 2019) or represent a step toward GVCs. For example, the effects of an increase in staple food prices vary according to a household's location in regard to local markets (D'Souza & Jolliffe, 2014). Indeed, a farmer's positioning in food distribution chains matters. However, more comprehensive evidence is required given the lack of attention to the issue (Feyaerts et al., 2020), highlighting the urgent need for a micro-level measure of value-chain positioning to aid future research. Better market positioning as an effective way to support welfare and productivity levels is a controversial proposition. If household consumption relies only on total earnings, all kinds of income would have the potential to improve food security (Montalbano et al., 2018). Deviations from this theory arise from multiple sources.

Selling agricultural production to only friends, neighbors, or both is traditionally considered a last-resort, low-productivity option for those facing high transaction costs and lacking a market or those who are highly risk-averse (Timmer, 1997). In particular, both fixed and proportional transaction costs significantly explain household behavior (Key et al., 2000). The relationship between transport costs and the choice of semi-subsistence production is confirmed by several empirical studies (Barrett, 2005; Osborne, 2005; Renkow et al., 2004). In such scenarios, markets fail to develop because global traders reinforce households' inclination toward semi-subsistence production through their limited efforts to reach those households. Furthermore, for most farmers in developing rural areas, interacting with markets is fraught with challenges, to the extent that many opt to limit their businesses to self-subsistence (Fackler & Goodwin, 2001; Fafchamps & Hill, 2005).

Plagued by the scattered nature of the available datasets, the existing evidence is mainly based on case studies and needs more theoretical frameworks for micro-analysis. The inconsistencies in the empirical and theoretical methods used for impact estimation make it difficult to compare results across or within countries (Montalbano et al., 2015). By developing a measure of market positioning for micro-analyses, this paper contributes to the debate concerning the relationship between different market participation nuances and food consumption.

3. The Proposed Positioning Measure

In general terms, positioning in value chains measures the distance between production and final demand (Montalbano & Nenci, 2022). The development and trade literature on value chains present different frameworks for this concept of distance.

In the development literature, a first approach of this concept is to consider distance as "*geographical distance*." Building on von Thünen's (1966) work on the "isolated state," the proximity to markets for agricultural products has garnered attention in the understanding of farmers' market participation (see, among others, Chamberlin & Jayne, 2013; Oosting et al., 2014; Marino et al., 2018). Development scholars often interpret geographical distance as a proxy for "remoteness by road", which is usually conceived as one of the main indicators of market access (Bagchi et al., 2021). Several studies highlight that distance plays a crucial role in farmers' decision-making process regarding the destination market (e.g., Poulton et al., 2006; Fischer & Qaim, 2012; Gyau et al., 2014; Kay, 2016; Corsi et al., 2017). Geographical distance has a significant impact on farmers' marketing choices, in turn determining the type of crop to cultivate (Bagchi et al., 2021).

The debate regarding the effects of market proximity on farmers' production and marketing strategies has been central to the discussions among development scholars (see, *inter alia*, Nanyeenya et al., 2007; Duncan et al., 2013; Gebreeyesus, 2015; Migose et al., 2018; Minten et al., 2018). Scholars seem to agree on the fact that remoteness and proximity to markets are relative terms; as such, they are influenced by context-specific factors like altitude and dryness

(Reardon et al., 2009; Reardon & Timmer, 2014). Moreover, there exist factors going beyond mere geography, like the quality of infrastructure, which may hinder proximity to markets (Kyeyamwa et al., 2008; Mutambara et al., 2013). Therefore, even though it is easy to obtain, the measure of geographical distance from main markets is often overshadowed by other indicators of market proximity, such as "travel time," that better denote additional factors as transaction costs (Vandercasteelen et al., 2018).

However, market proximity might not fully explain market participation (van der Lee et al., 2020). In many cases, geographical distance to end-markets does not adequately explain the intensification and participation patterns observed in rural markets, nor do other factors like travel costs or travel time (Minten et al., 2018). According to Kaplinsky and Morris (2001), three factors define value chains: key buyers, buying dynamics, and critical factors. Therefore, the basic notion behind better positioning in developing contexts rests on selling. In particular, if crop selling does not overtake the local level, then farmers are located upstream in the chain, whereas selling at or beyond the district characterize downstream positioning (Montalbano et al., 2018). As a result, another alternative measure of positioning in value chains is the one proposed by Montalbano et al. (2018), identifying positioning (upstream vs downstream) as a categorical variable; this would be later referred to as a "*Positioning Dummy*", defined by the identity of the intermediaries acquiring the crop.

Regardless of the efforts in understanding value chain positioning in rural contexts, the development literature still lacks a solid theoretical framework for measuring value chain participation. Selling schemes as well as geographical distances represent too naïve measures of value chain positioning. Current "development" measures of value chain positioning are missing to account for a key factor of chains structuring, well known in the early literature of GVCs, quantities. According to the classic view of supply in trade literature, a producer who sell disproportionately to final consumers is considered to be more downstream in the chains with respect to the others (Nenci, 2020).

Trade economists have long been framing the dynamics between quantities and positioning in supply chains by looking at Input-Output (I-O) tables able to provide a detailed picture of inter-industry commodity trading. The trade literature on value chain positioning classically applies I-O tables as the intellectual foundation and computation of any positioning measures (see, *inter alia*, Antràs et al., 2012; Fally, 2012; Antràs & Chor, 2013; Fally & Hillberry, 2015; Miller & Temurshoev, 2017; Wang et al., 2017). The main critique around I-O tables is that they only grasp a few nodes of the chain. For this reason, multiple I-O tables often converge to a unique table called the "World Input Output Table" (WIOT) providing a detailed picture of inter-industry commodity flows both within and across countries (see Table 1). In particular, a WIOT considers J countries and S sectors and contains information on intermediate purchases Z_{ij}^{rs} by industry in each country, the final-use expenditure F_i^r in each country on goods originating from each sector; the value added (VA_J^S).

Table 1: A World Input-Output Table

			Input use & value added							Final use			Total use
			Country 1			$\cdots$	Country J			Country 1	$\cdots$	Country J	
			Industry 1	$\cdots$	Industry S	$\cdots$	Industry 1	$\cdots$	Industry S				
Intermediate inputs supplied	Country 1	Industry 1	Z_{11}^{11}	$\cdots$	Z_{11}^{1S}	$\cdots$	Z_{1J}^{11}	$\cdots$	Z_{1J}^{1S}	F_{11}^{1}	$\cdots$	F_{1J}^{1}	Y_1^1
		$\cdots$	$\cdots$	Z_{11}^{rs}	$\cdots$	$\cdots$	$\cdots$	Z_{1J}^{rs}	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$
		Industry S	Z_{11}^{S1}	$\cdots$	Z_{11}^{SS}	$\cdots$	Z_{1J}^{S1}	$\cdots$	Z_{1J}^{SS}	F_{11}^{S}	$\cdots$	F_{1J}^{S}	Y_1^S
	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	Z_{ij}^{rs}	$\cdots$	$\cdots$	$\cdots$	$\cdots$	F_{ij}^{r}	$\cdots$	Y_i^r
	Country J	Industry 1	Z_{J1}^{11}	$\cdots$	Z_{J1}^{1S}	$\cdots$	Z_{JJ}^{11}	$\cdots$	Z_{JJ}^{1S}	F_{J1}^{1}	$\cdots$	F_{JJ}^{1}	Y_J^1
		$\cdots$	$\cdots$	Z_{J1}^{rs}	$\cdots$	$\cdots$	$\cdots$	Z_{JJ}^{rs}	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$
		Industry S	Z_{J1}^{S1}	$\cdots$	Z_{J1}^{SS}	$\cdots$	Z_{JJ}^{S1}	$\cdots$	Z_{JJ}^{SS}	F_{J1}^{S}	$\cdots$	F_{JJ}^{S}	Y_J^S
Value added			VA_1^1	$\cdots$	VA_1^S	VA_j^s	VA_J^1	$\cdots$	VA_J^S				
Gross output			Y_1^1	$\cdots$	Y_1^S	Y_j^s	Y_J^1	$\cdots$	Y_J^S	$\cdots$			

Source: Antràs and Chor (2018)

In this framework, the share of gross output in sector *r* in country *i* that is sold to the final consumer is equal to $\frac{F_i^r}{Y_i^r}$; this is a first measure of *upstreamness* in the chain. While the ratio $\frac{VA_j^s}{Y_j^s}$ can be considered a measure of *downstreamness* or, using Fally's (2012) terminology, the share of a country-industry's payments accounted for by payments to primary factors. Large values of both ratios are associated with higher levels of upstreamness or lower levels of downstreamness. Although quite informative in terms of size, these measures poorly release information around stage-positioning (Antràs & Chor, 2018). The main limitation of these simple measures is that they are unable to capture the heterogeneity in positioning coming beyond the logic of intermediate output and value added. In particular, these two basic measures may end up delivering exactly the same level of positioning in supply chains (Antràs & Chor, 2019).

In their seminal work on positioning in GVCs, Antràs and Chor (2018) suggest the inclusion in value chain positioning measures of an element ahead of mere quantities: the order number of the producing-stage in the chain. Following this logic, upstreamness in the chain, as developed independently by Fally (2012) and Antràs and Chor (2013) and consolidated in Antràs et al. (2012), is simply defined as the weighted average distance of a considered stage from the final demand; whether or not downstreamness, whose theoretical framework was originally proposed by Fally (2012), is envisaged as the weighted average distance from the primary factors of production. Antràs and Chor (2018; 2022) ultimately developed two main measures of positioning, whose premises and applications have been more recently relaxed (Bolatto et al., 2018; Alfaro et al., 2019; Antràs & Chor, 2022).

Concisely, the authors define upstreamness, U, as an infinite sequence of production stages starting from the end of the chain to the beginning of it, where

$$U_i^r = 1 \times \frac{F_i^r}{Y_i^r} + 2 \times \frac{\sum_{s=1}^{S}\sum_{j=1}^{J} a_{ij}^{rs} F_j^s}{Y_i^r} + \cdots. \qquad [1]$$

In this equation, a_{ij}^{rs} represents the dollar amount of each country's sector needed to produce one dollar's worth of industry output in another country (i.e., $a_{ij}^{rs} = \frac{Z_{ij}^{rs}}{Y_j^s}$). It is important to note that each term in Equation [1] is multiplied by its production-staging distance from final use plus one. In this sense, being at final use implies having a production-staging distance value equal to one (one plus zero); hence why, higher values of U_i^r indicate a more upstream position in the chain.

Conversely, in downstreamness, counting of production-stages starts at the primary factors of production. Following the rationale of Equation [1] and expanding from the $\frac{VA_j^s}{Y_j^s}$ ratio, downstreamness from factors of production is defined as:

$$D_j^s = 1 \times \frac{VA_j^s}{Y_j^s} + 2 \times \frac{\sum_{s=1}^{S}\sum_{j=1}^{J} b_{ij}^{rs} VA_i^r}{Y_j^s} + \cdots; \qquad [2]$$

where b_{ij}^{rs} represents the dollar amount of each country's sector needed to produce one dollar's worth of industry output in another country (i.e., $b_{ij}^{rs} = \frac{Z_{ij}^{rs}}{Y_i^r}$).

At the "macro-global" level, value chains refer to the sequences of production stages leading to the final consumer good, with each stage adding value, e.g., production, processing, marketing, transportation, distribution (Gereffi & Fernandez-Stark, 2016). In domestic value chains, instead, companies produce goods that are either consumed domestically or exported to other countries. According to the classic GVCs literature following Johnson (2014), the only "global value added" contemplated in domestic value chains is the one embodied in exports. However, farmers participating in domestic value chains are able to leverage their comparative advantage at any stage of the chain (De Loecker et al., 2016; World Bank, 2019; De Loecker et al., 2020). Therefore, although entailing information on only one single node of the chain, the analysis of value chains at the farmer level involves numerous actors whose participation in value chains have numerous positive spillovers on the local economy and domestic agri-food value chains (Bellemare et al., 2022).

As such, the adaptation of Antràs and Chor's (2018) framework to the analysis of the positioning of farmers in value chains requires some assumptions and is subject to several limitations. First, at the micro-level, data does not usually permit the retrieval of further information on the market chain, such as the intermediate purchases or the value added generated by each line of crop selling to each buyer. Hence, one can only consider the flow of sequential outputs as no, or very few, information is provided on the ones of inputs. It is also important to clarify that without information on inputs one cannot compute the value added and hence cannot pretend to provide positioning in agricultural value chains rather a decomposition of selling positioning or commercialization positioning that is more sophisticated than those normally applied in the empirical literature.

In addition, agricultural value chains do not follow strict sequential stages like those defined in Atràs and Chor (2018) as “snakes” chains but are much closer to those referred as “flatter chains” or “spiders”, with producers attaining inputs from multiple sources and selling through multiple channels. In particular, Baldwin and Venables (2013) famously introduced the term ‘snakes’ to refer to pure sequential value chains, in which each production stage obtains its inputs from a sole upstream stage. The authors (2013) also distinguish ‘snakes’ from ‘spiders’, which are flatter value chains in which each production stage may source from several upstream suppliers. The measures developed by Antràs and Chor in 2018 and summarized in Equation [1] and [2] apply to all production processes, both ‘snake’-like as well as ‘spider’-like processes.

Moreover, the issues of sequentiality in production has older roots than the seminal paper of Antràs and Chor in 2018. Caliendo and Parro (2015), for example, establish a quantitative framework across Input-Output linkages in models with a roundabout production structure without a clear sequentiality of production. Similarly, Bellemare and Barrett (2006) frame sequentiality of production specifically in agricultural markets by looking at the decision-making process of farmers. According to these two authors (2006), the sequentiality of farmers' decision-making process shapes power along the agri-food market chain by structuring it a sequential way. Specifically, when farmers decide simultaneously, then traders and other downstream actors on the chain hold uneven market power over farmers; whereas if farming households make these choices sequentially, by first deciding whether or not to participate in the market chain as either buyer or seller, and by then deciding how much to buy or sell and from whom to buy or sell, then farmers result to be less vulnerable (Bellemare and Barrett, 2006) and the chain more sequentially structured.

Finally, in 2017, in the Online Appendix[1] of their seminal paper "On the Geography of Global Value Chains", Antràs and Gortari (2017) replicate their obtained partial equilibrium model on the desired locations of production in non-sequential chains. More specifically, they consider a symmetric Cobb-Douglas technology with four stages contributing to the value added, but they assume that these four stages occur simultaneously. Assemblers in target country D have the possibility to source simultaneously each of the required four inputs. According to the authors (2017), the total absence of sequentiality of production leads to two important conclusions: (i) geographical distance from the final use matters; (ii) the frequency of domestic chains is more volatile with respect to changes in trade costs with respect to the case of sequential value chains. In particular, at the macro level, most remote countries are less likely to be a source of inputs than countries closer to the final use. Besides, the relative prevalence of domestic non-sequential value chains in destination country D declines much faster with trade cost reductions than in the case of domestic sequential value chains (Antràs and Gothari, 2017).

Moreover. there are some crops, like maize and cassava, which presents sequentiality traits more typical of their cropping process than others (Legesse & Gezmu, 2023; Masamha et al., 2018). These crops require a production flow that is sequential in nature like the provision of inputs, cultivation and harvesting, post-harvest handling and processing (Bamber et al., 2014). Even more important, according to Bamber et al. (2014) is the order of post-production activities like the marketing and distribution of the final product aiming to increase the shelf life of products, reducing losses, and constituting a large share of the value-added in agricultural goods. However, this sequentiality may be severely hindered by uncoordinated or inefficient distribution channels inhibited by the lack of a market information system regarding production and prices (USAID, 2013). Besides, as in the case of maize, several food losses are recorded at the farm level before selling activities during shelling and storage practices (USAID, 2015).

The discussion around the sequentiality of production has lost importance even in the recent approaches proposed by Antràs and Chor themselves. In a more recent work, Antràs (2020)

[1] Available at https://data.nber.org/data-appendix/w23456/.

investigates value chains within a broader framework away from strictly sequential production processes and “macro” analyses. A new definition of participation in value chains also comes into place: a producer participates in value chains if it contributes value to at least one stage of the chain. This demarcation is clearly agnostic about the specific form of value added and the chain configuration (Antràs & Chor, 2022).

Moving beyond theory, the assumption of strictly sequential, value-adding production stages has severely lost its strength in the face of the latest patterns of global integration and value addition (Davis et al., 2018). Especially in developing regions such as sub-Saharan Africa, the production cycle require closer interaction between producers and suppliers, with activities undertaken in parallel rather than in sequence (Morris et al., 2012). As such, nowadays, especially at the micro level, “snake” sequential chains have left space to flatter and wider chains that still maintains some sort of sequential order but are more complex and involve activities taking in place in parallel. This is the case of farmers’ value chains.

In this regard, a key driver of chain participation as well as structuring in value chains is vertical integration. Yet, vertical integration per se is not necessary for value chain participation as more often practitioners observe that farmers are part of a value chain even without a contract (Dihel et al., 2018). In this framework, the likelihood of vertical integration or the premises for it make farmers most likely to better position in the chain. In their groundbreaking work on GVCs structuring in 2013, Antràs and Chor devote great attention to vertical integration as defined by the price elasticity of demand of the good sold along the chain. Lower price elasticities of demand yield greater chances to be vertically integrated in the chain.

Given the discussion above, Table 2 proposes a rough adaptation of Table 1 for a generic farmers’ market chain. Note that this cannot be considered as the micro counterpart of Table 1 as it does not include the flows of inputs but only the sequential distribution of outputs. Likewise, at the micro level, in agricultural value chains, given the current data available, one can only focus on one node of the chains, i.e., farmers. The structuring of agricultural value chain relies on the role of intermediaries as production processes do not pertain to the sole farm level, but largely expand in the post-harvest process, spreading from storage to selling at wholesalers. Similarly, value chains in agriculture are crop-specific, as such, any positioning measurement needs to be evaluated separately for each crop market.

Table 2: Agricultural Value Chain Illustration Table

	Household Final Crop Sold			**Total Crop Sold per Household**
	Buyer 1	...	*Buyer S*	
Household 1	C_1^1	…	C_1^S	Y_1
…	…	C_i^r	…	Y_i
Household J	C_J^1	…	C_J^S	Y_J
Total Crop Sold per Buyer	C^1	…	C^S	

As suggested in Antràs & Chor (2019), a naïve measure of market positioning comes from simply reducing the measure proposed by Antràs et al. (2012) to the share of a farmer output sold to final consumers. Hence, positioning in crop selling chain is simply the share of crop sold by each farming, C_i^r, with respect to the total crop sold along the chain, Y.

3.1 A Micro-level Downstreamness Indicator À la Antràs and Chor

Theoretical research at micro-level has received less attention, even though chain construction is no less important for understanding the actor chain's performance (Antràs & Chor, 2022). This is because, at the micro-level, there is a fundamental data limitation. Usually, the available data does not allow for the retrieval of additional information on the market chain, including intermediate purchases or the value added at each selling stage to each buyer.

Indeed, there has been a recent wave of studies proposing measures of firms' participation in GVCs; however, they lack a unified framework. Among these studies, some of them result in a firm's participation index similar to the one envisioned in the input-output based literature (Veugelers et al., 2013; Giunta et al., 2022; Nenci et al., 2022) using as proxy of a firm’s participation in GVCs the percentage of imported intermediates over total inputs. Although ending up with different metrics, those studies share a certain degree of common ground based on the assumption that a two-way trade flow is essential to qualify the participation to GVCs.

Building upon these seminal papers, this study proposes a modified positioning indicator for agricultural value chains that focuses on farmers. In agricultural value chains, farmers trail a sequence of intermediaries through which crops pass from farmers to processors and then retailers and, engage in different value-adding opportunities (Mussema et al., 2021; Lu et al., 2015). As already mentioned, in farmer’s value chains, selling position is interpreted in view of Montalbano et al. (2018) as the identity of the intermediary to whom farming households sell their crops along the chain. Based on the reasoning of these authors, commercialization stages are numbered based on the downstream position of the acquiring intermediary in the chain (i.e., more downstream intermediaries are associated with higher values of Selling Position). Specifically, based on Table 2, the proposed measure can be expressed as:

$$D_i^r = \text{Selling Position n.}1 \times \frac{C_i^r}{Y} + \text{Selling Position n.}2 \times \frac{C_i^r}{Y} + \cdots; \qquad [3]$$

where the first integer term indicates the Selling Position number (i.e., the chain positioning of acquiring intermediaries), C_i^r equals the quantity of crop sold by each household, and Y is the total quantity of that crop sold along the crop-selling chain.

In brief, positioning in value chains can be seen as the extent to which one takes to arrive at final demand (Mancini et al., 2023). However, there are features such as distance and output buyers, commonly discussed in the development literature, that are not considered in the existing trade literature on firms in GVCs; as well as there are aspects of it like quantities sold which are not considered in the development literature.

In brief, there are three main reasons explaining why the current measures for chain positioning, coming from the development and trade literature on value chains, are not working: (i) lack of a "stand-alone" indicator ending up with chain-feature-specific estimates; (ii) lack of information completeness leading to fragmented interpretations; (iii) lack of consideration for vertical integration generating an exogenous boost in positioning.

