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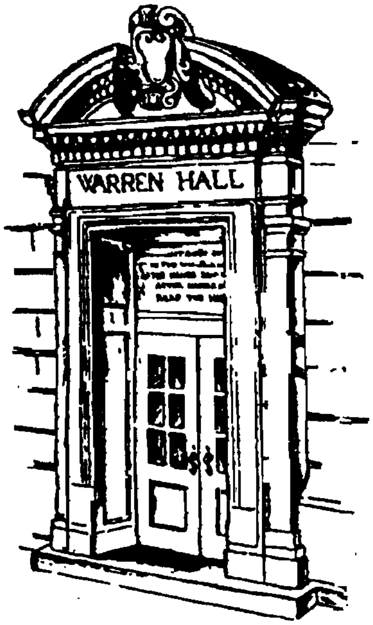

Staff Paper

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Price Transmission and Price Integration in Food Retail Markets:

The Case of Kinshasa (Zaire)

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ABSTRACT

Integration of commodity markets in developing countries has received considerable attention because price integration is perceived to be central to the success of food and agricultural policies. Price integration tests are performed in retail markets in Kinshasa (Zaire), i.e. between commodities, among retail markets, and between the wholesale and retail market level. Price transmission is measured by incorporating the co-integration concept into the classical long-run and short-run market integration test. It is shown that although wholesale prices are input prices for retailers, they lack short-run integration with retail prices. Differences exist between retail markets which do not reflect services or transportation costs. It is hypothesized that this is due to the existence of significant transactions costs and deficiencies in information transmission.

I. INTRODUCTION

The study of price integration in developing countries has a long history (Lele, 1971; Jones, 1972; Harriss, 1979; Southworth et al., 1979; Heytens, 1986; Delgado, 1986; Ravallion, 1986; Timmer, 1987). Market integration is important because it is central to the success of agricultural and food policies and to household food security through trade and storage policies. Implementation of these policies is easier when markets are integrated because integration reduces the management burden by allowing concentration on one commodity for stabilization policies. Integration implies that markets may be connected along some dimensions but not others. Geographical links may be stable at one point in time but break down in others and markets may react differently to variation in quality or variety.

Historically, the concept implied by the word "integration" has often been confused with that of perfect and effective competition. However, integrated markets do not have to be competitive (Harriss, 1979; Petzel, Monke, 1980; Monke, Petzel, 1984). Monke and Petzel (1984) define integrated markets as those in which prices of differentiated products do not behave "independently". Alternative statements of integration are that there is efficient arbitrage or that the law of one price holds between two regions. The failure of two or more markets to "be integrated" may be explained by a lack of linkage (autarkic markets), imperfect competition and impediments to efficient arbitrage, such as trade barriers, imperfect information or risk aversion.

In the early 1980s, structural adjustment programs were started in many countries in Africa. With respect to retail marketing, this meant price liberalization and the abolition of price and market controls. However, even with "right prices", agricultural retail markets can still suffer from deficiencies because of market failures and externalities. Given that the traditional food retailing sector involves an impressive number of individual transactions in product and information flows, questions about price efficiency and price integration arise.

In general, studies on food retailing in developing countries, and more specifically in Africa, are rare[1]. However, retailing costs constitute a large part of the final food price paid by the urban consumer. In Kinshasa (Zaire), retailing costs for most products have shown a dramatic increase recently. Retail margins of cassava, the main staple, increased from 18 percent of the consumer price for cassava from Bandundu and 12 percent for cassava from Bas-Zaire in 1984 to 35 and 45 percent respectively in 1989. This is a worrisome development given the importance of food in the household budget of the average urban consumer and the existing mal- and undernutrition in Kinshasa. A better understanding of the functioning and the price integration in retail markets might allow us to better delineate the appropriate role of the government.

The contribution of this paper is three-fold. First, it links the classical price integration methodology with the co-integration concept of time series analysis. Second, it applies this methodology in a spatial approach to retail food markets in the metropolitan area of Kinshasa. Third, it extends this analysis to study price transmission between different commodities and

[1] Some hypotheses are given for this (Meissner, 1989): many political leaders in developing countries refer to marketing as a wasteful, parasitic and socially irrelevant activity; the merchant class in many developing countries belongs to foreign minorities, which are accused of exploiting the indigenous populations; political leaders tend to assign marketing improvement activities a very low priority while actively putting up barriers to their effective performance; and hunger in the midst of plenty is primarily caused by inequitable income distribution, a matter outside the scope of marketing.

between different market levels. The structure of the paper is as follows. Section II describes the retailing system and the main characteristics of the average retailer. In Section III, estimation procedures are developed. Sections IV and V present the empirical results and conclusions.

II. DESCRIPTION OF THE RETAILING SYSTEM

Kinshasa is one of the biggest urban centers in Sub-Saharan Africa, with an estimated population of close to four million people. Demographic pressure has created enormous problems for housing, public provisions, transport, and food supplies. In May 1989, Kinshasa had 115 food markets with 72,000 food retailers (i.e. almost three percent of the urban population). The biggest market was the Marché Central with more than 15,000 retailers.

