The Contribution of Agriculture to Economic Growth
Some Empirical Evidence
Erh-Cheng Hwa

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The Contribution of Agriculture to Economic Growth
Some Empirical Evidence

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ABSTRACT

The paper analyzes the contribution of agriculture to economic growth. By employing cross-section data for the developing and developed countries during 1960-1970 and 1970-1979, it is found that in the context of Mr. Chenery-Syrquin's model intercountry variation in agricultural growth explains a significant portion of intercountry variation in the industrial (non-agricultural) growth. Further, in the context of an aggregate production function agricultural growth is found to contribute significantly to productivity increases and thus to overall economic growth. For the developing countries sample of the 1970-1979 period, the results show that a one percent increase in agricultural growth leads to approximately four-tenths of a percentage point increase in productivity. It is also found that export growth contributes positively to productivity growth while the inflation rate contributes negatively.

ACKNOWLEDGEMENTS

The author is grateful to Messrs. Guy Pfeffermann, Allan Gelb, John D. Shilling, and F. Desmond McCarthy for their comments on an earlier draft of this paper and to Mr. Soonwon Kwon for his assistance in the preparation of this paper. The author is, however, solely responsible for any remaining errors.
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I. INTRODUCTION

Despite the dominant position occupied by the agricultural sector in a traditional economy, many parts of the developing world have continuously denied agricultural and rural development adequate attention. This has often led to a stagnant agriculture that, in turn, has resulted in large shortfalls of domestic food production, balance of payment crises, and political instability.\(^1\) For a primitive agrarian economy, it is doubtful that industrialization can succeed without the prior or concurrent emergence of a productive agricultural sector.

This paper undertakes a statistical analysis of the significance of the contribution of agriculture to economic growth by the use of cross section data. The major conclusion of the analysis is that agricultural growth is a significant determinant of both industrial and overall economic growth. The empirical evidence thus reinforces the argument that agriculture and rural development should be given priority and be properly supported in an overall development strategy. The paper also shows that the rate of growth of export is positively correlated with the rate of economic growth. The inflation rate, however, has a negative correlation.

The paper contains three main sections. Section II analyzes the relationship between agriculture and industry during the development process. Section III examines the contribution of agriculture to economic growth in the framework of a production function. The summary and conclusions are given in the last section.

II. The Relationship Between Agriculture and Industrial Growth

The transition from a traditional agrarian economy to an industrialized economy is a dynamic process that inevitably involves complex interactions among many economic as well as social factors. The role of agriculture in the transitional process varies from country to country, conditioned by factor endowment, institutional arrangements, cultural background, historical factors, policy choices, etc. Nevertheless, drawing from the experience of both developing and developed countries, one can identify several important roles played by agriculture in the transition process [e.g. Johnston and Mellor (1961), Johnston and Kilby (1975)]: (1) agriculture generates markets for industrial products, especially light industrial products which have ready markets in the agricultural sector; (2) agriculture provides food and agricultural raw materials for industrial processing; (3) agriculture builds adequate food supplies which are a crucial factor in sustaining price stability; (4) agriculture provides exports to earn foreign exchange; (5) agriculture supplies the non-agricultural sector with capital and labor; and (6) in the case of a market-oriented agriculture, through the gradual accumulation of entrepreneurship and marketing capabilities in the agricultural sector, eases the process of industrialization. In sum, the agricultural sector supports industrialization
by providing a source of labor, capital and raw materials to the non-agriculture sector and by generating demand for industrial products.

The relationship between agriculture and industry may be one of interdependence and complementarity. For example, while providing inputs to industry, agriculture receives from industry modern farm inputs, advanced technologies, and consumption goods to increase agricultural productivity. The statistical significance of this relationship may be tested by the following non-linear model of the Chenery-Syrquin (1975) type which relates the rate of industrial growth (I) to per capita income (YN) and to the rate of agricultural growth (A):

\[ I = f (A, \ln YN, (\ln YN)^2) + u, \quad (1) \]

where \( u \) is a randomly distributed error term.

