Staff Paper

**Horticulture Farmers and Domestic
Supermarkets in Kenya**

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Summary. – Are the rural poor excluded from the market opportunities created by the rise of supermarkets in developing countries? We analyzed the farm-level impact of supermarket growth in Kenya's produce sub-sector which is dominated by smallholder producers. Two main findings emerged. First, the existence of a threshold capital vector at the entrance of the supermarket channel does hinder the entry of small, rainfed farms. Instead, the main supply response has come from a new group of medium-sized, fast-growing farms managed by well-educated farmers. Second, the heavy reliance on and higher wages paid to hired farm workers on supermarket-channel farms help to alleviate poverty for rural households with little land.

Horticulture Farmers and Domestic Supermarkets in Kenya

1. INTRODUCTION

Are the rural poor, many of whom are smallholder farmers or farm workers, excluded from the market opportunities created by the rise of supermarkets in Sub-Saharan Africa? While there are clear benefits to supermarkets for urban consumers (more variety, lower prices, safer and higher quality food), the net effect on rural producers is less straightforward. On the one hand, supermarkets create reliable, fast growing, year-round markets for producers and could become major contributors to the emerging successes in African agriculture pointed out in the literature (Gabre-Madhin and Haggblade 2003). On the other hand, the supermarkets' constant drive to increase the efficiency of the supply chain combined with their growing market share intensifies the level of competition among producers. This raises the concern that individual smallholder producers may not have the capacities to survive in this competitive market.

As the market share of supermarkets grows over time, commercial smallholder producers may (1) fall into subsistence agriculture, (2) reorganize and become preferred suppliers (the benefits of which are reduced risk and possibly higher average profits, see Dries and Swinnen 2004); or (3) become late entrants with a high likelihood of falling victim to the "agricultural treadmill". Lipton (with Longhurst 1989) argued how a similar phenomenon (a grain price drop felt by all farmers but constrained access to new yield-increasing technologies for poor farmers) was one of the failures in the early stages of the green revolution in terms of its poverty outcomes. Is the supermarket revolution, with its implied adoption of new technologies and marketing practices, having a similar effect? This paper explores the potential for such a differential farm-level impact by assessing: (1) the nature of the early entrants in the supermarket

channel (determinants of the farmer's channel choice); and (2) the technology and income effects of participation in the supermarket channel (versus the control, the traditional channel).

The rise of supermarkets in developing countries has received considerable attention in the development economics literature over the past few years (Reardon et al. 2003). That literature shows that (1) supermarkets are spreading quickly in urban areas; (2) supermarket chains are modernizing their product procurement systems, differentiating them from those used by traditional retailers and wholesalers. In Kenya for example, Neven and Reardon (2004) show that supermarkets are growing at an annual rate of 18% and have a 20% share of the urban food market overall (although only an extremely incipient 4% of the FFV (fresh fruit and vegetable) market).

Supermarket chains in Kenya have recently begun to modernize their procurement systems by centralizing procurement over the country into distribution centers (away from store-by-store sourcing), by selecting sets of preferred supplier-farmers and specialized wholesalers dedicated to sourcing from those farmers as well as the wholesale markets, and instituting incipient and basic private standards of quality. In 1997, when supermarkets first started selling FFV in a significant way, they procured from whatever source was available, hence sourcing only 30% direct, and the rest from traditional brokers. Over the past few years, the chains have begun shifting toward sourcing directly from farmers. In interviews, supermarket procurement officers told us that sourcing direct allows them to inspect the farm to judge potential reliability in volumes and quality by noting farm size, presence of irrigation, and the water source, allows them to cut out intermediaries' margins, and have more control of supply through direct communication. By 2003, they sourced 50% directly, and told us that share would grow.

The new procurement systems put more demands on the farmer than the traditional system – a spot market, fragmented, few if any standards, operating through many small brokers. The little research that has been done in developing countries on how supermarkets have changed market conditions and demands for farmers has nearly exclusively focused on the effects of European or US supermarket chains' effects on farmers in poor countries, such as Henson et al. (2005) for Zimbabwe, and Dolan and Humphrey (2000) and McCulloch and Ota (2002) for Kenya. However, despite the recent wave of research on domestic retail and wholesale sector transformation, there has been very little research on the effects of these changes on farmers.

This paper aims at that gap by focusing on the case of supermarkets and horticultural product producers in Kenya. We address three questions: (1) What are the determinants of the farmers' channel choice (supermarket vs. traditional)? (2) What are the production technology effects of participation in the supermarket channel? (3) What are the net income effects of participation in the supermarket channel?

The paper is structured as follows. Section two lays out the conceptual approach. Section three indicates how supermarket-channel and traditional-channel farmers were defined and describes the data collection. Section four analyzes the nature of farmers directly supplying supermarkets relative to farmers in other marketing channels. Section five uses the case of the kale supply chain to assess the determinants of supermarket channel participation and analyzes the production technology and net income effects of this participation. Section six concludes.