3.2 An Amended Micro-Level Downstreamness Indicator À la Antràs and Chor

In particular, the proposed à la Antràs and Chor measure in Subsection 3.1 presents some important caveats requiring additional specifications to be made. First, despite the inclusion of Selling Position in the chain, the measure considers only to *whom* the crop is sold but not *where* it is sold (i.e., if outside/inside the village, the district, or the region). Secondly, there is no concern in Equation [3] for the fact that farmers sell to multiple buyers/stages in the chain.

Farmers geographically closer to final markets are facing smaller transport costs and have the potential to gain extra profits than those more distant; it is, thus, worth exploring the welfare effect of positioning, net to geographical distance. Nevertheless, positioning in value chains is highly affected by trade costs. Specifically, in GVCs, there exists, on average, a negative association between changes in trade costs and positioning (Mancini et al., 2023). Hence, it sounds contradictory that, at micro level, there are farmers willing to travel outside their own region to sell their crop to a distant buyer. The underlying reasons around the choice of choosing a distant buyer are well-known in the literature thanks to seminal work of Fafchamps and Hill (2005). According to the authors, first, the choice of selling crop to a distant buyer is non-linear across wealthy and poor farmers; secondly, it seems to be determined by factors going beyond mere transaction costs like the shadow value of time and crop quantities to be sold. Farmers selling large quantities are more likely to sell to a distant buyer given the increasing returns in their own transport (Fafchamps & Hill, 2005). Taken together, one could easily argue that farmers selling to a more distant buyer are able to attach to these selling outlets lower opportunity costs than their counterparts selling just locally and, show better levels of performance; thus, they are more likely to be integrated vertically in the chain (Minten et al., 2019).

One must also consider what is the demand of the crop defining the chain under analysis. Price elasticities of demand are crucial in structuring value chains. According to Antràs and Chor's (2013), if the quantity demanded faced by the final buyer is sufficiently elastic downward vertical integration will occur in the final stages of the supply chain; otherwise, it will occur upward. Following up this theory, farmers selling crops with low price elasticities of demand (as it is commonly the case for all agricultural commodities) are more likely to be vertically integrated in the market chain. Moreover, following common economic wisdom, lower price elasticities imply more stable quantities demanded making vertical integration mechanisms safer investment opportunities than those in unstable markets. To this end, there is the need to further amend Selling Location to incorporate price elasticity of demand, ρ, as a tuning parameter.

Finally, the proposed indicator does not ponder on the reality that farmers sell their crop to multiple buyers in the crop value-chain and that some buyers of agricultural products may relate to the same stage of the crop selling chain, arising several lateral chains beyond the main vertical one (Liverpool-Tasie et al., 2021). Longer chains with more production steps presume lengthier calculations and bigger value ranges for the proposed downstreamness indicator than shorter ones. A stand-alone measure for positioning in value chains needs to weigh up for the fact the farmers' positioning must be comparable independently from the number of buyers or the length of the chain. A viable way to sort this out is to transform the indicator in Equation [3] from a "stage" indicator to an "index-score" indicator.

In brief, the micro-level downstreamness indicator à la Antràs and Chor in Equation [3] needs to be amended in order to develop a "stand-alone" indicator, coping with information completeness of its alternatives, as well as considering the chances for farmers to be vertically integrated in the chain, as follows:

$$D_i^r = p_i^r \times \frac{C_i^r}{Y} \times l_i^{r\,1/(1-\rho)}; \quad [4]$$

where p_{ij}^{rs} equals $\frac{Selling\ Position\ Number}{Total\ Number\ of\ Selling\ Positions}$, l_{ij}^{rs} equals $\frac{Selling\ Location\ Number}{Total\ Number\ of\ Selling\ Locations}$, C_i^r equals the quantity of crop sold, and Y equals the total quantity of that crop sold along the crop market selling chain. It is important to note that farming households are commonly involved in multiple crop value chains. Hence, the resulting positioning value attached to them will be the average of their positioning score in each single crop selling chain.

The mathematical formulation of the proposed indicator draws inspiration from Antràs and Chor's (2018) "stage" positioning indicator. Equation [4] yields values between 0 and 1, reflecting the standard inelasticity range [0; 1] of price elasticities. A value of 0 indicates perfect price demand inelasticity, while a value of 1 represents unitary price elasticity. The scores obtained from the indicator exhibit significant variation, as they are highly sensitive to factors such as selling position, quantity sold, selling location, and the price elasticity of demand.

A final remark needs to be made on the reasoning behind the turning parameter 1/(1- ρ). Following consumer demand theory, the results from output optimization have negative compensated own-price responses (Deaton & Muellbauer, 1980). These compensated own-price elasticities are, as predicted by theory, negative for the vast majority of commodities. Price elasticities of demand that are close to minus one suggests that the considered commodities are own-price unitary elastic (Tafere et al., 2010). In this context, crops usually report very low values of price elasticities of demand with maize and sorghum among the ones with lower values. Following Antràs and Chor (2013)'s theory (see Section A.2 in the Appendix for further details), price elasticity of demand ρ, is transmuted in Equation [4] as the tuning parameter 1/(1- ρ). This tuning paramer is equal to one, the lower the values of price elasticity demand (the usual case for crops). Hence, as theorized by Antràs and Chor (2013), farmers selling crops with lower elasticity values generally present higher chances to be vertically in the chain but also tuning parameters closer to one; whether farmers selling commodities with higher elasticities have lower chances to be vertically integrated in the chain and higher tuning parameters resulting in lower values of downstreamness (see Equation [4]).

The rationale behind the emphasis on price elasticity of demand stems from the understanding that buyers, particularly those operating in market chains with high demand volatility, may adopt a dual sourcing strategy. This strategy involves maintaining a select group of "reliable" farmers to cater to stable demand, while relying on spot purchases from local farming households to address unexpected surges in demand (Boudreau et al., 2023). Therefore, ensuring demand stability becomes a crucial aspect of the buyer-seller relationship. In rural settings where formal contracting institutions are limited, long-term relationships between farmers and buyers, characterized by informal agreements based on the future value of the relationship, prove mutually beneficial (Macchiavello, 2022). As highlighted by Macchiavello and Morjaria (2021), selling crops to well-established processors yields greater profitability compared to home-processing. Thus, beyond theoretical foundations, price elasticities of demand have substantial empirical implications for farmers' commercialization strategies and their positioning in the market.

In conclusion, the proposed amended indicator comprises features and elements of both strands of literatures like “selling position” and a measure of “selling location” or distance from the development literature; as well as the “crop ratio” and the production-stage distance structure in the equation from the trade literature on value chains. Moreover, a leading factor in Antràs and Chor (2013)’s seminal paper on value chain structuring is enhanced for consideration: the price elasticity of demand. Price elasticity of demand is added as a tuning parameter in the equation.

To illustrate the proposed indicator in a more relatable manner, let's consider the example of a farmer selling a substantial quantity of wheat, which is a crop with low demand elasticity, to a private company located outside their district. This scenario proves beneficial for both parties involved: from the farmer's perspective, selling to a private company guarantees predictable and well-defined profits from their farming activities. On the company's side, sourcing wheat from local farmers is generally more cost-effective than acquiring it from abroad. Moreover, the farmer's opportunity cost of selling outside the district is lower compared to selling to a closer but less profitable outlet (often considered the "easy-instinctive choice"). For the company purchasing the crop, the more stable or inelastic the demand for wheat, the greater the likelihood of establishing a contractual agreement and vertically integrating this selling-buying activity.

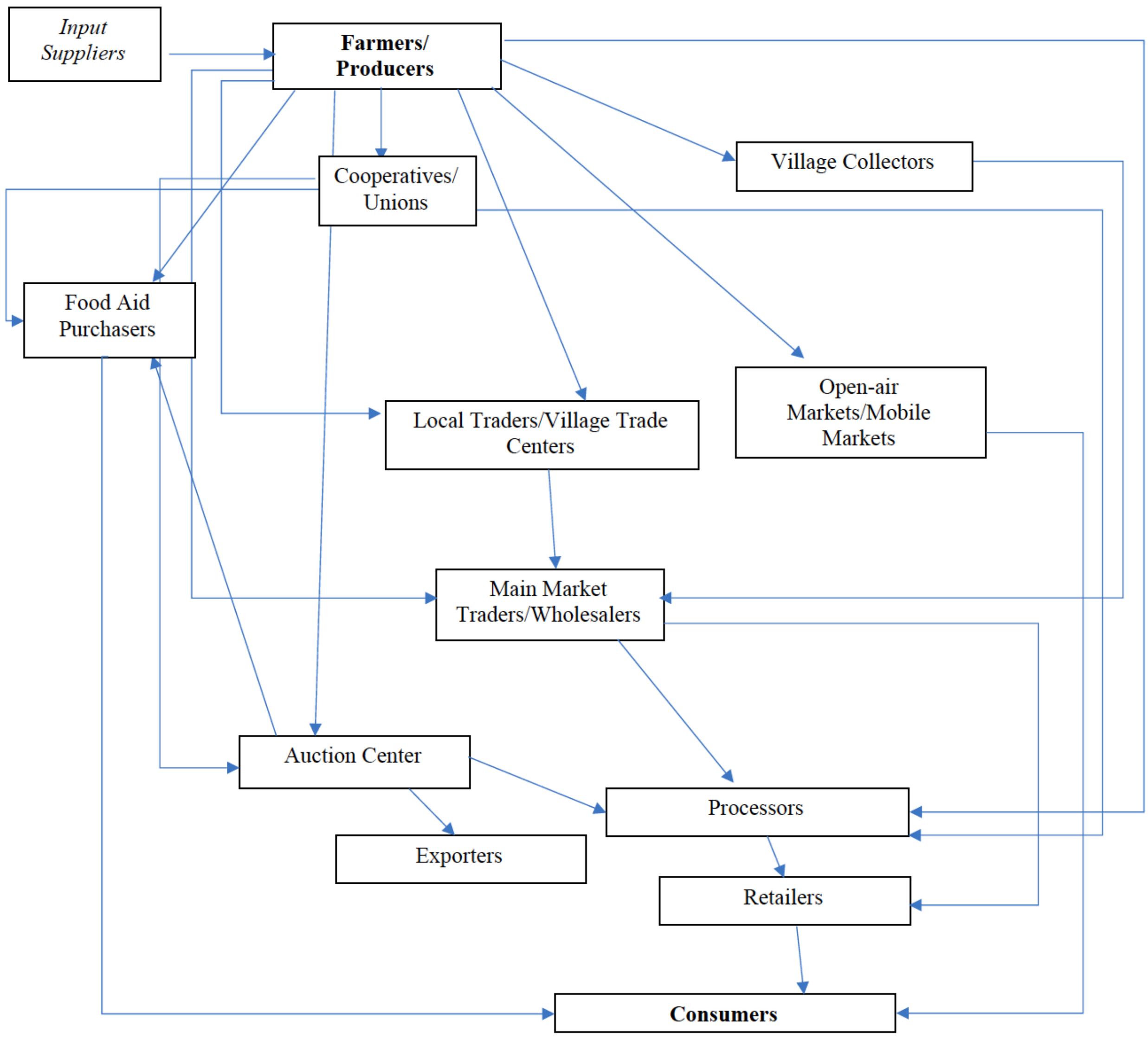
In brief, the proposed amended positioning indicator is built based on the advancement steps the literature has recently taken on positioning. In particular, the indicator is raised and amended through the following stages:

1) positioning is defined through the simplest version of positioning in commercialization reducing Antràs et al. (2012) to the share of total gross output $\frac{F_i^r}{Y}$;
2) the proposed indicator accounts for the novelties of Antràs and Chor (2013; 2018) introducing production-staging as a key assumption in the equation in point one intended as the identity of the intermediary acquiring the crop like in Montalbano et al. (2018). But the assumption of sequential production stages is relaxed on the basis of more recent approaches, global integration and value addition, that are agnostic about the specific form of value added and the chain configuration (Antràs & Chor, 2022; Davis et al., 2018);
3) it adds a new feature to the flow of reasoning performed by previous scholars on positioning by considering not only to *whom* the crop is sold but also *where* it is sold (i.e., if outside/inside the village, the district or the region);
4) price elasticity of demand is also considered given its relation to the chances of being vertically integrated along the chain;
5) the proposed measure also accounts for the fact that farmers often sell to multiple buyers in the value chain by reducing the final amended measure to a score dividing both the value of both position number and selling location by their totals.

4. Mapping Crop Value Chains in Ethiopia and Nigeria

Figure 1 visually illustrates the market outlets available to smallholder farmers during the harvest season, illustrating the various pathways through which their products can reach end consumers. It serves as a reference to understand the complexity of the market chain and the various opportunities for farmers to sell their produce.

Figure 1: A Standard Crop Value Chain in Ethiopia and Nigeria



Source: Author's adaptation from Gabre-Madhin & Goggin (2006); Ayele et al. (2021); Rashid & Negassa (2013), Gashaw & Kibret (2018); FAO (2020); Babama'aji et al. (2022).

Value chain operators are defined as those who own the product at any stage in the chain (Audet-Bélanger et al., 2013). The mapping of agricultural value chains should start at the input level (Ugonna et al., 2015). Seeds, fertilizers, pesticides, and herbicides are the production inputs mainly supplied by agricultural development agencies and/or private input suppliers (Ayele et al., 2021). Farmers are the actors who play the major role in production, from soil preparation to final harvesting of the crop. These actors are involved in land preparation, planting, cultivation, weeding, harvesting, postharvest management, and transportation of the produce to the nearest market (Gomez & Thivant, 2017; Adesiji et al., 2022). Depending on market conditions, smallholder farmers have access to a variety of market outlets for their products. As shown in Figure 1, during harvest, they may sell directly to rural consumers, village collectors, primary cooperatives, and/or district wholesalers.

In Nigeria and Ethiopia, farmers are integrated in agricultural value chains through multiple layers (Babama'aji et al., 2022; Ayele et al., 2021). Village collectors form the first layer as they are the crop buyers closest to farmers. Village collectors are the middlemen who meet farmers at their farm gates or along the roadside to buy the freshly harvested crop and transport it to wholesalers and/or retailers in the district market (Ayele et al., 2021).

Agricultural cooperatives and processors holding the chain by being the most vertically integrated actors. Cooperatives offer storage for their crop free of charge (USAID, 2017) and purchase crops from farmer. They resell farmers' crops to processors, exporters, and/or local food aid agencies (Gabre-Madhin & Goggin, 2006). Wholesale markets are generally located in main districts/towns and acquire crop directly from farmers or through village middlemen. Wholesalers sell products to processors and/or retailers (USAID, 2017) and have better access to storage and communication (Ayele et al., 2021).

Private companies play a crucial role for firms in both Nigeria and Ethiopia, offering improved downstream positioning in the market chain and serving as reliable outlets for selling crops. Engaging in supply chains contributes not only to higher incomes but also facilitates technology spillovers that enhance income stability and food security (Barrett et al., 2017). Furthermore, selling to private companies can generate positive spillover effects through neighboring farms' activities and characteristics, as well as interactions with other farm suppliers (Case, 1992; Bandiera & Rasul, 2006; Matuschke & Qaim, 2009).

Moreover, aside from the actors described above, two important additions should be made: mobile markets and commodity exchange markets. First, several shorter chains exist due to initiatives like farmers' markets or open-air food fairs (FAO, 2020); such is the case of mobile markets. Secondly, commodity exchanges in Africa epitomize a means for linking smallholder farmer linkages to markets, particularly formal markets.

The Ethiopian Commodity Exchange (ECX) was founded in 2008. ECX aims to connect suppliers and exporters more efficiently and transparently (Gashaw & Kibret, 2018) and differently from most of the commodity exchanges in Africa, it was government-driven since its creation (Robbins, 2011). Based on standard crop contracts, ECX was constructed as a trading platform for buyers and sellers.

Nigeria, instead, has three commodity exchanges with only one government-lead, the Nigerian Commodity Exchange (NCX), previously known as the Abuja Securities and Commodity Exchange (ASCE). Established a few years earlier, in 2006, ASCE started a massive effort to get commodity trading off the ground through the settlement of a new infrastructure (Arvanitis, 2014). This new system involved key elements like a trading platform, a warehousing system, a clearing and settlement mechanism as well as an arbitration and price information system. Despite the effort, trading developed on a very small scale and was limited to a few crops such as maize and soybeans (Rashid et al., 2009).

In conclusion, some crop value chains have fewer steps, making them shorter, while others convey several actors and are thus longer. Farmers may sell at different stages of the chain, highlighting different positions in relation to the final end-user. Finally, factors beyond the control framework of the value chain control framework may influence farmers' positioning and market participation, particularly in natural disasters such as drought or floods (Biggeri et al., 2018). For example, in 2011, several floods were reported in Ethiopia.[2]

5. Empirical framework

The empirical application will empirically test the performance of the proposed amended indicator compared to its alternatives, namely physical distance to the main market, selling downstreamness as a categorical variable, the share of total gross output or the basic à la Antràs and Chor micro-level positioning indicator. The construction of the indicator proposed in the previous section Relies on two primary measures: (i) selling location and (ii) selling position. The selling location is provided by the data itself and does not require a preliminary analysis; the selling position, however, is constructed based on the type of crop buyer.

The type of buyer (or market outlet) to whom farmers decide to sell their crops is crucial in determining their market participation and positioning. According to Montalbano et al. (2018), selling the crop to neighbors or relatives implies being outside the value chain while reaching the local market represents the initial step in the market chain's selling line, and bringing a product directly to the main market or a private company is most difficult and presumably a potentially more profitable option within the market chain (subject to testing). Therefore, the

[2] According to the Famine Early Warning Systems Network by USAID, in August 2011, 650 households were displaced because of floods.

market's highest or most downward position also epitomizes high management skills for selling crops, such as mobile markets and auction markets.

Thus, in this context, selling the crop to a local market is approximated to the notion of upstreamness (and it is supposed to be less rewarding) whereas downstream means selling the crop to a private trader in a district market or the government (and it is supposed to be more rewarding). Following this reasoning and Figure 1, farmers' market outlets are ordered according to their crop buyer or selling method.

Given the insufficient observation per each category in the considered datasets, seven position groups are then constructed as follows:

- Outlet n.1: Roadside → Selling Position n.1
- Outlet n.2: Agricultural Cooperatives → Selling Position n.2
- Outlet n.3: Farm-Based Association → Selling Position n.2
- Outlet n.4: Government Agencies → Selling Position n.3
- Outlet n.5: Political Leader → Selling Position n.3
- Outlet n.6: Private Trader in Local Market → Selling Position n.4
- Outlet n.7: Local Merchant/Grocery → Selling Position n.4
- Outlet n.8: Local Market → Selling Position n.5
- Outlet n.9: Mobile Market → Selling Position n.5
- Outlet n.10: Private Trader in Main Market → Selling Position n.6
- Outlet n.11: Main Market → Selling Position n.6
- Outlet n.12: Private Company → Selling Position n.7
- Outlet n.13: Auction Market → Selling Position n.7

Roadside selling is often not considered either as a "market outlet" or as an upstream choice due to its direct interaction with consumers. However, the evidence provided by Reardon et al.

(2012), Barrett and Swallow (2006), and Minten and Kyle (1999) supports the inclusion of roadside selling as part of the market chain. It serves as a direct link connecting farmers to modern retail markets, offering small-scale farmers an avenue to access broader markets and contributing to rural livelihoods and income diversification. Furthermore, selling roadside is positioned at the beginning of the market chain due to its close proximity to the source of agricultural production. Reardon et al. (2012) particularly argue that roadside selling serves as the initial point of contact between farmers and potential buyers, making fresh and unprocessed produce immediately available after harvest.

The proposed value chain structure should be contextualized within developing contexts, considering that more upstream selling options such as roadside selling are often influenced by specific regulations and conditions. In developing countries, where formal market institutions and infrastructure may be limited, upstream market outlets serve as a crucial avenue for small-scale farmers to connect with buyers and access markets. Also, a final note must be made for selling locations, whose score scale of 3 is defined, due to limited observations, as follows:

- Selling Location n.1: Selling within the village or near the village
- Selling Location n.2: Selling near the town or near the district
- Selling Location n.3: Selling outside the district or outside the region

It is important to underline again that the inclusion of this measure is crucial for obtaining a comprehensive, complete, and readily applicable indicator of farmers positioning in value chains. A side note is required in the case of farmers locating in main highly concentrated markets like Addis Ababa in Ethiopia; these have no incentive to sell outside the district or region as they already occupy an extremely favorable location for selling purpose (or distance wise). Therefore, the selling location factor is excluded from their positioning measure calculations.

The LSMS-ISA project's original microdata provides a unique opportunity to explore these research issues by exploiting a large household sample in a panel-data country framework. Panel regression is conducted using fixed effects, as random effects conditions are clearly violated in this context. However, the choice of market positioning implies a series of endogeneity features that are difficult to monitor in simple regressions. For this reason, several specifications including district-wave dummies and time-trends are included in the panel regression. As it will be explained in detail in the identification strategy in Section 7, different specifications will be employed, including a more general consumption variable that encompasses food expenditures and total consumption. To determine the sensitivity of the findings, the same empirical strategy proposed for food and total consumption will be implemented on food quantity.

Last, as supporting evidence of the importance of the proposed market-positioning indicator in the relationships outlined (i.e., market positioning–food security and market positioning–total consumption), in the Appendix, a machine-learning classification-tree mechanism is employed for Ethiopia. A classification tree is a purely data-driven predictive technique aimed at maximizing the predictive performance of a given outcome in out-of-sample scenarios. At the core of machine learning lies the firewall principle: none of the data involved in generating the predictive model should be used to evaluate its predictive performance (Mullainathan & Spiess, 2017). The trees are intuitive and composed solely of variables selected by the algorithm as highly correlated with the outcome variable, which is the dummy "Above-the-95th Percentile - Food Consumption/Total Consumption."