The model is derived in the following way. First, assume that the rate of growth of industry and of agriculture are both non-linear functions of per capita income variables:

\[ \dot{I} = \alpha_I \ln YN + \beta_I (\ln YN)^2 + \epsilon_I \quad (2) \]

and

\[ \dot{A} = \alpha_A \ln YN + \beta_A (\ln YN)^2 + \epsilon_A. \quad (3) \]

where \( \epsilon_I \) and \( \epsilon_A \) are random errors.
These are simplified reduced form models for the determination of industrial and agricultural growth. The per capita income variables are used as a summary measure of the stage of economic development in addition to being a measure of final demand. Chenery and Taylor (1968) have used similar models to study patterns of economic development. Alternatively, these regressions can be thought of as establishing "norms" for the rates of growth of industry and agriculture with reference to the stage of economic development as measured by the level of per capita income. It is possible to test the hypothesis of whether countries with higher industrial growth in relation to the "normal" industrial growth also are those with higher agricultural growth with reference to its norm. This can be done by regressing the residuals in equation (2) on the residuals in equation (3).

\[ \varepsilon_I = \gamma \varepsilon_A + u, \gamma > 0, \]  

where \( u \) is a randomly distributed error term.

Substituting (2) and (3) into (4) and rearranging terms yield

\[ \dot{I} = \gamma \dot{A} + (\alpha_I - \gamma \alpha_A) \ln YN - (\gamma \beta_A - \beta_I) (\ln YN)^2 + u. \]  

This is the explicit form of equation 1. This equation also implies that the disparity between industrial and agricultural growth, \( I - \dot{A} \), is a second order non-linear function of per capita income.

The estimation of equation (5) is based on two cross-country samples: one consists of 63 countries for the decade of the 1960s and the other has 87 countries for the decade of the 1970s. Both samples include
developing as well as developed countries. The data sources are provided in the Annex. The estimation results are contained below in Table 1.

**Table 1: ESTIMATED REGRESSION COEFFICIENTS FOR ANNUAL INDUSTRIAL GROWTH**

<table>
<thead>
<tr>
<th>Equation</th>
<th>Period</th>
<th>lnYN</th>
<th>(lnYN)^2</th>
<th>A</th>
<th>Constant</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1960-70</td>
<td>9.277*</td>
<td>-0.658*</td>
<td>-</td>
<td>-24.331*</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.7)</td>
<td>(2.8)</td>
<td></td>
<td>(2.1)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1970-79</td>
<td>13.068**</td>
<td>-0.904**</td>
<td>-</td>
<td>-40.594**</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.4)</td>
<td>(3.4)</td>
<td></td>
<td>(3.1)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1960-70</td>
<td>6.548</td>
<td>-0.458</td>
<td>0.491*</td>
<td>-16.730</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.8)</td>
<td>(1.8)</td>
<td>(2.1)</td>
<td>(2.1)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1970-79</td>
<td>9.477**</td>
<td>-0.649*</td>
<td>0.722**</td>
<td>-29.873*</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.6)</td>
<td>(2.6)</td>
<td>(4.1)</td>
<td>(2.4)</td>
<td></td>
</tr>
</tbody>
</table>

Note: This table is based on equation (5) in the text.

Numbers underneath respective coefficients in parenthesis are t-statistics. Coefficients with significance level above 5% are indicated by "*" and those above 1% are designated by "**".

The notations have the following meanings:

I = the average annual rate of growth of industry that comprises mining, manufacturing, construction, and electricity, water and gas.

YN = GNP per capita in 1970 and 1979, respectively, for the 1960-70 sample and the 1970-79 sample.

A = the average annual rate of growth of agriculture.

First, note that the regressions with the per capita income variables alone (equations 1 and 2) depict a parabolic curve, indicating that
at a relative low income level industrial growth will increase as per capita income increases and when per capita income reaches a certain level, the rate of industrial growth will reach a maximum and then taper off.

The third and fourth equations show that the growth rate of agriculture is a statistically significant variable in explaining industrial growth and it has the power to raise the $R^2$ significantly, especially for the 1970-79 sample. The introduction of the agriculture variable does not alter the signs of the per capita income variables but does reduce their statistical significance. The estimated regressions indicate that the disparity between industrial and agricultural growth is a second-order non-linear function in per capita income. Based on the 1970-79 cross section data of 87 countries, this disparity is illustrated in Table 2 for a selected number of income levels. As the table shows, the expected value of the disparity rises quickly over the low- and middle-income range (US $100 to US $1,500) and slowly tapers off after the middle income range.