2. CONCEPTUAL APPROACH

The rise of supermarkets in Kenya is here modeled as a shock to a domestic FFV supply system that has shown few dynamics over the last few decades, apart from a steady growth in volumes and in the number of rural producers in response to urbanization (Dijkstra 1999). On the one hand, supermarkets may pay higher prices to farmers and/or may offer them more demand reliability both in terms of price and volume. On the other hand, meeting the supermarket's higher standards for food safety and quality and other delivery conditions may imply the presence of (or additional investments in) certain production and marketing capital as well as an increased need for working capital to deal for example with higher input use and buyer credit. In other words, the rise of supermarkets in Kenya is hypothesized to contribute to an industrialization of the food system as observed in other countries. Here we shall take an essentially micro-level approach, focusing on how this shock impacts the behavior of FFV producers as individual agents.

First, we model the farmer's decision on whether to sell to supermarkets as a standard static adoption decision, where the adoption of X (in this case the supermarket channel) is determined by the incentives for and capacities of farmers (Feder et al. 1985). The different requirements of supermarkets are hypothesized to determine a K* vector of threshold capital requirements, embodying a technology, which suppliers must have before the supermarket channel enters their opportunity set. Different technologies as embodied in different capital vectors (e.g., a labor intensive K_L^* and capital intensive K_K^*) may exist, with both giving farmers the capacity to meet the supermarkets' requirements. Furthermore, K* may only be weakly enforced by supermarkets and will likely be a moving target for farmers (supermarket requirements become more stringent over time). K* may include physical capital (e.g., land, vehicles), human capital (e.g., business experience), financial capital (e.g., cash reserves) and

4

organizational capital (e.g., group membership). Farmers with a capital vector K>K* are expected to enter the supermarket channel if the incentives are there. Farmers with K<K* are by definition excluded from the supermarket channel. The latter may be undesirable from a social welfare point of view if the supermarket channel represents higher net incomes for farmers and if the smallholder farmers who make up the bulk of Kenya's population are being excluded from it. Our conceptual model then takes on the following general reduced form (i.e., the input demand function as derived from the farmer's profit function; Sadoulet and De Janvry, 1995):

$$\text{channel choice} = f(p, r, \sigma, k, z),$$

where p, r, σ, k and z represent output prices, input prices, risk factors (e.g., related to price, yield, etc.), quasi-fixed capital (e.g., farm size) and shift factors (e.g., location) respectively.

Second, we assess the differential effect of channel choice on production technology by comparing the production functions for farmers directly supplying supermarkets and farmers supplying traditional marketing channel agents. The distribution of the farmers over these two groups is not random but rather the outcome of a self-selection process and this non-randomness may bias the estimated coefficients in the production function. In order to control for this selectivity bias, we used Heckman's two-stage method (Heckman 1979).

Third, we assess the net income effect of channel choice using gross margin analysis. We then place this net income effect in the broader context of value chain theory (Kaplinsky and Morris 2001). According to value chain theory, the following dynamic models the growth process of a firm (or farm): (1) the participation of A in a supply chain takes on a particular governance structure (system access) depending on A's performance, the policies of the government and the channel captain of A's supply chain and the network relationships of A; (2) the benefits accruing to A depend on the governance structure for A and A's performance and

market power (distributional effects); (3) the amount of benefits accruing then determines the degree of upgrading; (4) the degree of upgrading in turn affects the performance of A (coming full circle: system dynamics). We will assess this model by comparing (income and risk related) benefits accruing to farmers, governance structures and upgrading/growth in the supermarket channel vs. the traditional channel.

3. DEFINITIONS AND DATA

The "supermarket-channel farmers" universe are farmers who are listed as direct suppliers of FFV (fresh fruit and vegetables) to the two leading supermarket chains (these chains now market 90% of the FFV sold through supermarkets in Kenya). The "traditional-channel farmers" universe is farmers who sell to traditional wholesalers but not directly to supermarkets. Two farmer surveys on samples from those universes were conducted. The first survey focused on the capacities of the farmers and the marketing methods they use and focused on a broad set of FFV items. 115 farmers (49 supermarket-channel & 66 traditional-channel farmers) were interviewed. The second survey focused on technology choices and net income effects and focused on kale growers only. 51 farmers (14 supermarket-channel & 37 traditional-channel farmers) were interviewed in this survey.

The supermarket-channel sample was chosen randomly from the preferred-supplier lists provided by the leading two supermarket chains. The traditional-channel sample consisted of kale, tomato, and banana growers selected in three stages. There were no lists or censuses or indeed any available information on the farmers in these areas. We thus first selected two main production areas for each product based on their relative importance as indicated by operators at

Nairobi's key FFV wholesale markets. Second, for each production area we selected a set of farmers considered to be a random representative and dispersed sample by the local government extension offices. Third, we used that initial sample as geographic nodes from which to randomly geographically select around them five additional farmers.

4. PATTERNS IN DIFFERENCES BETWEEN SUPERMARKET-CHANNEL FARMERS AND TRADITIONAL-CHANNEL FARMERS

Table 1 compares supermarket-channel and traditional-channel growers for kale, tomatoes, and bananas, the three products over which we sampled from each channel. These products were chosen because they are the two most important vegetables and the most important fruit in both consumption and production in Kenya. They also represent different risk-return trade-offs. Kale is a labor-intensive crop with a reliable yield, but generally low profit margins. Tomatoes are more capital-intensive to grow and their yield and market price varies more, but profit margins are generally higher. Bananas bring with them the risks and rewards of a more long term investment. Several salient differences between the farmers in the two channels emerge.

