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Growth in Sub-Saharan Africa

by

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Abstract

The paper investigates empirically the determinants of economic growth for a large sample of sub-Saharan African countries during 1981-92. The results indicate that (i) an increase in private investment has a relatively large positive impact on per capita growth; (ii) growth is stimulated by public policies that lower the budget deficit in relation to GDP (without reducing government investment), reduce the rate of inflation, maintain external competitiveness, promote structural reforms, encourage human capital development, and slow population growth; and (iii) convergence of per capita income occurs after controlling for human capital development and public policies.

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Summary

Aggregate economic performance in sub-Saharan Africa in recent years has remained unsatisfactory, in contrast to robust performance in developing countries elsewhere. Both domestic and external factors have contributed to this disappointing overall performance. Nevertheless, the experience of an increasing number of countries in the region suggests that economies can grow even when external conditions are unfavorable. There are indications that countries adopting and implementing broad-based macroeconomic and structural reforms have, on average, done better than others.

This paper investigates the macroeconomic and other determinants of growth in sub-Saharan Africa using data for 29 countries during 1981-92. The results can be summarized as follows: (i) there is support for conditional convergence of per capita income; (ii) an increase in private investment has a large positive impact on per capita growth; (iii) macroeconomic policies affect per capita growth through their effects both on the volume and on the efficiency of investment; (iv) growth is stimulated by public policies that lower the budget deficit in relation to GDP (without reducing government investment), reduce the rate of inflation, maintain external competitiveness, promote structural reforms, encourage human capital development, and slow population growth; and (v) droughts and deteriorations in the terms of trade inhibit per capita growth.

Notwithstanding the deleterious effects of adverse exogenous factors on sub-Saharan African growth, the results confirm the importance for growth of promoting appropriate and convincing policies and of avoiding policies that create distortions or increase uncertainty. The variables measuring the effects of macroeconomic policies and structural reforms are jointly statistically significant in influencing growth, indicating the benefits of implementing a comprehensive package of policies rather than piecemeal policy actions. Broad-based adjustment policies are more likely to be self-reinforcing and durable than isolated policy reforms, thus enhancing their credibility and the potential response of the private sector. As increases in private investment stimulate growth, the government should formulate and implement appropriate policies to encourage private sector development.

The results indicate that while reducing fiscal imbalances is beneficial to growth, doing so by cutting government investment is counterproductive. Instead, budget deficits should be reduced to sustainable levels through cuts in unproductive outlays and improved domestic revenue mobilization by broadening the domestic tax base and strengthening tax administration. Increased government expenditure on human capital development would enhance growth, both directly and also indirectly by slowing down population growth.

I. Introduction

Aggregate economic performance in sub-Saharan Africa during the last decade has remained unsatisfactory, in contrast to robust performance of developing countries elsewhere. Both domestic and external factors have contributed to this disappointing overall performance. The external environment, characterized by sharp declines in world commodity prices and substantial losses in the terms of trade, has been generally unfavorable. For many countries, the effects of these adverse external developments have been compounded by unfavorable weather. Also, virtually all countries in the region have been confronted with deep-rooted developmental constraints--rapid population growth, low human capital development, and inadequate infrastructure--which have constituted major impediments to private sector development and the supply response of the economies in general. In addition, ethnic conflicts, political instability, adverse security conditions, and protracted civil wars have aggravated the economic performance of several countries. Furthermore, governance concerns in several sub-Saharan African countries have been compounded by the legacy of repressive regimes in several African countries, as well as by bloated and inefficient public administrations, ineffective judicial systems, and complex administrative and institutional frameworks. Finally, inappropriate economic policies pursued by several countries have also contributed to the weak aggregate economic performance.

Nevertheless, the overall poor growth performance of sub-Saharan Africa has masked the important progress made by several countries, particularly since the mid-1980s, in lowering internal and external imbalances and addressing structural rigidities, and thus, at establishing the necessary conditions for resuming sustainable growth. On average, countries that have adopted and effectively implemented broad-based macroeconomic and structural reforms have done better than others. 1/ A recent paper by Hadjimichael and others (1995), using cross-section data during 1986-92, has demonstrated that after population growth and unfavorable weather, inappropriate macroeconomic policies were the second most important contributing factors to the poor per capita growth performance of sub-Saharan African countries. A number of other studies have provided evidence in support of the beneficial impact on growth of a stable macroeconomic environment. 2/

The current paper extends the empirical investigation of the determinants of growth in sub-Saharan Africa in three different ways. First, following Knight, Loayza, and Villanueva (1993), an extended version of the Mankiw, Romer, and Weil (1992) framework is applied to panel data for

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1/ See the paper by Hadjimichael and Ghura (1995a).

2/ For the case of developed and developing economies, see, for example, Fischer (1991, 1993), Khan and Kumar (1993), Knight, Loayza, and Villanueva (1993), Kormendi and Meguire (1985), Grier and Tullock (1989), and Levine and Renelt (1992) for a list of other relevant studies. For the case of Africa, see Bouton, Jones, and Kiguel (1994), Easterly and Levine (1993), Ghura (1995a and 1995b), Ghura and Grennes (1993), Ojo and Oshikoya (1995), Savvides (1995), and Wheeler (1984).

29 countries in the region during 1981-92. 1/ Second, following the papers by Khan and Kumar (1993) and Khan and Reinhart (1990), the contribution of private and government investment to growth is investigated. Finally, the effects on growth of macroeconomic policies, structural reforms, changes in the terms of trade, human capital, the weather, and political freedom are investigated. The results indicate that growth is stimulated by public policies that lower the budget deficit in relation to GDP (without reducing government investment), reduce the rate of inflation, maintain external competitiveness, promote structural reforms, encourage human capital development, and slow population growth. Also, an increase in private investment has a relatively large positive impact on per capita growth. In addition, convergence of per capita income occurs after controlling for human capital development and public policies.

The rest of this paper is organized as follows: Section II discusses briefly some theoretical considerations in the growth literature. Section III presents the empirical model and Section IV outlines the empirical framework and summarizes the estimation results. The last section summarizes the main conclusions and draws some policy implications.

II. Some Theoretical Considerations

In the Solow-Swan growth model, steady state growth depends on technological progress and population growth, both of which are exogenous to the model; in the absence of technological progress, steady state per capita output does not grow. In this framework, an increase in the savings rate raises per capita economic growth in the short run; however, owing to diminishing returns to capital, per capita output in the long run grows at the rate of exogenously given technological progress. As such, economic policies do not affect steady state economic growth, although they can affect the level of output or its growth rate when the economy is in transition from one steady state to another. An important prediction of neoclassical growth models is that the output levels of countries with similar technologies should converge to a given level in the steady state. A number of recent papers have shown that the unconditional convergence hypothesis does not appear to be consistent with the empirical evidence. Nevertheless, support for conditional convergence is usually found when account is taken of the effects on per capita growth of the rate of investment, population growth, and public policies. 2/

1/ This paper extends the analysis of growth in sub-Saharan African countries by Hadjimichael and others (1995) by considering a longer time period.

2/ See, for example, Barro (1991), Barro and Sala-i-Martin (1992), Khan and Kumar (1993), and Mankiw, Romer, and Weil (1992).

