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The Impact of Human Capital on Growth: Evidence from West Africa

Prepared by Emilio Sacerdoti, Sonia Brunschwig, and Jon Tang[1]

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Abstract

This paper analyzes the impact of human capital on growth, on the basis of refined calculations of human capital, and with a focus on West Africa. Using a growth-accounting methodology, it distinguishes the sources of growth between the accumulation of factors of production and changes in production intensity or efficiency. Private capital is found to be particularly important to growth, but human capital appears not to be significant. The paper also identifies the terms of trade, trade openness, the government deficit, and the share of government investment in total investment as key policy variables affecting growth.

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Author's E-Mail Address: esacerdoti@imf.org; sbrunschwig@imf.org; jwt2@acpub.duke.edu

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SUMMARY

The positive correlation between school enrollment ratios and output growth reported in the early growth literature should not be interpreted as evidence that human capital contributes positively to growth, as school enrollment is poorly correlated with human capital accumulation. In this paper, we refine calculations of human capital as an appropriate variable to include in a production function and build two series for countries in West Africa: the average years of schooling in the working population, derived from a methodology developed by Nehru, Swanson, and Dubey (1995); and a wage-weighted measure of relative labor productivity resulting from education, inspired by Denison (1967). In this paper we do not take into account contributions to human capital other than schooling.

Using a growth-accounting methodology to distinguish the sources of growth between the contribution of accumulation in the quantity of factors of production and the efficiency or intensity with which these factors are used, we find that growth in physical capital—particularly privately financed—contributes strongly to output growth, but that the impact of human capital accumulation is not significant. This result raises the issue of how higher cognitive skills resulting from more education could have a weak or even negative impact on output growth. It points to the importance, particularly in African countries, of implementing complementary reforms to create an environment more favorable to the productive application of skills.

Country-specific factors other than the accumulation of human and physical capital are important in explaining differences in per capita income growth across countries. To understand better the contribution of these factors, we estimate an extended growth equation that includes exogenous shocks and policy variables. We identify the terms of trade, the degree of trade openness, the government deficit, and the share of government investment in total investment as major components of differing country outcomes.

I. INTRODUCTION

Intuitively, one may expect human capital accumulation to contribute positively to economic growth. However, empirical support for this assumption appears less clear than had been previously believed. Bosworth, Collins, and Chen (1995) and Pritchett (1996) show that a positive correlation between school enrollment ratios and output growth should not be interpreted as evidence that human capital contributes positively to growth, as school enrollment is poorly correlated with the improved measure of human capital accumulation calculated by Nehru, Swanson, and Dubey (1995). However, while economists agree that enrollment ratios have no place in a production function equation, they do not share the same opinion about the way human capital is related to economic growth. Pritchett estimates the coefficient on human capital to be negative, but Nehru and Dhareshwar (1994) show that human capital contribution to growth is positive and significant.

Most recent empirical studies aimed at identifying the factors that contribute to economic growth have used a multicountry database developed at the World Bank that includes new series on human capital. However, as corresponding data on human capital are available for only few African countries, the coverage of these panel data estimations has been limited. In this paper, we extend the work done by Nehru-Swanson-Dubey to nine countries in West Africa, first by calculating the average years of schooling of the working population, and second by converting this measure of human capital into an index of labor productivity.

We then follow a growth-accounting methodology to distinguish the sources of growth between the contribution of accumulation in the quantity of factors of production and the efficiency or intensity with which these factors are used. We find that growth in physical capital, particularly privately financed, contributes strongly to output growth, but that the impact of human capital accumulation is not significant. Also, we find no evidence for conditional convergence. Moreover, we show that country-specific factors other than factor accumulation are important to understand differences in per capita income growth across countries. In an attempt to understand better the contribution to growth of factors other than the accumulation of human and physical capital, we estimate an extended growth equation that includes exogenous shocks and policy variables. We identify the terms of trade, the degree of trade openness, the government deficit, and the share of government investment in total investment as major components of country-specific effects.

II. HUMAN CAPITAL—A COMPARISON ACROSS WEST AFRICAN COUNTRIES

In his provocative article "Where Has All the Education Gone?" Lant Pritchett (1996) estimates the impact of the education attainment of the labor force on the rate of growth of output per worker to be consistently small and negative. In contrast to previous calculations, which used enrollment rates as a proxy for human capital growth, Pritchett's estimations are based on the calculations of average years of schooling of the working population realized by Barro and Lee (1993) and by Nehru, Swanson, and Dubey (1995), converted into a measure of educational capital.[2] Interestingly,

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[2]Pritchett assumes that an individual's marketable human capital equals the annualized value of the difference between the individual's wage and the wage of the rawest labor, and that the wage

(continued...)

Pritchett's results differ from those obtained by Nehru and Dhareshwar (1994) with two alternative measures of human capital: using both average years of schooling and a measure of human capital derived from country-specific information on the wage structure, these lattter authors find human capital to contribute positively to economic growth.

Pritchett's and Nehru-Dhareshwar's work, as well as the calculations of human capital done by Barro-Lee and by Nehru-Swanson-Dubey, cover a wide sample of countries at diverse stages of development; however, they include only a limited number of African countries. In this paper, we extend earlier studies by constructing two series of human capital for nine countries in West Africa. Among them, five countries (Senegal, Cote d'Ivoire, Mali, Cameroon, and Ghana) are covered in Nehru-Swanson-Dubey's study, but four countries (Niger, Guinea-Bissau, Burkina Faso, and Guinea) are not. First, we calculate human capital as the average years of schooling in the working population. Second, we measure it as a function of both the distribution of education in the working population and relative wages.

A. Human Capital Measured as Years of Schooling

Both Nehru-Swanson-Dubey and Barro-Lee identify human capital with the accumulated years of schooling present in the working-age population.[3] Barro-Lee use census reports of the educational level of the population aged 25 and over and extrapolate this information with data on school enrollment. Nehru-Swanson-Dubey rely solely on school enrollment data and use the perpetual inventory method, adjusted for mortality, to estimate human capital. For a number of countries in our sample, census data are limited and do not contain sufficient information to calculate the average years of schooling in the working population. Therefore, we construct human capital following the Nehru-Swanson-Dubey methodology.

In every year, we estimate the expected years of schooling of individuals aged 15 to 64 years, which we consider as constituting the labor force. For each age group, in order to calculate the probability of having successfully completed all the years of primary school, we take into consideration the probability of having been enrolled in primary school[4] and subtract the probability of repeating and dropping out to obtain the net enrollment ratio.[5] We repeat the exercise for the higher education

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[2](...continued)
increment associated with an additional year of schooling is constant across education levels and across countries.

[3]In doing so, these authors neglect the impact on human capital of on the job training or nonformal education, as well as the possible positive impact on productivity of better health.

[4]We use the gross enrollment ratio given by the World Bank, which corresponds to the ratio of children of any age enrolled in primary school to the number of children aged 7 to 12 years, the official age for primary school.

[5]Our definition of net enrollment ratio differs from the World Bank's definition: we define as net enrollment the gross enrollment ratio corrected for the repetition and dropout rate, while the World Bank considers as net enrollment the ratio of children between the ages of 7 and 12 enrolled in

(continued...)

levels. The expected years of education corresponding to each age group is then defined as the sum of the years of education in primary school up to the end of the fourth grade, up to the end of the sixth grade, in secondary school, and in tertiary school, weighted by the probability of having successfully completed the corresponding years. The average human capital of the working population is then calculated as a weighted average of the expected human capital of each age group, where the weights correspond to the probability that an individual of a certain age survived to a certain date.

Our calculations differ from Nehru-Swanson-Dubey's in a number of ways: First, we use survival probability distributions by age groups that are country specific, while Nehru-Swanson-Dubey use the same survival probability for all African countries. Second, we estimate the dropout rate using a methodology suggested by UNESCO (see Appendix II); the methodology used by Nehru-Swanson-Dubey to calculate dropout rates is unknown. Finally, in order to estimate a series of human capital stock starting in 1970, we extrapolate raw data, assuming that, before 1960, the enrollment ratio increased at a rate equal to one-third of the rate observed between 1960 and 1980; Nehru-Swanson-Dubey have chosen to maintain enrollment ratios and repetition rates constant for all years preceding the earliest available data.

Whenever possible, we compare our own estimations of human capital stock and growth rates with those obtained by other authors and find them to be rather close. Table 1 presents our results, as well as those obtained by Barro-Lee and by Nehru-Swanson-Dubey. It shows that Niger and Burkina Faso, with less than 0.5 years of schooling per worker, have the lowest levels of human capital in the region; meanwhile, Cameroon's and Ghana's working populations have the highest levels, at about three years of schooling on average.[6] However, the growth rates of human capital in Burkina Faso and Niger (some 5 percent) are the highest. In order to facilitate comparisons across countries, Figure 1 shows gross and net enrollment ratios and Figure 2 presents human capital derived from primary education and total human capital (derived from primary, secondary, and tertiary education). The stability of human capital is striking; the evolution of this variable is influenced only marginally by recent developments in enrollment rates, as the majority of the labor force received its education many years ago.

B. Wage-Weighted Human Capital

Years of schooling might be a good measure of educational achievement of the working population, but it may still not be the appropriate measure of human capital to incorporate in a production function. In order to capture the impact of education on the labor force production capacity, we convert information about the distribution of years of schooling in the working population into a distribution of relative wages associated with different degrees of school

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[5](...continued)
primary school to the total number of children of the same age group.

[6]By comparison, Denison (1967) reports that in 1950 Italy's working population had about four years of schooling.

achievement.[7] Relative wages are believed to be indicative of relative productivity as a function of education. Ideally, we would like to compare for different sectors of the economy the wage structure conditional on education. In practice however, information is available in some countries only for part of the private sector, in other countries only for the public administration. Whenever possible, we use country-specific information about the wage structure conditional on education attainment. Then, following Denison's methodology, we normalize the income of those who just completed primary education to one, and assume that two-thirds of the reported income differential between each of the other groups and that reference group represents differences in earnings owing to differences in education, as distinguished from other characteristics.[8] Appendix III describes labor market characteristics for our countries, compares them with Denison's observations for the United State in 1960, and explains how earning weights associated with each level of education are calculated.

It is important to realize that this transformation of years of schooling into education marginal productivity is not linear. Although we assume that, for each country, the earning weights corresponding to each level of education are constant through time, the way these weights affect the measure of human capital varies over time as the distribution of education in the population changes. This point will become important when we use our series to estimate the production function equation.

