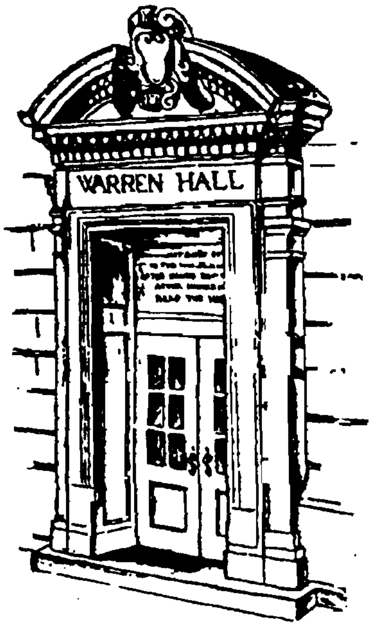

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Staff Paper

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The Effect of Distance and Road Quality

on Food Prices, Marketing Margins, and Traders' Wages:

Evidence from Zaire

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and
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ABSTRACT

Major investments in infrastructure rehabilitation have been undertaken by governments, development banks and donors in developing countries in recent decades. In Sub-Saharan Africa road deterioration is perceived to be one of the main causes for the limited supply response after price liberalization in agricultural markets. Studies of the quantitative effects on marketing margins are rare. This analysis shows that the wholesale - producer food price margin is strongly influenced by the quality of the road infrastructure. Evidence from Zaire shows that food prices decrease faster than transportation costs increase and that traders' wages are higher on bad roads. A trader's model incorporating uncertainty in input costs is used to explain this phenomenon.

I. INTRODUCTION

Producer-wholesale margins in Sub-Saharan countries are large compared to other continents[1]. These high margins in Africa affect the cost of food, reduce the area in which it is marketed and favor the use of imported food. Two major factors determine the producer - wholesale margin: transportation costs and transaction costs. Recent research has shown that long distance road transport in three African countries was about five times as expensive as in Pakistan (Hine, Rizet, 1991; Bonnafour, 1993). Poor road infrastructure increases transportation costs, but this is not the only factor. The institutions through which the food collection is organized also generate costs, i.e. transaction costs. In a recent study Binswanger et al. (1993) conclude that "the major effect of roads is not via their impact on private agricultural investment but rather on marketing opportunities and reduced transaction costs of all sorts" (p. 364). Worsening of infrastructure decreases the velocity of diffusion of price information, with a negative impact on price integration. Hence, given that information flows are the key to transaction costs, these costs are also expected to be affected by deterioration or improvement of infrastructure.

Previous research on the impact of marketing infrastructure on agriculture concludes that road quality has a positive effect on market integration (Goletti, 1994), increases the use of fertilizer (Ahmed, Hossain, 1990), and enhances agricultural output with an elasticity of about 0.20 (Binswanger et al., 1993). Using intercountry comparisons, Antle (1983) shows that

[1] Ahmed and Rustagi (1983) measure price spreads in food grain markets in five African and four Asian countries and they find that the ratio of the average producer prices to consumer prices ranges from 30 to 60 percent in African countries compared to 75 to 90 percent in Asia.

about 0.20 (Binswanger et al., 1993). Using intercountry comparisons, Antle (1983) shows that transport and communication infrastructure is an important constraint on agricultural productivity in developing countries. Goetz (1992) and de Janvry et al. (1991, 1992) argue that due to transaction costs a household specific price band exists for the same commodity between the effective price received for items sold and the effective price paid for a purchased item. The poorer the infrastructure, the greater the size of the band. Gersovitz (1989, 1992) shows how agricultural policy, i.e. panterritorial pricing, affects transport investment strategies and illustrates how an integrated analysis of tax and price policy would be necessary to assure optimal government policies.

In this paper, food price behavior from the producer to the wholesale level is studied. First, the determinants of the magnitude of the transport cost margin and the producer share is studied. Second, we look to see if (and to what extent) transport costs are transmitted to the producer in a liberalized environment. The incidence of transport costs determines how the benefits (costs) of a transport improvement (worsening) are shared between the producer and other economic agents, i.e. transporters, middlemen, and consumers. Third, transaction costs are analyzed as determinants of remuneration for the transaction costs caused by search, gathering, monitoring, bargaining, etc., of the itinerant traders, who buy the bulk of agricultural products in rural areas.

The structure of the paper is as follows. First, the food gathering and transportation system in Zaire is described. Section three deals with theoretical considerations. The next section discusses data and methodology. Section five discusses the empirical results while the paper followed by conclusions.

II. DESCRIPTION OF THE FOOD GATHERING AND TRANSPORTATION SYSTEM

A. Infrastructure

With its vast area of 2.3 million km^2, Zaire's road network is 145,000 km in length of which the rural network constitutes 104,000 km. In addition to the road network, Zaire has 16,000 km of navigable rivers. Most of the road network is in bad condition, with important sections almost impassable and access to some interior areas severely curtailed. Rural roads are maintained by local authorities who have neither the resources nor the organizational capacity to carry out the task. Depending on the product, transport costs make up one quarter to one third of the wholesale price of domestic products. The poor condition of rural roads has been blamed for this transportation cost and for the lack of competitiveness of domestic food supply compared to food imports (World Bank, 1988; Shapiro, Tollens, 1992). Despite enormous possibilities, food transport by river is less important than by road. The Department of Public Works estimated in 1984 that 61 percent of the food supply for Kinshasa arrived by road, 36 percent by river and 3 percent by railway. Figure 1 shows the main food supply channels to Kinshasa.