6. Data and Descriptive Statistics

This work employs data from the Ethiopia and Nigeria LSMS-ISA dataset collected by the Ethiopian Central Statistics Agency and the National Bureau of Statistics of Nigeria in collaboration with the World Bank. The Ethiopia LSMS-ISA socioeconomic survey was conducted in three successive waves from 2011 to 2016. The first wave ran from 2011 to 2012, the second from 2013 to 2014, and the third from 2015 to 2016. Similarly, in Nigeria, LSMS-ISA general household surveys were conducted during the same period: between 2010 and 2011 (first wave), between 2012 and 2013 (second wave) and between 2015 and 2016 (third wave). The LSMS-ISA surveys are all representative at a national, urban or rural, and regional level. Possible panel attrition issues were addressed by conducting unconditional ANOVA tests across samples. The final sample of farmers commercializing their crops consists of approximately 1460 observations for Ethiopia and 1178 for Nigeria.

This paper uses two sets of data from the World Bank LSMS-ISA dataset: household-level data and agricultural data. The household-level data includes modules related to the households' characteristics, while the agricultural data includes relevant postharvest information, such as buying outlets and selling locations. In addition, some data related to inputs used in the analysis are retrieved from the post-planting questionnaire. Specifically, in the LSMS-ISA postharvest questionnaire, farmers provide evidence of their main commercial partners by answering the question: “Who/What were the main buyers/outlets for your crop sales?” in the case of Ethiopia or “To whom did you mainly sell the harvest crop?” in the case of Nigeria. Answers to this question rely on a network roster of more than 30 possible actors. Households can indicate two commercial partners in their answer: a first (main) commercial partner and a second (minor) commercial partner. However, no matter how many actors indicated this answer, the question asking on the quantity of crop sold in total relies on a unique answer that does not distinguish across buyers/outlets (if more than one is indicated). For the sake of this analysis, only the first (main) buyer is considered with the total quantity. In addition, in those few cases where households indicated the same quantity, but two different types of crops were sold to the same first (main) buyer, only the quantity of crop most often sold is included in the calculation process.

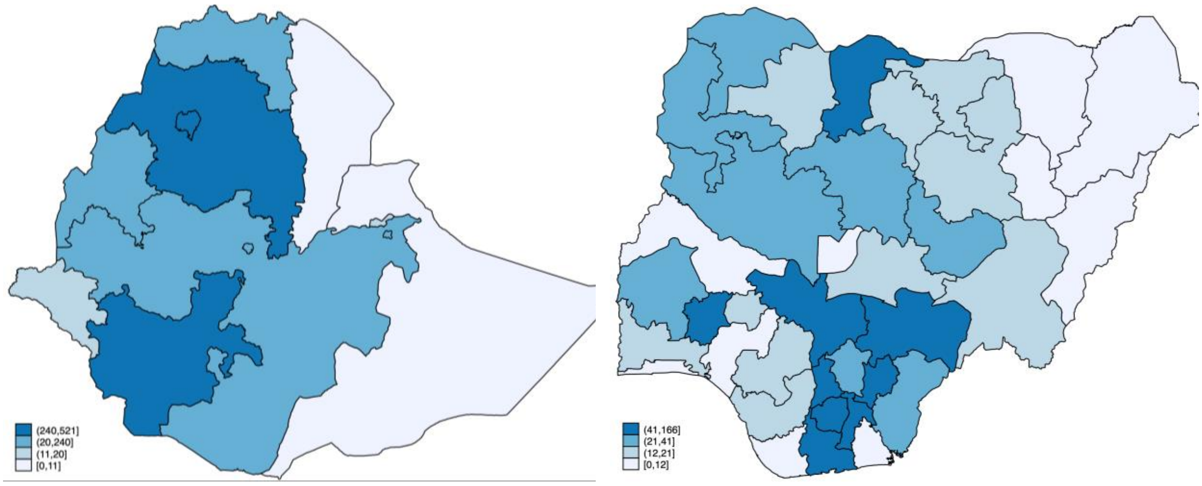
Household variables are defined in Table A.1 and their descriptive statistics are reported in Table A.2 for Ethiopia and A.3 for Nigeria, both in the Appendix. In the sample of Nigeria, household variables, such as adults' education and the age of the household head, as well as harvest crop and land size are omitted due to the presence of several missing observations.

Household heads in the Ethiopian sample are, on average, 46 years old and male. On average, household members have completed more than one year of schooling, and approximately three individuals are part of the labor force. On average, each household owns more than 9,000 square meters of land, from which they harvest approximately 915 kg of crops. Regarding land inputs generally, households receive free seed, although they keep purchasing the remainder of seed needed and use fertilizers. On average, in both samples, each household comprises six individuals, among whom there might be two children and a maximum of one infant. In the Nigerian sample, households use fertilizers, but they generally do not purchase them nor keep leftovers.

Geographically, households tend to be located far from the main market, that is, the capital (see Figure 2). In the Ethiopian sample, none of the households in the considered sample is in Addis Ababa. Specifically, households mainly concentrate in three regions: more than 35% of the population lives in the Southern Nations, Nationalities, and Peoples region; almost 30% in Amhara; and more than 15% in Oromia. In contrast, less than 15 households are located in Afar, Dire Dawa, Gambela, Harari, and Somali regions. The remaining 39 households are located in Benishangul-Gumuz. For the Nigerian sample, the Federal Capital City hosts only 11 households, while states like Ebonyi and Imo more than 10% of the total sample.

Figure 2: Household Density per Region/State

Ethiopia *Nigeria*



Source: Author's elaboration.

Regarding selling preferences, most households tend to sell a large part of their agricultural production to buyers or outlets outside the market, such as relatives, friends, and neighbors (Table 3).

Table 3: Quantity of Crop Sold (in Kilos) per Selling Outlet Across the Years

	Ethiopia			Nigeria		
	2011	**2013**	**2015**	**2011**	**2013**	**2015**
Relative	97.85	200	23.23	4771.4	272.1	1254.6
	(110.3)	(224)	(35.06)	(7813.1)	(252.1)	(2040.6)
Friend/Neighbor	55.44	590.80	22.21	738.3	815.1	743.1
	(60.42)	(1049.90)	(30.68)	(1041.0)	(1986.1)	(1790.5)
VDC Member	-	1.50	-	-	-	-
	-	(.)	-	-	-	-
Village Headman	37.28	100	-	-	1168.0	300
	(27.88)	(.)	-	-	(1081.8)	(.)
Main Farm	-	-	-	3916.7	75	1964.7
	-	-	-	(4710.1)	(63.64)	(2111.5)
Roadside	-	106.50	23.09	1092.9	2163.1	522.3
	-	(81.89)	(27.84)	(1554.5)	(3065.2)	(338.7)
Mobile Market	34.33	65.12	20.04	299.5	2450	3115.2
	(13.65)	(47.76)	(26.11)	(175.4)	(2757.7)	(9804.1)
Local Market (LM)	87.74	100.50	28.76	924.0	126821.1	860.5
	(147.5)	(154.80)	(57.82)	(2773.5)	(550475.6)	(2765.7)
Priv. Trader in LM	287.1	357.30	35.71	865.4	1024.2	677.2
	(928.6)	(856.90)	(90.25)	(2280.7)	(2454.9)	(1063.9)
Local Merchant	274.30	214.50	11.28	2202.2	2703.3	347.0
	(224.40)	(174.20)	(17.92)	(4001.2)	(11149.1)	(330.3)
Main Market (MM)	87.62	144	29.01	4786.3	717.4	1071.4
	(95.76)	(320.10)	(67.54)	(21614.3)	(1220.0)	(2135.2)
Priv. Trader in MM	131.10	423.20	47.23	638.6	1084.6	1560.2
	(189)	(2278.80)	(94.43)	(936.1)	(1937.5)	(1838.5)
Government Agency	15	-	-	-	1936.3	85.78
	(14.14)	-	-	-	(4379.8)	(.)
Auction Market	30	-	-	-	-	85.78
	(.)	-	-	-	-	(.)
Private Company				6173.3	2885.6	461.3
				(7666.0)	(4503.9)	(57.07)
Employer				-	-	400
				-	-	(.)
Sav. & Credit Coop.	2.60	1733.30	2.09	-	-	-
	(.)	(1527.50)	(1.36)	-	-	-
Agricultural Coop.	703	70	81.89	-	-	-
	(1623.20)	(.)	(170.10)	-	-	-
Farm. Association	53.75	56.60	162	350	-	-
	(34.49)	(40.51)	(198.30)	(.)	-	-
NGO	-	8	-	112.5	-	-
	-	(.)	-	(123.7)	-	-
Parastatal Org.				-	320	-
				-	(.)	-
Other	40	77.50	3.96	-	2375	593.1
	(41.43)	(65.51)	(3.58)	-	(3005.2)	(419.4)
Average	129.10	211.5	32.32	1539.6	4015.5	948.9
Observations	554	1074	923	396	861	591

Regarding Ethiopia, in 2013, following the floods in late 2011, the number of crops sold to friends or neighbors was almost three times the average quantity sold to any other outlet, and the number sold to savings and credit cooperatives was more than eight times higher than the average. This tendency decreased in 2015, when percentages of crops sold to buyers outside the markets returned to the levels of 2011 (e.g., the percentage of total crops sold to relatives is equal to five in both 2011 and 2015, while for friends/neighbors is equal to three in 2011 and four in 2015). Similar patterns are seen in the sample for Nigeria. The quantities of crop sold to private companies and main markets sharply decrease after 2011. In 2012, large crop quantities are sold locally through local markets. While in 2015, there is an increase in the quantities of crop sold through the mobile markets or via the private traders in the main market.

Following the statistics of Table 3, Table 4 groups the data by position and Table 5 by selling location as defined in Section 5.

Table 4: Quantity of Crop Sold (in Kilos) per Position

	Ethiopia			Nigeria		
	2011	**2013**	**2015**	**2011**	**2013**	**2015**
Position n.1	-	106.50	23.09	1092.9	2450	522.3
(selling roadside)	-	(81.89)	(27.84)	(1554.5)	(2757.7)	(338.7)
Position n.2	443.30	59.95	108.60	191.7	-	-
(selling to agricultural coop. or associations)	(1255.60)	(33.74)	(171.80)	(162.7)	-	-
Position n.3	15	-	-	-	-	85.78
(selling to government agents or political leaders)	(14.14)	-	-	-	-	(.)
Position n.4	285.30	346.20	32.41	1199.6	2260.0	652.8
(selling to a priv. trader in LM or merchant in LM)	(865.10)	(825)	(84.54)	(2805.0)	(9865.0)	(1029.7)
Position n.5	86.99	100.10	28.69	908.6	5922.1	969.5
(selling via mobile market or to LM directly)	(146.60)	(154)	(57.61)	(2740.8)	(108624.1)	(3447.0)
Position n.6	103.10	224.70	35.72	3988.6	1281.6	1127.6
(selling to a priv. trader in MM or to MM directly)	(137.40)	(1257.50)	(78.89)	(19453.9)	(2710.2)	(2101.6)
Position n.7	30	-		6173.3	2885.6	367.4
(selling to a private comp. or to the auction market)	(.)	-		(7666.0)	(4503.9)	(193.5)
Average	133	197.40	33.04	1488.9	4435.8	954.2
Observations	522	1027	884	347	758	515

In the sample for Ethiopia, farmers selling to formal outlets position upstream in the market chain by largely selling to agricultural cooperatives and farm-based associations (Table 4) in the village or near the town or district (Table 5). Specifically, households that sell their crops to the most upstream positions (n.1 and n.2) were 47% in 2011, 20% in 2013, and 58% in 2015.

At the same time, the percentages of those downstream positions n.5 and n.6 decreased in the years following the floods, precisely 36% in 2011, 27% in 2013, and 4% in 2015. Similarly, the quantity of crops sold outside the district/region significantly decrease after 2011.

Contrarywise to Ethiopia, in the Nigerian sample, farming households sell predominately in downstream positions (Position 6 and 7), but large quantities of crop are still sold through local markets. In terms of selling location, patterns similar to those in the sample for Ethiopia are observed with most quantities sold within the village. Nevertheless, before 2012, 38% of the crop was sold outside the region.

Table 5: Ethiopia – Quantity of Crop Sold (in Kilos) per Selling Location

	Ethiopia			Nigeria		
	2011	**2013**	**2015**	**2011**	**2013**	**2015**
Selling Location n.1 ***(selling within the village or near the village)***	158.30 (557.30)	168 (245.70)	26.89 (62.94)	678.3 (1716.5)	5784.1 (105928.9)	909.0 (2916.6)
Selling Location n.2 ***(selling in/near the town or in/near the district)***	105.50 (180.90)	229.70 (1248.20)	40.43 (83.95)	3329.9 (16322.8)	1061.3 (2505.9)	1152.9 (3482.3)
Selling Location n.3 ***(selling outside the district or outside the region)***	110 (106)	28.60 (25)	12.90 (23.38)	2450.7 (5128.5)	2116.1 (3255.7)	843.8 (1152.3)
Average	132.80	197.60	33.07	1488.9	4439.4	954.2
Observations	521	1026	883	347	757	515

Finally, Table 6 reports the descriptive statistics for the main outcome variables (food consumption and total consumption) and the statistics used for the sensitivity analysis (food quantity) for both samples.

Consumption values are expressed in per capita terms and are deflated in real/constant local currency values for the year 2010, using the Consumer Price Index (CPI) computed by the World Bank.[3] On average, Ethiopian and Nigerian households' food consumption represents more than 70% of their total consumption expenditure. Farmers are generally poor, with distribution highly skewed towards the minimum value (mean consumption equals less than 7% of the maximum value). The same kind of skewness is present in food consumption and quantity, where the mean quantity is not even 1% of the maximum value.

[3] Available at http://data.worldbank.org/indicator/FP.CPI.TOTL.

Table 6: Dependent Variables Summary Statistics

			N. of Obs.	Mean	St. Dev.	Min. Value	Max. Value
Ethiopia		**Food Consumption** ***(decimals, ETB)***	1,394	1,666.08	1891.68	156.24	41,616.74
		Total Consumption[4] ***(decimals, ETB)***	1,394	2,021.67	1986.22	188.59	42,073.02
	Sens. Testing	Food Quantity *(decimals, Kg)*	1,459	7.15	37.77	0.07	1,004.4
Nigeria		**Food Consumption** ***(decimals, NGN)***	1,178	56,075.51	74,259.26	4,751.17	1,672,537
		Total Consumption[5] ***(decimals, NGN))***	1,178	78,349.05	88,541.40	9,334.46	1,699,927
	Sens. Testing	Food Quantity *(decimals, Kg)*	1,175	32.9454	156.10	0.04	3268.39

7. Identification Strategy, Results, and Sensitivity

This section is articulated as follows: first, it outlines the identification strategy of this work and then reports the results, discussion, and policy implications of the analysis. The identification strategy outlined in Subsection 7.1 establishes the framework for reporting various types of results: an analysis comparing the performance of alternative positioning indicators (Subsection 7.2) and presents the primary results for the amended positioning indicator, along with sensitivity and robustness checks (see Subsections 7.3, 7.4, and 7.5, respectively). The comprehensive discussion of the results and an examination of the role of market intermediaries are presented in Subsection 7.6.

7.1 Identification Strategy

The proposed identification strategy establishes the empirical approach for evaluating the performance and effects of the amended positioning indicator. Based on the literature

[4] Following the LSMS-ISA documentation on the Ethiopia Socioeconomic Survey, consumption total expenditures include three sources: food, non-food and education expenses for each household.
[5] As specified in the "Basic Information Document" for the LSMS-ISA Nigeria General Household Survey, total consumption is calculated as the sum of all food, education, non-food, and imputed rent expenditures.

considering farmers' consumption in any period as a semi-logarithmic econometric specification, the identification strategy of this work tests ests whether there is a statistically significant relationship between the proposed value-chain positioning indicator for the natural log of food and total consumption.[6]

Based on empirical literature, a set of observable household characteristics is used as a proxy for several factors including households' preferences, expectations, and composition (Dercon, 2004; Chaudhuri, 2003), while the set of product characteristics such as such as fertilizer use, the receiving of free seed, the purchase of any seed, the seed type, the crop type, the land available for cropping and the quantity of crop harvested, controls for heterogeneity in production characteristics among farmers (Montalbano et al., 2018).

To examine the impact of farmers' market chain positioning on their consumption levels, the following specification is utilized:

$$C_{h,t} = \alpha_h + \beta_t + \phi_1 Down_{h,t} + \delta X_{h,t} + \varepsilon_{h,t}; \quad [5]$$

where $C_{h,t}$ is alternatively the natural log of household per adult equivalent of food consumption and total consumption, $Down_{h,t}$ represents the value of the proposed downstreamness indicator, and $X_{h,t}$, is the vector of control variables for household heterogeneity and includes observable household and production characteristic. In Equation [5], ϕ_1 represents the impact of downstream positioning on consumption. In this case, rejecting $H_{(0)}$: ϕ_1=0 implies that *changes* in the proposed market positioning indicator are empirically associated to *changes* in household food/total consumption. $X_{h,t}$, is the vector of controls for household heterogeneity and includes observable household and production characteristics. The results should be interpreted as changes in the value chain positioning indicator within households over time, thanks to the inclusion of household fixed effects. In the considered sample, there is indeed

[6] LSMS-ISA household surveys for Nigeria do not provide per adult equivalencies in consumption aggregates. Considering the current debate around the likelihood of incurring in mistakes when self-calculating equivalencies (see, Deaton & Margaret, 1998) and to make estimates across the two samples comparable, the consumption levels for Ethiopia are reported in terms of per capita in line with those for Nigeria.

within-variation among those interviewed for more than one surveying wave, which allows for the preservation of the same positioning score across time.[7]

Thanks to the panel specification above, this empirical strategy also controls for unobserved heterogeneity in the data by inserting a set of α_h controls to account for household fixed effects in the regression, village/district/region dummies, and a set of β_t time/wave fixed effects. Moreover, to avoid additional sources of unobserved heterogeneity, this analysis proposes two additional specifications: (i) the addition of a full set of village/district/region-wave dummies (that this paper simply refers to as 'district-wave' dummies) to control time-variant unobserved covariate characteristics at the village/district/region level; (ii) the further addition of household linear and squared wave/time-trends to control time-varying unobserved confounders. The resulting value for the market chain positioning of each farming household is calculated as the average of the positioning scores in each individual crop selling chain. Additionally, when possible, within the considered sample, crop fixed effects are always included as control variables in regression analysis.

Although a three-wave panel is unable to capture a real trend, the latter specification allows for controlling additional predictable unobservable components which may not be captured by the existing controls, thus further reducing the role of the stochastic components. Possible reverse causality between food/total consumption and market positioning is not expected to impact the estimates because proxies for food consumption and commercialization are measured in different time periods. The consumption questions typically refer to the last seven days before the interview, while the selling decisions are typically made at the end of the harvest season. To account for seasonality, an extra dummy is added to the analysis, one considering the month of the interview.

The proposed identification strategy considers only households participating in value chains, these constitute less than 7% of the observations in the considered sample. Given the modest portion of farmers not selling theirs crop in value chains, all the reported estimates consider only farmers selling in value chains. Aware of the possible selection biases caused by this choice, in the robustness checks, main results from Equation [5] are repeated using the so-called “Heckman correction.”

[7] In the sample for Ethiopia, among the 299 households who were interviewed for more than one surveying wave, none of these resulted in no variation in the positioning indicator value; the same applies in the sample for Nigeria to those 179 households interviewed for more than one surveying year.

Moreover, another possible source of bias in the estimates is detected, that of self-selection. Self-selection, or the ability of farmers to self-select themselves in the group of those with the highest improvements in consumptions and positioning, is questioned in the robustness checks through the implementation of the control function method proposed by Wooldridge in 2015. Summary statistics describing the differences across surveying years between "position changers" (or "movers") and "position static" (or "non-movers") are reported the Appendix.

The downstreamness indicator in the main analysis is the proposed amended indicator in Equation [4], whose performance in regression analysis is first tested in comparison to the simpler "à la Antràs and Chor" (AC) indicator adaptation in Equation [3] and the other alternative proxies of market positioning, like distance to the main market and a dummy variable equal to one when selling to downstream buyers (i.e., Selling Position n.6 and Selling Position n.7). Given the absence of more sophisticated empirical methods, the indicator performance is interpreted in relation to the results of the adjusted R-squared, the AIC and BIC coefficients within the proposed regression framework. Using the same LSMS-ISA survey data from Ethiopia and Nigeria, Equation [5] is applied to examine the relationship between the proposed downstreamness indicator's association with food quantity as an alternative outcome variable. This replication of the empirical strategy serves the purpose of sensitivity analysis. Additionally, robustness checks are conducted by replicating the main analysis with population sampling weights. These checks aim to test the robustness of the downstreamness indicator's association with the main outcome variables, namely food and total consumption.

7.2 Indicator Results

Table 7 presents a comparative analysis for the considered proxies of value chains positioning.