The empirical evidence thus indicates that over the course of economic development, agricultural growth is a significant determinant of industrial growth. As reasoned earlier, the relationship between agriculture and industry, however, is more likely to be interdependent rather than causal.
Table 2: EXPECTED DISPARITY BETWEEN THE RATES OF INDUSTRIAL AND AGRICULTURAL GROWTH
(in per cent)

<table>
<thead>
<tr>
<th>Per Capita Income (in US Dollars)</th>
<th></th>
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<tr>
<td>100</td>
<td>0.5</td>
</tr>
<tr>
<td>200</td>
<td>1.8</td>
</tr>
<tr>
<td>250</td>
<td>2.4</td>
</tr>
<tr>
<td>500</td>
<td>3.7</td>
</tr>
<tr>
<td>1,000</td>
<td>4.3</td>
</tr>
<tr>
<td>1,500</td>
<td>4.4</td>
</tr>
<tr>
<td>2,500</td>
<td>4.2</td>
</tr>
<tr>
<td>3,000</td>
<td>4.1</td>
</tr>
<tr>
<td>4,000</td>
<td>3.8</td>
</tr>
<tr>
<td>8,000</td>
<td>2.6</td>
</tr>
<tr>
<td>10,000</td>
<td>2.0</td>
</tr>
</tbody>
</table>

III. Agriculture and Overall Economic Growth - A Production Function Approach

The empirical evidence presented in the previous section suggests that the linkage between agriculture and industry may be strong and significant during economic development. In this section I will examine the contribution of agriculture to economic growth from the perspective of an aggregate production function. The hypothesis formulated and tested here is that agriculture contributes to economic growth through its impact on the rate of increase in productivity.

There are at least two reasons why agricultural performance is closely related to the overall productivity of an economy. First, industrialization and the accompanied urbanization generate a growing need for food and raw materials, which can only be met with adequate agricultural supplies. A poorly performed agricultural sector often results in a terms of trade that is against industry, in a loss of foreign exchange, or in an
inadequate demand for industrial output that restricts industrial expansion. These conditions would hamper the transfer of resources from agriculture to industry or make it very costly to do so. On the other hand, rapid agricultural growth makes feasible more per capita domestic consumption, higher exports of agricultural products, and greater absorption of agricultural labor force by the industrial sector. It would, therefore, increase the efficiency of the resource transfers. As Robinson (1971) has shown, transfers of capital and labor from a low productivity sector (agriculture) to a high productivity sector (manufacturing) could be a source of economic growth.

Second, high agricultural growth largely reflects high average labor productivity in agriculture which, in turn, is supported by the high quality of human resources and physical capital inputs into the rural sector. For instance, comparing the agricultural productivity differences between developing and developed countries, Hayami and Ruttan (1970) have found that about two-thirds of the differences can be accounted for by the difference in technology, as embodied in fixed working capital and in human capital, broadly conceived to include the education, skills, knowledge and capacity present in a country's population. These considerations suggest the inclusion of the rate of agricultural growth as an additional variable in an aggregate production function to measure both the effect of the efficiency of resource transfers between agriculture and industry and of the changes of agricultural productivity on economic growth.

Other Variables Affecting Productivity Change

It might be useful to consider other variables that might influence productivity changes to minimize misspecification of the production function
to be estimated below. Here, I will consider two variables — the rate of exports growth and the rate of inflation.¹

The contribution of the former to economic growth is usually rationalized on such grounds as: (1) exports provide for the economy of scale operations, and (2) higher export growth enhances competition which is brought from international markets. These factors would promote efficiency and therefore raise economic growth. The positive correlation between export growth rates and GNP growth rates for the LDCs has been found in a number of studies, i.e., Michalopoulos and Tay (1973), Michaely (1977), and Krueger (1977). Recently, in the context of an aggregate production function, Balassa (1978), Tyler (1981) and Feder (1982) have all found that the growth in exports contributes significantly to the intercountry differences in the rates of economic growth. These studies differed from earlier ones in that besides exports, they had simultaneously considered the contributions made by factor inputs, i.e., by capital and labor. They are, therefore, able to delineate more robustly the effects of exports on economic growth.

