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ECONOMIC AND POLICY FOUNDATIONS OF AGRICULTURAL EXPORTS FROM GHANA: A CO-INTEGRATIONANALYSIS

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ABSTRACT

This study was primarily undertaken to help bridge information gap and inform agricultural trade policy prescriptions on how growth observed in Ghana's agricultural export sector could be sustained and scaled up. Achievement of this purpose was sourced through usage of the Johansen Full Information Maximum Likelihood test.Findings from the respective estimations reveal that, structural weaknesses in production, trade and marketing environments preclude the country from exploiting growth enhancing opportunities in the short-run, while potential barriers to trade yield similar implication in the long-run. Minimization of both short and long-run inhibitions could further enhance agricultural export growth for Ghana. Based on estimates observed in this study, sustenance and scaling up of the Ghanaian agricultural export sector requires addressing of existing structural weaknesses and inefficiencies in production, trade and marketing, increased diversification of agricultural exports, increased openness to trade, attraction of export enhancing foreign direct investments, and increased domestic production.

INTRODUCTION

Anchoring economies on firm economic and policy roots is key to shielding such economies from economic storms. A key root in this regard for most developing economies has been, is and would continue to be agriculture. Agriculture employs not only over 50% of the total workforce in most developing countries, but most importantly, the sector has been a relevant and effective tool in the fight against poverty worldwide. In addition, the sector has been a key source of income generation for many small-holder farmers, processors and marketers in rural economies, and enhances earning of foreign exchange. Being primarily agrarian, Ghana's economy has since the immediate post-independence period been steered by developments and depressions in the agriculture sector. Having inherited fortune from the pre-independence era, use of inappropriate domestic policies (under the socialist model of the 1960s) including currency overvaluation, fueling of inflation, extreme reliance on cocoa exports,import licensing, price controls (Stryker 1990, 1991; Leith and Söderling, 2000; Tsikata, 1999) and ineffective state interventions exposed the Ghanaian economy to a "pseudo" resource curse. This in April 1983 incited the country's adoption of a more liberal model under the auspices of the IMF and the World Bank. Opting for a more liberal model by the then government was to help address prevailing fiscal, financial and marketing inefficiencies in the country to enhance revival of the agriculture sector and the economy on a broader perspective. Achievement of this was sourced through the Economic Recovery Program (ERP) and accompanying vital policy measures/programs initiated. Most important among such initiatives was the Medium Term Agricultural Development Programme (MTADP, 1991-2000), and its subs including the Agricultural Diversification Project (1991-1999), National Agricultural Research Project (NARP, 1991-1999), and National Agricultural Extension Project (NAEP, 1992-2000) among others. These initiatives together with the Accelerated Agricultural Development Strategy (AAGDS) initiated in 1996 led to a revival of the agriculture sector and the economy on a broader perspective from its collapse in the pre-ERP period. This development is perceived to have been primarily steered by diversification in agricultural exports, devaluation of the country's currency, increasing investment by

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international agencies and donors in the Ghanaian economy, and improvement in the macroeconomic environment. Although these initiatives are believed to have enhanced revival of the country's agriculture sector, the export-oriented dimension (as against the crop-production dimension) is believed to have benefited the most (Wolter, 2008). Value of agricultural exports increased from as low as US$268,927 (thousand) in 1983 to US$3,008,021 (thousand) in 2011. Growth of the agriculture sector since initiation of the Economic Recovery Program up to date is believed to have as well been steered by developments in the export-dimension of the sector. To ensure continuous growth of the sector (and the economy as a whole) requires not only improvement in the crop-production dimension (which lags behind and has received much attention over the past two decades), but as well sustenance and scaling up of both traditional and non-traditional export sectors.

Efforts made so far to inform policy decision on how the export-dimension could be sustained have primarily been directed towards identifying key determinants of exports for sub-sectors considered under the Agricultural Diversification Project (1991-1999) including cocoa (Boansi, 2013), oil palm (Kuwornu *et al,* 2009), pineapple (Gatune *et al,* 2013, Takane, 2004) and horticultural exports (including mango, papaya, etc.) (Egyir *et al,* 2012; Danielou and Ravry, 2005). These studies among others have revealed both affirmative and contrasting implications of various economic and policy indicators on agricultural exports. In spite of the numerous researches (in the form of articles and dissertations) conducted along this line, very little has actually been done to ascertain how such indicators influence aggregate agricultural exports on a broader perspective (as against focus on the sub-sectors). To inform policy prescriptions in this regards, effort is made in this study to identify the primary economic and policy foundations (drivers) of aggregate agricultural exports from Ghana. Achievement of this is sourced through a co-integration analysis, specifically, the use of Johansen Full Information Maximum Likelihood test.

