Effects of real exchange rate and gross domestic product on yam exports in Ghana

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ABSTRACT
The objective of this paper was to evaluate the responsiveness of Ghana's fresh yam export supply to real exchange rate and national income (GDP) with the use of time series data from 1990 to 2004. Data collected from various secondary sources were fitted into econometric models in linear, semi-log and double-logarithmic functional forms by employing the Ordinary Least Squares (OLS) method. The study found that generally, there has been an increasing trend in Ghanaian yam production and export levels at average annual growth rates of 18% and 17% respectively. Real exchange rate and per capita GDP were found to significantly ($P<0.05$) influence annual yam exports positively. Yam export was found to have an inelastic response to changes in real exchange rate and GDP per capita. The government of Ghana should formulate and implement policies that will lead to prudent exchange rate management and substantial expansion of the economy so as to boost yam exports to generate foreign exchange earnings to fuel the country's socio-economic development.
Key words: Ghana, Gross Domestic Product, Real Exchange Rate, Yam Exports, Time Series Data

INTRODUCTION
Like many other countries in Africa, Ghana has traditionally depended on a few export products (cocoa, timber, and mineral resources) as the main foreign exchange earners for the economy. The often-volatile nature of the world market price makes the economy very vulnerable to fluctuations in the prices of export commodities. Moreover, the geographical distribution of these resources means that only a few regions could participate in their production and export. This has resulted in wide spatial and socioeconomic disparities between the producing and non-producing regions (Konadu-Agyemang and Adanu, 2003). Within the past decade, however, a shift seems to have taken place. Under the auspices of the structural adjustment programme, emphasis was placed on nontraditional export commodities. This did not only help to reduce the vulnerability of the economy by diversifying the sources of export earnings, but it also engendered participation in the export trade by regions that have been left out traditionally. Yam has become an important export crop in Ghana. Currently, yam ranks second after pineapple in terms of volume and value of non-traditional export crops in Ghana (Asuming-Brempong, 1994). Factors that influence yam exports should be identified and examined so as to target the most critical ones through policy initiatives if Ghana is to take advantage of the export potentials of yam.

The quantities of food commodities exported each year are affected by a number of factors. While some of the factors pertaining to domestic demand may be relevant, other determinants may be overriding (Ferris, 1998). The export supply equation is expressed as a function of the expected level of real exchange rate, Gross Domestic Product (GDP), Product price on the domestic and international markets,

domestic production level, and exports from competing export countries. Other factors that may also be important include production level and price in competing exporting country (Warner and Krenin, 1983 and Fabiosa, 2002). Real exchange rate is one of the most important factors affecting the competitiveness of a country's export sector. In a study to examine the effect of exchange rate on pork exports in Canada, Fabiosa (2002) noted that the level of exchange rate has a positive impact on pork exports while the volatility of the exchange rate has a negative impact (also see Adubi and Okunmadewa, 1999). A study on exchange rate policy and macroeconomic performance in Ghana by Jebuni *et al.* (1991) found out that exports are positively related to exchange rate. In addition, this study also revealed that exchange rate is not significant in explaining cocoa exports because exchange rate depreciation may not be passed on to cocoa farmers in the form of higher domestic prices. However, in their examination of Turkish foreign trade, Ayrdın *et al.* (2004) revealed that real exchange rate is a statistically significant determinant of imports but not exports and that the effect of real exchange rate on trade deficits works through imports but not exports. GDP growth is associated with contraction in exports and expansion in imports as a result of the high purchasing power. Jebuni *et al.* (1991) found Ghanaian exports to be positively related to GDP.

A survey of the extant literature has revealed that empirical work on yam exports from Africa and the rest of the world is nonexistent. The general hypothesis that real exchange rate and GDP have significant effects on food commodity exports has not been tested and corroborated with yam export data from Ghana. The purpose of this study was therefore to test this hypothesis through empirical econometric analysis. This paper addresses the following objectives to:

- Examine the trends in the volume of yam production and exports in Ghana from 1990 to 2004 inclusive
- Evaluate the effects of Ghana's GDP and Real Exchange Rate on annual yam exports from Ghana during this period

METHODOLOGY

Data

For this study, secondary data obtained from Food and Agriculture Organization (FAO) data sources, Ministry of Food and Agriculture (Ghana), Ghana Export Promotions Council, Institute of Statistical, Social and Economic Research (ISSER) - Ghana and Bank of Ghana were used for analysis. Information collected included a fifteen year series of data on yam export quantities, domestic yam production figures, domestic and international yam prices, Gross Domestic Product per capita, and Exchange Rate since 1990, among others.