B. Marketing System

The gathering and transportation of local food products is in the hands of different types of traders: a. small itinerant traders[2], sometimes producers, without own means of transport (called "par-colis";) b. transporters with own means of transport (their own or rented); c. formal firms with regional offices and stores which sell consumer goods; the owners are often of Portuguese nationality; d. Non governmental organizations which sell products in stores in Kinshasa outside the typical markets; e. agro-businesses, which buy agricultural products for their employees or as inputs for their production process; f. parastatals or the government (especially the army) which buys food for their employees. Although no data are available on the significance of these different channels, it is commonly accepted that, except for maize or rice, most trade is in the hands of the small itinerant traders and that their importance has grown over time, especially since the zairianization process began in recent years (Goossens et al., 1994). The importance of the itinerant trader is also explained by the dominance of small farmers in rural areas[3], whose demand for marketing services is most easily met by small traders. A profile of these itinerant traders is given in Tables 1 and 2.

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[2] Itinerant traders are defined as traders who rent space on a truck, buy agricultural products in rural areas, and sell their merchandise, in the city on the parkings of trucks or in the port.

[3] Thorbecke (1992) observed this phenomenon in Pakistan. On average, farmers sold 31 percent of their marketed surplus to beoparis, i.e. the itinerant trader. The smallest farms (under 2.5 acres) sold 61 percent of their marketed surplus to itinerant traders, while this was only 15 percent for farms over 25 acres.

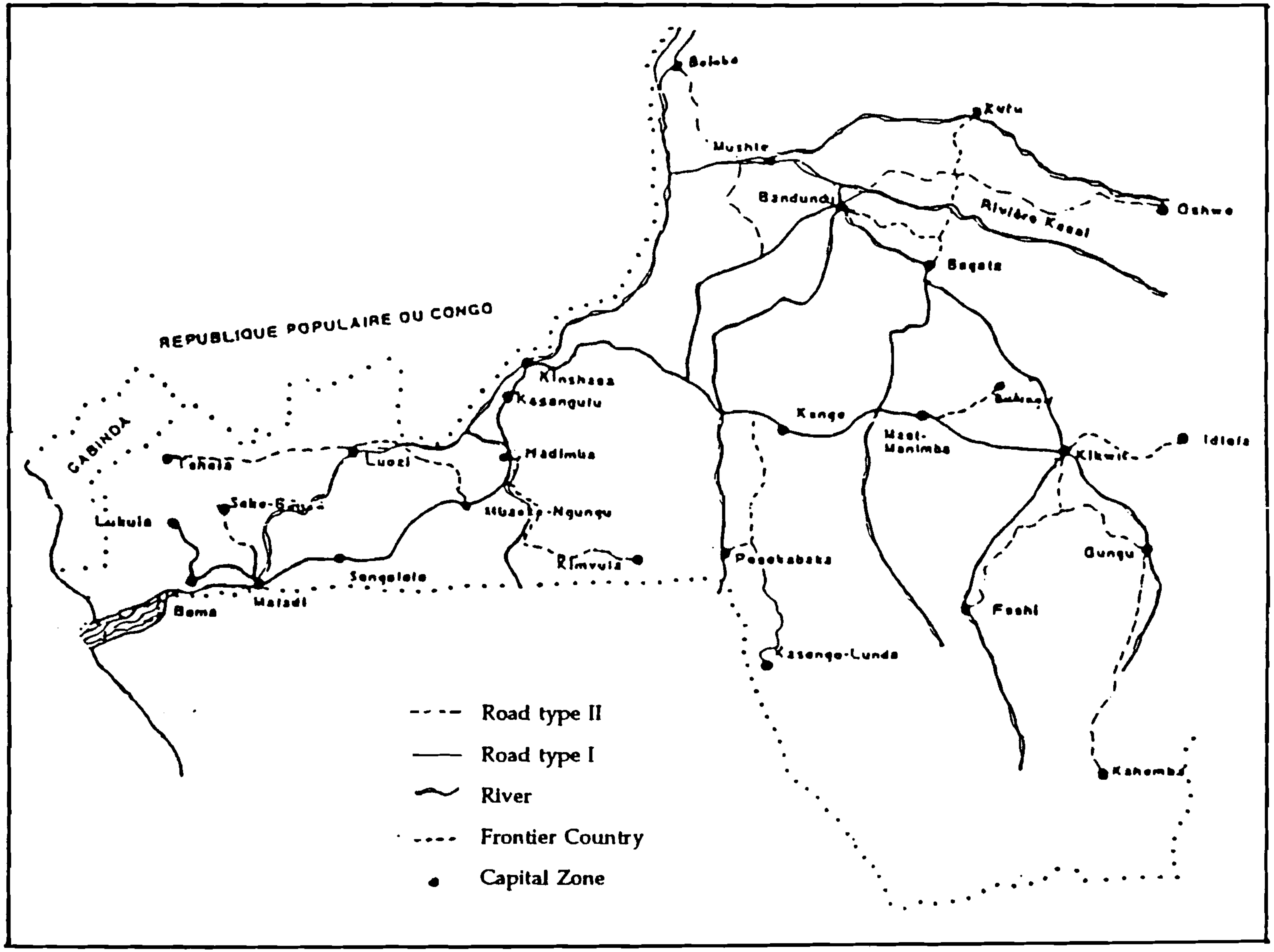

Figure 5.1: The Main Food Supply Roads and Rivers to Kinshasa

Table 1: Mean Values and Standard Deviation of the Main Variables with Respect to the Itinerant Trader