LITERATURE REVIEW

As funny as it may sound, efforts made to inform policy decisions on drivers of export growth have produced affirmations, contradictions and modifications to previous findings, while other researchers tend to misinterpret outcomes based on their understanding or perception about some key indicators. These observations are primarily attributed to differences in sub-sectors considered under the various research works. While some researches investigate determinants of cotton exports, others investigate cocoa exports, while others investigate rubber, oil-palm and pineapple exports among others. Based on the role each of these commodities play in the countries covered under such studies, the competitiveness of such sub-sectors, quality of such exports, global demand for such commodities, prevailing fiscal, marketing and infrastructural constraints and prevailing barriers to trade in such commodities, quite different outcomes are usually anticipated and observed. This tends to keep policy makers at sea (in confusion) on the actual effect of such indicators on aggregate exports (due to different implications observed for the sub-sectors). Among the common determinants noted in economic and trade literature are domestic production (sectorial production or real gross domestic product), foreign direct investment(FDI), nominal or real exchange rate(ER or RER), domestic and international demand, domestic and foreign prices, official development assistance, global stock/grindings ratio, and previous export growth. In this study however, effort is made to review literature on only variables that are of key interest to our current research besides other new indicators considered. Although FDI is perceived to fuel growth in less developed economies, its role in export promotion has been quite controversial. In as much as several cross-country studies affirm the hypothesis of a negative relationship between FDI and export growth (including Jeon 1992), others (including Hoekman and Djankov (1997), Sharma (2000) and Majeed and Ahmad (2006)) find no significant association between FDI and export growth, while others including Blake and Pain (1994), Cabral (1995), and Pfaffermayr (1996) reveal a significant positive effect of FDI on export performance of the recipient/host country.

These respective studies propose that the true role of FDI in export promotion to a greater extent depends on the motive behind such investments and prevailing domestic conditions. In as much as investments made to tap export markets through exploitation of competitive advantage of the recipient country stands stimulating export growth, domestic market capturing and tariff-jumping types of investment mostly inhibit growth (Majeed and Ahmad, 2006).In contrast to the notion that increased production in a closed economy yields an adverse implication for tradedue to the price decreasing effect of such increments, in an open economy, increased domestic production is deemed the primary cause of export expansion since the surplus is what is exhausted on the international market (Ball *et al,* 1966). In a study on the determinants of exports in developing countries, Majeed and Ahmad (2006) found a positive and highly significant effect of production (proxied respectively with Gross Domestic Product (GDP) and GDP growth) on export growth.

Level of production, they explained can be utilized at both domestic and international level at the same time, adding that, benefits of lower costproduction (based on relative advantage of such countries in agriculture goods) could be exhausted by export growth policies. In assessing determinants of export growth rate in Uganda for the period 1987-2006, although Agasha (2009) discovered that GDP has a significant positive effect on exports in the long run, none of the three lags introduced in the short-run had a significant effect on export growth. In affirmation of a positive association between GDP and export growth, Nadeem *et al* (2012) found a significant positive effect of GDP on exports from Pakistan. Similarly, in investigating the determinants of export performance for developing countries, Fugazza (2004) found a significant positive association between lagged GDP and export growth rate. Yusuf and Yusuf (2007) also found a significant positive association between lagged GDP and export growth for Nigeria.In contrast to the noted beneficial association between production and exports, Kumar and Rai (2007) discovered a significant negative association between production and export growth for tomato in India. This observation was however attributed to a possible coincidence between domestic and international production of the commodity, which triggered a depression in export price for the commodity, and hence

decreased exports from India. In addition to this observation, they found a significant positive association between tomato exports from the country and volume of international trade, signifying that international demand for the commodity is a key driver of exports from India. In affirming this association, Kumar *et al* (2008) found a positive association between volume of international trade in cucumber and Gherkin and the corresponding exports of these commodities from India. Foreign demand has as well be confirmed a key determinant of export growth for fruits and vegetables in sub-Saharan Africa by Takane (2004). In assessing the competitiveness and determinants of cocoa exports from Nigeria, Nwachuku *et al* (2010) also found a significant positive effect of domestic production and world volume of exports on exports of cocoa from Nigeria.

Besides the aforementioned indicators visited so far, another driver of exports that has received much attention and coverage in economic and trade literature is terms of trade. In as much as unfavorable terms of trade is perceived to generally dampen exports, favorable terms of trade has mostly been associated with export growth. In a study on the use of econometrics in policy design and implementation, Musinguzi and Obwona (2000) discovered that terms of trade and lagged export growth are significant determinants of exports in the current period, although effect of the former (ToT) was marginal. In a similar study, but under the title "Rethinking policy options for export earnings", Jayant (2006), also discovered that deterioration in terms of trade index is associated with contraction of export earnings. In assessing the effect of agricultural and financial sector reforms on export growth of cotton lint from Pakistan, Anwar *et al* (2010) revealed that exports of cotton lint is positively driven by increasing world demand for the commodity, export competitiveness of the country, and increase in trade openness. Nguohouo and Makolle (2013) also found a significant positive association between export growth and openness to trade for Cameroon.