The dependence of growth on exogenous technological progress in the neoclassical model, as well as the apparent inconsistency of convergence to hold with actual data have prompted investigation of alternative growth models. Endogenous growth models are able to generate a linkage between public policies and growth in the long run by assuming aggregate production functions that exhibit non-decreasing returns to scale. 1/ The remainder of this section provides a brief review of the main theoretical considerations in the current literature on growth.

1. Human capital

Recent endogenous growth models have shown that human capital accumulation can be an important source of long-term growth, either because it is a direct input into research (Romer (1990)) or because of its positive externalities (Lucas (1988), and Becker, Murphy, and Tamura (1990)). For example, Lucas (1988) proposes a model in which investment in human capital enhances the productivity of both the recipients of such capital and the society at large, thereby creating positive externalities. The decision of individuals to invest in human capital enhances technological progress. Hence, policies that enhance public and private investment in human capital affect long-run economic growth. Nevertheless, using a neoclassical framework, Mankiw, Romer, and Weil (1992) have shown that the contribution of human capital to growth is also consistent with the predictions of the Solow-Swan model.

2. Macroeconomic stability

Macroeconomic policies may affect economic growth either directly through their effect on the accumulation of factors of production, namely capital, or indirectly through their impact on the efficiency with which factors of production are used. Macroeconomic stability--reflected in low and stable inflation, sustainable budget deficits, and appropriate exchange rates--sends important signals to the private sector about the direction of economic policies and the credibility of the authorities regarding their commitment to manage the economy efficiently. Such stability, by facilitating long-term planning and investment decisions, encourages savings and private capital accumulation. The lack of macroeconomic stability, by creating an atmosphere of uncertainty, makes it difficult for economic agents to extract the correct signals from relative prices, such as the real returns to investment, and thus leads to inefficient allocation of resources (Barro (1976 and 1980)). An appropriate level of the real exchange rate, and an appropriate structure of relative prices and economic incentives in general, are key ingredients of a stable macroeconomic environment.

1/ See Barro and Sala-i-Martin (1995), Easterly and others (1991), and Renelt (1991) for surveys of the theoretical and empirical issues related to the neoclassical and endogenous growth models; see also Easterly (1993) and Otani and Villanueva (1989).

The effect of inflation on growth is ambiguous in the theoretical literature. According to the Tobin-Mundell effect, higher anticipated inflation leads to a lower real interest rate and causes portfolio adjustments away from real money balances toward real capital; hence, a higher anticipated inflation would be expected to raise real investment and growth. However, in the case of developing countries with underdeveloped domestic capital and financial markets, the portfolio adjustments would most likely be from real money balances to real assets, which are not usually included in private investment, or to assets denominated in foreign currency through capital flight. Thus, higher anticipated inflation in these countries would be expected to lower private investment and growth. In the cash-in-advance models (e.g., Stockman (1981)), anticipated inflation, by raising the cost of capital, lowers capital accumulation and economic growth.

Fiscal policy and the extent of government involvement in the economy have received considerable attention in the development literature. 1/ Other things being equal, a higher budget deficit will crowd out the private sector, as a result of lower access to bank credit, a higher real interest rates, and a more appreciated real exchange rate. Government investment has also been used in empirical studies as a direct proxy of the government's contribution to capital accumulation, as well as an indicator of the adequacy of basic economic and social infrastructure. Some studies have included government consumption to allow for the concern of supply side theories that higher government spending creates expectations of future tax liabilities that in turn distort incentives and lower economic growth (e.g., Kormendi and Meguire (1985)). Endogenous growth models have shown that fiscal policy can have significant effects on economic growth in the long run. For example, in a model that assumes constant returns to scale with respect to government inputs and private capital combined but diminishing returns with respect to private capital alone, Barro (1989 and 1990) has shown that high levels of government taxation distort savings decisions, which in turn lower economic growth in the steady state.

3. Trade policy

Outward-oriented trade policies are conducive to faster growth because they promote competition, encourage learning-by-doing, improve access to trade opportunities, raise the efficiency of resource allocation, and enhance positive externalities resulting from access to improved technology (Grossman and Helpman (1989a, 1989b, and 1991), Khan (1987), Lucas (1988), and Romer (1986 and 1990)). 2/ Also, Krueger (1974) has argued that the

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1/ Easterly and Rebelo (1993) discuss the effects of fiscal policy on growth.

2/ See Roubini and Sala-i-Martin (1991), Romer and Rivera-Batiz (1991), and Villanueva (1993) for a discussion of the linkages between trade orientation and growth.

existence of import quotas diverts productive resources to rent-seeking activities and reduces growth.

4. Structural policies

Structural and institutional reforms are essential to enhancing economic incentives and improving the allocation of resources, as well as removing the impediments to private sector development. 1/ Policies aimed at improving the efficiency of economic resources involve measures to reduce the wedges between prices and marginal costs, which typically arise from price controls, imperfect competition, subsidies and tax exemptions, distortive taxes, and exchange and trade restrictions (Khan (1987)). Policies to expand capacity include reforms aimed at raising savings and investment.

Other structural reforms include liberalization of administrative procedures for private sector activity and legal reforms. A common characteristic of countries with limited political rights and civil liberties is a lack of well-defined property rights and market-friendly legal institutions. The absence of these rights and institutions lowers the security for life and property, and as a consequence reduces the rate of accumulation and the efficiency of factors of production.

III. The Empirical Model

The paper assumes a Cobb-Douglas production function of the following form: 2/

$$Y = A_0(A_p K_p)^{\alpha}(A_h K_h)^{\beta}(A_L L)^{1-\alpha-\beta} , \qquad (1)$$

where Y is real output; L is labor; K_p and K_h are the physical and human capital stock, respectively; A_0 is an overall index of technology and efficiency in the economy; and A_p, A_h, and A_L are the physical and human capital-augmenting and labor-augmenting technology, respectively. Defining:

$$A = A_L(A_0 A_p^{\alpha} A_h^{\beta})^{1/(1-\alpha-\beta)} , \qquad (2)$$

1/ In the empirical section of this study, an attempt is made to capture the effects of structural reforms by the use of a dummy variable that assumes a value of 1 for countries adjudged to have made significant progress in alleviating structural rigidities during 1986-92 (see the description of the variable STRUC in Table 1).

2/ For simplicity, the time subscripts are excluded.

equation (1) can be rewritten as:

$$Y = K_p^{\alpha} K_h^{\beta} (A.L)^{1-\alpha-\beta} , \tag{3}$$

where the A encompasses all the factor-augmenting and the economy-wide levels of technology and efficiency; A now represents the overall labor-augmenting technology and efficiency level. 1/

Labor and labor-augmenting technology are assumed to grow according to the following functions,

$$L = L_0 e^{nt} , \tag{4}$$

and

$$A = A_0 e^{(gt + x\theta)} , \tag{5}$$

where n is the exogenous rate of growth of the labor force; t is a time index; g is the exogenous rate of technological progress; X is a vector of policy and other factors that can affect the level of technology and efficiency in the economy; and θ is a vector of coefficients related to these policy and other variables.

