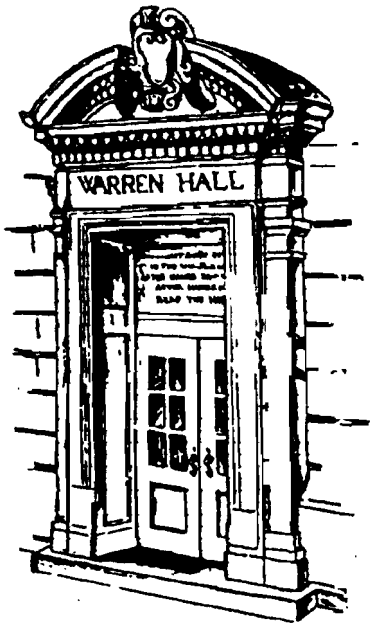

95-06

Staff Paper

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The Impact of International Prices and Exchange Rates on Domestic Food Prices in Zaire

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September 1995

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* Thanks to David Sahn and Lois Willett for helpful comments.

ABSTRACT

In sectoral trade analysis, agriculture is generally assumed to be a tradable sector. However, this is not the case within the time frame envisioned for policy reform programs in many developing countries. In this time frame, there are no agricultural products that can be classified as purely tradable or non-tradable. Evidence from Zaire shows that exchange rate changes have a differential impact on agricultural products depending on the characteristics of the product. The classification between tradable and non-tradable is not clear cut as the price of some non-tradables is also affected by changes in the international market or changes in the exchange rate.

I. INTRODUCTION

At the core of open economy models is the distinction between tradable and non-tradable goods and services. A good is considered non-tradable if domestic costs make the good too expensive to be exported but not expensive enough to be imported. Tradable goods are those that cross frontiers and, in theory, prices are then determined directly by world market conditions. International literature on the macroeconomics of agriculture states as one of its premises that agriculture is a tradable sector (see e.g. Krueger, Shiff, Valdes, 1988; Corden, 1985). This has implications for agricultural and food policy. Overvalued real exchange rates have been blamed in many African countries for the dramatic deterioration in agricultural sectors and trade balances. As a stylized fact, African countries overvalued their exchange rates which depressed the prices of tradables relative to non-tradables. The purpose was generally to lower the cost of food to urban consumers. This also implied a taxation of domestic agriculture. With more realistic exchange rates and with a shift of relative prices in favor of agriculture, the agricultural sector would be expected to perform better, producers would be better able to compete in international markets, and the elimination of implicit subsidies should cause imports of food and agricultural products to decline (World Bank, 1992; Jaeger, Humphreys, 1988).

Although the aggregation tradable - non-tradable simplifies the discussion and helps illuminate some important issues, it has limited empirical relevance (Mundlak et al., 1990). In the long run, it may be valid to regard agricultural response to macro policies as relative homogenous because substitution effects in consumption and production will tend to spread

the effect of these policies throughout the sector. However, this is not the case within the time frame envisioned for policy reform programs in many developing countries (Kyle, Swinnen, 1994). On the production side, structural impediments to trade such as poorly developed marketing networks are unlikely to change substantially over such a period. These impediments have heterogenous effects on different products because the prices of single products usually are determined by a different mix of domestic and traded components (Mundlak et al., 1990; Mundlak, Larson, 1992). On the demand side, marketing and transaction costs can greatly reduce the speed and extent of response to macro policy changes and cultural practices may decrease substitution elasticities. Hence, there are no products which can be classified as purely tradable or non-tradable. Understanding price transmission over time, across sectors or countries requires a measure of the share of the tradable component in the price of a product. This measure is useful in evaluating the response of micro prices to macro policies.

The purpose of this analysis is to try to understand the wide diversity in these responses. The specific questions we want to answer in this study is to what extent exchange rate changes have a different impact on prices of "tradable" and "non-tradable" agricultural products and to what extent and how fast world prices are transmitted. Price data from Zaire are used for the empirical tests. The structure of the chapter is as follows. First, the evolution of the exchange rate and agricultural trade in Zaire is discussed. Then, theoretical considerations are made. In a fourth section, the estimation procedures are explained. Section five presents the empirical results and section six summarizes the chapter.

II. ZAIRE AND AGRICULTURAL TRADE

A. The Exchange Rate

In many developing countries there have been quite significant parallel markets for foreign exchange at different times. The coverage and importance of these parallel markets vary from period to period. By the very nature of these markets - illegal or quasi-illegal - it is not possible to have accurate data on their volume of transactions and of their relative importance. Generally speaking, the parallel market premium will become higher as exchange controls become more pervasive and generalized and as fewer and fewer transactions are allowed through the parallel market (Edwards, 1988).

For most of the time after independence, the Zairian currency was grossly overvalued. An indication of this is the ratio of the parallel market exchange rate to the official exchange rate (Figure 1). The strongest appreciation of the Zaire occurred in 1978 and 1983. The turnaround in Zaire's adjustment effect came with the stabilization package adopted in September 1983 and implemented beginning in December 1983 (Tshishimbi, Glick, 1991). Before the 1983 reform, the Zairian economy unofficially operated under a multiple exchange rate system, with one legal and official rate and a number of semi-official as well as a multitude of unauthorized or illegal rates. In 1983, the government decided to unify the rates in the official market and to eliminate the spread between the official rate and the parallel markets. Initially, they succeeded and parallel market exchange rates were even below the official one after the devaluation of 1983. However, the gap gradually widened again. At the end of 1989,

parallel market exchange rates were 25 percent above the official exchange rates and by 1991, the parallel market premium exceeded 100 percent (Figure 1).

