Does Agriculture Really Matter for Economic Growth in Developing Countries?

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Abstract

In recent decades, the potential contribution of agriculture to economic growth has been a subject of much controversy among development economists. While some contend that agricultural development is a precondition to industrialization, others strongly disagree and argue for a different path. Taking advantage of recent developments in time series econometric methods, this paper re-examines the question of whether agriculture could serve as an engine of growth. Results from the empirical analysis provide strong evidence indicating that agriculture is an engine of economic growth. Furthermore, we find that trade openness has a positive effect on GDP growth.

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1. INTRODUCTION

The potential contribution of agriculture to economic growth has been an on-going subject of much controversy among development economists. Much of the early work on this issue coincided with the debate on the role of agriculture in promoting economic development in low-income nations in the aftermath of extended periods of colonial rule ((Lewis, 1954, Fei and Ranis, 1961; Jorgenson, 1961; Johnston and Mellor, 1961; Schultz, 1964). Much of these investigations were qualitative in nature and they emphasized the potential impact of the inter-sectoral linkages between agricultural and industrial manufacturing sectors. After a lull in research on this subject, the recent flurry of theoretical and empirical studies on the subject indicates that the debate has increased in intensity (Echevarria, 1997; Humphries and Knowles, 1998; Gemmell, Lloyd, and Mathew, 2000; Kogel and Prskawetz, 2001; Gollin, Parente, and Rogerson, 2002, 2007; Gardner, 2005; Olsson and Hibbs, 2005; Tiffin and Irz, 2006). Research on this issue is crucial because it helps inform domestic and international policy decisions regarding how scarce resources are allocated to agricultural research and infrastructure.

Nevertheless, recent empirical studies have yielded mixed and sometimes conflicting evidence and there remains a lack of consensus on the effect of agriculture on economic growth. While some researchers contend that agricultural development is a precondition to industrialization and economic growth, others strongly disagree and argue for a different path. Several authors argue that growth in the overall economy depends on the development of the agricultural sector (Schultz, 1964; Gollin, Parente, and Rogerson, 2002). Advocates of agriculture-led growth (ALG) contend that investment in agriculture and the accompanying creation of infrastructure and institutions in other sectors is a prerequisite for national economic growth (Schultz, 1964; Timmer, 1995, 2002). These researchers note that growth in the agricultural sector could be a catalyst for national output growth via its effect on rural incomes and provision of resources for transformation into an industrialized economy (Eicher and Staatz, 1984; Dowrick and Gemmell, 1991; Datt, and Ravallion, 1998; Thirtle, Lin, and Piesse, 2003). Prior attempts by various developing nations to industrialize their economy without prior development of the agricultural sector resulted in dismal economic growth rates and very skewed income distribution (Bhagwati and Srinivasan, 1975).

Table 1 contains a brief summary of the change in GDP per capita over three decades (1975-2005) for a selection of fifteen developing countries. Relative to the United States, GDP per capita in most of the nations in Africa (e.g., Nigeria and Senegal) and Latin America over the three decades has been very low and quite disappointing. In contrast, several Asian economies (e.g., China and Thailand) have experienced phenomenon growth in the past thirty years. Interestingly, much of the nations with poor growth records still have a relatively large share of their GDP coming from the agricultural sector. In most of the African nations, agriculture accounts for over 20 percent of GDP.

Johnston and Mellor (1961) observe that agriculture contributes to economic growth and development through five inter-sectoral linkages. The sectors are linked via: (i) supply of surplus *labor* to firms in the industrial sector; (ii) supply of *food* for domestic consumption; (iii) provision of *market* for industrial output; (iv) supply of domestic *savings* for industrial investment; and (v) supply of *foreign exchange* from agricultural export earnings to finance import of intermediate and capital goods. In addition to these five direct market-based linkages, Timmer (1995) also emphasized the importance of indirect non-market linkages that improves the quality of the major production factors (labor and capital). He observes that agriculture indirectly contributes to economic growth via its provision of better caloric nutrient intake by the poor, food availability, food price stability, and poverty reduction. He argued that the role of agriculture has been underestimated because of data limitations that preclude explicit quantitative analyses of the indirect effects of agriculture's contributions to capital and labor efficiency and total factor productivity. Thus, Timmer advocated for "a new modeling approach that can be applied to a broad cross-section of time series data at the national level. Such an approach that focuses on the analysis of national time series data is adopted in this paper.