Farm Size and Cropping Composition. The supermarket-channel farms are on average five times larger, in overall farm size, than traditional-channel farms (9-18 hectares versus 1.6-2.4 hectares per farm depending on the crop). Supermarket-channel farmers have less of their land under cultivation, but have a far larger percentage of it under irrigation (e.g., in the case of kale 75% is under irrigation versus 18% for traditional-channel farmers). Both the size and the irrigation advantages make sense from the point of view of the supermarket procurement officer: they want to minimize transaction costs (hence work with the fewest number possible) and have

product shipped to them year-round. The supermarket-channel farmers are also more diversified – producing twice the variety of crops compared to the traditional farmers, helping them to manage risk and reduce transaction costs for supermarkets to deal with them ("one stop shopping").

Farm Technology and Physical Capital. All of the supermarket-channel farmers have a cellular phone, 90% have their own means of motorized transportation, and a large percentage have an advanced irrigation system and a packing shed. By contrast, significantly fewer of the traditional-channel farmers use these technologies, with (cellular) phones being the technology with the highest degree of diffusion amongst traditional-channel farmers (at 30% of the farmers). Other technologies such as greenhouses, shadow netting and cold rooms were encountered, but only at very few farms, all of which are supermarket-channel farmers. The higher capital/labor ratio among supermarket-channel growers again makes sense in terms of the more demanding requirements of this channel in terms of quality standards (in particular cosmetic appearance), volumes, and consistency. The presence of these technologies is thus at present a very strong but not yet strict requirement (not all these technologies have a diffusion rate of 100% for all produce items), mainly because the FFV procurement system of the supermarkets is still in an early, formative stage.

Farm Technology and Human Capital. Supermarket-channel farmers have more farm workers but (on average) a lower labor-to-land ratio than traditional-channel farmers. This is mainly due to a heavy reliance on abundantly available family labor among the latter. For example for kale producers, we found that 79% of the permanent farm workers on traditional-channel farms are family members, while for supermarket-channel farms 79% are hired employees. There is also a clear pattern regarding education: traditional-channel farmers on

average have a primary education, while supermarket-channel farmers on average have a secondary education. This can be explained by the observation that many of the supermarket-channel farmers had (have) formal jobs in the private or public sector and started out as hobby-farmers. Furthermore, supermarket-channel farmers are more educated, on average with a secondary education versus only primary education for the traditional-channel horticulture farmers.

Farmer Organization. There is no significant difference between the channels in degree of organization or farmer association, both of them having a relatively low degree of association. In the subset of smaller farmers in the lower quartile of farm size among the supermarket channels, some farmer organizations have emerged in order to gain economies of scale in transportation and reduce transaction costs for the supermarket client. In one case, an NGO organizes them to participate in the channel, in another, a government-owned company organizes the small farmer, another farmer-group is assisted by a private sector marketing facilitator, and in yet another case a lead farmer contracts small farmers.

Farmer Export or Domestic Market Orientation. It is often assumed that local supermarkets merely "cherry pick" their supplies from the export market suppliers. We found this not to be the case where it would have seemed most likely, in produce. Export markets are of minor importance to FFV supermarket-channel growers, as only 15% of the latter also sell to export markets. This of course differs by product: those involved in higher value, lower volume items such as French beans or avocado tend to also export, while the farmers selling lower value and heavier products, the majority of the products, such as banana, tomato, and kale, are selling all to the domestic market.

What is then the "Composite Image" of these new Domestic Supermarket Suppliers?

The supermarket suppliers appear to be an emerging "domestic elite" in horticulture production, between the small traditional farmers producing for local fragment spot markets, and the mainly larger export farmers producing for a very demanding foreign (supermarket) market. They are thus in an intermediate position. This is especially interesting because the development literature often points to farmer-leaders or innovators, somewhat better capitalized than the average but not extremely distant in capacity, who forge the way in product diversification, market development, and technology modernization. Time will tell whether they set in train such a dynamic; we are observing this at the very early stages.

Our qualitative interviews showed that these farms are for the most part newly-emerging, African-owned farms that, before the recent emergence of the supermarkets, used their land mostly for cattle or grains or left it idle. Supermarkets offered reliable, low-transaction cost contractual arrangements which allowed the land-owners to start managing their farm as regular business operations. For supermarkets, these business-savvy, well-capitalized farms had just the right size for their current needs and the capacity to grow along with the supermarkets as they expand their produce sections.

5. THE IMPACT OF SUPERMARKETS IN THE KALE SUPPLY CHANNEL

For an exploration of the determinants and effects of channel participation, we focus on kale, with an adequate body of producers for supermarkets (and for traditional channels) to allow statistically significant testing, it is the product for which supermarkets have gone furthest in shifting to direct sourcing from farmers, and kale is the most important horticultural food product

and thus important in the agricultural diversification strategies of government – and farmers – alike.

5.1 Kale supply channels in Kenya

The entry of supermarkets in the kale supply chain leads to supply channel integration. Kale farmers in Kenya have potentially four market options. Depending on their capacities, they can sell to: (1) brokers from their farm; (2) brokers near the main road; (3) wholesalers in main urban areas; and (4) retailers or institutions directly. Which option is chosen is determined by the farmer's transportation capacity and willingness to take risks (costs and price risks increase downstream). Given that most traditional-channel farmers are risk-averse smallholder producers without (motorized) transportation, most farmers in this channel sell to brokers at the farm or near the main road. For example, 90% of the traditional channel farmers in our sample sell kale at the farm or the main road. Supermarket-channel farms on the other hand are larger, have their own transportation and are thus capable of taking their produce direct to the supermarkets.