The rate of inflation, however, affects economic growth negatively for at least the following reasons (Tsiang, 1983). First, inflation by increasing the variance of relative prices may make efficient planning of production difficult and as a result productivity suffers. Second, inflation accompanied by government controls would lead to very low real interest rates. This would lead to a false sense of cheapness of capital and to unproductive uses of such capital. Thirdly, below equilibrium interest rates accompanied by high inflation would turn the flow of savings away from

¹/ Exports and inflation, however, are not the only factors that influence productivity. Education could be another factor but is omitted here (Selowsky, 1969).
financial institutions and force them into unproductive investments such as hoardings of previous metals and investments on housing.

The Model

To test the hypothesis formulated above, I will use the following Cobb-Douglas production function:

\[ Y = C K^\alpha L^\beta e^{\text{log} R} \]  \hspace{2cm} (6)

where \( Y \) is gross domestic product; \( C \) is a scale parameter; \( K \) is capital stock, \( L \) is labor force; \( e^{\text{log} R} \) indicates the rate of technological change over time which is taken to be synonymous with productivity change.

Rewriting the variables in equation (6) in terms of the rate of change over time yields

\[ \dot{Y} = \alpha \dot{K} + \beta \dot{L} + \dot{R}. \]  \hspace{2cm} (7)

In the literature of production function analysis the productivity change (R) in the production function (7) is frequently treated as a "residual" and the production function is estimated accordingly. The argument presented here assumes that the rate of productivity change will be positively influenced by both the rates of agricultural growth (A) and export growth (X) but negatively related to the rate of inflation (P):

\[ \dot{R} = \gamma \dot{A} + \Theta \dot{X} + \eta \dot{P} + \epsilon, \quad \gamma, \Theta > 0, \eta < 0, \]  \hspace{2cm} (8)
where $\varepsilon$ is a residual, assumed to be randomly distributed. Combining (7) and (8) yields

$$\dot{Y} = \dot{a}K + \dot{b}L + \dot{y}A + \dot{\Theta}X + \dot{\eta}P + \varepsilon$$  \hspace{1cm} (9)

where $Y$ = the average annual rate of growth in GDP

$K$ = the average annual rate of growth in capital, proxied by the average investment rate

$L$ = the average annual rate of growth in labor force

$X$ = the average annual rate of growth in exports

$P$ = the average annual rate of inflation

Since agriculture is a part of total output, to test whether agricultural growth contributes significantly to productivity increases, we first regress the part of economic growth that cannot be explained by growth in factor inputs (capital and labor) and factors influencing the productivity change (export growth and inflation) on agricultural growth — that is, we regress the unexplained residuals of the production function on agricultural growth as the following:

$$\dot{Y} - \dot{a}K - \dot{b}L - \dot{\Theta}X - \dot{\eta}P = \dot{y}A + \varepsilon,$$  \hspace{1cm} (10)

where $\hat{\alpha}$, $\hat{\beta}$, $\hat{\gamma}$, and $\hat{\eta}$ are the estimates of $\alpha$, $\beta$, $\Theta$, and $\eta$, respectively, when agricultural growth ($A$) is omitted from equation (9).

---

1/ This should provide a robust test because, unlike total economic growth itself, the residuals of the production function as indicated by the left hand side of equation (10) need not bear any systematic relationship with agricultural growth, a priori.
The hypothesis is tested with cross-country samples from two periods: 1960-1970 and 1970-1979. For the first period, the sample includes 56 countries of which 41 are developing countries (Table 3). For the second period, because of the greater availability of country data, the sample is increased to 81 countries of which 68 are developing countries (Table 4). For both time periods, empirical results are obtained for the developing country sample as well as for the whole sample.

