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Distance to Market and Search Costs in an African Maize Market

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Abstract

Farm-gate buying by small itinerant buyers is the dominant mode of primary marketing in Tanzania's maize market. This paper estimates the effect of household distance to market on maize farm-gate prices, and the extent to which seasonally determined search costs can explain price variations between the lean and the harvest seasons using data from the most recent Tanzania Household Budget Survey (2007). The author observes that greater distance to market depresses farm-gate prices but that it is a relatively modest effect, and that this effect is pro-cyclical in that it is stronger during the harvest season when prices are lowest. The paper discusses the latter result with reference to search costs as an explanatory factor. It also briefly places the findings in the context of Tanzania's food security patterns, making a link between food insecurity and high search costs. The main policy conclusion is that coordinating mechanisms such as village market places (in parallel with farm-gate buying) may reduce transaction costs in rural markets.

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1.0 Introduction

Prior to the liberalization periods in the 1980s and 1990s, many African markets were run on a public monopsony basis, whereby procurement relied heavily on marketing through producer cooperatives and public buying networks. Direct producer to buyer relationships or marketplace transactions had not been fully developed. Post liberalization, these buying networks were dismantled and many producers found themselves geographically isolated and distant from markets. Farm-gate buying became one of the most prevalent marketing arrangements as private buyers quickly set-up buying networks in rural villages.

The liberalization of Tanzania's maize market took small farmers through a scenario very similar to the one described above. The cooperatives, which had been their main marketing channel, dissolved and itinerant buyers took their place. Since maize farmers' choice of marketing channel depends largely on the way that the market in which they operate is structured[2], farm-gate buying became the main marketing institution for a large proportion of maize growers, and today only a small proportion of Tanzania's maize growers sell their output at a marketplace. Maize growers retain a proportion of their annual output for household consumption[3]. The rest of their maize, the surplus, is sold mostly at the farm-gate to itinerant small maize buyers.

In this paper, we study the transaction costs of farm-gate buying. Using household level data from the most recent Tanzania Household Budget Survey (2007), we estimate the extent to which maize producers' distance to market (a measure of household remoteness or access to markets) affects farm-gate prices. We observe that greater distance to market depresses farm-gate prices but that it is a relatively modest effect, and that this effect is pro-cyclical in that it is stronger during the harvest season when prices are lowest. We discuss the role of search costs as a part of this framework.

We begin by describing maize traders and the farm-gate buying process in the first section. The second section presents our conceptual framework. It is followed by sections presenting the data used and a quantitative analysis using household budget survey data[4], before briefly concluding.

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[2] Proximity of markets, formal and informal rules governing buying and marketplaces and transaction costs such as search and transport all affect this choice.

[3] Field interviews with farmers and mills owners revealed that this maize is stored throughout the year, and milled into flour at the local "*posho*" mill at a high cost: approximately 15 to 30 percent of the value of the maize

[4] As a part of the research for this paper, field work was conducted in two major maize producing regions in Tanzania, namely Iringa (Southern) and Arusha (Northern) and in Dar es Salaam, the major urban trading centre for

2.0 Description of maize primary marketing

Maize traders can be broadly categorized under two main groups. The first group is the small itinerant traders that collect maize directly from the producers. They originate from and operate mostly at the village and ward levels. They are well known to the maize growers in the locality and have in some cases established a relationship of trust with producers through repeat transactions because they purchase and sell maize in the village all year round. The first transaction in the maize marketing chain takes place between the maize grower and these itinerant village-based traders. They perform the function of collecting maize and aggregating maize into larger consignments. Their business typically involves buying maize directly from the growers, aggregating their consignments and selling them either at the nearest urban market or at neighboring villages that have a maize deficit. They also act as buying agents for external buyers. They typically operate with low capital, no storage facilities and seek a quick return on their investments(less than one week). These traders tend to be based around the village centre or near the local marketplaces. They are also well informed about market prices, and manage their transactions to minimize price fluctuation risk.

The second group is medium to large maize traders that originate from outside of the village or ward. They buy maize from the markets and village-based traders in the lean season and directly from the producers at the farm-gate during the harvest season. They operate as wholesalers and handle relatively large quantities of maize and transact across regions and borders. These buyers collect maize from villages, rural towns and urban buying centers such as the markets in Iringa, Mebya and Arusha. They operate with more capital than village-based traders do. They benefit from some economies of scale in transport but like itinerant traders do not store maize for long durations either, usually for no longer than approximately one month (Santorum & Tibaijuka, 1992)[5].

Subsequent to the food market reforms of the late eighties, entry and exit in to domestic maize buying has been largely unregulated. Itinerant maize buyers in producing villages are not required

maize in Tanzania in March 2009. Maize producing villages, wholesale grain markets, retail markets and small maize mills were visited, and maize producers, traders, mill owners, market retailers, senior and technical local government officials were interviewed.

[5] The buyers and agents that work for the large vertically integrated maize processing and trading companies are included in this group.

to obtain a license or permit from any authority. Hence, the operational entry costs are fairly low. They operate informally, with few barriers to entry, allowing them to enter and exit the market flexibly throughout the year. They travel around the village on a bicycle, announcing prices and searching for households that have maize to sell. Typically, once the buyers have procured a sufficient quantity of maize, they return with a large vehicle such as a lorry to collect the purchased maize[6]. Many traders operate with little capital (from own savings), with no storage capacity or significant transport assets. This further facilitates entry and exit to the market.

The level of buyer activity in the maize market varies throughout the year. Buyer entry peaks during the harvest season when maize is abundantly available, and when many maize growers are ready to sell due to the erosion of their savings from the previous season. Non local traders from neighboring villages, regions and even from Dar es Salaam travel out to maize growing villages to collect maize grain. In contrast, the lean season sees a sharp reduction in buyer entry in the villages. Nonresident buyers tend to use regional markets and local buyers as agents during seasons of scarcity[7]. This means that the market share of local buyers in primary marketing is higher in the lean season, whereas non local buyers capture a significant market share in the harvest season. Despite the seasonal decline in the number of traders, overall demand for maize is high throughout the year. Buyers remain active in the procurement and trading of maize by revolving their working capital fairly quickly and by taking advantage of seasonal variations in prices so that trading activity tends to peak just before planting and during the harvest (World Bank, 2007).