Table 2 and Figure 3 report our results for the wage-weighted measure of human capital. It is immediately apparent that, for all countries, the growth rate of human capital is lower with the new measure than with average years of schooling, and that differences across countries are less important. The reason is that, with the Nehru-Swanson-Dubey methodology, individuals with no schooling are assigned a zero weight in the index of labor quality, while, with the wage-weighted human capital methodology, they are assumed to contribute positively to production in proportion to their wage. For comparison, in Table 4, we also present the growth rate of human capital calculated by Bosworth, Collins and Chen (1995) using Denison's U.S. earning weights. Their growth rates are always higher than ours, mainly because their calculations are based on the years of schooling from Barro-Lee, which also grow faster than our own estimates.

III. Estimation of the Production Function

Having constructed series of human capital, we use a growth-accounting methodology to distinguish the sources of growth between the contribution of factors of production accumulation and improvement in the efficiency or intensity with which these factors are used. We assume a production function with constant returns to scale:

$$Y^* = e^{\gamma t} K^{*\alpha} (H^* L)^{\beta},$$

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[7]This method was initially suggested by Denison, and was also been applied by Bosworth, Collins and Chen (1995) and by Nehru-Dhareshwar.

[8]Other characteristics include, for example, gender, age, region, and native ability and energy. Clearly, a sample of workers with higher education and higher wages is likely to be biased in terms of gender (male), age (older), region (urban), talent and dynamism (more talented and energetic).

with $0<\alpha<1$, $0<\beta<1$, and $\alpha+\beta=1$, and where Y^*=GDP, K^*=total physical capital, H^*=average human capital, and L=working population. This specification is equivalent to an equation in log and per capita terms in which log of output per worker (Y) depends on log of physical capital per worker (K), log of average human capital available in the working population (H), and total factor productivity, defined as a time trend (γt):

$$Y=\alpha K+\beta H+\gamma t.$$

This also means that the growth rate of output per worker (Ygr) depends on the growth of physical capital per worker (Kgr), the growth of average human capital (Hgr), and the growth in total factor productivity (γ):

$$Ygr=\alpha Kgr+\beta Hgr+\gamma.$$

In order to calculate the growth of physical capital per worker, we follow Bosworth, Collins, and Chen's (1995) perpetual inventory methodology, in which capital accumulation (ΔK) depends on investment (I) and depreciation (d), with the initial capital calculated by assuming an initial capital output ratio of 1.5, and with the rate of depreciation assumed to be 5 percent:

$$\Delta K=I-d*K.$$

Equivalently, we assume an initial share of capital income in the total value of production equal to 30 percent[9] and a rate of return on capital equal to 20 percent.[10] Note that we do not impose a constant capital-output ratio throughout the period. Therefore, we choose not to use the investment-to-GDP ratio as proxy for capital accumulation. For human capital growth, we use alternatively our series on average years of schooling (Hgr) and our wage-weighted measure ($wHgr$).

In order to calculate the respective contribution to growth of output per worker of physical capital per worker, average human capital, and total factor productivity (TFP), we estimate a growth-accounting equation with physical and human capital growth. We regress growth of output per worker on growth of capital labor substitution, growth of average human capital, and a constant, where the constant is the deterministic component of total factor productivity growth. In every period, total factor productivity is the sum of the estimated constant and the error term

$$TFPgr_t=Ygr-\alpha Kgr-\beta Hgr=\gamma_i+\varepsilon_{it},$$

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[9]This corresponds to the assumption that the α coefficient in the production function initially equals 0.3, which is consistent with the empirical results obtained by Mankiw, Romer and Weil (1990). In any case, we find our results to be robust to alternative assumptions about the initial capital-labor ratio.

[10]The average lending rates for the period were slightly below 20 percent.

where *i* represents the country and *t* the year. We estimate the production function under alternative hypotheses: i) with a common intercept, where γ is assumed identical for all countries and time periods; and ii) with fixed effects, where γ is assumed to vary across countries but to be constant across time. In order to test the hypothesis of conditional convergence, we also run the regression with the 1970 level of GDP per worker.

For all variables, we use panel data for eight countries,[11] with yearly observations for the period 1970-96. The source of data is described in Appendix I. We ran a Braush-Pagan test and identified heteroscedasticity (i.e. the variance of the error terms for each country are not constant over time). In addition, we found contemporaneous correlation (i.e. the error terms across countries are correlated). Under these conditions, it would not be efficient to run a simple ordinary least square (OLS) regression. In order to account for the properties of the data, we use a seemingly unrelated regression (SUR) methodology for our estimation. Results are presented in Table 3, columns 1 to 8.

With both measures of human capital, we find the evolution of GDP per worker to be positively and strongly correlated with the growth rate of physical capital. Human capital appears not to be significant. Moreover, the sign of the coefficient for the average years of education is negative when we assume a common intercept for all countries or when we run the equation with initial output per worker. However, the coefficient on human capital becomes positive when we allow total factor productivity to vary across countries, because of more precise estimates of country-specific effects.

From a purely statistical perspective, the weak significance of human capital in the growth equation is not surprising: the growth rate of human capital is extremely stable, because the evolution of education or skills in the working population is affected only marginally by recent changes in enrollment, while GDP growth is very volatile.[12] The weak significance of human capital may also indicate multicollinearity between human capital and other factors, as captured by the constant, which affect the growth of output per worker.

The initial GDP per worker is found not to be significant, thereby casting doubts on the hypothesis of conditional convergence. Alternatively, we use the 1970 human capital stock as an initial-condition variable and also find this variable not to be significant; moreover, the inclusion of initial human capital does not affect the sign or the significance of the other coefficients.

The estimated coefficient on physical capital is large relative to the share of this factor of production in total income (usually about 35 percent in poor countries).[13]This outcome may reflect a spurious correlation between the contemporaneous growth of output and capital. In order to obtain an unbiased estimate, we ran a two-stage least squares regression, using the lagged growth

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[11]Because of incomplete data, Guinea is not included in the growth analysis.

[12]Another problem may be that, for a few countries, we were not able to show that the growth rate of human capital is stationary, while the degree of integration for the growth rates of output per worker and physical capital per worker was found to be I(0).

[13]De Gregorio (1992) and Pritchett (1996) find estimates for the capital share of about 50 percent for a sample of Latin American countries and for 91 countries from all continents, respectively.

rate of capital as an instrument, and found the coefficient on physical capital to be about 0.35 (see Table 3, columns 9 to 11). Nevertheless, using an instrumental variable for physical capital does not improve the significance of human capital in the regression.

The sign of the constant, which corresponds to the deterministic component of the total factor productivity, depends on the model specification: assuming that total factor productivity evolved similarly in all countries (the common intercept hypothesis), we find it to be positive when average years of schooling is included in the equation, negative when the wage-weighted measure of human capital is included, and about zero when human capital is not taken into account.[14] With the fixed effects hypothesis, we find most country-specific total factor productivity growth to be negative.[15] The regression with fixed effects clearly indicates that the intensity and efficiency in the use of factors of production evolved very differently across countries; for example, it declined particularly sharply in Niger.

IV. The Role of Education in Output Growth

The result that the coefficient of human capital is only marginally significant, or even negative, is consistent with Pritchett's analysis and with the results obtained by Knight, Loayza, and Villanueva (1993) with panel data. Pritchett presents econometrics results for a large sample of countries indicating that educational capital per worker has a negative effect on per capita growth. However, Pritchett also notes that quantitative analysis across countries consistently shows that individuals with higher levels of education earn higher wages; moreover, various studies demonstrate that this positive correlation between education and wages is not due to some signaling or screening effect, but reflects the fact that schooling raises skills, which, in turn, raise wages.

How could higher cognitive skills resulting from more education appear to have a weak or even negative impact on macroeconomic growth, while having a positive impact on individual earnings? Pritchett attributes this apparent contradiction to a number of factors that may be particularly relevant for Africa. First, returns to schooling appear to differ sharply across economic activities and to be significantly lower in the agriculture sector.[16] Second, returns to schooling appear lower where technological progress is slow;[17] returns of education may therefore be limited in Africa, where there has been less technological change in agricultural production than in other developing

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[14]By comparison, for a sample of African countries and for a period starting in 1960, Fischer (1993) and Bosworth-Collins-Chen (1995) find average negative total factor productivity growths between -0.5 and -1.5.

[15]Our country-specific results are comparable to those obtained by Nehru-Dhareshwar (1994) for the period 1960-90.

[16]According to Jamison and Lau (1982), output of farmers increases by only 2 percent for each additional year of schooling.

[17]For instance, Rosenzweig and Foster (1996) find that cross-regional comparisons of farm profits indicate that returns to schooling seem to increase with technological innovation, such as the Green Revolution.

countries. Third, social and private rates of return to education may diverge if improved cognitive skills created by education are directed to rent seeking and other unproductive activities. In this case, low returns to schooling may reflect an environment that does not favor the productive application of skills. For example, Gelb, Knight, and Sabot (1991) estimate that, when the public sector accounts for a large share of the expansion of wage employment, growth of output per worker is reduced by 2 percentage points a year, owing to significant distortions in the labor markets. In fact, the waste of human capital associated with rent seeking is apparent in many developing countries, where growth-inhibiting policies such as a large urban bias, the implicit taxation of agriculture, and industrial protection reflect the efforts of small, educated elites to protect their gains. In summary, investment in education would need to be accompanied by complementary reforms in order to pay off socially, and may not result per se in higher growth. Nevertheless, education may have large social benefits besides raising economic output, such as lower infant mortality and better social cohesion.

V. Production Function with Exogenous Shocks and Policy Variables

The growth-accounting equation shows that physical and human capital explain only part of growth in GDP per worker. In this section, we try to identify factors, such as exogenous shocks and policy variables, that contribute to growth either because of their influence on the rate of physical capital accumulation or because they affect total factor productivity directly. This exercise should allow us to identify components of the country-specific factors obtained with the fixed effect model.

First, we run SURs including, one at a time, as variables the spread between the parallel and official exchange rate (*Premium*), changes in the terms of trade (*Totgr*), changes in measures of trade openness (changes in the ratio of exports plus imports to GDP –*dTrade*– and export growth —*Xgr*–) and in the ratio of government overall deficit to GDP (*dCB*), and the annual average inflation rate.[18] Second, we estimate the joint impact on output growth of physical capital accumulation and of selected groups of policy variables; we also examine the channels through which these policies affect growth by regressing capital accumulation and total factor productivity on each group of policy variables.