	Mean	Standard Deviation
Composition of Wholesale Price		
Transportation cost (% of the wholesale price)	27	10
Profit (% of the wholesale price)	34	16
Producer Share (% of the wholesale price)	39	15
Managerial capabilities	33	7
Age (years)	6	5
Experience in the job (years)		
	53	90
Characteristics load	988	1983
Number of sale units		
Value total load (1000 Z)	4	4
	20	11
Transport Costs	3	5
Days on the road	10	9
Days on the river	2	3
Days for the gathering of products - truck	3	4
Days for the gathering of products - boat	3	2
Days for selling products - truck	3	1
Days for selling products - boat	262	115
Number of trips a month - truck	42	60
Number of trips every six months - boat	653	293
Average distance road type I- truck (km)		
Average distance road type II - truck (km)		
Average distance - boat (km)		

Table 2: Characteristics of Itinerant Traders Expressed as a Percentage of All Itinerant Traders

	% of itinerant traders
<u>Managerial Capabilities</u>	81
Male	
Education:	19
- Primary School	51
- Secondary school unfinished	16
- Diplôme d'Etat	10
- Professional school	4
- University	10
Producer themselves	76
Trader during the whole year	8
Trader on occasion	
	12
<u>Transaction Costs</u>	13
Buy always at the same producer	12
Travel always with the same transporter	37
Sell always to the same retailers	39
Sell always on the same parking	85
Sell often on the same parking	8
Paid cash for sale	86
Paid cash to transporter before departure	33
Paid cash for purchase	68
Buy always at the same place	78
Only commercial links	
Original from the same region as producer	48
	42
<u>Market Conditions</u>	23
Bought on a rural market	31
Arrange price with other itinerant traders	
Fixed producer price by government	71
Losses on the trip	95
<u>Transport Costs</u>	57
Transport by truck	10
Pay taxes on parking	10
	3
<u>Product</u>	5
Who sell mainly cassava chips	4
Who sell mainly peanuts	3
Who sell mainly maize	4
Who sell mainly bananas	
Who sell mainly palm oil	
Who sell mainly cassava chikwangue	
Who sell mainly cassava pate	
Who sell mainly tomatoes	

III. THEORETICAL CONSIDERATIONS

This section presents a simple model of the itinerant trader system in a one-product, static, spatial, and closed economy. We assume one urban center and one rural area, at distance *d* from the urban center, characterized by identical producers. The itinerant trader's cost consists of three components: a. the cost of funds to buy food (purchase price P); b. transaction costs (search costs, bargaining costs, supervision costs, etc. denoted by T); c. transportation costs; d. Transportation costs are exogenous and increase with distance, i.e. $\partial D/\partial d > 0$. Transportation costs are also dependent on a "quality of the road" parameter α.

The itinerant trader has to solve the following profit-maximization problem:

$$Max_n \quad nWq_M(P) - n(P + D(d,\alpha) + T)q_M(P)$$

where n is the number of producers he has to deal with (the size of his clientele), W is the wholesale price in the urban center and q_M is the quantity marketed by the producer. It is assumed that the price elasticity of supply is strictly positive ($\partial q_M/\partial P > 0$) and that the underlying production function is a Leontief function such that no substitution between farm products and marketing and transaction services occurs. The choice variable is the size of the clientele of the itinerant trader. The first term in the maximand is the total revenue that the itinerant trader can make from a clientele of n producers. The second term reflects his costs.

Under perfect competition and certain input prices, the zero profit condition holds:

$$W - P - D(d,\alpha) - T = 0$$

In equilibrium, total marketed supply is equal to demand:

$$nNq_M(P) = Q_D(W)$$

where demand is a function of the wholesale price and it is assumed that $\partial Q_D/\partial W < 0$. N is the number of itinerant traders. The last two equations are the conditions for a competitive market equilibrium with P and W as the endogenous variables.

A. The Effect of Distance

We derive the effect of a change in *d*, i.e. the distance of the supply center from the urban center, on the endogenous variables. Taking derivatives of the equilibrium conditions with respect to *d*, solving for the unknowns and converting to elasticities, produces the following results:

$$\epsilon_{Wd} = \frac{\epsilon_{Dd}\epsilon_{Q_MP}S_D}{\epsilon_{Q_MP} - \epsilon_{Q_DW}S_P} > 0$$

$$\epsilon_{Pd} = \frac{\epsilon_{Dd}\epsilon_{Q_DW}S_D}{\epsilon_{Q_MP} - \epsilon_{Q_DW}S_P} < 0$$

where ϵ_{ij} is the elasticity of i with respect to a change in j and S_D and S_P are the shares of the transportation cost and the producer price in the final wholesale price respectively. Comparative statics produces clear results. An increase in distance increases the wholesale price in the urban center, reduces the producer price and hence, reduces the quantity marketed. The magnitude of the effect depends on the supply and demand elasticities and on the share of the producer price and transportation cost in the final wholesale price.

Transportation costs affect both consumers and producers. However, they might be affected differently as shown in the previous equations. If we define I_f as the part of the increase in the margin borne by the producer due to an increase in transportation costs, i.e.

$$I_f = \frac{|\frac{dP}{dD}|}{|\frac{dP}{dD}| + |\frac{dW}{dD}|}$$

then, it can be shown that (see Fisher, 1981):

$$I_f = \frac{1}{1 + \frac{\epsilon_{q_M P}}{\epsilon_{Q_D W} S_P}}$$

Hence, the more inelastic supply and the more elastic demand, the more farmers will suffer from a change in transportation costs and the less consumers are affected. The higher the producer share in the final wholesale price, the less weight is borne by the producers.