Method of data Analysis

Both descriptive and inferential analyses of the data were performed. Line graphs were used to conduct trend analysis for Ghana's yam production and export volumes. To examine the effects of real exchange rate and GDP on yam exports, multiple regression analysis was conducted by employing the Ordinary Least Squares (OLS) method. In applied econometric analysis of food commodity exports the double logarithmic regression model is the most popular of all the functional forms available primarily because of ease of interpretation of the coefficients (Warner and Krenin, 1983 and Jebuni *et al*, 1991). This double-log together with the linear and semi-log functional forms was used to estimate the yam export supply model to aid comparison. The implicit form of the model was expressed as:

$$X_t = f(Y, RER, P_{ct}, Q_t, X_{t-1}, X_c, P_c, WQ_t, \mu_t)$$

where:

X_t = Annual yam export from Ghana in metric tons

Y = GDP per capita for Ghana

RER = Real Exchange Rate for Ghana

P_G = Yam price ratio for Ghana (Domestic yam price in US S/World yam price in US$)

Q_t = Domestic yam production level (current year)

X_{t-1} = Previous year's yam exports from Ghana in metric tons

X_c = Yam export from major competing exporter (Ivory Coast) in current year

P_c = Yam price ratio for Ivory Coast (Domestic yam price/World yam price)

WQ_t = World yam output in current year

μ_i = Random Disturbance term

Expected relationships

When the local currency is undervalued, the country's export becomes more competitive on the international market. The reverse is the case; an overvaluation of the country's currency makes its exports less competitive. Therefore, it is expected that higher exchange rate will encourage yam exports.

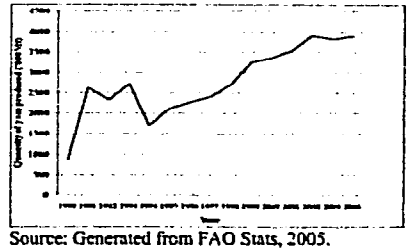
The country's GDP is also expected to have the same positive effect on yam exports. Yam is a domestic food commodity, which has both domestic and imported food substitutes. As the GDP increases, it improves the country's current account position and the country is better able to participate in international trade for the imported substitutes of yam. This will have a negative effect on domestic prices of yam, thus forcing domestic producers to export more to take advantage of better prices on the international market. The reverse is the same in the case of lower GDP.

Domestic yam production level is expected to have positive effect on yam export. The higher the supply of yam on the domestic market the lower the domestic prices of yam, creating incentive for producers to supply to the export market. However, the higher the domestic prices of yam relative to its cost of production, the lower the incentive for producers to export. Yam price in the major competing country (Ivory Coast) is expected to have a positive effect on Ghanaian yam exports. High domestic yam prices in Ivory Coast are expected to reduce export volume since less yam will be demanded on the international market, *ceteris paribus* (i.e. law of demand), and also because local producers will have lower incentive to export. Importing countries are more likely to look elsewhere for yam. Yam export from the major competing country (Ivory Coast) is expected to have an inverse relationship with the volume of yam exported from Ghana. Since the two countries supply yams to the same export market, an increase in supply from either country causes yams to be relatively cheaper (less competitive on the export market) and hence yam exporters from these countries are expected to reduce the volume of yam exports.