Table 4 shows that, individually, the exchange rate premium, the terms of trade, and the government deficit appear to have the most significant influence on growth; trade openness and inflation also appear to affect growth, although to a lesser extent. The exchange rate premium, itself a measure of distortions in the economy, influences growth both by discouraging investment and reducing incentives to use factors of production efficiently and intensively. Similarly, an increase in the terms of trade stimulates growth through both higher investment and better utilization of factors of production. Interestingly, it appears that the negative impact of the government deficit is felt mostly through reduced physical capital accumulation.

Table 5 shows that, when policy variables are combined, the most significant variable is changes in the terms of trade (*Totgr*): it influences growth by increasing both the rate of capital accumulation and the efficiency or intensity with which factors of production are used. The impact of export growth (*Xgr*, with one lag) is less clear, although the first equation indicates that it may be

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[18]The sources of data are described in Appendix I.

positively correlated with capital accumulation. Government deficit (*dCB*) seems to discourage capital accumulation, but we find its influence on production efficiency and output growth not to be significant. When *Premium* and *Inflation* are included in combination with other explanatory variables, they are found not to be significant.

The inclusion of exogenous shocks and policy parameters (changes in the terms of trade, export growth, and the government deficit) improves the fit of our regression: the adjusted R^2 increases from 0.12 to 0.14 assuming a common intercept, and from 0.11 to 0.13 under the assumption of fixed effects.

For each of the eight countries, Tables 6 and 7 show how the selected variables contribute to the growth of output per worker, under the hypothesis of fixed effects and common intercept, respectively, and compare the predictions of the model with the actual growth rates. Cameroon and Burkina Faso experienced the highest growth during the sample period (about 1.4 percent), while Niger and Ghana faced negative average growth. High growth in physical capital contributed greatly to the strong performance of Burkina Faso and Cameroon, while Niger and Ghana were also the only two countries with negative accumulation of physical capital. In Senegal and Côte d'Ivoire, where accumulation of capital was only about 0.7 percent a year, growth of output per worker was almost zero over the whole sample period. Declines in the terms of trade reduced slightly growth in Ghana, Senegal, and Mali, while marked improvements in the relative price of exports benefited, albeit modestly, Cameroon, Burkina Faso, Guinea-Bissau, and Côte d'Ivoire. The contribution of export growth to output growth was positive for all countries, and strongest in the case of Guinea-Bissau and Mali. The effect of government deficits was very small. For most countries, the estimated constant is negative, about -0.5, indicating that factors not included in the model contributed to reduce total factor productivity; the only exception is Ghana, where the constant is slightly positive. In two countries, Guinea-Bissau and Niger, variables not included in the model appear to have had a particularly negative impact on growth.

VI. Private Versus Public Capital Accumulation

What country-specific factor may have had such a negative influence on growth in Guinea-Bissau and Niger? In this section, we examine the hypothesis that private investment and public investment have different impacts on economic growth.[19] Figure 4 indicates that, while in Guinea-Bissau and Niger, the share of government investment in total investment was particularly high, it was very low in Cameroon by regional standards.

First, we estimate a growth equation in which we differentiate between private and public capital. The series of public capital is constructed using the perpetual inventory methodology, assuming that the initial public capital stock share in total capital stock is equal to the average government investment share in total investment for the period 1970-80 and that the initial capital-output ratio is 1.5, and using information on the share of government in total investment (*SIG*). The private capital stock is then calculated residually from the total capital stock and the public capital stock.

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[19]The relative importance of government versus private investment was examined among others, by Ghura (1997) for Cameroon, and by Ghali (1998) for Tunisia. Both studies support the idea that private capital formation is particularly important to growth.

Table 5 shows that, with both the assumption of a common intercept and the fixed-effects specification, private capital accumulation *(PrivKgr)* appears to have a stronger impact on growth than public capital accumulation (*GovKgr*). However, Table 8 indicates that, even when we distinguish between private and public capital accumulation, the constant for Guinea-Bissau and Niger remains highly negative. This means that, without the country-specific effect, we still overestimate growth in Guinea-Bissau and Niger, as growth of private capital appears to have been particularly strong in the first country, and as the decline in private capital appears to have been largely compensated by the growth of public capital in Niger.

Next, we include *SIG* (the share of government investment in total investment) in the regression, which we assume to be a measure of the quality of the capital stock. We find that the coefficient on this new variable has the expected negative sign, that the coefficient on private capital growth remains larger than that on public capital growth, and that the fit of the regression is improved (last column of Table 5). Comparing Tables 7 and 9, we see that, when *SIG* is included, the predicted growth rates for Guinea-Bissau and Mali are closer to the actual rates.

VII. Conclusion and Policy Implications

Physical capital accumulation appears to be one of the main determinants of growth in West Africa, with private investment playing a particularly important role. Investment in human capital is found not to be a significant contributing factor to economic growth. This result may reflect the fact that, for education to have a significant impact on growth, it needs to be accompanied by the implementation of structural reforms that enhance its social return. Therefore, policymakers should focus on creating an economic environment that is favorable to private investment and encourages the productive application of workers' skills. Measures to open up the economy to competition and stimulate exports should benefit growth by promoting technology adoption and reducing opportunities for rent seeking.

Table 1. Selected West African Countries: Human Capital from Education, 1970-97

(Stock as average years of schooling in the working population; and growth rate in percent)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Senegal																												
Primary school																												
Stock	0.73	0.74	0.75	0.77	0.78	0.80	0.82	0.84	0.85	0.87	0.89	0.90	0.92	0.94	0.96	0.97	0.99	1.01	1.03	1.05	1.08	1.10	1.13	1.15	1.18	1.21	1.24	1.26
Growth rate	1.5	1.5	1.7	2.1	2.1	2.2	2.2	2.1	2.0	1.9	1.9	1.9	2.0	1.9	1.8	2.0	1.9	1.9	2.0	2.1	2.1	2.3	2.4	2.4	2.4	2.4	2.3	2.2
Total schooling																												
Stock	0.83	0.84	0.86	0.88	0.90	0.92	0.94	0.97	0.99	1.01	1.03	1.06	1.08	1.11	1.13	1.16	1.18	1.21	1.24	1.26	1.29	1.33	1.36	1.40	1.44	1.47	1.51	1.55
Growth rate	1.6	1.6	1.9	2.3	2.4	2.5	2.5	2.4	2.3	2.3	2.3	2.3	2.3	2.2	2.1	2.3	2.2	2.2	2.2	2.4	2.4	2.6	2.6	2.6	2.6	2.6	2.5	2.5
Nehru-Swanson stock	0.65	0.72	0.77	0.85	0.94	1.02	1.10	1.18	1.26	1.36	1.41	1.49	1.58	1.67	1.75	1.84	1.92	2.01	...	...	...	...	...	...	...	...	...	...
Nehru-Swanson growth rate	...	10.8	6.9	10.4	10.6	8.5	7.8	7.3	6.8	7.9	3.7	5.7	6.0	5.7	4.8	5.1	4.3	4.7	...	...	...	...	...	...	...	...	...	...
Cote d'Ivoire																												
Primary school																												
Stock	1.27	1.28	1.30	1.31	1.33	1.35	1.38	1.40	1.42	1.44	1.46	1.47	1.49	1.52	1.54	1.56	1.59	1.62	1.65	1.69	1.72	1.75	1.78	1.80	1.82	1.84	1.86	1.88
Growth rate	1.1	1.1	1.3	1.5	1.4	1.6	1.6	1.5	1.5	1.4	1.2	1.3	1.3	1.4	1.4	1.6	1.7	2.0	2.0	2.0	1.9	1.8	1.6	1.3	1.2	1.1	1.1	1.1
Total schooling																												
Stock	1.31	1.33	1.34	1.37	1.39	1.42	1.44	1.47	1.50	1.52	1.55	1.58	1.60	1.63	1.66	1.70	1.74	1.78	1.83	1.88	1.92	1.97	2.01	2.05	2.09	2.12	2.15	2.19
Growth rate	1.2	1.2	1.4	1.7	1.7	1.8	1.9	1.8	1.8	1.8	1.6	1.8	1.8	1.8	1.9	2.1	2.3	2.6	2.6	2.6	2.5	2.4	2.1	1.9	1.7	1.6	1.6	1.6
Nehru-Swanson stock	0.56	0.64	0.72	0.80	0.87	0.95	1.03	1.11	1.20	1.29	1.38	1.47	1.57	1.67	1.77	1.88	1.99	2.11	...	...	...	...	...	...	...	...	...	...
Nehru-Swanson growth rate	...	14.3	12.5	11.1	8.7	9.2	8.4	7.8	8.1	7.5	7.0	6.5	6.8	6.4	6.0	6.2	5.9	6.0	...	...	...	...	...	...	...	...	...	...
Niger																												
Primary school																												
Stock	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.37
Growth rate	4.6	4.6	5.4	6.2	6.3	6.6	6.6	6.3	6.2	6.2	6.1	6.0	6.1	6.0	6.9	7.1	7.9	6.8	6.9	7.0	6.9	5.8	5.2	4.9	5.1	5.3	4.9	4.9
Total schooling																												
Stock	0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.19	0.20	0.22	0.23	0.25	0.27	0.29	0.31	0.32	0.34	0.36	0.38	0.40	0.42	0.44
Growth rate	4.3	4.3	4.8	5.4	5.5	5.7	5.7	5.5	5.3	5.4	5.3	5.3	5.5	5.5	6.3	6.8	7.6	6.7	6.9	7.2	7.1	6.2	5.6	5.2	5.1	5.2	4.9	5.0
Burkina Faso																												
Primary school																												
Stock	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20	0.21	0.21	0.22	0.23	0.23	0.24	0.25	0.25	0.26	0.27	0.28	0.29	0.30	0.32	0.33	0.35	0.37	0.39
Growth rate	2.1	2.1	2.4	2.7	2.8	3.0	3.1	2.9	2.9	2.9	2.7	3.0	3.2	3.3	3.3	2.8	3.0	3.2	3.4	3.0	3.2	3.8	4.5	4.8	5.0	4.8	5.2	5.1
Total schooling																												
Stock	0.18	0.18	0.19	0.19	0.20	0.20	0.21	0.22	0.22	0.23	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.29	0.31	0.31	0.33	0.34	0.35	0.37	0.39	0.41	0.43	0.45
Growth rate	2.1	2.1	2.4	2.7	2.7	2.9	2.9	2.8	2.8	2.8	2.6	3.4	3.6	3.6	3.6	3.2	2.9	3.1	3.5	3.2	3.4	3.9	4.6	4.8	5.0	4.9	5.3	5.2
Guinea-Bissau																												
Primary school																												
Stock	0.28	0.29	0.29	0.30	0.31	0.32	0.33	0.35	0.36	0.37	0.39	0.41	0.43	0.46	0.49	0.52	0.56	0.60	0.64	0.67	0.69	0.72	0.74	0.76	0.78	0.80	0.82	0.84
Growth rate	2.9	2.9	2.9	2.9	2.9	3.2	3.5	3.8	4.0	4.2	4.7	5.1	5.4	5.7	6.0	6.9	7.3	7.9	6.5	3.9	3.7	3.5	3.1	2.3	2.8	2.7	2.5	2.3
Total schooling																												
Stock	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.41	0.42	0.44	0.47	0.49	0.51	0.54	0.57	0.60	0.64	0.69	0.73	0.76	0.79	0.81	0.84	0.86	0.88	0.90	0.93	0.95
Growth rate	2.7	2.7	2.6	2.6	2.6	3.1	3.6	4.0	4.3	4.6	4.8	5.0	5.1	5.1	5.2	6.2	6.6	7.2	6.1	3.8	3.6	3.4	3.1	2.4	2.7	2.6	2.4	2.2
Barro-Lee stock	...	...	...	...	...	...	...	...	...	...	0.30	...	...	...	...	0.50	...	...	...	...	0.70	...	...	...	...	...	...	...
Barro-Lee growth rate	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10.8	...	...	...	...	7.0	...	...	...	...	...	...	...