Let S_g and S_h be the fractions of income invested in physical and human capital, respectively; for simplicity it is assumed that both types of capital stock depreciate at the same rate δ. Thus, physical and human capital are accumulated according to the following functions:

$$\frac{dK_p}{dt} = S_p Y - \delta K_p , \tag{6}$$

and

$$\frac{dK_h}{dt} = S_h Y - \delta K_h . \tag{7}$$

1/ Barro and Sala-i-Martin (1995, p. 54) show that for a steady state to exist, technological progress must be labor-augmenting.

Next, let k_p and k_h be the stock of physical and human capital in terms of effective labor units, that is, $k_p = K_p/A.L$ and $k_h = K_h/A.L$. Let also y be the level of output per effective unit of labor, that is, $y = Y/A.L$. Rewriting the production and accumulation functions in terms of quantities per effective labor unit gives:

$$y = k_p^{\alpha} k_h^{\beta} , \tag{3'}$$

$$\frac{dk_p}{dt} = s_p y - (n + g + \delta) k_p , \tag{6'}$$

and

$$\frac{dk_h}{dt} = s_h y - (n + g + \delta) k_h . \tag{7'}$$

In the steady state, the levels of physical and human capital per effective labor unit are constant. Thus, setting (6') and (7') to zero and solving the resulting equations gives:

$$k_p^* = \left(\frac{s_p^{1-\beta} s_h^{\beta}}{n + g + \delta} \right)^{1/(1 - \alpha - \beta)} , \tag{8a}$$

and

$$k_h^* = \left(\frac{s_p^{\alpha} s_h^{1-\alpha}}{n + g + \delta} \right)^{1/(1 - \alpha - \beta)} , \tag{8b}$$

Substituting (8a) and (8b) in (3') and taking natural logarithms gives the steady state output per effective labor unit:

$$\ln(y^*) = -\left(\frac{\xi}{1 - \xi} \right) \ln(n + g + \delta) + \left(\frac{\alpha}{1 - \xi} \right) \ln(s_p) + \left(\frac{\beta}{1 - \xi} \right) \ln(s_h) , \tag{9}$$

where $\xi = (\alpha + \beta)$.

An empirical counterpart of (9) can be obtained by taking the natural logarithm of $y = Y/A.L$, and substituting for A from equation (5):

$$\ln\left(\frac{Y}{L}\right) = \ln(A_0) + gt + X\theta - \left(\frac{\xi}{1-\xi}\right)\ln(n + g + \delta)$$

$$+ \left(\frac{\alpha}{1-\xi}\right)\ln(S_p) + \left(\frac{\beta}{1-\xi}\right)\ln(S_h) \ . \qquad (10)$$

The terms $\xi/1-\xi$, $\alpha/1-\xi$, and $\beta/1-\xi$ in the above equations are the elasticities of per capita income with respect to population growth, and the fraction of income invested in physical and human capital, respectively. This model predicts that the sum of the elasticities with respect to S_p and S_h is equal to that on $(n + g + \delta)$.

Finally, following Mankiw, Romer, and Weil (1992), the transition of actual output per effective labor unit to its steady state level is approximated by:

$$\frac{d\ln(y)}{dt} = \lambda[\ln(y^*) - \ln(y)] \ , \qquad (11)$$

where $\lambda = (n + \gamma + \delta)(1 - \xi)$ is the speed of convergence, y is the actual output per effective labor unit, and the other variables are defined as before. Equation (11) implies that: 1/

$$\ln(y) = (1 - e^{\lambda t})\ln(y^*) + e^{\lambda t}\ln(y_0) \ , \qquad (12)$$

where y_0 is output per effective labor unit at time t_0. Subtracting y_0 from both sides of (12) and substituting $\ln(y^*)$ from equation (10) gives:

$$\ln(y) - \ln(y_0) = (1 - e^{\lambda T})\left[-\left(\frac{\xi}{1-\xi}\right)\ln(n + g + \delta) + \left(\frac{\alpha}{1-\xi}\right)\ln(S_p)\right.$$

$$\left. + \left(\frac{\beta}{1-\xi}\right)\ln(S_h) + X\theta - \ln(y_0) + gt + \ln(A_0)\right] \ , \qquad (13)$$

where T is the length of time under consideration.

1/ See Knight, Loayza, and Villanueva (1993, p. 518) for details.

An empirical counterpart of equation (13) for the i-th sub-Saharan African country considered in this study is written as follows:

$$YGPC_{i,t} = \eta_0 \ln(Y0_i) + \eta_1 \ln(PG_{i,t} + g + \delta) + \eta_2 \ln(PIY_{i,t}) + \eta_3 \ln(GIY_{i,t})$$

$$+ \eta_4 \ln(HCI_i) + \theta_1 INFL_{i,t} + \theta_2 BDYE_{i,t} + \theta_3 RERG_{i,t} + \theta_4 XG_{i,t}$$

$$+ \theta_5 STRUC + \theta_6 TTG_{i,t} + \theta_7 DRY_{i,t} + \theta_8 PR_{i,t} + u_i + v_t + e_{i,t} , \qquad (14)$$

where YGPC is per capita real GDP growth rate; Y0 is a measure of initial income; PG is population growth rate; PIY and GIY are the ratios of private and government investment to GDP, respectively; HCI is an indicator of human capital development, measured alternatively by gross primary and secondary school enrollment ratios, and life expectancy at birth; INFL is the rate of inflation; BDYE is the ratio of the government budget deficit (excluding grants) to GDP; RERG is the percentage change in the real effective exchange rate; XG is the growth of export volume; STRUC is a dummy variable for countries that implemented significant structural reforms during 1986-92; TTG is the percentage change in the external terms of trade; DRY is a proxy for inadequate rainfall; PR is an index of political rights; and u_i, v_t, and $e_{i,t}$ are the country-specific, time-specific, and overall error terms, respectively. Note that the variables HCI and Y0 vary only across countries. Table 1 gives the definitions and sources of the variables. Following Mankiw, Romer, and Weil (1992), it is assumed that $(g + \delta) = 0.05$. Small variations of this assumed figure do not alter the results of estimation in a significant way.

From equation (14), the elasticities of per capita income with respect to population growth, and the fraction of income invested in public and human capital (i.e., $\xi/1-\xi$, $\alpha/1-\xi$, and $\beta/1-\xi$) are obtained from the expressions $\eta_1/-\eta_0$, $\eta_2/-\eta_0$, and $\eta_3/-\eta_0$, respectively. Also, the prediction that the sum of the elasticities on S_p and S_h is equal to that on $(n + g + \delta)$ can be tested by the null hypothesis: $\eta_1 + \eta_2 + \eta_3 = 0$. Further, if the null hypothesis: $\eta_2 - \eta_3 = 0$ were not rejected, it would imply that the elasticities of growth with respect to the ratios of private and government investment are equal. In addition, the speed of convergence is obtained by the formula:

