THE RISE OF AGRIBUSINESSES AND ITS DISTRIBUTIONAL CONSEQUENCES

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ABSTRACT. Crops are often modelled as homogeneous products exchanged in perfectly competitive markets. Yet smallholder farmers face high trade barriers in selling their crops. Agribusinesses with better access to world markets can enable farmers to overcome these barriers. But they may also raise buyer power in the thin crop markets faced by farmers. We document that farmers selling to agribusinesses receive higher incomes and higher trickle down from world crop price movements. Incorporating these facts and endogenous buyer power, we quantify the aggregate gains from trade and their distribution between farmers and their intermediaries for three low-income countries in the 2000s.

JEL Codes: F1, F6, Q1, O1.
Keywords: Agribusiness, market power, intermediated trade, middlemen, oligopsony.

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1. Introduction

Agriculture continues to support a vast majority of people, particularly in low-income countries, where it is the main source of livelihood, employment and exports. Much of the literature in international trade treats crops as homogeneous products that are exchanged in perfectly competitive markets. While this may be a reasonable assumption to characterise world commodity markets, a vast literature finds that farmers face high trade barriers in selling their crops at home and abroad. About 80 per cent of the world's farmers are smallholders who sell through intermediaries such as traders, state parastatals and agribusinesses, which often constitute thin crop markets for farmers (Lowder et al. 2014).

Following a string of national reforms in the 1980-1990s, governments have moved away from directly controlling crop markets to encouraging participation by agribusinesses. There has been an accompanying increase in the production of export crops and entry of new intermediaries including supermarket chains, agro-industrial firms, and export oriented companies offering outgrower schemes (UNCTAD 2009).

The rise of these agribusinesses offer opportunities for reducing the barriers that farmers face when accessing markets for their crops. But there are growing concerns that agribusiness reforms may also have contributed to creating a dual structure in farming activities, with few large agribusinesses that have the scale and capital to access world markets and many small farmers who continue to face low yields, low prices for their produce or high barriers to market access.[1] More recently, the introduction and rollback of contract farming laws in India present a stark example of these arguments. Farmer protests followed the introduction of laws aimed at boosting farm exports, among concerns in certain communities over income losses stemming from entry of agribusinesses and erosion of state protection in crop markets.

This paper embeds both these channels of increased productivity from agribusinesses and the potential for losses for small farmers from thin markets to examine the welfare consequences of intermediation in crop sales of farmers. It starts with the observation that farmers selling through agribusinesses tend to be larger and to get higher transmission from world price movements. Embedding these empirical regularities in a theoretical model of the microstructure of intermediation, it shows that heterogeneity across farmers and their endogenous sorting to different buyers is critical in determining the direction

[1]Surveys by Barrett and Mutambatsere (2008), Collier and Dercon (2014), Dillon and Dambro (2017), and Barrett et al. (forthcoming).

and the extent to which world prices and entry costs of intermediaries impact farm incomes. The reasoning behind this is that farmer sorting determines the farm supply elasticity to different intermediaries and hence the resulting endogenous market power of intermediaries.

Inequality and buyer power introduce a wedge between the aggregate gains from trade and the gains from trade that accrue to small farmers. Farmgate prices paid by intermediaries are higher when farm productivity is more equally distributed. In this case, the usual intuition for the welfare gains from trade goes through. As world prices rise or entry costs for intermediaries fall, intermediaries compete more fiercely and pay higher farmgate prices. The aggregate gains from trade and the producer gains from trade therefore move in the same direction.

But the opposite can happen for small farmers who sell through traders when farm productivity is highly unequal. As relatively productive farmers switch to agribusinesses, farm supply to traders takes a hit because the remaining farmers are much smaller than the farmers who switch. Traders experience reduced profitability and exit, making the crop market less competitive for the smallest farmers who are left behind. Consequently, these small farmers who rely on surviving traders face thinner markets and are worse-off after a rise in world prices or a reduction in agribusiness entry costs.

We apply the model to trade data and microdata on farm earnings from three low-income countries in the 2000s to infer the division of gains from trade between farmers and intermediaries. Trade data on exports of crops and farmer-buyer-crop income data provide estimates of the aggregate gains from trade and the farmer gains from trade across different intermediaries respectively. But intermediary data are scarce, and impacts of world prices on intermediation profits can rarely be directly estimated.

The model bridges the data gap by providing national income accounting identities which we operationalise empirically to infer the gains from trade retained by intermediaries, including agribusinesses. In our sample, the main finding is that half the world price increases of a crop went to the exporting country as their aggregate export gains. Intermediaries retained the majority of the gains from trade, with less than a third of the export gains going to farmers. Both agribusinesses and traders obtained a larger share of the per unit world price rise, and hence farmers lost out in relative terms but gained in absolute terms. While the individual gains from trade to farmers who started to sell to agribusinesses after the world price rise were substantive, the switching farmers were too small to result in large aggregate productivity gains from better intermediation.

The findings help conceptualise the various channels through which export gains are distributed across smallholder farmers in the presence of buyer power and a dualistic crop market. In doing so, the paper contributes to a large literature examining welfare in the presence of market power and rents, typically on the seller side (e.g. Dixit and Norman 1980, Helpman and Krugman 1985, Vives 1999). Early work on monopsony shows that market power can overturn classic welfare results (Bishop 1966, Feenstra 1980; Markusen and Robson 1980; McCulloch and Yellen 1980; Bhagwati et al. 1998, Devadoss and Song 2006).

A growing body of work is examining monopsony in factor markets (e.g. Manning 2011, Abel et al. 2018, Syverson 2019). We focus on agricultural markets faced by smallholder farmers because they are a striking example of the importance of monopsony power for economic welfare and equity (Antras and Costinot 2011). Recent contributions have modelled the microfoundations of buyer power in crop markets, such as matching frictions and reputational rents (e.g. Bardhan et al. 2013, Chau et al. 2009, Sheveleva and Krishna 2016).[2] We abstract away from the microfoundations, which are difficult to apply to large-scale data that are typically available for analysis in international trade. Instead, we draw on advances in monopolistic competition models of international trade (Helpman 2006, Melitz and Redding 2015), generalise them to intermediation and oligopsonistic power, and provide a mapping from observable sufficient statistics to welfare impacts.