3.0 Analytical framework

Although the role of itinerant traders is undoubtedly critical given the absence of other marketing outlets, empirical evidence, such as Fafchamps & Hill's (2004) analysis of farm-gate buying in Uganda's coffee market, shows that farm-gate buying is generally less remunerative for producers than selling at the marketplace. We anticipate a similar outcome for maize producers in Tanzania. We consider whether the prices received by growers who sell at the farm-gate fall as

[6] Maize is sold on the spot, ungraded and on a cash basis. In some instances the payment is deferred and the buyer pays the maize grower after he or she has sold the maize they collected. This mostly occurs when the buyer is well known to the seller.
[7] Fieldwork interviews.

the distance of the household to market increases. This is an approximate measure of household remoteness.

We expect the transaction costs associated with distance to market to be absorbed by the small maize producers because they are price takers in both harvest and lean seasons[8]. Village maize buyers (both local and non local) are also price takers that mostly operate locally[9]. They do not transact directly with consumers as they sell the maize they have collected to other traders or processors. They depend on the daily prices reported in regional markets and the central Dar es Salaam market to establish their buying prices[10]. Price determination in these reference markets is based mostly on national supply and demand conditions since maize tends to behave as a non-tradable good with the exception of some road or rail-linked transit markets (World Bank, 2000). Hence, the main avenue for a buyer to recover the costs they have incurred is to pass them on to the maize producers. Similarly, the most obvious way for a buyer to increase their trading profit margin is by pushing producer prices down as far as possible given the competitive environment and the rent opportunities.

We also consider whether the effect of distance to market is subject to seasonal variation and whether search costs have a role to play in explaining the variation. We expect search costs to be higher during the harvest season due to the seasonally differentiated pattern of buyer entry. Our previous brief description of the maize marketing system partially explained the reasoning behind this hypothesis. We described how non local maize buyers are more active in the harvest season as they enter the market directly to procure maize in villages, whereas in the lean season they would procure indirectly using marketplaces and buyer networks. Whilst the former is a more involved and time consuming process, the latter is more coordinated. The implication of this seasonally differentiated buying strategy is higher search related transaction costs in the harvest season[11]. Hence, we anticipate that costs will have a stronger negative effect on maize prices in the harvest season as household distance to market increases.

But what explains this pattern of buyer activity? Ideally, we would expect buyers to minimize all of their costs for any transaction, so that if procuring maize indirectly through village-based

[8] When interviewed, they reported that they have little room for negotiation with buyers and that they tended to readily accept the prices offered to them.
[9] 89 percent of rural traders operate within the confines of their ward or district (World Bank, 2007).
[10] Traders in regional markets reported that they refer to the wholesale markets in Dar es Salaam to establish trading prices when interviewed.
[11] The search costs of non local buyers are higher than those of the village-based buyers irrespective of season. Non local buyers travel longer distances to procure maize, have less information about areas in abundance and have less established networks at the village level.

buyers provides economies, it would be the strategy of choice irrespective of season. Under this set up, the village-based buyers would be the main procurers of maize throughout the year, and would have strong business networks with buyers across the country and with local markets. They would handle orders and prepare consignments to be sent to non-local buyers or to the local marketplaces. However this does not seem to be the prevalent arrangement, particularly in the harvest season. This is likely to be due to limitations in trust and networking between traders when large quantities of working capital are involved. Local village buyers have a small supply of working capital and so would normally need to be forwarded with the cash required to purchase maize on behalf of another buyer. The generally weak contract enforcement and legal context makes such largely trust based transactions more difficult in the harvest season when hefty sums are exchanged and large quantities of maize are bought and distributed within and outside of Tanzania. Loss of capital for a trader at this stage, which marks the start of the trading season, would be likely to put him out of action for most of the remaining season. Moreover, since the number of marketplaces remains largely constant all year round, marketplaces become very competitive when the number of buyers shoots up in the harvest season. In this situation, it is not surprising that most buyers opt to engage in direct farm-gate procurement despite the added search costs, especially since the unit costs of search are lower in the harvest season than in the lean season due to the sheer abundance of maize.

In sum, in this paper, we attempt to estimate the effect of household distance to market on maize farm-gate prices, and the extent to which seasonally determined search costs can explain price variations between the lean and the harvest seasons.

Definition of search costs

Before proceeding further with this paper, we must first define buyer search costs. We define them using a standard definition as the costs incurred by a buyer in locating a seller with whom he or she may complete a transaction (Bakos, 1997). This includes costs related to transport, information and maintaining market networks that a buyer incurs in finding a seller, in addition to the opportunity cost of the time spent searching for sellers. Several studies have noted that many components of search costs tend to be fixed (Renkow, Hallstrom & Karanja, 2004; Alene et al, 2008). Payments for transportation services constitute a large share of the marketing costs

between the farm-gate and wholesale markets[12]. Overall, these costs disproportionally add to total marketing costs at the first two segments of the supply chain, particularly the village to primary markets segment as indicated in table 1. Because of this, the itinerant buyer must minimize these and other costs by collecting as much maize as transport capacity allows. The risk of collecting too little maize after having incurred the costs of travelling to and around the village is significantly minimized in the harvest season when maize is more abundant than it would be in the lean season.

Table 1[13]: Marketing costs at various stage of the supply chain

Market segment	**Cost element**	**US$ per ton**
Farm-gate-primary market	Storage/rental fee	0.80
	Transportation charges	6.40
	Hired labor loading/unloading	1.92
	Council cess	1.60
	Sub total	**10.72**
Primary-secondary market	Storage/rental fee	1.20
	Transportation charges	27.00
	Hired labor loading/unloading	4.00
	Council cess	1.60
	Drying tent/empty bags	0.5
	Sub total	**34.30**
Secondary-wholesale market/miller	Storage/rental fee	0.11
	Transportation charges	41.40
	Hired labor loading/unloading	4.00
	Council cess	0.0
	Sub total	**45.51**
	Total	**90.53**

Search costs are extremely common in many markets. As consumers, most of us have experienced this phenomenon, for instance, when searching for the best price for a new computer online or on the high street. Anderson & Renault (1999) provide another informative example of how search costs function is given by: the tourist trap. Tourist areas are often dominated by low quality, high cost restaurants that offer relatively undifferentiated menus, but that nevertheless have full tables. Their good fortune is caused by the high search costs faced by the average tourist, who is unaware of the local alternatives and that values leisure time highly.

[12] This refers to transaction costs that are normally measured in surveys, which exclude, amongst others, costs related information, search and bargaining.