B. The Effect of Road Quality

Assume that there are two types of road: a "good quality" road with a known transportation cost $\bar{D}$ and a "bad quality" road where the transportation cost has an uncertain cost but a known distribution[5]:

$$D \sim N(\bar{D}, \sigma_D^2)$$

The impact of uncertain input costs can be found following the logic used in Sandmo (1971) for uncertain output prices. As defined before, the profit function is:

$$\pi(n) = nWq_M - n(D + P + T)q_M$$

Using the utility function

[5] Practical examples of uncertainty include heavy rainfall destroying the road, trucks stuck on the road and blocking it, broken bridges, road toll blocks by soldiers, etc..

$$u(\pi) \ with \ u'(\pi) > 0 \ and \ u''(\pi) < 0$$

the expected utility of profit is

$$E\{u(nWq_M - n(D + P + T)q_M)\}$$

The first and second order conditions for optimal resource allocation are:

$$E\{u'(\pi)(q_M W - q_M(D + P + T)\} = 0$$

$$E\{u''(\pi)(q_M W - q_M(D + P + T))^2\} < 0$$

The first order condition is used to show that (see Minten, 1995):

$$E\{u'(\pi)(q_M(W - P - T) - q_M\bar{D})\} > 0$$

Since u'(π) is non-negative by assumption and intuition, this implies that W-P-T > $\bar{D}$ at the optimum. In other words, expected utility is maximized when the wholesale price exceeds the expected costs. This is in contrast to the case of certain input costs where W-P-T would equal $\bar{D}$.

Invoking the mean variance approximation, the magnitude of this difference can be quantified. Using the utility function u(π) = u(E(π)), the first order condition of the maximization problem becomes:

$$\frac{\partial u(\pi)}{\partial n} = \frac{\partial u(.)}{\partial E(\pi)}\frac{\partial E(\pi)}{\partial n} + \frac{\partial u(.)}{\partial V(\pi)}\frac{\partial V(\pi)}{\partial n} = 0$$

where V(π) is the variance of profits. This implies that

The term in square brackets is the ratio of the marginal effects of profit variance and expected profit on utility - that is, the rate of substitution in utility terms of expected profit for profit

$$\frac{\partial E(\pi)}{\partial n} + [\frac{\partial u(.)}{\partial V(\pi)}/\frac{\partial u(.)}{\partial E(\pi)}]\frac{\partial V(\pi)}{\partial n} = 0$$

variance. Using the same logic as in Anderson et al. (1977) and substituting in expressions for $\partial E(\pi)/\partial n$ and $\partial V(\pi)/\partial n$, this results in:

$$\bar{D} = (W - P - T) - R[(W - P - T)^2\frac{\partial V(n)}{\partial n}]$$

The optimum is achieved when the mean transportation cost exceeds the wholesale price minus transaction and purchase costs by an amount determined by R, i.e. the "risk evaluation differential quotient"[6], the marginal variance of output and (W-P-T) squared. The difference between the factor costs and the expected value marginal product is sometimes termed the marginal risk deduction. Hence, the introduction of uncertainty in input prices induces an increase in the trader's margin.

In the empirical part, the determinants of producer shares and transport costs margins are looked at. The transmission of transportation costs to producer prices for different road qualities is tested, i.e.

$$H_0: \frac{\Delta P}{\Delta d} - \frac{\Delta D}{\Delta d} = 0 \textit{ versus } H_1: \frac{\Delta P}{\Delta d} - \frac{\Delta D}{\Delta d} \neq 0$$

where *d* is distance. Since W is fixed and P is the only endogenous variable that changes in a cross-sectional analysis, this constitutes a test of the proposition derived from the assumption of uncertain input prices. Complete transmission (the H_0 hypothesis) implies that transaction

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6 $$R = -[\frac{\partial u(.)}{\partial V(\pi)}/\frac{\partial u(.)}{\partial E(\pi)}]$$

costs per unit do not change significantly with distance. In this case, the area where products are marketed is larger compared to the case when per unit transaction costs would increase with respect to distance. In a last analysis, the impact of distance and road quality on the itinerant trader's wage (*w*) as a remuneration for these transactions costs is looked at. Days on the road, days to search and days to sell products are taken into consideration in the calculation of a daily wage. For each road quality the following hypotheses are tested:

$$H_0: \frac{\Delta w}{\Delta d} = 0 \textit{ versus } H_1: \frac{\Delta w}{\Delta d} \neq 0$$

IV. DATA AND METHODOLOGY

A. Data

A survey in Kinshasa (Zaire) was conducted in October - November 1990. The survey was carried out by a research team from the K.U.Leuven (Belgium) in collaboration with the Department of Markets, Prices and Rural Credit (DMPCC) and the Study and Planning Unit (SEP), both within the Ministry of Agriculture. 1405 itinerant traders were surveyed, 1000 on the parkings of trucks and 405 in the port. In the beginning of 1990, an exhaustive list of the truck parkings was established. 55 parkings were identified where the number of arrivals of trucks varied between 0.5 and 12 a day. The sampling plan was established as follows. The first stage was to regroup parkings that were in the same neighborhood and supplied the same retail markets. The second phase was to conduct a stratification by number of arrivals a day. The three strata were: 1. more than 5 trucks a day; 2. 3 to 5 trucks a day; 3. less than 3 trucks a day. In each stratum, one third of the parkings were randomly selected and the number of questionnaires was determined by the average daily arrival of trucks. One itinerant trader per truck was randomly chosen and interviewed.