Table 7: Downstreamness Indicators Comparison – Main Results for Ethiopia

	Food Consumption					**Total Consumption**				
	Adjusted Down.	**À Ant. & Ch. Down.**	**(ln) Crop Share**	**(ln) Distance to Market**	**Down. as Dummy**	**Adjusted Down.**	**Down. À la Ant. & Ch.**	**(ln) Crop Share**	**(ln) Distance to Market**	**Down. as Dummy**
Positioning	42.01***	3.569***	0.104*	-0.196	0.0567	35.96***	3.053***	0.0782	-0.0554	0.0410
	(12.91)	(1.226)	(0.0619)	(1.638)	(0.100)	(11.01)	(1.044)	(0.0528)	(1.442)	(0.0862)
Fem. Head	0.195	0.0421	-0.0329	-0.132	-0.104	0.0233	-0.108	-0.176	-0.214	-0.229
	(0.679)	(0.739)	(0.794)	(0.821)	(0.825)	(0.589)	(0.641)	(0.690)	(0.722)	(0.713)
Age Head	0.0179**	0.0181**	0.0198***	0.0122	0.0192***	0.0169***	0.0171***	0.0185***	0.0113+	0.0181***
	(0.00748)	(0.00750)	(0.00748)	(0.00856)	(0.00731)	(0.00650)	(0.00650)	(0.00649)	(0.00768)	(0.00639)
HH Labor	0.0187	0.0167	0.0155	0.0535	0.0198	0.0387	0.0370	0.0361	0.0707+	0.0393
	(0.0506)	(0.0511)	(0.0510)	(0.0513)	(0.0507)	(0.0456)	(0.0458)	(0.0459)	(0.0461)	(0.0456)
Hous. Size	-0.268***	-0.268***	-0.277***	-0.284***	-0.275***	-0.226***	-0.226***	-0.234***	-0.247***	-0.232***
	(0.0552)	(0.0552)	(0.0557)	(0.0559)	(0.0552)	(0.0510)	(0.0510)	(0.0513)	(0.0533)	(0.0511)
Educ. Ad.	1.485	1.166	1.025	0.308	0.540	1.609+	1.336	1.154	0.668	0.786
	(1.250)	(1.233)	(1.269)	(1.166)	(1.269)	(1.075)	(1.063)	(1.100)	(0.971)	(1.096)
N. of Inf.	0.144**	0.140**	0.136*	0.0482	0.129*	0.0959+	0.0922+	0.0873+	0.0269	0.0819
	(0.0696)	(0.0693)	(0.0701)	(0.0727)	(0.0712)	(0.0599)	(0.0596)	(0.0602)	(0.0613)	(0.0603)
N. of Child	0.0533	0.0603	0.0803*	0.102**	0.0920**	0.0459	0.0519	0.0706*	0.0854**	0.0794*
	(0.0479)	(0.0478)	(0.0474)	(0.0462)	(0.0457)	(0.0421)	(0.0421)	(0.0418)	(0.0412)	(0.0407)
Av. Educ.	-1.475	-1.160	-1.019	-0.282	-0.531	-1.591+	-1.321	-1.137	-0.635	-0.768
	(1.251)	(1.234)	(1.270)	(1.161)	(1.270)	(1.077)	(1.065)	(1.102)	(0.967)	(1.098)
Harv. Cr.	0.00007	0.00007	0.00006	0.00008	0.00006	0.00006	0.00006	0.00006	0.00007	0.00005
	(0.00007)	(0.00007)	(0.00006)	(0.00005)	(0.00007)	(0.00006)	(0.00006)	(0.00006)	(0.00005)	(0.00006)
Field Size	0.000006	0.000006	0.000005	0.000005	0.000006	0.000008	0.000008	0.000005	0.000006	0.000007
	(0.000007)	(0.000007)	(0.000007)	(0.000007)	(0.000007)	(0.000007)	(0.000007)	(0.000007)	(0.000007)	(0.000007)
Free Seed	0.143	0.107	0.203	0.162	0.183	-0.0907	-0.122	-0.0414	-0.0289	-0.0565
	(0.402)	(0.400)	(0.395)	(0.330)	(0.370)	(0.374)	(0.375)	(0.367)	(0.311)	(0.351)
Seed Purc.	0.118	0.115	0.0819	-0.0175	0.0744	0.0136	0.0107	-0.0180	-0.0958	-0.0235
	(0.175)	(0.173)	(0.174)	(0.169)	(0.177)	(0.159)	(0.157)	(0.158)	(0.153)	(0.161)
Fert. Use	-0.150	-0.172	-0.209+	-0.157	-0.216	-0.119	-0.137	-0.171	-0.110	-0.176
	(0.137)	(0.139)	(0.143)	(0.111)	(0.151)	(0.116)	(0.117)	(0.123)	(0.0965)	(0.129)
Seed FE* **Crop FE***	-	-	-	-	-	-	-	-	-	-
Time FE*	-	-	-	-	-	-	-	-	-	-
Dist. FE*	-	-	-	-	-	-	-	-	-	-
HH Trends	-	-	-	-	-	-	-	-	-	-
Constant	6.039***	6.226***	6.730***	9.253	6.277***	6.659***	6.819***	7.200***	8.844+	6.858***
	(0.986)	(0.989)	(1.086)	(6.577)	(1.026)	(0.853)	(0.857)	(0.936)	(5.817)	(0.887)
Obs.	1,387	1,387	1,387	1,381	1,387	1,387	1,387	1,387	1,381	1,387
N. HH_id	1,097	1,097	1,097	1,093	1,097	1,097	1,097	1,097	1,093	1,097
R-sq. Adj.	0.718	0.716	0.708	0.643	0.704	0.727	0.759	0.717	0.687	0.749
AIC	-1316.97	-1306.11	-1266.77	-1013.52	-1251.08	-1697.19	-1686.64	-1644.86	-1371.93	-1633.08
BIC	-615.49	-604.63	-565.29	-375.39	-549.61	-995.71	-985.16	-943.38	-733.80	-931.60

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

To evaluate the performance of the amended indicator, several comparisons were made with alternative proxies of market positioning. Specifically, the simpler "à la Antràs and Chor" (AC) indicator, the unsophisticated crop share of the total quantity sold along the chain, distance to the main market, and the categorical variable "selling to downstream buyers" were examined alongside the amended indicator. The analysis was conducted using the sample data for Ethiopia. The results from Equation [5], which included district dummies and time trends, showed significant downstreamness coefficients only for the adjusted and AC indicators, as indicated in Table 7. This finding challenges the commonly used proxies for marketing factors, orientation, and positioning that have been traditionally employed in empirical studies (e.g., *inter alia*, Montalbano et al., 2018; Migose et al., 2018; Mkuna & Wale, 2022). Furthermore, model comparison using adjusted R-squared, AIC, and BIC coefficients further supported the superior performance of the proposed indicators compared to the non-AC ones, as shown in Table 7. These findings highlight the greater efficiency and effectiveness of the amended indicator in capturing market positioning.

Tables A.4 and A.5 offer insights into the models based on quintiles and main crops, showing that the amended indicator consistently has the highest significance level, highest adjusted R-squared values, and lowest AIC and BIC criteria. The AC indicators outperform the alternatives in observations up to the 3rd quartiles, especially in maize production. Descriptive statistics for the proposed amended positioning indicator can be found in Table 8.

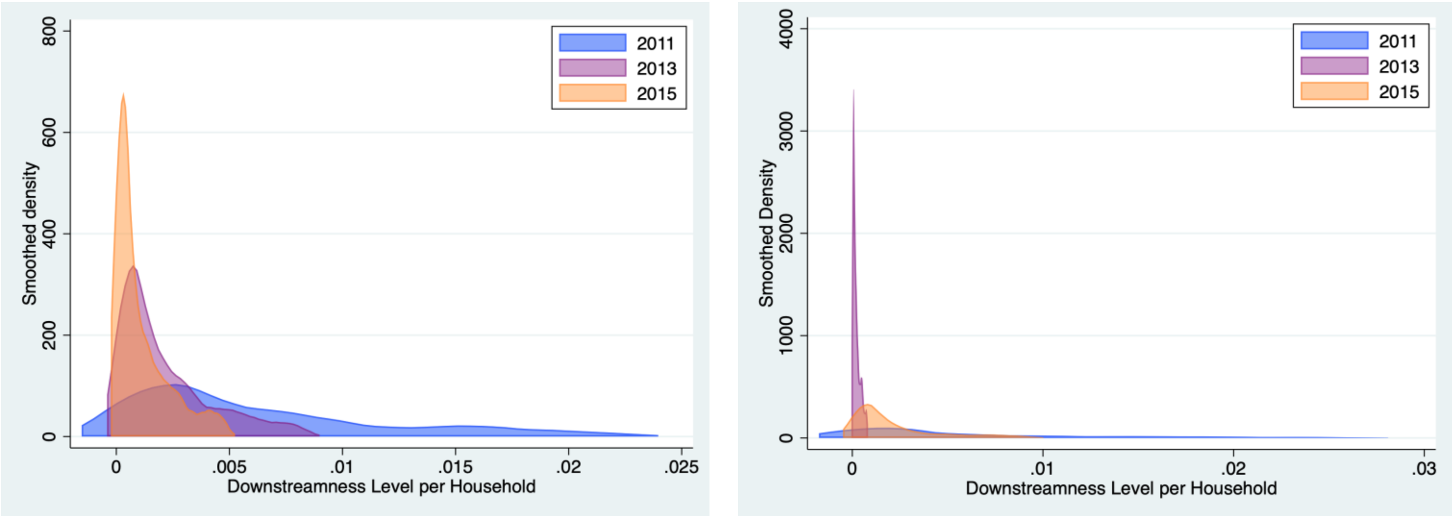
Table 8: Downstreamness Indicator Results

		N. of observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Ethiopia	**Downstreamness in 2011 *(decimals)***	521	0.021757	0.065071	0	0.704935
	Downstreamness in 2013 *(decimals)*	1,026	0.018650	0.072349	0.000019	0.699783
	Downstreamness in 2015 *(decimals)*	883	0.018235	0.066194	0.000012	0.704935
Nigeria	**Downstreamness in 2011 *(decimals)***	346	0.048960	0.118564	0.000005	1
	Downstreamness in 2013 *(decimals)*	757	0.002883	0.027114	0	0.445774
	Downstreamness in 2015 *(decimals)*	515	0.032263	0.088104	0.000014	0.857143

The study findings indicate that in the Ethiopian sample, the positioning indicator for crop-specific value chains ranges from 0 to 0.7, with rural households having an average downstreamness value of approximately 0.02 (Table 8). In Nigeria, there is greater heterogeneity in downstreamness values, with a maximum of 1 in 2011 and a decrease to 0.45 in 2013, deviating from the observed trend in 2011 and 2015 (Table 8). These findings support the transition of food supply chains from local and fragmented to longer and geographically connected ones (IFAD, 2016). Farmers in the market chain predominantly position themselves upstream (Montalbano et al., 2018), and the crops they sell exhibit low price elasticity of demand (see Table A.6 and Table A.7 in the Appendix). Analyzing the data while excluding outliers reveals micro-trends in market positioning dynamics over the years (Figure 3 and, Figure A.1 and Figure A.2 in the Appendix)

Figure 3: Household Downstreamness Values - Kernel Density by Year

Ethiopia *Nigeria*



The quasi-bell-shaped kernel density distributions in the Appendix (Figures A.3, A.4, and A.5 for Ethiopia, and Figures A.6, A.7, and A.8 for Nigeria) support the validity of the proposed indicator, excluding outliers to examine the significance of small variations. It is important to note that the indicator results have a range between 0 and 1, with lower elasticities leading to higher downstreamness values and higher elasticities leading to lower downstreamness values.

7.3 Indicator Empirical Testing with Food and Total Consumption

Table 9 presents the estimated coefficients for Equation [5] for food and total consumption in Ethiopia.

Table 9: Main Results for Ethiopia – Panel Fixed Effects Clustered by Household ID

	Food Consumption			Total Consumption		
	Wave Fixed Effects	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**	**Wave Fixed Effects**	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**
Downstreamness	31.04**	43.11***	42.01***	27.17*	36.13***	35.96***
	(15.03)	(12.74)	(12.91)	(14.31)	(11.03)	(11.01)
Female Head	0.183	0.180	0.195	0.0319	0.0715	0.0233
	(0.637)	(0.629)	(0.679)	(0.584)	(0.528)	(0.589)
Age Head	0.0195**	0.0181**	0.0179**	0.0177**	0.0171***	0.0169***
	(0.00774)	(0.00743)	(0.00748)	(0.00748)	(0.00652)	(0.00650)
Household Labor	-0.0271	0.0173	0.0187	-0.0136	0.0349	0.0387
	(0.0455)	(0.0516)	(0.0506)	(0.0415)	(0.0468)	(0.0456)
Household Size	-0.161***	-0.273***	-0.268***	-0.145***	-0.229***	-0.226***
	(0.0590)	(0.0556)	(0.0552)	(0.0558)	(0.0515)	(0.0510)
Education Adults	-0.400*	1.571	1.485	-0.462**	1.675+	1.609+
	(0.215)	(1.242)	(1.250)	(0.197)	(1.073)	(1.075)
N. of Infants	0.0983	0.151**	0.144**	0.0828	0.102*	0.0959+
	(0.0790)	(0.0698)	(0.0696)	(0.0700)	(0.0600)	(0.0599)
N. of Child	-0.00503	0.0539	0.0533	-0.0165	0.0478	0.0459
	(0.0494)	(0.0473)	(0.0479)	(0.0444)	(0.0414)	(0.0421)
Average Education	0.454**	-1.556	-1.475	0.526***	-1.654+	-1.591+
	(0.215)	(1.243)	(1.251)	(0.197)	(1.076)	(1.077)
Harvest Crop	0.00006	0.00007	0.00007	0.00003	0.00006	0.00006
	(0.00006)	(0.00007)	(0.00007)	(0.00005)	(0.00006)	(0.00006)
Field Size	0.00001	0.000006	0.000006	0.000009	0.000009	0.000008
	(0.000009)	(0.000008)	(0.000007)	(0.000006)	(0.000007)	(0.000007)
Free Seed	-0.555	0.134	0.143	-0.596*	-0.114	-0.0907
	(0.380)	(0.396)	(0.402)	(0.350)	(0.367)	(0.374)
Seed Purchase	0.182	0.0954	0.118	0.105	-0.00246	0.0136
	(0.152)	(0.176)	(0.175)	(0.131)	(0.160)	(0.159)
Fertilizer Use	-0.0363	-0.144	-0.150	-0.00724	-0.102	-0.119
	(0.103)	(0.135)	(0.137)	(0.0916)	(0.114)	(0.116)
Seed Type Dummy* **Crop Code Dummy***	-	-	-	-	-	-
Year Dummy* Month Dummy*	-	-	-	-	-	-
Region Dummy* Woreda Dummy* Zone Dummy* Town Dummy* Subcity Dummy* Kebele Dummy*		-	-		-	-
HH Trends HH Trends^2			-			-
Constant	7.650***	5.948***	6.039***	7.991***	6.554***	6.659***
	(0.628)	(0.991)	(0.986)	(0.583)	(0.848)	(0.853)
Observations	1,387	1,387	1,387	1,387	1,387	1,387
Number of HH_id	1,097	1,097	1,097	1,097	1,097	1,097
R-squared Adjusted	0.306	0.717	0.718	0.314	0.725	0.727

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

The findings highlight a positive relationship between the proposed positioning indicator values and consumption levels. All estimates were adjusted for household production characteristics to account for additional latent variables that could explain variations in market positioning, effectively reducing potential endogeneity resulting from selectivity bias (Fafchamps & Hill, 2005).

The key result of these estimates is a significant and positive association between market positioning and food and total consumption among farmers, as evidenced across different specifications. By accounting for time- and geography-related factors, it is observed that Ethiopian farmers positioned downstream in the market experience significantly higher per-capita consumption levels compared to farming households with similar characteristics but lower positioning scores. Specifically, on average and holding other factors constant, a marginal increase of 0.01 in the positioning indicator value corresponds to an increase of more than 50% in per-capita food consumption and over 40% in per-capita total consumption. These patterns refute the notion that food consumption patterns are exclusively influenced by changes in food prices relative to non-food expenditure costs. It is important to emphasize that failure to consider household trends and account for household and geographical characteristics in the estimation equation would result in a downward bias in the estimated "market positioning effect" when comparing coefficients across columns. Furthermore, the findings demonstrate similar dynamics for food and total consumption, with lower significance observed in the baseline specification and a general downward bias if district indicators are not included as control variables.

Although the hypothesized change of 0.01 in the positioning indicator score is relatively small compared to the inherent variability captured by the standard deviations of the calculated coefficients for the downstreamness indicator across the different specifications provided, it still represents a shift in the coefficient estimate which is worth to be considered. Within-variation in downstreamness equal to or greater than 0.01 is observed in less than 2% of the cases for Ethiopia. Among these households who experience such a change in overall positioning, despite there are not significant variations in initial levels of downstreamness, the biggest variations in food consumption levels are recorded by those whose change in positioning is driven by a modification in quantities sold and the identity of the crop buyer.

Table 10 presents the main results for Nigeria.

Table 10: Main Results for Nigeria – Panel Fixed Effects Clustered by Household ID

	Food Consumption			**Total Consumption**		
	Wave Fixed Effects	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**	**Wave Fixed Effects**	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**
Downstreamness	31.50***	33.39***	33.85***	26.79**	31.56**	31.46**
	(11.94)	(12.16)	(12.50)	(10.75)	(13.97)	(14.19)
Female Head	0.0206	-0.0463	-0.0345	0.0437	-0.181	-0.145
	(0.194)	(0.170)	(0.181)	(0.180)	(0.173)	(0.187)
Household Labor	-0.137***	-0.0251	-0.0290	-0.113***	-0.0216	-0.0264
	(0.0305)	(0.0371)	(0.0383)	(0.0270)	(0.0354)	(0.0377)
Household Size	0.0279	-0.0144	-0.0132	0.0173	0.0137	0.0136
	(0.0374)	(0.0409)	(0.0399)	(0.0469)	(0.0364)	(0.0354)
N. of Infants	0.00635	-0.0173	-0.0114	-0.0153	-0.0309	-0.0348
	(0.0598)	(0.0757)	(0.0411)	(0.0562)	(0.0772)	(0.0860)
N. of Child	-0.0236	-0.0183	-0.0187	-0.0202	-0.0241	-0.0143
	(0.0418)	(0.0391)	(0.0814)	(0.0353)	(0.0390)	(0.0423)
Fertilizer Use	-0.00118	0.0594	0.0657	-0.0607	-0.0498	-0.0365
	(0.167)	(0.180)	(0.183)	(0.151)	(0.191)	(0.194)
Fertil. Purchase	0.149	0.0378	0.0515	0.154	0.128	0.142
	(0.173)	(0.183)	(0.182)	(0.150)	(0.184)	(0.184)
Leftover Fertil.	0.180	0.195	0.181	0.147	0.150	0.131
	(0.148)	(0.204)	(0.210)	(0.142)	(0.173)	(0.179)
Free Fertilizer	-1.079***	0.0480	-0.204	-0.608***	0.0697	-0.221
	(0.0875)	(0.191)	(0.327)	(0.0827)	(0.215)	(0.380)
Year Dummy*	-	-	-	-	-	-
State Dummy* Local Government Area Dummy*	-	-	-	-	-	-
HH Trends HH Trends^2		-	-		-	-
Constant	10.75***	11.45***	10.93***	11.08***	11.49***	11.03***
	(0.236)	(0.277)	(0.512)	(0.276)	(0.244)	(0.576)
Num. Obs.	1,178	1,178	1,178	1,178	1,178	1,178
Num. HH_id	979	979	979	979	979	979
R-squared Adj.	0.406	0.819	0.821	0.317	0.735	0.738

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

Like Ethiopia, market outlets for Nigerian farmers include local and district markets, traders, agricultural cooperatives, farmer-based associations, and auction markets. Unlike that of Ethiopia, some farmers in Nigeria register to sell directly to processors (i.e., private companies). The variety of crops sold is similar to that listed for Ethiopia, with the addition of non-food crops such as cotton. Equation [5] of the empirical strategy is applied to the Nigerian panel dataset, with a few differences due to the available data.[8]

[8] The variable "crop code" is not controlled for in the case of Nigeria, given the few changes in labeling across the years that may have altered the panel dataset combined "crop code" variable. Also, interview month is omitted

The results are nearly identical to those obtained for Ethiopia. In all specifications of the outcome variables, if rural households can increase their positioning indicator value by 0.01, on average and holding other factors constant, they can achieve an approximate 40% increase in per-capita food consumption and around 37% increase in per-capita total consumption.

Hence, controlling factors such as district/village dummies and time trends, Ethiopian farmers who participate and have a better position in the market chain register, on average and *ceteris paribus*, have a per-capita equivalent consumption level higher than those farming households with the same characteristics and who have a lower position-indicator score. The results for both food and total consumption are perfectly aligned.

7.4 Sensitivity Analysis

Table 11 shows the result of the sensitivity analysis for food quantity in both samples. Food quantity is also measured in logarithmic form, just like consumption. Food quantity is positively affected by higher positioning scores for all the specifications provided for both samples.

Results in both countries are very similar. If rural households are able to increase their positioning indicator value by 0.01, on average, and *ceteris paribus*, they are able to more than double their food quantity level both in Ethiopia and Nigeria. Therefore, the impact of increased positioning in value chains on food quantity per household is much greater, in terms of magnitude, than the impact on food and total consumption levels per capita.

