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Fertilizer market liberalization and private retail trade in Kenya

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Abstract

This paper examined the factors influencing the entry and sales decision of private traders in fertilizer retail trade in a liberalized market using survey data from Kenya. A two-stage econometric model is used to examine traders' entry and sales decision. The results provide insights into factors that are associated with private retail traders' entry and sales decisions in an era of liberalized fertilizer markets. It shows substantial entry into fertilizer retail trade following market liberalization. Relatively limited investments in trading assets and equipment are predicted to hold back firm expansion. Implications drawn from the study provide insights into likely research and policy interventions.

Keywords: Fertilizer; Market liberalization; Regression analysis; Kenya

Introduction

Improved management of soil fertility on smallholder farms is essential for raising crop productivity, food supply, soil quality, and reducing poverty in many African countries (Barrett et al., 2002a). Sustained use of inorganic fertilizer can contribute significantly to improving soil fertility management but use of the input remains very low (Mwangi, 1997). Markets that operate efficiently, leading to improved availability and access to the input are essential for increasing use of inorganic fertilizer on smallholder farms.

The economic cost associated with poorly performing domestic markets was an important reason for liberalization of agricultural input markets under structural adjustment and stabilization programs. Agricultural market reform policies that removed regulatory controls on marketing, reduced exchange rate distortions and

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restricted the role of parastatal enterprises were expected to encourage the development of efficient and competitive input markets, stimulating input demand and generating sustained growth in crop productivity. Several studies provide evidence of private trader entry into liberalized input markets in Africa (Beynon et al., 1992; Argwings-Kodhek, 1996; Badiane, 1998; Kherallah et al., 2000; Omamo and Mose, 2001). Yet there is widespread concern that reform programs have not produced the expected benefits for private retailers and farmers (Badiane, 1998; Kherallah et al., 2000). Retail trade in agricultural inputs has expanded rapidly but many traders appear to have difficulties expanding trading activities. Few traders have invested in productive assets or distribution facilities such as storage, transportation, or advisory services (Beynon et al., 1992; Badiane, 1998; Kherallah et al., 2000). These observations suggest that constraints to the expansion of private trade appear to be just as important as entry barriers.

This paper examines the effect of fertilizer liberalization policies on the entry and sales decision of private traders in Kenya. We focus on retail trade because this level has experienced the most significant trader entry following market reforms (Argwings-Kodhek, 1996; Mose, 1998; IFDC, 2001; Wanzala et al., 2001).

The rest of the paper is organized as follows. Section 2 discusses the evolution of fertilizer market liberalization policies in Kenya. This is followed by a description of the data and presentation of descriptive statistics in Section 3. The econometric model and model hypotheses are presented in Section 4. Empirical results are reported in Section 5. The paper concludes with a discussion of policy and research implications.

Evolution of fertilizer market liberalization policies in Kenya

Kenya provides an interesting case study for examining the impact of liberalization of fertilizer marketing. Although the pace of the liberalization process extended over a decade, fertilizer markets are now completely liberalized (Argwings-Kodhek, 1996; Omamo and Mose, 2001).

Prior to the mid 1980s, the government was extensively involved in the import, pricing, and marketing of fertilizer using policy instruments such as price subsidies, price control, licensing of importers and distributors, and import quotas. A state parastatal, the Kenya Farmers Association (KFA) (later Kenya Grain Growers Cooperative Union (KGGCU)), had significant control over fertilizer procurement and domestic distribution. These policies diminished the role of the private sector in fertilizer pricing and marketing and led to near monopoly status of the parastatal KFA. By the early 1980s, the parastatal controlled over 80% of the fertilizer market in Kenya (Agriconsult). During this period, access to fertilizer in rural areas was difficult particularly in semi-arid areas with poor infrastructure and where many smallholder farmers did not use the input. This widely perceived failure in fertilizer policy put increased pressure on the government to gradually liberalize fertilizer markets. This resulted in a number of policy changes between 1983 and 1993, including authorization of smaller fertilizer packages, elimination of import quotas, price control, import licenses, and foreign exchange controls. By

1994, the fertilizer market was completely liberalized (Argwings-Kodhek, 1996; Omamo and Mose, 2001).

