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**The Role of Capital Accumulation, Adjustment
and Structural Change for Economic Take-Off:
Empirical Evidence from African Growth Episodes**

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RÉSUMÉ

Dans ce document, nous analysons des périodes de croissance prolongées en Afrique sur la base d'estimations en données de panel pour 27 pays sur la période 1960-1996. Seulement une douzaine de telles épisodes de croissance « rapide » sont décelables en Afrique depuis 1960 et beaucoup d'entre elles se sont soldées par des échec. Nous utilisons à titre comparatif l'ensemble des informations disponibles sur les performances macro-économiques en Afrique, afin d'évaluer le caractère soutenable des épisodes de croissance en cours. Notre principale conclusion est qu'une croissance soutenable doit reposer sur une combinaison équilibrée d'accumulation du capital, d'ajustement macro-économique et de changement structurel. En complément des déterminants usuels de la productivité globale des facteurs nous construisons un indicateur de l'effet de la réallocation du travail ainsi qu'un indicateur de diversification économique, dont nous testons l'impact sur la croissance. Nous proposons également une analyse des comportements d'investissement, qui dépendent des progrès de productivité des facteurs, tout en influençant la croissance par extension des facteurs. De plus nous proposons un cadre d'analyse des période de croissance prolongée en vue d'évaluer leur soutenabilité.

SUMMARY

In this paper, we analyze extended periods of growth in Africa based on panel estimations from 27 African countries during the 1960-1996 period. Only a dozen of such “fast” growth episodes are observable in Africa since 1960, and many of them have failed after a while. We use all existing information on macro-economic performance in Africa in a comparative way, in order to assess the sustainability of current growth episodes. Our main conclusion is that sustainable growth needs to be based on a balanced mix of capital accumulation, macroeconomic adjustment and structural change. In addition to more commonly used determinants of Total Factor Productivity, we construct a measure for the effect of labor reallocation as well as an index of economic diversification and estimate the impact of the latter on long term growth. We also build an analysis of investment behavior, which is linked to total factor productivity progress, while influencing economic growth through factor accumulation. Further we propose a framework for the analysis of extended growth periods, in view of assessing their sustainability.

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INTRODUCTION

The good economic performers of the 1960s, 70s and early 80s in Africa turned out to be disappointments in nearly all cases, in large part due to increasing inefficiencies bringing growth and investment to a halt. On the contrary, the recent improvement in economic performance in several African countries, has been fuelled by the removal of market distortions and to a less extent by structural change, while a significant progress in terms of higher investment rates has been absent (see e.g. Fischer, Hernández-Catá and Khan, 1998). What can be learned from the past and what does a detailed analysis of the present tell us about the future? The experience from emerging economies in East Asia suggests that capital accumulation is more important than total factor productivity (TFP) gains in the economic take-off process. However, the role of TFP gains can not be ignored. Low levels of productivity may constitute a disincentive to invest or lead to financial difficulties, which may hamper growth for an extended period of time. This study indicates that while earlier attempts to economic take-off failed, largely due to low productivity levels, the current ones may be jeopardized by a lack of capital accumulation. The question is therefore: is Africa repeating the mistake of a one sided, narrow based growth promotion by relying predominantly on productivity gains, while in the 1970s and 1970s it relied mainly on factor accumulation? We argue that the answer to this question will depend in part on the nature of such productivity gains.

Rapid TFP growth can be explained in such poor, small and moderately open economies by two sets of arguments. First, productivity gain can be achieved at the aggregate level through the implementation of a successful adjustment policy: if macroeconomic disorder and waste can be reduced, this will undoubtedly improve economic growth performance. But such TFP gains can not be sustained beyond a point where the economy comes close to efficient macroeconomic management. Second, improved productivity can result from structural changes, which induce allocation of factors to new, more productive, activities. As an example, Lucas (1993) argued that the creation of the “Asian Miracles” relied on structural changes leading to the production of increasingly sophisticated product mixes.

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We maintain that if TFP gains are predominantly of the former kind, growth is not sustainable without an increase in savings and investment rates. On the other hand, TFP gains through structural change are not likely to occur in the absence of significant investments. We conclude that sustainable growth needs to be based on a balanced mix of capital accumulation and structural change, while adjusting macroeconomic policies is necessary, in order to keep distortions at the lowest possible level. We further propose a framework for investigation of this issue for African economies.

The analysis in this article is based on a panel data set of 27 African economies for which data has been assembled over the years 1960-1996 (see **appendix 1** for details on the data sources). We study past and current extended periods of strong growth in Africa. The objective is two fold: we try to explain why growth ended in some cases and we attempt to assess the sustainability of the current periods. Both objectives are pursued in a context of determining the role of capital accumulation versus Total Factor Productivity (TFP) gains in the growth process.