In contrast to the ALG arguments above, proponents of the opposite viewpoint contend that the agricultural sector does not have strong linkages to other sectors and lack adequate innovative structure necessary for fostering higher productivity and export growth (Lewis, 1954, Hirschman, 1958; Fei and Ranis, 1961; Jorgenson, 1961). In a theoretical analysis, Matsuyama (1992) used the comparative advantage argument to refute the claim that agricultural productivity is an engine of economic growth. Further reflecting this negative view of agriculture in the development process, policymakers in many developing countries proposed and adopted development strategies that were anti-agriculture and rather emphasized the role of the manufacturing sector as the preferred source of economic growth (Okonkwo, 1989; Schiff and Valdez, 1998). In many developing countries, the agricultural sector was subject to heavy taxation. For example, prior to agricultural reforms in 1979, Chinese agriculture was under a heavy tax burden and the revenues were used to subsidize urban and industrial development (Yao, 2000).

Although several studies have outlined the theoretical relationship between agriculture and economic growth, disagreements still persist. The causal dynamics between agriculture and economic growth is an empirical question worthy of further investigation. In a critique of previous empirical analyses on the role of agriculture in economic growth, Tsakok and Gardner (2007) argue that most early studies based on econometric investigation of cross-sectional data for a panel of countries have significant limitations and have not provided definitive results. Specifically, results from earlier studies using ordinary least squares (OLS) regression and simple correlation coefficient tests may have misspecification problems as the correlations may be spurious because they failed to account for the data's dynamic time series properties (e.g., unit roots and cointegration). Also, the results are limited to showing only that agriculture and GDP growth are correlated, but could not provide information on the direction of causality. The issue of causality is dynamic in nature and is best examined using a dynamic time series modeling framework. Furthermore, the implicit assumption of an identical production function across different types of economies may be unrealistic as the level of technology may vary across countries.

Recently, Tiffin and Irz (2006) used bivariate Granger causality tests to examine the causal relationships between agricultural value-added and economic growth for a panel of countries. They found strong evidence in support of causality from agriculture to economic growth for developing countries, but the causality results for developed countries were inconclusive. The study by Tiffin and Irz (2006) is an improvement on previous cross-sectional analyses since it employed recent advancements in time series modeling techniques (cointegration and error correction models). Nevertheless, their empirical results may suffer from misspecification problems (e.g., omitted variables) because they failed to control for the potential influence of other key determinants of economic growth. As emphasized in earlier critiques of related literature on economic growth, simple bivariate causality analyses of this sort are prone to spurious correlation because they ignore the potential role of other important factors (e.g., trade, capital and labor) as suggested by neoclassical growth theory (Edwards, 1993; Caporale and Pittis, 1997; Frankel and Romer, 1999; Awokuse, 2008). Thus, this current study uses a multivariate causality framework to examine the dynamic causal linkages between agriculture and economic growth across a diverse panel of developing countries.

This current analysis attempts to bridge the gap in the empirical literature on the dynamic interaction between agriculture and economic growth. The objective of this study is to re-examine the relationship between agriculture and economic growth by applying recent advances in time series analysis to national data from a diverse group of fifteen developing and transition economies in Africa, Asia and Latin America. Specifically, our basic model is an extension of the neoclassical growth model that incorporates agriculture as a key contributor to growth via its effect on total factor productivity. Also, we use the autoregressive distributed lag (ARDL) error correction modeling approach to investigate both short-run and long-run dynamic causal relationships between agriculture and economic growth. Results from the empirical analysis provide strong evidence indicating that agriculture is an engine of economic growth. Furthermore, the results also suggest that trade openness has a positive effect on GDP growth. The remainder of the paper is organized as follows.