A more controversial and highly misinterpreted driver of exports in literature has been and continues to be exchange rate (ER and RER). As a surrogate measure of incentive for exports, various researches have observed both positive and negative association between export growth and these indicators, but usually infer the same meaning to either signs. In as much as nominal exchange rate reflects the amount of currency an entity can receive in exchange for another currency, it fails to account for differences in price levels. The real exchange rate on the other hand, is the purchasing power of a currency relative to another at current exchange rates and prices, the two rates thereby holding different meanings. The real exchange rate, by its purchasing power component, facilitates comparison of prices of goods in different countries. Because of the capacity of real exchange rate to take price differential and inflation into account, a rise in the level of this index indicates appreciation of a host country's currency, which is mostly associated with declines in export volume/growth. In contrast however, entirely the opposite holds for the nominal exchange rate due to the index's inability to adjust for inflation and price differential. Increments and declines in these two indices therefore have different implications and need to be factored-in in interpretation of results instead of them being mostly used interchangeably by various researchers. In line with usage of these indices in various studies, Agasha (2009) found a mixed signal (positive effect) for the association between real exchange rate and export growth in the long-run. The effect for any of the three lags introduced in the short-run model was however not significant. This discovery affirms a relevant finding by Musinguzi and Obwona (2000) that real exchange rate has insignificant effect on export growth rate. In contrast to these however, Sharma (2000) observed a significant negative association between real exchange rate and export growth for India, inferring appropriately that a fall in domestic prices due to exchange rate depreciation makes exports cheaper in the global market, which consequently stimulate increased demand. Similarly, Kuwornu*et al* (2009) and Cline (2004) found a valid positive association between depreciation in real exchange rate and export growth. Attending to the nominal side of this index, Yusuf and Yusuf (2007) found a significant positive association between nominal exchange rate and exports of rubber from Nigeria. Although use was made of the nominal exchange rate, a significant negative association observed between the index and export growth by Abolagba*et al* (2010) and Ngouhouo and Makolle (2013) was misinterpreted as holding a meaning similar to the association between export growth and real exchange rate. A priori expecting a positive association between nominal exchange rate and exports of cocoa from Nigeria, Nwachuku*et al* (2010) rather found a significant negative association between these two variables. This observation was attributed to a declining productivity of the Nigerian economy and a corresponding weak currency.

MATERIALS AND METHODS

Analytical Framework

Although three unique techniques (namely the Engle-Granger approach (Engle and Granger, 1987), Phillips-Ouliaris residual-based test (Phillips and Ouliaris, 1998) and the Johansen Full Information Maximum Likelihood test (Johansen and Juselius, 1990) have been proposed in literature for co-integration analysis/exploration, the Johansen technique is made use of in this study due to the unique advantages it holds over the other methods. Besides being criticized of small-sample biases (Stock, 1987; Bannerjee*et al,* 1986), the Engle-Granger method tends to produce inconsistent estimates, as short-run dynamics are primarily ignored in production of the long-run estimates. This results in provision of short-run effects that are not guided by and inconsistent with long-run estimates. In addition, both the Engle-Granger and Phillips-Ouliaris approaches assume a single co-integrating vector in a system of variables regardless of the number of variables in that system. In reality however, there is a possibility of observing $n-1$ co-integrating equations in a system of n variables, a system attribute mostly precluded by these approaches. Under the Johansen technique, co-integration variables are built directly from maximum likelihood estimation, with short-run effects guided by and consistent with long-run outcomes. In addition, this technique allows for all possible co-integrating relationships and permits empirical determination of the number of co-integrating vectors. In spite of these positive attributes of the Johansen procedure, the selected technique for our analysis is heavily reliant on asymptotic properties and extremely sensitive to

specification errors. Having selected it as the choice approach, the Johansen Full Information Maximum Likelihood test commences with the definition of a vector auto-regression given as follows:

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \ldots + \Pi_p X_{t-p} + \mu_t \quad (1)$$

Where $X_t$is an $(n\times1)$ vector of $I(1)$ variables, $\Pi_1$through Π_p represents $(m\times m)$ matrix of coefficients, andμ_t is $(n\times1)$ vector of innovations. Following identification of appropriate lags to use in various specifications and confirmation of co-integrating equation(s) in the system under study, equation (1) becomes a less appropriate set-up. In its stead, a more appropriate set-up dubbed "*vector equilibrium correction model*" (VECM) (Lütkepohl and Krätzig, 2004) or "*vector error correction model*" is used. The VECM is obtained through a special parameterization that supports analysis of the co-integrating structure(s). This is obtained through subtraction of X_{t-1}on both sides of equation (1), yielding the following expression:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{p-1} \Delta X_{t-p+1} - \Pi X_{t-p} + \mu_t \quad (2)$$