We highlight the dual structure of crop markets faced by farmers, which is also related to a new body of work on co-existence of small and large firms (e.g. Parenti 2018, Helpman and Niswonger 2022). On the measurement and empirical sides, our findings relate to work on the consumer gains from trade under intermediation (Atkin and Donaldson 2012, Startz 2018 and Grant and Startz 2019), though our focus is on producer gains.

The paper is also related to a large body of work in development and agricultural economics examining farmer-buyer interactions. Much of this analysis has focused on specific crops and experimental evidence which usually precludes analysis of large firms, world price movements and national policies. Recent work has examined the role of trade in farming (e.g., Dippel et al. 2016, Dragusanu and Nunn 2020, Bustos et al. 2020, Macchiavello and Morjaria 2020, Fajgelbaum and Redding 2021; survey in Atkin and Khandelwal 2019) and we contribute to this literature by examining agribusinesses.

[2]See Tomar (2018) and Chatterjee (2019) on behind the border barriers.

The paper is organised as follows. Section 2 documents empirical regularities in crop intermediation. Section 3 embeds the regularities in a theoretical framework to determine sorting, pricing and welfare comparative statics. Section 4 applies the theory to quantify the division of the gains from trade observed in Section 2. Section 5 concludes.

2. Agribusiness Facts

In this section, we highlight three facts related to the prevalence of intermediation prevalence and differences in farmgate incomes and trickle down rates across intermediaries. They are drawn from the World Bank's Living Standard and Measurement Surveys (LSMS) which provide consistent panels of households from Ethiopia (2004, 2006) and Malawi (2010, 2013, 2016) and from the Rural Household Survey of Kenya (2000, 2004, 2007, 2010) which offers comparable farmer panels.[3]

2.1. **Empirical Regularities.**

1. Small farmers often piggy-back on agribusinesses and other intermediaries to sell their produce in crop markets at home and abroad. We consider a pooled sample of 6,725 households growing 90 distinct crops with over 22,000 distinct household-crop observations in Ethiopia (2,459 households), Malawi (2,770 households) and Kenya (1,496 households). About four-fifths of farm sales are made to intermediaries, including cooperatives (23.5%), traders (39.1%) and agribusinesses (16%), and the rest are directly to consumers (21.5%).

For Kenya, we have a panel spanning over a decade and find that agribusinesses almost doubled their market share from 19.8% to 37.8% of crop purchases from smallholder farmers (who farm less than fifty acres of land). The broad facts are supported by case study evidence, such as from potato farming for Pepsi Co in Punjab and tobacco production for BAT in Africa, which document a trend towards agro-industrial exporters.[4]

[EXHIBIT 1]

2. Farmers selling to agribusinesses have higher farm earnings and larger farms. A less well-known fact is that farmers who sell to agribusinesses have higher farm incomes and larger farms. The 1,068 households that sell to agribusinesses have an

[3]All observations from Kenya are weighted by half to account for double the number of waves, while observations from Malawi for 2016 are excluded from panel results due to a change in sampling. While the LSMS data is standard, a description of the Kenya data is in the Appendix.

[4]Runsten 1994, Goodman and Watts 1997, Warning and Key 2002, Robbins and Ferris 2003, Reardon and Timmer 2007, Minten et al. 2009, Minot 2011.

average farm income of USD 1,562 per year (in 2010 values), compared to USD 505 for households that do not sell to agribusinesses at all. Farmers selling to agribusinesses have, on average, 7.3 acres of land, compared to 4.1 for households that sell to other buyers.

Following the vast literature on exporter premia (Melitz and Redding 2015), these patterns can be examined more systematically in Table 1A by regressing household outcomes respectively on an indicator for whether the household sells crops to agribusinesses. Farmers who sell to agribusinesses have 133 per cent higher incomes and 45 per cent larger acreage, than those for farmers who do not engage with agribusinesses. Panel B regresses household-crop income and household-crop prices on an indicator for whether the farmer sold that crop to an agribusiness. Even at the household-crop level, farmers who sold to agribusinesses have substantially higher incomes. They receive higher farmgate prices but these are not statistically significant. (Acreage is not always available at the household-crop level).[5]

Almost all sales to agribusinesses are of crops that are exported by the country, so we do not report them separately. Including an indicator for export crops and its interaction with the indicator for selling to agribusinesses, the income premia is estimated to be 133 per cent at the household level and 118 per cent at the household-crop level.

3. Farmers selling to agribusinesses receive a higher trickle down of world price movements into farm earnings. While the elasticity of factor prices to world prices is an important line of research in international economics, systematic evidence on the transmission of world prices into farm incomes and farmgate prices is sparse. Table 1C estimates a first-difference regression of the change in the farmgate price of a crop sold by a household with respect to the change in the world price of that crop. Source country fixed effects are included to account for country-year differences such as through exchange rate movements. Column 1 shows that, on average, a 1 percent increase in the world price of a crop raises the farmgate price received for that crop by 0.1554 percent.

Column 2 contains the interactions of world price changes with the initial share of agribusinesses in the crop income of the household and the change in the agribusiness share in household-crop sales across waves. Farmers who increased their share of sales to agribusinesses experience a 0.1735 percent higher trickle down to farmgate prices. Farmers that previously sold to agribusinesses show a negligible additional passthrough (0.0310).

[5]We exclude sales to cooperatives and state parastatals to focus on private sector buyers, but results barely change when the latter are included in other buyers as well.

Farmers moving more towards agribusinesses also have higher prices, consistent with the agribusiness premia reported before.

By the metric of world price transmission, agribusinesses therefore make farmers more connected to world markets for crops.[6] It is worth noting though that this also implies that agribusinesses pass on more of any reductions in world prices to farmers. The Online Appendix considers heterogeneity in trickle down rates by increases or decreases in world prices, which suggest that farmers selling to agribusinesses are not shielded from world price reductions.