A close look at the historical evidence on African economic growth shows that only one country, Botswana, has known a continuous growth path from 1960 up to present². However, a number of extended rapid growth periods have been observed in the past, from the early 1960s to the 1980s. Such performance has been found in, Côte d'Ivoire (1960-78) – henceforth called Côte d'Ivoire I, Egypt (1964-85)³, Kenya (1961-79) and South Africa (1960-74). In the wake of the oil shocks, a few other countries experienced high growth from the mid-1970s to the mid 1980s: Cameroon (1972-86), Algeria (1973-85) and Tunisia (1970-81). Finally, some countries have rebounded in recent years: Côte d'Ivoire (from 1994) – henceforth called Côte d'Ivoire II, Ghana (from 1983), Mauritius (from 1980) and Uganda (from 1987).

The study is organized as follows: Sector 2 discusses the analytical framework. In section 3, we provide estimated results of the production function. Section 4 discusses the growth accounting that can be obtained from this equation for our sample of 12 African extended growth episodes. Section 5 analyses the sources of TFP growth. Section 6 completes the picture through an analysis of savings and investment behaviors and likely future performances. Section 7 concludes.

ANALYTICAL FRAMEWORK

The core of our analysis is a production function explaining the long term relation between income on one hand and labor and capital as well as productivity variables on the other. We assume constant returns to scale and thus obtain a co-integrated production function of the following form:

² However, due to lack of data for the diversification indicator (see below), only the period starting in 1970 is studied in the case of Botswana.

³ Egypt's strong growth period could be counted from 1960 but we will analyse only the period after 1964 due to lack of data. It is also worth mentioning that Angola enjoyed strong growth between the 1960 and 1973. However, we are unable to study this period, again due to lack of data before 1985.

$$\frac{Y}{L} = \left(\frac{K}{L}\right)^a * TFP$$

where Y = GDP, L = labor, K the capital stock and TFP is the Total Factor Productivity, which is determined by the following vector of variables:

- the black market premium in the exchange rate market (separated between CFA and non CFA countries), which is used as an index of domestic price distortions;
- a human capital stock series, defined as the average number of schooling years in the working age population;
- exports divided by labor;
- an index of the effect of labor reallocation on aggregate productivity;
- an index of economic diversification (see further below);
- a dummy variable for conflicts (internal and external);
- a country dummy variable, which takes account of cross country productivity differentials;
- a country specific determinist trend, accounting for differences in exogenous productivity growth among countries.

Most of our independent variables have been used in several previous studies and therefore require only a brief theoretical explanation. The first variable is conceived as a proxy for the implementation of adjustment programs. Market distortions, as measured by the black market premium can be expected to impede efficient allocations of resources, and thereby hamper productivity⁴. The next four variables describe structural change factors. The role of human capital is stressed by, Nehru, Swanson and Dubey (1993), Edwards (1997) and Romer (1990), just to mention a few. Theoretical and empirical evidence of the influence of exports and/or openness on productivity has been provided by Feder (1982), de Melo and Robinson (1990), Edwards (1998), Sachs and Warner (1997) and Tybout (1992) among others. TFP gains are assumed to derive from external effects such as exposure to foreign competition, technology transfer and economies of scale, or from increased speed of convergence towards richer countries⁵.

Including an effect of reallocation of production factors is a quite common feature in growth theory, although it is rarely introduced in empirical work. A notable exception is

⁴ One exception is CFA zone members, where very small black market premiums do not necessarily imply good macro-economic management. We will come back to this issue when analysing the Cote d'Ivoire II episode.

⁵ It has been argued by some observers (see e.g. Dessus, 1998) that what matters for TFP is imports rather than exports. Indeed, when included in the regression, imports turned out highly significant as well (not reported here). However, we decided to keep exports in our analysis, given that it is more commonly used than imports.

Young's (1995) work on East Asia. According to Young, most TFP gains in East Asia from the 1960s to the early 1990s derived from inter-sectoral reallocations of labor. In fact, non-agricultural and manufacturing employment increased one and a half to two times as fast as the aggregate working population. Poirson (1998) also stresses that in most fast growing countries, growth is accompanied by significant positive reallocation effects, based on labor movement from agriculture (where labor productivity is typically low) to non-agriculture sectors.

Introducing a complete index of reallocation effects (including inter sectoral movement of both labor and capital) would go beyond the scope of this work, seeing the difficulty in finding the detailed time series information on the sectoral distribution of capital that this would imply. However, experience shows that the labor reallocation effect is substantially higher than the capital reallocation effect, when the latter can be measured (see, e.g. Dessus, Shea and Shi (1995) on Taiwan). Moreover, within the labor reallocation effect, the most significant element is derived from movement from agriculture to the non-agriculture sector. In our empirical application, we introduce only this effect, which is defined by the following equation, adapted from Syrquin (1986):

$$\Gamma_t = (1-\alpha) \sum_{i=Ag, non-Ag} u_{i,t-1} \frac{\ell_{i,t} - \ell_{i,t-1}}{\ell_{i,t-1}}$$

where Γ_t is the TFP gain due to labor reallocation from agriculture to non-agriculture at time t , $\ell_{i,t}$ is sector i 's share of total labor force and $u_{i,t}$ is the contribution to GDP by sector i . A level index of the effect of sectoral labor allocation is then computed by calculating cumulated annual increments. This index is one explanatory variable of TFP, with a theoretical parameter equal to 1.