Tables 1 and 2 show the characteristics of the average retailer. Food retailing is extremely small scale and fragmented. Typically, a food retailer buys a few bags of food products from an itinerant trader or a semi-wholesaler and sells the products in small fractions to the customer. In general, little transformation of the product is required. The quantity bought at the wholesale level serves the retailer from 3 to 6 days on average. Hence, it would be expected that prices are transmitted relatively fast from wholesale to retail.

Retailers operate on a cash-and-carry basis and have a relatively narrow line of goods. The traditional marketing structure involves massive numbers of individual transactions. In addition transaction costs are elevated by the need for personal inspection of predominantly unpacked and ungraded goods. Most food retailing is done by women. Only the marketing of palm oil and living animals is partly done by men. Three quarters of the retailers say they bargain about the price with the supplier while sixty percent bargain about the price with the consumer. The lack of standardized sale units is a major reason for this and cheating on weights, measures and quality happens regularly. Minten (1995) shows how endogenous institutions developed in retail markets in Kinshasa as a result of significant transaction costs and asymmetric information.

Table 1: Mean Values and Standard Deviation of the Main Variables with Respect to the Retailer in Kinshasa (October - November 1990)

	Mean	Standard Deviation
<u>Managerial capabilities</u>		
Age (years)	37.2	8.6
Experience in the job (years)	9.1	7.2
<u>Number of bags bought at once</u>		
Cassava	2.9	8.4
Maize	2.7	4.4
Rice	1.4	0.8
Peanuts	2.6	6.1
Bananas (racine)	8.5	9.6
Palm oil (barrel)	3.7	8.7
Vegetables	4.7	11.6
Beans	11.0	25.2
<u>Number of days to sell product</u>		
Cassava	2.7	1.5
Maize	3.3	2.5
Rice	3.6	2.6
Peanuts	3.2	2.2
Bananas	4.3	4.0
Palm oil	6.2	6.2
Vegetables	2.1	2.8
Beans	5.1	3.9
<u>Losses (in %)</u>		
Cassava	3.5	9.4
Maize	5.8	24.9
Rice	2.3	6.3
Peanuts	2.9	9.5
Bananas	12.5	14.0
Palm oil	2.7	7.7
Vegetables	6.1	10.0
Beans	1.4	1.8
<u>Total value merchandise (1000 Z)</u>	94.8	387.6

Table 2: Characteristics of Retailers in Kinshasa Expressed as a Percentage of All Retailers (October - November 1990)

	% of retailers
Managerial Capabilities	
Male	5
Education:	
- Primary school	48
- Secondary school unfinished	43
- Diplôme d'Etat	2
- Professional school	7
- University	0
Transaction Costs	
Buy always or often with the same trader	26
Always sell the same products	85
Buy always at the same place	27
Tribal links with trader	4
Gets credit from the seller	22
Member of a likelembe	27
Member of a savings bank	.3
Member of "papa carte"	7
Owner of the table	78
Market Conditions	
Arrange price with other retailers	60
Fixed producer price by government	28
Know prices on other markets	50
Transport	
By pousse-pousse	44
By bus	19
By mini-bus	18
By taxi	3
By carrier	10
Myself	7
Product	
Bought from itinerant trader	39
Bought from wholesaler	27
Bought from semi-wholesaler	22
Bought from retailer	12

III. ESTIMATION METHODOLOGY

A. Data

Monthly food prices on nine retail markets and five wholesale markets in Kinshasa (Zaire) were gathered by the division of markets, prices and rural credit (DMPCC) and the project K.U.Leuven - A.G.C.D. in the ministry of agriculture during the period 1984 - 1989, i.e. immediately after the implementation of the structural adjustment program. Four of the surveyed markets have a wholesale and retail market. The integration hypotheses are tested on deflated monthly prices.

B. A Review

Static price correlation has been the most common measure of market integration in agriculture (Lele, 1971; Jones, 1972; Southworth et al., 1979) but problems with this statistical test, especially the susceptibility to common trends, have led researchers to advocate the use of other procedures. The static bivariate method has been extended into a dynamic model of spatial price differentials in the model proposed by Ravallion (1986), which tests for short- versus long-run integration by correlating the price in one region with lagged own prices and contemporaneous and lagged prices in another market. This method has been applied widely to measure spatial integration (see Heytens, 1986; Timmer, 1987; Faminow, Benson, 1990). In this model, the price series for each local market is permitted to have its own autoregressive structure and a dynamic relationship with market prices in a trading region. The Ravallion model appears to be a significant improvement for testing the nature of market integration, but some obvious problems remain (Heytens, 1986): determining appropriate reference prices (when there is no central wholesale or retail market) and variable specifications will be a problem in situations where a broad understanding of the market is limited; simultaneous equations bias is always a possibility, necessitating instrumental variables or faith that the bias is not too large; the model's parameters are likely to be sensitive to the time length of the data; and a high standard error on the coefficient for wholesale price may be due to its high correlation with lagged retail prices rather than weak market integration.

Delgado (1986) uses a variance components method to measure integration. It involves showing that after removing a common seasonal trend and seasonal mean prices for each market, interactions between the residual price terms across markets are independent. Sexton, Kling and Carman (1991) develop an alternative methodology based on three market states that exhaust the possible arbitrage conditions: shortage, glut, and efficient market integration. With this approach prices are not treated as predetermined variables in the regression model[2], interregional shipment costs are endogenous and estimated within the model[3], and the probability that markets are integrated is allowed to vary continuously. Constant mean transactions costs over time represents a fairly strong assumption of these two models and

[2] The choice of a price as predetermined is an arbitrary one and has been criticized by Timmer (1974) and others.