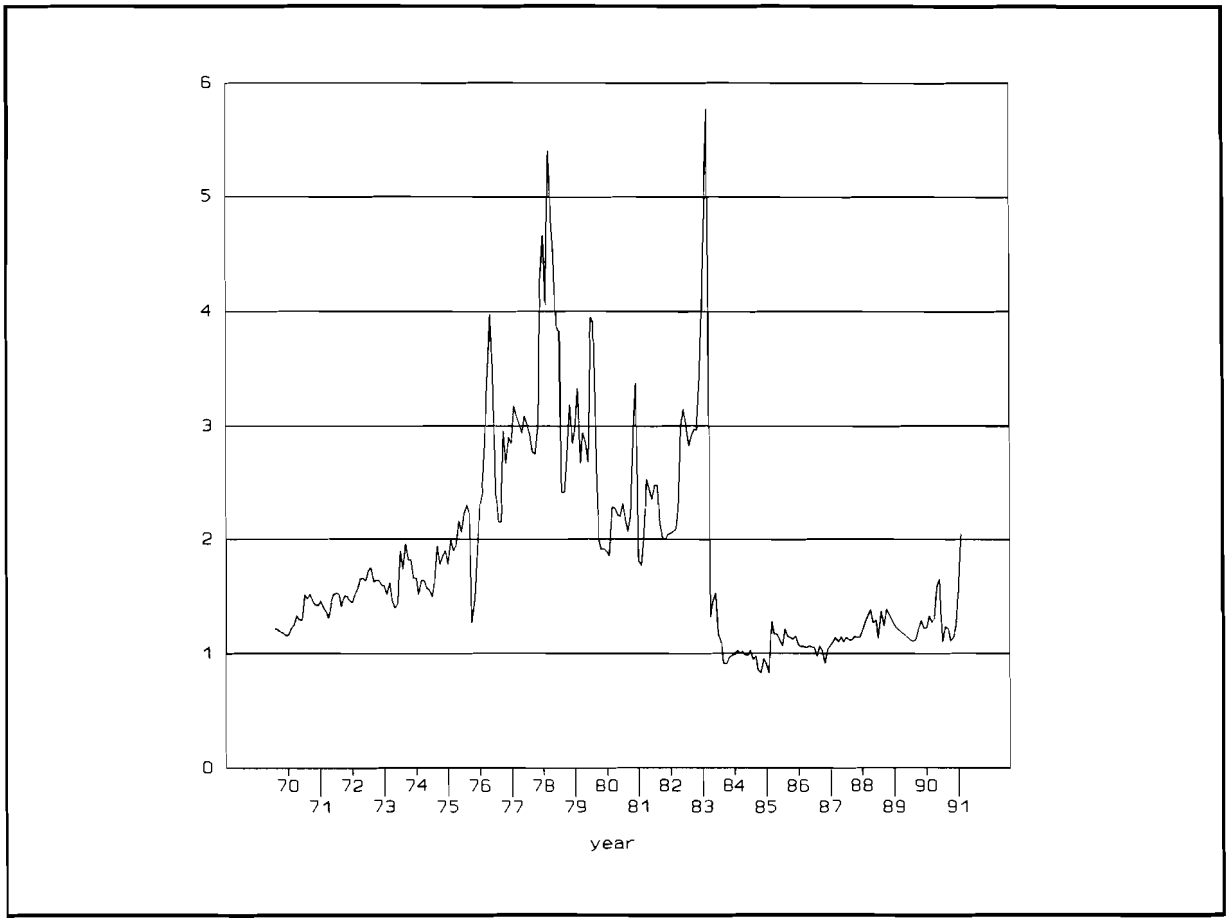

Figure 1: Ratio of the Parallel Exchange Rate to the Official Exchange Rate for Zaire from 1970 to 1990 (Source: IMF, International Financial Statistics Yearbook and Pick's Currency Yearbook, Various Issues)

Exchange rate policy is the central pillar of many adjustment programs that seek to

alter relative prices and raise incentives for producers[1]. The feasibility of effectuating and sustaining real devaluation, however, has been the subject of considerable debate. To evaluate the effect of a devaluation, the real exchange rate is used. The real exchange rate (e) is defined here, after Edwards (1988), as

$$e = \frac{E * P^T}{P^{NT}}$$

where E is the nominal exchange rate, P^T is the price of tradables, and P^{NT} is the price of non-tradables[2]. While countries have and continue to nominally depreciate their currencies, it has been argued that real exchange rate changes have not been so easy to achieve. This is because of the pressure that devaluation places on the prices of non-tradables, bringing about a general inflation that fails to raise significantly the prices of tradables relative to non-traded goods. Inflation rates in Zaire were low until 1974. They averaged 3 percent monthly for the period from 1974 to 1984 with exceptions for the peaks in 1978 and 1983. From 1984 on, inflation rates increased almost steadily until 1989. After the political and economic turmoil in recent years, inflation rates that reached 500 percent a month were not uncommon. Inflation rates are related to exchange rates in such a way that each nominal devaluation is followed by a sharp increase in inflation rates. Figure 2 shows the evolution of the real exchange rate (official

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[1] The importance of exchange rate policies for agriculture was recently illustrated by several authors. Using a SAM model for a Mexican village, Taylor and Adelman (1994) show that income effects are nearly three times larger for an exchange rate increase than for a staple price increase. Rouis et al. (1994) show that aggregate agriculture supply elasticities with respect to price incentives, including real exchange rate depreciation, are positive in Sub-Saharan Africa and comparable to that in other parts of the developing world.

[2] A problem with this measure refers to choosing price indexes - or components of price indexes - that are good proxies for the price of tradables and non-tradables. Some authors suggest using the domestic consumer price index as a proxy for non-tradable prices, and a foreign wholesale or producer price index as a proxy for the world price of tradables. An additional problem involves choosing the correct E.

and parallel) in Zaire over the period 1970 to 1991. The level of the real official exchange rate increased significantly after the 1983 reform and parallel and official exchange rates were closely interlinked compared to the previous period.

B. Agricultural Trade

Food is imported in Zaire on a commercial and a concessional basis. Compared to other African countries, per capita food aid is low: 3.8 kg/capita compared to 7.1 kg/capita for Sub-Saharan Africa as a whole over the decade 1980-90. Most of the food aid is oriented towards the cities of Kinshasa and Lubumbashi and so has significant importance for these urban centers. Statistics for food imports in Zaire differ according to the source consulted, and need to be interpreted with caution. At the end of the eighties, total food imports amounted to 450 thousand tons per year, mainly consisting of cereals but also with significant quantities of fish, beef, poultry, and rice. In terms of import value, livestock products came first with an annual value between 25 and 30 million dollars, followed by fish (20 to 25 million dollars), wheat (commercial imports), wheat flour, sugar, rice and maize. If concessional wheat imports are added to the commercial wheat and wheat flour imports, they become the first item in import value.

Compared to the 1970s, the imports of maize and maize flour from Southern Africa have decreased substantially, declining from nearly two hundred thousand tons in the early seventies. Since 1985 official maize imports, commercial and concessional, have remained stable, averaging under 70 thousand tons annually (Table 1). However, there are still sizeable unrecorded imports from Zambia, estimated at 30 to 60 thousand tons per year in 1988 (Shapiro, Tollens, 1992).