B. Estimation Procedures

Transportation Costs and Producer Share

The objective is to estimate a transport margin and a producer share function. In this function, all explanatory variables related to the margin itself are included. We relate the transportation margin (DM) and the producer share (PS) to the observed data in the following expression:

$$DM_{ki} = \frac{D_{ki}}{W_k}; \quad PS_{ki} = \frac{P_{ki}}{W_k}$$

where D_{ki} is the transportation cost for commodity k at place i, P_{ki} is the producer price for commodity k at place i and W_k the wholesale price for commodity k in Kinshasa.

Since each is a ratio of two values, each is automatically expressed in real terms and a general price rise has no effect on the transportation margin or producer share[7]. The functional relationship between the ratio and its arguments are commodity and place specific:

[7] Since monthly inflation soared to 100 percent during the survey period, this is a particularly important characteristic.

$$DM_{ki} = f(A_i,\ T_i,\ Z_k)$$
$$PS_{ki} = g(A_i,\ T_i,\ ME_i,\ Z_k)$$

where A are transport related costs, T transaction costs, ME producer market environment conditions, and Z product dummies. These equations are estimated in a seemingly unrelated regression system (SUR) to improve efficiency because of contemporaneous correlation. However, since explanatory variables in each equation are overlapping, gains from the generalized least squares compared to ordinary least squares are limited.

Distance enters into the transport margin function because larger trade margins are expected for longer routes and smaller margins for shorter routes and vice-versa for producer prices. Distances are measured using the 1988 map of the "Institut Géographique du Zaire". The distance from Kinshasa to the loading point is proxied using the distance in kilometers from Kinshasa to the capital of the administrative zone. Road conditions are taken into consideration by constructing two categories: paved roads (type I) and dirt roads (type II). Distances along rivers are not differentiated for accessibility given their rather homogeneous situation. This specification allows us to estimate how different types of roads influence the marketing margin and how road transport costs compare to river transport costs. Tomek and Robinson (1990) observe that transportation costs per km often decline as the distance traveled increases. Thus, the cost of moving commodities between two points is often not a linear function of the distance. To account for this, a logarithmic form with respect to distance is used.

Correction for particular market conditions is done through the use of a dummy variable for price arrangements by the itinerant trader, selling on a market or in the village, and price fixing by the government[8]. The influence of transactions costs is measured through dummy variables that take into account the existence of a personalized system of exchange or a credit system between buyer and seller. The fact that the trader is a producer or full-time trader might allow him to perform transactions more or less efficiently. The transportation margin and producer price are commodity dependent and it is expected that commodities which are perishable or which have a high volume to weight ratio are characterized by a higher transportation margin and a lower producer price.

[8] Since independence, Zaire's agricultural producer policy can be divided into three periods. In the period from 1960 to 1967, the government set a ceiling price each agricultural season and traders were not allowed to buy at a higher price than this imposed one. This system was also practiced during the colonial period and its purpose was to keep urban food prices low. From 1967 to 1983, the maximum price policy was converted to a minimum price policy. Under this policy, the traders were not allowed to offer a price lower than a bottom price imposed by regional authorities each season. The purpose was to protect farmers' income as shown in the following quote of the Ministry of Agriculture (SEP, 1990): "Le système de prix minima permet d'éviter la chute des prix ex-ferme en dessous de coûts de production consentis, particulièrement au cours de la campagne du produit consideré." Agricultural marketing was liberalized from 1983 on and no prices were officially set by the government although the government still intervened in determining "la campagne de commercialisation", i.e. in setting dates when farmers are allowed to start selling their products after harvest. However, price setting at the local level in remote parts of the country continued even after 1983.

Transport Price Transmission

The hypothesis that transport prices are transmitted to producers (and transactions costs and profits do not change) holds if $R\beta = r$, i.e.

$$\begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} \theta_{1j} \\ \theta_{2j} \end{bmatrix} = \begin{bmatrix} 0 \end{bmatrix} \quad for \quad j = 1,2,3$$

where θ_{ij} is the coefficient j of the distance variable in equation i. j=1,2,3 is an indication of road type I, road type II and river while i=1,2 is the producer price and transportation price share equation respectively. A way to develop a test statistic for testing H_0: $R\beta = r$ against H_1: $R\beta \neq r$ is to use an extended version of the single equation F-test. Assuming the errors are normally distributed, an expression for λ_f can be derived (Judge, 1988):

$$\lambda_f = \frac{g/J}{(y - X\hat{\beta})'(\sum^{-1} \otimes I)(y - X\hat{\beta})/(MT - K)} \sim F_{(J,MT-K)}$$

where the system of equations is:

$$y = X\beta + \epsilon$$

and T is the number of observations, M is the number of equations, K is the number of regressors, J is the number of restrictions, $\Sigma \otimes I$ is the covariance matrix, and

$$g = (R\hat{\beta} - r)'(R[X'(\sum^{-1} \otimes I)X]^{-1}R')^{-1}(R\hat{\beta} - r)$$

It can be shown that the denominator converges in probability to one and hence can be omitted, leaving

as a new operational statistic that has an approximate $F_{(J,MT-K)}$ distribution (Judge, 1988).