Section 2 discusses the conceptual framework while section 3 describes the econometric methodological issues. Section 4 presents empirical findings and section 5 contains the concluding remarks.

2. CONCEPTUAL FRAMEWORK

The Solow-Swan neoclassical growth theory and its extensions is a popularly adopted framework for analyzing the process of economic growth and development. Assuming a constant-return-to-scale aggregate production function expressed as:

(1) $$Y_t = K_t \, L_t^{\#} B_t$$

where Y, K, L, and B represent real GDP per capita, real gross capital, labor, and the Hicks-neutral productivity term, respectively. The contribution of agriculture to aggregate economic growth could be modeled via its effect on total factor productivity or as an intermediate input in the industrial production sector (Timmer, 1995; Ruttan, 2000, p. 51). Early development theories viewed agriculture as an important source of resources to finance the development of the industrial sector. Thus, agricultural production growth serves as an engine of growth for the overall economy.

Hwa (1988) argues that agriculture is an engine of growth and added agriculture to the standard Solow-Swan growth equation as a measure of linkages between the rural and industrial sector of the economy. Similarly, we also include additional determinants of growth (exports and inflation rate) that have been found to be robust in explaining aggregate productivity growth (Hwa 1988; Barro and Lee, 1994). Thus, B in equation (1) is assumed to be a function of agriculture (A), exports (X) and inflation (P), a proxy for other macroeconomic factors:

(2) $$B = F(A,X,P) = A_t\, X_t^{\#} P_t$$

Next, substituting (2) in to (1) yields the following:

(3) $$Y_t = K_t^{\alpha} L_t^{\beta} A_t^{\delta} X_t^{\phi} P_t^{\gamma}$$

Taking natural logs of equation (3) and including an error term yields:

(4) $$\ln Y_t = \alpha \ln K_t + \beta \ln L_t + \delta \ln A_t + \phi \ln X_t + \gamma \ln P_t + \varepsilon_t$$

According to the export-led growth literature, exports growth is a measure of outward orientation and could also serve as a proxy for internationally competitive cost structure. Export expansion can be a catalyst for output growth both directly, as a component of aggregate output, as well as indirectly through efficient resource allocation, greater capacity utilization, exploitation of economies of scale, and stimulation of technological improvement due to foreign market competition (Helpman and Krugman 1985; Awokuse, 2008). Also, higher level of investment (gross capital formation) should stimulate growth while agricultural productivity is expected to have a positive effect on aggregate economic growth. Similar to Hwa (1988), export expansion is expected to have a positive effect on growth while macroeconomic instability, captured by high inflation rates, should have a negative effect on economic growth.

3. ECONOMETRIC METHODOLOGY

Cointegration Test – ARDL Approach

Recently, the Autoregressive Distributed Lag (ARDL) approach to cointegration and error correction models (ECMs) was proposed by Pesaran, Shin and Smith (2001) as an alternative to Johansen's multivariate cointegration test (Johansen and Juselius, 1990). While the popular Johansen multivariate cointegration modeling technique is widely accepted as an improvement on the residual-based Engle and Granger (1987) two-step cointegration test, this approach still have notable limitations because of its dependence on pre-tests for the order of integration and its inapplicability to systems with mixed order of integration. Due to the limited power of existing unit root tests, the Johansen cointegration testing procedure could result in inaccurate inference regarding causal structure and the nature of long-run relationships among variables.