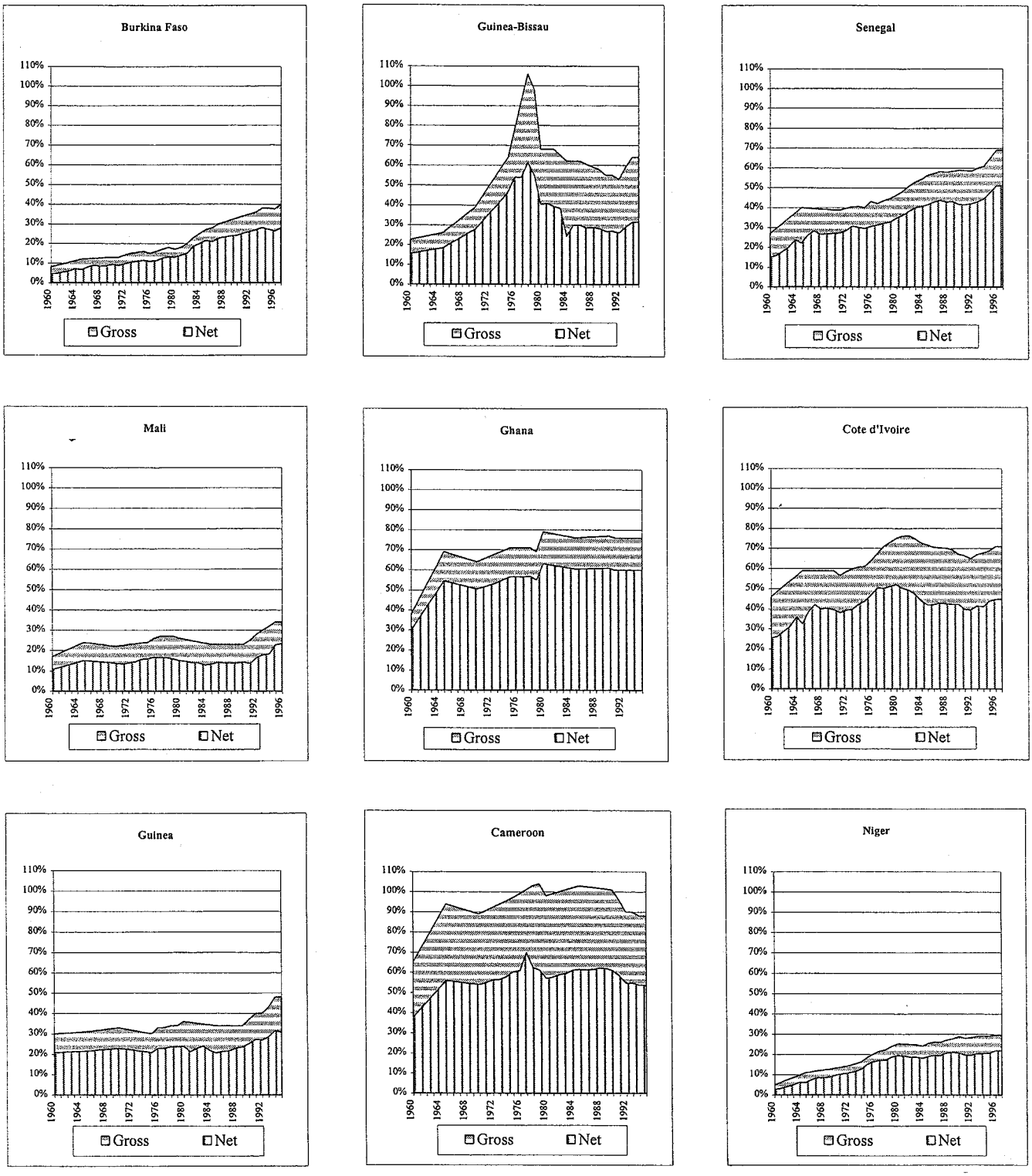
Table 1. Selected West African Countries: Human Capital from Education, 1970-97 (concluded)

(Stock as average years of schooling in the working population; and growth rate in percent)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Mali																												
Primary school																												
Stock	0.41	0.42	0.43	0.43	0.44	0.45	0.46	0.46	0.47	0.48	0.48	0.49	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.55	0.56	0.57	0.57	0.58	0.59	0.59	0.60	0.61
Growth rate	1.4	1.4	1.6	1.8	2.0	1.8	1.7	1.6	1.5	1.4	0.9	1.2	1.2	1.6	1.7	1.9	1.7	1.7	1.5	1.4	1.2	1.0	1.0	1.3	1.2	1.2	1.1	1.1
Total schooling																												
Stock	0.50	0.51	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.57	0.58	0.59	0.60	0.61	0.62	0.63	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	0.73	0.74	0.75	0.76
Growth rate	1.4	1.4	1.5	1.7	1.8	1.7	1.7	1.6	1.5	1.4	1.1	1.4	1.4	1.8	2.0	2.3	2.2	2.1	1.8	1.6	1.4	1.2	1.1	1.3	1.2	1.3	1.2	1.2
Barro Lee stock	...	...	...	...	...	...	...	...	...	...	0.70	...	...	...	...	0.80	...	...	...	...	0.90	...	...	...	...	...	...	...
Barro-Lee growth rate	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.7%	...	...	...	...	2.4%	...	...	...	...	...	...	...
Nehru-Swanson stock	0.25	0.28	0.32	0.36	0.41	0.46	0.51	0.56	0.62	0.68	0.74	0.80	0.86	0.91	0.96	1.01	1.07	1.12	...	...	...	...	...	...	...	...	...	...
Nehru-Swanson growth rate	...	12.0	14.3	12.5	13.9	12.2	10.9	9.8	10.7	9.7	9.4	8.1	6.6	6.0	5.7	5.6	5.4	5.0	...	...	...	...	...	...	...	...	...	...
Cameroon																												
Primary school																												
Stock	1.77	1.79	1.82	1.85	1.89	1.92	1.96	1.99	2.02	2.05	2.08	2.11	2.15	2.18	2.21	2.25	2.29	2.33	2.37	2.40	2.44	2.47	2.51	2.55	2.59	2.62	2.66	2.70
Growth rate	1.3	1.3	1.5	1.7	1.9	1.8	1.8	1.7	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.8	1.7	1.8	1.5	1.5	1.4	1.5	1.5	1.5	1.4	1.4	1.4
Total schooling																												
Stock	1.89	1.91	1.94	1.98	2.02	2.05	2.09	2.13	2.16	2.20	2.23	2.27	2.31	2.35	2.39	2.44	2.49	2.54	2.60	2.65	2.70	2.75	2.80	2.86	2.91	2.97	3.02	3.08
Growth rate	1.4	1.4	1.6	1.8	1.9	1.9	1.8	1.7	1.7	1.6	1.6	1.7	1.7	1.7	1.8	1.9	2.2	2.1	2.2	1.9	1.9	1.8	2.0	2.0	2.0	1.9	1.9	1.9
Barro-Lee stock	...	...	...	...	...	...	...	...	...	...	2.40	...	...	...	...	2.70	...	...	...	...	3.10	...	...	...	...	...	...	...
Barro-Lee growth rate	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.4%	...	...	...	...	2.8%	...	...	...	...	...	...	...
Nehru-Swanson stock	1.20	1.29	1.40	1.50	1.61	1.72	1.84	1.96	2.08	2.20	2.31	2.43	2.54	2.66	2.78	2.90	3.02	3.13	...	...	...	...	...	...	...	...	...	...
Nehru-Swanson growth rate	...	7.7	8.0	7.7	7.1	7.0	6.9	6.5	6.1	5.8	5.1	5.0	4.7	4.7	4.5	4.3	3.9	3.7	...	...	...	...	...	...	...	...	...	...
Ghana																												
Primary school																												
Stock	1.11	1.14	1.14	1.19	1.23	1.26	1.30	1.33	1.36	1.39	1.42	1.46	1.49	1.53	1.57	1.60	1.64	1.67	1.71	1.75	1.79	1.83	1.87	1.91	1.95	1.98	2.02	2.06
Growth rate	1.9	1.9	0.3	4.7	3.0	2.8	2.7	2.5	2.4	2.2	2.2	2.3	2.5	2.6	2.3	2.2	2.3	2.2	2.0	2.5	2.4	2.2	2.1	2.1	2.0	1.9	1.9	1.8
Total schooling																												
Stock	1.50	1.53	1.56	1.60	1.64	1.69	1.73	1.77	1.80	1.84	1.88	1.93	1.99	2.05	2.12	2.18	2.24	2.31	2.37	2.44	2.51	2.59	2.66	2.72	2.79	2.86	2.92	2.99
Growth rate	1.9	1.9	2.2	2.4	2.7	2.5	2.4	2.3	2.2	2.1	2.3	2.6	2.9	3.1	3.2	3.0	2.9	2.8	2.7	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3	2.2
Barro-Lee stock	...	...	...	...	...	...	...	...	...	...	3.40	...	...	...	...	3.60	...	...	...	...	3.60	...	...	...	...	...	...	...
Barro-Lee growth rate	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.1	...	...	...	...	0.0	...	...	...	...	...	...	...
Nehru-Swanson stock	2.41	2.56	2.74	2.94	3.14	3.32	3.47	3.61	3.72	3.83	3.93	4.03	4.12	4.21	4.30	4.39	4.47	4.54	...	...	...	...	...	...	...	...	...	...
Nehru-Swanson growth rate	...	6.2	7.0	7.3	6.8	5.7	4.5	4.0	3.0	3.0	2.6	2.5	2.2	2.2	2.1	2.1	1.8	1.6	...	...	...	...	...	...	...	...	...	...
Guinea																												
Primary school																												
Stock	0.67	0.67	0.67	0.67	0.67	0.68	0.68	0.68	0.68	0.69	0.69	0.69	0.69	0.69	0.70	0.70	0.70	0.70	0.71	0.71	0.72	0.72	0.72	0.73	0.73	0.73	0.74	0.74
Growth rate	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.4	0.3	0.4	0.7	0.7	0.7	0.6	0.5	0.2	0.5	0.7	0.6	0.6
Total schooling																												
Stock	0.70	0.71	0.71	0.71	0.72	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.82	0.83	0.84	0.86	0.87	0.89	0.90	0.91	0.92	0.93	0.94	0.95	0.96
Growth rate	0.5	0.5	0.5	0.6	0.6	0.8	1.0	1.1	1.3	1.4	1.4	1.3	1.3	1.2	1.1	1.3	1.4	1.4	1.7	1.7	1.6	1.4	1.2	0.9	1.1	1.1	1.0	0.9