$$\lambda = -\ln(1+T.\eta_0)/T \qquad (15)$$

Table 1. Definitions and Sources of Variables 1/

YGPC	Growth in per capita real GDP.
TIY	Total investment as a ratio to GDP.
GIY	Government investment as a ratio to GDP.
PIY	Private investment as a ratio to GDP, measured as TIY-GIY.
PG	Population growth.
Y0	Initial income, measured by per capita GNP in 1980 (expressed in US dollars). Source: World Bank, World Tables.
HCI	Index of human capital development. Three alternative variables are used to measure this index. PRI: average primary school enrollment ratios for the years 1980 and 1990; SEC: average secondary school enrollment ratios for the years 1980 and 1990; and LIFE: average life expectancy at birth during 1980-92. Sources: World Bank, World Tables, and World Bank (1988).
INFL	Annual rate of consumer price inflation.
DEFYI	Government budget deficit (including grants) as a ratio to GDP.
DEFYE	Government budget deficit (excluding grants) as a ratio to GDP.
RERG	Percentage change in the real effective exchange rate (REER). For each country, the REER is a weighted index of the nominal exchange rates adjusted for the differential between the domestic inflation rate and the rates of inflation in partner countries using a geometric weighing method (see Wickham (1987) for details). A positive value for RERG denotes an appreciation of the REER. Source: World Economic Outlook data base.
XG	Export volume growth, measured as total exports deflated by export unit value, both measured in US dollars. The export unit value is from the World Economic Outlook data base.
TTG	Percentage change in the terms of trade. Source: World Economic Outlook data base.
YGFD	Percentage change in an index of per capita food production. Source: World Bank, World Tables.
DRY	A dummy variable as a proxy for the extent of inadequate rainfall. It takes a value of 1 if the value of YGFD is less than 0 (and 0 otherwise).
PR	Index of political rights obtained from Gastil (1987), McColm and others (1991), and Freedom House (New York). The methodology used by the compilers for the calculation of this index entails the rating of countries on a seven-point (1-7) scale for levels of political rights, with a rating of 1 denoting full political rights. For the purpose of the current study, the inverse of these ratings are used so that a rise in the index denotes an improvement in the degree of political rights. The latter are defined as rights to participate meaningfully in the political process, such as the right of all adults to vote and compete for public office, and for elected representatives to have a decisive vote on public policies.
STRUC	Index of structural reforms, measured by a dummy variable which takes a value of 1 (and 0 otherwise) for countries adjudged as strong adjusters during 1987-92. Two categories of countries are covered by this classification. First, countries in the sample that implemented broadly appropriate policies under IMF-supported adjustment programs for at least three years during 1986-92, namely, Burundi, The Gambia, Ghana, Lesotho, Malawi, Mali, Niger, Senegal, Tanzania, Togo, Uganda, and Kenya. Second, countries that implemented appropriate policies during 1987-92 and did not need to adopt major adjustment programs, with or without support from the IMF, namely, Botswana, Mauritius, Swaziland, and Zimbabwe.
CFA8183, CFA8486, CFA8789, and CFA9092	Dummy variables for CFA franc countries during the subperiods: 1981-83, 1984-86, 1987-89, and 1990-92, respectively. The CFA franc countries included in this study are: Burkina Faso, Cameroon, Central African Republic, Congo, Côte d'Ivoire, Gabon, Mali, Niger, Senegal, and Togo.
CFA1, and CFA2	The combined dummy variables CFA8183 and CFA8486 (for CFA1), and CFA8789 and CFA9092 (for CFA2), respectively.

1/ See Table 2 for a list of countries included in this study. The data (except for the ones indicated) are from the Economic Trends in Africa (ETA) data base of the IMF.

IV. Empirical Results

Equation (14) is estimated with panel data for 29 countries in sub-Saharan Africa. Using annual data for the period 1981-92, four observations are constructed for each country by taking 3-year nonoverlapping averages of the variables during the subperiods 1981-83, 1984-86, 1987-89, and 1990-92; thus there are a total of 116 observations. 1/ The time period (1981-92) was chosen because data for several explanatory variables, such as private and government investment and comparable indicators of macroeconomic policies, are available only since 1980 for the group of countries considered. 2/ The choice of countries was dictated by the availability of data for the complete set of variables for each country during the full period 1981-92 (see Table 2 for a list of countries included). Given the panel nature of the data set, the error term for equation (14) accordingly has three components: u_i and v_t which capture country- and time-specific effects, respectively, and e_{it} which is an error term common to all countries.

In order to deal with time effects, the data are processed to remove the time means from the series, and the resulting model is estimated without an intercept. In regard to the treatment of country heterogeneity, the use of the least squares dummy variables (LSDV) procedure is quite common. However, with the inclusion of time-invariant variables (YO, HCI, and STRUC) in the regression analysis, the LSDV procedure cannot be implemented because the vector of dummy variables is perfectly collinear with these variables. Instead, the country-specific effects are captured by the inclusion of country-specific information imbedded in the indicators for the level of human capital development, the stance of economic policies, changes in the terms of trade, the degree of political freedom, and a proxy for the weather. In addition, dummy variables for subgroups of countries (CFA8183, CFA8486, CFA8789, and CFA9092, and STRUC) are used to account for the possibility of fixed effects stemming from a priori information regarding country characteristics and institutional arrangements.

Table 2 gives the averages of the variables for each country during 1981-92. For convenience, the sample of countries is classified into four subgroups: high growth countries (HGCs), with per capita growth greater than or equal to 1 percent; medium-to-low growth countries (MLGCs), with per capita growth less than 1 percent but greater than or equal to 0 percent; weak growth countries, with per capita growth less than 0 percent but greater than or equal to -1 percent; and very weak growth countries, with

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1/ The empirical evidence on the determinants of growth in developing countries provided by Khan and Kumar (1993) indicates that moving from a 3-year average to a 5-year average of the data makes little difference to the results. Given the relatively short time period considered in this study, use of the 3-year average of the data to smooth the series seems reasonable.

2/ The data for the series in levels are available starting in 1980; thus, data for the series that are expressed in growth rates start in 1981.