In contrast, the ARDL approach allows for causal inference based on ECMs and is a very good alternative to conventional cointegration tests because it bypasses the need for potentially biased pre-tests for unit root. The ARDL technique is invariant to mixed orders of integration since the tests do not depend on whether the variables are I(0) or I(1) or a combination of the two (Morley, 2006). Thus, the determination of the existence of long-run relationships does not require that the variables be of the same order of integration. Also, this modeling approach also yields desirable statistical properties in small samples. Pesaran, Shin and Smith (2001) shows that long-run estimates from ARDL estimation are super-consistent and that valid inference could be made using standard asymptotic theory. The error correction version of the ARDL model based on equation (4) for both GDP per capita growth and agricultural value added could be expressed as:

(5a)

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta Y_{t-i} + \sum_{i=0}^{p} \beta_{2i} \Delta K_{t-i} + \sum_{i=0}^{p} \beta_{3i} \Delta L_{t-i} + \sum_{i=0}^{p} \beta_{4i} \Delta A_{t-i} + \sum_{i=0}^{p} \beta_{5i} \Delta X_{t-i} + \sum_{i=0}^{p} \beta_{6i} \Delta P_{t-i}$$

$$+ \lambda_1 Y_{t-1} + \lambda_2 K_{t-1} + \lambda_3 L_{t-1} + \lambda_4 A_{t-1} + \lambda_5 X_{t-1} + \lambda_6 P_{t-1} + \varepsilon_t$$

(5b)

$$\Delta A_t = \delta_0 + \sum_{i=1}^{p}\delta_{1i}\Delta A_{t-i} + \sum_{i=0}^{p}\delta_{2i}\Delta K_{t-i} + \sum_{i=0}^{p}\delta_{3i}\Delta L_{t-i} + \sum_{i=0}^{p}\delta_{4i}\Delta Y_{t-i} + \sum_{i=0}^{p}\delta_{5i}\Delta X_{t-i} + \sum_{i=0}^{p}\delta_{6i}\Delta P_{t-i}$$
$$+ \eta_1 Y_{t-1} + \eta_2 K_{t-1} + \lambda_3 L_{t-1} + \eta_4 A_{t-1} + \eta_5 X_{t-1} + \eta_6 P_{t-1} + \varepsilon_t$$

where p denotes the lag length, and ε_t is i.i.d. p-dimensional Gaussian error with mean zero and variance matrix Λ(white noise disturbance term).

The ARDL approach to cointegration analysis involves the estimation of the conditional error correction model by OLS. A 'bounds test' for cointegration (null hypothesis of non-cointegration) is based on F-test restrictions of the joint significance of the estimated coefficients of the lagged level variables in equations (5a) and (5b). Since the asymptotic distribution of the F-statistics is non-standard, Pesaran, Shin and Smith (2001) provides two sets of adjusted critical values that provides the lower and upper bounds used for inference. While the first set of critical values assume that the variables are I(0), the other assumes they are I(1). Cointegration exists and there is evidence of a long run relationship if the computed F-statistic exceeds the upper bound critical value. However, we cannot reject the null hypothesis no cointegration if the F-statistic is below the lower bound. The results will be deemed inconclusive for a value within the bounds. The Akaike Information Criterion (AIC) was used to determine the optimal lag length (p) for the ARDL model. The adequacy of the specified models were also examined with various dagnostic tests for serial correlation (LM test), functional form (Ramsey's RESET test), hetersokedasticity (White's test) and structural stability (CUSUM and CUSUMSQ tests).

Multivariate Granger Causality test

If the bounds test suggests that cointegration exist, the next step is to investigate the short-run dynamics via the analysis of Granger causality tests. This involves the estimation of an error correction model (ECM). According to Granger's representation theorem (see Engle and Granger, 1987), a cointegrated system can be expressed and estimated as an ECM. This framework is desirable because it allows for the determination of the direction of causation between agriculture and economic growth while providing estimates on both short-run and long-run relationships. While cointegration tests provide information about long-run relationships among the variables, Granger causality tests provide information on short-run dynamics. We estimated two ECMs in order to test for Granger causality where the first equation has GDP per capita as the dependent variabe and the second has agricultural value added as the dependent variable. Two null hypotheses were examined: a) agricultural value added does not Granger-cause GDP per capita; b) GDP per capita does not Granger-cause agricultural value added.