Figure 1. Selected West African Countries: Gross and Net Enrollment in Primary School, 1960-97 1/

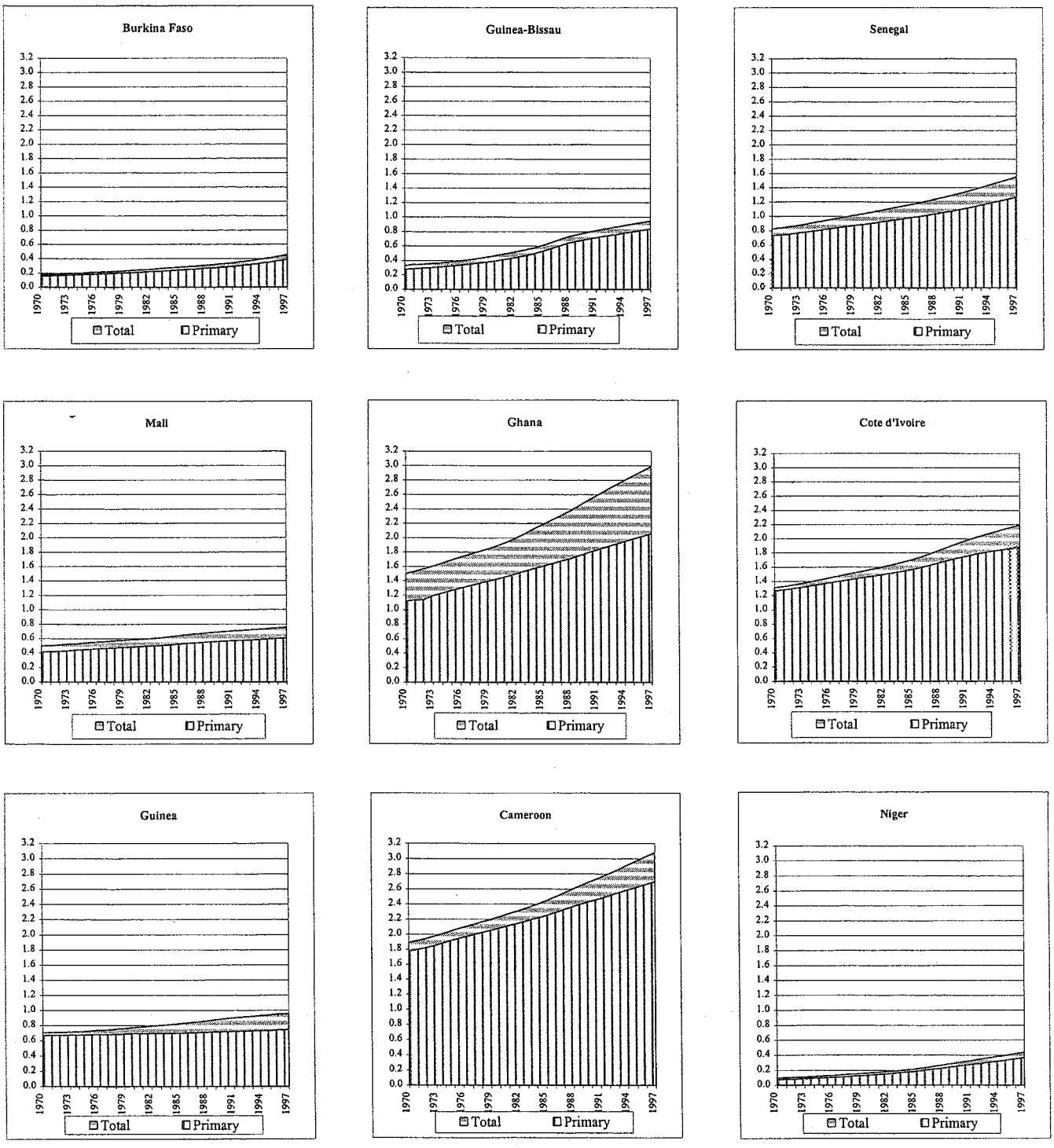
(In percent)



1/ Gross enrollment is defined as the number of children of any age registered in primary school, in percent of the population between the age of 6 and 11, the years in which a child should theoretically be in primary school. The net enrollment is defined as gross enrollment corrected for repeaters and drop-out.

Figure 2. Selected West African Countries: Human Capital Stock from Total and Primary Schooling, 1970-97 1/

(In years of education)



1/ Human capital measured in average years of schooling in the population.

Table 2. Selected West African Countries: Wage-Weighted Human Capital, 1970-97

(Stock as index of education-related labor productivity, completion of primary school=1; and growth rate in percent)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Senegal																												
Stock	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.61	0.61	0.61	0.62	0.62	0.62	0.62	0.62	0.63	0.63	0.63	0.63	0.64	0.64	0.64	0.65	0.65	0.65
Growth rate	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
Nehru-Dhareshwar growth rate	0.5	0.4	0.4	0.4	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	...	...	...
Cote d'Ivoire																												
Stock	0.63	0.64	0.64	0.64	0.64	0.64	0.64	0.65	0.65	0.65	0.65	0.66	0.66	0.66	0.66	0.67	0.67	0.67	0.68	0.68	0.68	0.69	0.69	0.69	0.70	0.70	0.70	0.71
Growth rate	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4
Niger																												
Stock	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.56
Growth rate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Burkina Faso																												
Stock	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.56	0.56
Growth rate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Guinea-Bissau																												
Stock	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.60	0.60
Growth rate	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.6	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Mali																												
Stock	0.56	0.56	0.56	0.56	0.56	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Growth rate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Nehru-Dhareshwar growth rate	...	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.4	0.3	0.4	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.0	0.0	...	...	...
Cameroon																												
Stock	0.68	0.68	0.69	0.69	0.69	0.70	0.70	0.70	0.71	0.71	0.71	0.71	0.72	0.72	0.72	0.73	0.73	0.74	0.74	0.75	0.75	0.76	0.76	0.76	0.77	0.77	0.78	0.78
Growth rate	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Nehru-Dhareshwar growth rate	...	0.5	0.5	0.5	0.5	0.4	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	...	...	...
Ghana																												
Stock	0.64	0.64	0.64	0.65	0.65	0.65	0.66	0.66	0.66	0.67	0.67	0.67	0.68	0.68	0.69	0.69	0.70	0.70	0.71	0.71	0.72	0.72	0.73	0.73	0.74	0.74	0.75	0.75
Growth rate	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.6	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6
Nehru-Dhareshwar growth rate	...	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.4	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	...	...	...
Guinea																												
Stock	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Growth rate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1

Figure 3. Selected West African Countries: Wage-weighted Human Capital Stock from Primary and Total Schooling, 1970-97

(Index of education-related labor productivity, completion of primary school=1)