Table 2. Period Average of the Variables by Country, 1981–92

Countries 2/	Variables 1/ YGPC	TIY	PIY	GIY	PG	PRI	SEC	LIFE	Y0	INFL	BDYI	RERG	XG	TTG	PR	YGFD
High growth countries (HGC) 3/																
Botswana	5.51	29.9	20.4	9.6	3.6	107.5	32.0	66.4	780	11.1	−12.8	−1.0	9.2	2.0	0.67	−1.7
Mauritius	4.00	25.0	17.0	8.0	0.9	102.0	48.0	68.4	1180	9.2	5.3	−1.8	6.8	5.1	0.54	2.6
Congo 4/	1.81	27.5	16.4	11.1	3.1	161.5	85.0	51.3	850	6.3	9.6	0.1	9.0	−3.6	0.16	−0.3
Cape Verde	1.79	41.0	24.8	16.2	2.5	115.5	13.5	65.9	530	10.8	7.8	1.2	0.6	1.7	0.28	−0.9
Burundi	1.50	16.7	5.1	11.7	2.9	46.5	4.5	48.1	200	7.5	7.3	−2.9	7.2	−2.0	0.14	−0.1
Medium–to–low growth countries (MLGC) 5/																
Uganda	0.90	9.3	6.7	2.6	2.6	60.5	9.0	46.7	280	92.7	3.1	−15.0	6.7	−9.4	0.20	0.6
Burkina Faso 4/	0.86	19.2	11.4	7.8	2.6	27.5	5.5	46.8	240	1.9	9.5	−2.8	−1.4	1.1	0.16	3.0
Mali 4/	0.51	18.6	8.0	10.7	1.9	25.5	8.0	46.1	240	1.5	5.4	−2.9	13.2	−2.2	0.18	−0.2
Nigeria	0.40	20.4	11.2	9.1	3.4	88.0	19.5	50.2	930	21.9	7.4	−8.8	−0.5	−5.0	0.26	1.9
Swaziland	0.38	23.4	15.6	7.8	3.5	105.5	42.5	55.2	820	12.7	0.1	−2.3	7.8	−3.0	0.19	−1.7
Kenya	0.14	19.6	11.8	7.8	3.7	105.0	24.5	57.5	420	13.8	5.7	−2.6	−2.0	−2.4	0.18	−0.2
Senegal 4/	0.13	13.4	10.0	3.4	2.9	52.5	13.5	47.1	510	4.9	3.3	−1.0	4.2	2.6	0.28	2.9
Weak growth countries (WGC) 6/																
Zimbabwe	−0.19	20.6	17.3	3.3	3.3	101.0	29.0	59.3	710	17.1	4.7	−5.9	−1.7	6.1	0.23	−3.2
Lesotho	−0.31	56.6	37.4	19.2	3.0	109.5	22.0	58.3	410	14.2	9.4	−0.5	11.0	1.7	0.18	−2.8
Tanzania	−0.32	25.9	19.9	6.0	3.1	81.0	6.5	51.2	290	27.3	5.5	−5.7	2.1	−5.8	0.17	−1.3
Ghana	−0.61	9.2	3.8	5.4	3.4	78.5	39.5	54.0	410	41.5	3.5	−4.7	6.1	−5.4	0.22	0.2
Cameroon 4/	−0.73	21.8	12.8	9.0	3.1	99.5	23.0	53.5	760	7.3	4.7	0.7	10.1	−8.2	0.17	−1.6
The Gambia	−0.80	20.6	11.6	9.0	3.6	53.5	11.5	43.1	350	16.5	3.8	−2.2	12.9	9.1	0.44	1.0
Gabon 4/	−0.95	32.8	24.7	8.1	2.1	116.5	22.0	51.7	3830	5.0	3.8	−1.9	6.3	−4.0	0.19	−1.6
Very weak growth countries (VWGC) 7/																
Togo 4/	−1.08	23.6	14.7	8.9	3.5	114.5	28.0	52.8	410	3.5	4.1	−2.1	0.5	−1.3	0.16	−1.2
Malawi	−1.17	14.7	8.5	6.2	3.2	63.0	4.0	45.2	180	16.0	8.8	−0.9	2.1	−1.0	0.16	−5.4
Rwanda	−1.26	15.7	8.4	7.3	3.3	67.0	5.5	45.1	240	6.1	5.3	−0.6	−5.0	2.0	0.17	−1.3
Central African Republic 4/	−1.83	12.1	2.1	10.0	2.7	69.5	13.0	47.0	320	5.1	5.9	−0.9	9.6	0.5	0.15	−1.2
Ethiopia	−1.89	11.4	5.7	5.8	3.3	33.0	11.0	46.1	120	7.1	7.1	2.6	−5.3	−2.0	0.15	−1.2
Madagascar	−2.37	10.6	3.6	7.0	2.5	117.0	16.5	50.5	430	16.8	4.8	−5.2	−6.7	−2.2	0.20	−1.8
Sierra Leone	−2.42	12.0	8.7	3.3	3.0	50.0	15.0	41.0	320	74.7	8.7	−0.5	−2.5	1.0	0.19	−1.3
Zambia	−3.01	9.1	5.0	4.1	3.8	91.0	18.0	50.3	600	64.8	9.6	0.4	−3.4	0.9	0.24	−2.1
Côte d'Ivoire 4/	−3.61	14.5	8.7	5.8	3.7	75.0	21.0	55.1	1180	4.6	9.3	0.1	−5.2	−7.7	0.17	−0.7
Niger 4/	−4.20	12.1	2.9	9.2	3.4	27.0	5.5	44.4	440	2.2	6.0	−5.3	0.9	−0.6	0.15	−1.1
Group and subgroup averages 8/																
Group	−0.30	20.3	12.2	8.0	3.0	80.8	20.6	51.7	620	18.1	5.4	−2.5	3.2	−1.1	0.23	−0.7
HGC	2.92	28.0	16.7	11.3	2.6	106.6	36.6	60.0	708	9.0	3.4	−0.9	6.6	0.7	0.36	--
MLGC	0.47	17.7	10.7	7.0	2.9	66.4	17.5	50.0	491	21.4	4.9	−5.0	4.0	−2.6	0.21	0.9
WGC	−0.56	26.8	18.2	8.6	3.1	91.4	21.9	53.0	966	18.4	5.1	−2.9	6.7	−0.9	0.23	−1.3
VWGC	−2.29	13.6	6.8	6.8	3.2	70.7	13.8	47.8	424	20.1	7.0	−1.2	−1.5	−1.0	0.17	−1.7
CFA	−0.91	19.6	11.2	8.4	2.9	76.9	22.5	49.6	878	4.2	6.2	−1.6	4.7	−2.3	0.18	−0.2
NCFA 9/	0.01	20.6	12.8	7.9	3.1	82.9	19.6	52.8	484	25.4	5.0	−3.0	2.4	−0.4	0.25	−1.0

1/ See table 1 for definitions and sources of variables.
2/ Only sub–Saharan African countries with complete data series during 1981–92 for all the variables used in the regressions are included in this study.
3/ Countries with average per capita growth rates greater than or equal to 1 percent during 1981–92.
4/ CFA franc countries (CFA).
5/ Countries with average per capita growth rates less than 1 percent but greater than or equal to 0 percent during 1981–92.
6/ Countries with average per capita growth rates less than 0 percent but greater than or equal to −1 percent during 1981–92.
7/ Countries with average per capita growth rates below −1 percent during 1981–92.
8/ Unweighted averages.
9/ Non–CFA franc countries.

per capita growth less than -1 percent. The data indicate that, in general, countries with relatively higher growth rates had higher investment ratios, lower population growth rates, higher primary and secondary school enrollment ratios and life expectancy at birth, lower inflation rates, lower budget deficit ratios, higher export volume growth, a somewhat more depreciated real effective exchange rate, a higher degree of political rights. However, the countries with faster growth rates did not necessarily experience a more favorable external environment (in terms of changes in their terms of trade) than those with poor growth performance. Nevertheless, these broad trends are not clear cut at the individual country level, with the data averaged over a 12-year period. For example, Lesotho had an average ratio of private investment of 37 percent during 1981-92, and yet experienced negative average growth during the same period. Also, Uganda, with a high average rate of inflation experienced positive per capita growth.

Table 3 gives the matrix of correlation coefficients between pairs of variables. A number of the conventional and policy variables are significantly correlated with per capita growth. The empirical linkage between private investment and growth is stronger than that for government investment. It is interesting to note that although the measures of human capital development--life expectancy at birth (LIFE) and primary and secondary school enrollment ratios (PRI and SEC)--are highly correlated, LIFE has a stronger empirical relationship with growth than either PRI or SEC; thus, the variable LIFE is used in the regressions. In addition, there is a significant positive correlation between increases in political rights and per capita growth. Furthermore, there is no support for unconditional convergence as the correlation coefficient between per capita growth and the initial income level is positive, albeit insignificant. Also, the simple correlations between growth, on the one hand, and inflation, the percentage change in the real effective exchange rate, and the change in the terms of trade, on the other are not significant. As regards the CFA franc countries, their significantly lower rates of inflation during 1981-92, did not translate into higher growth rates (than the other sub-Saharan African countries); in fact, this group of countries registered on average significantly lower per capita growth rates during 1987-92.