$\Gamma_1 = \Pi_1 - I, \Gamma_2 = \Pi_2 - \Gamma_1, \Gamma_3 = \Pi_3 - \Gamma_2,$ and $\Pi = I - \Pi_1 - \Pi_2 - \ldots - \Pi_p$

In equation (2), ΔX_t is $I(0)$ (Stationary), i= 1, 2,…,p-1 are all stationary and u_t is also assumed$I(0)$. For the equation to be meaningful and valid, ΠX_{t-p} is expected to and must be stationary. The matrix Πin the above specification determines the extent to which the system under study is co-integrated and is primarily referred to as the *impact matrix* (Ssekuma, 2011). This matrix can be decomposed into two unique sub matrices α and β, where the former measures the rate of error correction (speed of adjustment in the system) and the latter contains *r* co-integrating vectors. The Γs in equation (2) are indicators of short-run effects, with Π hauling the long-run estimates. For variables to be co-integrated, by guidelines for performing co-integration analysis, they are expected to be integrated of the same order and are all a priori treated endogenous unless some are found stationary at level. In this case, should such variables stand having significant effect on the long-run co-integrating space and affect the short-run model, they are treated exogenous, with equation (2) being re-written as follows (Kuwornu *et al,* 2011):

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_{p-1} \Delta X_{t-p+1} - \Pi X_{t-p} + \upsilon D_t + \mu_t \quad (3)$$

WhereD_t represents the stationary *(I(0))* variable(s). To appropriately capture rich dynamics in the system under study, Harris and Sollis (2003) advise the use of variables that have a high probability of affecting the short-run behavior of the model. Following developments in Ghana's economy pre and post-ERP, we place sole emphasis on some specific variables specified in the next section. In selecting the appropriate lag order for the respective specifications however, two unique likelihood ratio (LR) tests have so far been made use of in literature. These are the trace test and the maximal-eigenvalue test. In as much as the former is a joint test of the null hypothesis of *r* co-integrating vectors against the alternative of greater than *r*, the latter conducts separate tests on the individual eigenvalues for a null hypothesis that the number of co-integrating vectors is *r*, against an alternative of *r+1*. The trace test is however mostly preferred to the maximal-eigenvalue test due to its ability to show more robustness to both skewness and excess kurtosis in the innovations than the maximal-eigenvalue test (Harris 1995). The respective tests are expressed as follows:

$$Jtrace(r) = -T \sum_{i=r+1}^{p} \ln(1-\lambda_i) \quad (4)$$

$$Jmax(r, r+1) = -T \ln(1-\lambda_{r+1}) \quad (5)$$

The lag order selection however precedes a co-integration test, under which analysts have the option of assuming no deterministic trend in data, assuming linear trends in data or assuming quadratic trends in data. Selection of the appropriate assumption(s) however is based on what the analyst(s) seeks to address and the variables considered. If the variables covered include significant policy indicators in trade issues, it would be more appropriate for the analyst to either assume linear trend in data by including intercepts in both normalized (long-run) and short-run equations (but no trend) or assume no deterministic trend (the latter of which may be too restrictive due to the possibility of having external influences on exports). In situations where the variables considered include minimal policy indicators, assuming a linear deterministic trend (trend and intercept in normalized equation(s), but only intercept in short-run equation(s)) may be more appropriate. Only in extreme cases should the quadratic deterministic trend assumption be employed. Since most of the variables selected in this study have some policy linkages, we assume a linear deterministic trend (intercept in both co-integrating equation and in VAR, but no trend).

Model Specification

Having noted several drivers of exports in literature, our selection of indicators for this study is based on developments inpre- and post-ERP periods in Ghana. Use of these variables is deemed a more appropriate step to identifying the key determinants of agricultural export growth for the country over the past three decades.

$$\ln(EXPVG) = f\,(ln(RGDP), ln(FDI), ln(ToT), ln(ER), ln(EXPVW), ln(ICOCOAGRI), ln(INFLA)) \quad (6)$$

A priori expectation :{*ln*(RGDP), *ln*(ToT), *ln*(EXR), *ln*(EXPVW), *ln*(ICOCOAGRI)} > 0, {*ln*(FDI), *ln* (INFLA)} <> 0