There is no strong evidence of policy reversals or significant policy constraints on private trade since fertilizer market was liberalized. Entry into fertilizer retail trade is fairly easy and markets are relatively competitive. An estimated 7000–8000 retailers are currently operating in the domestic market during the peak sales season (IFDC, 2001). The majority of these traders are small-scale pure retailers and agents for large importers and wholesalers operating in rural trading centers (Omamo and Mose, 2001; Wanzala et al., 2001). This category of fertilizer traders did not exist before market liberalization (Argwings-Kodhek, 1996; Mose, 1998). The ease of entry into fertilizer retail trade is in contrast to entry at the import and wholesale levels where high domestic interest rates, suppliers restrictions on minimum quantities, cumbersome import procedures and payment condition impose significant barriers to entry (Rocco, 1997; Wanzala et al., 2001).

Data

Data for the study were collected in a cross-section survey of private input traders in Machakos district of eastern Kenya between September and November 1997. The survey was conducted in three major agro-ecological zones—the semi-humid tropics with average annual rainfall of 800–1000 mm, the transitional zone with average annual rainfall of 600–800 mm, and the semi-arid tropics with annual rainfall of 400–600 mm. The sample was drawn across all agro-ecological zones in the district to ensure adequate coverage of the major characteristics of input traders. Private input traders were randomly selected from a sample frame of all agricultural input traders compiled annually by the Inputs Division at the District Agricultural Office of the Ministry of Agriculture and Rural Development. This ensured that every input trader had a known chance of being selected and that the results are representative of the population of input traders in the district.

Several traders sold fertilizer, seeds, and other agro-chemicals but some only sold agricultural equipment such as *pangas*[1] and hoes. Table 1 shows important characteristics of the input traders in the sample (Table 1).

The sample comprised 131 traders. Of these, 62% were selling fertilizer at the time of the survey. About 90% of traders selling fertilizer were pure retailers while the rest carried out both wholesale and retail trade. Traders were more likely to be selling fertilizer in the wetter semi-humid tropics and transitional zone compared to the drier semi-arid tropics. About 60% of all traders in the survey sold improved seeds and other agro-chemicals such as pesticides.

Table 2 provides additional information on the sample of fertilizer traders. Fertilizer market liberalization triggered substantial entry into fertilizer retail trade across all agro-ecological zones. Seventy percent of traders in the sample started selling fertilizer after 1994. The greatest quantity of fertilizer sales was in the

[1] A panga is a local farm implement used for cutting.

Table 1
Characteristics of traders

	Semi-humid tropics ($n = 26$)	Transitional zone ($n = 80$)	Semi-arid tropics ($n = 25$)	Total ($n = 131$)
Percentages of traders				
Sell fertilizer	73	68	32	62
Sell agrochemicals	62	61	52	60
Own store	54	35	68	45
Total numbers workers	3 (3)	2 (2)	2 (2)	2 (2)
Population density (KM^2)[a]	793 (348)	777 (1137)	163 (143)	663 (934)

Sources: Survey data.
[a] 1999 population and housing census.

transition zone although sales varied considerably within agro-ecological zones. However, the median values provided additional evidence of greater fertilizer sales in the transitional zone. Price margins for the traditional 50 kg bag of fertilizer was estimated as the difference between sale price and purchase price. The sale price of fertilizer depended mainly on wholesale price and transport cost. The latter accounted for over 90% of marketing cost. The price margins did not include storage costs because of the high rates of turnover in fertilizer sales. Less than 10% of traders reported storing fertilizer for more than 1 month. Instead, they bought the quantities they expected to sell over a relatively short period, minimizing storage costs and avoiding tying capital up. The relatively high price margins in the semi-

Table 2
Characteristics of fertilizer traders

	Semi-humid tropics ($n = 19$)	Transitional zone ($n = 54$)	Semi-arid tropics ($n = 8$)	Total ($n = 81$)
Percentages of traders				
Entered fertilizer market since 1994	53	80	90	70
Obtain credit for fertilizer trade	16	17	13	16
Own transport	21	13	13	15
Own store	47	30	63	37
Advise customers	90	96	88	94
Value of fertilizer sold (Kshs 1000)				
Mean	232	349	78	295
Standard deviation	251	440	116	389
Median	85	148	42	116
Fertilizer price margin (Ksh/kg)				
Mean	5.30	4.70	8.50	5.20
Standard deviation	2.00	2.30	5.20	2.80
Median	4.90	4.50	8.00	4.80

Source: Survey data.

arid zone suggested that transportation and distribution costs were relatively high in this area.