Figure 1 illustrates how the shift from the standard traditional supply chain to the supermarket supply chain for kale implies a vertical integration, with the farmer integrating the broker and part of the wholesale function and capturing a far greater part of the marketing margin. This extends earlier research on the applicability of market channel theory in Kenya to the supermarket channel. Dijkstra (2001) showed how channel theory (i.e., vertical channel disintegration is negatively correlated with the size of producers and retailers) explains long supply channels for FFV in Kenya. Here we find the mirror image: supermarkets (as large retailers) and supermarket-channel farmers (as larger producers) lead to short supply channels.

The traditional kale supply chain provides marketing solutions to smallholder farmers, but is characterized by (1) many intermediaries along the chain, (2) a small percentage of the marketing margin captured by the farmer, (3) high transaction costs (produce changes hands many times via spot markets), and (4) brokers with high market power (they trade the largest volumes and are most knowledgeable about prices at the farm and in the wholesale markets). By stark contrast, the *supermarket supply chain for kale* (1) is direct, (2) allows the farmer to capture a large portion of the marketing margin, (3) is more efficient from a transaction cost point of view (more contractual relationship), and (4) is controlled by supermarkets instead of brokers.

5.2 Determinants of farmer participation in the supermarket channel

In this section we assess how farm characteristics determine the participation of the farm in the supermarket channel for kale (Y). Since negative dependent variables are not possible and assuming non-linear effects of the explanatory variables (X), we modeled this channel adoption decision as a probit model. In their most general form, adoption functions contain the following five categories of explanatory variables: prices of inputs and outputs, risk factors, quasi-fixed capital and shift factors.

Output prices, input prices and risk factors (including transaction costs) are in part implicit to the channel choice (which determines governance structure) and are further determined by farm characteristics such as its location and size. Therefore input and output prices and risk factors will not be directly entered in the implementation model. Two other variables normally presented in adoption models, household size (quasi-fixed capital) and location (shift factor), were also omitted here. Most of the supermarket-channel farmers rely for the greater part on hired employees, making size of the household (indicating the availability of

family labor) not a very meaningful variable. Location was left out the model because the traditional-channel farmers were selected from only two nearby divisions so that for this sub-sample there was too little variation over the location variable.

This implies that our channel choice model will mainly be determined by quasi-fixed capital. The latter both represents resources internal to the farm and at the same time co-determines access to external resources. For example, size of the land owned by the farmers is a direct resource as well as an indicator of access to credit (Carter and Wiebe 1990). One further departure from the standard adoption model is that for the size of the farm, land ownership and the presence (or absence) of an irrigation system we used the 1999 situation. The 1999 data reflect the position of the farms at the time when they became suppliers to supermarkets (all the supermarket-channel farmers became suppliers to supermarkets around or shortly after 1999). If we would have used the current situation (e.g., the size of the farm in 2004) then there could potentially be an endogeneity problem as farm-size could well have been influenced by supermarket channel participation.

The risk factor and quasi-fixed capital explanatory variables we included here capture risk-sensitivity (land ownership), land capital (size of the farm), access to financial capital (size of land and ownership, education), human capital (age, education, gender) and physical capital (presence of an irrigation system). Each of these explanatory variables is hypothesized to ceteris paribus increase the probability of adoption of the supermarket channel. With regard to gender it is hypothesized that men are more likely to enter the supermarket channel because they (1) are assumed to have better access to the required production factors and (2) tend to get more involved when the transactions become more formal, sizeable and rewarding (Dolan 2001). Based on the above, the implementation model has the following determinant variables (X):

(a) the percentage of the farm size that is owned in 1999 (percent owned 99);

(b) the size of the farm in ha in 1999 (size 99);

(c) the number of years of schooling of the head of the farm (education of head);

(d) the age in years of the head of the farm (age of head);

(e) the gender of the head of the farm (gender of head); and

(f) a dummy indicating if the farm had an irrigation system in 1999 (irrigation 99).

Table 2 presents the probit estimators of the model. The results are as hypothesized, namely, the probability of a farm participating in the supermarket channel increases as the farm (i) is larger and (ii) has drip or overhead irrigation. The marginal effect indicates that, for the average farm (in terms of the independent variables), having one more hectare of land (i.e., a relatively large 10% increase relative to the average size of 4 ha) increased the probability that the farm will participate in the supermarket channel with nearly 12% while having a drip or overhead irrigation system increases this probability with 46%. The latter indicates that having irrigation is a critical capital requirement for farms who want to become FFV suppliers to supermarkets. Education, age, gender and land-ownership did ceteris paribus not have a statistically significant effect on the probability of a farm entering the supermarket channel.