Where

$ln\,(EXPVG)$ -log of value of agricultural exports from Ghana
$ln\,(RGDP)$ -log of real gross domestic product
$ln\,(FDI)$ -log of net foreign direct investment (inflows)
$ln\,(ToT)$ -log of terms of trade index of exports
$ln(ER)$ -log of nominal exchange rate (GH¢/US$)
$ln\,(EXPVW)$ -log of world value of agricultural exports (as proxy for international demand and trade)
$ln(ICOCOAGRI)$-log of index of agricultural export diversification
$ln\,(INFLA)$ -log of inflation

With cocoa accounting for 96 percent of Ghana's agricultural exports in 1986 (García *et al* 2006), we conceptually define diversification in agricultural exports as the degree of decline for share of cocoa (cocoa beans in specific) in total agricultural exports. To appropriately award weight to this decline, we introduce an appropriate expression for this instead of using percentage changes in shares. In this study, we define the index of agricultural exports diversification as follows

$$ICOCOAGRI = \frac{1}{\left(\frac{valueofcocoabeansexports}{valueoftotalagriculturalexports}\right)} \quad (7)$$

By this expression, any increment for the share of cocoa beans in total agricultural exports could lead to a decline in the index, with entirely the opposite being anticipated for a decline in share of cocoa beans in total agricultural exports. This expression renders the index symmetric in that, use of the index as expressed in equation (7), would yield same magnitude of effect but opposite sign when the index is inverted (thus capturing export reliance (share of cocoa beans in total agricultural exports) instead of diversification). As a major player in the cocoa beans market, increment in the value of cocoa beans exports is possibly achieved through either increases in volume of exports or price of exports, each having a likely adverse implicationfor future values of export. Increment in volume of cocoa exports stand inducing an adding-up effect on the global cocoa market which subsequently trigger decline in prices for future exports, while current increments in price of exports lead to declines in future demand. By this, we perceive extreme reliance on cocoa beans a potential inhibitor of agricultural export growth, and diversification as a key stimulator of export growth, hence our a priori expectation about this index. Besides the index of diversification (which we computed), all the other variables were gathered from the agricultural trade database of FAO (FAOSTAT), development indicators of the World Bank, and UNCTAD STAT (United Nations Conference on Trade and Development Statistics)

Data Verification

Second only to variable selection in relevance, a unit root test is deemed the most important step in co-integration analysis. For variables to be co-integrated, they are expected to be integrated of the same order. The order of variables in a system is however ascertained through a unit root test. In this study, we employed the Augmented Dickey-Fuller test for data verification. As shown in *Table 1*, all the variables selected for our analysis (except the index of diversification and inflation) are found non-stationary at level, but become stationary on first difference at the 1percent level. By this, with the exception of the index of diversification and inflation, all the other variables are *I*(1) and hence areassumed endogenous in the VAR specification. The index of diversification and inflation are however found stationary at level, the former being significant at the 5percent level and the latter at the 1percent level.

Lag Order Selection and Test of Co-integration

In selecting the appropriate lag order to use for the test of co-integration and in the respective long- and short-run specifications, the Akaike information criterion (AIC), the Schwarz criterion (SC) and the Hannan-Quinn criterion (HC) have been used extensively in literature as the primary criteria, with the sequential modified LR test statistic (each test at 5percent level) and the final prediction error being used as secondary criteria for check/control. In this study however, both the primary criteria and the secondary criteria selected lag order one. Accordingly, we select lag order one for the test of co-integration and for the VAR specification or VECM (should co-integration be confirmed). Similarly, assuming a linear deterministic trend (intercept in both normalized and short–run equations) in data, the trace test confirmed the existence of one co-integrating equation at the 5 percent level. Accordingly, the VECM specification as expressed in equation (3) is deemed the most appropriate equation for this study. Output for the respective long- and short-run equations are presented and discussed in the "Results and Discussion" section below

RESULTS AND DISCUSSION

Bearing in mind weakness in the Johansen technique of being heavily reliant on asymptotic properties and sensitive to specification errors, relevant diagnostic tests were performed to ensure that the results we discuss are not spurious. The residual series of the VECM was tested for normality, non-serial correlation, and homoscedasticity. In addition, the observed estimates (coefficients) were tested for stability using the CUSUM and CUSUM of Squares tests. Outcome of the diagnostic tests confirmed a normally distributed residual series, which is non-serially correlated and homoscedastic. These affirmations are reflected in *Table 2* through a Jarque-Bera statistic (and its corresponding probability), three lags of Q-stat and through a Breusch-Pagan-Godfrey heteroscedasticity test. Although no indications of autocorrelation were found even up to the tenth lag, we present outcome for only three lags to confirm lack of first or high