Only 16% of sampled traders acquired credit for fertilizer trade. Traders reported that the dominant source of financing was use of own-funds. Very few traders have invested in productive assets to facilitate fertilizer trade. Only 16 of the sample traders have their own transportation and about twice as much, 37%, own their store.

An interesting marketing innovation in fertilizer trade is the breaking of the traditional 50 kg fertilizer bags into smaller sizes. This practice is widespread with 98% of sampled traders repacking fertilizer into smaller sizes particularly into 1 and 2 kg packages that are well-liked by smallholder farmers (Omiti et al., 1999; Freeman and Omiti, 2003).

Model specification

Fertilizer market liberalization policies in Kenya provided opportunities for private sector participation in fertilizer trade (Agriconsult, undated; Argwings-Kodhek, 1996; Omamo and Mose, 2001; Wanzala et al., 2001). However, it is not clear which traders responded to these opportunities. Economic theory suggests that participation in fertilizer markets is conditioned by traders' willingness and capacity to invest. But the variables that influence willingness and capacity to invest may differ. Some traders may be willing to sell fertilizer but are prevented from doing so because of various constraints. The willingness to participate in fertilizer trade is conditioned by asset or liquidity position, the state of physical infrastructure, skill or experience in selling agro-chemicals, and ex-ante transaction costs of actually trading in fertilizer. The capacity to sell fertilizer is conditioned by relative returns to fertilizer trade and trader's risk attitudes. The factors associated with traders' entry and sales decision were therefore, categorized into variables representing asset and liquidity position, risk preferences, relative returns to fertilizer trade, store location, and transaction costs.

We postulate that a trader follows a two-stage process in making fertilizer trading decision. The first stage involves an entry decision in which the trader decides whether or not to sell fertilizer. In the second stage, depending on the entry decision, the trader makes the fertilizer sales decision.

A probit model is used to estimate traders' entry decision. The model involves the entire sample of traders and links the probability of selling fertilizer with a range of explanatory variables measuring traders' asset, liquidity position including access to credit, risk preferences, store location, and transaction costs. The model is specified by:

$$S_i^* = \gamma W' + u_i \quad \text{where } u_i \text{ is distributed as } N(0, \sigma_u) \tag{1}$$

$$\text{Prob}(S_i = 1) = \Phi(\gamma W_i) \quad \text{for traders with } S_i^* > 0 \text{ or } \gamma W_i > -u_i \tag{2}$$

where S_i^* is a latent variable indexing entry in fertilizer market, S is an observable dichotomous variable, W is a vector of exogenous variables and Φ is the cumulative distribution of u that is assumed to be normally distributed.

Table 3 shows the description of the variables used in the empirical analysis. The dependent variable in the probit model takes a value of 1 for a trader selling fertilizer and 0 for a trader not selling fertilizer. An Inverse Mills Ratio is obtained from the estimated probit model and is included as an additional explanatory variable in the second stage OLS regression equation for fertilizer sales. This corrects for sample selection problems arising from the inclusion of some variables that are likely to influence the entry decision in a non-random manner.

Table 3
Description of variables

Variable	Type	Description	Mean	Standard deviation
ECOZONE1	Binary	1=if semi-humid tropics, 0 otherwise	0.1985	0.4004
ECOZONE3	Binary	1=if semi-arid tropics, 0 otherwise	0.1908	0.3945
AGROCHEM	Binary	1=if trader sold other agrochemicals, 0 otherwise	0.5954	0.4927
LKNWDGE	Binary	1=if lack of technical knowledge on fertilizer use was constant on fertilizer trade, 0 otherwise	0.1679	0.3752
LKLIQ	Binary	1=if liquidity or access to credit was constraint on fertilizer trade, 0 otherwise	0.1145	0.3196
LKTRDINF	Binary	1=if lack of fertilizer trade information was constraint on fertilizer trade, 0 otherwise	0.1527	0.3611
LKSUPPL	Binary	1=if lack of fertilizer suppliers was a constraint to fertilizer trade, 0 otherwise	0.0687	0.2539
STOREOWN	Binary	Ownership of the store: 1=trader owns store, 0 otherwise	0.4500	0.5000
OWNSEX	Binary	Gender of trader: 1=trader is male, 0 trader is female	0.8244	0.3819
LKDEMAND	Binary	1=if lack of demand was a constraint on fertilizer trade, 0 otherwise	0.3511	0.4792
OWNEDUCN	Binary	Education of trader: 1=trader has at least secondary education, 0 otherwise	0.8702	0.3373
POPLNDLG	Continuous	Population density in store location (persons/km^{-2})	5.7996	1.1250
TOTWKRS	Continuous	Total number of people employed in the store	2.4700	1.8500
OBTNCRDT	Binary	1=if the trader obtained credit for fertilizer trade, 0 otherwise	0.0992	0.3000
OWNTRANS	Binary	Vehicle ownership: 1=trader owns vehicle that is used for fertilizer trade, 0 otherwise	0.0916	0.2896
ADVCUSTM	Binary	1=if trader offered technical advice on fertilizer use to customers, 0 otherwise	0.5800	0.5000
FRTPFTB	Binary	1=if trader perceives fertilizer to be more profitable, 0 otherwise	0.1145	0.3196
PRCMGN	Continuous	Price margin per kg of fertilizer (Ksh/kg)	144.9620	165.7090
STOCKFRT	Binary	1=if trader sold fertilizer, 0 otherwise	0.6183	0.4877
SELLVAL	Continuous	Value of fertilizer sold (Ksh)	182443.1	337119.4