First, turn to the developing country sample results for the 1960-1970 period, and note that capital and labor contribute to slightly less than one third of the variations in total output (Table 5, equation 1). When the rate of export growth (X) and inflation (P) are added to the regression, this increases the explained variations in total output from one third to slightly less than one-half (equation 2) and reduces the labor elasticity from 1.6 to 1.2. All the variables are significant at above the 5 percent level, except for the inflation rate. The estimated coefficients obtained for the all-country sample that includes the developed countries are very similar to those obtained for the developing country sample -- compare equation 2 with equation 6, for example -- and they are more efficient as evidenced by higher t-values which reflects a larger sample. Table 6 contains the empirical results of the contribution of agricultural growth to the portion of economic growth that is not explained by capital and labor inputs and by productivity changes due to export growth and inflation. It is shown that the marginal contribution of agriculture to economic growth is statistically significant at above the one percent level (equations 1 and 2). It indicates that agricultural growth accounted for an additional 18 percent of the increase in total productivity for the developing countries during 1960-70 and 16 percent for the
<table>
<thead>
<tr>
<th>Country</th>
<th>GDP (Y)</th>
<th>Capital (K)</th>
<th>Force (L)</th>
<th>Exports (X)</th>
<th>Prices (P)</th>
<th>Agriculture (A)</th>
</tr>
</thead>
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<tr>
<td>Bangladesh</td>
<td>3.6</td>
<td>11.3</td>
<td>2.1</td>
<td>6.5</td>
<td>3.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>4.4</td>
<td>5.7</td>
<td>2.0</td>
<td>3.6</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
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<td>1.0</td>
<td>4.3</td>
<td>1.7</td>
<td>2.3</td>
<td>4.5</td>
<td>-1.5</td>
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<td>1.1</td>
<td>-11.6</td>
<td>2.7</td>
<td>4.1</td>
</tr>
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<td>3.0</td>
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<td>6.0</td>
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<td>8.1</td>
<td>4.1</td>
<td>0.8</td>
</tr>
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<td>1.2</td>
<td>1.7</td>
<td>2.9</td>
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<td>9.0</td>
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<td>1.6</td>
<td>2.5</td>
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<td>-2.3</td>
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<td>2.1</td>
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<td>2.2</td>
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**Table 5: ESTIMATED REGRESSION COEFFICIENTS FOR ANNUAL GROWTH IN GDP, 1960-70**

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<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>0.105</td>
<td>0.418</td>
<td>0.146</td>
<td>-0.038</td>
<td>0.556</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.2)</td>
<td>(2.1)</td>
<td>(5.0)</td>
<td>(1.8)</td>
<td>(4.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>0.083*</td>
<td>0.315</td>
<td>0.145**</td>
<td>-0.041</td>
<td>0.547**</td>
<td>0.681</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.7)</td>
<td>(1.3)</td>
<td>(5.1)</td>
<td>(2.0)</td>
<td>(4.7)</td>
<td>(0.8)</td>
<td></td>
</tr>
</tbody>
</table>

Note: This table is based on equation (9) in the text.

Numbers underneath respective coefficients in parenthesis are t-statistics. Coefficients with significance level above 5% are indicated by "*" and above 1% by a "**".

all-country samples and that a one percentage increase in agricultural growth yielded a 0.4 percent increase of the "unexplained" growth for the developing country sample and a 0.3 percent increase for the all country sample, respectively.
Table 6: ESTIMATED REGRESSION COEFFICIENT FOR ANNUAL UNEXPLAINED GROWTH IN GDP

<table>
<thead>
<tr>
<th>Equation</th>
<th>Period</th>
<th>Country</th>
<th>A</th>
<th>Constant</th>
<th>R^2</th>
<th>No. of Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1960-1970</td>
<td>Developing</td>
<td>0.402**</td>
<td>-1.223</td>
<td>0.18</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3.0)</td>
<td>(2.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>All</td>
<td>0.322**</td>
<td>-0.880</td>
<td>0.16</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3.0)</td>
<td>(2.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1970-1979</td>
<td>Developing</td>
<td>0.348**</td>
<td>-0.693</td>
<td>0.20</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.1)</td>
<td>(2.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>All</td>
<td>0.353**</td>
<td>-0.693</td>
<td>0.21</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.6)</td>
<td>(2.9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This table is based on equation (10) in the text.

Numbers underneath respective coefficients in parenthesis are t-statistics. Coefficients with significance level above 5% are indicated by "**" and above 1% by "***".