5.3 Supermarket channel participation and the farmer's production technology

In the microeconomic theory of the firm, technology is represented by a production function which reflects the technological relation that exists between any particular combination of inputs and the resulting levels of outputs q (Sadoulet and de Janvry 1995). These inputs consist of an X

vector of variable inputs (e.g., fertilizer) and a Z vector of quasi-fixed inputs (e.g., land). Here we select the Cobb-Douglas production function which is the most used functional form for the analysis of farm efficiency (Battese, 1992):

$$q = A \, X^\alpha \, Z^\beta$$

By selecting land, labor, and fertilizer as the inputs and taking the natural logs, we get the following two production functions which we want to estimate and compare:

Supermarket-channel farmers: $lnoutput = A_{1} + \alpha_1 * lnlabor + \beta_1 * lnland + \gamma_1 * lnfertil + e_1$ (1)

Traditional-channel farmers: $lnoutput = A_{2} + \alpha_2 * lnlabor + \beta_2 * lnland + \gamma_2 * lnfertil + e_2$ (2)

Whereby lnoutput is defined as the natural log of output measured in kg of kale produced by the farmer from the current acreage over one cycle; lnlabor is the natural log of the number of full work-days used for land preparation, planting and weeding of kale; lnland is the natural log of the number of ha-months used for kale growing (we want to take into account a harvest cycle length which over the sample varied from 2 to 12 months[1]); and lnfertil is the natural log of the number of kg of fertilizer applied to the current planted area over one cycle (summarized over the various types of fertilizer which in terms of value per kg do not differ widely). The last term, e, is the estimated error (disturbance) which contains the unobserved explanatory factors.

The distribution of the farmers over the two groups (supermarket channel, traditional channel) is not random but rather the outcome of a self-selection process. In order to control for this (potential) selectivity bias, we used Heckman's two-stage method. In the first step, this method calculates the inverse Mill's ratio (λ) for each observation (via a probit model for channel choice) which then in the second step is added to the substantial model (the production function) as a control variable (adding the term $\delta_i * \lambda$ in equations (1) and (2) above).

Table 3 lists the estimated parameters for both models. The λ regressor is significant for the revised equation (2) which means its presence corrected for a self-selection bias. We further found that both models are significant and that the signs of the coefficients are as expected, namely output increases as, ceteris paribus, more land or more fertilizer are used. Labor was found not to have a statistically significant effect in either model.

Table 4 compares the marginal product values (MPV) for the significant coefficients of table 3. Several observations can be made. First, the data indicate that the MPV differs greatly between the two groups of farmers: in absolute terms the MPV is larger for the well-capitalized supermarket-channel farmers while as a relative measure (relative to gross revenue) it is larger for the traditional-channel farmers who capture only a small percentage of the marketing margin. Where one additional ha-month of land would increase revenue from the sale of kale with Ksh7,946 for traditional-channel farmers (i.e., roughly 10% of their average total revenue per ha), it would increase revenues for supermarket-channel farmers with Ksh19,940 (i.e., roughly 5% of their average total revenue per ha).

Second, each of the calculated MPVs is larger than the corresponding factor cost, indicating that these factors (land, fertilizer) are used below the optimal quantity for both groups of farmers. For traditional-channel farmers, this may indicate that land access is constrained by a limited access to land (high population density). For supermarket-channel farmers, who on average only use 70% of their land, the bottleneck is more likely to be found in the limited access to capital for irrigation system expansion.

Third, the average land productivity and the average labor productivity are respectively 59% and 73% higher for supermarket-channel farmers than for traditional-channel farmers. This results from the more capital intensive production methods used by supermarket-channel

16

farmers. Relative to daily wages (which are Ksh150/day and Ksh120/day for supermarket-channel and traditional-channel farmers respectively) average labor productivity is four times the wage rate for supermarket-channel farmers and three times the wage rate for traditional-market farmers. This extends to the supermarket-led part of the FFV supply system, the findings of Carter and Wiebe (1990) that higher access to capital (in this case of the supermarket-channel farmers) impacts the agrarian structure and productivity in Kenya.

5.4 Net income effect of supplying supermarkets

Table 5 provides a gross margin analysis for two types of farmers. The top half of the table (production) allows for a straightforward comparison between supermarket-channel and traditional-channel farmers. The marketing part forced us to make a choice because the two groups of farmers do not sell to the same buyers, nor does either group always sell all produce to a single or the same buyer over time. However, in most cases, both types of farmers sell most of their harvest to a single type of buyer. In Table 5 we opted to compare the most extreme (but also most common) marketing choices, namely supermarket-channel farmers sell (nearly) 100% of their kale to supermarkets (applies to 60% of the farmers) and traditional-channel farmers sell (nearly) 100% of their kale to a broker at the farm (applies to 46% of the farmers).

Table 5 indicates that there are substantial differences between the two groups of farmers. First, supermarket-channel farmers use on average twice the amount of inputs (fertilizer, manure, chemicals) per ha used by traditional-channel farmers and their variable production costs further include the cost of using tractors and irrigation systems. Given these higher input levels, yields per ha and per worker are higher for supermarket-channel farmers[2]. Second, traditional-channel farmers use more labor per ha, mostly because there is an abundance of family labor relative to

17

the small farm sizes. Third, wages for hired labor are higher in the supermarket channel than in the traditional channel which is in line with the higher labor productivity. Fourth, there is almost no difference in the production cost per kg of kale between the two groups of farmers, with both types of farmers producing kale at about 3.5Ksh/kg (US$0.05/kg) on average. Fifth, different marketing practices lead to essential differences in profitability between the two farmer types. Whereas traditional-channel farmers incur only limited marketing costs, they sell to brokers at a low farm-gate price which allows them to break even at best. Supermarket-channel farmers on the other hand incur transportation costs, but receive a price which is more than three times the farm-gate price, resulting in a gross profit of about 40%[3].