The fertilizer sales regression involves a sub-set of traders in the survey selling fertilizer. The reduced form equation for the OLS regression is specified by:

$$Y_i = f(A_i, L, R_i, \pi_j, S, T) \tag{3}$$

where A is a vector of assets available to a trader, L represents liquidity position, R represents risk preference, π represents relative return to fertilizer trade, S represents the location of the store, and T is a vector of transaction costs.

We acknowledge that some of the explanatory variables are unobservable or difficult to measure empirically. For example ability, liquidity position, and risk preference are unobservable variables (Judge et al., 1985). Similarly, transactions costs are very difficult to measure empirically (Kherallah and Kirsten, 2001). In the empirical analysis we deal with this situation by using proxy variables as observable indicators of unobservable or difficult to measure variables.

Private traders need to be able to mobilize the necessary resources for investing in equipment and distribution facilities if the transition to a private sector led fertilizer marketing system is to be successful. The level of traders' assets as well as their liquidity position is an indication of ability to participate in fertilizer markets. Two variables are used to capture the influence of asset on fertilizer trading decisions, store ownership measured by whether or not the trader owns the store, and firm size for which the total number of full time employees is used as a proxy. Storeowners are hypothesized to have invested in storage facilities and are therefore, more likely to respond to opportunities for selling fertilizer. Larger firms are expected to have better access to financial, human, and management resources that are necessary for investing in fertilizer trade. These firms are also more likely to benefit from scale economies in retail trade because of their wider distribution and sales network. Both asset variables are therefore, expected to have a positive influence on the entry and sales decision. The ability to fund trading activities is determined by the overall liquidity position of the trader, which in turn is influenced by whether a trader obtained credit for fertilizer trade. High cost of capital and liquidity constraint impose severe entry barrier to trade in input markets (Kherallah et al., 2000). In Kenya, relatively high annual lending rates, up to 30%, prevent many traders from borrowing. Liquidity position is measured by a variable indicating whether or not a trader cited lack of access to credit or inadequate capital as a constraint to trading activities. It is hypothesized that lack of access to credit and liquidity constraints are negatively associated with entry and sales decision.

Traders' risk preferences are unobservable but their socio-economic characteristics are assumed to closely reflect risk attitudes. We therefore, included the trader's age, gender, level of education attained, and years of experience selling agro-chemicals as proxy variables. It is difficult to predict a priori the influence of age on entry decision. Older traders may be more risk averse and therefore, less inclined to invest in fertilizer trade. On the other hand, credit market imperfections and reliance on own-capital implies that younger traders are less likely to invest in fertilizer trade because of their smaller capital base. Better educated traders as well as those with experience selling agro-chemicals are hypothesized to have higher

management skills and therefore, more likely to accurately assess opportunities for fertilizer trade. These traders are expected to expand trading activities in response to new opportunities. Traders with experience selling agro-chemicals are also hypothesized to have developed contacts with input suppliers that facilitate entry into fertilizer markets. Gender biases in access to resources and opportunities for trade are hypothesized to favor male traders compared to female traders. The coefficient on the variable for male trader is therefore, expected to have a positive influence on entry decision.