Table 1. Unit Root Test

Intercept + trend at level, intercept at first difference

	ADF-Stat Level	Max-Lag 7,SIC	ADF-Stat 1st diff	Max-Lag 7,SIC
Agricultural exports total				
Ln EXPVG	-2.663495	0	-5.763379***	0
Ln RGDP	3.048001	0	-5.041726***	2
Ln FDI	-2.581818	0	-5.123672***	2
Ln ToT	-2.328289	0	-5.567222***	1
Ln EXR	-1.339719	0	-4.437220***	0
Ln EXPVW	-1.238162	0	-3.907426***	0
Ln ICOCAGRI	-3.931022**	0	-6.680307***	1
Ln INFLA	-5.109522***	0	-8.449780***	0

***1percent, **5percent

order serial correlation. Stability test of coefficients also affirmed highly reliable and stable coefficients, a reflection of appropriately specified model. In this regard, we deemed the outcome of our VECM estimation valid andproceed with discussion accordingly.

In interpreting outcome of the VECM, the variables included in our analysis are found to explain about 45.6 percent (based on the adjusted R-squared figure, and 62.5 percent based on the R-squared figure)of the variations in value of agricultural exports from Ghana. A total of about 20 percent of deviations from the long-run equilibrium are corrected for in the current period (reflecting a general increasing trend, due to the lower speed of adjustment), and this speed of adjustment is found significant at the 1percent level. In addition, the joint effect of the explanatory variables on the explained is found significant at the 1 percent level, a claim affirmed by the F-statistic and its' correspondingly probability.

In line with our a priori expectation, in the long-run, value of agricultural exports from Ghana is found to be significantly and positively driven by increments in real gross domestic product (RGDP), FDI and terms of trade index of exports (ToT). In contrast to our expectation however, we observe a negative (instead of positive) but insignificant coefficient for nominal exchange rate(ER), and a significant and negative (instead of positive) coefficient for value of world agricultural exports (EXPVW). By these, value of agricultural exports from Ghana is in the long-run dependent primarily on RGDP, FDI, ToT, and EXPVW.

$$lnEXPVG = 7.413lnRGDP + 1.194lnFDI + 2.359lnToT - 0.901lnEXR - 8.764lnEXPVW + 99.645 \quad (8)$$

(4.162) (0.266) (1.185) (0.542) (1.588)
(1.781*) (4.496***) (1.992*) (-1.663) (-5.518***)

The positive intercept term indicates that should prevailing conditions be maintained, value of Ghana's agricultural exports would continue to increase in the long-run. This indicates that, Ghana's agricultural export sector is generally in a good position/standing. Having observed the respective estimates in equation (8), the corresponding short-run equation for the normalized is presented as follows:

$$\Delta \ln(EXPVG_t) = \Gamma_0 + \sum_{i=0}^{n} \Gamma_{1i}\, \Delta ln(EXPVG_{t-1}) + \sum_{i=0}^{n} \Gamma_{2i}\, \Delta \ln(RGDP_{t-1}) + \sum_{i=0}^{n} \Gamma_{3i}\, \Delta \ln(FDI_{t-1}) + \sum_{i=0}^{n} \Gamma_{4i}\, \Delta \ln(ToT_{t-1}) + \sum_{i=0}^{n} \Gamma_{5i}\, \Delta \ln(EXR_{t-1}) + \sum_{i=0}^{n} \Gamma_{6i}\, \Delta \ln(EXPW_{t-1}) + \Gamma_{7\mathrm{i}} \ln(ICOCOAGRI_t) + \Gamma_{8\mathrm{i}} \ln(INFLA_t) - \propto (RESIDUAL_{t-1}) \quad (9)$$

From equation (9),Γ's indicates short-run effect of changes in the explanatory variables on the explained variable and α stands for speed of adjustment in the system under study. All variables that entered the short-run equation except terms of trade index of exports, inflation and the intercept term, are found significant. By this, value of agricultural exports from Ghana is in the short-run dependent on previous value of exports from Ghana, lagged real gross domestic product, lagged foreign direct investment, lagged nominal exchange rate, lagged value of world agricultural exports, and current level of export diversification.Attending to the respective variables, real gross domestic product (as a measure of domestic production) is found a key stimulator of export growth in both the long and short runs. In the long-run, a 1percent increase in RGDP leads to a 7.41 percent increase in value of agricultural exports, significant at the 10percent level. In the short-run, a one percent increase in RGDP leads to a 6.49 percent increase in value of exports. With Ghana being noted as an open economy (and more open following trade liberalization and initiation of the ERP), increments in domestic production offer an opportunity for foreign exchange earnings through exports of surplus output. Increasing gross domestic product is as well an indication of the country's engagement in extensive production and trade over the period, each of which creates a favorable platform for stimulating export growth. The association between RGDP and export growth found in this studyaffirms propositions by Ball et al (1968), Nadeem *et al* (2012), Majeed and Ahmad (2006), Agasha (2009), Fugazza (2004) and Yusuf and Yusuf (2007) that increments in GDP stimulate export growth.