[13] Source: World Bank survey carried out in November-December 2008.

Search costs are closely related to information asymmetries and the bargaining process. The lack of information drives potential buyers or sellers to search for each other. Having found one another, the outcome of their subsequent bargaining is affected by the search costs. A buyer who has incurred high search costs in attempting to find an appropriate seller is likely to pay a higher price simply to avoid recommencing the costly search as long as the premium paid to the first seller does not exceed the cost of the search process itself. This is the intuitive result that underlies the outcomes of some of the important contributions to search theory that establish a link between search costs, competition and price dispersion, namely, that for homogenous goods, even modest buyer search costs can lead to monopoly pricing by sellers (Salop & Stiglitz, 1977; Stiglitz, 1989 and Diamond, 1971). Once monopoly prices are established throughout the market, buyers will no longer expect any value in searching, leading to a situation referred to as the Diamond Paradox: monopoly pricing without search. Most price dispersion models conclude that search costs reduce both consumer and social welfare and that lowering search costs for one buyer will have the positive externality of reducing prices for all buyers by stimulating competition.

Much of the literature relating to search costs is theoretical but some applied empirical studies exist, such as Vukina & Zheng's (2007) analysis of search costs and price dispersion in the US hog market. What most of this literature (theoretical or applied) has in common is that it refers to buyers who are price takers. Therefore, the buyer absorbs the search costs allowing for the possibility for sellers to engage in monopoly pricing. Some literature, such as Vakis, Sadoulet and de Janvry's (2003) study of Peruvian producers, considers search costs incurred by the sellers. This study demonstrates that households that sell in distant markets to attain better prices incur "not trivial" costs in searching for buyers. Almost two-thirds of the households in their survey that sold at distance markets found the buyer in advance by incurring some search costs. They also importantly note that:

> "...transaction costs have a large unobservable component, and hence their measure can only be indirectly revealed from the behavior of potential agents in these markets. In addition, with the exception of transaction costs attributes like distance to markets and transportation costs, aspects like market information or search and bargaining procedures are rarely included in most surveys and are unlikely to be comprehensive when included." *(Vakis et al, 2003, page 2).*

In the remaining sections of this paper, we will empirically test our hypotheses. This requires a measure of search costs from the perspective of the buyer for each transaction. As adeptly summarized in the quote above, this information is often missing, as is the case for our case study. To get around this constraint, the approach we adopt is to use a proxy, namely the distance of maize sellers to the marketplace. The further away a seller is from a market point where buyers and sellers congregate, the more difficult he or she is to find, causing buyers to incur higher search costs in transacting with them. Hence, the more remote a maize growing household is, the higher the search costs associated with their transactions and the lower the prices they receive for their maize.

The use of proxies to estimate search costs is common in the literature on this topic. In their study of small-scale farming households in South Africa Randela, Alemu & Groenewald (2008) use distance to markets as a proxy for search costs (amongst other variables) to identify factors that determine the extent of commercialization or market participation. Kuksov (2002) considers online marketplaces and the share of online sales as proxies for buyer and seller search costs and Benjamin & Lusht (1993) proxy the search costs associated with finding a rental apartment using the characteristics of the managing agent (e.g. whether they have a well-located rental office). Most studies (including this one) use proxies because of the dearth of data measuring specific transaction costs. Household budget surveys and agricultural censuses in particular do not tend to include a module directly measuring transaction costs, possibly because the large amount of detail that this would entail could make the survey unwieldy.

Given such data constraints, we have selected distance to market as a proxy for search cost because of its relevance to the marketing structure of Tanzania's maize market. The procurement of maize is a largely physical exercise that requires buyers to travel around villages visiting households, literally knocking on doors. The buyers travel mostly by bicycle (or sometimes on foot accompanied by a donkey), and some announce their arrival using a megaphone.

Using this proxy, the estimation challenge is to separate between straightforward marketing transaction costs, which are largely transport costs, and the costs relating to the search activity including search related transport. To do this, it helps to consider buyer transaction costs in two segments. The first is cross-country transport costs to the district or rural area where maize is produced. This segment represents the bulk of the buyer's marketing costs as shown in *table 1*. Here, we expect search costs to be negligible as information about maize producing areas is

widely dispersed in the market. Having arrived at the location, identifying maize selling households necessitates distinguishing and locating households that are ready to sell from those that have already sold their maize, and those that have chosen to postpone selling. Hence, we consider buyer search costs to be concentrated in this latter segment. The costs of this search process will be directly associated with the proximity of the household from the local market. Therefore, by using distance to markets as a proxy for search costs, we are making the assumption that all of the costs associated with the second segment are related to search.

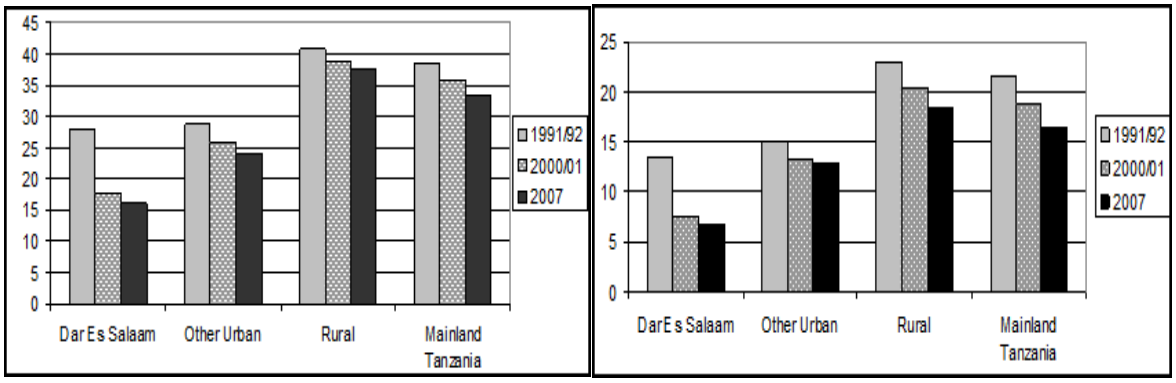
The benefit of this approach is that it allows us to use Household Budget Survey data in measuring the effects of search costs on producer prices. Given the general standardization of such surveys, this approach may facilitate comparative analyses of estimated search costs in cross sectional and longitudinal analyses.