Likewise, the empirical estimates obtained for the period 1970-1979 support the general patterns observed for the earlier period 1960-1970 (Table 7). In addition, the estimates for 1970-79 are statistically more efficient compared with the previous sample. For instance, the inflation rate is found to be significant at above the five-percent significance level, even though its negative impact on economic growth in absolute terms becomes smaller. The estimated coefficients of export growth are nearly twice as large as those obtained for the 1960-1970 sample, indicating that the marginal contribution of exports to economic growth appears to be greater in the 1970s. The contribution of agriculture to the increase in productivity is again found to be significant and accounts for 20 percent of the "unexplained" variations in economic growth (Table 6, equations 3 and 4), which is somewhat higher than the 18 percent estimated for the 1960-1970 period. A one percent increase in
Table 7: ESTIMATED REGRESSION COEFFICIENTS FOR ANNUAL GROWTH IN GDP, 1970-1979

<table>
<thead>
<tr>
<th>Equations</th>
<th>Country</th>
<th>K</th>
<th>L</th>
<th>X</th>
<th>P</th>
<th>A</th>
<th>Constant</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Developing</td>
<td>0.141**</td>
<td>0.626</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.0)</td>
<td>(1.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>0.103**</td>
<td>0.790**</td>
<td>0.279**</td>
<td>-0.022</td>
<td></td>
<td></td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.4)</td>
<td>(3.0)</td>
<td>(5.8)</td>
<td>(2.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0.095**</td>
<td>0.600**</td>
<td>0.236**</td>
<td>-0.023*</td>
<td>0.379**</td>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.2)</td>
<td>(2.5)</td>
<td>(5.4)</td>
<td>(2.9)</td>
<td>(4.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0.098**</td>
<td>0.625*</td>
<td>0.235</td>
<td>-0.022*</td>
<td>0.380**</td>
<td>-0.139</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.7)</td>
<td>(2.0)</td>
<td>(5.1)</td>
<td>(2.6)</td>
<td>(4.2)</td>
<td>(0.1)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>All</td>
<td>0.129**</td>
<td>0.714**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.0)</td>
<td>(2.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0.079**</td>
<td>0.961**</td>
<td>0.263**</td>
<td>-0.020*</td>
<td></td>
<td></td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.3)</td>
<td>(4.4)</td>
<td>(6.0)</td>
<td>(2.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>0.076**</td>
<td>0.730**</td>
<td>0.224**</td>
<td>-0.021*</td>
<td>0.378**</td>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.6)</td>
<td>(3.6)</td>
<td>(5.6)</td>
<td>(2.8)</td>
<td>(4.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>0.096**</td>
<td>0.829**</td>
<td>0.219**</td>
<td>-0.020*</td>
<td>0.380**</td>
<td>-0.697</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.9)</td>
<td>(3.4)</td>
<td>(5.3)</td>
<td>(2.5)</td>
<td>(4.6)</td>
<td>(0.8)</td>
<td></td>
</tr>
</tbody>
</table>

Note: This table is based on equation (9) in the text.

Numbers underneath respective coefficients in parenthesis are t-statistics. Coefficients with significance level above 5% are indicated by "*" and above 1% by a "**".

Agricultural growth is estimated to increase productivity by 0.35 percent during the 1970s.

When the rate of agricultural growth is introduced as an additional variable in the production function in a multiple regression context, its additional contribution to economic growth in terms of the R²'s is reduced.
because of multicollinearity. Furthermore, for the 1960-1970 period, there is a significant correlation between agricultural growth and labor force growth, so much so that the marginal contribution of agriculture to economic growth as measured by the coefficients of agricultural growth are increased significantly while those of labor force growth are correspondingly reduced. For the developing country sample, the coefficient of agricultural growth is increased from 0.40 (equation 1, Table 6) to 0.63 (equation 4, Table 5), while that of labor force growth is reduced from 1.20 to 0.49 after the introduction of agricultural growth (\(A\)). But for the 1970-1979 period, however, the regression coefficients remain largely the same (0.79 to 0.60) after the addition of \(A\). The estimated elasticity of agricultural growth is increased only slightly from 0.35 to 0.38 for the developing country sample and shows little change for the all country sample (Table 7). Thus the marginal contribution of agriculture to productivity growth can be more confidently delineated from other influences during this period. The estimated equation for the developing country sample is then used for a "sources" of economic growth analysis discussed below.