4. EMPIRICAL RESULTS AND DISCUSSION

Data Issues

The data set used in the analysis consists of annual observations over 1971 to 2006 for a selection of 15 developing and transition economies from three regions: Asia (China, India, Indonesia, Malaysia and Thailand); Latin America (Brazil, Chile, Colombia, Mexico and Venezuela); and Sub-Saharan Africa (Kenya, Nigeria, Senegal, South Africa and Zambia). Although the key relationship of interest is that between real GDP growth and agriculture, four additional control (exogenous) variables were included in the estimated multivariate ARDL models. Thus, the variables used in the analysis are as follows: real GDP per capita (Y), gross capital formation per worker as proxy for capital (K), population as proxy for labor (L), agricultural value added per worker (A), real exports (X), and inflation rate as proxy for domestic macroeconomic policy environment (P). All data series (except inflation rate) are in natural logarithms and were obtained from International Monetary Fund's International Financial Statistics (IFS) database and the World Bank's World Development Indicators.

Cointegration and ARDL-ECM Regression Results

First, univariate time series properties were examined using two unit root tests: augmented Dickey and Fuller (1979) test and the KPSS Lagrange Multiplier (LM) tests, proposed by Kwiatkowski et al. (1992). While the ADF procedure tests for the null hypothesis of non-stationarity, the KPSS procedure tests for the null hypothesis of stationarity. The combination of the ADF and KPSS tests is a form of confirmatory analysis that has been shown to be more robust in determining the presence of unit roots (Kwiatkowski et al., 1992, p. 176). A combination of both test results for each variable in the system across each of the countries suggest that while most of the variables are I(1), some series were I(0). However, none of the variables is I(2). The mixed data integration properties confirm that the ARDL cointegration technique is preferable to other conventional cointegration approaches (e.g., Johansen multivariate test). Results for unit root tests are available upon request.

Next, we estimate the bounds test in order to determine if a long-run relationship exists between the variables for each country in the analysis. Table 2 contains the empirical results for the ARDL bounds test for cointegration. The optimal lag lengths were selected using the Akaike information criteria (AIC) while ensuring that the estimated residuals are not serially correlated. In each case the computed test statistic is larger than the critical value upper bounds computed by Pesaran, Shin and Smith (2001). This result implies that the null hypothesis of non-cointegration could be rejected for all the countries at the 10 percent significance level. Thus, the results suggest that a long-run relationship exists between agriculture and GDP growth. The nature of the relationships could be investigated via the analyses of estimated parameters from the ARDL-ECM model regressions.

Table 3 contains the estimated long-run regression coefficients based on the ARDL-ECM model specification. With few exceptions, gross capital formation appears to have a positive and statistically significant effect on economic growth in all the countries. This result is consistent with stylized facts regarding the positive contribution of capital in the neoclassical theory of economic growth. It is well established in the development economics literature that capital formation is a key determinant of economic growth. However, while capital formation is necessary for economic growth, it is not a sufficient condition for growth. Also, the result agrees with the data on the recent experiences and economic conditions in these economies. For example in Africa, the effect of capital formation is particularly strong for Nigeria and South Africa which are the two largest economies in the region. It is plausible to argue that these two African nations have the largest endowment of capital relative to the other nations in the region. In contrast to the significant impact of capital on growth, labor appears to have a relatively weaker effect across all countries. The labor parameter estimate is statistically significant for only five of the countries (three of which are in Africa).

In recent years, the role of exports (or trade openness) in stimulating economic growth has been the subject of many empirical studies (Edwards, 1993; Awokuse, 2008). Advocates of the export-led-growth hypothesis argue that the expansion of the export sector can be a catalyst for output growth via various channels. As shown in table 3, exports has a significantly positive effect on GDP growth in most of the Asian and Latin American countries. In contrast, the evidence for exports as an engine of growth in Africa is quite weak. Surprisingly, the exports coefficient is not statistically significant for any of the five sub-Saharan African. This result further supports the existing evidence on Africa's dismal growth experience and increasing economic isolation from world markets as an exporter.