4.0 The data

Our empirical analysis is based on the Tanzania Household Budget Survey (HBS) of 2007. The most recent round of the National Bureau of Statistic's HBSs was undertaken in 2007. It collected information on a wide range of household and individual characteristics. They include consumption (income) poverty and trends in productive and social sector indicators. The particular content that is of interest to us relates to maize growing households and variables such as maize prices, distance to markets and household characteristics.

One of the main findings of the 2007 HBS is that rate of poverty reduction in Tanzania has been modest. Figures 1 and 2 show the development in the food and basic needs poverty incidence from the 1991/92 HBS, 2000/01 HBS and 2007 HBS.

Figures 1 and 2[14]



Progress was made in reducing food and basic needs poverty in Dar es Salaam from 1991 to 2000, which slowed down from 2001 to 2007. The fact that the population of Dar es Salaam grew significantly from 2001 to 2007 may have dampened progress if the city population had grown due to rural-urban migration of the poor. But reduction of the rural poverty ratio between 2001 and 2007 has also been slow: 37.4 percent of the rural population lived below the basic needs poverty line in 2007 compared to 38.7 percent in 2001 and 40.8 percent in 1991. This modest reduction in the poverty ratio recorded by the HBS has, however, not been able to compensate for population growth (of about 2.6 percent per year). As a result, the absolute number of people living in poverty in Tanzania increased by one million between 2001 and 2007, despite the reduction in the overall proportion of the poor.

Many of these poor households rely mostly on agriculture, particularly maize, where relative prices have been deteriorating. The price of maize has declined relative to the prices of other basic foods such as sugar and cooking oil. In 2000/01, 5.8kg of maize had to be sold to obtain 1 kg of sugar, and this had increased to 6.0kg in 2007. Expressed in maize, the price of a liter of cooking oil increased from 8.7 kg in 2000/01 to 8.8 in 2007. The deterioration was more notable for rice as shown in table 2.

Table 2: Price of processed products relative to price of locally produced products

	Maize grain		Rice (paddy)	
	2001	**2007**	**2001**	**2007**
Sugar	5.8	6.0	3.5	4.0
Cooking oil	8.7	8.8	5.2	5.8
Maize flour	2.0	2.0	1.2	1.3

Source: Poverty monitoring group, 2008.

[14] Source: Poverty monitoring group, 2008.

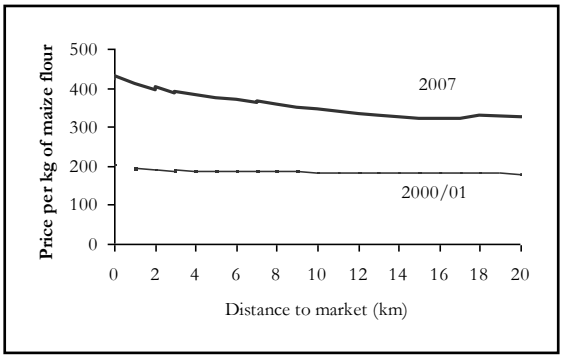
Using HBS data presents some challenges, the main one being the absence of data or responses that match exactly with the hypotheses we made in this paper. For instance, the HBS does not collect information related to transaction and search costs. Moreover, the data set that is available to us is a household data set, and does not include any information about local assets and conditions. This will require us to use proxies in some instances without sacrificing the robustness of the analysis and the precision of the results.

5.0 The analysis

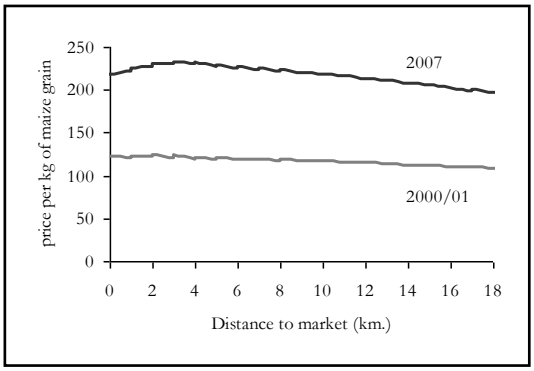
The 2007 HBS indicates that distances to the markets have been increasingly affecting rural prices. Figures 3 and 4 below show that in 2000/ 01 maize prices remained constant as household distance to markets increased. But by 2007, the price of maize had become more responsive to distances decreasing the further the households were from the market. This implies that maize growing households that live further away from markets have become more vulnerable. It may also partly explain why the HBS recorded a decline in rural consumption by the bottom ten percent of the rural population.

Figures 3 and 4: Farm gate price of maize and distance to market

Maize flour



Maize grain



Source: Poverty monitoring group, 2008.

Additionally, figure 5 below shows that being further away from the marketplace is associated with lower maize prices. It charts maize prices by distance to markets and shows that the further the household is from the market, the lower the farm-gate price. This suggests that a significant share of the difference between farm-gate prices in a given period and area for a homogenous good such as maize (henceforth referred to as price dispersion) can be accounted for by the distance of the household to the local marketplace. Additionally, figure 6 presents the coefficient of variation (a measure of price dispersion being the ratio of the standard deviation to the mean) by distance to market quartiles and by season. It shows that price dispersion increases with distance from the marketplace. So households that are further away from the market experience larger price fluctuations than those near to the market in both the harvest and lean seasons. It also shows that price dispersion is lower during the harvest season irrespective of distance to market.

Figure 5

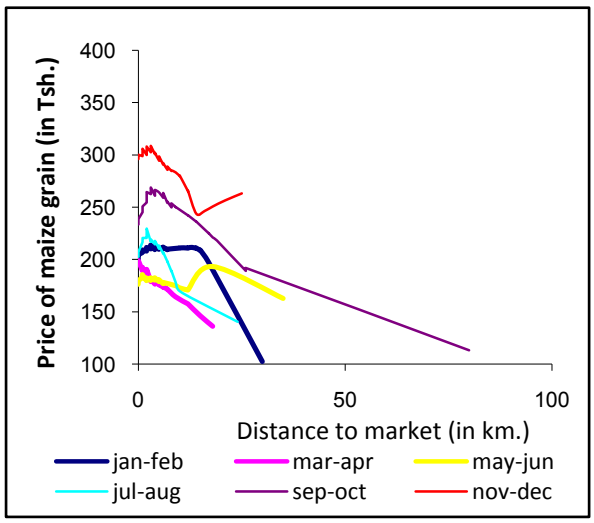
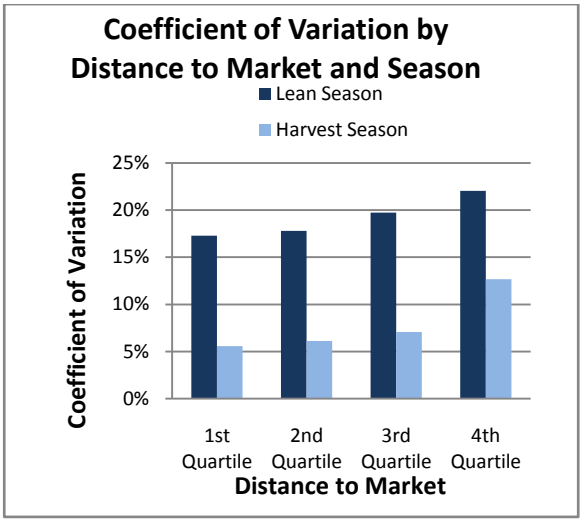