For individual traditional-channel farmers, shifting from a broker at the gate to selling to supermarkets would not have a positive net income effect as the transportation costs would be prohibitive (given the small volumes). However, if traditional-channel farmers would join together in organizing efficient transportation for marketing their output, supplying to supermarkets would allow them to capture the 40% gross profit margin now enjoyed by the supermarket-channel farmers. Two key factors hinder the emergence of marketing groups amongst traditional-channel farmers. First, there is a lack of experience in marketing produce (in fact, many farmers dislike to be engaged in marketing activities). Second, risk-averseness deters traditional-channel farmers from selling to more downstream buyers. Selling to wholesalers exposes farmers to high price fluctuation risks which may average out for a broker or large farmer supplying daily, but could financially cripple a group of smallholders marketing maybe only once a month. Selling to supermarkets, which could provide more stable prices, requires that farmers have access to affordable credit and are willing to risk taking out a loan to invest in

the irrigation system required by supermarkets. Also, selling to supermarkets, who may take a month to pay, often exceeds the working capital capacities of cash-strapped smallholder farmers.

5.5 Supermarkets and farmer growth dynamics

Supermarkets pay the highest wholesale prices in the market (about 10-20% higher than traditional retailers), but other benefits of selling to supermarkets are even more important to farmers than the higher price. While 34% of the supermarket-channel farmers say that the higher price is the key reason for selling to supermarkets, 46% say that the ease of selling to supermarkets is the key attraction. The ease of selling follows from the lower transaction costs and the lower market risks in the supermarket channel.

Consider a listed farmer in the supermarket channel. Since supplies are order-based, the farmer is certain, before harvesting, that the sale will take place and at what price. Prices paid by supermarkets remain stable over longer time intervals. Relative to the smaller traditional wholesale and retail buyers, supermarkets order bigger volumes which reduce transaction costs for farmers. These orders are also coming in throughout the year with some reliability. While supermarkets and their FFV suppliers start to build up long term relationships, 95% of the traditional-channel farmers are selling in spot markets with buyers varying all the time.

The combination of higher net incomes, lower transaction costs and greater stability in volumes and prices in the supermarket channel, have created a strong growth dynamic: the average farmed acreage of supermarket-channel farmers increased by 104% over 1999-2004, compared to by only 10% for traditional-channel farmers. Growing this fast, the current list of supermarket-channel farmers are likely to be able to follow growing demand for FFV by

supermarkets for the next five years: 71% of these farmers state that, should supermarkets ask them to, they could double their current supply of kale within one (five month) production cycle.

6. SUMMARY AND CONCLUSIONS

This paper focused on a critical question in today's economic development debate: do the rural poor benefit from the market opportunities created by the rise of supermarkets in developing countries? The analysis presented here indicates that the answer to this question depends on whether the rural household is a net seller or a net buyer of food.

Commercial smallholder farmers (net food sellers) have largely been excluded from the supermarket channel due to capacity constraints in production and marketing. Although the overall productivity of the mainly smallholder producers in the traditional channel is similar to that of supermarket channel farmers, smallholder farmers lack the size and modern irrigation system which are needed to comply with the supermarket's requirements for larger and year-round supplies. Group formation and affordable low-tech irrigation systems have not emerged to the point where they resolved these capacity constraints of smallholder producers in any significant way. On the marketing side, supermarkets want their suppliers to be responsive to demand fluctuations which require that supermarket-channel farmers need to have good business management skills as well as reliable access to transportation and communication technology. The overall implication is that there exists a threshold capital vector at the entrance of the supermarket channel which constrains the entry of smallholder producers who make up only 25% of the supermarket-channel farmers as opposed to the vast majority of the traditional-channel farmers.

With high-capacity export-oriented fruits and vegetables farms also largely absent from the supermarket channel due to a largely different product focus, the main supply response to the rise of supermarkets in Kenya has come from a new group of farmers. These are mostly recently established, medium-sized farms managed by well-educated farmers and specialized in supplying supermarkets. Around 40% of supermarket-channel farmers fell in this category in 2004 and it is expected that these farmers will become dominant in the supplier base over the next five years.

The smallholder farmer's constrained access to supermarkets is undesirable from a development perspective because selling to supermarkets does represent an opportunity to break the poverty cycle. Most traditional-channel farmers do not own motorized transportation and lack the scale to rent it. These farmers are thus forced to sell to brokers who come to the farms at prices that allow them to break-even at best. On the other hand, supermarket-channel farmers who supply directly to supermarkets operate on healthy gross profit margins. The combination of higher gross profits and a stable long term trading relationship has been the key determinant of a strong growth dynamic amongst supermarket-channel farmers. The latter have, on average over the last five years, grown ten times as fast as the traditional-channel farmers in this study. Furthermore, the strong growth of the current supermarket-channel farmers indicates that they will not only keep pace with the growth of supermarkets but even increase their share of the supermarkets' FFV supplies over time. The implication for smallholder farmers is that, ceteris paribus, the supermarket channel will be closed off to them as time goes by.