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due to several missing observations. Consumption data rely on the postharvest surveying visit. Data on fertilizer use are from the post-planting questionnaire.

Table 11: Sensitivity Testing with Food Quantity

	Food Quantity (Ethiopia)			Food Quantity (Nigeria)		
	Wave Fixed Effects	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**	**Wave Fixed Effects**	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**
Downstreamness	61.86**	70.51*	81.38**	61.07**	82.03***	78.18***
	(26.55)	(36.81)	(36.54)	(25.31)	(26.60)	(28.09)
Female Head	-0.956	-0.939+	-1.125+	-0.629	-0.768**	-0.632+
	(0.945)	(0.620)	(0.732)	(0.523)	(0.382)	(0.407)
Age Head	0.0203	0.0135	0.0127			
	(0.0173)	(0.0136)	(0.0135)			
Household Labor	-0.122	-0.0596	-0.0459	-0.123*	0.103	0.101
	(0.111)	(0.122)	(0.121)	(0.0686)	(0.0870)	(0.0883)
Household Size	0.195*	0.0999	0.0894	0.239***	0.0846	0.0756
	(0.1000)	(0.111)	(0.110)	(0.0687)	(0.0647)	(0.0659)
Education Adults	-1.373**	2.859*	1.802			
	(0.697)	(1.554)	(1.542)			
N. of Infants	-0.0336	0.282*	0.296*	0.163	0.221*	-0.105+
	(0.147)	(0.158)	(0.159)	(0.121)	(0.128)	(0.0961)
N. of Child	-0.0734	-0.0297	-0.0453	-0.152*	-0.118	0.206
	(0.0904)	(0.0959)	(0.0974)	(0.0812)	(0.0936)	(0.127)
Average Education	1.501**	-2.705*	-1.638			
	(0.700)	(1.564)	(1.544)			
Harvest Crop	-0.0000249	-0.000183+	-0.000146			
	(0.0000951)	(0.000117)	(0.000121)			
Field Size	-0.00000320	-0.0000174	-0.0000189+			
	(0.0000113)	(0.0000131)	(0.0000127)			
Free Seed/Fert.	0.0387	-0.350	-0.323	-0.755***	-0.461	-0.498
	(0.310)	(0.690)	(0.673)	(0.0875)	(0.326)	(0.426)
Seed/Fert. Purchase	-0.282	-0.115	-0.139	0.521*	0.662*	0.655*
	(0.356)	(0.352)	(0.338)	(0.313)	(0.344)	(0.350)
Fertilizer Use	-0.218	0.130	0.0860	-0.288	-0.193	-0.155
	(0.216)	(0.275)	(0.264)	(0.267)	(0.301)	(0.304)
Letfover Fert.				0.310	0.736***	0.711***
				(0.397)	(0.220)	(0.223)
Seed Type Dummy* **Crop Code Dummy***	-	-	-			
Year Dummy* Month Dummy*	-	-	-	-	-	-
Reg./State Dummy* Wor./Loc. Gov. Area Dummy*	-	-	-	-	-	-
HH Trends HH Trends^2		-	-		-	-
Constant	-1.086	7.683***	7.756***	2.066***	2.081***	2.885***
	(1.048)	(1.974)	(1.916)	(0.432)	(0.384)	(0.767)
Observations	1,452	1,452	1,452	1,175	1,175	1,175
Number of HH_id	1,121	1,121	1,121	977	977	977
R-squared Adjusted	0.126	0.534	0.544	0.592	0.875	0.876

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

7.5 Robustness Checks

Table 12: Main Results with Population Sampling Weights for Ethiopia

	Food Consumption			Total Consumption		
	Wave Fixed Effects	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**	**Wave Fixed Effects**	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**
Downstreamness	22.68+	21.85+	21.47+	20.08+	21.81*	22.39*
	(15.07)	(14.50)	(14.61)	(13.58)	(13.00)	(12.97)
Female Head	0.0796	-0.734+	-0.872*	-0.0425	-0.659*	-0.839**
	(0.678)	(0.461)	(0.503)	(0.622)	(0.374)	(0.419)
Age Head	0.0192**	0.0212***	0.0206***	0.0172**	0.0192***	0.0187***
	(0.00845)	(0.00746)	(0.00745)	(0.00814)	(0.00670)	(0.00663)
Household Labor	0.0155	0.0244	0.0223	0.0101	0.0464	0.0459
	(0.0454)	(0.0534)	(0.0518)	(0.0419)	(0.0510)	(0.0493)
Household Size	-0.175***	-0.291***	-0.279***	-0.136**	-0.242***	-0.232***
	(0.0589)	(0.0616)	(0.0608)	(0.0585)	(0.0595)	(0.0583)
Education Adults	-0.497***	1.638	1.754	-0.542***	1.791	1.911+
	(0.174)	(1.414)	(1.414)	(0.143)	(1.245)	(1.232)
N. of Infants	0.132*	0.196***	0.195***	0.107	0.136**	0.135**
	(0.0768)	(0.0699)	(0.0701)	(0.0680)	(0.0639)	(0.0645)
N. of Child	-0.0321	0.0365	0.0263	-0.0446	0.0281	0.0162
	(0.0514)	(0.0481)	(0.0494)	(0.0467)	(0.0461)	(0.0469)
Average Education	0.540***	-1.636	-1.759	0.591***	-1.789	-1.912+
	(0.176)	(1.419)	(1.418)	(0.145)	(1.251)	(1.237)
Harvest Crop	0.00005	0.000122*	0.000129**	0.00001	0.000105*	0.000114*
	(0.00006)	(0.00006)	(0.00006)	(0.00005)	(0.00006)	(0.00006)
Field Size	0.000009	-0.000002	-0.000003	0.000007	0.0000009	-0.0000006
	(0.000007)	(0.000007)	(0.000007)	(0.000006)	(0.000007)	(0.000007)
Free Seed	-0.289	0.210	0.228	-0.382	-0.0498	-0.0233
	(0.356)	(0.367)	(0.373)	(0.326)	(0.340)	(0.348)
Seed Purchase	0.167	0.227	0.245	0.0768	0.106	0.122
	(0.171)	(0.162)	(0.160)	(0.139)	(0.152)	(0.150)
Fertilizer Use	-0.00348	-0.203*	-0.232**	0.0293	-0.109	-0.142
	(0.104)	(0.116)	(0.117)	(0.0859)	(0.109)	(0.110)
Seed Type Dummy* **Crop Code Dummy***	-	-	-	-	-	-
Year Dummy* Month Dummy*	-	-	-	-	-	-
Region Dummy* Woreda Dummy* Zone Dummy* Town Dummy* Subcity Dummy* Kebele Dummy*	-	-	-	-	-	-
HH Trends HH Trends^2		-	-		-	-
Constant	7.236***	6.906***	7.045***	7.605***	7.562***	7.679***
	(0.618)	(1.231)	(1.216)	(0.581)	(1.069)	(1.054)
Observations	1,387	1,387	1,387	1,387	1,387	1,387
Number of HH_id	1,097	1,097	1,097	1,097	1,097	1,097
R-squared Adjusted	0.333	0.722	0.726	0.338	0.704	0.709

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

Robustness checks are reported in Table 12 above for Ethiopia and Table 13 for Nigeria. Table 12 shows the results of Table 9 replicated with population sampling weights.[9] Results are robust and consistent with what was previously obtained. As in Table 9, results for both food and total consumption show the same dynamics: lower significance for the baseline specification and a downward bias if district dummies are not in the control group but only the wave dummies are considered.

Table 13: Main Results with Population Sampling Weights for Nigeria

	Food Consumption			**Total Consumption**		
	Wave Fixed Effects	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**	**Wave Fixed Effects**	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**
Downstreamness	15.96	20.52*	21.58**	11.98	18.26	18.56+
	(12.26)	(10.46)	(10.79)	(10.89)	(13.01)	(13.02)
Female Head	0.148	0.0108	-0.0111	0.129	-0.155	-0.157
	(0.217)	(0.139)	(0.145)	(0.191)	(0.128)	(0.137)
Household Labor	-0.135***	-0.0629*	-0.0623+	-0.107***	-0.0496	-0.0506
	(0.0336)	(0.0374)	(0.0395)	(0.0285)	(0.0349)	(0.0381)
Household Size	0.00595	0.0156	0.0177	-0.0120	0.0394	0.0403
	(0.0422)	(0.0335)	(0.0323)	(0.0666)	(0.0340)	(0.0326)
N. of Infants	0.00354	-0.0707	-0.00433	-0.00757	-0.0789	-0.0726
	(0.0700)	(0.0674)	(0.0358)	(0.0708)	(0.0690)	(0.0772)
N. of Child	-0.00415	-0.00797	-0.0644	-0.0171	-0.0212	-0.0150
	(0.0393)	(0.0340)	(0.0725)	(0.0355)	(0.0357)	(0.0389)
Fertilizer Use	-0.00430	-0.00221	0.00907	-0.0220	-0.0575	-0.0387
	(0.168)	(0.168)	(0.171)	(0.158)	(0.179)	(0.180)
Fertil. Purchase	0.161	-0.0302	-0.0102	0.131	0.0330	0.0541
	(0.157)	(0.157)	(0.158)	(0.144)	(0.158)	(0.160)
Leftover Fertil.	0.205	0.0763	0.0853	0.169	0.140	0.144
	(0.147)	(0.171)	(0.174)	(0.143)	(0.175)	(0.179)
Free Fertilizer	-1.112***	0.173	-0.248	-0.651***	0.143	-0.323
	(0.0852)	(0.173)	(0.321)	(0.0844)	(0.202)	(0.405)
Year Dummy*	-	-	-	-	-	-
State Dummy* Local Government Area Dummy*	-	-	-	-	-	-
HH Trends HH Trends²		-	-		-	-
Constant	10.90***	11.27***	10.38***	11.29***	11.38***	10.52***
	(0.265)	(0.232)	(0.506)	(0.382)	(0.229)	(0.645)
Num. Obs.	1,172	1,172	1,172	1,172	1,172	1,172
Num. HH_id	973	973	973	973	973	973
R-squared Adj.	0.326	0.827	0.834	0.227	0.756	0.765

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

[9] Conversely to Nigeria, combined population weights are not reported in the LSMS-ISA Ethiopia Rural Socioeconomic Surveys. To avoid mistakenly corrections, population weights were adjusted across the years by attaching the latest weight to the household's highest surveying wave.

Similarly, in Table 13 above, the results for Nigeria (shown in Table 10) are replicated with the provided population sampling weights.

Controlling for factors such as district/village dummies, Ethiopian and Nigerian households who participate and have a better position in the market chain register, on average and *ceteris paribus*, have a per-capita equivalent food and total consumption level around 20% times higher than those farming households with the same characteristics and who have a position-indicator score lower than 0.01 unit. Coefficient estimates for the proposed amended positioning indicator in Table 12 and 13 are significant for almost all the specifications provided in both samples.

In addition, in Table A.8. in the Appendix, main results for Ethiopia are replicated considering consumption levels normalized per adult equivalent instead of household size. Estimates are entirely in line with those reported in Table 9. When assessing the relationship between market positioning and consumption levels, selection issues may arise. Farming households may choose to participate in markets and position in value chains because of characteristics influencing their consumption levels and their market position.

Possible selection bias coming from the exclusion from the main sample of around 100 households commercializing their crop but not in value chains, is controlled via *xtheckmanfe* a Stata module introduced by Rios-Avila in 2021 able to estimate fixed effects panel models in the presence of endogeneity and sample selection using the estimator proposed in Wooldridge (1995) and Semykina and Wooldridge (2010). *Xtheckmanfe* delivers standard errors using a bootstrap procedure. Results controlling for time fixed effected and adjusted with the Heckman correction are reported in Table A.9 in the Appendix. It is important to note that *xtheckmanfe* computational algorithms do not converge when including control variables like “household average education level” and “crop code” with several zeros or missing values. For this reason, in order to show the robustness of the panel fixed-effects estimates, even with such minor changes in the regression model, Heckman-panel-fixed-effects estimates are reported next to those resulting from the first specification of Equation [5] excluding those cited control variables. Heckman results are consistent and in line with the main ones. Bootstrap replications are set to 250.

Moreover, another possible source of bias is taken into consideration: the one coming from “movers” versus “non-movers” (i.e., farmers changing market positioning across the years and those that do not). Regarding this matter, Table A.10 in the Appendix presents descriptive statistics for two groups of farmers: "movers," who either altered their market positioning or had only one market observation in two surveying waves, and "non-movers," who maintained a consistent market position or had no recorded commercialization data in two consecutive surveying waves.

When assessing the relationship between market positioning and consumption levels, selection issues may arise. Farming households may choose to participate in markets and position in value chains because of characteristics influencing their consumption levels and their market position. To tackle this issue more incisively, a control function (CF) approach is implemented to cope with possible self-selection bias. This means including in the main regression the estimated residual of a first stage equation (see Table A.11 in the Appendix) where the usual controls are used as exclusion restrictions in the linear model having as dependent variable the binary variable “Positioning Downstreamness” equal to 1 when Position is equal to 6 or 7. This residual (denoted as ρ in Table A.12 in the Appendix) is by definition uncorrelated with the endogenous variable and can help to derive unbiased estimators in the main equation, thus softening possible self-selection in the obtained estimates (Wooldridge, 2015).

Following Wooldridge (2015), in first stage, an Ordinary Least Squares (OLS) regression is implemented. In the OLS regressions (Table A.11 in the Appendix) most of the variables related included as exclusion restrictions are not significantly associated with the probability of positioning downstream. The residuals from the OLS regressions in Table A.11 in the Appendix are included in Equation [5] to control for selection. Table A.12 in the Appendix reports the results, showing very consistent outcomes with the previous regressions.

7.6 Discussion and Policy Implications

To summarize, the empirical outcomes indicated that changes in market positioning significantly and consistently matters to increasing the consumption levels of Ethiopian farmers selling crops in the market chain. From this perspective, the findings of Montalbano et al. (2018) extend to Ethiopia regarding the positive role of farmers’ market participation in Uganda. However, the results contradict the conclusion of Montalbano et al. (2018), arguing instead for the non-significance of market intermediaries. The access to markets offered by local traders can be comparable to what farmers would receive at the nearest wholesale or retail market if certain conditions apply, such as better selling location and higher quantity sold.

Table 14 reports the outcomes of estimates of Equation [5] considering as independent variables crop share instead of the downstreamness level and as additional control the position number as defined in Section 5. This analysis checks on the role of market intermediaries by regressing consumptions levels on the share of crop sold in the market chain, and by controlling for the usual household characteristics as well as market position.

As shown in Table 14, the share of crop quantity sold in the chain positively affects food and total consumption when controlling for household characteristics, along with positioning in value chains. The positioning is expressed as a dummy variable for the identity of market intermediaries, following the approach of Montalbano et al. (2018). Across different specifications, the coefficients for the quantity share are consistently significant at levels below the 15th percentile, contradicting the findings of Montalbano et al. (2018). These results have significant policy implications: facilitating access to intermediaries positioned downstream in the market chain enhances the positive effects of crop shares sold along the chain on farmers' consumption levels.

Table 14: Testing the Significance of Market Outlets for Ethiopia

	Food Consumption			Total Consumption		
	Wave Fixed Effects	District-Wave Fixed Effects	Wave Fixed Effect HH Trends	Wave Fixed Effects	District-Wave Fixed Effects	Wave Fixed Effect HH Trends
Quantity Share	0.105**	0.123**	0.107*	0.102**	0.0880*	0.0800+
	(0.0499)	(0.0578)	(0.0608)	(0.0449)	(0.0491)	(0.0512)
Female Head	0.0466	-0.616	-0.679	-0.0761	-0.703	-0.821*
	(0.684)	(0.605)	(0.631)	(0.626)	(0.454)	(0.493)
Age Head	0.0197**	0.0217***	0.0212***	0.0178**	0.0201***	0.0197***
	(0.00778)	(0.00695)	(0.00695)	(0.00748)	(0.00606)	(0.00601)
Household Labor	-0.0168	0.0270	0.0328	-0.00567	0.0443	0.0520
	(0.0444)	(0.0515)	(0.0508)	(0.0404)	(0.0468)	(0.0458)
Household Size	-0.170***	-0.300***	-0.293***	-0.152***	-0.254***	-0.249***
	(0.0584)	(0.0550)	(0.0541)	(0.0545)	(0.0503)	(0.0495)
Education Adults	-0.342+	1.641	1.266	-0.398*	1.475	1.148
	(0.236)	(1.314)	(1.337)	(0.217)	(1.145)	(1.167)
N. of Infants	0.0996	0.155**	0.145**	0.0864	0.106*	0.0969
	(0.0807)	(0.0735)	(0.0735)	(0.0713)	(0.0612)	(0.0615)
N. of Child	0.0103	0.0628	0.0594	-0.00428	0.0547	0.0497
	(0.0495)	(0.0464)	(0.0469)	(0.0439)	(0.0407)	(0.0411)
Average Education	0.403*	-1.623	-1.255	0.466**	-1.450	-1.128
	(0.236)	(1.316)	(1.337)	(0.218)	(1.148)	(1.168)
Harvest Crop	0.00006	0.000127*	0.000137*	0.00004	0.000112*	0.000127**
	(0.00006)	(0.00007)	(0.00007)	(0.00005)	(0.00006)	(0.00006)
Field Size	0.00001*	0.000005	0.000005	0.00001*	0.000008	0.000007
	(0.000007)	(0.000008)	(0.000008)	(0.000006)	(0.000007)	(0.000007)
Free Seed	-0.522	0.187	0.203	-0.559*	-0.0620	-0.0287
	(0.365)	(0.377)	(0.379)	(0.335)	(0.350)	(0.355)
Seed Purchase	0.156	0.0651	0.0998	0.0811	-0.0302	-0.00159
	(0.153)	(0.167)	(0.165)	(0.131)	(0.154)	(0.151)
Fertilizer Use	-0.0366	-0.221	-0.227	-0.0127	-0.175	-0.192
	(0.110)	(0.142)	(0.145)	(0.0991)	(0.121)	(0.123)
Seed Type Dummy* **Crop Code Dummy***	-	-	-	-	-	-
Position Dummy*	-	-	-	-	-	-
Year Dummy* Month Dummy*	-	-	-	-	-	-
Region Dummy* Woreda Dummy* Zone Dummy* Town Dummy* Subcity Dummy* Kebele Dummy*		-	-		-	-
HH Trends HH Trends^2			-			-
Constant	7.868***	6.122***	5.958***	8.122***	6.372***	6.273***
	(0.671)	(1.116)	(1.121)	(0.613)	(0.948)	(0.957)
Observations	1,387	1,387	1,387	1,387	1,387	1,387
Number of HH_id	1,097	1,097	1,097	1,097	1,097	1,097
R-squared Adjusted	0.316	0.720	0.724	0.326	0.731	0.735

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1

As ancillary evidence of the relevance in the sample data of the market positioning indicator for consumption levels, Figures A.9 and A.10 in the Appendix show the classification tree for food consumption and total consumption, respectively. In both cases, market positioning is among the variables selected and interacts with other household characteristics depending on whether the value of each variable is below or above the reported thresholds (95^{th} percentile). The tree classifies each observation in the dataset as either above or below the threshold value of "Food Consumption" or "Total Consumption." It must be noted that although the relationships depict signal correlation rather than causation, they are in harmony with the results from the panel-regression analysis. In addition, as explained in Section 3, a key metric of stage-positioning in agricultural market chain relies on the identity of intermediaries.

Finally, a concern should be sounded concerning the external validity of these findings. Since the focus is on investigating market positioning, the overwhelming majority of farmers who produce crops only for home consumption are excluded from the analysis. This gap hampers the ability of the analysis to derive consistent estimates for the entire population of a crop producer.

Nevertheless, results of the parallel test conducted for Nigeria are highly reassuring regarding the proposed amended indicator's external validity. In particular, the reproduction of the proposed indicator for Nigerian farmers' crop value chains leads to results very similar to those obtained for Ethiopia. When excluding outliers, the downstreamness values of Nigerian farming households range from 0 to 0.30. The distribution of these values is skewed towards zero, especially in the year 2013 (refer to Figures A.7 in the Appendix). Nevertheless, the effects of market positioning on consumption levels are approximately equal to those obtained for Ethiopia.

8. Conclusions

Crop commercialization is among the main drivers of economic development today. Agricultural trade increases incomes and improves nutrition, yet this effect depends on a series of factors such as positioning in the market chain. Researchers have long debated the role of commercialization and market participation but have yet to develop a method to assess the effect of positioning, especially at the level of small farmers, involving relevant features such as transaction costs, contract enforcement and market shocks.

Although the study of farmers' market decisions dates back to the 1990s (Fafchamps, 1992; von Braun, 1995; Key et al., 2000), a systematic approach to how the market is structured at the farmer level still needs to be addressed. The motivation behind this work lies on the idea that farmers selling to wholesalers/producers are better off than farmers that sell to the most proximate markets. A robust theoretical approach to positioning smallholder farmers in value chains would provide a foundation for modern rural-development literature. This work adjusts Antràs and Chor's downstreamness indicator to farming households' selling locations and buyer-market chains. It contributes to the literature by creating a conceptual framework for farmers' market positioning and a replicable setting for assessing the effects of market positioning on both food security and welfare levels.