[3] Data on transport and storage costs, their variation across location and time and aggregate flows through the hierarchy of markets at any given time period are usually very difficult and expensive to obtain (Delgado, 1986)

implies that empirical applications of the model require relatively short time series and/or periods of relatively stable prices.

Alderman (1993), Palaskas and Harriss-White (1993) and Alexander and Wyeth (1994) are the first to take into account the concept of co-integration for the measurement of price integration. Alderman (1993) has stationary price series (I(0)) in Ghana and hence, testing for co-integration becomes impossible. Palaskas and Harriss-White (1993) develop a sequence of three tests to assess "full market integration" in the markets of West Bengal. They also add an extended structural and institutional description of the marketing system to complement their quantitative analysis. Alexander and Wyeth (1994) link the concept of co-integration to market integration, exogeneity and directions of causality in Indonesia.

In conclusion, researchers have tried to refine the static market integration measure in a spatial and temporal manner. In many cases more information than solely price data is needed. However, detailed structural market models are heavy in their demands on data, which often result in undesirable levels of aggregation and use of dubious proxies. It seems necessary that market integration evidence must be assessed on a case-by-case basis with additional information on market structure and production technology. It is also important to note that the existence of market integration does not imply perfect competition and no uniform, easy test is yet available to enable us to make this inference without knowing more about the market structure.

C. Estimation Procedures

In the case of the retail price as dependent variable, the Ravallion procedure can be formulated as:

$$R_t=\sum_{j=1}^{m} \beta_j R_{t-j}+\sum_{i=0}^{n} \gamma_i W_{t-i}+\eta X_t+\epsilon_t$$

where W_t and R_t are the contemporaneous prices in the wholesale and retail market, m and n are the number of lags on retail and wholesale markets respectively and X is a vector of other influences on the retail price.

Markets are not vertically integrated if the wholesale market price does not influence the price in the retail market. With short-run integration, price changes are fully and immediately passed on to the retail market with no lagged effects (strong form) or with lagged effects (weak form). Long-run integration requires that a unit price change is fully passed on over time but with the potential for lagged effects. Formally, the hypothesis for segmentation is:

$$H_1\text{: } \gamma_i=0 \ \ (i=0,\ldots,n)$$

for short-run integration (weak form):

$$H_2\text{: } \gamma_0=1;\ \sum_{j=1}^{m} \beta_j+\sum_{i=1}^{n} \gamma_i=0$$

for short-run integration (strong form):

$$H_3:\ \gamma_0=1;\ \beta_j=0\ (j=1,\ldots,m);\ \gamma_i=0\ (i=1,\ldots,n)$$

and for long-run integration:

$$H_4:\ \sum_{j=1}^{m}\beta_j+\sum_{i=0}^{n}\gamma_i=1$$

The appropriate test for these different hypotheses are F-tests where H_1, H_2, H_3 and H_4 are distributed as $F(n+1,T^*)$, $F(2,T^*)$, $F(n+m+1,T^*)$ and $F(1,T^*)$ respectively and T^* is the number of observations corrected for the degrees of freedom used in the regression of the unrestricted model.

The Ravallion model can be placed in a more general framework, based on co-integration between price series. The first step is to determine the "order of integration" of each of the price series. A time series $\{y_t\}$ is stationary if the joint distribution of y_t and $y_{t+\tau}$ is independent of time. A series is said to be integrated of order 1 (=I(1)) if although the series is itself non-stationary, the first differences in this series form a stationary series. If the series must be differenced k times to achieve stationarity, then the series is I(k). The standard procedure for determining the order of integration of a time series is the Augmented Dickey-Fuller (ADF) test which requires regressing Δy_t on a constant y_{t-1} and several lags of Δy_t. The t statistic on the estimated coefficient of y_{t-1} is used to test the null hypothesis H_0: $y_t \sim I(1)$.

The next step after testing for integration of the individual price series is to test for co-integration between them. The notion of co-integration is based on the idea that although two time series are integrated, their difference or some other linear combination of them is stationary. Co-integration of the two time series is easily tested by the procedure of Engle and Granger (1987). The first step of Engle and Granger's procedure is to perform an OLS regression of R_t on a constant and W_t. A test of co-integration is then that the residuals z_t from this co-integration regression be stationary. Thus the ADF tests applied to these residuals should yield statistics which are large and negative, so as to reject the null hypothesis of integration of order 1 in favor of stationarity.