The regression results are summarized in Table 4. All regressions are corrected for heteroscedasticity by a feasible generalized least squares (GLS) procedure implemented in two steps. First, an ordinary least squares (OLS) procedure was used to estimate each regression equation with pooled data; the residuals from this step were used to calculate the standard deviation for each country. Second, the country-specific standard deviations were used to scale all the included variables and an OLS procedure was applied again to the pooled transformed data to obtain the feasible GLS estimators. It should be noted that under the GLS estimation procedure used in this paper, the conventional coefficient of determination (R^2) loses its usual interpretation (for details, see Judge and others (1985, pp. 31-32)). Buse (1973) has suggested an alternative measure for

Table 3. Matrix of Correlation Coefficients for Pairs of Variables 1/

	ln(TIY)	ln(PIY)	ln(GIY)	ln(PG+.05)	ln(PRI)	ln(SEC)	ln(LIFE)	ln(Y0)	INF	DEFYE	RERG	XG	TTG	PR	DRY	STRUC	CFA1	CFA2
YGPC	0.36 ***	0.33 ***	0.23 **	−0.24 **	0.14	0.15	0.31 ***	0.08	−0.10	−0.36 ***	−0.14	0.20 **	0.15	0.21 **	−0.29 ***	0.28 ***	0.09	−0.25 ***
ln(TIY)	1	0.85 ***	0.65 ***	−0.19 *	0.40 ***	0.25 ***	0.52 ***	0.34 ***	−0.38 ***	−0.12	0.09	0.12	0.03	0.19 **	−0.01	0.14	0.09	−0.06
ln(PIY)		1	0.21 **	−0.14	0.47 ***	0.35 ***	0.52 ***	0.41 ***	−0.15	−0.15 *	0.03	0.12	0.02	0.27 ***	−0.08	0.18 *	−0.10	−0.03
ln(GIY)			1	−0.14	0.08	−0.01	0.24 ***	0.01	−0.44 ***	−−	0.18 **	0.01	−0.01	0.01	0.03	0.01	0.25 ***	−0.17 *
ln(PG+.05)				1	−0.01	−0.09	−0.25 **	−0.20 **	0.10	−0.01	−−	−−	−0.06	−0.19 **	−0.02	−0.07	−0.05	−0.03
ln(PRI)					1	0.72 ***	0.66 ***	0.61 ***	0.06	−0.14 **	0.02	0.01	−0.04	0.19 **	0.03	−0.05	−0.13	−0.13
ln(SEC)						1	0.61 ***	0.66 ***	−−	−0.20 **	0.04	0.09	0.01	0.28 ***	−0.09	−0.01	0.02	0.02
ln(LIFE)							1	0.52 ***	−0.16 *	−0.27 ***	0.06	0.03	0.03	0.43 ***	−0.12	0.09	−0.13	−0.13
ln(Y0)								1	−0.11	−0.17 *	0.02	0.07	−0.04	0.27 ***	−0.08	−0.09	0.16 *	0.16 *
INFL									1	0.02	−0.08	−0.08	−0.06	0.03	−0.02	−0.03	−0.19 **	−0.37 ***
DEFYE										1	0.09	−0.24 ***	−0.04	−0.41 ***	−0.02	−0.36 ***	−−	0.14
RERG											1	−0.17 *	0.10	0.12	0.12	0.03	0.11	0.05
XG												1	−0.14	0.05	−0.13	0.11	0.06	0.07
TTG													1	0.10	−0.22	−0.13	0.04	−0.09
PR														1	−0.05	0.18 *	−0.19 ***	−0.17
DRY															1	0.11	−0.07	0.02

1/ See Table 1 for definitions and sources of variables. Panel data are used to calculate these correlation coefficients. The symbols ***, ** and * beside the estimated coefficients denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4. Estimates of the Growth Equation 1/

Explanatory variables 2/	Regression Number (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conventional variables								
ln(Y0)	0.0037	−0.0034	−0.0048	−0.0097 **	−0.0091 **	−0.0085 **	−0.0083 **	−0.0081 **
	(1.14)	(1.14)	(1.48)	(2.62)	(2.20)	(2.07)	(1.99)	(1.99)
ln(PG+.05)	---	−0.0867 ***	−0.1010 ***	−0.0955 ***	−0.0853 ***	−0.0756 ***	−0.0700 ***	−0.0868 ***
		(3.96)	(4.93)	(4.96)	(4.29)	(4.51)	(4.13)	(4.80)
ln(TIY)	---	0.0258 ***	---	---	---	---	0.0189 ***	---
		(6.76)					(3.89)	
ln(PIY)	---	---	0.0146 ***	0.0121 ***	0.0126 ***	0.0113 ***	---	---
			(5.36)	(4.18)	(4.29)	(3.99)		
ln(GIY)	---	---	0.0082 **	0.0071 *	0.0095 **	0.0082 **	---	---
			(2.16)	(1.79)	(2.46)	(2.25)		
ln(LIFE)	---	---	---	0.0545 ***	0.0339 *	0.0410 **	0.0435 **	0.0581 ***
				(2.75)	(1.85)	(2.25)	(2.44)	(3.21)
Policy−related variables								
INFL	---	---	---	---	−0.004	−0.001	−0.005	−0.021 ***
					(0.35)	(0.12)	(0.39)	(2.74)
DEFYE	---	---	---	---	−0.118 ***	−0.109 ***	−0.107 ***	−0.080 **
					(3.20)	(2.93)	(3.01)	(2.32)
RERG	---	---	---	---	−0.039 ***	−0.033 **	−0.033 **	−0.030 **
					(2.86)	(2.50)	(2.49)	(2.61)
XG	---	---	---	---	0.055 ***	0.045 ***	0.042 ***	0.048 ***
					(3.59)	(3.10)	(2.77)	(3.24)
STRUC	---	---	---	---	0.0111 ***	0.0151 ***	0.0156 ***	0.0184 ***
					(2.87)	(3.60)	(3.83)	(4.48)
Other variables								
TTG	---	---	---	---	---	0.047 ***	0.046 ***	0.050 ***
						(2.71)	(2.69)	(2.81)
PR	---	---	---	---	---	−0.0092	−0.0052	0.0059
						(0.58)	(0.33)	(0.38)
DRY	---	---	---	---	---	−0.0064 **	−0.0057 **	−0.0073 ***
						(2.31)	(1.99)	(2.69)
CFA8183	0.0049	−0.0043	0.0004	0.0013	−0.0015	0.0013	0.0013	0.0063
	(0.52)	(0.55)	(0.05)	(0.16)	(0.22)	(0.19)	(0.17)	(0.77)
CFA8486	--	--	0.0017	0.0042	0.0015	0.0082	0.0057	0.0035
			(0.23)	(0.53)	(0.23)	(1.17)	(0.76)	(0.43)
CFA8789	−0.0251 ***	−0.0223 ***	−0.0186 **	−0.0172 ***	−0.0230 ***	−0.0215 ***	−0.0237 ***	−0.0288 ***
	(2.65)	(2.85)	(2.56)	(2.21)	(3.02)	(2.76)	(2.94)	(3.43)
CFA9092	−0.0110	−0.0076	−0.0070	−0.0028	−0.0075	−0.0039	−0.0038	−0.0105
	(1.16)	(0.96)	(0.97)	(0.37)	(0.97)	(0.48)	(0.44)	(1.21)
ADJ−RSQ 3/	0.068	0.498	0.486	0.501	0.689	0.694	0.700	0.659
F1 4/	1.85	19.23 ***	13.96 ***	13.08 ***	16.14 ***	13.36 ***	14.67 ***	15.43 ***
N 5/	116	116	116	116	116	116	116	116
Implied rate of convergence	−0.0036	0.0035	0.0050	0.0101	0.0097	0.0091	0.0088	0.0085
F2 6/	...	6.37 **	12.33 ***	0.66	1.28	0.22	0.04	...