Using a national, representative household survey in Ethiopia and in Nigeria, the paper explores whether changes in market positioning scores correlate with higher consumption levels. The results demonstrate that farmers who can sell more downstream in the value chain benefit in terms of food consumption and total consumption. Micro-variations in market positioning largely affect rural development. The proposed analysis also shows that the amended indicator à la Antras and Chor performs better than the most viable alternatives in assessing the welfare implications of market positioning. These results are robust for the different specifications of the empirical strategy, and sensitivity testing is provided that confirms this work's research question by using food quantity. In addition, robustness checks confirm the strength of the obtained results.

The result of this work leaves important implications on the functioning degree of local market structures as well as the ability of intermediaries to exploit farmers unable to reach final markets. The proposed market positioning indicator and its empirical testing pave the way to future research in micro-analyses. Given the relevance of market-chain analysis at the micro-level, new and better data will better structure the links between local value chains and GVCs.

Although a network roster for inputs acquisition is provided in the currently available datasets, it often presents several missing observations making it difficult for comparison across countries. It would be useful to move from an analysis centered on farmers to data collection of trade flows for all the actors that contribute to the agricultural chain; this will allow to describe the value added that is generated along a farmer's selling line. In this respect, international organizations will likely present additional features related to farmers' market practices in the near future.

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Appendix

Table A.1: Variable Definitions and Other Basic Information

Variable name	Definition	Time period	Source
Gender of the Household Head	Gender of the household head *(binary, 1=female)*	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Age of the Household Head *(decimals)*	Age years of the household head *(decimals)*	2011-2015	World Bank LSMS-ISA Ethiopia only
Number of Household Members in the Labor Force *(decimals)*	Number of household members (*binary, 1=female)*	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Household Size *(decimals)*	Number of people in the household *(decimals)*	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Average Years of Education for Household Adults *(decimals, years of schooling)*	Average education level attained by the household adult members *(values from 0 to 8)*	2011-2015	World Bank LSMS-ISA Ethiopia only
Average Years of Education for Household Head *(decimals, years of schooling)*	Average education level attained by the household head *(values from 0 to 8)*	2011-2015	World Bank LSMS-ISA Ethiopia only
Number of Household Infants *(decimals)*	Number of household members in the infant age range *(decimals)*	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Number of Household Children *(decimals)*	Number of household members in the children age range *(decimals)*	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Household Years of Education *(decimals, years of schooling)*	Average education level attained by all household members *(values from 0 to 8)*	2011-2015	World Bank LSMS-ISA Ethiopia only
Harvest Crop *(decimals, Kg)*	Quantity of crop harvest in the surveying period *(decimals, Kg)*	2011-2015	World Bank LSMS-ISA Ethiopia only
Field Size *(decimals, Ha)*	Average field size in the surveying period *(decimals, Ha)*	2011-2015	World Bank LSMS-ISA Ethiopia only
Free Seed	Event of receiving free seed ***(binary, 1=no and 2=yes)***	2011-2015	World Bank LSMS-ISA Ethiopia only
Seed Purchase	Necessity of purchasing seed ***(binary, 1=no and 2=yes)***	2011-2015	World Bank LSMS-ISA Ethiopia only
Fertilizer Use	Use of fertilizers ***(binary, 1=no and 2=yes)***	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Fertilizer Purchase	Purchase of fertilizers ***(binary, 0=no and 1=yes)***	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Leftover Fertilizer	Presence of leftover fertilizers ***(binary, 0=no and 1=yes)***	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria
Free Fertilizer	Event of receiving free fertilizers ***(binary, 0=no and 1=yes)***	2010-2016	World Bank LSMS-ISA Ethiopia and Nigeria

Table A.2: Households Summary Statistics for Ethiopia

	N. of observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Gender of the Household Head ***(binary, 1=female)***	1,460	0.18	0.39	0	1
Age of the Household Head ***(decimals)***	1,460	45.72	14.21	18	97
Number of Household Members in the Labor Force ***(decimals)***	1,460	2.69	1.38	0	10
Household Size ***(decimals)***	1,460	5.77	2.19	1	14
Average Years of Education for Household Adults ***(decimals, years of schooling)***	1,460	1.70	1.83	0	8
Number of Household Infants ***(decimals)***	1,460	0.58	0.80	0	5
Number of Household Children ***(decimals)***	1,460	2.39	1.68	0	10
Household Years of Education ***(decimals, years of schooling)***	1,460	1.70	1.83	0	8
Harvest Crop ***(decimals, Kg)***	1,460	914.13	752.98	0	3,249.61
Field Size ***(decimals, m^2)***	1,460	9,030.31	9,370.73	0	38,917.46
Free Seed ***(binary, 2=yes)***	1,459	1.99	0.12	1	2
Seed Purchase ***(binary, 2=yes)***	1,462	1.94	0.24	1	2
Fertilizer Use ***(binary, 2=yes)***	1,462	1.81	0.40	1	2

Table A.3: Households Summary Statistics for Nigeria

	N. of observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Gender of the Household Head *(binary, 1=female)*	1,178	0.20	0.40	0	1
Number of Household Members in the Labor Force *(decimals)*	1,178	2.48	2.13	0	13
Household Size *(decimals)*	1,178	6.41	3.27	1	28
Number of Household Infants *(decimals)*	1,178	0.55	0.92	0	6
Number of Household Children *(decimals)*	1,178	1.90	2.22	0	14
Fertilizer Purchase *(binary, 1=yes))*	1,178	0.33	0.47	0	1
Letfover Fertilizer *(binary, 1=yes)*	1,178	0.03	0.17	0	1
Free Fertilizer *(binary, 1=yes)*	1,178	0.01	0.10	0	1
Fertilizer Use *(binary, 1=organic)*	1,178	1.69	0.46	1	2

Table A.4: Downstreamness Indicators Comparison by Quintile for Ethiopia

	Food Consumption					Total Consumption				
	Adjusted Down.	**Down. À la Ant. & Ch.**	**(ln) Crop Share**	**Distance to Market**	**Down. as Dummy**	**Adjusted Down.**	**Down. À la Ant. & Ch.**	**(ln) Crop Share**	**Distance to Market**	**Down. as Dummy**
Up to 1st Q.										
Positioning	*-232.9**** *(0.000)*	*-25.91**** *(0.000)*	*-1.277**** *(0.000)*	*-0.721**** *(0.000)*	*-5.424**** *(0.000)*	*-51.15**** *(0.000)*	*-5.142**** *(0. 000)*	*-0.0388**** *(0.000)*	*81.58**** *(0.000)*	*0.101**** *(0.000)*
Observations	292	292	292	289	292	289	289	289	284	289
R-sq. Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AIC	-	-	-	-	-	-	-	-	-	-
BIC	-	-	-	-	-	-	-	-	-	-
Up to 2nd Q.										
Positioning	*9.724**** *(0.000)*	*1.349**** *(0.000)*	*0.0522**** *(0.000)*	*-5.119**** *(1.008)*	*-0.0715**** *(0.000)*	*42.40**** *(0.000)*	*5.958**** *(0. 000)*	*0.147**** *(0.000)*	*-6.207**** *(1.128)*	*-0.370**** *(0.000)*
Observations	570	570	570	564	570	578	578	578	573	578
R-sq. Adj.	1.00	1.00	1.00	0.995	1.00	1.00	1.00	1.00	0.998	1.00
AIC	-	-	-	-3416.40	-	-	-	-	-4156.29	-
BIC	-	-	-	-3329.70	-	-	-	-	-4051.87	-
Up to 3rd Q.										
Positioning	*55.40*** *(23.89)*	*6.617**** *(2.024)*	*0.233**** *(0.0698)*	*0.579* *(1.576)*	*0.000652* *(0.137)*	*76.13**** *(13.70)*	*5.932**** *(1.535)*	*0.127*** *(0.0535)*	*-0.553* *(1.373)*	*0.224** *(0.099)*
Observations	855	855	8.55	849	855	864	864	864	859	864
R-sq. Adj.	0.938	0.941	0.942	0.910	0.932	0.960	0.956	0.948	0.926	0.945
AIC	-2854.72	-2893.27	-2915.32	-2509.49	-2776.86	-3473.32	-3374.20	-3237.60	-2909.87	-3197.50
BIC	-2645.67	-2668.97	-2701.524	-2310.23	-2563.06	-3263.81	-3164.69	-3028.09	-2714.89	-2987.99
Up to 4th Q.										
Positioning	*28.05+* *(19.07)*	*2.641+* *(1.714)*	0.103 *(0.0771)*	*1.694* *(1.539)*	*-0.0403* *(0.137)*	*25.07+* *(15.32)*	*2.297+* *(1.435)*	0.102* (0.0554)	*0.926* *(1.579)*	*-0.0395* *(0.110)*
Observations	1,131	1,131	1,131	1,125	1,131	1,144	1,144	1,144	1,138	1,144
R-sq. Adj.	0.838	0.839	0.837	0.787	0.834	0.868	0.869	0.868	0.833	0.864
AIC	-2412.49	-2415.12	-2403.59	-2106.72	-2380.28	-2783.76	-2787.40	-2779.93	-2522.46	-2745.19
BIC	-1924.50	-1922.12	-1910.57	-1664.47	-1892.29	-2234.16	-2237.79	-2230.32	-2023.79	-2195.58
Up to 5th Q.										
Positioning	*42.01**** *(12.91)*	*3.569**** *(1.226)*	*0.104** (0.0619)	*-0.196* *(1.638)*	*0.0567* *(0.100)*	*35.96**** *(11.01)*	*3.053**** *(1.044)*	*0.0782+* (0.0528)	*-0.0554* *(1.442)*	*0.0410* *(0.0862)*
Observations	1,387	1,387	1,387	1,381	1,387	1,387	1,387	1,387	1,381	1,387
R-sq. Adj.	0.718	0.716	0.708	0.643	0.704	0.727	0.759	0.717	0.687	0.749
AIC	-1316.97	-1306.11	-1266.77	-1013.52	-1251.08	-1697.19	-1686.64	-1644.86	-1371.93	-1633.08
BIC	-615.49	-604.63	-565.29	-375.39	-549.61	-995.71	-985.16	-943.38	-733.80	-931.60

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1.
All estimates with a number of decimals above 6 are rounded to the third decimal unit.
Regression controls and intercepts are not reported.

Table A.5: Downstreamness Indicators Comparison by Main Crop for Ethiopia

	Food Consumption					**Total Consumption**				
	Adjusted Down.	**Down. À la Ant. & Ch.**	**(ln) Crop Share**	**Distance to Market**	**Down. as Dummy**	**Adjusted Down.**	**Down. À la Ant. & Ch.**	**(ln) Crop Share**	**Distance to Market**	**Down. as Dummy**
Teff										
Positioning	*-60.14* *(47.69)*	*-3.362* *(4.590)*	*-0.178* *(0.167)*	*310.5**** *(67.03)*	*-1.550**** *(0.0263)*	*-98.18*** *(39.42)*	*-7.674** *(3.948)*	*-0.305*** *(0.136)*	*324.9**** *(49.59)*	*-1.412**** *(0.0325)*
Observations	368	368	368	366	368	368	368	368	366	368
R-sq. Adj.	0.947	0.944	0.946	0.970	1.00	0.953	0.954	0.951	0.981	0.999
AIC	-1114.85	-1095.84	-1109.40	-1333.25	-2874.13	-1245.94	-1204.47	-1233.37	-1534.53	-2611.82
BIC	-1024.97	-1005.95	-1019.52	-1247.91	-2784.24	-1156.05	-1114.59	-1143.48	-1444.77	-2521.93
Maize										
Positioning	*87.95**** *(21.30)*	*7.722**** *(1.586)*	*0.102* *(0.165)*	*-1.425* *(3.006)*	*-0.453* *(0.502)*	*49.93**** *(8.154)*	*4.282**** *(0.619)*	*0.0561* *(0.0892)*	*-2.023* *(1.838)*	*-0.136* *(0.282)*
Observations	272	272	272	272	272	272	272	272	272	272
R-sq. Adj.	0.994	0.996	0.990	0.991	0.991	0.998	0.998	0.996	0.997	0.996
AIC	-1471.13	-1506.15	-1301.95	-1297.27	-1293.71	-1818.29	-1842.19	-162.80	-1646.24	-1621.40
BIC	-1413.44	-1448.46	-1244.26	-1239.58	-1236.02	-1760.60	-1784.50	-1572.10	-1588.55	-1563.71
Sorghum										
Positioning	*131.7**** *(0.0029)*	*8.149**** *(0.0001)*	*0.473**** *(0.000)*	*-68.21* *(.)*	*3.008**** *(0.000)*	*225.2**** *(0.004)*	*13.94**** *(0.0001)*	*0.809**** *(0.000)*	*-116.6* *(.)*	*4.305**** *(0.000)*
Observations	167	167	167	167	167	167	167	167	167	167
R-sq. Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AIC	-	-	-	-	-	-	-	-	-	-
BIC	-	-	-	-	-	-	-	-	-	-
Wheat										
Positioning	*457.1* *(.)*	*50.89* *(.)*	*5.547**** *(0.000)*	*-420.7**** *(0.744)*	*-1.742**** *(.)*	456.8 (.)	50.86 (.)	5.543*** (0.000)	-332.5*** (0.643)	-1.741*** (.)
Observations	150	150	150	148	150	150	150	150	148	150
R-sq. Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AIC	-	-	-	-	-	-	-	-	-	-
BIC	-	-	-	-	-	-	-	-	-	-
Sorghum or Wheat										
Positioning	*8.936* *(22.12)*	*-0.0532* *(1.679)*	*-0.150** *(0.0771)*	*-97.12**** *(13.84)*	*-0.208* *(0.192)*	*70.32**** *(15.06)*	*5.2878**** *(1.153)*	*0.222*** *(0.0899)*	*-114.5**** *(7.745)*	*-0.132* *(0.171)*
Observations	317	317	317	317	317	317	317	317	317	317
R-sq. Adj.	0.981	0.981	0.982	0.994	0.984	0.989	0.987	0.980	0.998	0.981
AIC	-1177.82	-1175.60	-1191.27	-1533.66	-1189.90	-1385.28	-1321.33	-1228.85	-1901.08	-1197.30
BIC	-1076.33	-1074.11	-1089.78	-1439.84	-1088.41	-1283.79	-1219.84	-11127.36	-1807.26	-1095.80

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1.
All estimates with a number of decimals above 6 are rounded to the third decimal unit.
Regression controls and intercepts are not reported.

Table A.6: Commercialized Crops Price Elasticity of Demand for Ethiopia

Crop type	Elasticity
Barley	-0.948
Maize	-0.746
Millet	-1.074
Sorghum	-0.656
Teff	-0.888
Wheat	-0.981
Mung Bean	-0.952
Haricot Beans	-0.952
Horse Beans	-0.952
Lentils	-0.952
Field Peas	-0.952
Soya Beans	-0.952
Red Kideny Beans	-0.952
Lineseed	-0.999
Ground Nuts	-0.983
Nueg	-0.999
Rape Seed	-0.999
Sesame	-0.999
Fenugreek	-0.976

Source: Adapted from Tafere et al. (2010).

Table A.7: Commercialized Crops Price Elasticity of Demand for Nigeria

Crop type	Elasticity
Barley	-0.948
Maize	-0.44
Plantain	-0.3228
Oil Palm Tree	-0.3228
Melon	0.7017
Okro	-0.3228
Pepper	-0.3228
Cocoyam	-0.3228
Yam	-0.21
Rice	0.14
Beans/Cowpea	-0.7
Guinea Courn/Sorghum	-0.8
Cassava Old	-0.0667
Banana	-0.3858
Ground Nut/Peanuts	-0.535
Soya BeANS	-0.5035
Onion	-0.3228
Pumpkin Seed	-0.3228
Potato	-0.3228
Shelled Maize (Grain)	-0.44
White Yam	-0.21
Water Yam	-0.21
Cocoa	-0.333
Cotton	-0.74
Cashew	0.7017
Kolanut	-0.5035

Source: Adapted from World Bank Group (1982), Akinleye & Rahji (2007), Pan et al (2009), Ashagidigbi (2019), Obayelu et al. (2019), Adeniji (2019).