Figure 6



Source: Author's computation using Tanzania Household Budget Survey 2007

To further explore the role of search costs and distances to markets and test our first hypothesis, we test a model of the determinants of maize prices using OLS regression. We commence with a simple univariate model:

$$p_i = \alpha DM_i + \mu_i \quad (1)$$

where p_i is the maize price and DM_i is a variable indicating the distance of the household from the nearest market in kilometres.

Our results are presented in the first column of table 3. They show that maize prices fall as the households' distance to market. However, we cannot take these preliminary results at face value since we need to take a range of other variables into account in order to be able to control for variables that may affect our dependent variable, and to attain more robust results in general. To do this, we use model (2), a model that estimates the effects of distance to market on maize prices while controlling for other factors that may influence cash income:

$$logp_i = \alpha logDM_i + \sum \delta X_i + \sum \delta Y_i + \mu_i \quad (2)$$

where X_i is a vector of household assets that are likely to influence maize prices. These are dummy variables that indicate whether the household owns a radio, telephone, bicycle, motorcycle or car. We include radios and telephones in the list of assets because they represent the maize farmers' access to information about prices, information that is likely to be used to decide when and where to sell all or some of their maize, particularly for producers who engage in speculation. The remaining assets are related to the households' transport capacity. They reflect the capacity of maize farmers to move with their produce in search of better prices by, for instance, transporting their maize to the market. Y_i is a vector of control variables composed of a set of household characteristics (age, gender and literacy of the household head and household size). It also includes controls for region and a dummy for seasonality that distinguishes between harvest and lean seasons. In addition, we include the average monthly maize price in Dar es Salaam with the control variables to account for the effects of national supply, demand and price conditions[15]. We use $logp_i$ and $logDM_i$ as we do not expect the relationship between prices and distance to market to be linear: there may be a large price difference going from 1 to 10 km, but less of a difference between 400 to 410km.

[15] VIF test results do not show a multicolinearity problem

Here again, the results (presented in the second column of table 3) show a significant and inverse relationship between distance to market and maize prices. Maize prices received by farmers fall as the distance between their household and the nearest marketplace increases[16].

Although significant, the measured effect of distance to markets is relatively small. The largest measured effect on maize prices comes from our season dummies, indicating the important role of seasonality on maize prices. There is also a statistically significant relationship between average monthly price of maize in Dar es Salaam and maize prices realized by households at the village level. In addition, household size is significant and positive, indicating that larger households receive higher prices. This may be because households with more family members have more individuals that can market produce in markets where prices are higher.

[16] Using the household's distance to all-season passable roads in model (2) in lieu of distance to markets as a proxy does not yield a significant result. This is likely to be because this variable is only a partial measure of the households' geographical position in relation to traders.

Table 3: Determinants of producer maize prices											
Model #		**1**		**2**		**3**		**4**		**5**	
		Without Controls		**With Controls**		**Interaction Variable**		**Southern Region**		**Northern Regions**	
Variable		**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
Distance to market		-0.802***	0.221577	-0.01***	0.0019228	-0.0045**	0.002063	-0.0118***	0.003157	-0.002887	0.004594
Age of household head				-0.0000164	0.0000964	-0.000015	0.000095	0.0000884	0.00016	0.000135	0.000216
Household size				-0.0013**	0.0005427	-0.0013**	0.000538	-0.003***	0.000863	-0.002338	0.001482
Season	Harvest			0.0911***	0.003766	0.083***	0.003919	0.0935***	0.006689	0.091***	0.008661
Gender of household head dummy	Female			0.001814	0.0036517	0.002374	0.003620	-0.0025958	0.006275	0.002918	0.008279
Literacy Dummy	Literate			-0.0024653	0.0034142	-0.002183	0.003384	-0.0069641	0.005741	0.005459	0.008254
Owns radio	Yes			0.0028993	0.0033103	0.003185	0.003281	0.0104825	0.005516	-0.001781	0.007837
Owns phone	Yes			-0.0668***	0.0215497	-0.063***	0.021369	-0.1009**	0.039242	-0.020726	0.032404
Owns bicycle	Yes			0.0019621	0.0032789	0.001766	0.003250	0.0000057	0.005483	0.000915	0.007617
Owns motorcycle	Yes			-0.0019652	0.0125435	-0.002208	0.012434	-0.0137555	0.020738	0.007946	0.023388
Owns car	Yes			0.0190001	0.0236407	0.017455	0.023436	0.0136565	0.045591	-0.000946	0.041448
Price of maize in Dar es Salaam				0.7349***	0.006605	0.734***	0.006548	0.735***	0.010858	0.753***	0.015299
Region		(Included but results not presented: significant at 1%)									
Interaction variable: distance to market * season						-0.007***	0.001053	-0.0029***	0.001953	-0.011***	0.001987
Constant		223.87***	1.098909	1.513***	0.0360621	1.512***	0.035748	1.513***	0.05885	1.417***	0.081869
No. of observations		2750		2750		2750		1134		450	
R - squared		0.0047		0.8348		0.8377		0.8194		0.8664	
Adjusted R - squared		0.0044		0.833		0.8359		0.8163		0.8618	

We now consider whether distance to market affects maize prices differently by season in order to test our second hypothesis: whether search costs are higher in the harvest season. As described previously, market conditions change significantly between the harvest and the lean seasons. The number of players (both buyers and sellers) declines during the lean season as the number of transactions falls. It is plausible that because of this, search costs will vary by season, giving a temporal dimension to market distances. To do this, we use an interaction variable to test the following model:

$$logp_i = \alpha logDM_i + \sum \beta X_i + \sum \delta Y_i + \gamma DMM + \mu_i \quad (3)$$

where DMM is an interaction variable between season and distance to market[17]. With this addition, we find that search costs are higher in the harvest season than in the lean season. This confirms our second hypothesis: that after controlling for the effects of seasonality, prices will dip lower for a given distance to market in the harvest season than in the lean season.