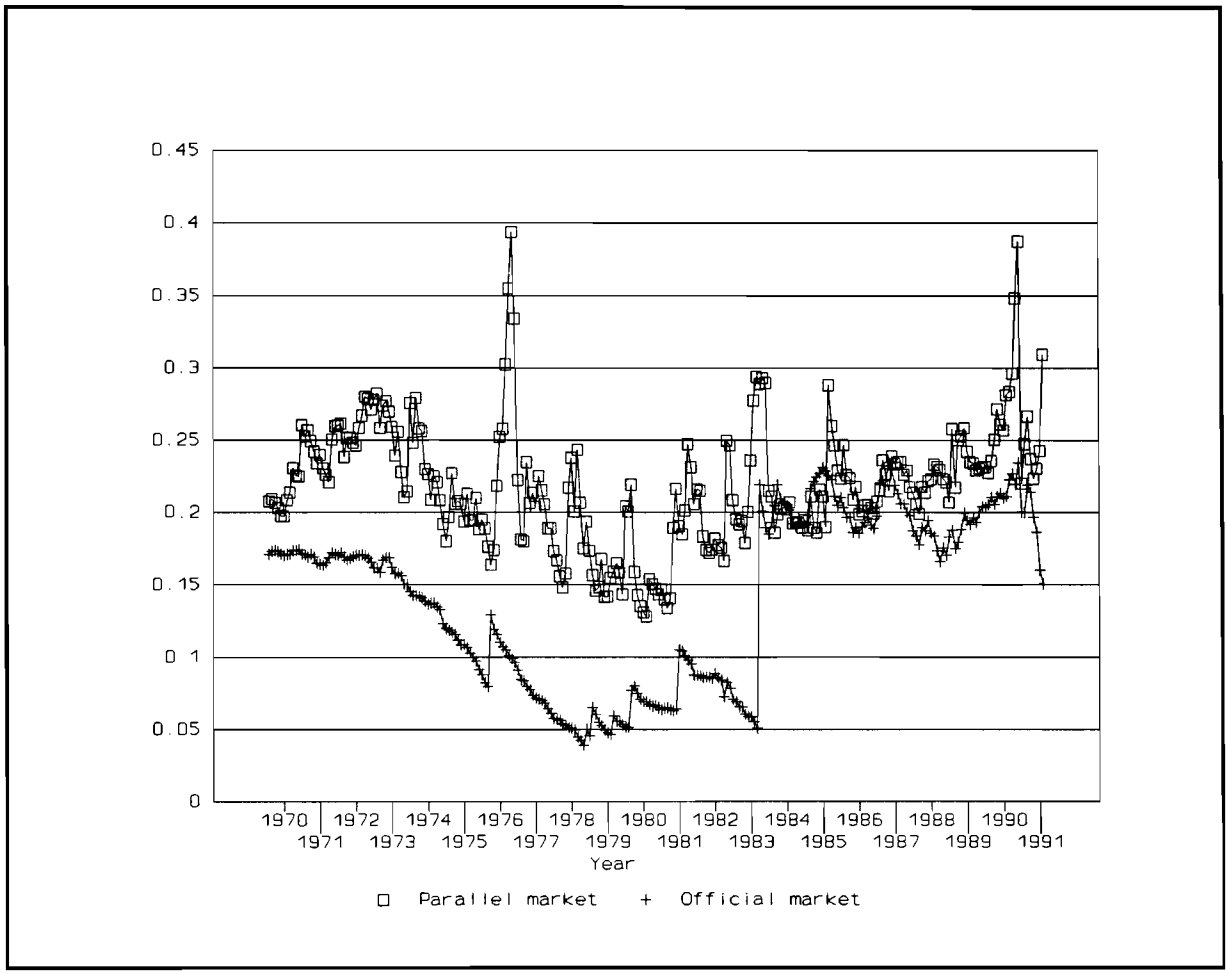

Figure 2: Official and Parallel Market Bilateral (with Respect to the U.S.) Real Exchange Rate Indexes[3] in Zaire from 1970 to 1991 (Source: Based on Data Obtained from Various Issues of Pick's Currency Yearbook, World Currency Yearbook, the Economic Report to the President (U.S.), the IRES-Index and Shapiro, Tollens (1992))

Rice imports are increasing steadily, mainly from Thailand and to a lesser extent, Uruguay and Taiwan. There have also been some PL 480 concessionary rice imports. Rice is

[3] In my calculations, I use the Producer Price Index of all finished goods in the U.S. as a proxy for the P^T and the IRES Consumer Price Index in Zaire as a proxy for P^{NT}. Since the CPI contains some tradables, it is not the ideal measure of P^{NT}. Still, the fact that consumer price indexes are heavily influenced by non-tradable goods and non-tradable activities, such as retail, make them a reasonable proxy for P^{NT} (Edwards, 1991).

considered a convenience food and its consumption is increasing rapidly particularly in rural areas which are well integrated in the marketing system like Bas-Zaire. Imported rice fetches a premium over domestically produced rice because of greater purity and uniformity in quality. This premium was around 20 to 30 percent over the 1984-1989 period. Since 1975, the US has accounted for a sizeable share of Zaire's wheat imports. The U.S. is the leading supplier of wheat to Zaire by means of both the Export Enhancement Program and the Pl-480 Title I, Concessional Sales for local currency. The European Union, especially France and Belgium, supply the rest of Zaire's wheat and flour needs. Wheat imports doubled from 140 thousand ton in the beginning of the eighties to 270 thousand tons in the beginning of the nineties. Local wheat production is very limited and does not reach Kinshasa or the Bas-Zaire markets where most of the wheat is consumed.

Zaire's exports are dominated by mineral products (copper, diamond, gold, etc.). In 1959, agricultural exports accounted for 40 percent of total exports but its share has been steadily declining since. Coffee is Zaire's most important agricultural export, accounting for 80 percent of agricultural export receipts and 9 percent of total exports in 1988. Other agricultural export products include rubber, tea, and cocoa. As is the case for all crops, poor marketing infrastructure constitutes a significant barrier to export. Another barrier is quality. OZACAF, which oversees pricing, production, and export sales of coffee, grades over 90 percent of exports as medium or below.

Table 1: Estimated Food Imports and Exports of Selected Crops (Thousands of Tons) from 1982-1990 in Zaire

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Imports:									
Maize	68	51	50	36	58	67	-	-	-
Wheat (total)	137	161	223	212	263	250	256	247	271
- Commercial	69	95	118	113	207	156	157	173	183
- Concessional	68	66	105	99	56	94	99	74	88
Rice (total)	33	35	35	42	105	137	100	156	51
- Commercial	30	32	32	42	105	52	85	94	43
- Concessional	3	3	3	0	0	85	15	62	8
Exports:									
Coffee	66	67	65	79	131	89	68	98	-

Source: Tollens, Shapiro, 1992; Zairian Ministry of Agriculture; SEP, 1988

III. THEORETICAL CONSIDERATIONS

There is a range of prices for which the commodity is non-tradable - i.e. neither an importable nor an exportable. This range is given by (Dornbusch, 1980):

$$P_x \leq \frac{P^*}{1 + q_v} - q_f < P_n < P^*(1 + q_v) + q_f \leq P_m$$

where P_x is the domestic price of an exportable, P_m is the domestic price of an importable, P_n is the domestic price of a non-tradable, P^* is the world market price, q_v are the variable marketing and transaction costs, and q_f are the fixed marketing and transaction costs. The magnitude of the non-tradable range depends on fixed costs, such as warehouses or refrigeration, as on variable costs, such as transport costs which depend on the number of units transported. If P^E is defined as the border price between exportables and non-tradables and P^I as the border price between non-tradables and importables, then $P^I - P^E$ is a measure of the magnitude of the non-tradable range. Taking derivatives with respect to fixed and variable

marketing and transaction costs gives:

$$\frac{\partial(P^I - P^E)}{\partial q_v} = \frac{(P^* - q_f)}{(1 + q_v)^2} + (P^* + q_f) > 0$$

$$\frac{\partial(P^I - P^E)}{\partial q_f} = (1 + q_v) + \frac{1}{(1 + q_v)} > 0$$

Hence, the non-tradable range increases with increasing marketing and transaction costs. The higher the volume in a given market, the lower per unit fixed costs will be and the more likely trade will occur.