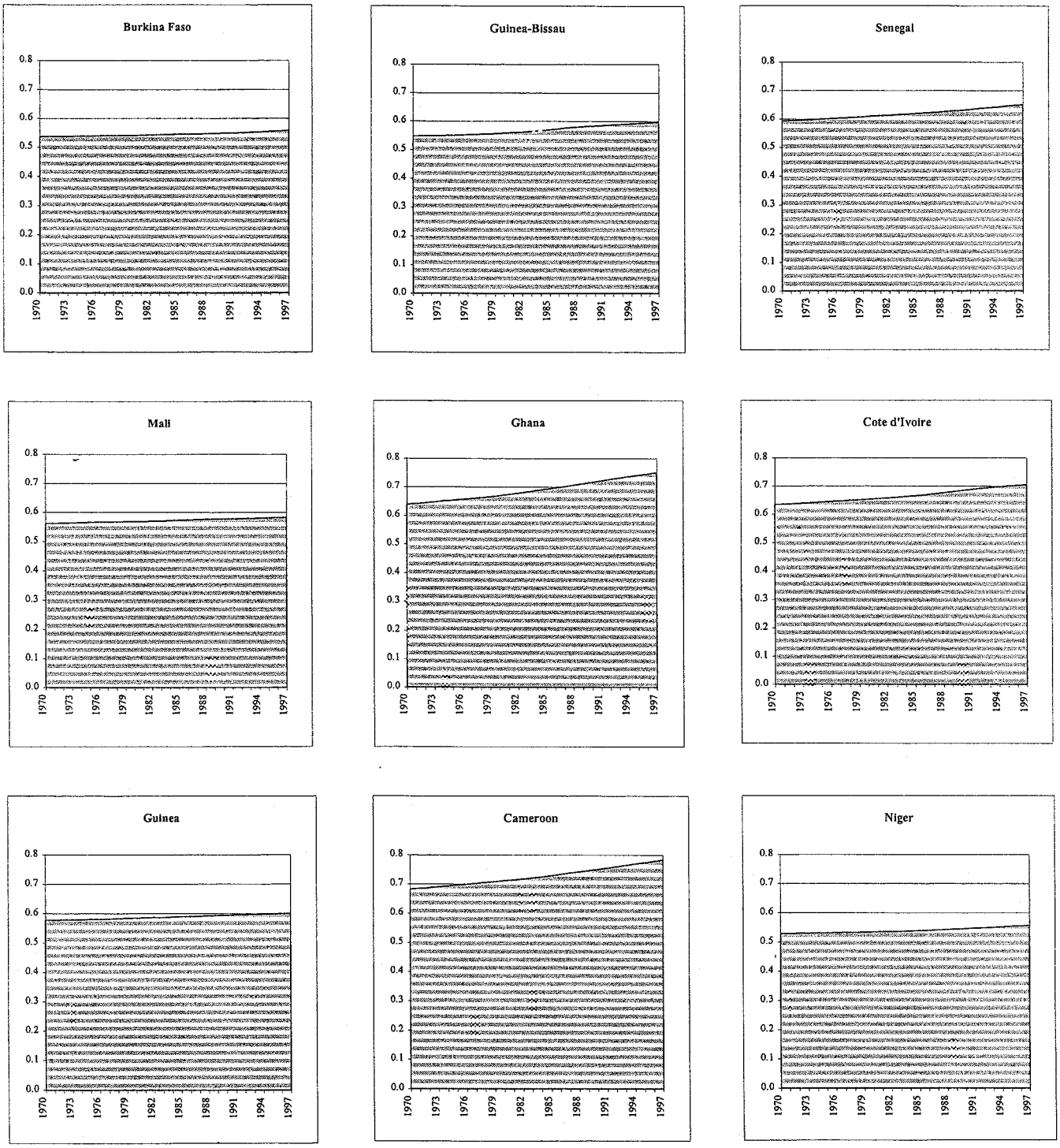


Table 3. Growth-Accounting Estimate of GDP Per Worker Growth, 1970-96

Explanatory Variable 1/	Regression (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
									(With instrumental variable)		
Kgr	0.600***	0.679***	0.593***	0.615***	0.639***	0.669***	0.701***	0.648***	0.303**	0.322**	0.368***
	(8.116)	(8.015)	(7.995)	(8.352)	(7.974)	(7.919)	(7.539)	(7.739)	(2.029)	(2.184)	(3.092)
Hgr	-0.309			-0.225	-0.076	0.425				0.033	-0.258
	(-1.538)			(-1.600)	(-0.266)	(1.061)				(0.057)	(-1.028)
wHgr		2.709*					4.775				
		(1.914)					(1.287)				
Common intercept	0.664	-1.143*	-0.054								0.493
	(1.172)	(-1.726)	(-0.156)								(0.570)
1970 GDP per worker				0.001							
				(1.457)							
1970 human capital					0.550						
					(1.079)						
Fixed effects											
Burkina Faso						-1.907	-1.238	-0.420	0.623	0.456	
Cameroon						-1.470	-3.220	-0.634	0.416	0.296	
Ghana						-0.501	-2.202	0.561	-0.155	-0.209	
Guinea-Bissau						-3.708	-3.672	-1.900	-0.004	-0.209	
Mali						-1.523	-1.602	-0.800	0.095	-0.011	
Senegal						-1.367	-2.022	-0.367	-0.275	-0.364	
Cote d'Ivoire						-1.091	-2.174	-0.267	-0.229	-0.300	
Niger						-4.153	-2.575	-1.719	-1.812	-1.999	
R^2	0.131	0.132	0.124	0.133	0.132	0.149	0.154	0.148	...	...	...
Adj. R^2 2/	0.123	0.124	0.120	0.125	0.119	0.112	0.116	0.114	...	...	...
DW 3/	1.97	1.96	1.96	1.97	1.97	2.00	2.00	2.00	...	...	...

Notes: The T-statistics are in parentheses. ***, **, and * denote the significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

1/ See Appendix I for the definition and source of the variables.

2/ Adj. R^2 is the coefficient of determination adjusted for the degree of freedom.

3/ DW is the Durbin-Watson test statistic for serial correlation.

Table 4. Impact of Shocks and Policy Variables on Growth of Output, Capital, and Factor Productivity, 1970-96 1/

(With fixed effects)

Explanatory Variable 2/	Dependent Variable, in Terms of Growth Per Worker																	
	GDP	Capital	TFP	GDP	Capital	TFP	GDP	Capital	TFP	GDP	Capital	TFP	GDP	Capital	TFP	GDP	Capital	TFP
Premium 3/	-0.617***	-0.078***	-0.406***															
	(-7.106)	(-2.839)	(-3.944)															
Totgr (lag 1)				0.077***	0.025***	0.066***												
				(3.578)	(2.775)	(3.389)												
Xgr (lag 1)							0.023*	0.007	0.018*									
							(1.920)	(1.534)	(1.668)									
dTrade (lag 1)										0.099**	0.015	0.049						
										(2.164)	(0.948)	(1.149)						
Inflation													-0.040**	-0.002	-0.017			
													(-2.416)	(-0.302)	(-1.106)			
dCB																-0.275***	-0.055**	-0.065
																(-6.690)	(-2.015)	(-1.436)
R^2	0.092	0.335	0.093	0.067	0.263	0.034	0.043	0.247	0.024	0.042	0.249	0.016	0.011	0.228	0.015	0.109	0.241	0.050
Adj. R^2 2/	0.037	0.294	0.037	0.029	0.234	-0.005	0.003	0.216	-0.017	0.001	0.217	-0.026	-0.027	0.198	-0.024	0.075	0.212	0.012
DW 3/	1.77	0.39	1.96	1.99	0.41	2.04	1.96	0.39	2.03	1.93	0.37	2.05	1.87	0.40	2.00	1.76	0.40	1.96

Notes: The T-statistics are in parentheses. ***, **, and * denote the significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

1/ The countries in the study are Senegal, Cote d'Ivoire, Burkina Faso, Cameroon, Ghana, Niger, Guinea-Bissau, and Mali.

2/ See Appendix I for the definition and source of the variables.

3/ For *Premium*, data were available since 1978 only.

4/ Adj. R^2 is the coefficient of determination adjusted for the degree of freedom.

5/ DW is the Durbin-Watson test statistic for serial correlation.

Table 5. Growth Accounting with Shocks and Policy Variables, 1970-96 1/

Explanatory Variable 2/	Dependent Variable, in Terms of Growth Per Worker										
	GDP	Capital	TFP	GDP	Capital	TFP	GDP	Capital	TFP	GDP	GDP
					(With common intercept)						
Kgr	0.430***			0.466***			0.479***				
	(4.920)			(6.801)			(7.124)				
GovKgr										0.151**	0.165**
										(2.358)	(2.564)
PrivKgr										0.235***	0.240***
										(4.764)	(4.784)
Totgr (lag 1)	0.095***	0.017**	0.110***	0.068***	0.027***	0.063***	0.072***	0.022**	0.065***	0.062***	0.059***
	(4.313)	(2.095)	(5.220)	(3.229)	(2.718)	(2.992)	(3.523)	(2.071)	(3.171)	(2.819)	(2.681)
Xgr (lag 1)	0.018*	0.019***	0.018*	0.013	0.006	0.008	0.012	0.007	0.008	0.014	0.017
	(1.764)	(4.355)	(1.670)	(1.232)	(1.336)	(0.760)	(1.124)	(1.419)	(0.709)	(1.327)	(1.544)
Inflation	-0.011	-0.008*	-0.001								
	(-0.949)	(-1.905)	(-0.060)								
dCB	0.052	-0.068**	0.085	-0.039	-0.079***	-0.023				-0.051	-0.057
	(0.860)	(-2.452)	(1.410)	(-0.910)	(-2.985)	(-0.512)				(-1.190)	(-1.325)
Premium 3/	0.077	-0.001	0.172*								
	(0.864)	(-0.026)	(1.795)								
SIG											-0.014
											(-1.332)
Constant	0.664	0.334***	0.072	-0.170	1.161***	-0.274	-0.146	1.140***	-0.248	-0.051	0.411
	(1.651)	(3.322)	(0.183)	(-0.543)	(11.335)	(-0.894)	(-0.480)	(10.247)	(-0.821)	(-1.190)	(0.751)
R^2	0.172	0.075	-0.034	0.153	0.025	0.022	0.132	0.015	0.007	0.153	0.161
Adj. R^2 4/	0.133	0.039	-0.074	0.136	0.010	0.007	0.119	0.005	-0.003	0.132	0.136
DW 5/	1.90	0.28	1.91	2.01	0.33	1.97	2.04	0.30	1.99	2.02	2.03
					(With fixed effects)						
Kgr				0.506***			0.523***				
				(6.160)			(6.624)				
GovKgr										0.177***	
										(2.681)	
PrivKgr										0.226***	
										(3.807)	
Totgr (lag 1)				0.065***	0.026***	0.061***	0.070***	0.023**	0.065***	0.059***	
				(3.043)	(2.775)	(2.883)	(3.403)	(2.376)	(3.212)	(2.674)	
Xgr (lag 1)				0.015	0.005	0.013	0.013	0.006	0.012	0.016	
				(1.360)	(1.111)	(1.231)	(1.237)	(1.181)	(1.124)	(1.474)	
Inflation											
dCB				-0.049	-0.070***	-0.047				-0.066	
				(-1.168)	(-2.851)	(-1.131)				(-1.553)	
Premium 3/											
R^2				0.177	0.273	0.063	0.152	0.260	0.037	0.177	
Adj. R^2 4/				0.129	0.235	0.014	0.108	0.225	-0.008	0.125	
DW 5/				2.04	0.42	2.01	2.08	0.40	2.05	2.04	

Notes: The T-statistics are in parentheses. ***, **, and * denote the significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

1/ The countries in the study are Senegal, Cote d'Ivoire, Burkina Faso, Cameroon, Ghana, Niger, Guinea-Bissau, and Mali.

2/ See Appendix I for the definition and source of the variables.

3/ For *Premium*, data were available since 1978 only.