The robustness of this result could be affected if our season variable does not fully control for the effect of seasonality. In this case, the seasonal effect shown above might have been captured in the coefficient of the interaction variable, and may be influencing the results described above. The difficulty in adequately controlling for seasonality lies in the fact that regional variations exist in the timings of the maize harvest season. For instance, the harvest season in southern regions is concentrated around the months of July and August whilst northern regions such as Arusha and Kilimanjaro have an additional harvest season between November and December each year (RATES, 2003).

To tackle this, we apply model (3) individually to southern and northern regions using the relevant periods in defining the season variable. The results of this exercise presented in the last two columns of table 3 below confirm our previous results. Search costs are higher in the harvest season in both Southern and Northern regions.

This finding is informative of the adequacy of our proxy as an estimate for search costs. Although it is reasonable to expect that greater distance to market may be associated with lower farm-gate prices, it is less clear why this effect would be stronger in the harvest season unless there is an underlying explanatory factor. One such potential factor is seasonality in transport

[17] We have mean centred the distance to markets variable in the interaction to facilitate interpretation.

costs. However, empirical studies and surveys of transport costs in Africa have shown that costs are inversely proportional to load size: the cost of transporting a unit of maize is lower the bigger the load (World Bank, 2007; Teravaninthorn and Raballand, 2009). Since large loads are easier to coordinate during the harvest season, the cost of transport per ton maize is minimized. So, standard transport costs are unlikely to be the explanation, indicating a role for search costs in explaining these findings through the channels discussed in the analytical framework.

Other explanations and the strength of the proxy variable

One of the challenges of using proxy indicators is the identification problem. Using distance to market as a proxy for search costs opens the possibility that our identifying variable measures factors other than search costs. If this is the case, then it would be difficult to attribute the results we describe in this paper to the effects of search and information costs associated with farm-gate buying. The question is whether there are other reasons besides buyer search costs and seller information costs that would cause the prices received by households that are distant from the market to be lower than those nearer the market. We identify two such factors.

The first is competition. On average, rural trading businesses face competition from only five other businesses, providing each one with a relatively high market share (World Bank, 2007). In this context, maize growing households that are distant from the market may be reached by fewer buyers, creating an opportunity for monopsony rents that push producer prices down as the distance from market increases. In addition, since remote households tend to be more vulnerable, their bargaining power will be further diminished. This will be the case if buyers tend to concentrate around the village and market centers and avoid covering long distances in search of maize.

Nonetheless, this effect is unlikely to be present. In this scenario, we would expect monopsonistic market power at the village level to be most concentrated during the lean season when buyers are already relatively scarce. So we would expect remote households to experience a significant downward pressure on maize prices at that time. However, our results show the opposite effect, namely that maize prices decrease more with distance during the harvest, not the lean season. This leads us to conclude that weak competition and monopsony rents do not comprise an underlying and undetected factor influencing our results. It also corroborates the

findings from our interviews with maize growing households, who reported that they do not generally have a difficulty in finding a buyer for their maize when they are ready to market it.

The second factor is volume. Remote households also tend to be more vulnerable and resource poor, particularly since they have limited access to infrastructure and social and economic facilities. If these households are also less productive, they may be making smaller volume transactions when it comes to selling their maize. In addition, small transactions are less attractive to buyers and may attract lower prices.

To explore this potential effect, we examine the farm size of households in relation to their distance from market in table 5 below. We use farm sizes as an indicator of the volumes of maize produced by farmers[18]. Table 4 shows that relatively remote households do not tend to have smaller farm sizes than households located nearer to the marketplace. For instance, in the southern Iringa and central Dodoma regions, households in the middle tercile tend to have the largest farms whilst in the northern Arusha region, farm sizes tend to be similar irrespective of distance to market. This leads us to discount the possibility that small volume sales are another casual factor that has not been accounted for.

Besides competition and volume, other factors such as the quality of maize are unlikely to play a relevant role here. Production related quality issues can be significant but are likely to affect households irrespective of their distance to market. Storage related quality issues are also important, particularly since only four percent of maize growing households make use of effective storage facilities. On the whole, households do not tend to have adequate storage amenities and post-harvest losses can be large. Of the maize growing households that do store maize, only two percent do so to sell it later in the season[19]. Their main reason for storing maize is for household consumption.

Table 4: Household farm size by distance to market (terciles)

	Iringa	Arusha	Dodoma
Lowest	3.1	2.8	4.9
Middle	6.9	2.6	7.1
Highest	4.0	2.7	6.1

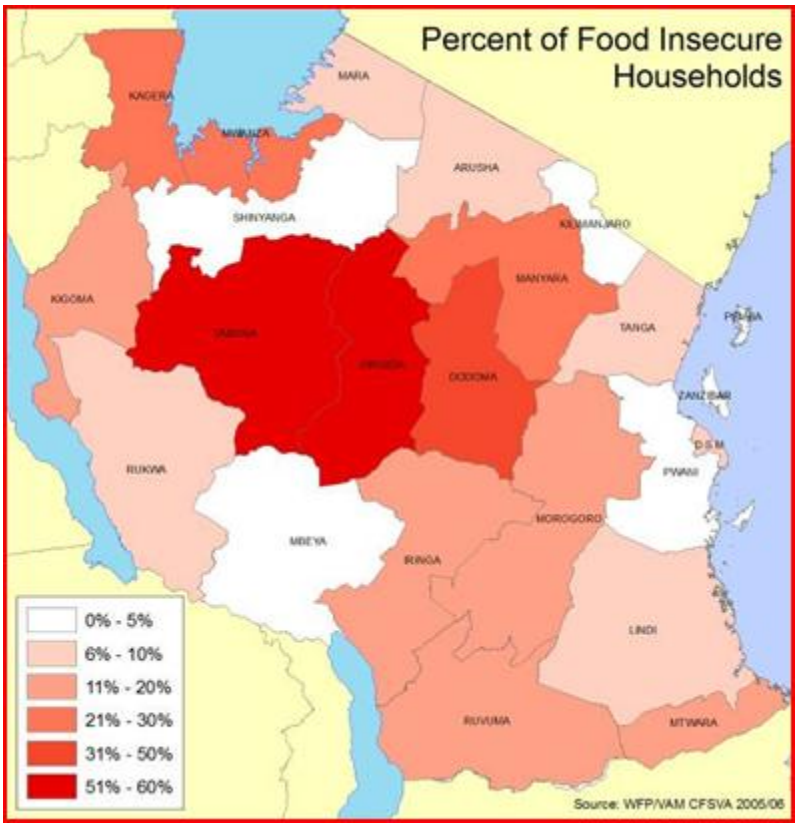
Source: Author's calculations from HBS 2007.