If prices are not co-integrated, the Ravallion model is not appropriate to measure price integration because variables that are integrated but not co-integrated can drift apart without bound and so no long-run equilibrium exists. If they are co-integrated, the Engle-Granger representation theorem validates the use of the Ravallion model, i.e. using an error correction mechanism taking the form of an auto-regression with a single "disequilibrium term" (Alexander, Wyeth, 1994). For those products that are co-integrated, a first difference specification with an error term correction term can be written as:

$$\Delta R_t = \sum_{j=1}^{m} a_j \Delta R_{t-j} + \sum_{i=0}^{n} b_i \Delta W_{t-i} - r_1 R_{t-1} + w_1 W_{t-1} + dX_t + \epsilon_t$$

or

$$\Delta R_t = \sum_{j=1}^{m} a_j \Delta R_{t-j} + \sum_{i=0}^{n} b_i \Delta W_{t-i} + c_1 z_{t-1} + dX_t + \epsilon_t$$

where z_t is the error-term derived from the estimation of the long run relationship (in which all variables are in levels). z_t can be interpreted as the distance that the system is away from equilibrium. An error correction model states that changes in R_t depend not only on changes in W_t but also on the extent of disequilibrium between the levels of R_t and W_t. The error correction property arises from the fact that if R_{t-1} is above its equilibrium value R^*, ΔR_t will be lower than would otherwise be the case and vice versa if R_{t-1} is below R^*. The speed with which the system approaches its equilibrium depends on the proximity of c_1 to -1 while the term $b_0\Delta W_t$ is considered to be the immediate or short-run effect.

The first difference formulation can be linked to the Ravallion specification because

$$\beta_1=a_1+1;\ \beta_2=a_2-a_1;\ \beta_3=a_3-a_2;\ \ldots;\ \gamma_0=b_0;\ \gamma_1=b_1-b_0;\ \gamma_2=b_2-b_1;\ \ldots$$

The error correction model can then be re-formulated in "level coefficients" as:

$$\begin{aligned}\Delta R_t=\gamma_0\Delta W_t-(\gamma_2+\ldots+\gamma_n)\Delta W_{t-1}-(\gamma_3+\ldots+\gamma_n)\Delta W_{t-2}-\ldots-(\gamma_n)\Delta W_{t-n}\\ -(\beta_2+\ldots+\beta_m)\Delta R_{t-1}-(\beta_3+\ldots+\beta_m)\Delta R_{t-2}-\ldots-(\beta_m)\Delta R_{t-m}+\\ (\gamma_0+\gamma_1+\gamma_2+\ldots+\gamma_n)W_{t-1}-(1-\beta_1-\beta_2-\ldots-\beta_m)R_{t-1}\end{aligned}$$

In this way, retail price changes are attributed to the past wholesale and retail price, to the current change in the wholesale price and to the past changes in wholesale and retail prices.[4]

Given co-integration, the hypotheses for market integration can now be rewritten in easily testable hypotheses for:

a. market segmentation:

$$H_1:\ w_1=0;\ b_i=0\ (i=0,\ldots,n)$$

b. short-run integration (weak form):

$$H_2:\ b_0=1;\ r_1=w_1$$

c. short-run integration (strong form):

[4] This regression would not be sensible unless the right-hand variables are co-integrated. A regression involving a right-hand set of variables integrated of an order different from the order of integration of the left-hand side is just as problematic as a regression between two unrelated non-stationary series. In each case, the distribution of the statistics are non-standard (Banerjee et al., 1993)

$$H_3\text{: } b_0=1;\ w_1=1;\ r_1=1;\ a_j=0\ (j=1,\ldots,m);\ b_i=0\ (i=1,\ldots,n)$$

d. long-run integration:

$$H_4\text{: } r_1=w_1$$

Hence, long-run integration is a necessary condition for short-run integration. The F-tests for the different hypotheses are distributed as $F(n+1,T^*)$, $F(2,T^*)$, $F(n+m+3,T^*)$ and $F(1,T^*)$ respectively.

IV. EMPIRICAL RESULTS[5]

A. Integration Between Wholesale and Retail Markets

Table 3 shows the F-values for the tests for segmentation and integration of retail and wholesale markets using the traditional Ravallion procedure in levels. The residuals do not

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[5] An efficient market, by definition, transmits prices instantly. But lags occur as inputs move through the marketing system. In this analysis, four lags for level regressions and three lags for difference equations are taken into consideration. Banerjee et al. (1993) report studies that find that the loss of efficiency from choosing too long a lag is small compared to too short a length. Compared to the fast turnover of retailers (Table 1), four months is a sufficiently long period. Four explanations for lags are generally given (Hall et al., 1981): a. time is required as food products are transported, processed, stored and moved through the wholesale and retail sector; b. repricing and remarking goods at the retail level is costly; c. price reporting and collection method may exaggerate actual lags; d. the market may have imperfections, such as a poor information transmission system or noncompetitive firms.

The three first reasons do not seem to apply to the Zairian distribution system: a. for most commodities, retailers buy and sell their products in less than one week; b. prices are often not posted and if they are, it is often the quantity that is used as the adjustment variable instead of the posted price, i.e retailers will only mark large changes in their posted prices (50 percent, 100 percent) but will more readily adjust the quantity sold; c. price collection and reporting methods occurred during the same week; d. this might be true and this is one of the objects of this research.

show any significant auto-correlation. The null hypothesis of market segmentation between wholesale and retail prices is rejected for all products except for bananas. Most products are integrated in the long run, i.e. a unit price change at the wholesale level is fully transmitted to the retail level. Short-run integration is almost non existent for the level specification; only palm oil, maize in grains and local rice are short-run integrated in the weak sense. No product is short-run integrated in the strong sense.