Furthermore, the results indicate that inflation rate (proxy for macroeconomic policies) has not been an important determinant of long-run GDP growth. For instance, while inflation appears to have a negative impact on long-run growth in most nations, it's effect is not statistically signifcant at conventional levels. This finding may be due to the reactionary and short-term nature of macroeconomic policy interventions in many of these countries. Also, the annual data frequency used in the analyses may be inadequate in capturing the magnitude of volatililty in macroeconomic policies. Although the discussion of the contirbution of other determinants of growth is informative, these has been the focus of many previous studies. Of greater interest in this study is the role of agriculture in promoting economic growth. Thus, this paper examines results for both long-run and short-run estimates of the the impact of the agricultural sector on GDP growth in relatively greater detail.

With regards to the role of agriculture, results from Table 3 suggests that this sector makes a signigicant contribution to aggregate economic growth in the long-run. The estimated parameter on agriculture is statistically signifcant for 10 of the 15 countries examined. For sub-Saharan African nations, the coefficeint on agriculture value added is positive and significant for only two nations (Kenya and South Africa). These results capture the prevailing conditions in many African nations that have experienced a significant shift in their agricultural economies in the past four decades. After independence from colonial rule in the 1960s, many African countries were net exporters. However, in recent years several of these nations have become net food importers and recipients of food aid (e.g., Senegal, Zambia and Zimbabwe). In the case of Nigeria, a major petroleum exporter (OPEC member), government policies and investments has been disproportionately focused on the petroleum production sector at the expense of agriculture. According to Okonkwo (1989), since the discovery of crude oil in Nigeria, "the non-oil export sector of the economy, more specifically the agricultural sector, has been declining consistently with further increases in oil exports (p. 375)."

Relative to the African case, agriculture's contribution to economic growth appears to be stronger in the Asian region. Agricultural value added has a positive and significant effect on GDP growth in four out of the five nations considered. This finding supports recent governmental efforts to promote agriculture by many Asian economies. For example, in the late 1970s China embarked on a comprehensive agricultural reform program. De Brauw, Huang, and Rozelle (2004) note that China's agrarian reform policies can be divided into two distinct stages: the incentive reforms (1979-1984) and the gradual market liberalization period (1985-1995). In the first phase of the reform process the initial emphasis was on the decollectivization of agricultural production. The primary goal of decollectivization was to afford producers with more freedom by the reassignment of the property rights of farmers and correcting for the disincentives against high productivity inherent to collective farming systems (Lin, 1992; De Brauw, Huang, and Rozelle, 2004).

The second phase of China's agricultural reform focused on the liberalization of state-controlled agricultural distribution system. Specifically, the government introduced policies that encouraged commercialization of rural grain through the removal of the gap between government and market prices and the reduction of mandatory delivery quotas (Sicular, 1995). In subsequent years, important market institutions (e.g., wholesale markets, futures markets, and information systems) were organized (Park, Rozelle, and Huang, 2002). The empirical evidence from this study further supports the view, espoused by several researchers, that Chinese agricultural policy reforms have been relatively effective in promoting agriculture as an engine of economic growth.

The results obtained for the countries in Latin America are similar to those in Asia. The empirical evidence indicate that agriculture plays an important role in stimulating long-run GDP growth in three countries (Brazil, Colombia, and Mexico). In particular, the finding for Brazil is not surprising when we consider the phenomenal expansion in Brazilian agricultural production and exports in recent decades. According to recent data from the Brazilian Ministry of Agriculture, the nations's agricultural exports increased from US$24.8 billion to US$49.4 billion between 2002 and 2006 (i.e., a 99 percent increase in five years). Brazil competes with the US and major EU agricultural producers for a notable share of the world market for several agricultural commodities. For example, Brazil is a top producer and exporter of beef, broilers, coffee, soybeans and oilseeds, sugar, and sugar-based ethanol. The current analysis shows that agriculture has made a significant contribution to Brazilian economic growth.