$$\hat{\lambda}_f = \frac{\hat{g}}{J}$$

The Wage of the Itinerant Trader

The daily wage (w) of the itinerant trader is defined as follows:

$$w = \frac{\sum_j (W_j - D_j - P_j)q_j}{d_D + d_G + d_S}$$

where j is product j, q is the number of units bought by the itinerant trader, W,D, and P are the wholesale price, transportation cost and purchase price respectively and d_D, d_G, and d_S are the days for transport, gathering, and selling of the merchandise. The empirical relationship with the wage as the dependent variable is as follows:

$$w = h(M, A_i, T_i, ME_i)$$

Managerial capacities (M) are proxied by variables for the age, education level, experience on the job, gender (which might reflect a different access to information), and full-time, part-time trader or producer. A Mincer-type earnings function is estimated to incorporate potential level-off effects after a certain period on the job. The other variables (transport, transaction, and market environment) retain the same meaning as in the previous expressions.

V. EMPIRICAL RESULTS

Producer Share and Transportation Cost Share Determinants and Its Transmission

Tables 3 and 4 show the results of the seemingly unrelated regression model of the two equations with the ratio of the purchase price and transport price over the wholesale price in percentage as dependent variables. The system weighted R^2 has a reasonably high value for a cross-sectional analysis. To test for multi-collinearity of the variables, Variance Inflation Factors (VIFs) and condition-indices are calculated. The kilometers on road type I and on the river show a high correlation for both equations (VIFs for these coefficients in all cases are larger than 20; conditions indices are larger than 20)[9]. For the other variables no severe multi-collinearity is present.

As the magnitude of the distance coefficients is of particular importance for this study, it was decided to run separate regressions for itinerant traders on trucks and on boats as there is no degree of freedom problem. This solves the multi-collinearity problem. The results for the distance coefficients are shown in Table 5. All distance coefficients are significant at the 1 percent level and in the three cases producer prices drop faster than transport costs increase. 100 extra kilometers on the river increases the transportation share by 0.16 percent. Shipping by boat is the cheapest way to transport food. In this case, food prices also decrease at a slower rate compared to road transport. Road conditions clearly influence the transport margin. Transport on road of type II is three times more expensive than transport on road of type I. 100 extra kilometers of type II road increase the transport-wholesale price ratio by 3 percent while this figure drops to 1 percent on paved roads.

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[9] The itinerant trader is traveling by boat or by truck which implies zero kilometers on the road and a positive number for kilometers on the river or vice-versa. This causes a strong negative correlation between these distance coefficients.

Table 3: Regression Results for the Ratio of Transport Costs to the Wholesale Price (in %) as Dependent Variable (SUR Model)#

	Parameter Estimate	Standard error	t - value
Intercept	13.95	2.60	5.36
Transport			
Days on the trip	0.03	0.03	1.07
Kilometers on river*	1.12	0.40	2.77
Kilometers on road type I*	2.78	0.46	6.03
Kilometers on road type II*	1.24	0.13	9.61
Total value (10^6 Z)	-0.29	0.17	-1.74
Return merchandise (1=yes;0=no)	-0.30	0.51	-0.59
Breakdown truck (1=yes;0=no)	0.29	0.61	0.47
Always same parking (1=yes;0=no)	-1.96	0.62	-3.15
Often same parking (1=yes;0=no)	-2.30	0.60	-3.86
Dummy transaction costs (1=yes;0=no)			
Same transporter	-0.20	0.47	-0.43
Cash payment to transporter	0.81	0.79	1.03
Producer	-0.27	1.15	-0.23
Full-time trader	1.33	0.51	2.60
Market Conditions (1=yes;0=no)			
Losses	1.75	0.47	3.69
Sold on a rural market	-0.79	0.47	-1.70
Dummy different products (0=Cassava chips)			
Peanuts	-3.83	0.81	-4.74
Maize	-2.59	0.89	-2.90
Plantains	-6.91	1.86	-3.72
Bananas	-4.87	1.83	-2.66
Palm oil	1.77	1.07	1.66
Cassava chikwangue	-1.67	1.31	-1.27
Cassava paste	4.77	1.39	2.72
Tomatoes	2.48	1.22	2.04
Beans	-5.19	3.26	-1.60
Gourd	-5.52	2.16	-2.55
Sesame	-12.01	2.65	-4.54
Other	-4.27	1.83	-2.33
Regression Statistics			
Number of Observations	1360		
Adjusted R^2 (OLS)	0.35		
System Weighted R^2	0.35		

#: results only for itinerant traders with a strictly positive transport and purchase price
*: in logarithm

Table 4: Regression Results for the Ratio of the Purchase Price to the Wholesale Price (in %) as Dependent Variable (SUR Model)#