Extensive levels of agricultural market segmentation imply that supply conditions and the state of infrastructure in a store's location condition trader's ability to respond to trading opportunities (Badiane, 1998). Poor rural infrastructure raises marketing and distribution cost that is passed on as high farm-gate input cost and lower farm incomes (Omamo, 1998). Both of these factors reduce the derived demand for fertilizer and results in smaller quantity of fertilizer sales. Demand conditions are also expected to influence the entry and sales decision. The density of population in the store location is used to capture potential demand for fertilizer. This data comes from the Kenya 1999 population census and was measured by the population density in the administrative unit (sub-location) in which a trader's store is located (Government of Kenya, 2001). It is expected that high population density is positively correlated with high level of local demand for fertilizer and favorable trade prospects. Hence, willingness to enter fertilizer market as well as the sales level is expected to increase with rising population density. A variable representing the agro-ecological zone in the store location is assumed to capture important supply, infrastructure, and demand conditions influencing entry and sales decision. Traders located in the semi-arid zones are expected to be less likely to enter fertilizer markets or expand sales because this area has the lowest and most variable rainfall levels as well as the poorest state of infrastructure (KARI, 1995).

Some traders are likely to be precluded from entering fertilizer markets because they face high transaction costs that are specific to them. Transaction costs are hypothesized to drive large wedges between fertilizer purchase and sales price. They therefore, impose high entry barriers that make trade unprofitable for several traders. These costs are difficult to observe so they are measured by proxy variables representing whether or not a trader cited lack of access to fertilizer trade information, wholesale suppliers, and limited technical knowledge about fertilizer as important constraints on the entry decision.

Several of these variables are expected to influence both the entry and sales decision while others influence the entry decision but not the sales decision. Additional explanatory variables capturing investment in transportation facilities, advisory service to farmers, relative returns to fertilizer trading, and price margin were included in the second stage OLS regression. Investment in transportation provides an important source of competitive advantage. The coefficient on this variable is expected to have a positive influence on fertilizer sales. Provision of advisory service to farmers is assumed to be a trade strategy that is expected to expand sales. Relative return in fertilizer trade is an indication of the profitability of fertilizer trading activities. Traders who report higher relative returns in fertilizer

trade are expected to have greater incentives to expand trade compared to those who do not. The magnitude of price margins reflects traders' ability to reduce unit cost of trading activities. More efficient traders are expected to have lower price margins and the greatest incentives to increase sales.

OLS regression coefficients are weighted by the inverse of the square of firm size to correct for likely heteroscedasticity problems that can result from the nature of the disturbance term in the second stage of sample selection models (Green, 1993). The full model is identified because the OLS regression excludes some explanatory variables that are in the first stage probit regression. For example, lack of access to wholesale suppliers and fertilizer trade information are likely to influence the decision to enter fertilizer trade but not the level of fertilizer sales once a trader has decided to sell the input. The OLS model is specified in double-log form.

There are strong theoretical reasons to believe that several of the proxy variables in the probit and second stage OLS regression models are correlated with other variables that explain traders' entry and fertilizer sales decisions. For example, relative profitability of fertilizer trade affects the volume of fertilizer a trader chooses to buy and sell. But volume of sales also affects a trader's perception of profitability particularly when there are scale economies. Such correlation is likely to cause problems of simultaneity bias, leading to bias and inconsistency in the resulting regression coefficient estimates. These problems can affect the validity of the inferences from the empirical model, leading to erroneous conclusions about the importance of individual explanatory variables and compromise the results of the paper. An appropriate estimation technique for the potential simultaneity problem would be the use of instrumental variables that help separate the exogenous and endogenous components of the explanatory variables. However, valid instrumental variables that are correlated with the choice variables but not with the error term were not available.

In the absence of valid instrumental variables we can estimate the empirical model without the proxy variables that potentially bias the coefficient estimates. But this causes omitted variable problems that also leads to bias and inconsistent coefficient estimates. We are therefore, faced with the classic dilemma of using proxy variables versus ignoring unobservable and difficult to measure variables in the empirical model. Since both regression equations are likely to yield potentially biased and inconsistent coefficient estimates, we selected the empirical model that produced estimates with less bias and inconsistency (Judge et al., 1985). We therefore, proceeded to estimate a model that suffers omitted variables bias (without proxy variables) and another model that suffers simultaneity bias (with proxy variables). We then compared the models. The results suggested that the model that included the proxy variables had greater predictive power than the model that omitted these variables.[2] We therefore, proceeded to present the results of the model that included the proxy variables with the caveat that it is a predictive

[2] The results from the model without the proxy variables are not shown here because of space restrictions. We however, obtained fewer significant regression coefficients and the overall fit of the probit and OLS regressions were lower in this model.

model rather than a causal model. In this case, the explanatory variables are better predictors of more fundamental causal variables and the regression results indicate degrees of association rather than causal relationships.