[18] Data of the quantity of maize produced by household was not available.
[19] Tanzania Sample Census of Agriculture 2002/03.

Distance to markets, search costs and food security

The most recent food security assessment of Tanzania conducted by the World Food Program in 2005/06 indicates that the areas with the highest food insecurity are in the centre of the country (figure 7). The assessment shows that both of the most food insecure regions, Tabora and Singida, (in which over 50 percent of households are labeled as food insecure) are slightly more reliant on purchasing food than on their own production (50-75 percent purchased food, less than 50 percent consumed from own production). High prices could potentially be responsible for this, but maize prices in Tabora and Singida were not in the highest two price quintiles in the period under review. Therefore, while maize prices may not be as high as in other regions, people in these central areas are unable to provide adequately for themselves (WFP, 2007).

Figure 7[20]: Household food insecurity map



[20] Source: WFP 2007.

Search and information costs might provide part of the explanation for this. Distances to markets are highest for households in central areas, particularly Tabora, Singida and Manyara (table 5), suggesting a link between search costs and food insecurity. Food markets in maize producing villages are scarce, particularly in the central producing areas. Many villages do not have a marketplace or retail point where maize is sold in small quantities for household consumption. Since almost all the households produce maize, demand for purchased maize is low around the harvest season. When household maize stocks are depleted in the lean season, maize is purchased from neighbors that have remaining stocks or from village-based buyers. As the year progresses, sourcing maize becomes more difficult and risky. Maize prices also hit their peak during this time of the year. Door-to-door buying of small quantities of maize from neighbors who are also concerned about their own household's food security is not an efficient way of procuring maize. It increases the buyers' search costs, limits their information about market conditions and prices, and reduces their bargaining power.

Table 5: Distance to market by region

Region	Description	Mean	Std. Err.
Mtwara	Southern	0.21	0.037
Ruvuma	Southern	0.49	0.075
Lindi	Southern	0.67	0.115
Iringa	Southern	1.54	0.247
Mara	Northern	1.69	0.153
Morogoro	Southern	1.96	0.233
Mbeya	Southern	1.99	0.186
Kilimanjaro	Northern	2.10	0.183
Mwanza	Northern	2.82	0.326
Pwani	Coastal	3.14	0.378
Rukwa	Southern	3.19	0.379
Dodoma	Central	3.69	0.323
Arusha	Northern	4.66	0.638

Tanga	Coastal	5.05	0.385
Shinyanga	Central	5.70	0.364
Singida	Central	6.27	0.432
Manyara	Central	6.87	0.531
Tabora	Central	8.37	0.754

Source: Author's calculations using HBS 2007 data.

An important route out of poverty for maize growers is the option of applying the available factors of production to an activity other than producing maize[21]. With her land, labor, capital and knowledge, a maize grower may choose to grow an alternative high value crop such as sunflowers or other horticultural produce. The decision to do so would entail a shift for the household from producing their staple food to purchasing it. However, in the absence of a secure mechanism for purchasing food within the village, the risk of facing food insecurity may exceed the premium that could be attained from switching to higher value crops. The farmer is effectively locked in a cycle of food production for subsistence that prevents their entry into more profitable markets.

6.0 Concluding remarks

In the post reform period, farm-gate buying has emerged as the most prevalent mechanism for marketing maize in many regions of Tanzania. In this paper, we estimate the transaction costs associated with farm-gate buying, specifically search and information costs, using a measure of household remoteness (distance to market) as a proxy. We showed that the dispersion of maize producers and the farm-gate buying system make transaction costs such as search and village to town transport particularly widen the price gap, causing a downwards pressure on producer prices. We also showed that since non local buyers with limited information about the local market enter and search for maize more actively when maize is abundant, buyer search costs incurred are likely to be higher in the harvest season than in the lean season.

[21] Maize is an annual crop. Unlike perennial crops such as cashew, coffee or banana, the decision to plant maize must be newly made each year.

As is necessary when estimation parameters rely on proxy measures, we also discussed potential factors other than search costs that might explain our results to conclude that the likelihood if a major identification problem is low. Going forward, more direct measures of transaction costs related to sequential search patterns, as in the case of Tanzania's maize market, would be informative of the causes of price dispersion in an otherwise homogenous market.

We conclude that reducing search costs is may be important for reducing transaction costs affecting remote maize producers. Establishing market places in rural villages (in parallel with farm-gate buying) is an intervention that may go a long way towards overcoming many of these constraints. It would reduce search costs for a large proportion of buyers, increase price information for producers and create a reliable retail market for food in the village. This is particularly important for rural districts with a high proportion of food producers and villages that are distant from the roads network and the ward centre. The central maize producing regions fit this profile.

Having said this, it is important to note that rural market places are not a panacea. Opportunities for rent seeking abound therein, including local government taxes and market operations by traders to gain control and market shares. Therefore, a purely market based selling system for maize might not necessarily lead to a better outcome for small farmers. It may be that a combination of well governed market places in parallel with farm-gate buying would increase the access of maize farmers to competitive markets with low transaction costs.