It has been argued that the non-tradable price range is commodity specific (Kyle, 1992). Agricultural commodities are more likely to exhibit the characteristics of non-traded goods the smaller the size of the market, the more poorly developed the supporting transport infrastructure, the more fixed costs as refrigeration and warehouses, the higher the ratio of bulk to value, the more perishable the commodity, and the more quickly existing sellers can change prices. A product may also exhibit different degrees of tradedness at the micro level due to different degrees of marketing and transaction services embodied in the product at the point of wholesale or retail sale. Kyle and Swinnen (1994) link commodity specific reactions to the concept of contestable markets. A potential competitor keeps the existing producers honest in the sense that they must price according to competitive conditions even in the absence of visible competition. The presence of large fixed costs in production or marketing of a specific commodity can cause a market to be uncontested.

The tradability is not only commodity specific, it can also change in space and over time. Depending on the institutional and physical infrastructure, marketing and transaction costs can be rather high which implies substantial variation in the degree of tradedness of agricultural commodities in different regions of a country depending on the location of consumption and production. Because of the deterioration of marketing infrastructure, this is

a major problem in Sub-Saharan Africa. A second issue is that the tradability of a commodity can change over time. It can cross boundaries and move from being non-tradable to being either an exportable or an importable[4].

An implication of the difference in tradability of agricultural goods is a differential impact of changes in the exchange rate on domestic agricultural prices. In a classical and simple model of an economy that produces and uses non-tradables (X_0) and tradable (X_1) goods, the total value of production is defined as (Bruno, 1976):

$$TVP = p_0X_0 + p_1X_1$$

where p_i is the domestic price. The negative slope of the production possibility curve (PPC) $\partial X_0/\partial X_1$ at any point measures the marginal rate of substitution in aggregate production between X_0 and X_1, which has the dimension of a real rate of exchange ($=e$). If the PPC is assumed to have a well-behaved convex shape, the following price and output responses are obtained for an increase in e (Bruno, 1976):

$$\frac{\partial X_0}{\partial e} < 0; \frac{\partial X_1}{\partial e} > 0; \frac{\partial p_0}{\partial e} < 0; \frac{\partial p_1}{\partial e} > 0$$

An exchange rate devaluation increases the production of tradables, decreases the production of non-tradables, increases the price of tradables and decreases the (relative) price of non-tradables.

Hopkins (1992) extends this analysis to a three sector open economy model with a tradable and non-tradable agricultural sector and an industrial sector. If agricultural goods are tradable, the effects of a devaluation are straightforward. As a result domestic prices and output

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[4] The case of palm oil in Zaire is an interesting one: over time, it moved from an exportable (Zaire was one of the largest world producers of palm oil in the 1950s and 1960s) to a non-tradable to an importable (at the end of the 1980s, Malaysian palm oil was found on Zairian markets). The same is true for cotton and groundnut oil.

shift up and there is a reduction in the quantity of imports. The effect of a devaluation on non-tradable agricultural products is uncertain. If the substitution effects between tradable and non-tradable agricultural goods are more important than the negative income effect due to a fall in labor incomes, a devaluation will have a positive impact on the price of non-tradables. If the negative income effect is greater than the substitution effect, the impact of a devaluation on the price of non-tradable agricultural products is uncertain.

IV. ESTIMATION PROCEDURES

A. Data

Food prices on five wholesale markets in Kinshasa were gathered by the Department of Markets, Prices and Rural Credit (DMPCC) and the K.U.Leuven-A.G.C.D. project in the Ministry of Agriculture during the period 1984 - 1989. Monthly prices are available for this whole period. World market prices, expressed in dollars, are found in several issues of the FAO Quarterly Bulletin. The proxies for the relevant world market prices are: rice, Thailand, broken, A1, super, FOB Bangkok; maize, USA, no. 2, yellow, FOB gulf; wheat, Hard Winter No 2, ordinary protein, FOB gulf[5]; potatoes, USA, average producer; cassava, Bangkok, wholesale, pellets; beans, UK, CIF; bananas, Hamburg, FOB, Central America, importer to wholesale; peanuts, Europe, CIF, any origin, shelled; palm oil, North Sea Ports, CIF, 5 % bulk, Sumatra/Malaysia; coffee, Robustas. Official exchange rates come out of IMF's International Financial Statistics Yearbook and parallel exchange rates are found in Pick's

[5] The retail price of bread was compared to the world market price of wheat.

Currency Yearbook and Shapiro, Tollens (1992)[6].

B. Estimation Procedures

If traded goods are arbitraged, an exchange rate change will result in prices for traded goods equaling across countries, i.e.

$$E_{kt}^{CIF} = E_t P_{kt}^{W}(1 + T)$$

where P_{kt}^{CIF} is the price of commodity k at time t at the border, P_{kt}^{W} is the world market price of commodity k at time t, E is the nominal exchange rate, and T are the net taxes. This equation is based on the assumption that the exchange rate is neither under- nor overvalued so that the difference between domestic and foreign inflation rates is fully reflected in E_t, and that there is no difference in product quality, marketing and transaction costs, and other domestic non-traded inputs.

Practically, the domestic price response to world prices and exchange rates is measured through estimation of the previous equation after taking logs and deflating (see Bejarano et al., 1993; Carter et al., 1990; Jabara, Schwartz, 1987):

where CPI^{Z}_{t} is the Consumer Price Index in Zaire, PPI^{W}_{t} is the Producer Price Index of all

[6] Surveys of the economic activity in border areas of Zaire, where more than sixty percent of the population and activities are concentrated, and sector studies of main goods traded at the regional level and with the rest of the world show that, overall, Zaire's trade with its African partners is more than ten times the trade recorded by Zaire itself as well as the Sub-Saharan countries, and that local imports and exports are significantly higher than what is shown in trade statistics. Depending on the years, between 30 to 60 percent of national coffee production is smuggled out of Zaire. Part of the food export and import is done via the parallel market. Especially in the Bandundu and Bas-Zaire region, food, especially cassava, is smuggled to Congo. In this case it is expected that food prices will react to changes in parallel market exchange rates instead of official exchange rates. This justifies the use of the parallel exchange rate in this analysis.

$$\ln\frac{P_{kt}^{CIF}}{CPI_t^Z} = \alpha + \beta\ln\frac{E_t * PPI_t^W}{CPI_t^Z} + \gamma\ln\frac{P_{kt}^W * (1 + T)}{PPI_t^W} + \epsilon_{kt}$$

finished goods in the U.S. and ϵ_t the error term. This equation can be re-expressed as:

$$\ln p_{kt}^{CIF} = \alpha + \beta\ln e_t + \gamma\ln p_{kt}^w(1 + t) + \epsilon_{kt}$$

ß is the exchange rate transmission elasticity. It is expected that ß > 0 for a tradable product and has an uncertain sign for non-tradable products. Domestic prices can be affected by exchange rate changes without being affected by the world price of that particular product because of substitution effects in consumption and production between different agricultural goods, because of a change in input costs like fertilizer and chemicals or because of changes in domestic marketing costs[7].