Using the estimated regressions on economic growth, the average rate of economic growth during a period can be decomposed according to the "sources" of economic growth. To estimate the contributions made by each source of growth, a constant term should be inserted into the equation, which has so far been suppressed, in order to capture the composite effect on productivity changes of all other factors omitted from the equation. The empirical evidence obtained here, however, does not suggest that the constant term is statistically significant (compare equation 3 with equation 4 in Table 7, for instance). Thus the effect of the excluded variables -- such as
education, health, and nutrition level of the work force, etc. -- on productivity changes may have already been captured by the variables, i.e., exports, agriculture, and inflation included in the regression. For the developing countries sample of the 1970-1979 period, during which the average rate of growth is 4.4 percent, the sources-of-growth decomposition indicates that capital and labor jointly contribute to about 81 percent of the growth in total output with the former contributing 48 percent and the latter 33 percent. The remaining 19 percent of the output growth is explained by the productivity change which in turn is contributed by agricultural growth, export growth, and inflation (Table 8).  

It is worth noting that for the developing countries, the contribution of agricultural growth to productivity growth (0.8 percent) is greater than that of export growth (0.6 percent). Agriculture's contributing share in total productivity growth (17 percent) is also greater than that of export growth (14 percent). Finally, one percentage increase in the inflation rate is estimated to have reduced output growth by 0.4 percent due to its detrimental effect on productivity growth.

1/ Since it is the property of the ordinary least squares method that the average value of the dependent variable in the sample period is exactly equal to the average of the predicted value of the dependent variable, the sample average of the dependent variable can be exactly decomposed according to the contributing variables included in the regression. As the \( R^2 \) indicates, the unexplained variation in the dependent variable is large. Therefore, the chances are high that some variables with explanatory power might have been excluded. Hence, this decomposition is meaningful only insofar as it evaluates the relative contribution made by each included explanatory variable.
Table 8: SOURCES OF ECONOMIC GROWTH, 1970-1979

<table>
<thead>
<tr>
<th>Factors of production:</th>
<th>Rate of Growth (%)</th>
<th>Share (%)</th>
<th>Mean Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>3.5</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>2.1</td>
<td>48</td>
<td>21.6 b/</td>
</tr>
<tr>
<td></td>
<td>1.4</td>
<td>33</td>
<td>2.3</td>
</tr>
<tr>
<td>Productivity change:</td>
<td>0.9</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export</td>
<td>0.6</td>
<td>14</td>
<td>2.7</td>
</tr>
<tr>
<td>Inflation</td>
<td>-0.4</td>
<td>-9</td>
<td>19.1</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.8</td>
<td>17</td>
<td>2.0</td>
</tr>
<tr>
<td>Other a/</td>
<td>-0.1</td>
<td>-3</td>
<td></td>
</tr>
<tr>
<td>Total (GDP)</td>
<td>4.4</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Calculation is based on equation 4 in Table 7.

a/ Reflecting the constant term.
b/ Investment as a proportion of GDP.

IV. Summary and Conclusion

Using cross section data of the 1960s and the 1970s, this paper has shown that intercountry variation in agricultural growth is a significant determinant of intercountry variation in industrial growth. It has also demonstrated empirically that agricultural growth induces productivity increases and, therefore, facilitates overall economic growth. As argued in the paper, this result may stem from the fact that rapid agricultural growth raises the efficiency of resource (capital and labor) transfers between the agricultural and the non-agricultural sectors resulting in an increase in overall productivity. Also rapid agricultural growth itself may reflect high
agricultural productivity. The paper also confirms earlier findings on the positive contribution of export growth to the increase of productivity. In addition, it shows that inflation has the opposite effect on productivity.

The implication of the main thrust of this paper for the long term development strategy of low income LDCs is clear: an appropriate agricultural development strategy should be formulated to accelerate their agricultural growth rates. While agriculture is inevitably a "declining industry" from the point of view of its share in total output in the course of long-term development, it should not be excessively squeezed for resources to support non-agricultural activities and therefore prematurely "abandoned".