RESULTS AND DISCUSSION

Trend Analysis

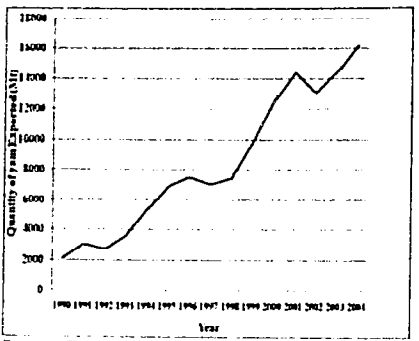
Yam production between 1990 and 2004 experienced a steady increase at an average rate of 18% per annum (Figure 1). The trend line shows a clear pattern of the business cycle in the early 1990s where the production level of the previous year affected the production level of the current year based on farmers' reaction to prices in the previous season (Cobweb theorem).



Source: Generated from FAO Stats, 2005.

Figure 1: Trend in yam production in Ghana

Yam exports from Ghana grew consistently at an average rate of about 17% per annum (Figure 2). This trend can be explained by the high demand for fresh yam tubers in the United States and Europe mainly due to the increasing population of African migrants in these western countries.



Source: Generated from FAO Stats, 2005.

Figure 2: Trend in yam exports from Ghana

Effects of Real Exchange Rate and GDP on Ghanaian yam exports

Table 1 provides the yam export estimates for the linear, semi-log and double-log models. The descriptive statistics of the variables entering the models have been provided in the appendix. All the three models have F-statistics that are significant at the one (1) percent level. This means that the explanatory variables in each of the models explain the variations in annual yam exports from Ghana. The models have adjusted multiple coefficients of determination (R^2) of more than 90%, indicating that the identified regressors explain more than 90% of the variations in yam exports from Ghana. Since time series data was used for the analysis, the Durbin-Watson (DW) statistic was used to test for autocorrelation. The test results (figures provided under each model) show no evidence of autocorrelation in the models.

In all three models, Ghana's GDP per capita and real exchange rate were found to significantly influence yam exports positively (Table 1). This result is consistent with the findings of Fabiosa (2002) and Jebuni *et al* (1991). However, real exchange rate had a very strong influence on yam exports at the 1% and 5% levels whereas per capita GDP was significant only at the 5% and 10% levels. From the log-log model, yam export was found to be inelastic with respect to both RER and GDP per capita. This implies that annual yam exports from Ghana increase at a declining rate with increasing real exchange rate and per capita GDP. A ten percent increase in RER and per capita GDP will cause annual yam exports to increase by 4.8% and 4.6% respectively.

Apart from RER and per capita GDP, the other important determinants of Ghanaian yam exports include domestic yam production level (current and previous year's output), total world yam production level and Ghana's yam exports during the immediate past year. Yam exports from Ivory Coast, a major competitor, were found to have no significant effect on Ghana's yam exports. This partly means that the international yam export market is significantly large with a huge demand-supply gap yet to be satisfied. This implies that given the current level of yam exports from Ivory Coast, Ghana could expand its yam export market share without any serious threat from the major competitor, at least in the short to medium term.

Table 1: Yam export model estimates in Ghana

Variable	Linear model	Semi-log model	Log-log model
Constant	-32019.34 (-3.120)**	3.521 (3.050)**	-19.561(-1.944)***
Ghana's Yam output-current year	-0.267 (-1.918)***	-0.443 (-3.956)*	-0.298 (-2.46)**
Ghana's Yam output-previous year	-0.251 (-1.807)	-0.399 (-3.571)*	-0.178 (-2.395)**
Ghana's GDP per capita	0.580 (2.803)**	0.331 (1.987)***	0.455 (1.901)***
Real Exchange Rate (RER)	0.469 (3.903)*	0.358 (3.704)*	0.476 (2.854)**
Ghana's yam exports – previous year	0.238 (1.598)	0.340 (2.840)**	0.423 (1.871)
Yam price ratio for Ghana (P^d/P^w)	-0.104 (-1.268)	-0.080 (-1.213)	-0.013 (-0.192)
Yam price ratio for Ivory Coast (P^d/P^w)	0.107 (0.658)	0.103 (0.788)	-0.038 (-0.343)
World Yam Output – Current year	0.335 (1.609)	0.879 (5.253)*	0.440 (3.215)*
Yam exports from Ivory Coast-current year	0.001(0.003)	0.034 (0.747)	0.054 (0.700)
R	*0.994*	*0.996*	*0.994*
Adjusted R^2	*0.969*	*0.980*	*0.973*
F(d.f; Significant level)	*52.88 (15; 0.000)*	*82.24 (15;0.000)*	*69.19 (15; 0.000)*
Durbin Watson Statistic	*2.636*	*2.721*	*1.830*

*T-values are in parenthesis; * =significant at 1%; ** =significant at 5%; *** =Significant at 10%*

Dependent Variables: Quantity of yam exported from Ghana (linear model); Natural Logarithm (Ln) of quantity of yam exported from Ghana for the semi-log and double log models.