Short-run Dynamics: Does Agriculture Stimulate Growth?

In addition to the analysis of the long-run relationships discussed above, short-run dynamics are also explored by performing multivariate Granger causality tests based on the ARDL-ECM estimates. F-statistics (and corresponding probability values) for Granger causality tests are presented in Table 4. Emphasis is only placed on the relationship between agricultural value added and real GDP. Two cases were considered: (i) agriculture does not Granger-cause GDP growth, and (ii) GDP growth does not Granger-cause agricultural value added. Economic theory suggests that both cases are equally likely. Although not shown in Table 4, the estimated lagged error correction term is negative and statistically significant for each of the estimated country ARDL-ECM regressions. A statistically significant error correction term implies that long-run causality exists such that past equilibrium errors play a significant role in determining current outcomes. This finding is consistent with the cointegration test results summarized in the previous section.

The direction of Granger causality flow is captured through the joint significance tests of the coefficients of the lagged-differences of the explanatory variables. The empirical evidence strongly suggests that agriculture makes a significant contribution to economic growth in the short-run. Specifically, the null hypothesis that agriculture does not 'Granger-cause' real GDP could be rejected at the 1% (or 5%) level for 14 of the 15 developing countries in the study. The only exception is Thailand where the null hypothesis could not be rejected at conventional levels. This result is consistent with previous findings for developing countries by Tiffin and Irz (2006) who also concluded that agricultural value added 'Granger-cause' GDP growth. Interestingly, there is also some evidence supporting reverse causal flow from GDP growth to agriculture for 10 of the 15 countries. The oil producing developing nations in the sample (Nigeria, Indonesia and Venezuela) show stronger evidence of causal flow from agriculture to GDP growth and very little or no evidence of the reverse causal flow from GDP growth to agriculture. This finding may be a reflection of the so-called 'Dutch Disease' where resources from the agricultural sector were siphoned to the industrial sector (Okonkwo, 1989; Fardmanesh, 1991).

5. SUMMARY AND CONCLUDING REMARKS

In recent decades, the potential contribution of agriculture to economic growth has been a subject of much controversy among development economists. While some contend that agricultural development is a precondition to industrialization, others strongly disagree and argue for a different path. Despite much debate and qualitative analyses of the contribution of agriculture to economic growth and development, few empirical investigations on this issue exist. This paper examines the role of agriculture as an "engine of growth" by analyzing data for 15 developing and transition economies in Africa, Asia and Latin America with the aid of the autoregressive distributed lag (ARDL) model proposed by Pesaran, Shin and Smith (2001).

Results from the empirical analysis provide strong evidence indicating that agriculture is an engine of economic growth. Furthermore, the results also suggest that trade openness has a positive effect on GDP per capita. This study provides evidence in support of increasing public and private resources alloated to agricultural research and infrastructure development. This is particularly needed in many developing countries where the agricultural sector has been marginalized. In many cases, developing countries that were net food exporters (e.g., Zimbabwe) have become net food importers and have become dependent on internattional food aid. Of course, this change in fortune could be attributed to natural distasters and changes in climatic conditions such as drought (e.g., Niger). However, in many other cases, the demise of the agricultural sector has been driven by domestic policies that intentionally promoted industrialization-led development while marginalizing the agricultural sector.

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Note: Data obtained from World Bank Development Indicators, 2008.

Notes:

[a] denotes case IV with unrestricted intercept and restricted trend.
[b] denotes case III with unrestricted intercept and no trend.
[c] denotes case I with no intercept and no trend.
F-test is obtained by joint zero restrictions on coefficients.
Critical values are obtained from computed table by Pesaran, Shin and Smith (2001).

Notes:

ARDL(Lag) selected based on Akaike Information Criterion

*, ** and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively. Values in parentheses are t-statistics. The numbers in brackets are the optimal lag-lengths for the ARDL model, based on the Akaike information criteria.