3. From Facts to Theory

This section develops a theoretical framework to embed the empirical regularities into the microstructure of intermediation in crop markets. We consider a small open economy that takes the world price p of its export crop as given. For simplicity, farmers do not have direct access to the world crop market and rely on intermediaries to sell their produce. Intermediation is provided by Traders and Agribusinesses who compete oligopsonistically. In what follows, we characterise pricing decisions and welfare comparative statics with respect to world prices and entry costs.

3.0.1. *Farmers.* A continuum of farmers, each endowed with a unit of land, have linear utility for a numeraire consumption good and therefore maximise farm earnings. Farmers draw their productivity φ from a Pareto distribution $G(\varphi) = 1 - (\varphi_{\min}/\varphi)^k$ where $\varphi \geq \varphi_{\min} > 0$ and $k \geq 1$. Higher productivity is isomorphic to greater farm output or farm size endowment. Higher values of $\varphi_{\min}$ reflect higher average farm productivity, while lower values of the shape parameter k summarise higher inequality in the productivity of land. The Gini index of land productivity/size is $1/(2k-1)$, and $k = 1$ corresponds to perfect inequality (Gini=1) while $k \to \infty$ to perfect equality (Gini=0).

Farmers choose whether to sell their produce to traders or to engage with agribusinesses. Agribusinesses pay more but require investments from farmers, denoted by $f > 0$ in terms of the consumption good. As is standard in the trade literature, this will generate the stylised fact of income premia for farmers selling to agribusinesses. Let p_t denote the price that farmers receive from selling to traders and p_a the price received from agribusinesses.

[6]In contrast to 0.1554, recent work by Zavala (2021) finds a trickle down rate that is about double for Ecuador, though it is smaller for larger intermediaries.

Then a farmer with productivity draw φ chooses to sell to agribusinesses if

$$\varphi \geq f/\left(p_a - p_t\right) \equiv \varphi_a. \tag{3.1}$$

Remark 1 below summarises the farmer sorting pattern. The Online Appendix and earlier working papers contain generalisations to multiple stages of agribusiness activity, subsistence crops, multiple crops, comparative advantage (differences in $\varphi_{\min}$ across crops), government purchases and different formulations of fixed investments and economic rents for agribusinesses.[7]

Remark 1. *As long as $p_a > p_t$, crop markets have a dual structure where higher productivity farmers ($\varphi \geq \varphi_a$) sell to agribusinesses and lower productivity farmers ($\varphi_a > \varphi \geq \varphi_{\min}$) sell to traders.*

3.0.2. *Intermediaries.* There are N identical traders who compete in a Cournot oligopsonistic fashion to procure farm produce. Each trader pays an entry cost of f_t units of the consumption good to commence trade. They have an intermediation productivity denoted by $0 \leq m_t \leq 1$, so that they receive pm_t net of intermediation costs. They pay farmers p_t and trader t purchases q_t units of the produce. Then the profit of a trader is $\pi_t = (pm_t - p_t)q_t$ and m_t acts like the inverse of an iceberg trade cost.

There are M identical agribusinesses who incur entry costs $f_a > 0$ to compete in a Cournot oligopsonistic way in agribusiness activities, such as marketing, processing and exporting, which increase the marketable surplus of farm produce. Realising quality or productivity gains in marketable farm surplus is often a key motivation for agribusiness-friendly policies across the world, and we assume $m_a \geq m_t$. Profit from providing agribusiness services to farmers is $\pi_a = (pm_a - p_a)q_a$ where q_a is the quantity sold to agribusiness a by all farmers.

Summing across all intermediaries and given all else equal, it is straightforward to see that the export price earned in world markets by intermediaries is $p_x \equiv pm_t \frac{Nq_t}{Nq_t + Mq_a} + pm_a \frac{Mq_a}{Nq_t + Mq_a}$. It rises with world prices, intermediation productivity and the market share of agribusinesses (who provide better access to world markets).

3.0.3. *Prices.* Considering a symmetric Cournot equilibrium, the optimal farmgate price paid by an intermediary i equates the markdown on intermediated world prices to the inverse of i's perceived elasticity of supply from farmers: $\left(pm_i - p_i\right)/p_i = 1/\left(\partial \ln q_i / \partial \ln p_i\right)$.

[7] Dhingra and Tenreyro (2017, 2020)

The total quantity supplied by farmers to agribusiness a and all other agribusinesses $-a$ is $q_a + q_{-a} = \int_{\varphi_a}^{\infty} \varphi dG(\varphi) = \frac{k}{k-1}\varphi_{\min}^{k} f^{-k+1}(p_a - p_t)^{k-1}$. Taking q_{-a} and trader prices as given, agribusiness a's perceived elasticity of supply is

$$\partial q_a / \partial p_a = k\varphi_{\min}^{k} f^{-k+1}(p_a - p_t)^{k-2} = (k-1)(q_a + q_{-a})/(p_a - p_t).$$

In a symmetric Cournot equilibrium, $q_a + q_{-a} = Mq_a$ and the price paid by agribusinesses to farmers is:

$$p_a = \frac{M(k-1)pm_a + p_t}{M(k-1)+1} \tag{3.2}$$

The optimal price paid by agribusinesses is a weighted average of the world price (net of intermediation costs) and the price paid by traders. The weights depend on the entry of agribusinesses and the inequality in farm supply. As might be expected, perfect competition among agribusinesses ($M \to \infty$) results in complete passthrough of world prices into farmgate prices, net of intermediation costs ($p_a = pm_a$). A less apparent result is that a perfectly equal land distribution ($k \to \infty$) also results in complete passthrough because prices no longer determine the extent to which farmers alter their supply to intermediaries. When intermediaries are oligopsonistic (finite M and k), farmers receive a smaller share of the price net of trade costs, $p_a < pm_a$ because $0 < M(k-1)/(M(k-1)+1) < 1$ for finite values of entry and farm heterogeneity.