	Parameter Estimate	Standard error	t - value
Intercept	52.60	3.84	13.71
<u>Transport</u>			
Kilometers on river*	-2.93	0.54	-5.38
Kilometers on road type I*	-2.00	0.63	-3.15
Kilometers on road type II*	-1.82	0.18	-10.20
Total value (10^6 Z)	-0.33	0.23	-1.43
Return merchandise	-0.00	0.72	-0.00
<u>Dummy transaction costs (1=yes;0=no)</u>			
Same tribe (region)	-0.31	0.77	-0.41
Always or often same producer	0.04	0.66	0.06
Only commercial linkages	1.30	0.74	1.75
Cash payment to seller	1.07	0.93	1.15
Producer	-2.69	1.64	-1.64
Full-time trader	-0.81	0.71	-1.15
<u>Market conditions (1=yes;0=no)</u>			
Sold on a rural market	-0.90	0.65	-1.39
Price fixing by the govt	-0.52	0.47	-1.10
Price fixing by itinerant traders	0.03	0.65	-0.04
<u>Dummy different products (0=Cassava chips)</u>			
Peanuts	9.57	1.11	8.62
Maize	2.86	1.24	2.29
Plantains	-4.67	2.60	-1.80
Bananas	-7.00	2.56	-2.74
Palm oil	14.75	1.52	9.73
Cassava chikwangue	11.06	1.83	6.04
Cassava paste	-0.70	1.93	-0.36
Tomatoes	7.86	1.69	4.65
Beans	27.27	4.53	6.02
Gourd	19.34	3.00	6.45
Sesame	18.50	3.68	5.03
Other	6.06	2.55	2.38
<u>Regression Statistics</u>			
Number of Observations	1360		
Adjusted R^2 (OLS)	0.29		
System Weighted R^2	0.35		

#: results only for itinerant traders with a strictly positive transport and purchase price
*: in logarithm

Table 5: The Impact of Distance on the Producer and Transportation Cost Share (Distance in Kilometers in Logarithm and in Levels, Calculated at the Mean) and Results from the Hypothesis Test that Distance Coefficients in Both Equations are Equal (Separate Regressions for Transport by Boat and by Truck)

	In logarithm		Per km, evaluated at the mean		F-value	Prob>F
	Producer share	Transportation share	Producer share	Transportation share		
I. Road Transport						
-km on road type I	-3.33 (-4.12)#	2.63 (4.20)	-0.0127	0.0100	0.67	0.41
-km on road type II	-1.71 (-9.39)	1.23 (8.83)	-0.0403	0.0290	6.33	0.01
II. River transport						
-km on the river	-2.88 (-3.03)	1.30 (2.25)	-0.0035	0.0016	2.16	0.14

#: values in brackets are t-values

As explained in the methodology section, a cross-equation constraint was imposed to test if transportation costs are transmitted to producer prices for the three transport types (road I, road II, river). The hypothesis that transport costs are transmitted to producer prices could not be rejected at the five percent significance level as measured by the F-test for road type I and for the river (Table 5). If the itinerant trader faces more transportation costs, producer prices will decrease to the same extent. Hence, per unit transaction costs do not change significantly over distance for these types of transport. The coefficients on the producer share are significantly different from the coefficient on the transportation cost in the case of road type II. Bad roads not only increase transportation costs but they also increase uncertainty and transactions costs significantly.

Most of the proxies for transaction costs show a logical but statistically insignificant effect. Origin from the same region for trader and seller does not influence producer or transportation shares significantly while commercial linkages between the trader and the producer increase the producer share by 1.3 percent compared to other types of relationship (family, tribe, religion). Switching costs measured through the fact that the itinerant trader buys always or often from the same producer or travels with the same transporter are not significant in the producer and transportation share respectively. The effects of cash payments to the producer, rural trader and the transporter and the effects of a full-time trader or producer are insignificant or very small.

Minimum price fixing by the authorities does not significantly affect the purchase price and even shows the reverse sign of what would be expected. Price arrangements among itinerant traders do not seem to affect purchase price or transport costs. An increase in the total value of the merchandise reduces the per unit transport costs, indicating that bigger traders may be able to work out better deals with the transporter. Different products show significantly different shares of producer prices and transport prices in the final wholesale price. Using cassava chips as the benchmark, most products show a higher producer share in the final wholesale price. Beans show the highest producer share while perishable products like bananas, plantains, and cassava paste show the lowest.

The Determinants of the Wage of the Itinerant Trader

Table 6 shows the regression with the logarithm[9] of the daily wage as the dependent variable[10]. The R^2 of the regression is rather low, i.e. 13 percent, which is not uncommon for cross-sectional analysis. The daily wage of the itinerant trader increases the further he goes on the river and on the dirt roads. It does not change significantly for paved roads. His daily wage increases by 3 percent for every 100 km he goes further on the river while it increases by 42 percent for every 100 km extra on dirt road. Although transport by boat is significantly

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[9] A logarithm was used to reduce the influence of large wages and to facilitate interpretation.

[10] In this specification, the distance coefficients were expressed in levels which eliminated their collinearity problem. Collinearity exists for the experience variable and its square (VIF is 7.01 and 5.94 respectively). For the other variables, VIFs were below 3.

cheaper than by truck, daily wages do not differ much because of the longer time involved in trips on boats. The daily wage is strongly related to the size of the itinerant trader. The further itinerant traders go, the less competition they face and the more easily they find products. The effect is more pronounced on lower quality roads. The fact that the itinerant trader increases his average wage on lower quality roads is a reward for the extra risk and uncertainty he is exposed to[12].

Managerial capabilities show a strong effect on the wage of the itinerant trader. A university degree increases the wage by 56 percent compared to a primary school degree. To a lesser but strongly significant extent, these same effects hold for other types of education. A 1 year change in age increases the wage by 3 percent. The Mincer-type learning effect is insignificant. The wage of the full-time trader is 26 percent higher than the wage of the occasional trader while producers earn 42 percent more. However, this last fact is because producers do not have to purchase the products they are trading.