CONCLUSIONS

Generally, there has been an increasing trend in both the quantity of yam produced and quantity exported. The average growth rate in exports and that of yam output are almost the same (about 17% and 18% respectively). The study failed to reject the null hypothesis that real exchange rate and GDP have significant effects on Ghanaian yam exports. A positive but inelastic relationship was found between RER and GDP on one hand and yam exports from Ghana on the other hand. A 10% increase in GDP per capita and RER (devaluation of the Ghanaian Cedi) causes a less than proportionate (4.6% and 4.8% respectively) increase in annual yam exports from Ghana, *ceteris paribus*. Whereas other factors like domestic yam production level and previous year's yam exports had significant effects on annual yam exports from Ghana, the effect of yam exports from Ivory Coast was statistically insignificant at the 10% level. The real exchange rate and GDP are important factors that shape the Ghanaian yam export market. It would, therefore, be necessary for government to pay attention to prudent exchange rate management and general expansion of the capacity of the economy if Ghana is to take advantage of

the export potentials of yam.

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Appendix

Table 1: Summary statistics of variables in the regression models for yams in Ghana

Variable	N	Min.	Maximum	Mean	Std. Deviation
Ghanaian yam exported in current year (Mt)	15	2122.00	16169.00	8392.4667	4720.4336
Yam exports from Ivory Coast-current year	15	0.00	2469.00	1238.3333	819.4035
Previous year's yam exports from Ghana	15	2122.00	16169.00	8392.4667	4720.4336
Yam production in Ghana-current year (Mt)	15	877000.0	3900000.0	2769051.200	867922.4842
Quantity of yam produced in cote d'voire	15	2528.00	3050.00	2891.2067	132.0822
World Yam Output in current year	15	21114.20	40048.10	34011.6733	5307.8991
World yam output for previous year	15	21114.20	40048.10	34011.6733	5307.8991
GDP per Capita for Ghana	15	209.47	272.18	236.1642	18.9563
Real Exchange rate for Ghana	15	326.33	10643.40	4183.3087	4340.5148
Yam Producer price for Ghana ($)/ton	15	126.29	373.82	234.2180	63.0456
Yam producer price for Ivory Coast	15	69.47	506.25	198.3620	150.1474
World Yam price ($)/ton	15	186.00	828.00	586.1333	157.2377
Price ratio for Ghana (Px/Pw)	15	0.26	1.15	0.4399	0.2250
Price ratio for Ivory Coast	15	0.10	0.80	0.3419	0.2237
LNX	15	7.66	9.69	8.8545	0.6609
LNXT1	15	7.66	9.69	8.8545	0.6609
LNPX	15	4.84	5.92	5.4214	0.2775
LNPW	15	5.23	6.72	6.3263	0.3535
LNQ	15	13.68	15.18	14.7741	0.3898
LNXC	14	4.03	7.81	6.8901	1.0304
LNPC	15	4.24	6.23	5.0428	0.7125
LNGDPGH	15	5.34	5.61	5.4616	0.07947
LNRER	15	5.79	9.27	7.6617	1.2990
LNPRATIO	15	1.36	0.14	0.9049	0.3905
QT1	15	877000	3900000	2769051.20	867922.48
LNQT1	15	13.68	15.18	14.7741	0.3898
LNPRATIC	15	2.26	0.23	1.2835	0.6811
Ln quatity produced in Ivory coast	15	7.84	8.02	7.9684	0.04725
In world yam output	15	9.96	10.60	10.4214	0.1735
In world yam output for previous year	15	9.96	10.60	10.4214	0.1735

Source: Authors' own estimation.

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