While cross section analysis serves to uncover the common variables that determine the complex growth processes underlying individual countries and to summarize their "average" or "normal" experience and thus a point of reference for analyzing individual country performance, it should be supplemented by detailed country studies to examine country specific factors. Given the often unique conditions surrounding developing country agriculture, the examination of the contribution of agriculture to economic growth through the use of cross section data as was done in this paper should clearly not be exempted from these remarks.
REFERENCES


ANNEX

DATA SOURCES

The data used in the paper are mostly obtained from world development indicators annex of the World Development Report 1981 published by the World Bank: 1979 GNP per capita in dollars (YN), average annual rate of inflation (P) are from Table 1 of the annex (pp. 134-135); the average annual growth rate of GDP (Y), agriculture (A), industry (I) are from Table 2 (pp. 136-137); the average annual growth rate of merchandise export is from Table 8 (pp. 148-149). The average investment rate (K) for the period and the 1970 GNP per capita are obtained from Economic and Social Data Division of the World Bank. The average annual growth rate of labor force (L), is derived from Social Indicators Data Sheets for individual countries compiled by the Economic and Social Data Division as of May 1982.
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In the fall of 1979, the African Governors of the World Bank addressed a memorandum to the Bank's president expressing their alarm at the dim economic prospects for the nations of sub-Saharan Africa and asking that the Bank prepare a "special paper on the economic development problems of these countries" and an appropriate program for helping them. This report, building on the Lagos Plan of Action, is the response to that request.

The report discusses the factors that explain slow economic growth in Africa in the recent past, analyzes policy changes and program orientations needed to promote faster growth, and concludes with a set of recommendations to donors, including the recommendation that aid to Africa should double in real terms to bring about renewed African development and growth in the 1980s. The report's agenda for action is general; it indicates broad policy and program directions, overall priorities for action, and key areas for donor attention. Like the Lagos Plan, the report recognizes that Africa has enormous economic potential, which awaits fuller development.


Development Strategies in Semi-Industrial Economies
Bela Balassa

Provides an analysis of development strategies in semi-industrial economies that have established an industrial base. Endeavors to quantify the systems of incentives that are applied in six semi-industrial developing economies—Argentina, Colombia, Israel, Korea, Singapore, and Taiwan—and to indicate the effects of these systems on the allocation of resources, international trade, and economic growth.

The Johns Hopkins University Press, 1982. 416 pages (including appendices, index).


Economic Growth and Human Resources
Norman Hicks, assisted by Jahangir Boroumand


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The Extent of Poverty in Latin America
Oscar Altimir

This work originated in a research project for the measurement and analysis of income distribution in the Latin American countries, undertaken jointly by the Economic Commission for Latin America and the World Bank. Presents estimates of the extent of absolute poverty for ten Latin American countries and for the region as a whole in the 1970s.


ISBN 0-8213-0012-1. $5.00.
First Things First: Meeting Basic Human Needs in the Developing Countries
Paul Streeten, with Shahid Javed Burki, Mahbub ul Haq, Norman Hicks, and Frances Stewart

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This book answers the critics of the basic needs approach, views this approach as a logical step in the evolution of economic analysis and development policy, and presents a clear-sighted interpretation of the issues. Based on the actual experience of various countries—their successes and failures—the book is a distillation of World Bank studies of the operational implications of meeting basic needs. It also discusses the presumed conflict between economic growth and basic needs, the relation between the New International Economic Order and basic needs, and the relation between human rights and basic needs.


The Hungarian Economic Reform, 1968–81
Bela Balassa

Reviews the Hungarian experience with the economic reform introduced in 1968 and provides a short description of the antecedents of the reform. Analyzes specific reform measures concerning agriculture, decisionmaking by industrial firms, price determination, the exchange rate, export subsidies, import protection, and investment decisions and indicates their effects on the economy. Also examines the economic effects of tendencies toward recentralization in the 1970s, as well as recent policy measures aimed at reversing these tendencies.


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Explores the Brazilian experience from the point of view of political economy and computable general equilibrium income distribution models.

Oxford University Press, 1980. 368 pages (including references, appendices, index).

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