Having potential characteristics of stimulating export diversification, advancing technological progress, improving quality of products and processes, opening new dimensions to trade through trade creation and diversion, and strengthening the host country's capital formation, innovation capacity and organizational and managerial practices, FDI has in literature been noted to yield quite controversial implications for export growth. In this study, we note however in the long-run that a 1 percent increase in FDI in the Ghanaian economy leads to a 1.19 percent increase in value of agricultural exports, significant at the 1 percent level. This long-run association could be attributed to strengthening of the pre-ERP weak agricultural sub-sectors by such investments (mostly in horticultural exports), technological progress in the country's production activities, processing and quality management, trade creation in favor of Ghana (which paves room for enhanced international trade between Ghana and its investing partners), and to improved competitiveness enhanced through such investments. Noting the challenge of production and trade activities in the country due to infrastructural, production and marketing constraints in the short-run however, we find temptingly that, foreign direct investment yields an inelastic, yet negative and significant effect (-0.24) on export growth.

In as much as this short-run observation affirms proposition by Jeon (1992) of a significant negative association between FDI and export growth, we deem this short-run effect a mixed signal and attribute this observation more to existing constraints in the short run. The long-run association however affirms propositions by Blake and Pain (1994), Cabral (1995), Pfaffermayr (1996) of a positive and significant effect of FDI on export growth.Being open to trade presents a country not only with greater market opportunities, but as well exposes the country to greater competition, thereby shaping efficiency in production and exports. Being open to trade is therefore presumed a good step to stimulating export growth. A 1 percent increase in the index of trade openness (ToT) in the long-run leads to a 2.36 percent increase in value of agricultural exports from Ghana, significant at the 10 percent level. The short-run effect is however found insignificant, a confirmation of existing production and export growth inhibiting forces/constraints which preclude the country from exploiting opportunities in the short-run. The long-run association is in conformity with propositions by Nguohouo and Makolle (2013), Agasha (2009), Musinguzi and Obwona

Table 2. Short-run estimates of agricultural export supply function for Ghana

Variables	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta lnEXPVG_{t-1}$	-0.404	0.201	-2.005	0.059*
$\Delta lnRGDP_{t-1}$	6.489	2.250	2.884	0.009***
$\Delta lnFDI_{t-1}$	-0.240	0.082	-2.949	0.008***
$\Delta lnToT_{t-1}$	0.387	0.360	1.075	0.295
$\Delta lnEXR_{t-1}$	-0.662	0.327	-2.024	0.057*
$\Delta lnEXPVW_{t-1}$ 1.211	0.650	1.862	0.078*	
$lnICOCOAGRI_t$	1.375	0.584 2.354	0.029**	
$lnINFLA_t$	0.032	0.097	0.332	0.743
Intercept-0.472	0.413	-1.142	0.267	
$RESIDUAL_{t-1}$-0.200	0.052	-3.805	0.001***	
R-squared	0.625	Mean dependent var0.064		
Adjusted R-squared	0.456	S.D. dependent var0.282		
Log likelihood	10.617	S.E. of regression	0.208	
F-Statistic3.696Sum squared resid	0.865			
Prob (F-statistic)0.007Jarque- Bera	1.212 (0.546)			
Durbin-Watson stat1.871Q-stat 1	0.031 (0.861)			
Akaike info criterion-0.041 Q-stat 2	0.333 (0.847)			
Schwarz criterion0.426	Q-stat 33.082 (0.379)			
Hannan-Quinn criter. 0.108	B-P-G Het Test, F-stat:	1.196 (0.367)		

***1%,**5%, *10%, ( )– Probability

(2000) and Jayant (2006) of a significant positive association between increments in terms of trade index and export growth. Although depreciation in a country's currency is believed to stimulate export growth, we find no significant effect of depreciation of the cedi on agricultural export growth in the long-run. In the short-run however, although we a priori expected a positive association between currency depreciation (thus, increment in nominal exchange rate) and export growth, entirely the opposite was observed. A 1 percent increase in nominal exchange rate for Ghana is noted to dampen exports by 0.66 percent, significant at the 10 percent level. Inability of the country to exploit benefits from exchange rate depreciation in the short-run, again confirms some peculiar constraints that inhibit export growth. This has been noted across three respective variable associations (thus between each of FDI, ToT, ER, and export growth).