Empirical results

Results from probit and least square regression are presented in Tables 4 and 5, respectively. The estimated probit model suggested a reasonably good fit with the explanatory variables correctly predicting the entry decision of 82% of traders who did not sell fertilizer and 94% of traders who sold fertilizer. Overall, the estimated model correctly predicted about 90% of traders' entry decision.

The coefficient on store location in the semi-arid agro-ecological zone was negative and significantly associated with traders' entry decisions predicting that traders in the drier agro-ecological zones were less likely to enter fertilizer trade compared with those in the wetter locations. This prediction is consistent with Omamo and Mose (2001) finding that the underlying production potential in a region is an important factor influencing traders' decisions to participate in fertilizer trade.

Experience selling agro-chemicals was strongly and positively associated with entry decisions. The prediction is that traders with experience selling agro-chemicals were more likely to sell fertilizer. These traders may have developed trade networks that reduced the costs of obtaining fertilizer trade information and searching for wholesale suppliers. It is also likely that these traders benefited from complementarities in farmers' input purchasing decision. Adding fertilizer to other agricultural inputs, such as seed and pesticides, provided farmers with a ''one stop'' facility where they purchased several farm inputs.

Table 4
Probit model results

Variable	Estimated coefficient	Standard error	*t*-value
ECOZONE1	0.2393	0.4705	0.509
ECOZONE3	−0.8021*	0.4603	−1.742
AGROCHEM	1.7197*	0.3420	5.029
LKNWDGE	0.3504	0.4784	0.732
LKLIQ	−3.0112*	0.9611	−3.133
LKTRDINF	−0.8980*	0.4207	−2.135
LKSUPPL	−1.2624*	0.5892	−2.143
STOREOWN	−0.4439	0.3374	−1.316
OWNSEX	0.1782	0.4351	0.041
LKDEMAND	−0.8363	0.3507	−0.238
OWNEDUCN	0.3845	0.5727	0.671
POPLNDLG	0.1588	0.1797	0.884
TOTWKRS	0.1562*	0.1014	1.541
CONSTANT	−1.4473	1.2856	−1.126
Percentage of correct predictions	0.89		
Number of observations = 131			

* Significant at 0.1 level.

Table 5
OLS results

Variable	Estimated coefficient	Standard error	*t*-value
ECOZONE1	−100.8625	68.2701	−1.477
ECOZONE3	−140.9947	96.9189	−1.455
STOREOWN	−23.6369	64.4480	−0.367
OWNEDUCN	77.7316	99.9131	0.778
POPLNDLG	32.9775	32.0001	1.031
TOTWKRS	122.3990*	36.9205	3.315
OBTNCRDT	124.8691	83.7104	1.492
OWNTRANS	24.0437	848642	0.283
ADVCUSTM	234.3381	154.2379	1.519
FRTPFTB	182.3082*	86.8401	2.099
PRCMGN	0.6146*	0.2231	2.754
LAMBDA	−111.2082	79.7226	−1.395
CONSTANT	−616.9119	308.7861	−1.998

Number of observations = 81; *F*-statistic = 2.89; Adjusted $R^2 = 0.22$..
* Significant at 0.1 level.

The proxy variables for subjective transaction costs, measured by access to fertilizer trade information and access to wholesale suppliers, were negatively associated with traders' entry decisions. The model prediction is that traders that perceived high cost of getting fertilizer trade information and fertilizer supplies were less likely to sell the input. This statistical association however, needs to be interpreted with caution because the proxy variables we have used can reflect many things in addition to transaction costs.

Firm size was positively associated with entry decision but the statistical relationship was weak. This probably reflected the small-scale nature of many fertilizer retailers. Survey results showed that on average fertilizer retail enterprises employed about two full time workers.

The two demand side variables, traders' perception of demand conditions and population density, were not associated with traders' entry decisions. Again, this result needs to be interpreted with caution as it may well be that other variables are simply better predictors of the underlying relationship between demand and entry decisions. Lack of technical knowledge of fertilizer was also not associated with entry into retail trade predicting that a trader need not have any specialized knowledge about fertilizer to start selling the input.