γ is the elasticity of the domestic price with respect to the world price or the world price elasticity of transmission. A value of 1 implies that the variations in the world prices are fully transmitted to the domestic prices whereas a value of 0 implies no transmission at all. There are several reasons why this elasticity would differ from 1 (Mundlak, Larson, 1992): a. omitted variables (specifically tax policy variables) are correlated with the world price; b.

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[7] This can be seen in the following equation. Suppose that domestic prices are determined by a tradable component and a non-tradable component, i.e.

$$\ln p_{kt}^{CIF} = \kappa_k(\alpha + \beta\ln e_t + \gamma\ln p_{kt}^w(1 + t) + \epsilon_{kt}) + (1 - \kappa_k)\ln p_t^d$$

where κ_k is the share of the tradable component in the price of commodity k and p_t^d is the aggregate price of the non-tradable (domestic) component. Under these conditions, the empirical transmission elasticity is a measure of $\kappa_k\beta$ and $\kappa_k\gamma$ and is thus smaller than would be expected if there were no domestic transportation, finance, storage, transaction, or other costs involved. However, although these are non-tradable services, they are to a certain extent influenced by international prices. This is particularly the case in Africa. Ahmed and Rustagi (1987) present evidence that the import content of marketing costs in Africa are double or triple that in Asia, reaching levels as high as 50 percent. Fuel, vehicles and spare parts are the principal tradable inputs.

measurement errors: the world price used in a given study can differ from the one pertinent for the particular country; c. the degree of tradedness of the different agricultural commodities, i.e. it is expected that $\gamma = 0$ for non-tradables and $\gamma = 1$ for perfect tradables.

In the empirical treatment of this equation, only observations for agricultural prices at the wholesale level in Kinshasa are available. As Kinshasa is 300 km away from the main port (Matadi), marketing and transaction costs have to be taken into consideration. Assume a markup relation exists as follows:

$$p_{kt} = p_{kt}^{CIF} * (1 + \tau)$$

where τ is the per unit transport cost from Matadi to Kinshasa, p_{kt} is the wholesale price in Kinshasa of commodity k at time t. Combined with the previous equations[8], we get:

$$\ln p_{kt} = \alpha + \beta \ln e_t + \gamma \ln p_{kt}^{W}(1 + t) + \eta \ln(1 + \tau) + \epsilon_{kt}$$

In the empirical estimation, a trend variable and seasonal dummies (because of changing road conditions and changing degree of competition) will be used as proxies for marketing and transaction costs.

To combine the effect of changes in international prices and the exchange rate, international prices can be expressed in domestic currency as follows:

$$\ln P_{kt} = \alpha + \gamma(\ln P_{kt}^{w}(1 + T) - \ln E_t) + \eta \ln(1 + \tau) + \epsilon_{kt}$$

In the case of non-tradable goods where no relevant world market price is available, P^W is defined as the weighted average of the international price of imported agricultural goods (see Hopkins, 1992).

If a set of variables requires differencing to be stationary and if the set of variables is

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[8] It is assumed in this analysis that international transportation costs did not change over the period 1984 - 1989 and hence that it is incorporated in the intercept.

co-integrated, then a VARIMA in differences will be mis-specified and an Error Correction Model (ECM) is necessary. A stationarity assumption is equivalent to saying that the generating mechanism of the process is itself time-invariant, so that neither the form nor the parameter values of the generation procedure change through time (Granger, Newbold, 1986). When domestic prices are co-integrated with world market prices and exchange rates, an ECM specification can be written as:

$$\Delta \ln p_{kt} = \beta \Delta \ln e_t + \gamma \Delta \ln p_{kt}^{W}(1 + t) + \eta \Delta \ln(1 + \tau) + c_1 z_{t-1} + \epsilon_{kt}$$

where z_{t-1} is the error correction term.

V. EMPIRICAL RESULTS

The empirical results are based on two types of models. First, a co-integration test is done and based on these results, a difference equation or error correction model is specified (Model A). Second, a Koyck model in levels is estimated with the purpose of incorporating partial adjustment effects (Model B).

Model A: Co-integration and Difference Equation

The order of integration for the different variables is measured using the Augmented Dickey-Fuller test. Most prices are integrated of order one, i.e. they become stationary after first differencing. An Engle-Granger co-integration test is then performed for wholesale prices as dependent and parallel exchange rate and world market prices as independent variables using a model with and without a trend variable. Except for maize, domestic wholesale prices, world market prices and exchange rates are not co-integrated based on the MacKinnon critical values of 10 percent (Table 2). Engle-Granger co-integration tests for domestic wholesale prices,

official exchange rates and a weighted basket of prices of imported food (rice, maize, wheat) confirm this result.

The bulk of the trade of maize is in the hands of a few big traders and a NGO (CDI-Bwamanda). Demand is not only for food purposes but also for industrial use, i.e. breweries. Trade in maize seems very well organized and apparently, this makes maize more subject to international conditions. It is remarkable that tradable products such as coffee, wheat and rice are not co-integrated with the exchange rate and world market prices. Lack of co-integration for coffee may be due to lack of liberalization. Although formally liberalized, most of the producers still perceive coffee prices as imposed by the government (SEP, 1987). An explanation for lack of co-integration for wheat and rice might be that imported rice and wheat constitute a big part of the food aid program which might dampen commercial transmission elasticities. For example, in 1986-87 US exporters sold wheat and wheat flour to Zaire under the Export Enhancement Program, receiving an announced bonus of approximately $23 per ton, or 20 percent less than world market prices (Ames, Mukendi, 1990)[9]. Another factor is that monthly periods might not be the appropriate time interval to measure this transmission. Lack of co-integration justifies an estimation of the first difference equation without error correction terms (except for maize).

[9] The export bonuses for Zaire declined to $13.48 per ton in 1989, reflecting changing world market conditions. EEP bonuses were available for approximately 40 percent of Zaire's wheat imports but shortages of foreign exchange limited the share of the market supplied by EEP-subsidized wheat (Ames, Mukendi, 1990).

Table 2: Engle-Granger Co-integration Test for Wholesale Prices as Dependent and Exchange Rates and World Market Prices as Independent Variables (Deflated Prices; 1984-1989; Four Lags)

	Trend			No trend		
	Co-integrating vector		t-statistic[a]	Co-integrating vector		t-statistic
Wholesale prices	exchange rate	world price		exchange rate	world price	
Peanuts in shell	-0.94	-0.01	-3.90	-0.97	0.09	-3.79
Bananas	-1.96	0.02	-3.29	-1.29	0.23	-2.17
Cassava BDD	-0.46	0.30	-2.43	0.23	0.56	-3.27
Cassava BZ	-0.39	0.41	-2.46	0.59	0.59	-2.77
White Beans	-1.14	-0.13	-3.21	-0.50	-0.13	-1.76
Bread[**]	-0.02	-0.20	-2.66	-0.07	-0.17	-2.35
Plantains	-1.42	0.22	-2.69	-1.28	0.26	-2.57
Palm oil	-0.93	-0.37	-2.91	-0.21	-0.62	-2.92
Maize	-0.66	-0.31	-4.25	-0.36	-0.47	-4.60
Potatoes	-1.45	0.006	-2.69	-1.28	-0.01	-2.42
Local rice	-0.64	-0.36	-3.42	-2.94	-0.42	-2.95
Imported rice[*]	-0.69	-0.46	-3.77	-0.40	-0.52	-3.32
Coffee[**]	-0.25	0.14	-2.72	-0.37	-0.14	-1.33

[a] = Dickey-Fuller t-statistic
[*] = retail level prices
[**] = retail level prices, January 1971 - December 1988
MacKinnon critical values: a. trend: 1 %, -5.00; 5 %, -4.33; 10 %, -3.99. b. no trend: 1 %, -4.54; 5 %, -3.89; 10 %, -3.56.