1/ The numbers in parentheses below the estimated coefficients are the absolute values of the t−ratios. The symbols ***, **, and * beside the estimated coefficients denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

2/ See Table 1 for definitions of variables used.

3/ ADJ−RSQ is an adjusted goodness of fit for heteroscedastic models (Buse (1973)).

4/ F1 is the statistic for the test of the null hypothesis that the joint effect of all the variables included on the right hand side of the estimated equation is zero.

5/ Using annual data during 1981−92, for each of the 29 countries, four observations are constructed by taking 3−year nonoverlapping averages of the variables during the subperiods 1981−83, 1984−86, 1987−89, and 1990−92.

6/ F2 is the statistic of the null hypothesis that either the sum of the coefficients for ln(TIY) and ln(LIFE), or the sum of the coefficients for ln(PIY), ln(GIY) and ln(LIFE) is equal to the coefficient on ln(PG+.05).

the adjusted goodness of fit for GLS models, calculated as the proportion of weighted variation in the dependent variable explained by the regression.

From regression (1), the hypothesis of unconditional convergence is rejected, confirming the results by Barro and Sala-i-Martin (1992), and Mankiw, Romer and Weil (1992) for a diverse group of countries; and Ghura (1995a) for sub-Saharan African countries. Regressions (2) and (3) give the estimation results of the Solow-Swan model, excluding human capital. These results imply a slow but statistically insignificant rate of convergence of about 0.5 percent per year. 1/ Also, population growth exerts a relatively large adverse impact on per capita growth. Further, the effect of investment is positive and significant, as expected. From regression (3), the impact of the private investment ratio is larger than that of the government investment ratio, confirming a similar result by Khan and Reinhart (1990). However, on the basis of an F-test, the hypothesis that the estimated coefficients on these two forms of investment are equal could not be rejected. The impact of a one-standard-deviation increase in the private investment ratio is estimated to raise growth by about 1 percentage point, and a one-standard-deviation increase in the government investment ratio is estimated to raise growth by about 0.5 percentage point. Finally, from regressions (2) and (3), which do not control for human capital, the null hypothesis (given by F2 in Table 4) of the equality of the absolute values of the coefficients of physical capital and population growth is rejected, indicating perhaps the lack of an important component of capital, namely human capital.

Regression (4) reports the results of the Solow-Swan-type growth model augmented by human capital. The coefficient on initial income is now negative and statistically significant, implying that after controlling for human capital, poorer countries tend to grow faster than the less poor ones (conditional convergence), confirming a similar result by Barro (1991) for a diverse set of countries. 2/ The estimated speed of convergence is about 1 percent a year. The measure of human capital is positively and significantly correlated with per capita growth, confirming similar results by Barro (1989), and Mankiw, Romer, and Weil (1992) for a diverse group of countries, and Ghura (1995a) for the case of sub-Saharan African countries during 1970-90. Again, population growth lowers per capita growth with an elasticity which is much larger than that reported by Mankiw, Romer, and Weil (1992), and Knight, Loayza, and Villanueva (1993). Thus, it appears that increases in population have a much larger adverse impact on per capita growth in sub-Saharan African countries than in other regions. One way to attenuate this adverse effect would be to raise investment in human capital,

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1/ Obtained by setting T = 13 in equation (15). Note that initial income (Y0) is for the year 1980.

2/ See also the papers by Ghura (1995a) for sub-Saharan Africa, Savvides (1995) for Africa, Khan and Kumar (1993) for developing countries, Barro and Sala-i-Martin (1992), Knight, Loayza, and Villanueva (1993), and Mankiw, Romer, and Weil (1992).

as implied by the significant negative correlation between human capital development and population growth (Table 3). The estimated coefficient on human capital from regression (4) is 0.055 (with a standard deviation of 0.02); the data imply that a one-standard-deviation increase in life expectancy (which corresponds to about 7 years for the data sample used in this paper) would be expected to raise, on average, per capita growth by about 0.7 percentage point a year. This result is indicative of the potential gains from improvements in human capital in the context of sub-Saharan African countries, given the existing weaknesses.

Finally, in regression (4), the null hypothesis of the equality between the absolute values of the sum of the coefficients on physical and human capital on the one hand and that on population growth on the other (given by F2 in Table 4) cannot be rejected. Nevertheless, the estimated share in total income of human and physical capital from the restricted regression is 0.89, which is substantially higher than the share of 0.67 found by Mankiw, Romer, and Weil (1992) in the context of a diverse group of countries. 1/

The results of regression (5) indicate that the policy environment matters for growth. The estimated coefficients on the budget deficit ratio and the changes in the real effective exchange rate are negative and the coefficient on export volume growth is positive, and are all highly significant. Thus, countries experienced faster growth rates (than other countries in the sample) if they had: lower budget deficit ratios; 2/ higher export volume growth rates; 3/ pursued deeper structural reforms; and faster convergence of the actual real effective exchange rates toward the respective equilibrium levels. During the period under investigation, most sub-Saharan African countries experienced large deteriorations in their terms of trade, which caused the equilibrium real exchange rate to depreciate, other things being equal. In this context, a real depreciation (that is, a decline in the real effective exchange rate) can be considered

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1/ The share of physical capital alone was estimated at around 0.5 by Khan and Kumar (1993) for a group of developing countries and De Gregorio (1991) for latin American countries.

2/ Barro (1991) and Fischer (1991), for a diverse group of countries, and Easterly and Levine (1993) and Ghura (1995b), for sub-Saharan Africa, found significant adverse effects of increases in the budget deficit ratio on growth.