Table 3: F-values for the Tests of Long-Run and Short-Run Integration and Segmentation Between Wholesale and Retail Markets for the Main Agricultural Products in Kinshasa (Monthly Prices; Deflated; 1984-1989, In Levels)

	Long-run	Short-run (strong)	Short-run (weak)	Segmentation
Peanuts in shell	1.8*	5.0	4.3	11.7
Peanuts grain	3.2*	23.4	3.6	18.5
Plantains	1.0*	15.8	20.6	3.4
Bananas	1.4*	18.9	15.5	1.1*
Cassava BDD	3.6*	9.7	3.3	6.3
Cassava BZ	0.15*	13.1	3.4	5.0
Cassava flour	3.9*	24.6	10.4	3.4
White Beans	7.0	9.3	12.5	19.3
Colored Beans	7.9	5.8	4.7	54.7
Palm oil	0.0*	18.4	0.2*	8.8
Maize in grains	1.2*	10.3	1*	25.4
Maize flour	0.1*	29.2	4	5.6
Local rice	4.7	13.3	2.5*	41.2
Imported rice	9.6	19.7	6.1	27.8
Tomatoes	5.8	11.8	6.1	8.1

* = significant at the 1 % level

The results of the augmented Dickey Fuller test show that, except for tomatoes, which is stationary in levels, all prices become stationary after first differencing, i.e. they are all integrated of order 1 (=I(1)). Results of the Engle-Granger co-integration test for retail prices as dependent and wholesale prices as independent variables imply that peanuts in grain (with peanuts in shell at the wholesale level), bananas, cassava, maize, imported rice and tomatoes are co-integrated over the different market levels as measured by the Dickey-Fuller t-statistic. The most consumed and perishable products are co-integrated, i.e. wholesale and retail prices move together in the long run.

For those products that are co-integrated, F-values are calculated using an error correction model to test for short-run integration (Table 4). No product is strong short-run integrated and only cassava from Bas-Zaire is weak short-run integrated at the 1 percent level. The failure to find short-run integration is mostly due to the fact that the coefficient c_1 (which measures the speed with which the system approaches its long-run equilibrium) is significantly different from -1. The coefficients b_0 ($=\gamma_0$), a measure for the immediate effect, are in most cases close to 1 (Table 4). Price differences are transmitted but there is no immediate correction for deviations from the long-run equilibrium.

Table 4: F-values for the Tests of Strong and Weak Short-Run Integration between Wholesale and Retail Markets and the Value of the b_0 Coefficient for Co-integrated Agricultural Products in Kinshasa (Monthly Prices; Deflated; 1984-1989; Error Correction Model)

	Strong short-run integration	Weak short-run integration	b_0	
			Value	Standard error
Peanuts grain	240.7	4.7	1.5	0.2
Bananas	48.5	5.7	0.3	0.1
Cassava BDD	55.6	3.7	1.1	0.2
Cassava BZ	46.7	1.7*	0.7	0.2
Maize in grains	38.4	5.0	1.1	0.3
Maize flour	158.2	5.8	1.8	.1
Imported rice	57.6	2.7	1.3	0.1
Tomatoes	17.1	3.3	0.6	0.1

* = significant at the 1 % level

B. Integration Between Retail Markets

Table 5 shows the level of retail prices of the nine most important retail markets in Kinshasa, where the average of all markets has been set equal to 100. There is a significant difference in prices between different retail markets. Some differences are apparently due to distribution systems for a particular product (e.g. beans are cheapest on Zomba-Zikida, close to the port where the beans from northern Zaire arrive) while for other price gaps, there is no conclusive explanation. Average differences in price levels between retail markets range from 31 percent for maize flour to 10 percent for imported rice. Agricultural product markets in Kinshasa are characterized by essentially identical commodities being sold at markedly different prices. The magnitudes of the price differences are sufficiently large that "location" or "service" differences cannot fully account for the observed price differences[6].

Based on the daily consumption of a household of eight persons in Kinshasa, the price of a food basket for each market is calculated. It is interesting to note that the price of this basket is highest on those markets which are not located near a semi-wholesale market, i.e. Marché Central, Lemba and Bandal. On those markets, the price level is 3 percent to 8 percent higher than the average of the city. Between the Marché Central and the market of Zomba-Zikida, there is a price difference of 9 percent for a distance of only 2 km. The difference in price level between the Lemba market and the Matete market (the nearest semi-wholesale market) is 12 percent.

[6] Stiglitz (1987) shows that with asymmetric information and positive search costs, theoretical models can be constructed that generate these kinds of price distributions.