Figure A.1: Ethiopia Household Downstreamness Values - Density by Year

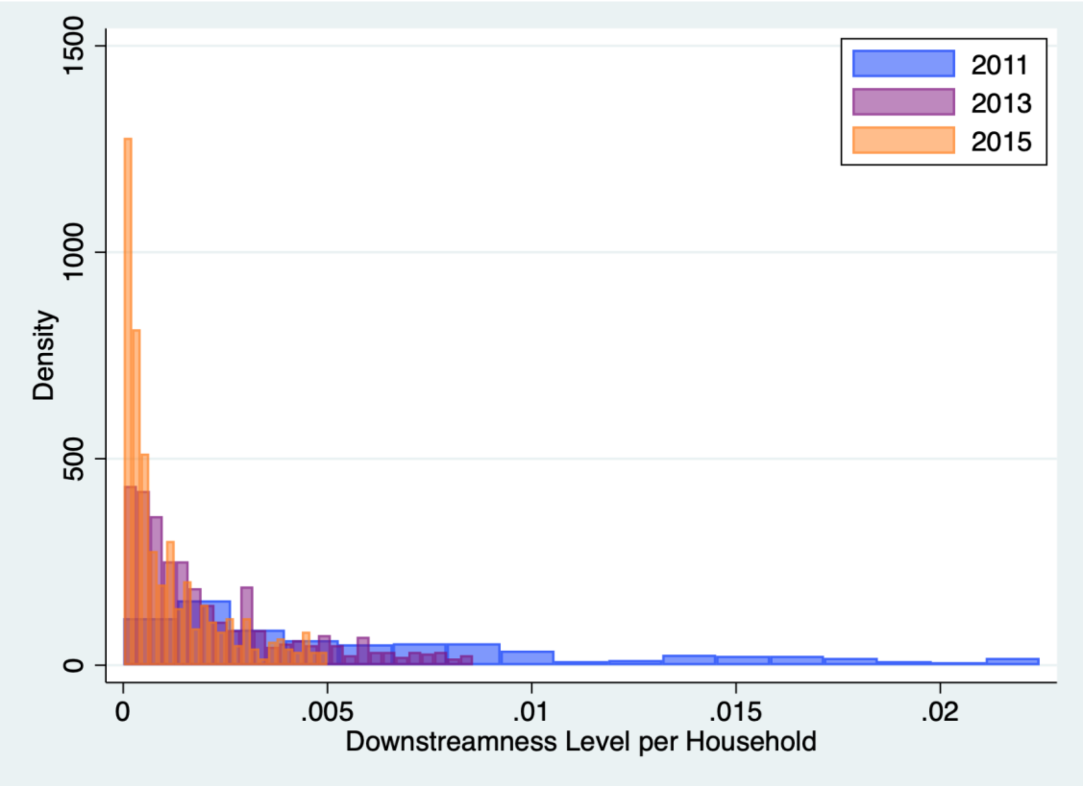

Figure A.2: Nigeria Household Downstreamness Values - Density by Year

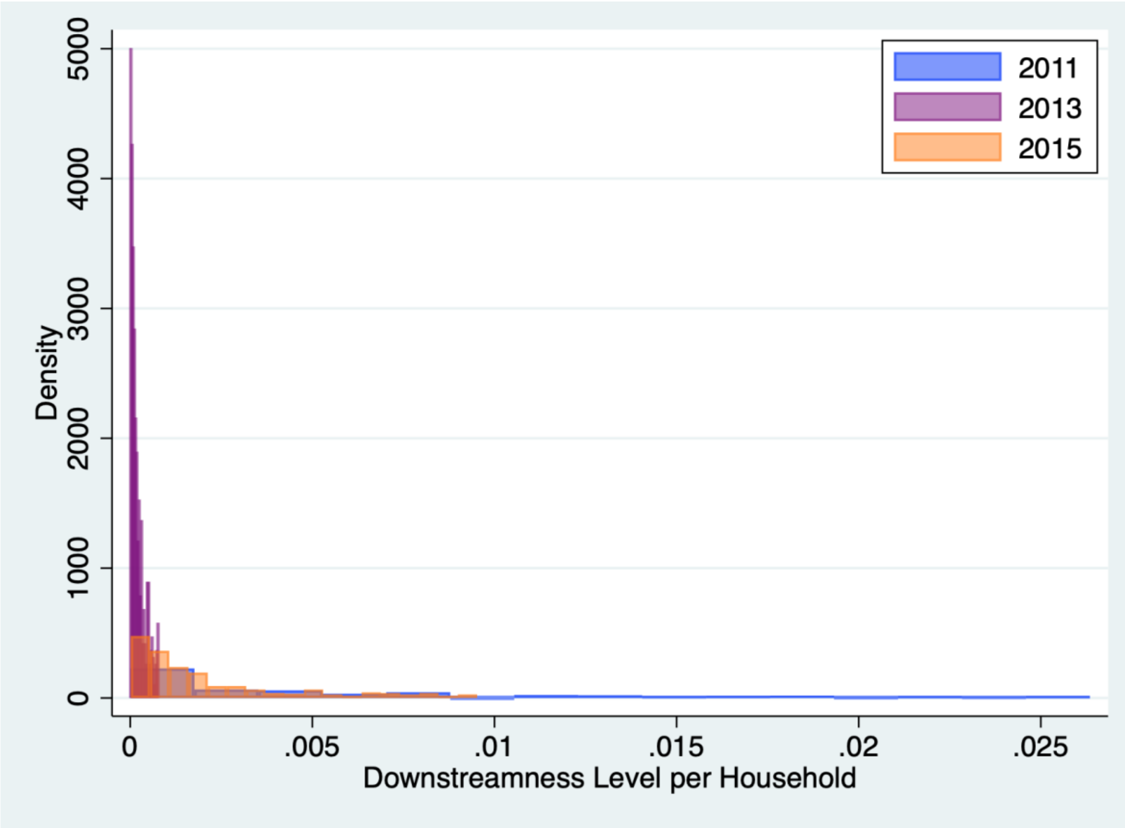

Figure A.3: Kernel Density Downstreamness Positioning Indicator Ethiopia 2011

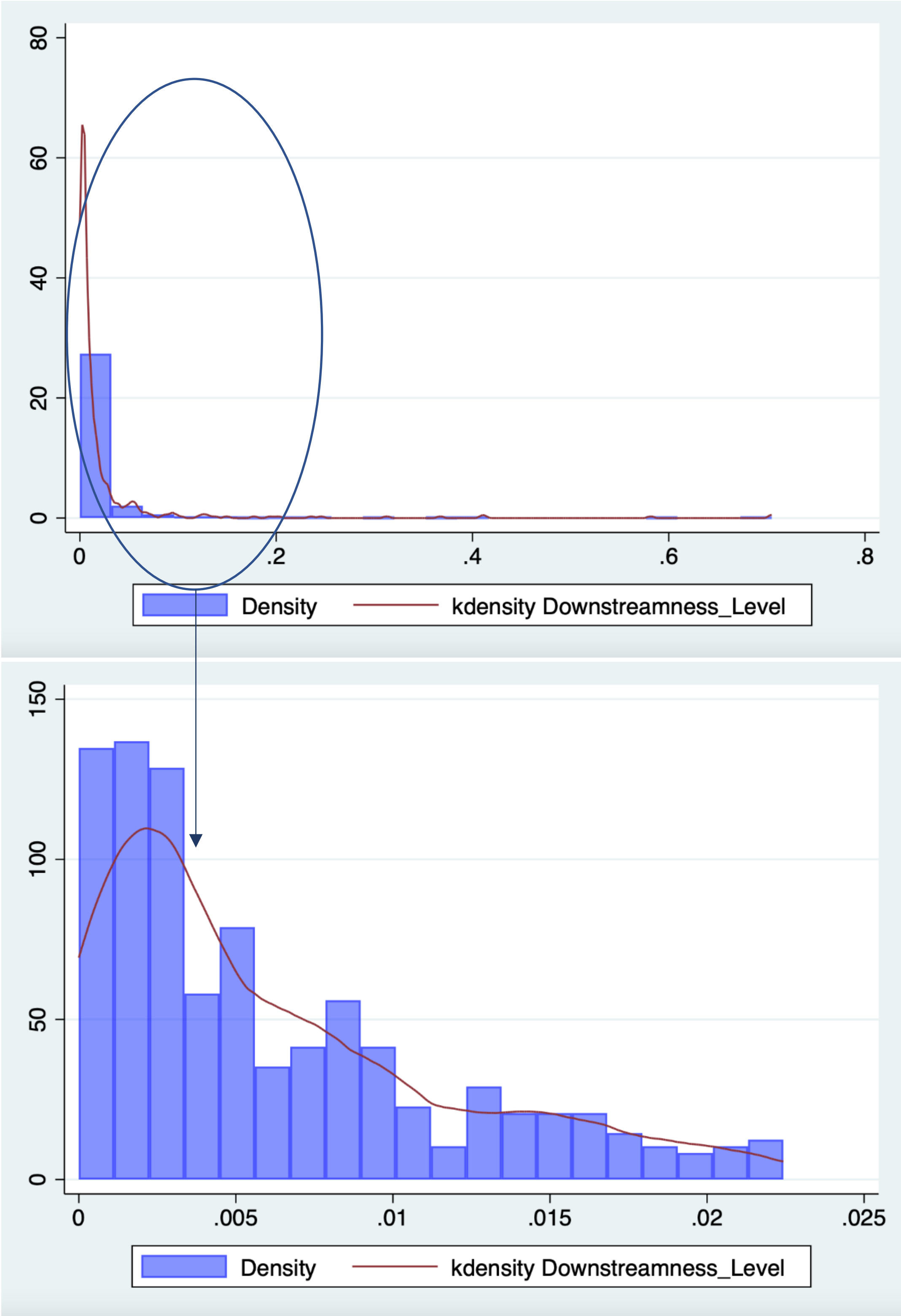

Figure A.4: Kernel Density Downstreamness Positioning Indicator Ethiopia 2013

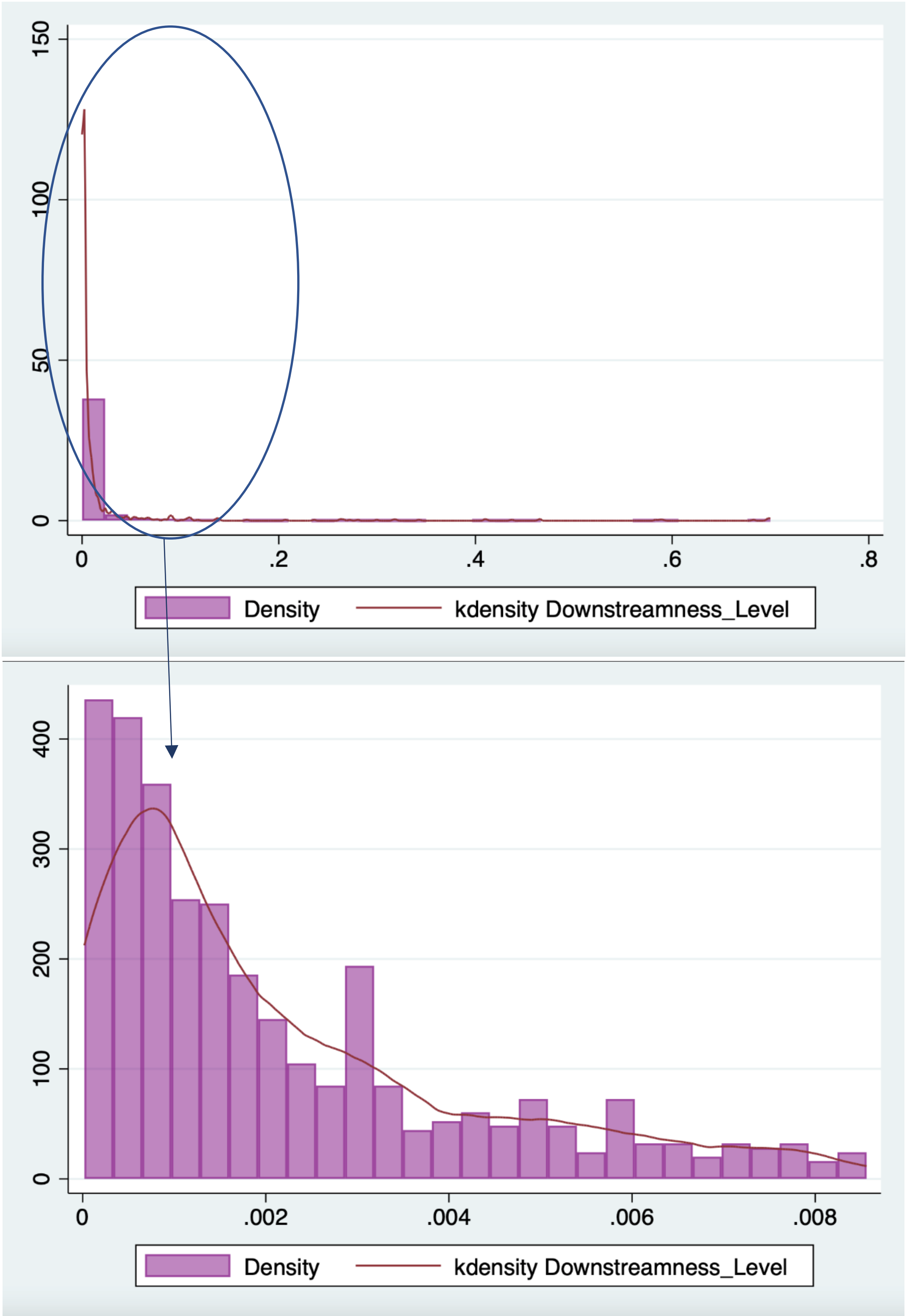

Figure A.5: Kernel Density Downstreamness Positioning Indicator Ethiopia 2015

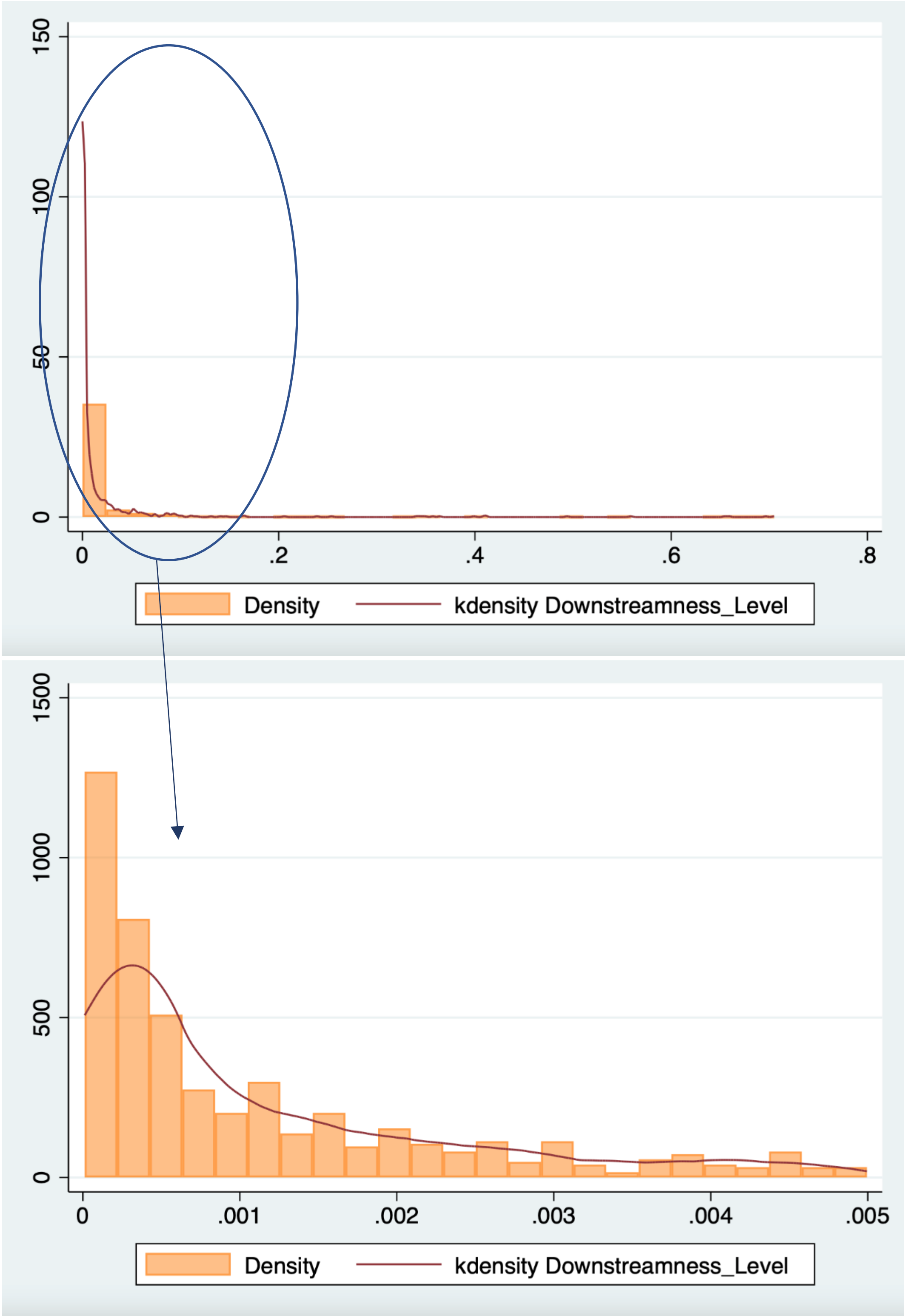

Figure A.6: Kernel Density Downstreamness Positioning Indicator Nigeria 2011

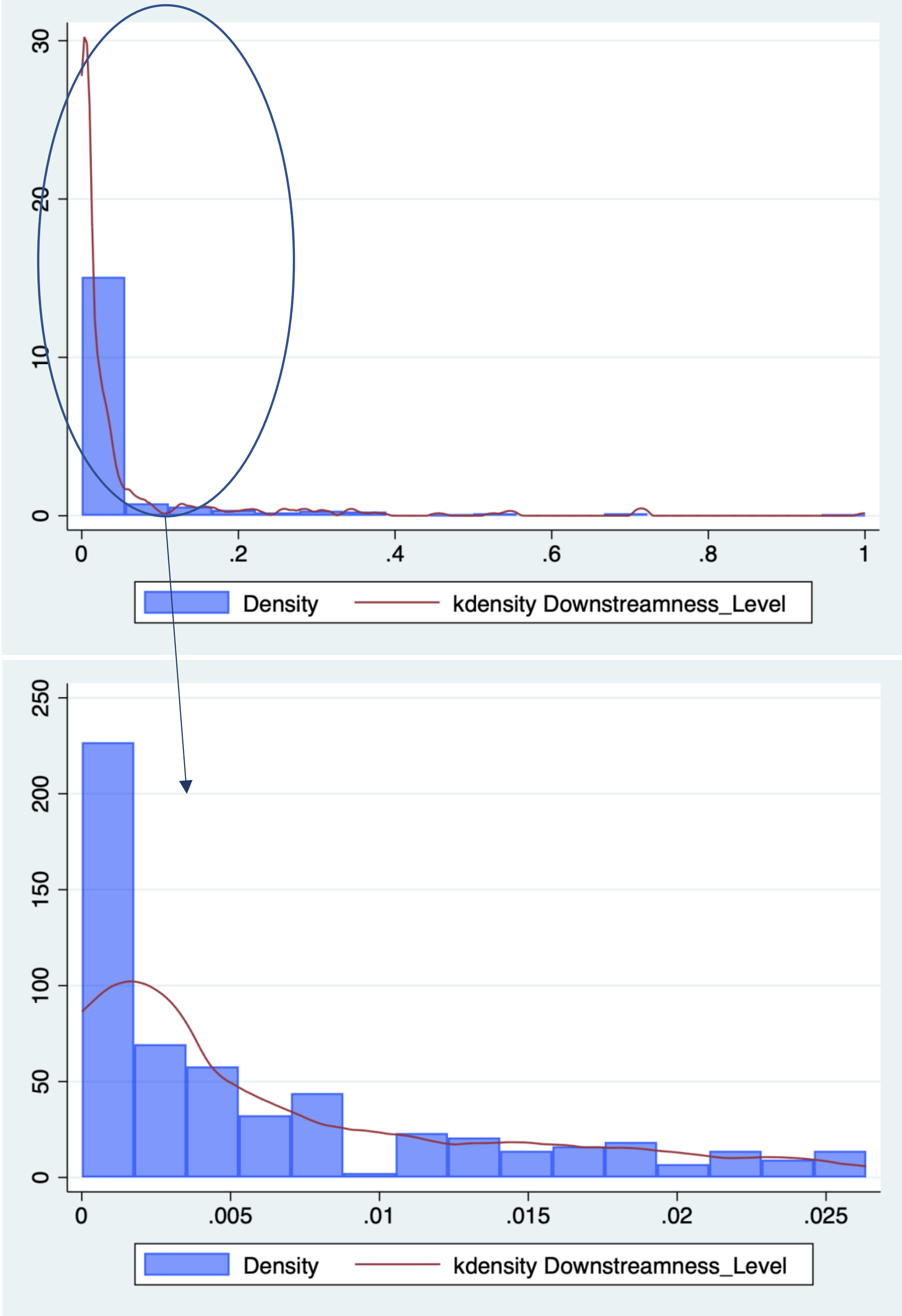

Figure A.7: Kernel Density Downstreamness Positioning Indicator Nigeria 2013

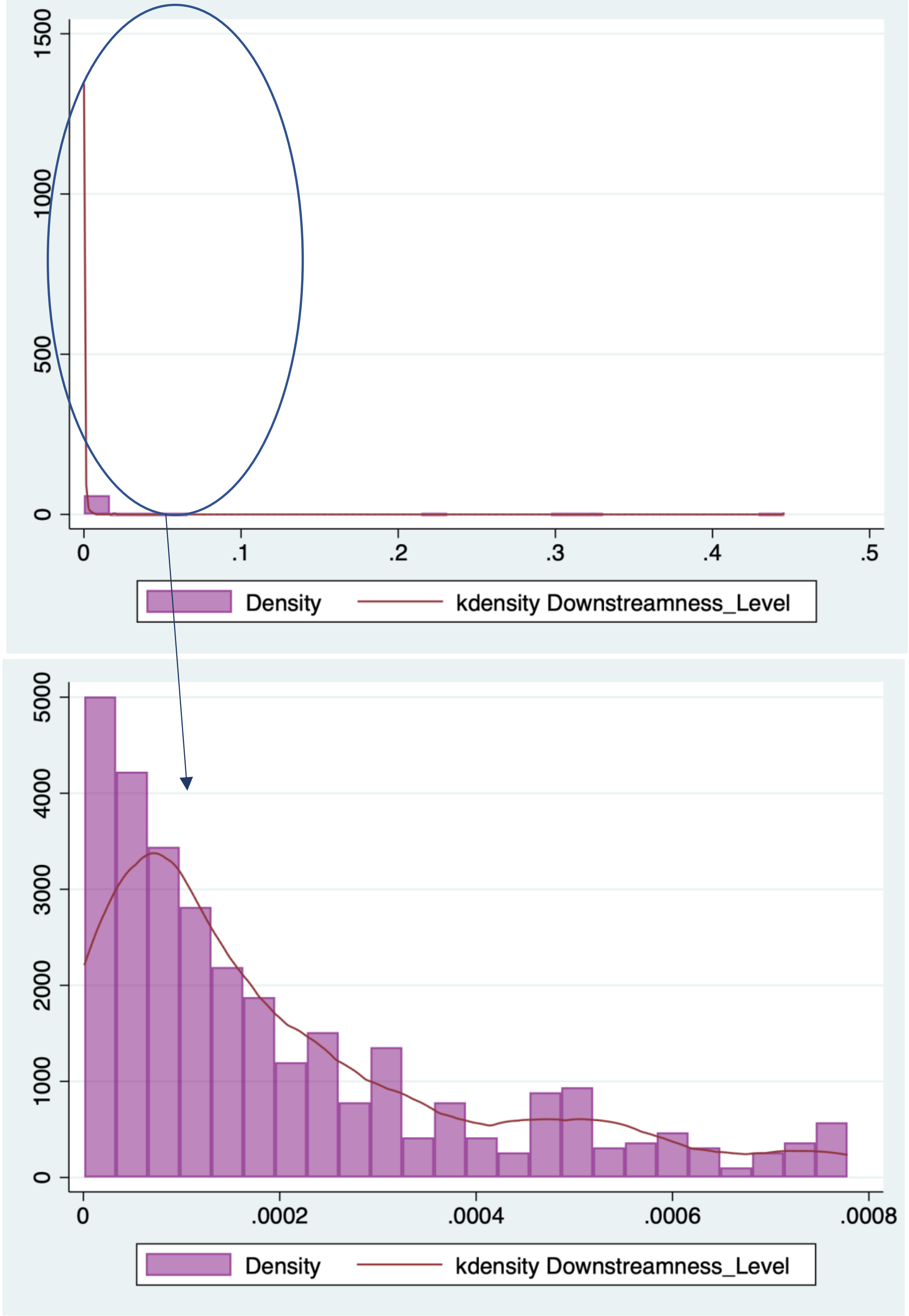

Figure A.8: Kernel Density Downstreamness Positioning Indicator Nigeria 2015

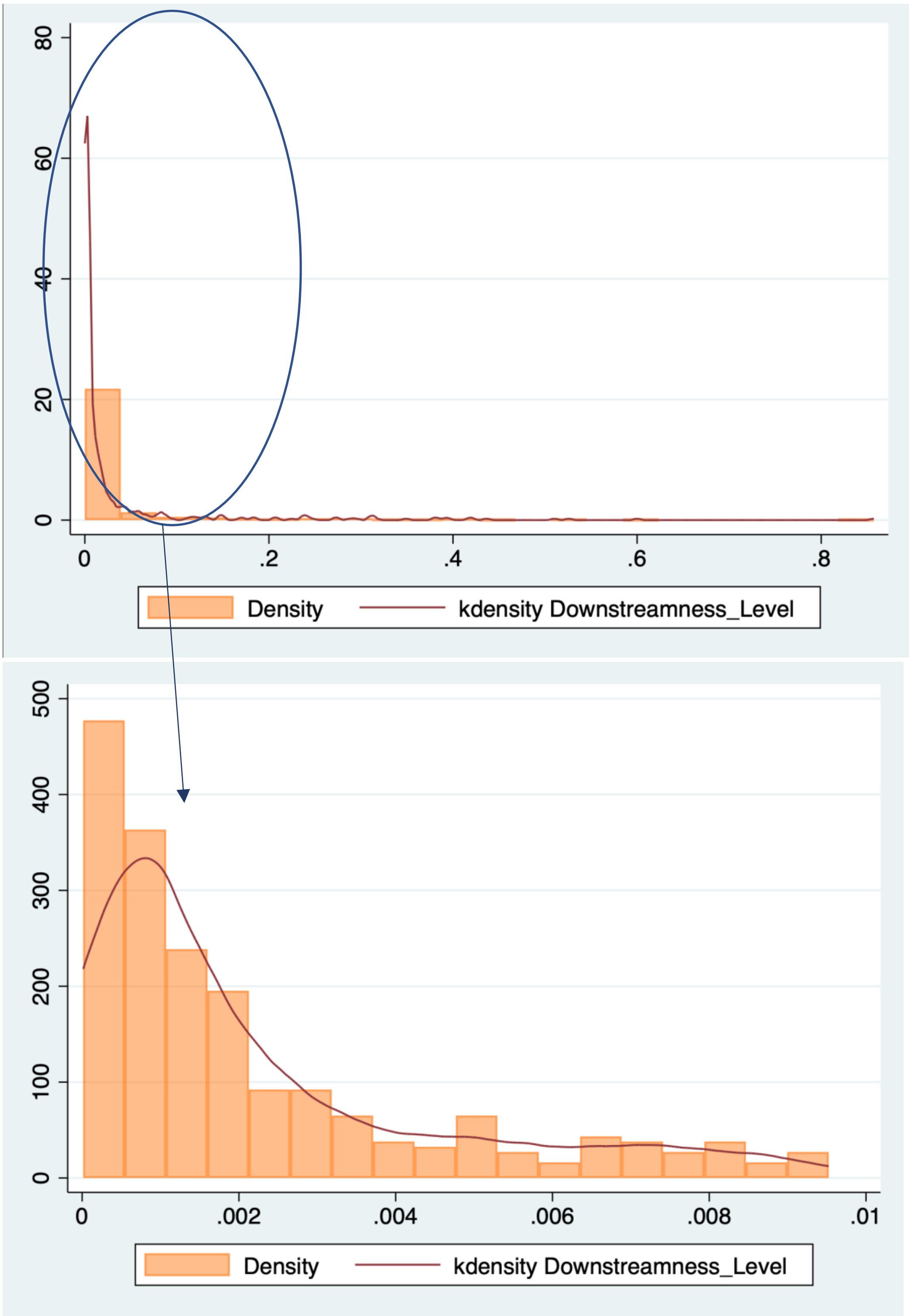

Table A.8: Ethiopia Main Results with Consumption per Adult Equivalent

	Food Consumption			Total Consumption		
	Wave Fixed Effects	District-Wave Fixed Effects	Wave Fixed Effect HH Trends	Wave Fixed Effects	District-Wave Fixed Effects	Wave Fixed Effect HH Trends
Downstreamness	28.10*	38.38***	38.03***	24.23+	31.40***	31.99***
	(15.48)	(12.29)	(12.41)	(14.77)	(10.77)	(10.65)
Female Head	0.190	0.192	0.185	0.0385	0.0836	0.0134
	(0.655)	(0.692)	(0.723)	(0.601)	(0.594)	(0.635)
Age Head	0.0151+	0.0131+	0.0130+	0.0132	0.0121+	0.0121+
	(0.00939)	(0.00895)	(0.00898)	(0.00919)	(0.00806)	(0.00800)
Household Labor	-0.162***	-0.113**	-0.112**	-0.148***	-0.0955*	-0.0917*
	(0.0513)	(0.0540)	(0.0534)	(0.0474)	(0.0494)	(0.0486)
Household Size	0.00290	-0.108*	-0.106*	0.0197	-0.0644	-0.0642
	(0.0648)	(0.0581)	(0.0578)	(0.0627)	(0.0545)	(0.0540)
Education Adults	-0.429**	1.690	1.650	-0.491***	1.793+	1.774+
	(0.195)	(1.276)	(1.289)	(0.176)	(1.092)	(1.101)
N. of Infants	0.149*	0.187***	0.184**	0.133*	0.138**	0.135**
	(0.0806)	(0.0713)	(0.0718)	(0.0719)	(0.0629)	(0.0630)
N. of Child	-0.125**	-0.0935*	-0.0942*	-0.137***	-0.0997**	-0.102**
	(0.0517)	(0.0493)	(0.0499)	(0.0478)	(0.0443)	(0.0448)
Average Education	0.474**	-1.694	-1.656	0.546***	-1.791+	-1.772+
	(0.196)	(1.279)	(1.291)	(0.176)	(1.096)	(1.104)
Harvest Crop	0.00006	0.00008	0.00009	0.00003	0.00007	0.00008+
	(0.00006)	(0.00006)	(0.00006)	(0.00005)	(0.00005)	(0.00005)
Field Size	0.00001	0.000005	0.000005	0.000008	0.000007	0.000006
	(0.000007)	(0.000007)	(0.000007)	(0.000006)	(0.000007)	(0.000007)
Free Seed	-0.673	0.255	0.263	-0.713*	0.00653	0.0291
	(0.424)	(0.400)	(0.405)	(0.396)	(0.376)	(0.382)
Seed Purchase	0.160	0.176	0.187	0.0829	0.0786	0.0822
	(0.142)	(0.174)	(0.175)	(0.120)	(0.154)	(0.155)
Fertilizer Use	-0.0568	-0.167	-0.173	-0.0277	-0.125	-0.142
	(0.103)	(0.135)	(0.138)	(0.0919)	(0.114)	(0.116)
Seed Type Dummy* Crop Code Dummy*	-	-	-	-	-	-
Year Dummy* Month Dummy*	-	-	-	-	-	-
Region Dummy* Woreda Dummy* Zone Dummy* Town Dummy* Subcity Dummy* Kebele Dummy*		-	-		-	-
HH Trends HH Trends^2			-			-
Constant	7.816***	6.793***	6.844***	8.157***	7.399***	7.463***
	(0.707)	(0.970)	(0.974)	(0.666)	(0.838)	(0.849)
Observations	1,387	1,387	1,387	1,387	1,387	1,387
Number of HH_id	1,097	1,097	1,097	1,097	1,097	1,097
R-squared Adjusted	0.222	0.698	0.698	0.224	0.703	0.704

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1.

Table A.9: Sample Bias – Panel FE with the Heckman Correction

	Food Consumption		Total Consumption	
	Heckman	FE	Heckman	FE
	Wave Fixed Effects	Wave Fixed Effects	Wave Fixed Effects	Wave Fixed Effects
Downstreamness	49.91*	29.54**	47.51*	25.86**
	(25.83)	(12.17)	(25.18)	(11.55)
Female Head	0.126	0.187	-0.152	0.0174
	(0.874)	(0.653)	(0.795)	(0.586)
Age Head	0.00647	0.0145*	-0.00179	0.0123+
	(0.0292)	(0.00863)	(0.0270)	(0.00850)
Household Labor	-0.0212	0.0181	0.0221	0.0331
	(0.0981)	(0.0450)	(0.0898)	(0.0417)
Household Size	-0.325***	-0.200***	-0.294***	-0.197***
	(0.110)	(0.0641)	(0.104)	(0.0601)
Education Adults	0.0340	0.0585**	0.0399	0.0630***
	(0.0513)	(0.0275)	(0.0452)	(0.0240)
N. of Infants	0.0892	0.0859	0.0641	0.0792
	(0.149)	(0.0753)	(0.133)	(0.0675)
N. of Child	0.0193	0.00579	0.0229	0.00198
	(0.105)	(0.0472)	(0.0948)	(0.0427)
Harvest Crop	0.00006	0.00007	0.00008	0.00005
	(0.000115)	(0.00005)	(0.000102)	(0.00005)
Field Size	0.00001	0.00001*	0.00001	0.000009+
	(0.00001)	(0.000006)	(0.00001)	(0.00005)
Free Seed	-0.0297	-0.450	-0.112	-0.481
	(0.575)	(0.358)	(0.522)	(0.327)
Seed Purchase	0.232	0.114	0.123	0.0389
	(0.265)	(0.148)	(0.220)	(0.130)
Fertilizer Use	-0.0269	-0.0498	-0.0584	-0.0138
	(0.190)	(0.0955)	(0.173)	(0.0833)
Seed Type Dummy*	-	-	-	0.123
Time FE*		-	-	-
Constant	7.594***	7.786***	7.656***	8.145***
	(0.335)	(0.607)	(0.300)	(0.565)
Observations	1,455	1,387	1,455	1,387
Boostrap Replications	232		232	
Number of HH_id		1,097		1,097
R-squared Adjusted		0.257	0.235	0.250

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1.

Note: Control variables "household average education level" and "crop code" are excluded as their inclusion in the regression models does not allow convergence in the Heckman Fixed Effect computational tools.

Table A.10: Summary Statistics Non-Movers vs Movers

		N. of observations		Mean		Standard Deviation		Minimum Value		Maximum Value	
		M	NM	M	NM	M	NM	M	NM	M	NM
Between Wave 1 and Wave 2	**Gender Hous. Head *(binary)***	970	492	0.18	0.19	0.38	0.39	0	0	1	1
	Age Hous. Head *(decimals)*	970	492	45.32	46.50	14.36	1.89	10	21	97	85
	Hous. Labor Force *(decimals)*	970	492	2.71	2.64	1.37	1.39	0	0	10	8
	Household Size *(decimals)*	970	492	5.66	5.98	2.20	2.16	1	1	14	13
	Av. Educ. Adults *(decimals)*	969	491	1.63	1.85	1.80	1.88	0	0	8	8
	Household Infants *(decimals)*	970	492	0.54	0.65	0.82	0.79	0	0	4	5