4/ Adj. R^2 is the coefficient of determination adjusted for the degree of freedom.

5/ DW is the Durbin-Watson test statistic for serial correlation.

Table 6. Selected West African Countries: Determinants of Per Capita Income Growth, 1970-96

(With fixed effects)

Explanatory Variable	Mean	Contribution to the Growth of (In percent)			Mean	Contribution to the Growth of (In percent)			Mean	Contribution to the Growth of (In percent)			Mean	Contribution to the Growth of (In percent)		
		GDP per worker	Capital per worker	TFP per worker		GDP per worker	Capital per worker	TFP per worker		GDP per worker	Capital per worker	TFP per worker		GDP per worker	Capital per worker	TFP per worker
		Guinea-Bissau				Burkina Faso				Cameroon				Ghana		
Kgr	4.12	2.09			2.81	1.42			3.10	1.57			-1.36	-0.69		
Totgr (lag 1)	1.46	0.10	0.04	0.09	1.16	0.08	0.03	0.07	1.66	0.11	0.04	0.10	-0.96	-0.06	-0.03	-0.06
Xgr (lag 1)	16.56	0.25	0.09	0.21	9.36	0.14	0.05	0.12	8.89	0.13	0.05	0.12	7.36	0.11	0.04	0.10
dCB	0.11	-0.01	-0.01	-0.01	0.62	-0.03	-0.04	-0.03	0.03	0.00	0.00	0.00	-0.21	0.01	0.01	0.01
Constant		-1.66	4.00	-2.02		-0.18	2.85	-0.51		-0.47	3.02	-0.86		0.10	-1.56	0.32
Estimated growth		0.76	4.12	-1.72		1.43	2.89	-0.35		1.34	3.11	-0.65		-0.53	-1.54	0.36
Actual growth		0.77	4.12	-1.71		1.40	2.81	-0.32		1.37	3.10	-0.63		-0.32	-1.36	0.37
		Mali				Senegal				Cote d'Ivoire				Niger		
Kgr	2.89	1.46			0.77	0.39			0.64	0.32			-0.05	-0.03		
Totgr (lag 1)	-0.78	-0.05	-0.02	-0.05	-0.44	-0.03	-0.01	-0.03	1.44	0.09	0.04	0.09	0.21	0.01	0.01	0.01
Xgr (lag 1)	12.62	0.19	0.06	0.16	4.58	0.07	0.02	0.06	6.12	0.09	0.03	0.08	0.41	0.01	0.00	0.01
dCB	0.20	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.10	0.00	-0.01	0.00	-0.19	0.01	0.01	0.01
Constant		-0.61	2.79	-0.93		-0.46	0.59	-0.51		-0.51	0.33	-0.50		-1.99	0.04	-2.00
Estimated growth		0.98	2.82	-0.83		-0.03	0.60	-0.48		0.00	0.39	-0.34		-1.99	0.06	-1.97
Actual growth		1.07	2.89	-0.82		0.13	0.77	-0.45		0.15	0.64	-0.32		-1.75	-0.05	-1.77

The estimated equations are $Ygr = a_i + 0.506*Kgr + 0.065*Totgr(-1) + 0.015*Xgr(-1) - 0.049*dCB$,
$Kgr = b_i + 0.026*Totgr(-1) + 0.005*Xgr(-1) - 0.070*dCB$, and
$TFPgr = c_i + 0.061*Totgr(-1) + 0.013*Xgr(-1) - 0.047*dCB$, where a_i, b_i, and c_i are the country-specific effects.

Table 7. Selected West African Countries: Determinants of Per Capita Income Growth, 1970-96

(With common intercept)

Explanatory variable	Mean	Contribution to the Growth of (In percent)			Mean	Contribution to the Growth of (In percent)			Mean	Contribution to the Growth of (In percent)			Mean	Contribution to the Growth of (In percent)		
		GDP per worker	Capital per worker	TFP per worker		GDP per worker	Capital per worker	TFP per worker		GDP per worker	Capital per worker	TFP per worker		GDP per worker	Capital per worker	TFP per worker
		Guinea-Bissau				Burkina Faso				Cameroon				Ghana		
Kgr	4.12	1.92			2.81	1.31			3.10	1.44			-1.36	-0.63		
Totgr (lag 1)	1.46	0.10	0.04	0.09	1.16	0.08	0.03	0.07	1.66	0.11	0.04	0.10	-0.96	-0.07	-0.03	-0.06
Xgr (lag 1)	16.56	0.22	0.10	0.13	9.36	0.12	0.06	0.08	8.89	0.12	0.06	0.07	7.36	0.10	0.05	0.06
dCB	0.11	0.00	-0.01	0.00	0.62	-0.02	-0.05	-0.01	0.03	0.00	0.00	0.00	-0.21	0.01	0.02	0.00
Constant		-0.17	1.16	-0.02		-0.17	1.16	-0.02		-0.17	1.16	-0.02		-0.17	1.16	-0.02
Estimated growth		2.06	1.30	0.20		1.32	1.20	0.11		1.50	1.26	0.15		-0.76	1.20	-0.02
Actual growth		0.77	4.12	-1.71		1.40	2.81	-0.32		1.37	3.10	-0.63		-0.32	-1.36	0.37
		Mali				Senegal				Cote d'Ivoire				Niger		
Kgr	2.89	1.35			0.77	0.36			0.64	0.30			-0.05	-0.02		
Totgr (lag 1)	-0.78	-0.05	-0.02	-0.05	-0.44	-0.03	-0.01	-0.03	1.44	0.10	0.04	0.09	0.21	0.01	0.01	0.01
Xgr (lag 1)	12.62	0.17	0.08	0.10	4.58	0.06	0.03	0.04	6.12	0.08	0.04	0.05	0.41	0.01	0.00	0.00
dCB	0.20	-0.01	-0.02	0.00	0.00	0.00	0.00	0.00	0.10	0.00	-0.01	0.00	-0.19	0.01	0.02	0.00
Constant		-0.17	1.16	-0.02		-0.17	1.16	-0.02		-0.17	1.16	-0.02		-0.17	1.16	-0.02
Estimated growth		1.28	1.20	0.03		0.22	1.18	-0.01		0.30	1.23	0.12		-0.17	1.18	0.00
Actual growth		1.07	2.89	-0.82		0.13	0.77	-0.45		0.15	0.64	-0.32		-1.75	-0.05	-1.77

The estimated equations are $Ygr = -0.170 + 0.466*Kgr + 0.068*Totgr(-1) + 0.013*Xgr(-1) - 0.039*dCB$,
$Kgr = 1.161 + 0.027*Totgr(-1) + 0.006*Xgr(-1) - 0.079*dCB$, and
$TFPgr = -0.274 + 0.063*Totgr(-1) + 0.008*Xgr(-1) - 0.023*dCB$.

Figure 4. Selected West African Countries: Share of Government Investment in Total Investment, 1970-97

(In percent)

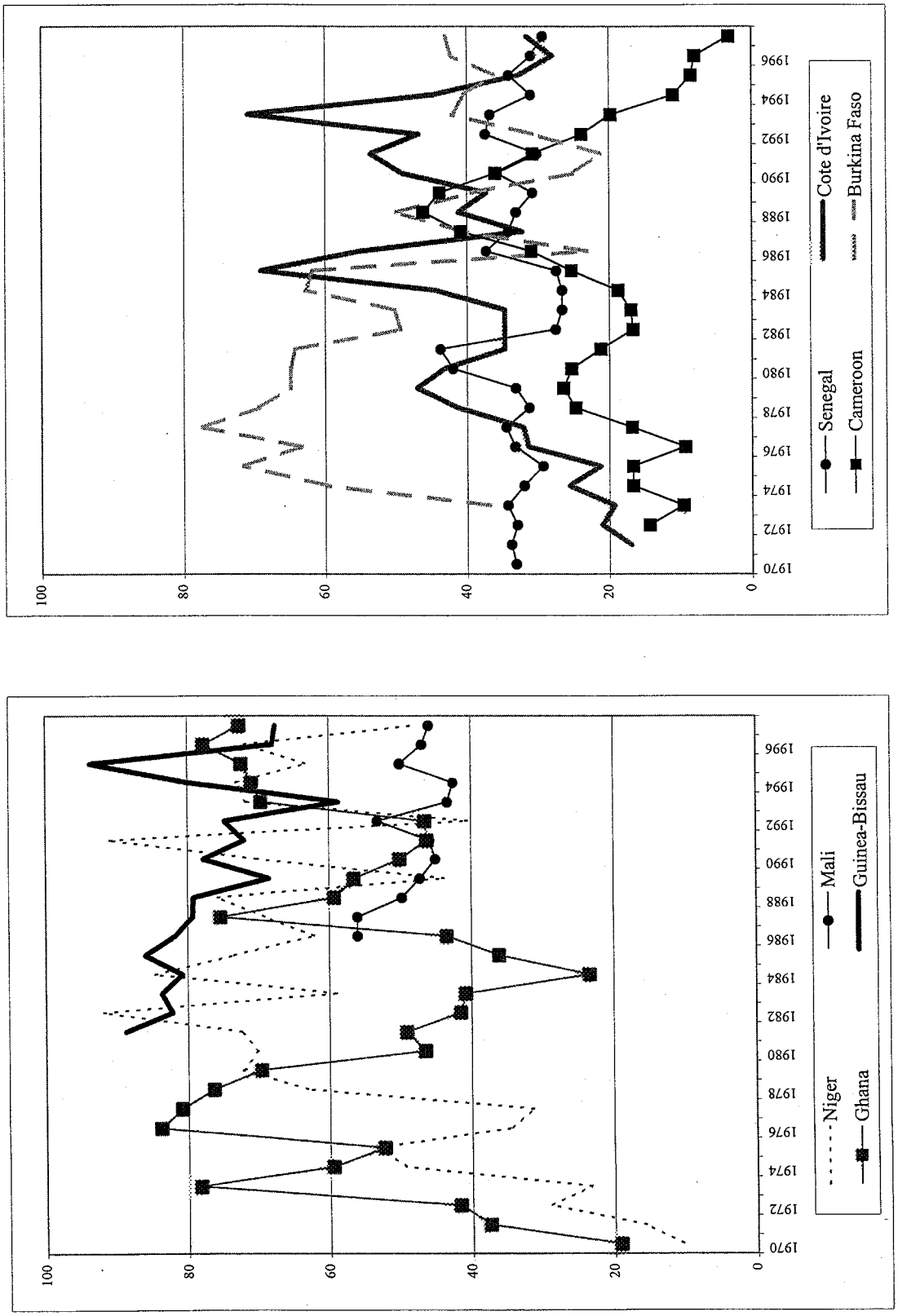


Table 8. Selected West African Countries: Contribution of Private and Public Capital Accumulation to Growth, 1970-96