The price paid by traders provides a floor for what agribusinesses must pay to induce farmers to undertake the investments needed to sell to agribusinesses. Proceeding similarly, the total quantity supplied by farmers to trader t and all other traders $-t$ is $q_t + q_{-t} = \int_{\varphi_{\min}}^{\varphi_a} \varphi dG(\varphi) = \frac{k}{k-1}\varphi_{\min}^{k}\left(\varphi_{\min}^{-k+1} - f^{-k+1}(p_a - p_t)^{k-1}\right)$. Taking the decisions of agribusinesses and other traders as given, the optimal price paid by traders to farmers is

$$p_t = \frac{\mu N(k-1)}{\mu N(k-1)+1} pm_t, \tag{3.3}$$

where $\mu \equiv \frac{f^{-k+1}(p_a-p_t)^{k-2}p_t}{\varphi_{\min}^{-k+1} - f^{-k+1}(p_a-p_t)^{k-1}} = \frac{Mq_a}{Nq_t}\frac{p_t}{p_a-p_t}$ summarises the direct competition that traders face from agribusinesses through shared farm supply. Under finite entry and farm inequality, the markdown paid by traders depends on the entry of traders, inequality and the relative quantities and prices of agribusinesses, as we summarise below.

Remark 2. *Prices received by farmers rise with the number of of traders and agribusinesses in the crop market and with equality in the farm productivity distribution (holding all else constant). In the benchmark case of perfect competition among intermediaries or a*

perfectly equal farm productivity distribution, farmers receive the full world price, net of intermediation costs.

3.0.4. *Entry.* Free entry of intermediaries ensures average profits are driven down to entry costs. Ignoring the integer constraint, free entry gives:

$$(pm_a - p_a)\, q_a - f_a = 0, \tag{3.4}$$

$$(pm_t - p_t)\, q_t - f_t = 0. \tag{3.5}$$

3.0.5. *General Equilibrium.* The general equilibrium of the economy is determined by the optimal cutoff equation 3.1, optimal price equations 3.2 and 3.3, and free entry conditions 3.4 and 3.5, given a set of world crop prices. Resource clearing is subsumed in these equilibrium conditions, so the model results in national income identities, that we discuss later.

Substituting for the cutoff and entry, the two unknown prices p_a and p_t are determined by two equilibrium equations:

$$(pm_a - p_a)^2 (p_a - p_t)^{k-2} = f_a f^{k-1} / k\varphi_{\min}^k \tag{3.6}$$

$$(pm_t - p_t)^2 (p_a - p_t)^{k-2} = f_t f^{k-1} / k\varphi_{\min}^k \tag{3.7}$$

Solving these, the price paid by agribusinesses is $p_a = pm_a - (f_a/f_t)^{1/2} (pm_t - p_t)$, which rises with world prices, reductions in agribusiness entry barriers and the price paid by traders (because of interlinked markets).

Substituting for the price of traders into it, the model solution for agribusiness prices is:

$$(pm_a - p_a)^2 \left((f_t/f_a)^{1/2} pm_a - pm_t + p_a \left(1 - (f_t/f_a)^{1/2} \right) \right)^{k-2} = f^{k-1} f_a / k\varphi_{\min}^k, \tag{3.8}$$

and a solution exists and is unique as long as the SOCs hold, which occurs for sufficiently productive agribusinesses as summarised below.[8]

Remark 3. *For sufficiently productive agribusinesses, an equilibrium exists and is unique.*

[8]The second-order conditions for profit maximisation are $(k-2)(pm_a - p_a) - \frac{M+1}{M}(p_a - p_t) < 0$ and $(k-2)(pm_t - p_t) + \frac{N+1}{N}(p_a - p_t) > 0$. A unique solution is guaranteed for $k < 2$ and for $k > 2$, a sufficient condition in terms of primitives is $m_a/m_t > \left((k/2 - 1) \left(1 - (f_t/f_a)^{1/2} \right) - 1 \right) (f_t/f_a)^{1/2}$. This ensures a monotonically decreasing LHS for equation 3.8 that ranges over high enough values to guarantee sales to agribusinesses. It applies to any possible set of parameter values because it holds when traders are perfectly competitive, though the condition can be weakened outside of a competitive fringe of traders.

3.1. **Gains from Trade and Entry.** We now examine comparative statics of farm incomes by totally differentiating equations 3.6 and 3.7 with respect to world prices and agribusiness entry costs and using the SOCs and the existence condition to arrive at Proposition 4 below (see Online Appendix for details).

Proposition 4. *Prices paid by agribusinesses to farmers rise with world prices p and with reductions in agribusiness entry costs f_a. Prices paid by traders to farmers rise with world prices and with reductions in agribusiness entry costs when farm productivity is more equal ($k > 2$) and fall otherwise ($k < 2$). Prices paid by agribusinesses respond more than prices paid by traders.*
The share of the pie going to farmers moves in the same direction as changes in prices paid to farmers when agribusiness entry barriers change. But changes in the shares going to farmers are ambiguous when world prices change, except for farmers selling to traders who lose (or gain) under high inequality when world prices rise (or fall).

The economic reasoning behind this arises in many settings where factor prices rise with output prices and entry. In general terms, the optimal price paid by agribusinesses is $p_a = \frac{\mu_a\theta_a}{\mu_a\theta_a+1}pm_a$ where $\mu_a \equiv \partial \ln\left(q_a + q_{-a}\right)/\partial \ln p_a$ is the aggregate crop supply elasticity to agribusinesses and $\theta_a \equiv 1/\left(\partial \ln\left(q_a + q_{-a}\right)/\partial \ln q_a\right)$ is the inverse of the perceived elasticity of aggregate supply to own purchases of the agribusiness. The pass-through into farmgate prices is therefore $d\ln p_a = 1 + \frac{1}{1+\mu_a\theta_a} d\ln \mu_a\theta_a$ where the direct impact comes from the rise in farm surplus and the indirect impact from increased competition among intermediaries. Under Pareto productivity and Cournot oligopsony, the aggregate supply elasticity to prices is $\mu_a = k - 1$ and to own purchases is $\theta_a = \left(\left(q_a + q_{-a}\right)/q_a\right) \cdot \left(\partial\left(q_a + q_{-a}\right)/\partial q_a\right) = M \cdot 1$. The change in markdowns can be seen from free entry of agribusinesses. From the envelope theorem, free entry ensures $d\ln q_a\left(p_a, p, f_a\right) = -\frac{pm_a}{pm_a - p_a} d\ln p + d\ln f_a$. A rise in world prices and a reduction in entry costs encourage entry and lower the purchases made by an individual agribusiness, which is an inverse measure of the degree of competition among agribusinesses. Then the commonly-made assumption that markdowns $\mu\theta$ decrease with agribusiness size gives the main result of income gains for farmers selling through agribusinesses. For changes in entry barriers, the gains are high enough to increase the share of the pie going to farmers. But for changes in world prices, there are also direct revenue gains to intermediaries, so farmgate prices are not sufficient to summarise changes in farmer shares.