Summarizing, the probit regression on entry decision predicted that traders in the wetter zones with experience selling agro-chemicals and access to financial resources, fertilizer trade information and wholesale suppliers were more likely to respond to the retail trade opportunities arising from liberalization of fertilizer markets.

The OLS regression estimates for the sales equation predicted that variation in level of fertilizer sales was positively and significantly associated with the size of the business, relative profitability of fertilizer, and price margins. Larger retailers may be selling greater quantities of fertilizer because they had a wider customer

base that included large-scale farmers, smaller retailers, and small-scale farmers. For example, only 20% of retailers in the survey carried the full range of fertilizer packages that farmers demanded. Traders who reported higher relative profitability of fertilizer were predicted to be selling larger quantities of fertilizer. However, without detailed information on cost structures, relative returns, and market conditions it is difficult to read much into the significance of the coefficient on this variable. The coefficient on price margins was positive and significantly associated with levels of the fertilizer sales. But the prediction that greater fertilizer sales were associated with rising margins is counter-intuitive, as one would expect traders with the lowest margin to have the greatest incentives to expand fertilizer sales.

The coefficients on the variables for population density, use of credit for fertilizer trading, ownership of transportation, and provision of advisory services to customers were positively associated with levels of fertilizer sales. But none of these variables were predicted to be important in fertilizer sales decisions. As indicated earlier, these findings should be interpreted with caution, as it might simply be that these variables were not good predictors of traders' underlying sales decisions.

Implications and conclusions

The evidence on the impact of fertilizer market liberalization on functioning of domestic markets and its effects on crop productivity, food supply, and poverty is mixed. The findings from this study provide further evidence that liberalization of fertilizer markets is associated with increased participation of the private sector in fertilizer retail trade. This result is consistent with other studies in Africa that showed substantial entry into fertilizer retail trade following liberalization of fertilizer markets (Beynon et al., 1992; Argwings-Kodhek, 1996; Badiane, 1998; Kherallah et al., 2000; Omamo and Mose, 2001). It however, appears that the removal of policy and regulatory controls encouraged entry into retail trade, with traders mainly using own-capital as start up funds.

The prediction that entry decisions are associated with trader specific characteristics, such as their subjective perception of the cost of searching for information on fertilizer trade and suppliers, might suggest that policy interventions that improve the flow of information on fertilizer marketing and trade opportunities would promote fertilizer trade.

The prediction that lack of technical knowledge of fertilizer was relatively unimportant in trader's entry decision is worrying particularly when one considers that these traders do not employ staff with specialized skills to advise farmers. Farmer knowledge and learning are important factors conditioning adoption of knowledge-based and management-intensive technologies such as fertilizer (Freeman and Coe, 2002; Barrett et al., 2002b). With many extension systems in Africa moribund and facing serious financial constraints, serious efforts need to be made to strengthen the technical capacity of private traders so that they can combine their increasing role in supplying fertilizer with provision of informal extension advice.

Key variables such as use of credit, transport ownership, and store ownership were predicted to be insignificant in traders' sales decisions. Although one would

expect these asset variables to be important, it is plausible that are relatively unimportant for the majority of retailers selling relatively small quantities of fertilizer, in the smallest units of measurement, on a seasonal basis in rural markets. These traders form the bulk of those entering fertilizer retail trade in Kenya in the post-liberalization era (Omamo and Mose, 2001; Wanzala et al., 2001). Thus, while there is an observed massive entry, these findings are consistent with other studies of market liberalization in Africa that point to massive entry but lingering difficulties in firm expansion (Beynon et al., 1992; Barrett, 1997; Badiane, 1998; Kherallah et al., 2000).

This paper estimated a predictive rather than a causal model of fertilizer traders' behavior under liberalized markets. This is an important limitation of the study because the statistical relationships implied do not explain traders' entry and sales decisions. A more rigorous specification is required to make causal interpretation of the factors that explain traders' entry and sales decisions. A second limitation of the study is that it focuses on fertilizer retail trade. The willingness and capacity of retailers to invest in fertilizer retail trade is influenced, in part, by reductions in marketing margins and increases in market efficiency at other levels in the sub-sector, particularly at the wholesale and import levels. There is evidence that substantial entry barriers persist at these levels (Argwings-Kodhek, 1996; Wanzala et al. 2001). Hence major opportunities for efficiency gains were not examined. Future empirical research that examines the constraints and incentives for private sector participation in fertilizer trade using a sub-sector framework might therefore, provide more useful policy insights.

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