The result of the regression of the difference equation with deflated domestic wholesale prices as dependent and real parallel exchange rates and deflated international prices as independent variables are shown in Table 3[10]. Seemingly Unrelated Regression (SUR) is used for estimation in this analysis to account for the possible contemporaneous correlation of error terms across equations. Four lags are incorporated for the exchange rate and international

[10] In the case of a "non-tradable", i.e. a Zairian good that is neither imported nor exported, international prices were proxied by a weighted average, based on the importance in actual imports in 1987, of the price of the imported foods (i.e. maize, wheat, and rice). Non-tradables were also regressed on their respective international price. This did not change the results significantly. The problem of quality differences in domestic goods and world market goods posed a problem for the latter approach. Relevant time series for the "correct" world market price are difficult to get. Hence, it is expected that there is bias in the estimation of the world price elasticity of transmission due to measurement errors. It is acknowledged that the non-availability of relevant time series may mask some existing price transmissions. For example, most coffee in Zaire is of very poor quality and the retail price might be a very poor indicator. Imported palm oil form Malaysia is refined palm oil while local palm oil is crude and unrefined.

prices, based on the results of the Koyck model. Peanuts, bananas, palm oil, maize, bread[11], potatoes, and rice are significantly affected by the exchange rate as measured by the t-statistic; bread, white beans, cassava, coffee and rice are affected by the world market price. All of the significant coefficients show the right sign, i.e. a depreciation of the real exchange rate increases the domestic price of the agricultural good. Potatoes and rice are the only products that show a contemporaneous impact of the exchange rate or the world market price. In all cases, the influence of exchange rate and international prices is small as none of the coefficients, except for white beans, have a value higher than 1, i.e. a change in world market prices or real exchange rates is only partially transmitted to domestic prices. It must be noted that the explanatory power of most regressions is low which is not uncommon for first difference regressions.

[11] For coffee and bread, there was a price series available from 1970 to 1988 but only at the retail level. Because of the different time period, these two regressions were estimated in a separate SUR system.

Table 3: Seemingly Unrelated Regression for a System of Difference Equations for the Estimation of Exchange Rate and World Price Transmission Elasticity for Domestic Wholesale Food Market Prices in Kinshasa during the Period January 1984 - December 1989 (t-Values are Given in Brackets; Real Values)

Independent variables	Dependent variable: $\Delta \ln p_t$						
	Peanuts	Bananas	Cassava BDD	Cassava BZ	White Beans	Bread**	Plantains
Intercept	-0.01 (-0.25)	-0.01 (-0.30)	0.08 (2.51)	0.06 (1.94)	0.04 (1.11)	0.00 (0.10)	-0.05 (-0.81)
$\Delta \ln e_t$	-0.03 (-0.17)	0.45 (1.22)	0.22 (1.07)	0.14 (0.79)	0.18 (0.76)	0.05 (0.76)	0.17 (0.47)
$\Delta \ln e_{t-1}$	0.27 (1.20)	0.75 (1.85)	0.23 (1.01)	0.24 (1.20)	0.03 (0.10)	0.03 (0.50)	-0.00 (-0.02)
$\Delta \ln e_{t-2}$	0.36 (1.49)	0.11 (0.25)	-0.04 (-0.15)	0.20 (0.97)	-0.01 (-0.03)	0.13 (2.01)	0.15 (0.36)
$\Delta \ln e_{t-3}$	0.45 (1.73)	0.05 (0.11)	-0.32 (-1.29)	-0.08 (-0.38)	-0.34 (-1.15)	0.04 (0.66)	0.68 (1.49)
$\Delta \ln e_{t-4}$	-0.04 (-0.17)	0.20 (0.47)	-0.31 (-1.28)	-0.25 (-1.20)	-0.10 (-0.36)	0.01 (0.24)	0.45 (1.03)
$\Delta \ln p_t^W$	-0.77 (-1.48)	0.29 (0.33)	0.39 (0.78)	0.37 (0.87)	-0.26 (-0.43)	-0.01 (-0.12)	0.50 (0.55)
$\Delta \ln p_{t-1}^W$	0.20 (0.40)	-0.64 (-0.75)	0.18 (0.38)	0.17 (0.42)	0.52 (0.93)	0.25 (1.85)	-1.10 (-1.29)
$\Delta \ln p_{t-2}^W$	0.18 (0.37)	0.28 (0.34)	-0.36 (-0.77)	-0.31 (-0.76)	-0.06 (-0.11)	-0.09 (-0.72)	-0.64 (-0.75)
$\Delta \ln p_{t-3}^W$	-0.50 (-1.05)	-0.60 (-0.72)	-0.15 (-0.34)	-0.17 (-0.44)	1.04 (1.90)	0.07 (0.49)	0.11 (0.14)
$\Delta \ln p_{t-4}^W$	0.62 (1.33)	0.79 (0.98)	0.53 (1.20)	0.68 (1.77)	-0.16 (-0.29)	-0.04 (-0.33)	0.89 (1.10)
S_1	-0.07 (-1.59)	0.02 (0.20)	-0.12 (-2.51)	-0.10 (-2.22)	-0.16 (-2.85)	-0.01 (-0.60)	0.04 (0.45)
S_2	0.05 (1.05)	0.03 (0.36)	-0.12 (-2.69)	-0.08 (-1.89)	0.06 (1.12)	-0.00 (-0.24)	-0.03 (-0.31)
S_3	0.06 (1.35)	0.04 (0.51)	-0.11 (-2.38)	-0.07 (-1.67)	-0.05 (-1.00)	0.01 (0.43)	0.21 (2.57)
R^2	0.35	0.15	0.22	0.25	0.40	0.04	0.33
Durbin-Watson stat	2.30	2.48	2.42	1.65	2.56	2.03	2.32

* = retail level prices

** = retail level prices, January 1971 - December 1988, estimated in a separate SUR

BDD = Bandundu

BZ = Bas-Zaire

S_1, S_2, S_3 are seasonal dummies for months 1 to 3, 4 to 6, 7 to 9 respectively.