The usual intuition of factor income gains is more subtle in our setting because inequality in farm productivity determines the elasticity of the quantity supplied by farmers to traders and agribusinesses, and hence the market power in intermediation. As world prices rise or agribusiness entry barriers fall, agribusiness profits rise linearly from the direct impact. This induces entry and greater competition among agribusinesses who must now offer higher farmgate prices. More farmers switch from selling through traders to selling through agribusinesses. For relatively equal distributions of farm productivity (larger values of k), the usual intuition goes through for the spillovers to prices offered by traders. The reduced supply of crops to traders puts competitive pressure on them to pay more to farmers. Intermediary markets therefore become more competitive and farmgate prices rise for all farmers.

The opposite occurs for small farmers who sell through traders when inequality is high ($k < 2$). As before, the direct impacts are larger for agribusinesses and more farmers switch to selling to agribusinesses to get the higher farmgate prices paid by them. But the indirect impacts are different because now the volumes are heavily skewed towards farms with relatively higher productivity. Even for small shares of farmers switching to agribusinesses, the shift in volume is large because the switching farmers have much higher volumes than the small farmers who are left behind with traders. The disproportionate drop in scale from this indirect business stealing by agribusinesses lowers the profitability of traders. This induces exit of traders and the smallest farmers who continue to rely on the surviving traders are left in thinner crop markets and are worse-off.

The critical point occurs at $k = 2$ because then the supply curves faced by agribusinesses and traders become linear. Therefore the direct impact of a linear increase in agribusiness profitability is exactly matched by the rate at which switching patterns of farmers induce changes in the relative supply to different intermediaries.

To understand welfare impacts, we now come back to resource clearing. Aggregate revenue of the economy from crop exports is $R = Mpm_a q_a + Npm_t q_t$. In equilibrium, aggregate revenues must equal aggregate incomes of factors $I + \Pi$ where $I \equiv I_a + I_t = p_a \int_{\varphi_a}^{\infty} \varphi dG + p_t \int_{\varphi_{\min}}^{\varphi_a} \varphi dG$ are farm incomes from agribusinesses and traders. Total profits of agribusinesses and traders are $\Pi \equiv \Pi_a + \Pi_t = (pm_a - p_a) \int_{\varphi_a}^{\infty} \varphi dG + (pm_t - p_t) \int_{\varphi_{\min}}^{\varphi_a} \varphi dG$. Writing the national income identities in terms of first differences of equilibrium outcomes ($\Delta X(p, f_a) = X\left(p', f_a'\right) - X(p, f_a)$ where $'$ denotes a new set

of world prices and/or agribusiness entry costs), the aggregate comparative statics with respect to world prices and entry costs can be determined as follows:

$$\Delta R/R = \left(\Delta\Pi_a + \Delta\Pi_t + \Delta I_a + \Delta I_t\right)/R = \sum_{i\in a,t} \Delta\mathscr{M}_i R_i/R + \sum_{i\in a,t} \Delta\left(1-\mathscr{M}_i\right) R_i/R \tag{3.9}$$

where R_a and R_t are the export revenues of agribusinesses and traders respectively. $\mathscr{M}_i$ denotes intermediary markdowns of world prices to farmgate prices: $\mathscr{M}_i \equiv 1 - p_i/pm_i$. $\Delta\mathscr{M}_i R_i/R$ can be further decomposed into the change in markups $\Delta\mathscr{M}_i$ and the change in market share of each intermediary $\Delta\left(R_i/R\right)$ which arises because farmers switch between traders and agribusinesses, resulting in changes in real aggregate revenue from differences in intermediation technologies.

In many trade models, commonly made assumptions guarantee that trade values on the RHS of 3.9 co-move with factor incomes on the LHS. For example, when aggregate profits are a constant fraction of revenues or when firm profit margins arise from choke prices (see Costinot and Rodriguez-Clare 2014). In these models, information on trade values, the trade elasticity and factor shares summarises both the aggregate and individual gains from trade. In our setting, aggregate gains from trade need not co-move with incomes of small farmers because markdowns vary among the cross-section of intermediaries and they vary with model primitives (like world prices or entry costs).

4. Division of the Aggregate Gains from Trade

We can estimate the aggregate gains from trade and the farmer gains from trade with data on exports, farmgate prices and incomes, and world price movements. The usual constraint in quantifying the division of the gains from trade comes from a paucity of comprehensive information on intermediaries. The national income identity ensures that the aggregate gains are a sum of the income gains to farmers and the profit gains of intermediaries. Then by definition, having estimated the aggregate gains and the gains to farmers, we can infer the intermediary gains. Here we focus on the gains from world price movements and in the Online Appendix, we examine welfare impacts from a national policy that reduced entry barriers to operation of agribusiness activities.

4.1. **Aggregate Gains.**

Let $\mu \equiv \Delta p/p$ denote the passthrough of world price movements to export prices p received by the source country. Q_e is the quantity produced by farmers

who switch from traders to agribusinesses. Then the aggregate welfare gains from trade are:

$$\eta \equiv \Delta R/R = \mu p m_a Q_a + \mu p m_t Q_t' + \left(p' m_a - p m_t\right) Q_e \tag{4.1}$$

where the first two terms on the RHS are the direct effect of world price changes for agribusiness and trader revenues, while the third term is export productivity gain from farmers switching to agribusinesses, who offer better intermediation than traders.