3/ The beneficial effect of outward-oriented trade strategies has been documented by a number of authors, including Agarwala (1983), Alam (1991), Cottani, Cavallo, and Khan (1991), Dollar (1992), Edwards (1988, 1992, and 1993b), Feder (1983), Ghura (1995a), Ghura and Grennes (1993), Knight, Loayza, and Villanueva (1993), Ram (1987), and Roubini and Sala-i-Martin (1991). See also Edwards (1993a) for a list of related empirical studies.

as a narrowing of the gap between actual and equilibrium real exchange rates. 1/

The coefficient on the variable STRUC has a positive and significant effect on growth, supporting the view that broadly-based structural reforms alleviate the impediments to private sector development and stimulate economic growth. The fact that the variable STRUC is significant after controlling for the effects of the other variables indicates that it is capturing the independent effects of structural reforms. However, inflation did not have a significant independent direct effect on per capita growth when included with the other policy-related variables, although its effect is negative; it is argued below that the impact of inflation was registered indirectly through its effect on the volume of investment. It must be noted that the null hypothesis that the estimated coefficients on the policy-related variables are jointly equal to zero is rejected. This result is indicative of the potential benefits of implementing a comprehensive package of policies rather than piecemeal policy actions. Broad-based adjustment policies are more likely to be self-reinforcing and durable than isolated policy reforms, thus enhancing their credibility and the potential response of the private sector. 2/

Regressions (6)-(7) investigate the effects of some additional factors on growth. The external environment seems to have exerted a statistically significant influence on growth in sub-Saharan Africa during 1981-92. The estimated effect of changes in the terms of trade is positive and significant, supporting the notion that terms of trade losses, have contributed in part to the poor growth performance of sub-Saharan African

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1/ The empirical evidence on the effects of adjustments in the (real or nominal) exchange rate on growth is inconclusive. Some studies report expansionary effects (Conolly (1983), Ghura (1995b), Gylfason and Schmid (1983), Nugent and Glezakos (1982), and Nunnenkamp and Schweickert (1990)), whereas others report contractionary effects (Branson (1986) for Kenya; Sheehey (1986) and Solimano (1986) for Latin America; and Agenor (1991), and Khan and Knight (1982) for a diverse group of developing economies). Edwards (1986) reports a neutral effect.

2/ See the paper by Hadjimichael and Ghura (1995b) for an empirical investigation of the effects macroeconomic policies on private savings and investment in sub-Saharan African countries during 1986-92.

countries during 1986-92. 1/ However, the adverse effects of terms of trade losses on per capita growth seem to have been offset to some extent by declines in the real effective exchange rate. It is interesting to note that once account is taken of other determinants of growth, the effect of the variable measuring political rights (PR) is not significant, contrary to the significant effects reported by Fosu (1992) and Savvides (1995) for the case of Africa. Also, inadequate rainfall appears to have reduced per capita growth on average in sub-Saharan Africa during 1981-92.

The last regression (8) attempts, albeit in a somewhat crude way, to investigate the channels through which economic policies affect growth--through their effects on either the volume or the efficiency of investment. As noted by Kormendi and Meguire (1985), if a policy variable works mainly through the efficiency channel, the inclusion of the investment ratio in the growth equation would raise the significance of the coefficient of the policy variable, but would not change (substantially) the value of its coefficient. However, if a policy variable works mainly through the volume of investment channel, the inclusion of the investment ratio would lower the significance and magnitude of the coefficient of the policy variable. The results indicate that both channels are at work for the group of countries included in this study. The significant effect of inflation on growth in regression (8) suggests that this influence is effected through the volume channel. 2/ The effects of the other policy-related variables, however, were registered mainly through the efficiency channel. 3/

1/ The effects of the terms of trade on growth have been investigated by other empirical studies; Ghura (1995a), Ghura and Grennes (1993) and Hadjimichael and others (1995), in the context of sub-Saharan African countries, found support for the adverse effects on growth of declines in the terms of trade. However, Fry (1986), in the context of Asian countries for the period 1961-83, and De Gregorio (1991) in the context of Latin America for the period 1950-85, found no support for the direct effect of the terms of trade on growth. Also, in the context of Latin American countries, Edwards (1983) found statistically significant relationships between the terms of trade and growth for only two of the six countries considered.

2/ The negative effect of inflation lends support to the predictions of cash-in-advance models, thus confirming the results of other studies, e.g., De Gregorio (1993), Fischer (1991), Ghura (1995a and 1995b), Grier and Tullock (1989), and Kormendi and Meguire (1985).

3/ Using the total investment ratio, Fischer (1991) and Kormendi and Meguire (1985) found the effects of policy variables on growth to be transmitted through both the efficiency and volume channels, whereas, De Gregorio (1993) and De Gregorio and Guidotti (1992) found these effects to be registered through the efficiency channel.

A final result of interest concerns the dummy variables for the CFA franc countries. 1/ The average per capita growth rate of the CFA franc countries was about 2 percentage points a year lower than the average for sub-Saharan Africa as a whole during 1987-89, despite the fact that they had significantly lower levels of inflation than the other countries in the region. An analysis of the data indicates that the CFA franc countries, as a group, had significantly lower average government investment rates, and measures of human capital development during 1987-89 (than the average for sub-Saharan Africa). Also, in contrast with the other countries in the region, the decline in the real effective exchange rate of the CFA franc countries during 1987-89 was very modest in comparison to the recorded reduction in their terms of trade. Since the regressions control for all of these factors, the dummy for the CFA franc countries could be capturing the effects of the low confidence by the private sector in the thrust of government policies, as well as the impact of structural rigidities.

V. Conclusions and Policy Implications

The determinants of economic growth have been widely investigated by a number of recent studies. This paper has extended the investigation to the case of 29 sub-Saharan African countries during 1981-92. The main findings of this paper can be summarized as follows: (i) there is evidence in favor of conditional convergence of per capita income; (ii) an increase in private investment has a relatively large impact on per capita growth; (iii) macroeconomic policies affect per capita growth through their effects both on the volume and on the efficiency of investment; (iv) growth is stimulated by public policies that lower the budget deficit in relation to GDP (without reducing government investment), reduce the rate of inflation, maintain external competitiveness, promote structural reforms, encourage human capital development, and lower population growth; and (v) adverse exogenous factors (deteriorations in the terms of trade and droughts) have significant negative effects on per capita growth.

Notwithstanding the significant effects of exogenous factors on sub-Saharan African growth, the results of this study indicate that growth in the region can be enhanced by policies that encourage macroeconomic stability, remove tax and other price distortions, and alleviate the impediments to private sector development through structural reforms. The variables measuring the effects of macroeconomic policies and structural reforms are jointly statistically significant in influencing growth, indicating the benefits of implementing a comprehensive package of policies rather than piecemeal policy actions. As increases in private investment

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1/ It must be noted that the estimated results do not change significantly if the four dummy variables for the CFA franc countries for the four subperiods are replaced with one dummy variable for the full period.

stimulate growth, the government should formulate and implement appropriate policies to encourage private sector development. Broad-based adjustment policies are more likely to be self-reinforcing and durable than isolated policy reforms, thus enhancing their credibility and the potential response of the private sector. In addition, a stable macroeconomic environment would also stimulate private sector savings and raise the efficiency and volume of private investment, thus speeding up the process of achieving sustainable growth.

The results also indicate that while lowering the budget deficit is beneficial to economic growth, doing so by cutting government investment is counterproductive. Thus, alternative ways of lowering the budget deficits would be needed. As many sub-Saharan African countries are characterized by narrow tax bases, weaknesses in tax administration, and a proliferation of tax exemptions, there is significant potential for raising tax receipts by broadening the tax base, improving the tax administration, and rationalizing the tax system. Such reforms would allow an increase in government revenue and investment without necessarily raising tax rates that would tend to undermine private investment. Increased government expenditure on education and health would help raise human capital and contribute to growth, both directly and also indirectly by slowing down population growth.

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