Table 5: Indices of Price Levels of the Main Agricultural Products on Nine Retail Markets in Kinshasa during the Period 1984 - 1988 (Mean = 100)

	M.C.	Z.Z.	Gam	Y.S.	Lem	Mat	Mas	24N	Ban*
Cassava chips[7]	109	102	99	92	104	100	103	91	100
Cassava flour	113	103	100	93	106	99	104	83	106
Cassava roots	109	89	89	96	103	109	118	94	92
Chikwangue	110	101	96	91	106	97	101	97	106
Maize in grains	104	97	102	101	108	96	89	99	104
Maize flour	120	104	101	94	102	90	89	99	103
Local rice	94	94	96	103	105	96	107	102	103
Imported rice	97	96	98	101	104	96	106	101	102
Peanuts in shell	110	87	96	104	98	85	95	105	120
Peanuts grain	101	98	98	98	106	95	96	101	107
White beans	100	94	97	102	105	99	103	100	100
Colored beans	97	91	96	104	107	98	106	99	101
Bananas	110	105	102	94	102	84	93	102	108
Plantains	110	103	100	99	97	85	96	101	110
Cassava leaves	109	101	97	103	106	93	94	97	100
Biteku-teku	101	97	92	105	115	93	102	96	99
Ngai-ngai	105	95	95	102	115	93	93	100	102
Courge	111	101	98	97	108	101	91	94	100
Tomatoes	108	92	89	103	113	94	97	99	106
Potatoes	111	90	87	119	118	96	91	94	93
Basket	108	99	97	101	106	94	94	99	103

*: M.C. = Marché Central; Z.Z. = Zomba Zikida; Gam = Gambela; Y.S. = Yolo-Sud; Lem = Lemba; Mat = Matete; Mas = Masina; 24N = 24 Novembre; Ban = Bandal

[7] The difference in price level is partially explained by a difference in quality (cassava from Bandundu versus cassava from Bas-Zaire).

Price integration of the same product on different retail markets is tested using the co-integration approach for three important products: maize, cassava and beans. At the 5 percent level, maize and beans are I(1) on all markets. At the 1 percent level, all series are I(1).

To test for co-integration and short-run integration, the Marché Central for maize and cassava and Zikida for beans are chosen as the reference market and as the dependent variable. OLS estimates of the Ravallion type model may only be applied consistently to those equations for which the reference market is exogenous. The Marché Central as the biggest retail market and Zikida as the distribution center for beans are assumed to approach these exogenous conditions. The Dickey Fuller t-statistic to test for co-integration between price series shows that for maize and cassava, all retail markets are co-integrated with the Marché Central (Table 6). For white beans, at the 5 percent level three markets and at the 1 percent level five markets out of eight are co-integrated with the Zikida market. The hypothesis of weak and strong short-run integration is rejected for the three products on all markets given co-integration.

Table 6: Co-integration and Integration Tests for Maize Grains, White Beans and Cassava on Different Retail Markets in Kinshasa (1984-1986; Weekly Prices; Nominal; Three Lags)

	Dickey Fuller t-statistic* (co-integration)	F-values**	
		Weak short-run integration	Strong short-run integration
Maize grains:			
Bandal	-4.8	20.2	18.0
Bumbu	-3.9	8.1	8.0
Marché Central	dependent var.	-	-
Gambela	-4.2	17.4	16.0
Lemba	-5.4	5.9	5.5
Masina	-5.0	11.2	21.0
Matete	-4.1	9.3	10.4
Yolo	-4.7	3.8	3.4
Zikida	-4.8	12.7	11.3
White beans:			
Bandal	-4.8	3.6	4.2
Bumbu	-3.8	10.1	9.1
Marché Central	-4.5	8.9	8.3
Gambela	-4.4	5.5	5.4
Lemba	-3.6	20.3	28.6
Masina	-3.4	not co-int.	not co-int.
Matete	-3.5	not co-int.	not co-int.
Yolo	-3.5	not co-int.	not co-int.
Zikida	dependent var.	-	-
Cassava:			
Bandal	-4.8	7.7	7.0
Bumbu	-5.9	4.5	4.0
Marché Central	dependent var.	-	-
Gambela	-4.6	7.5	6.8
Lemba	-4.5	11.6	13.4
Masina	-4.4	10.67	16.6
Matete	-4.6	16.5	21.7
Yolo	-4.5	9.3	14.4
Zikida	-4.8	5.5	5.6

*: MacKinnon critical values: 1%-4.43
5%-3.84
10%-3.54
**: F^* (120,8) at 5 % = 2.02; F^* (120,9) at 5 % = 1.96

C. Integration Between Transformed Products and Substitutes

Engle and Granger (1987) argue that individual time series can wander extensively and yet some pairs of series may be expected to move so that they do not drift too far apart such as prices of the same commodity in different markets or close substitutes in the same market. Engle-Granger co-integration tests are done for related and transformed products (Table 7). At the retail level, maize grains - maize flour and imported rice - local rice are co-integrated. Only the products characterized by some kind of standardization (rice and maize) are co-integrated (rice is imported in standard bags and maize bags are standardized because trade is in the hands of one NGO and a few big traders). At the wholesale level, cassava from Bandundu and from Bas-Zaire[8] show a significant Dickey-Fuller t-statistic. Cassava from Bandundu and Bas-Zaire can be considered substitutes at the wholesale level while at the retail level, they are not co-integrated and are directed to different markets.

[8] The cassava chips from Bandundu are considered to be of a lower quality than the cassava chips from Bas-Zaire because of the higher expected losses (because of the shocks on the trips, the chips are more damaged from the longer trip from Bandundu than from Bas-Zaire) and a less white color (caused by drying in the sun or by smoke and by the water composition during the rettery of cassava).