	Hous. Children *(decimals)*	970	492	2.35	2.48	1.68	1.67	0	0	10	8
	Hous. Education *(decimals)*	969	492	1.63	1.85	1.79	1.88	0	0	8	8
	Harvest Crop *(decimals, Kg)*	970	492	817.53	1106.91	718.27	781.06	0	0	3249.61	3230
	Field Size *(decimals, m^2)*	970	492	9522.82	8066.65	9444.17	9144.86	0	0	38917.5	38050.83
	Free Seed *(binary, 2=yes)*	967	492	0.98	1.00	0.14	0.06	0	0	1	1
	Seed Purchase *(binary, 2=yes)*	970	492	0.95	0.92	0.23	0.27	0	0	1	1
	Fertilizer Use *(binary, 2=yes)*	970	492	0.84	0.74	0.37	0.44	0	0	1	1
Between Wave 2 and Wave 3	**Gender Hous. Head (binary)**	1183	279	0.19	0.14	0.39	0.34	0	0	1	1
	Age Hous. Head *(decimals)*	1183	279	46.23	43.58	14.05	14.71	18	18	87	97
	Hous. Labor Force *(decimals)*	1183	279	2.73	2.52	1.42	1.17	0	0	10	6
	Household Size *(decimals)*	1183	279	5.89	5.27	2.19	2.11	1	1	14	11
	Av. Educ. Adults *(decimals)*	1181	279	1.75	1.52	1.85	1.74	0	0	8	7
	Household Infants *(decimals)*	1183	279	0.72	0	0.84	0	0	0	5	0
	Hous. Children *(decimals)*	1183	279	2.55	1.72	1.71	1.35	0	0	10	5
	Hous. Education *(decimals)*	1181	279	1.75	1.51	1.85	1.73	0	0	8	7
	Harvest Crop *(decimals, Kg)*	1183	279	940.63	805.85	72.94	647.37	0	0	3249.61	3122
	Field Size *(decimals, m^2)*	1183	277	8935.27	9446.25	9236.24	9895.60	0	0	38858.3	38917.46
	Free Seed *(binary, 2=yes)*	1182	279	1.00	0.95	0.06	0.23	0	0	1	1
	Seed Purchase *(binary, 2=yes)*	1183	279	0.93	0.96	0.26	0.19	0	0	1	1
	Fertilizer Use (binary, 2=yes)	1183	279	0.79	0.87	0.41	0.33	0	0	1	1

Legend: “M” stands for “Position-Movers,” while “NM” stands for “Non-Position-Movers”.

Table A.11: Self-Selection Bias – OLS for Residuals Calculation

	Positioning Downstream in the Chain		
	Wave Fixed effects	**District-Wave Fixed Effects**	**Wave Fixed Effect HH Trends**
Female Head	-0.0106	-0.0121	-0.0113
	(0.0362)	(0.0341)	(0.0342)
Age Head	-0.000187	-0.000768	-0.000779
	(0.00108)	(0.000974)	(0.000973)
Household Labor	0.00388	-0.00380	-0.00398
	(0.0171)	(0.0161)	(0.0161)
Household Size	0.00210	0.00488	0.00502
	(0.0156)	(0.0144)	(0.0144)
Education Adults	-0.370***	-0.408**	-0.408**
	(0.0699)	(0.197)	(0.197)
N. of Infants	-0.00550	-0.00270	-0.00271
	(0.0234)	(0.0228)	(0.0227)
N. of Child	0.00337	0.00283	0.00282
	(0.0170)	(0.0161)	(0.0161)
Average Education	0.379***	0.418**	0.418**
	(0.0710)	(0.197)	(0.198)
Harvest Crop	0.00003	0.000006	0.000006
	(0.00002)	(0.000002)	(0.000002)
Field Size	-0.000002	-0.000001	-0.000001
	(0.000001)	(0.000002)	(0.000002)
Free Seed	-0.0679	0.0253	0.0259
	(0.121)	(0.0917)	(0.0919)
Seed Purchase	0.0756	0.0328	0.0331
	(0.0533)	(0.0542)	(0.0543)
Fertilizer Use	-0.0132	0.0165	0.0161
	(0.0352)	(0.0378)	(0.0378)
Seed Type Dummy* **Crop Code Dummy***	-	-	-
Position Dummy*	-	-	-
Year Dummy* Month Dummy*	-	-	-
Region Dummy* Woreda Dummy* Zone Dummy* Town Dummy* Subcity Dummy* Kebele Dummy*		-	-
HH Trends HH $Trends^2$			-
Constant	0.690**	0.506	0.553
	(0.331)	(0.564)	(0.577)
Observations	1,455	1,455	1,455
R-squared Adjusted	0.035	0.299	0.4298

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1.

Table A.12: Self-Selection Bias – Control Function Method

	Food Consumption			Total Consumption		
	Wave Fixed Effects	District-Wave Fixed Effects	Wave Fixed Effect HH Trends	Wave Fixed Effects	District-Wave Fixed Effects	Wave Fixed Effect HH Trends
Downstreamness	27.23*	43.03***	41.03***	24.28+	36.23***	35.86***
	(15.71)	(13.04)	(13.07)	(14.97)	(11.23)	(11.20)
Female Head	0.109	0.177	0.108	-0.0243	0.0757	0.0191
	(0.628)	(0.632)	(0.686)	(0.579)	(0.531)	(0.592)
Age Head	0.0188**	0.0181**	0.0198***	0.0171**	0.0171***	0.0169***
	(0.00799)	(0.00743)	(0.00658)	(0.00767)	(0.00652)	(0.00650)
Household Labor	-0.0197	0.0175	0.0107	-0.00807	0.0346	0.0390
	(0.0460)	(0.0518)	(0.0496)	(0.0421)	(0.0469)	(0.0456)
Household Size	-0.162***	-0.273***	0.00665	-0.145***	-0.229***	-0.226***
	(0.0590)	(0.0555)	(0.0562)	(0.0557)	(0.0515)	(0.0510)
Education Adults	-0.473**	1.578	1.024	-0.517**	1.666	1.617
	(0.223)	(1.254)	(1.286)	(0.205)	(1.085)	(1.084)
N. of Infants	0.0937	0.152**	0.131*	0.0793	0.102*	0.0963
	(0.0791)	(0.0694)	(0.0707)	(0.0701)	(0.0596)	(0.0596)
N. of Child	-0.00396	0.0538	0.0295	-0.0157	0.0480	0.0456
	(0.0493)	(0.0471)	(0.0488)	(0.0443)	(0.0414)	(0.0421)
Average Education	0.534**	-1.563	-1.010	0.587***	-1.645	-1.599+
	(0.224)	(1.256)	(1.288)	(0.206)	(1.088)	(1.086)
Harvest Crop	0.00005	0.00007	0.00009	0.00003	0.00006	0.00007
	(0.00006)	(0.00007)	(0.00007)	(0.00005)	(0.00006)	(0.00006)
Field Size	0.00001+	0.000006	0.000009	0.000009	0.000009	0.000008
	(0.000007)	(0.000008)	(0.000008)	(0.000006)	(0.000007)	(0.000007)
Free Seed	-0.570	0.135	0.352	-0.607*	-0.114	-0.0903
	(0.377)	(0.396)	(0.349)	(0.349)	(0.367)	(0.374)
Seed Purchase	0.194	0.0953	0.0921	0.114	-0.00234	0.0136
	(0.153)	(0.176)	(0.191)	(0.132)	(0.160)	(0.159)
Fertilizer Use	-0.0136	-0.143	-0.162	0.0100	-0.102	-0.118
	(0.106)	(0.136)	(0.137)	(0.0950)	(0.115)	(0.117)
Seed Type Dummy* **Crop Code Dummy***	-	-	-	-	-	-
Position Dummy*	-	-	-	-	-	-
Time Dummy**	-	-	-	-	-	-
Region Dummy* Woreda Dummy* Zone Dummy* Town Dummy* Subcity Dummy* Kebele Dummy*		-	-		-	-
HH Trends			-			-
ρ	7.973***	6.238***	6.256***	8.306***	-0.00707	0.00676
	(0.632)	(0.987)	(0.976)	(0.586)	(0.0869)	(0.0871)
Constant	7.973***	6.238***	6.256***	8.306***	6.837***	6.950***
	(0.632)	(0.987)	(0.976)	(0.586)	(0.848)	(0.855)
Observations	1,387	1,387	1,387	1,387	1,387	1,387
Number of HH_id	1,097	1,097	1,097	1,097	1,097	1,097
R-squared Adjusted	0.193	0.667	0.643	0.213	0.683	0.685

Robust standard errors in parentheses: +p<0.15, *** p<0.01, ** p<0.05, * p<0.1.

Figure A.9: Ethiopia - Classification Tree for Food Consumption above 95 Percentile

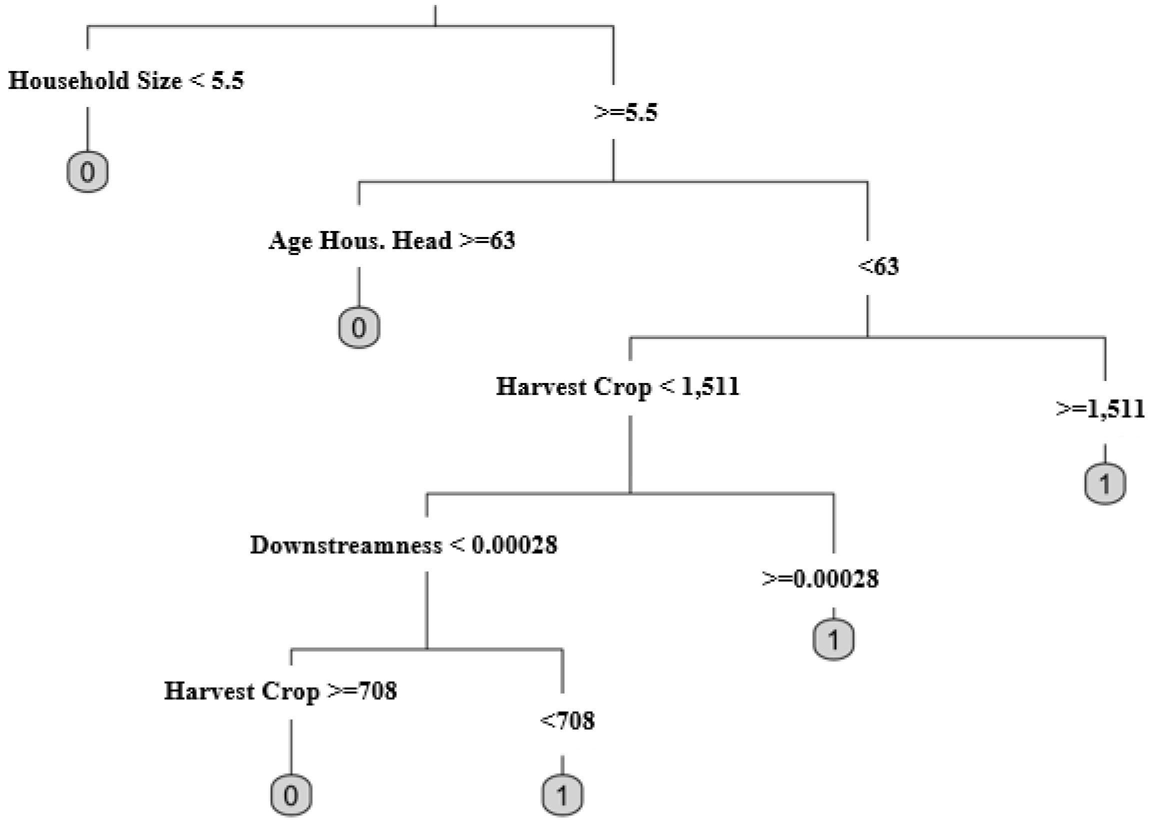

Figure A.10: Ethiopia - Classification Tree for Total Consumption above 95 Percentile