To arrive at the aggregate gains from trade for the source country $\hat{\eta}$, we first regress export gains on world price movements. On average, exports of a crop rise by $\hat{\eta} = 0.52\%$ when the world price of that crop rises by 1%. Main results of this Section are in Table 2, and full details are in the Online Appendix.

4.2. **Farmer Income Gains.** Stylised fact 3 showed the transmission of world price movements to farmgate prices across different intermediaries. But because the choice of intermediaries is endogenous, the model-implied trickle down rates need to account for intermediary choice and the general equilibrium feedback to prices.

The first-difference regression for the change in farmgate price is:

$$\Delta \ln p_{ch}^{farmgate} = \eta_t \Delta \ln p_c^{world} + \eta_1 A_{ch} \Delta \ln p_c^{world} + \eta_2 A_{ch} + \alpha_s + \epsilon_{ch}$$

where $\Delta \ln p_{ch}^{farmgate}$ is the change in log price received for crop c by farming household h over its two survey waves and A_{ch} is an indicator for sales to agribusinesses. A key difference from stylised fact 3 is that the sample only contains farmers that continue to sell to traders or agribusinesses: $A_{ch}' = A_{ch} = 1$ or $A_{ch}' = A_{ch} = 0$. On average, farmers selling to traders get $\hat{\eta}_t = 0.16\%$ for a 1% rise in world prices of their crop. Farmers selling to agribusinesses receive a higher trickle down, $\hat{\eta}_a = \hat{\eta}_t + \hat{\eta}_1 = 0.25\%$.

The income gains for farmers who switch between agribusinesses and traders is $\Delta I_e \equiv \left(p_a' - p_t\right) Q_e$, which is estimated in first-differences of income levels of switchers as:

$$\Delta Income_{ch}^{farmgate} = \eta_e \Delta \ln p_c^{world} + \alpha_s + \epsilon_{ch}$$

The estimated income gain is $\Delta \hat{I}_e = 0.0283\%$ of overall initial farm incomes or $\hat{\eta}_e = 0.16\%$ of the mean initial crop income of switchers.

4.3. **Intermediary Gains from Trade.** To infer the intermediary gains from trade, we first express intermediary profit changes in terms of (observable) changes in exports and

farmer incomes. Then we calibrate theory relationships to determine the markdown rates of intermediaries.

The gains from trade to agribusinesses can be obtained from the difference between revenues and farm incomes for farmers selling to agribusinesses:

$$\Delta\Pi_a/R = (I_a/I)(I/R)(\mu/(1-\mathscr{M}_a) - \eta_a) + (\Delta I_e/I + I_e/I)(I/R)\mathscr{M}'_a/(1-\mathscr{M}'_a) \tag{4.2}$$

These gains consist of the direct increase in world prices (embodied in μ), the indirect reduction from paying more to farmers (embodied in η_a) and the increase in productivity from farmers switching to agribusinesses shown in the second term. Similarly, the gains to small traders are

$$\Delta\Pi_t/R = (I_t/I - I_e/I)(I/R)(\mu/(1-\mathscr{M}_t) - \eta_t) - (I_e/I)(I/R)\mathscr{M}_t/(1-\mathscr{M}_t). \tag{4.3}$$

We have already estimated $\eta_a, \eta_t, \Delta I_e/I$ and we observe the income shares across intermediaries $I_a/I, I_t/I, I_e/I$. If we had the export transmission rate μ and the markdowns $\mathscr{M}, \mathscr{M}'$, then we would also have the gains from trade across agribusinesses and traders.

By definition, $R_i = I_i + \Pi_i = I_i/(1-\mathscr{M}_i)$ for $i = a, t$. We can therefore rewrite the aggregate gains from trade as:

$$\begin{aligned}\eta =& \mu(I_a/I)(I/R)/(1-\mathscr{M}_a) + \mu(I_t/I - I_e/I)(I/R)/(1-\mathscr{M}_t) \\ &+ (\Delta I_e/I)(I/R)/(1-\mathscr{M}'_a) + (I_e/I)(I/R)(1/(1-\mathscr{M}'_a) - 1/(1-\mathscr{M}_t))\end{aligned} \tag{4.4}$$

and the average markdown as:

$$I/R \equiv I/\sum_{i=a,t} R_i = \sum_{i=a,t} (I/I_i)/(1-\mathscr{M}_i). \tag{4.5}$$

It can now be seen that if we had the markdowns, then we could get the direct passthrough μ through the total passthrough $\hat{\eta}$ and income shares, which we already have from trade and farm data.

Also, by definition, new markdowns are $\mathscr{M}'_i \equiv \mathscr{M}_i + \Delta\mathscr{M}_i$ for $i = a, t$. So if we have initial markdown rates, we can use our estimates of the passthrough to farmers with respect to world price movements to get the change in markdown rates: $\Delta\mathscr{M}_i/\mathscr{M}_i = (1/\mathscr{M}_i - 1)(\Delta p/p - \Delta p_i/p_i) = (1/\mathscr{M}_i - 1)(\mu - \eta_i)$. Therefore, the new unobserved markdowns are obtained as:

$$1 - \mathscr{M}'_i = (1 - \mu + \eta_i)(1 - \mathscr{M}_i) \tag{4.6}$$

where μ, η_i have already been estimated.

To get the initial agribusiness markdown $\mathscr{M}_a$, we put together primary data on profit margins of agribusinesses listed on the Nairobi stock exchange. (There were no agribusiness firms listed in Malawi or Ethiopia, and agribusinesses could serve these markets from Kenya, which had a capital market). Listed companies are mandated to declare their annual company accounts by law, and we manually compile profits and sales for listed agricultural companies from accounts available from the Capital Markets Authority of Kenya for each year from 1999 to 2010 (more in Online Appendix). There are 13 agribusiness companies which operate in almost all years since the start of the exchange, with an average annual revenue of 6.2 billion Kenyan Shillings per firm. The companies include multinational firms like Limuru (Unilever) and British American Tobacco Company and domestic conglomerates like the Unga group and Uchumi supermarkets, which are well-recognized brands in Kenya. Their mean profit margin is $\mathscr{M}_a = 0.12$.