(With fixed effects)

Explanatory Variable	Mean	Contribution to Growth (In percent)	Mean	Contribution to Growth (In percent)	Mean	Contribution to Growth (In percent)	Mean	Contribution to Growth (In percent)
	Guinea-Bissau		Burkina Faso		Cameroon		Ghana	
GovKgr	3.88	0.69	1.47	0.26	4.35	0.77	-1.22	-0.22
PrivKgr	5.04	1.14	4.51	1.02	2.80	0.63	-1.51	-0.34
Totgr (lag 1)	1.46	0.09	1.16	0.07	1.66	0.10	-0.96	-0.06
Xgr (lag 1)	16.56	0.26	9.36	0.15	8.89	0.14	7.36	0.12
dCB	0.11	-0.01	0.62	-0.04	0.03	0.00	-0.21	0.01
Constant		-1.42		-0.03		-0.31		0.10
Estimated growth		0.75		1.43		1.33		-0.38
Actual growth		0.77		1.40		1.37		-0.32
	Mali		Senegal		Cote d'Ivoire		Niger	
GovKgr	2.35	0.42	0.60	0.11	1.54	0.27	1.22	0.22
PrivKgr	3.56	0.80	0.86	0.19	0.22	0.05	-1.29	-0.29
Totgr (lag 1)	-0.78	-0.05	-0.44	-0.03	1.44	0.09	0.21	0.01
Xgr (lag 1)	12.62	0.20	4.58	0.07	6.12	0.10	0.41	0.01
dCB	0.20	-0.01	0.00	0.00	0.10	-0.01	-0.19	0.01
Constant		-0.40		-0.40		-0.55		-1.92
Estimated growth		0.96		-0.05		-0.05		-1.96
Actual growth		1.07		0.13		0.15		-1.75

The estimated equation is $Ygr = a_i + 0.177*GovKgr + 0.226*PrivKgr + 0.059*Totgr(-1) + 0.016*Xgr(-1) - 0.066*dCB$,
where a_i are the country-specific effects captured by the constant.

Table 9. Selected West African Countries: Contribution of Capital Accumulation to Growth, Including SIG Variable, 1970-96

(With common intercept)

Explanatory Variable	Mean	Contribution to Growth (In percent)	Mean	Contribution to Growth (In percent)	Mean	Contribution to Growth (In percent)	Mean	Contribution to Growth (In percent)
	Guinea-Bissau		Burkina Faso		Cameroon		Ghana	
GovKgr	3.88	0.64	1.47	0.24	4.35	0.72	-1.22	-0.20
PrivKgr	5.04	1.21	4.51	1.08	2.80	0.67	-1.51	-0.36
Totgr (lag 1)	1.46	0.09	1.16	0.07	1.66	0.10	-0.96	-0.06
Xgr (lag 1)	16.56	0.28	9.36	0.16	8.89	0.15	7.36	0.12
dCB	0.11	-0.01	0.62	-0.03	0.03	0.00	-0.21	0.01
SIG	81.58	-1.11	49.99	-0.68	21.33	-0.29	57.69	-0.78
Constant		0.41		0.41		0.41		0.41
Estimated growth		1.51		1.25		1.76		-0.86
Actual growth		0.77		1.40		1.37		-0.32
	Mali		Senegal		Cote d'Ivoire		Niger	
GovKgr	2.35	0.39	0.60	0.10	1.54	0.25	1.22	0.20
PrivKgr	3.56	0.85	0.86	0.21	0.22	0.05	-1.29	-0.31
Totgr (lag 1)	-0.78	-0.05	-0.44	-0.03	1.44	0.08	0.21	0.01
Xgr (lag 1)	12.62	0.21	4.58	0.08	6.12	0.10	0.41	0.01
dCB	0.20	-0.01	0.00	0.00	0.10	-0.01	-0.19	0.01
SIG	52.64	-0.71	32.93	-0.45	38.53	-0.52	59.37	-0.80
Constant		0.41		0.41		0.41		0.41
Estimated growth		1.09		0.32		0.38		-0.47
Actual growth		1.07		0.13		0.15		-1.75

The estimated equation is $Ygr = 0.41 + 0.165*GovKgr + 0.240*PrivKgr + 0.059*Totgr(-1) + 0.017*Xgr(-1) - 0.057*dCB - 0.014*SIG$.

Source and Definition of Data

Variable	Definition	Source [1]	Data Range
CB	Central government overall balance including grants, in percentage of GDP	WEO	1969-96
CPI	Consumer price index, 1990=100	WEO	1969-96
Drop	Dropout rate	Calculated by using UNESCO formula	1970-96
Export	Exports of goods and services at market prices in local currency, in constant 1990 prices	WDI	1969-96
GDI	Gross domestic investment in local currency, in constant 1990 prices	WDI	1969-96
GovK	Log of the stock of public capital per worker in local currency, in constant 1990 prices	Derived from *GDI*, *SIG*, and *K*	1969-96
GPRI	Gross primary school enrollment	WDI / ADI / UNESCO	1970-96
GSEC	Gross secondary school enrollment	WDI / ADI	1970-96
H	Log of human capital stock	Derived from *Drop*, *GPRI*, *GSEC*, *REP*, and *SURV*	1970-97
Import	Imports of goods and services at market prices in local currency, in constant 1990 prices	WDI	1969-96
Inflation	Growth rate of *CPI*	Derived from *CPI*	1970-96
Initial	Log of GDP per worker in 1970 (in constant US$)	WDI	1970
K	Log of capital stock per worker in local currency, in constant 1990 prices. The stock is calculated by assuming the initial capital-to-output ratio to be 1.5 and using the "perpetual inventory method" to build the stock.	Derived from *Y* and *GDI*	1969-96
L	Total labor force	WDI	1969-96
Premium	Parallel exchange rate over official exchange rate	ADI	1978-96, 1991-96 for Guinea Bissau

[1]WEO = World Economic Outlook database, International Monetary Fund; AFR = African Department (IMF) database; WDI = World Development Indicators database (1998), World Bank; ADI = African Development Indicators database (1997), World Bank; and UNESCO = United Nations Educational, Scientific and Culture Organization.

Source and Definition of Data

Variable	Definition	Source [2]	Data Range
PrivK	Log of the stock of private capital per worker in local currency, in constant 1990 prices	Derived residually from *K* and *GovK*	1969-96
REP	Repetition rate	WDI / UNESCO	1970-96
SIG	Government investment in percentage of total investment	WEO	1969-96
SURV	Survival probability by age group	WB demographic data	1996
Tot	Log of terms of trade of goods and services, index 1990 = 100	AFR / WEO	1969-96
Trade	Ratio of exports and imports of goods and services to GDP	Derived from *Export*, *Import*, and *Y*	1969-96
X	Export of goods in local currency, in constant 1990 prices	WDI	1969-96
Y	Log of GDP in local currency per worker, in constant 1990 prices	WDI, derived from *L*	1969-96

[2]WEO = World Economic Outlook database, International Monetary Fund; AFR = African Department (IMF) database; WDI = World Development Indicators database (1998), World Bank; ADI = African Development Indicators database (1997), World Bank; and UNESCO = United Nations Educational, Scientific and Culture Organization.

APPENDIX II

Definition of Dropout Rate in Primary School

Primary dropout rate = Total number of dropouts/total enrollment.

Total number of dropouts (for e.g., 1994) = Total enrollment (1994) + grade one enrollment (1995) - total number of repeaters in grade one (1994) - total number of new entrants to the first grade of secondary education (1995) - total enrollment (1995).

Earning Weights Associated with Education

In the case of Burkina Faso, we use mainly information about the mid-career wage structure in the public administration.[1] With the wage corresponding to completion of primary education normalized to one, wage indexes in the public administration vary between 0.7 and 2.5.[2] Information about income in the private sector, although limited, indicates wide discrepancies in living standards across regions and activities.[3] We choose to ignore the urban-rural gap in income levels and assume that the private wage of those with no education is half the lowest public wage. Then, assuming that two-thirds of the wage differential in urban areas is due to education, we obtain the following earning weights: 0.5 for the rawest type of labor, 0.8 for those with minimum education in public administration, 0.9 for those who completed four years of education, 1.5 for those who completed secondary school, and 2.0 for those who completed four years of tertiary education. It is interesting to note that the relative wage structure and the corresponding earning weights in Burkina Faso are very similar to those of the United States in the 1960s, as reported by Denison (1967),[4] except for the wage of those with no education, which we assume to be lower.

In Mali, a 1994 UNDP study on public service earnings indicates that the wage structure is less skewed than that of Burkina. We use this information to calculate the earning weights corresponding to secondary school and four years of graduate education, 1.4 and 1.9, respectively. In the case of Ghana, we use Canagarajah and Mazumdar's result (1997) on the impact of different levels of education on both private and public wages, derived from a regression equation that takes into account separately the impact of personal, sectoral, and regional characteristics. Interestingly, the estimated coefficients indicate that, in 1991, the relative wage differential due to education in Ghana was again almost identical to the one in Burkina Faso for public administration. In the case of countries where no specific information on the wage structure was available, we simply assumed that the earning weights were identical to those in Burkina Faso.

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[1]Clearly, the relative wage distribution in public administration, which is determined as a result of a political decision, may reflect other factors than relative production capacity. Nevertheless, one would hope that it is still strongly correlated with productivity.

[2]This corresponds to both the 1994 and the 1996 wage structure. The reader should realized that we assumed the least-skilled public worker to have at least some education.

[3]From "Recent Economic Developments" (1998), we see that, on average, urban occupations appear to yield a revenue equal to 50-60 percent of the lowest wage in the civil service, but that farmers earn much less.

[4]Denison calculated the U.S. education weights as follows: 0.7 for no education, 1.0 for completion of primary education (in this case, eight years of schooling), 1.2 for secondary education, and 1.8 for a four years of college. In order to compare his results with ours, we need to rebase primary education to six years of schooling. Then, the corresponding weights for the U.S. become 0.8, 1.0, 1.4, and 2.1.

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