Price collusion by the itinerant traders results in a lower wage while fixing of the producer price by the government results in a higher wage. It seems that fixing the minimum price benefits the trader more than it does the producer. Trade with the same person (seller, transporter, buyer) or within the same tribe as a means to overcome asymmetric information has no significant effect on the wage. Cash payment by the consumer or retailer increases the wage of the itinerant trader by 40 percent. This seems illogical at first sight because one would expect that the cost of credit has to be paid. A potential explanation might be that cash payment by consumers or retailers might serve as a screening device of the purchasing power of the customer with a stronger bargaining power for the seller.

[12] It could be argued that part of this is also due to monopoly and oligopoly rents. However, there is no evidence that this would be different for different transport types.

Table 6: Regression Results for the Logarithm of the Daily Wage of the Itinerant Trader as Dependent Variable

	Parameter Estimate	Standard error	t - value
Intercept	7.2812	0.2903	25.08
Managerial Capabilities			
Gender (1 = male; 0 = female)	-0.0677	0.0925	-0.73
Age	0.0352	0.0060	5.88
Experience	0.0069	0.0172	0.40
$(Experience)^2$	-0.00008	0.0006	-0.13
Secondary school education*	0.4045	0.0984	4.11
"Diplôme d'Etat"*	0.4403	0.1247	3.53
Professional degree*	0.5161	0.1368	3.77
University degree*	0.5556	0.1969	2.82
Producer (1 = yes;0 = no)	0.4177	0.1529	2.73
Always Trader (1 = yes;0 = no)	0.2644	0.0807	3.27
Transport			
Kilometers on river	0.0003	0.0001	3.52
Kilometers on road type I	-0.0003	0.0003	-0.83
Kilometers on road type II	0.0042	0.0007	6.13
Retour merchandise (1 = yes;0 = no)	0.1357	0.0791	1.71
Breakdown truck (1 = yes;0 = no)	-0.1395	0.0988	-1.41
Dummy transaction costs (1 = yes;0 = no)			
Same tribe (region) as seller	-0.1410	0.0891	-1.58
Same transporter	0.1258	0.0795	1.58
Same retailer	0.0305	0.0826	0.37
Always or often same producer	-0.0888	0.0778	-1.14
Only commercial linkages	-0.0046	0.0863	-0.05
Cash payment of buyer	0.3995	0.1044	3.82
Cash payment of transporter	-0.2172	0.1259	-1.72
Cash payment to seller	-0.0289	0.1081	-0.27
Market conditions (1 = yes;0 = no)			
Losses	-0.0889	0.0766	-1.16
Sold on a rural market	0.0636	0.0725	0.88
Price fixing by the government	0.1047	0.0539	1.94
Price fixing by itinerant traders	-0.1588	0.0755	-2.10
Regression Statistics			
Number of Observations	1383		
R^2	0.15		
Adjusted R^2	0.13		

* = compared to primary school or no formal education

VI. CONCLUSIONS

This paper examines the behavior of the producer-wholesale price margin of domestic products between the urban center of Kinshasa and the rural areas. Transportation is three times more expensive on bad roads than on paved roads. Boat transport is cheapest. Transport costs are completely transmitted to producers for all types of transport. However, for bad roads not only transportation costs but also uncertainty and other transaction costs increase significantly[12]. Producer prices decrease four times as fast for every kilometer traveled on bad roads as compared to good roads. The quantitative pay-off of road improvement on agricultural producers is thus significant. The daily wage of the itinerant trader increases significantly the further he travels on the river or on dirt roads. The highest pay-off is on dirt roads. His average daily wage increases by 40 percent for every 100 km extra. This is probably partly due to the cost of the extra risk he is exposed to.

The transmission of transport costs to producers has several policy implications. First, minimum price fixing by the government without additional measures[13], the prevalent policy in the 70s and the beginning of the 80s, will effectively reduce the area where domestic food is sold. Hence, price fixing has a theoretically ambiguous effect. It improves prices for those producers that live close to the urban center while producers that live far away are left out. Second, road improvement effectively reduces transportation costs, and increases producer

[12] Creightney (1993) puts it this way: "A transport improvement may lower input prices and hence production costs, improve access to credit, facilitate technological diffusion, increase the area of land under cultivation, or increase the availability of "incentive" goods. Other benefits from a transport improvement may include increased trade and competition from imports, in turn leading to improved production efficiency, downward pressure on consumer prices, and reduced seasonal price fluctuations. Stronger social and economic linkages between rural and urban areas and increased non-farm employment may also develop."

[13] The government itself was not involved in buying or storing agricultural products.

prices. Hence, it also increases the area where food is sold and it changes the type of food that is sold. Third, securing lower transportation costs through, for example, less interruption in the provision of fuel or less taxes on imported trucks, will indeed increase producer prices.

It has been argued that the use of family and tribal links in marketing is a means of reducing asymmetric information. Results from the liberalized food marketing system in Zaire show the importance of family and tribal links in determining producer shares, transportation shares and wages of itinerant traders is minor. Managerial capabilities as measured by education and age are of far greater importance.

This study has limitations and extensions are possible. First, although assumed constant in the model, total transaction costs might increase or decrease with distance and road quality. On one hand, uncertainty and supervision costs are expected to rise the longer the trip and the worse the road. On the other hand, the itinerant trader may face relatively less bargaining and search costs as it is expected that he faces less competition from other traders the further he goes and that he might better be able to secure a bigger load. A more extensive model and more detailed data would allow this kind of analysis. Second, high inflation during the survey may effect results in the wage determinant equation. Third, this analysis focused on the Kinshasa market in Zaire. It would be useful if similar studies could be done on other urban markets, other countries, and over time.

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