Table 7: Engle-Granger Co-integration Tests for Transformed Products and Substitutes (Monthly Deflated Products; Four Lags; 1984-1989; DMPCC Data)

	Dickey-Fuller t-statistic	
	Trend	No Trend
Retail prices:		
Peanuts in shell, peanuts in grain	-2.42	-3.23
Plantains, bananas	-3.26	-2.72
White beans, colored beans	-3.78	-0.79
Cassava Bandundu, cassava Bas-Zaire	-2.13	-2.24
Cassava Bandundu, cassava flour	-2.83	-2.62
Cassava Bandundu, cassava roots	-3.09	-2.53
Cassava Bas-Zaire, chikwange	-3.52	-1.91
Maize grains, maize flour	-3.81	-3.61
Imported rice, local rice	-4.79	-3.94
Wholesale prices:		
Plantains, bananas	-2.53	-2.95
Cassava Bandundu, cassava Bas-Zaire	-4.15	-4.31
White beans, colored beans	-3.06	-2.42

MacKinnon Critical values:			
	trend	1 %	-4.56
		5 %	-3.93
		10 %	-3.60
	no trend	1 %	-4.06
		5 %	-3.42
		10 %	-3.11

D. Other Influences on the Retail Margin and on Price Transmission

Time within the marketing season represents important changes in demand and supply for seasonal commodities. Most direct retailing costs like taxes, the price of a table, transport, etc. do not have a seasonal component. Other costs which are more difficult to measure might fluctuate over the year. As the season progresses, availability of seasonal substitute products may increase. Because of lower quality (more humidity) and higher perishability during the wet season, marketing losses will be larger, which will increase the marketing margin.

Using the Ravallion approach, F-tests are performed to test for the significance of the different "other" variables in the X matrix of the co-integrated products using an ECM (Table 8). At the 1 percent level, seasonality for tomatoes and exchange rates for maize flour are found to be significant. Tomatoes are only produced during a limited period in the year and thin markets might be an explanation for the significant seasonality. Gasoline does not significantly affect the price transmission of the co-integrated products.

Table 8: F-values for Tests of Other Influences on Price Transmission between Wholesale and Retail Markets for the Co-integrated Agricultural Products in Kinshasa (Monthly Prices; Deflated; 1984-1989; Error Correction Model)

	Exchange Rate#	Gasoline	Seasonality
Peanuts grain	1.15	0.13	1.45
Bananas	0.23	0.25	1.25
Cassava BDD	0.52	1.50	0.23
Cassava BZ	0.36	0.88	0.28
Maize in grains	0.15	0.29	1.92
Maize flour	8.85*	0.01	3.32
Imported rice	0.05	0.46	0.66
Tomatoes	0.18	1.60	5.14*

#: parallel exchange rate
*: significant at the 1 % level

Seasonal indices are calculated for the distribution margin of all products. For some products, there is a seasonal movement in the distribution margin but this is not true for all products. The amplitude of the seasonal fluctuations in the margin is much larger than that in the retail prices but the stability of the movement is less. Of the 132 indices (11 products multiplied by 12 months), 28 are significant with a probability of 0.68 and 4 with a probability of 0.95 (Table 9). The amplitude varies from 122 percent for maize to 38 percent for regular bananas. The marketing margin is largest when retail prices are highest and smallest when retail prices are lowest.

Table 9: Amplitudes and Maximum and Minimum Periods for Seasonal Movements in the Retail Margin on the Markets of Kinshasa during the Period 1984-1989 (Monthly Prices)

Product	Amplitude in %	Minimum	Maximum	Significant indices (at 68 %)
Cassava Bandundu	42	August	February	3
Cassava Bas-Zaire	51	February	September	2
Corn	122	June	November	7
Rice	63	February	July	1
Peanuts	54	June	January	2
White Beans	95	October	February	2
Colored Beans	44	March	January	1
Tomatoes	84	October	May	5
Plantains	64	September	July	2
Bananas	38	February	June	1
Palm oil	57	December	September	2

Other price movements in retail prices exist. One is related to the timing of the payday (Minten, 1995). Cassava prices show monthly movements, i.e. the price at the end and at the beginning of the month is eleven percent higher than in the middle of the month. Most traders are aware of this movement and adjust to it. This means that the monthly movement in demand is even larger. This movement is caused by the fact that most consumers get their salary on a fixed date: government officials get it on the 20th of the month; workers in the private sector often receive an advance on the 15th of the month and the rest at the end; most workers in the informal sector are paid at the end of the month. This monthly movement is especially harmful for the poor because they purchase small quantities of food in small time intervals.

V. CONCLUSIONS

Retail margins of agricultural products make up a significant part of the final consumer price on the markets of Kinshasa. Price integration tests are performed between products, between retail markets and between wholesale and retail markets to better understand price behavior in these markets. Price integration is measured by incorporating the co-integration concept into the "classical" long-run and short-run test.

The main results are: 1. Between the wholesale and retail level, co-integration for some products is found. Although wholesale prices are input prices for retailers, strong and weak short-run integration with retail prices is generally absent. 2. Between retail markets price differences exist which do not reflect service or transportation costs. Retail markets located near semi-wholesale markets are characterized by lower prices. Most retail markets are co-integrated among each other for the most important products but no evidence for short-run integration is found. 3. No co-integration is found between transformed products and the raw material at the retail level, except for the transformation of maize from grain to flour. Local and imported rice are the only products that are co-integrated and can be considered close substitutes at the retail level. 4. No other factors influence significantly the wholesale - retail price transmission. Retail margins show large but unstable seasonal movements which might be a cause of food insecurity for the urban consumer.