The noted constraints to production and export growth pointed-out by Brooks *et al* (2007) are generally classified as structural weaknesses and include inadequate roads, poor access to markets, inappropriate agricultural practices, and low technology. Addressing of these constraints, which were as well highlighted in the 1990s, is key to making the best out of export opportunities in both the short and long-run.Although increasing international trade and demand (represented by value of world agricultural exports) is perceived to stimulate export growth, in this study, this presumption was affirmed only in the short-run. The long run association between increments in value of world agricultural exports and export growth for Ghana is against our a priori expectation. The short-run observation could be attributed to production constraints in Ghana's export destinations which leave them with no other option than meeting domestic demands through importations from Ghana and other countries. Such move stimulates export growth from Ghana. In the long-run however, most of these countries are able to address existing short-run constraints, and adjust to developments in domestic and international markets. To avoid expending excessively and exposing domestic industries to competition, most of such countries tend to instill trade barriers which limits the capacity of Ghana and other countries in entering of their markets. This consequently dampens export growth for Ghana (and other countries who share common destinations with Ghana). In as much as increments in value of world agricultural export significantly dampen agricultural exports from Ghana in the long-run, such increment stimulates export growth in the short-run. A 1 percent increase in value of world agricultural exports leads to 8.76 percent decrease in value of agricultural exports from Ghana in the long-run, significant at the 1 percent level. In the short-run however, such increment leads to 1.21 percent increase in value of agricultural exports from Ghana, significant at the 10 percent level. Both the long- and short-run implications are found elastic. The short-run effect affirms propositions by Anwar *et al* (2010), Kumar and Rai (2007), Kumar *et al* (2008) and Nwachuku *et al* (2010).

In conformity with our a priori expectation on the effect of export diversification, we observe that a 1 percent increase in agricultural export diversification leads to 1.38 percent increase in value of agricultural exports, significant at the 5 percent level. Diversifying agricultural exports minimizes or possibly prevents potential adding-up effects on the world market (which drives down world prices and exports). Diversifying exports therefore yields beneficial rather than harmful implications on export growth. Besides stimulating export growth, export diversification is a vital measure for shielding economies against shocks from the international market. Finally, we find as well a significant and negative association between lagged value of agricultural exports and current value of agricultural exports. Increment in value of exports is primarily achieved either through increases in volume of exports or export price faced by exporters. In a less diversified economy like Ghana (which has about 21percent market share for cocoa in the world market) where cocoa accounted for approximately 96 percent of Ghana's agricultural exports in 1986 (García *et al,* 2006) and 70percent between the years 2007-2011 (based on FAO estimates), both increment in volume of exports, and export price stand inducing adverse implications on export growth in the subsequent years due to adding up effect and decrease in demand. To prevent this however, it would be more appropriate for the country to intensify efforts to diversify exports, not only with a purpose of pursuing increased value of exports, but as well shielding the country from depression-

inducing shocks from the world market as was observed in the early 1960s to 1970s. A one percent increase in lagged value of agricultural exports leads to a 0.40 percent decrease in current value of exports, significant at the 10 percent level.

Conclusion

Following initiation of the Economic Recovery Program in April 1983 and accompanying production and export enhancing initiatives like the Accelerated Agricultural Development Strategy (AAGDS), Medium Term Agricultural Development Programme (MTADP, 1991-2000) and its subs including the Agricultural Diversification Project (1991-1999), National Agricultural Research Project (NARP, 1991-1999), and National Agricultural Extension Project (NAEP, 1992-2000) among others, efforts have been made by various researchers to inform policy prescriptions on how growth observed in the agricultural export-dimension of Ghana can be sustained and scaled-up. In spite of the efforts made so far, very little emphasis has actually been placed on aggregate agricultural exports, as majority of the studies conducted so far focus on sub-sectors. To bridge information gap and inform relevant policy prescriptions, we through a co-integration analysis tried to determine the magnitude and effects of key economic and policy drivers of exports. Findings from the study shows that structural weaknesses in production, trade and marketing environments preclude the country from exploiting growth enhancing opportunities in the short-run, while potential barriers to trade yield similar implication in the long-run.

Minimization of both short and long-run constraints could further enhance agricultural export growth for Ghana. Results from the respective equations show that, in the long-run, RGDP, FDI and ToT are key stimulators of export growth, while increments in EXPVW dampen export growth, the latter being attributed to potential barriers to trade. In the short-run however, export growth is stimulated by increments in RGDP, EXPVW and ICOCOAGRI (index of export diversification). Increments in lagged EXPVG, FDI, and EXR are however found to dampen export value. These observations are attributed to existing structural weaknesses in the short-run, production and marketing inefficiencies and high reliance of the country on cocoa exports (which is mostly associated with an adding-up effect due to the high market share of Ghana on the world cocoa market). Sustenance and scaling up of the Ghanaian agricultural export sector requires addressing of existing structural weaknesses and inefficiencies in production, trade and marketing, increased diversification of agricultural exports, increased openness to trade, attraction of export enhancing foreign direct investments, and increased domestic production.

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