Table 3: (continued)

Independent variables	Dependent variable: $\Delta \ln p_t$					
	Palm oil	Maize***	Potatoes	Local rice	Imported Rice*	Coffee**
Intercept	-0.00 (-0.18)	-1.81 (-2.88)	0.06 (0.76)	0.01 (0.22)	-0.01 (-0.37)	-0.01 (-2.03)
$\Delta \ln e_t$	0.14 (0.99)	0.17 (1.18)	0.78 (1.69)	0.39 (1.86)	0.14 (0.59)	0.04 (1.08)
$\Delta \ln e_{t-1}$	0.17 (1.10)	0.15 (0.76)	0.28 (0.55)	-0.05 (-0.23)	-0.18 (-0.72)	-0.00 (-0.14)
$\Delta \ln e_{t-2}$	0.48 (3.00)	0.42 (2.15)	-0.01 (-0.02)	-0.17 (-0.68)	-0.28 (-1.12)	-0.03 (-0.81)
$\Delta \ln e_{t-3}$	-0.18 (-1.08)	0.33 (1.74)	-0.44 (-0.76)	-0.19 (-0.74)	-0.10 (-0.37)	0.00 (0.03)
$\Delta \ln e_{t-4}$	-0.10 (-0.60)	-0.10 (-0.52)	-0.31 (-0.58)	-0.02 (-0.09)	-0.02 (-0.08)	-0.01 (0.19)
$\Delta \ln p_t^W$	-0.35 (-1.02)	0.01 (0.06)	0.02 (0.02)	-0.34 (-0.82)	-0.17 (-0.61)	0.10 (1.80)
$\Delta \ln p_{t-1}^W$	0.47 (1.47)	0.16 (0.87)	0.46 (0.42)	0.34 (0.89)	0.16 (0.53)	0.00 (0.05)
$\Delta \ln p_{t-2}^W$	0.18 (0.57)	0.10 (0.60)	-0.20 (-0.18)	0.27 (0.74)	0.68 (2.07)	0.03 (0.46)
$\Delta \ln p_{t-3}^W$	-0.03 (-0.10)	-0.17 (-0.95)	0.25 (0.23)	0.02 (0.06)	-0.43 (-1.39)	0.03 (0.56)
$\Delta \ln p_{t-4}^W$	0.36 (1.17)	-0.04 (-0.22)	-0.23 (-0.22)	-0.30 (-0.83)	0.31 (1.11)	-0.00 (-0.08)
S_1	-0.03 (-0.80)	-0.04 (-1.30)	-0.05 (-0.47)	0.06 (1.34)	0.09 (1.59)	0.03 (2.38)
S_2	-0.02 (-0.70)	-0.11 (-2.91)	-0.14 (-1.40)	-0.07 (-1.40)	-0.00 (-0.06)	0.01 (1.04)
S_3	0.00 (0.30)	-0.04 (-1.17)	-0.01 (-0.06)	-0.02 (-0.39)	0.01 (0.16)	0.02 (1.75)
R^2	0.40	0.53	0.13	0.30	0.27	0.07
Durbin-Watson stat.	2.16	1.69	2.88	2.04	1.92	1.71

* = retail level prices
** = retail level prices, January 1971 - December 1988, estimated in a separate SUR
*** = Error correction model
BDD = Bandundu
BZ = Bas-Zaire
S_1, S_2, S_3 are seasonal dummies for months 1 to 3, 4 to 6, 7 to 9 respectively.

In order to more fully explore the role of lagged exchange rates and lagged international prices, a polynomial distributed lag model (or Almon lag) was specified. A second-order polynomial with four lags was used with an endpoint constraint equal to zero. None of the products, except for rice and coffee, shows a significant overall effect for the exchange rate and the international price measured through the t-statistic. More lags were incorporated in the polynomial function, a nominal specification was used, an unconstrained polynomial was specified, and the weighted sum of international prices of actual imported products was replaced by the respective international price of the non-tradable but this did not alter the results significantly (Minten, 1995).

Model B: The Koyck model

Table 4 shows the results of the regression in levels of domestic prices on exchange rate and world market prices[12]. All the regressions are estimated using a Seemingly Unrelated Regression system. The h-statistic (Durbin's test I) is calculated to test for autocorrelation. Only for cassava from Bas-Zaire can autocorrelation not be rejected (h=2.46). In the case of autocorrelation and lagged dependent variables consistent estimates can be obtained by the method of instrumental variables. A frequent choice for the instrumental variable for the lagged dependent variable is the lagged independent variable (Greene, 1993). This technique is applied to the regression for cassava from Bas-Zaire.

The empirical results confirm partially the results of the difference equation specification and reflect the differential impact of changes in exchange rates on the domestic prices of the different products. Table 4 shows the results of the regression for thirteen

[12] The level regression was estimated with a trend variable and the difference specification without. It can easily be shown that after differencing the trend variable is incorporated in the intercept.

products. Seven out of thirteen (peanuts, bananas, bread, maize, potatoes, rice, and coffee) are significant at the 10 percent level with respect to the exchange rate transmission. All tradables (except for imported rice) are significantly affected by changes in the exchange rate. Three non-tradables (peanuts, bananas, potatoes) are affected as well. Using the partial adjustment or Koyck approach, short-run and long-run elasticities are calculated for the significant coefficients and compared to the impact measured by the difference equation (Table 5). The magnitude of the two estimates are comparable. All coefficients show the expected sign. An increase of 1 percent in the exchange rate raises the price of bananas and peanuts by more than 1 percent in the long run: 1.21 percent and 1.97 percent respectively. These products are very sensitive to exchange rate changes. Potatoes are close to a unit exchange rate transmission elasticity. Total adjustment (at the 10 percent level) to changing exchange rates is done within five months for all products.

Because of the high value of the coefficient on the lagged dependent variable, long-run elasticities for coffee and bread are not calculated. This high value is partly explained by the longer time period used in the analysis, including the period before liberalization when prices for coffee were set at a fixed level by the government. Six out of thirteen (maize, potatoes, rice, coffee, cassava) are significant with respect to the world price transmission elasticity. Even for those products that are significant, a change in the world price is only partially transmitted.

Table 4: Coefficient Estimates for Exchange Rate and World Price Transmission Elasticity for Domestic Wholesale Food Market Prices in Kinshasa during the Period January 1984 - December 1989 (t-Values are Given in Brackets; Real Values; Seemingly Unrelated Regression)