Until now, we have only used the direct estimates for trickle down to exports and farmers, the national income accounting identities which must hold in general equilibrium and the observed profit margin of agribusinesses. We still need the initial trader markdown rate and we now deploy the structure of the model where differences in trickle down rates summarise the differences in markdowns across intermediaries. The relative profit margins of agribusinesses and traders are given by free entry equations 3.6 and 3.7. Dividing the equations by each other gives an intuitive result that the ratio of their profit margins reflect their entry cost differences: $(pm_a - p_a) / (pm_t - p_t) = (f_a/f_t)^{1/2}$. Totally differentiating this relationship with respect to world prices gives $\left(\frac{pm_a - p_a}{pm_a}\right) / \left(\frac{pm_t - p_t}{pm_t}\right) = \left(\Delta p/p - \frac{p_a}{pm_a}\Delta p_a/p_a\right) / (\Delta p/p - \Delta p_t/p_t)$. Rewriting in terms of markdowns and world transmission rates then gives $\mathscr{M}_a/\mathscr{M}_t = (\mu - (1 - \mathscr{M}_a)\,\eta_a) / (\mu - \eta_t\,(1 - \mathscr{M}_t))$. The initial markdown rate of traders can therefore be written in terms of agribusiness markdowns and the world price transmission rates as:

$$\mathscr{M}_t = \mathscr{M}_a\,(\mu - \eta_t) / (\mu - \eta_a + \mathscr{M}_a\,(\eta_a - \eta_t)) \tag{4.7}$$

Before proceeding to these results, we summarise the solution concept for profit gains in Proposition 5 and the mapping of data to equilibrium relationships in Table 2.

Proposition 5. *Given estimates of the trickle down of world price changes to exports and farmgate prices of incumbent farmers η, η_a, η_t, the income gains of switching farmers η_e, observed income shares of incumbent and switching farmers by intermediaries I_i/I*

for $i = a, t, e$ and the observed markdown of agribusiness companies $\mathscr{M}_a$, the system of equations 4.4, 4.5, 4.6 and 4.7 determine the the unknowns - the direct world price trickle down to export prices μ, farm incomes as a share of revenues I/R, the new agribusiness markdown $\mathscr{M}'_a$ and the initial trader markdown $\mathscr{M}_t$. Having solved for these unknowns, the gains from trade to agribusinesses and traders are given by equations 4.2 and 4.3 respectively.

[EXHIBIT 2]

4.4. **The Division of the Gains from Trade.** The division of the gains from trade from solving for Proposition 5 is:

$$0.5171 = \Delta R/R = \Delta\Pi_a/R + \Delta\Pi_t/R + \Delta I/R = 0.1365 + 0.2188 + 0.1619$$

A 1% world price increase raised export revenues by 0.5171%. Over a quarter of this 0.5171%, or 0.1365%, went to agribusinesses. Over forty percent, or 0.2188% went to traders. Farm incomes rose by the remainder which comprises over thirty percent, or 0.1619%.

The initial income share of farmers is inferred as $I/R = 85.3\%$. With the average change in world prices of about 37%, this implies that farm incomes rose to $85.3 + 16.19 \times 0.37 = 91.3\%$ of initial revenues (note that this could be higher than 100% as it is evaluated in terms of initial revenues).

Part of this gain in farm incomes came from better intermediation productivity of agribusinesses which increased the size of the export pie as farmers switched from traders to agribusinesses. We estimate this to be about 1% (0.5171-0.5074), because the direct trickle down of a 1% world price increase to exports turns out to be $\hat{\mu} = 0.5074\%$. This is moderate in size, but not because the individual gains from switching to farmers $\hat{\eta}_e$ were small. Rather, because farmers who switched were relatively small in size.

The distribution of productivity among farmers selling to traders is highly skewed towards small volumes, so that the aggregate gains to productivity were not large. But the model explains that this feature also ensured that aggregate business stealing by agribusinesses was not large enough to create a collapse of crop markets outside agribusiness activity despite substantial world price increases that are more favourable to agribusinesses. Consequently, even the smallest farmers (who continued to sell to traders) experienced positive gains from trade.

But there was a concomitant rise in inequality between farmers and intermediaries as world prices increased. Agribusiness margins rose from a rate of 0.120 to 0.347 while trader margins rise from 0.155 to 0.449. Evaluated at the mean world price change, profit margins rose by $0.37 \times \mathscr{M}_i'/\mathscr{M}_i$, or about 1% each for agribusinesses and traders. Buyer power of agribusinesses rose because they gained market share in crop sales of farmers. Surviving traders also gained market power because their exit overwhelmed the offsetting effect of farmers switching to agribusinesses.

Agribusinesses operated on smaller per unit margins than traders in our sample. This reflects their higher intermediation productivity, which also interacted positively with world prices. Free entry gives $m_a/m_t = (f_a/f_t)^{1/2}(\mathscr{M}_t/\mathscr{M}_a) > (\mathscr{M}_t/\mathscr{M}_a) = 1.30$ under higher entry costs for agribusinesses $f_a > f_t$. From the markdown rates, we infer that agribusinesses are at least 30% more productive in intermediation than traders. But many farmers are too small to be able to benefit from their better intermediation technology.

Overall, the bulk of the gains from trade accrued to intermediaries, but farmers also received positive gains from world price increases through an expansion in the size of the export pie directly and to some degree, indirectly from productivity gains.

5. Conclusion

The presence of agribusinesses as buyers of farm produce has grown in recent decades. Yet there is limited systematic analysis of their contribution to the aggregate gains from trade and the division of the gains among agribusinesses, traders and smallholder farmers who they buy from.

This paper starts from the observation that farmers selling through agribusinesses tend to be larger and to get higher transmission from world price movements. We embed these empirical regularities in a theoretical model that features heterogeneous farmers. Agribusiness intermediation requires material fixed-investment outlays from farmers, while offering higher prices. Thus, agribusiness intermediation tends to "select" higher income farmers, creating a dualistic structure in crop markets.