Better access to price information could be a remedy for the lack of short-run integration. Kinshasa is characterized by a number of scattered semi-wholesale markets without adequate infrastructure. One or a small number of large public wholesale and retail markets could provide Kinshasa with a location where large numbers of wholesalers, retailers and even consumers can exchange goods. They can be a better way to bring buyers and sellers together with a more efficient price transmission mechanism and characterized by less spatial variability in prices. Second, public gathering and dissemination of information on food prices are likely to improve market performance. Marion (1986) shows in an empirical study on the impact of information on food prices that increased information leads to a more efficient allocation of resources, a reduction of price dispersion and a lowering of average retail prices.

REFERENCES

Alderman, H., Intercommodity Price Transmittal: Analysis of Food Markets in Ghana, Oxford Bulletin of Economics and Statistics, Vol. 55, No. 1, February 1993, pp. 43-64

Alexander, C., Wyeth, J., Co-integration and Market Integration: An Application to the Indonesian Rice Market, Journal of Development Studies, Vol. 30, No. 2, January 1994, pp. 303-328

Banerjee, A., Dolado, J., Galbraith, J.W., Hendry, D.F., Co-Integration, Error-Correction, and the Econometric Analysis of Non-Stationary Data, Oxford University Press, Oxford, 1993

Delgado, C.L., A Variance Components Approach to Food Grain Market Integration in Northern Nigeria, American Journal of Agricultural Economics, Vol. 68, 1986, pp. 970-979

Engle, R.F., Granger, C.W.J., Co-Integration and Error-Correction: Representation, Estimation, and Testing, Econometrica, Vol. 55, No. 2, March 1987, pp. 251-276

Faminow, M.D., Benson, B.L., Integration of Spatial Markets, American Journal of Agricultural Economics, Vol. 72, 1990, pp. 49-62

Goossens, F., Minten, B., Tollens, E., Nourrir Kinshasa: Une Etude de l'Approvissionement de la Ville de Kinshasa, K.U.Leuven - l'Harmattan, Paris, 1994, 397 p.

Hall, L.L., Tomek, W.G., Ruther, N.L., Kyereme, S.S., Case Studies in the Transmission of Farm Prices, Department of Agricultural Economics, Cornell University, Working Paper, 1981, pg.

Harriss, B., There is Method in My Madness: Or is it Vice Versa? Measuring Agricultural Market Performance, Food Research Institute Studies, Vol. 17, 1979, pp. 197-218

Heytens, P.J., Testing Market Integration, Food Research Studies, Vol. XX, No.1, 1986, pp. 25-41

Jones, W.O., Marketing Staple Food Crops in Tropical Africa, Cornell University Press, Ithaca, 1972

Lele, U., Food Grain Marketing in India: Private Performance and Public Policy, Cornell University Press, Ithaca, 1971

Marion, B.W., The Organization and Performance of the U.S. Food System, N.C. 117 Committee, Lexington Books, Lexington, Massachusetts, 1986

Meissner, F., Effective Food Marketing - A Tool for Socio-Economic Development in the Third World, Food Policy, Vol. 14, No. 2, May 1989, pp. 90-96

Minten, B.J., Price Transmission and Transaction Costs in a Liberalized Food Marketing System: the Case of Zaire, Ph.D. Dissertation, ARME, Cornell University, August 1995

Monke, E., Petzel, T., Market Integration: An Application to International Trade in Cotton, American Journal of Agricultural Economics, Vol. 66, No. 4, 1984, pp. 481-487

Palaskas, T.B., Harriss-White, B., Testing Market Integration: New Approaches with Case Material from the West Bengal Food Economy, Journal of Development Studies, Vol. 30, No. 1, October 1993, pp. 1-57

Petzel, T., Monke, E., The Integration of the International Rice Market, Food Research Institute Studies, Vol. 17, No. 3, 1979-1980, pp. 307-326

Ravallion, M., Testing Market Integration, American Journal of Agricultural Economics, february 1986, pp. 102-109

Sexton, R.J., Kling, C.L., Carman, H.F., Market Integration, Efficiency of Arbitrage, and Imperfect Competition: Methodology and Application to U.S. Celery, American Journal of Agricultural Economics, August 1991, pp. 568-580

Southworth, V.R., Jones, W.O., Pearson, S.R., Food Crop Marketing in the Atebubu District (Ghana), Food Research Institute Studies, Volume XVII, No. 2, 1979, pp. 157-197

Stiglitz, J.E., Competition and the Number of Firms in a Market: Are Duopolies More Competitive than Atomistic Markets?, Journal of Political Economy, Vol. 95, No. 5, 1987, pp. 1041-1061

Timmer, C.P., A Model of Rice Marketing Margins in Indonesia, Food Research Institute Studies, Vol. 13, No. 2, 1974, pp. 145-167

Timmer, C.P., The Corn Economy of Indonesia, Cornell University Press, Ithaca, NY, 1987

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