For poor rural households with little or no land (net food buyers), the supermarket-channel farms create new and more rewarding jobs in the rural areas. Farms supplying supermarkets have adopted capital intensive technologies. They use more quasi-fixed capital

(e.g., irrigation systems) and apply (per ha) twice the amount of fertilizer, manure and chemicals used by traditional-channel farmers. Consequently, average labor productivity is about 60-70% higher for supermarket farms. Although supermarket-channel farmers have a lower labor-to-land ratio, they rely heavily on hired workers. On average, 80% of the full-time workers on supermarket-channel farms are hired laborers. Commensurate with their higher labor productivity, these hired farm workers are paid a higher wage on average and are given more full-time jobs, given the more year-round production schemes on supermarket-channel farms. Furthermore, the heavier reliance on farm inputs in the supermarket channel stimulates growth and creates new jobs in the input sector, some of which will be taken up by the rural poor.

In summary, our research finds that the impact of the rise of supermarkets on the rural poor has two main components. For smallholder producers, the supermarket channel has been difficult to enter due to the existence of a threshold capital vector which includes physical, financial and human capital and covers both the production and marketing functions. For rural households with little land, new and more rewarding farm worker jobs have been created on the new medium-sized and capital-intensive farms that have provided the main supply response to the rise of supermarkets in Kenya. The latter thus initiated a structural transformation process in the domestic produce marketing system from one that is static, fractioned and supplied by smallholder farms using family labor to one that is dynamic, more vertically integrated and supplied by larger farms using hired labor. Whether the net overall impact of this transformation process on the rural poor will be positive or negative depends on which of the two impact components will dominate: decreased farm income or increased off-farm income.

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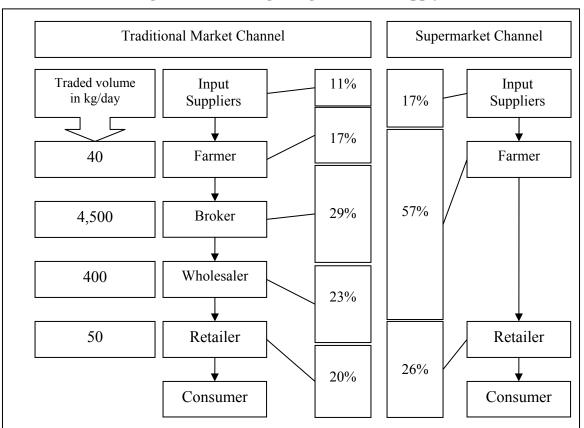The John Hopkins University Press.

Figure 1: Marketing Margins in Kale Supply Chains

Note: input suppliers margin in traditional chain assumes farmers buy seeds and manure, rather than use their own.
Source: authors' farmer survey, interviews with channel participants, including brokers, wholesalers and retailers and price-measurements throughout the chain.

Table 1: Differences between Supermarket-Channel and Traditional-Channel Farmers

Crop	Tomato		Kale		Banana	
Farm characteristic	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=12)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**
farm size (ha)	2.5 *	9.3 *	1.5 *	18.5 *	2.3	13.8
land irrigated (% of farm size)	93 **	100 **	18 ***	75 ***	41	66
land farmed (% of farm size)	89	80	87 *	71 *	93	88
permanent employees(#/farm)	4	19	3 **	33 **	3	8
casual labor (#/farm)	10 **	17 **	4 *	19 *	4 ***	11 ***
Family labor (% of permanent)	47 ***	3 ***	79 ***	21 ***	74 ***	11 ***
labor-to-land ratio (farm level)	1.4	0.9	1.6	1.1	1.1	0.5
labor-to-land ratio (aggregate)	0.9	0.9	1.1	0.9	0.6	0.4
schooling farm head (yrs)	9 **	13 **	7 ***	13 ***	7 ***	15 ***
farms with phone (%)	29	100	31 ***	100 ***	24	100
farms with irrigation system (%)	100	100	27 ***	92 ***	55	100
farms with drip/overhead irrig. (%)	5	40	18 ***	92 ***	32	40
farms with transp. vehicles (%)	14	80	9 ***	100 ***	5	80
farms with a packing shed (%)	0	80	0 ***	75 ***	0	40
% of hh income from farming	87	82	81	60	87	60
# of different horticultural products grown (at a given time)	2 *	5 *	3 ***	7 ***	3	2
farms collaborating with other farms (%)	46	0	32	33	29	80
farms member of coop/assoc. (%)	18	0	73 ***	8 ***	77	0

Notes: *=significant at the 10% level, ** = significant at the 5% level, *** significant at the 1% level.
Transportation to buyer is for transportation beyond the main road. Most kale farmers will take produce to brokers near main road on a donkey cart.
Source: authors' farmer survey 2003.

Table 2: Determinants of Farmer Adoption of the Supermarket Channel (Probit Results)

Independent variables	P(Supplies kale to supermarkets) (s.e.)	Marginal effect
Size 99	0.30 (0.157)*	+11.8%
Education head	0.19 (0.164)	-
Percent owned 99	-0.01 (0.014)	-
Irrigation 99	1.35 (0.746)*	+46%
Gender of head	0.55 (1.078)	-
Age of head	0.02 (0.031)	-
Constant	-5.76 (3.930)	-
No. of observations	57	
(Pseudo) R-square	0.7621	

Notes: * = significant at the 10% level. Marginal effect measured at the mean
levels of the determinant variables.
Source: authors' farmer survey 2004

Table 3: Heckit Two-Stage Estimates of the Cobb-Douglas Production Functions

Dependent variable: lnoutput Independent variables	Supermarket farmers Coefficient (s.e.)	Traditional market farmers Coefficient (s.e.)
Constant	6.8237 (1.1484)***	6.6034 (0.8699)***
Lnland	0.8681 (0.3133)***	0.5794 (0.2453)**
Lnlabor	-0.3254 (0.2527)	0.0446 (0.2388)
Lnfertil	0.2407 (0.1070)**	0.2030 (0.1553)
Mill's lambda	0.1952 (0.2471)	0.9889 (0.5379)**
Wald Chi^2	107.3	28.25
Significance	0.0000	0.0000

Notes: ** = significant at the 5% level, *** significant at the 1% level.
Source: authors' farmer survey 2004.