The model features endogenous oligopsony power in intermediation that responds to world price movements and other market conditions such as entry barriers. This provides the potential for differences in the aggregate gains from trade and the individual gains from trade to farmers and intermediaries. National income identities and world price trickledown in the model enable inference of the individual gains from trade, including intermediary profit gains that are rarely directly observable.

The model is applied to quantify the welfare gains from world price movements for three low-income countries, for which household panels and buyer types are available. We find that half of the gains in world price over a decade accrued to these exporting countries. Farmers got less than a third of the export gains. Intermediaries retained the bulk of the gains, with two-thirds of profit gains going to traders and one-third to agribusinesses.

The findings show that trade and farm data can help in opening up the black box of gains from trade in crop markets. We infer that agribusinesses are at least 30 percent more productive than traders. But most farmers remain too small to be able to access world markets through them.

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6. Exhibits

TABLE 1. Agribusiness and Trickledown Premia for Farmers

A. Income and Size Premia of Farmers

	(1) $\ln Income_{ht}$	(2) $\ln Acreage_{ht}$
Farmer Household Sold to Agribusinesses A_{ht}	1.3335	0.4520
	(0.0538)	(0.0352)
Country-Year FE	Yes	Yes
N	11,604	11,579
R^2	0.139	0.021

B. Income and Price Premia at Farmer-Crop Level

	(1) $\ln Income_{cht}$	(2) $\ln Price_{cht}$
Farmer Household Sold Crop to Agribusinesses A_{cht}	0.9954	0.1739
	(0.1685)	(0.1022)
Crop-Country-Year FE	Yes	Yes
N	32,062	32,062
R^2	0.312	0.595

C. Trickledown Premia

	(1) $\Delta \ln Price_{ch}$	(2) $\Delta \ln Price_{ch}$
Change in Log of World Crop Price: $\Delta \ln p_c^{world}$	0.1554	0.1544
	(0.0565)	(0.0562)
ΔAgribusiness Share$_{ch}$·$\Delta \ln p_c^{world}$		0.1735
		(0.0436)
Agribusiness Share$_{ch}$·$\Delta \ln p_c^{world}$		0.0310
		(0.0739)
ΔAgribusiness Share$_{ch}$		0.2927
		(0.1010)
Agribusiness Share$_{ch}$		-0.0152
		(0.0880)
Country FE	Yes	Yes
N	6,211	6,211
R^2	0.034	0.040

The dependent variable in Panel A is the income from all crops of household h in year t in Column 1 and acreage of fields of household h in Column 2, in Panel B is the income and price from crop c in Columns 1 and 2, and in Panel C is the change in sales-weighted mean log price received for crop c by household h during survey year 1 relative to the previous survey year 0. The RHS in Panels A and B is an indicator for selling to agribusinesses which is A_{cht} for crop c in Panel B and $A_{ht} = \max_c A_{cht}$ for the household in Panel A. Agribusiness is defined as private company/business in the World Bank LSMS for Ethiopia and Malawi (distinct from local merchant/trader/parastatal/market), and as large company/miller/processor/exporter in the Rural Household Surveys of Kenya for all waves. Agribusiness share is the share of crop income received from agribusinesses in survey year 0 and the change in agribusiness share is relative to the previous survey. The RHS in Panel C is the change in the log trade-weighted world price for the crop (lagged by one year) between survey years, excluding source countries in the sample. Country-year fixed effects are included in A, crop-country-year fixed effects in B and country fixed effects in the first differences estimation in C. Standard errors are clustered by households in parentheses in A and also by crop-country in B and C. Panel C is weighted by crop income shares of households to ensure a summed weight of 1 for each household.

Table 2. Mapping of Model Parameters to Data

	Model Parameter/Variable	Estimating Relationships	Estimated/Observed Value
1	**Exports**		
	Transmission of World Prices to Exports	$\Delta \ln Exports_{cs} = \eta \cdot \Delta \ln p_c^{world} + \alpha_s + \epsilon_{cs}$	$\hat{\eta} = 0.5171$
		for crop c from source country s from UN Comtrade.	
2	**Incumbent Farmgate Incomes**		
	Transmission of World Prices to:	$\Delta \ln p_{ch}^{farm} = \eta_t \Delta \ln p_c^{world} + \eta_1 A_{ch} \Delta \ln p_c^{world} + \eta_2 A_{ch} + \alpha_s + \epsilon_{ch}$	
2a	Farmer-crops who continue	for crop c sold by household h who continues to sell to Traders	$\hat{\eta}_t = 0.1558$
	to sell to Traders	$(A'_{ch} = A_{ch} = 0)$, and	
2b	Farmer-crops who continue	for crop c sold by household $h$who continues to sell to Agribusinesses	$\hat{\eta}_a = \hat{\eta}_t + \hat{\eta}_1$
	to sell to Agribusinesses	$(A'_{ch} = A_{ch} = 1)$	$\hat{\eta}_a = 0.1558 + 0.0869$
3	**Switchers' Farmgate Incomes**		
	Farmer-crops who switch between	$\Delta Income_{ch}^{farm} = \eta_e \Delta \ln p_c^{world} + \alpha_s + \epsilon_{ch}$	$\Delta \hat{I}_e / I = 0.0283$
	Traders and Agribusinesses	for switching farmer-crops $(A'_{ch} \neq A_{ch})$.	$\hat{\eta}_e = 16\%$
			of their mean income
4	**Intermediary Market Shares**		
4a	Incumbent Farmer-crops in 2a, 2b	Directly observed from household data	$I_t/I = 0.7593$
		Directly observed from household data	$I_a/I = 0.2407$
4b	Switching Farmer-crops in 3	Directly observed from household data	$I_e/I = 0.1256$
5	**Agribusiness Profit Margins**		
	Sales-weighted Profit Margins	Directly observed from profits and sales in	$\mathscr{M}_a = \Pi_a / R_a = 0.12$
		company accounts of listed Agribusinesses	