Independent variables	Dependent variable: ln p_t						
	Peanuts	Bananas	Cassava BDD	Cassava BZ**	White Beans	Bread***	Plan-tains
Intercept	-2.55 (-3.17)	-4.62 (-3.81)	-1.25 (-2.03)	-1.80 (-1.80)	-1.08 (-1.32)	-0.31 (-2.16)	-1.78 (-1.62)
ln e_t	0.48 (2.58)	0.87 (3.01)	0.11 (0.72)	0.06 (0.25)	0.21 (1.03)	0.07 (1.95)	0.24 (0.85)
ln p_t^w	-0.06 (-0.40)	0.05 (0.21)	0.27 (1.86)	0.83 (2.46)	0.16 (0.97)	0.04 (1.49)	0.39 (1.55)
S_1	-0.13 (-3.20)	-0.00 (-0.00)	-0.03 (-0.91)	0.01 (0.26)	-0.14 (-3.30)	-0.02 (-1.04)	-0.03 (-0.50)
S_2	-0.06 (-1.30)	0.02 (0.30)	-0.08 (-2.26)	-0.11 (-2.11)	0.03 (0.72)	-0.00 (-0.24)	-0.11 (-1.71)
S_3	0.00 (0.01)	0.06 (0.91)	-0.08 (-2.10)	-0.13 (-2.22)	-0.02 (-0.50)	-0.01 (-0.39)	0.13 (1.84)
ln $Trend_t$	-0.01 (-0.52)	-0.05 (-1.12)	-0.06 (-1.89)	-0.09 (-1.67)	-0.02 (-0.68)	-0.01 (-1.16)	0.04 (0.72)
ln p_{t-1}	0.62 (7.01)	0.56 (6.59)	0.57 (7.66)	0.08 (0.26)	0.68 (8.60)	0.93 (41.30)	0.68 (9.24)
R^2 DW stat	0.79 1.93	0.71 2.25	0.83 1.99	0.68 1.52	0.75 2.20	0.95 1.99	0.76 1.96

* = retail level prices
** = Two Stage Least Square Estimation
*** = retail level prices, January 1971 - December 1988, estimated in a separate SUR
BDD = Bandundu
BZ = Bas-Zaire
S_1, S_2, S_3 are seasonal dummies for months 1 to 3, 4 to 6, 7 to 9 respectively.

Table 4: (continued)

Independent variables	Dependent variable: ln p_t					
	Palm oil	Maize	Potatoes	Local rice	Imported rice*	Coffee***
Intercept	-0.65 (-1.31)	-2.63 (-4.48)	-5.22 (-5.35)	-1.94 (-3.11)	-1.36 (-1.99)	-0.25 (-2.10)
ln e_t	0.12 (0.91)	0.38 (2.99)	0.90 (3.72)	0.29 (1.91)	0.19 (1.17)	0.04 (1.87)
ln p_t^W	0.16 (1.31)	0.15 (1.78)	0.60 (2.80)	0.20 (1.59)	0.20 (2.76)	0.03 (2.71)
S_1	-0.03 (-0.89)	-0.05 (-1.63)	0.02 (0.42)	0.09 (2.45)	0.08 (2.00)	0.03 (2.87)
S_2	-0.04 (-1.25)	-0.13 (-3.71)	-0.16 (-2.95)	-0.00 (-0.02)	0.01 (0.27)	0.01 (1.40)
S_3	0.01 (0.45)	-0.05 (-1.30)	-0.02 (-0.30)	0.01 (0.29)	0.01 (0.25)	0.02 (1.98)
ln $Trend_t$	-0.06 (-2.14)	-0.04 (-1.36)	0.02 (0.50)	-0.01 (-0.48)	-0.00 (-0.09)	0.00 (0.24)
ln p_{t-1}	0.77 (12.61)	0.47 (5.63)	-0.01 (-0.09)	0.56 (7.70)	0.64 (9.28)	0.97 (58.88)
R^2 DW stat.	0.92 2.06	0.77 2.09	0.69 2.05	0.77 1.78	0.79 1.73	0.95 1.75

* = retail level prices
** = Two Stage Least Square Estimation
*** = retail level prices, January 1971 - December 1988, estimated in a separate SUR
BDD = Bandundu
BZ = Bas-Zaire
S_1, S_2, S_3 are seasonal dummies for months 1 to 3, 4 to 6, 7 to 9 respectively.

Table 5: Exchange Rate Transmission Elasticity of the Main Agricultural Products at the Wholesale Level in Kinshasa (Zaire) during the Period January 1984 - December 1989

Product	Difference equation	Koyck model	
		Short-run	Long-run
Peanuts	0.45	0.48	1.26
Plantains	n.s.	n.s.	n.s.
Bananas	0.75	0.87	1.97
Cassava Bandundu	n.s.	n.s.	n.s.
Cassava Bas-Zaire	n.s.	n.s.	n.s.
White Beans	n.s.	n.s.	n.s.
Palm oil	0.48	n.s.	n.s.
Maize	0.75	0.38	0.72
Potatoes	0.79	0.90	0.90
Local rice	0.39	0.29	0.66
Imported rice*	n.s.	n.s.	n.s.
Coffee**	n.s.	0.04	-
Bread**	0.13	0.07	-

n.s. = not significant
* = retail level prices
** = retail level prices, January 1971 - December 1988

The domestic price of imported rice is affected by world market prices and not by exchange rates. This seemingly illogical result might be explained by the fact that the parallel exchange rate might not be a good proxy of the actual exchange rate for this commodity. The same problem exists for cassava. Given that the world market price is proxied by a basket of prices of imported goods, substitution effects may account for this. This might also mean that low prices of maize, rice and wheat depress the price of cassava. A 1 percent increase of the price of imported food increases the price of cassava with 0.27 percent and 0.83 percent for cassava from Bandundu and Bas-Zaire respectively. Other domestic prices (rice, peanuts, bananas, bread) are influenced by exchange rates and not by world market prices. Substitution effects and the influence of the exchange rate on marketing and transaction costs, embedded

in the final price of the product, can explain this phenomenon. To combine the effect of changes in international prices and in the exchange rate, a regression was run where the international prices of all products were converted in Zaires. In that case, none of the products was significantly affected by the price of its international complement. This confirms the influence of exchange rates on domestic prices through other effects than the world market price of that particular good, i.e. through input cost, marketing costs, substitution, etc.

VI. CONCLUSIONS

This paper deals with the influence of macro-policies and more specifically exchange rates on domestic agricultural prices in Zaire. It is argued that exchange rate changes have a differential impact on agricultural product prices depending on the characteristics of the product. Except for maize, no product is significantly co-integrated with exchange rates and world market prices. Based on a difference equation specification and a Koyck model, almost all tradables are significantly affected by changes in the exchange rate and some non-tradables are affected as well. Hence, the classification between tradables and non-tradables based on exchange rate responses is not clear cut as the price of non-tradables is also affected by changes in the international market or changes in the exchange rate.

World price changes and exchange rate changes are never fully transmitted to domestic prices. In general, the impact of exchange rate policies is less than that in a variety of other countries. For example, Mundlak and Larson (1992) estimate that for most countries about 70 to 80 percent of the variations in world prices for tradable products, depending on the commodity, are transmitted to domestic prices. The magnitude of the impact of price and exchange rate reforms in Zaire may thus be exaggerated. Other factors such as inefficient government involvement in marketing, cumbersome custom procedures, imperfect

information, corruption, taxes, deficient infrastructure, credit services, politics and other as yet unidentified factors are of much greater importance in determining price transmission from international to domestic markets.

The fact that there is a differential impact within agriculture to real exchange rates and to world market prices has implications for policy packages. First, people who produce or consume certain commodities may be affected by macro policies differently than others. The differential impact indicates that complementary policies may be required to achieve desired results for some agricultural subsectors. Second, because not only prices of tradables (importables and exportables) are affected by exchange rate changes but also the prices of non-tradables, food security considerations have to be adapted.

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