Table 4: Input Use and Farm Efficiency

Input	Supermarket farmers				Traditional farmers			
	MPV		FC		MPV		FC	
Land (ha-months)	19,940Ksh	>	1,647Ksh		7,946Ksh	>	2,675Ksh	
Fertilizer (kg)	56Ksh	>	28Ksh					
Productivity Measures								
Labor productivity (average output value per work day)	605Ksh				349Ksh			
Land productivity (average output value per ha-month)	25,352Ksh				15,899Ksh			

Notes: marginal product value (MPV) valued at farm-gate price of Ksh3.6/kg. Factor costs (FC) are sub-sample averages.
Source: authors' farmer survey 2004.

Table 5: Gross Margin Analysis Kale Supermarket vs. Traditional-channel farmers

Data are per acre		Farmers supplying 100% to supermarkets				Farmers supplying 100% to brokers at the farm			
Line Items[1]	Unit	Units	Unit Cost (Ksh)	Cost Total (Ksh)	% of Rev.	Units	Unit Cost (Ksh)	Cost Total (Ksh)	% of Rev.
Seed **	Kg	0.4	1280	512	0.3	1.1	790	869	2.6
Inorganic fertilizer	Kg	314	28.0	8,792	5.7	177	28.8	5,098	15.1
Manure ***	MT	6.6	1,300	8,580	5.6	3.3	2,100	6,930	20.6
Chemicals *	L	3.3	1,090	3,597	2.3	1.6	1,135	1,816	5.4
Cost Irrigation (var.)	Month	5.4	2,200	11,880	7.7	0	na	0	0
Tractor rental	Acre	1	2,000	2,000	1.3	0	na	0	0
Total inputs				*35,361*	*23.0*			*14,713*	*43.7*
Labor by activity									
Land preparation	Mds	17	150	2,550	1.7	28	120	3,360	10.0
Planting	Mds	12	150	1,800	1.2	19	120	2,280	6.8
Weeding	Mds	55	150	8,250	5.4	85	120	10,200	30.3
Labor by Source									
Family labor ***	Mds	8	150	1200	0.8	120	120	14400	42.8
Hired labor ***	Mds	76	150	11400	7.4	12	120	1440	4.3
Total Labor Cost	Mds	84	150	12,600	8.2	132	120	15,840	47.1
Total Product. Cost	**Kg**	**12,800**	**3.7**	**47,961**	**31.2**	**9,350**	**3.3**	**30,533**	**0.8**
Harvesting	Mds	77	170	13,090	8.5	26	120	3,120	9.3
Take & Sell Market	Mds	29	300	8,700	5.7	0	Na	0	0
Rope (bag or bunch)	Pce	19,700	0.08	1,576	1.0	125	2	250	0.7
Bags	Bag	Na	Na	0	0	125	20	2,500	7.4
Transport (var.)	Km	1,700	10	17,000	11.1	0	Na	0	0
Phone Cost	Na	Na	Na	390	0.3	Na	Na	0	0
Total Market. Cost	**Kg**	**12,800**	**3.2**	**40,756**	**26.5**	**9,350**	**0.6**	**5,870**	**17.4**
Total Cost			**6.9**	**88,717**	**57.8**		**3.9**	**36,423**	**108**
Total Revenue			**12.0**	**153,600**	**100.0**		**3.6**	**33,660**	**100**
Gross Profit			**5.1**	**64,883**	**42.2**		**-0.3**	**-2,763**	**-8.2**
Gross Profit (excl. family labor)			**5.2**	**66,083**	**43.0**		**1.2**	**11,637**	**34.6**
Yield		**12.8 MT/acre**				**9.4 MT/acre**			

Notes: (1) significance for production line items: * = significant at the 10% level , ** = significant at the 5% level, *** significant at the 1% level; (2) numbers are indicative only as they are based on the farmer's estimations, not direct measurement; (3) prices used are weighed sample averages for both groups of farmers; (4) weight conversions used: 1 bag=75kg, 1 bunch=0.65kg (authors' field measurements).
Source: authors' farmer survey 2004.

NOTES

[1] Kale leaves can be harvested from the same plants at regular intervals over periods stretching up to 12 months, although the normal harvest cycle is about three months.

[2] Yields per hectare vary greatly because of differences in variety, harvest cycle length, soil quality, climate and farm practices, but are estimated at 15MT per ha on average (MoARD 2002) while yields up to 37MT per hectare are possible (for comparison, kale yields in the US can go up to 44MT per hectare; Oregon State University 2002). The relatively high yield found here for traditional-channel farmers may be due to the specific selection of our sample (a key kale production area for the Nairobi market) or to the farmer's overestimation of the quantity harvested and/or underestimation of the area under kale.

[3] 93% of the supermarket-channel farmers said that supplying to supermarkets has affected their profitability positively.