Annex I **Summary statistics**

Variable	Mean	Std. Dev.	Min	Max
Household size	5.0	2.94	1	32
Age of head of household	46	15.62	20	97
Distance to market (km)	3.35	5.14	0	35
Dar es salaam maize price (Tsh)	197.2	52.02	151.25	305.54
Male head of household	77%	0.01		
Literate head of household	66%	0.01		
Owns radio	63%	0.01		
Owns phone	0.4%	0.00		
Owns car	0.3%	0.00		
Owns motorcycle	1.2%	0.00		
Owns bicycle	47%	0.01		

Annex II Coefficient of correlation table

	Season	Region	Gender	Age of household head	Literacy of household head	Household size	Distance to market	Radio	Phone	Car	Motorcycle	Bicycle	Dar es Salaam maize price
Season	1												
Region	0.0042	1											
Gender	0.0197	-0.0495	1										
Age of household head	-0.013	-0.0241	0.1416	1									
Literacy of household head	-0.0132	-0.0243	-0.2733	-0.2909	1								
Household size	-0.0271	0.191	-0.1798	0.0469	0.049	1							
Distance to market	0.0095	0.0986	-0.0279	0.0053	-0.1735	0.1819	1						
Radio	-0.0172	-0.0028	-0.2461	-0.1477	0.298	0.1573	-0.0748	1					
Phone	-0.0299	-0.0261	0.0113	-0.0199	0.0377	-0.0006	-0.0085	0.0513	1				
Car	0.005	-0.0064	0.0089	0.024	0.018	0.055	-0.0221	0.0449	0.0842	1			
Motorcycle	0.0064	0.0033	-0.0195	-0.0296	0.0373	0.0404	-0.0249	0.0679	-0.0075	0.0982	1		
Bicycle	-0.0213	0.2189	-0.2801	-0.1315	0.1718	0.2978	0.0335	0.3441	-0.001	0.0036	-0.0083	1	
Dar es Salaam maize price	-0.3487	0.0004	0.0243	-0.0059	0.0018	-0.0043	0.0153	0.0303	0.0319	0.0015	0.0102	-0.0024	1

References

1. Alene A. D., Manyong V.M. , Omanya G., Mignouna H.D., Bokanga M. & Odhiambo G. (2008). 'Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya'. *Food Policy* 33, 318–328
2. Anderson, S. & Renault, R. (1999) 'Pricing, Product Diversity, and Search Costs: A Bertrand-Chamberlin-Diamond Model'. *RAND Journal of Economics*. The RAND Corporation, vol. 30(4), pages 719-735.
3. Andrianarison, F. (2010) 'Getting Prices Right: Mobile Phone Diffusion, Market Efficiency and Inequality'. *Paper presented at the CSAE Conference 2010 Economic Development in Africa*, 21st - 23rd March 2010 Oxford.
4. Bakos, Y. (1997) 'Reducing Buyer Search Costs: Implications for Electronic Marketplaces'. *Management Science*, Volume 43, Number 12.
5. Benjamin, J. D. And Lusht K.M. (1993). 'Search Costs and Apartment Rents'. *Journal of Real Estate Finance and Economics* 6:189-197.
6. Diamond, P. (1985). 'Search Theory' *Massachusetts Institute of Technology (MIT), Department of Economics working papers* 389.
7. Fafchamps, M. and Hill, R. (2005). 'Selling at the Farm-Gate or Travelling to Market'. *American Journal of Agricultural Economics*, 87(3): 717-34.
8. Kuksov D. (2002). 'Buyer Search Costs and Endogenous Product Design'. *Draft Paper University of California*, Berkeley.
9. NBS (2008) 'Household Budget Survey 2007 Analytical Report', *http://www.nbs.go.tz/HBS/Main_Report2007.html.*
10. NBS (2006). 'National Sample Census of Agriculture 2002/03 – Volume II Crop Sector'.
11. Randela, R.; Alemu Z. G. & Groenewald J. A. (2008). 'Factors enhancing market participation by small-scale cotton farmers' *Agrekon*, Vol 47, No 4.
12. RATES - Centre for Regional Agricultural Trade Expansion Support (2003). 'Maize Market Assessment and Baseline Study for Tanzania'.
13. RATIN - Regional Agricultural Trade Intelligence Network (2005). 'Food Trade Bulletin for East Africa', 1st September, Issue 26: *www.fews.net/docs/Publications/1000789.pdf*
14. Renkow, M.; Hallstrom D. G. & Karanja D. D. (2004) 'Rural infrastructure, transactions costs and market participation in Kenya'. *Journal of Development Economics 73,* 349– 367.
15. Rheingold, H. (2005) 'Farmers, Phones and Markets : Mobile Technology in Rural development'. Retrieved May 27, 2009 from

http://www.thefeaturearchives.com/topic/Technology/Farmers__Phones_and_Markets__Mobile_Technology_In_Rural_Development.html.

16. Salop, S. and Stiglitz, J. (1977). 'Bargains and ripoffs: a model of monopolistically competitive price dispersion'. *Review of Economic Studies*, 493-510.
17. Santorum, A. and Tibaijuka, A. (1991) 'Trading responses to food market liberalization in Tanzania'. *Edited version of a paper presented at a workshop on 'Market Liberalization and Private Sector Response in Eastern and Southern Africa'*, Harare, Zimbabwe, 2-4 October 1991.
18. Stiglitz, J. (1989). 'Imperfect information in the product market' in *Handbook of Industrial Organisation*, R. Schmalensee and R.D. Willig (editors). North Holland, New York. pp. 769 - 847
19. Teravaninthorn, S. and G. Raballand (2009). '*Transport Prices and Costs in Africa: A Review of the Main Trade Corridors.*' Washington, D.C.: The World Bank.
20. Vakis, R., Sadoulet, E. and de Janvry, A. (2003). 'Measuring Transactions Costs from Observed Behavior: Market Choices in Peru'. *Department of Agricultural & Resource Economics, UC Berkeley, Working Paper Series* # 962.
21. Vukina, T. & Zheng, X. (2007) 'Can Bargaining Theory Explain the Price Dispersion Puzzle? Evidence from an Agricultural Market'. Department of Agricultural and Resource Economics *North Carolina State University working paper.*
22. World Bank. (2000). 'Agriculture in Tanzania since 1986: follower or leader of growth'. *A World Bank country study*. World Bank, Washington D.C.
23. World Bank. (2007) 'Tanzania Pilot Rural Investment Climate Assessment'. Sustainable Development Network Report No. 40108-TZ.
24. World Bank. (2008). 'Eastern Africa - A Study of Regional Maize Market and Marketing Costs'. Agriculture and Rural Development Unit (AFTAR).
25. World Food Program. (2007). 'Tanzania Comprehensive Food Security and Vulnerability Assessment'. *http://documents.wfp.org/stellent/groups/public/documents/ena/wfp103646.pdf*