In principle, the reallocation effect can be empirically tested (see, e.g. Poirson, 1998). However, the available times series information is somewhat sketchy. The time series that we use, from the World Bank, are merely interpolations based on (at best) one estimate every 5 years. Therefore, rather than estimating the parameter for the labor reallocation effect, we have fixed it at its theoretical value equal to 1 (with α in the equation used to compute Γ_t being set at its robustly estimated value of 0.45)⁶.

The inclusion of a diversity index constitutes the other main originality of our study. Although moving factors from one low-productivity sector to a higher-productivity sector enhances TFP, this is not necessarily the only impact of structural changes on TFP. In this article, we also attempt to test whether a diversification of economic activity has an impact on TFP, diversification being defined as the spreading of production to a growing number of different outputs which do not necessarily imply different productivity levels. The reason for testing the impact of diversification on productivity is empirical. It derives from the observation that rapid economic growth seems to be accompanied by a higher degree of

⁶ Another issue is that the true relationship between observable data and TFP is not log-linear. However, we have also successfully tested a log-linear approximation, which gives reasonably similar results. This estimation is not reported below.

diversification (for instance, in our sample, Mauritius provides an illustration of this, to be contrasted with the absence of diversification of the South African industry).

The impact of diversification on income may be transmitted mainly through two mechanisms. The first is the idea that diversification in itself may enter as a production factor by increasing the productivity of both labor and human capital, as in the, now standard, model by Romer (1990). According to Romer's model, the economy is divided into three sectors: a final good sector, an intermediate good sector and a research sector. The research sector uses human capital and common accumulated knowledge in order to produce new designs which it sells (or rents) to the producers of intermediate goods. Finally, the final goods sector acquires intermediate goods in order to produce goods for consumption. A crucial point in this model is that the diversity of intermediate inputs enhances productivity in the final good sector. This technological assumption that diversity enhances productivity may be indirectly tested through studying the impact of production diversity within an economy⁷.

The second mechanism through which diversification can increase income is by expanding the possibilities to spread investment risks over a wider portfolio. In other words, greater diversification will enhance average capital productivity in the long run by providing better investment opportunities at lower risk. Cemoglu and Zilibotti (1997) demonstrate a model where lack of diversification leads economic agents to invest in low return, safe traditional projects, rather than in riskier projects with higher growth potential. The absence of possibilities to spread risks by investing in a diversified high growth portfolio, will hamper capital productivity in the short run and capital accumulation in the long run.

A significantly simpler model than that of Acemoglu and Zilibotti can be used to illustrate this point. Assume a representative agent, maximizing profit subject to a certain aversion to risk:

$$\text{Max}_q \sum_{i=1}^N [E_i(q) - bV_i(q)]$$

where $E_i(q)$ is the expected value of profits from project i given the level of risk, q , $V_i(q)$ is the variance of the profits as a function of risk, b is a constant measuring the degree of risk aversion of the agent and N is the number of projects available to the agent for investment. If all projects are equivalent the maximizing problem becomes:

⁷ In theory, the same effect could be obtained through an increase in the degree of openness. In other words, diversified inputs could be imported rather than produced locally. One may therefore expect the effect of diversification to be decreasing with the level of openness. We attempted to test this assumption by introducing the diversification index interacted with imports as a share of GDP. However, we did not manage to obtain any significant results.

$$\text{Max}_q E(q) - \frac{b}{N} V(q)$$

which implies:

$$E'(q) = \frac{b}{N} V'(q)$$

Both the expected value and the variance of profits can be assumed to increase with the level of risk. Hence:

$$E'(q) > 0$$

$$V'(q) > 0$$

It is further reasonable to assume decreasing marginal returns to risk.

$$E''(q) < 0$$

Moreover, the risk itself can be defined as the variance of the outcome of a project, which is to say $V(q) = q$, $V'(q) = 1$. This implies, from the solution of the maximization problem:

$$E'(q) = \frac{b}{N}$$

Since $E''(q) < 0$ and b is a constant, q must increase as N increases. In other words, the agent will invest in riskier, and on average more profitable, projects if he is able to spread the risk through a more diversified portfolio.

The ideal measure of diversification would include data on production of all goods and services in the economy. Since GDP data is not available at a sufficiently detailed level, we use the composition of exports to the OECD countries as a proxy for the diversification of the economy as a whole⁸. This has the weakness of not taking into account the diversification of non-tradables, especially service. However, there is no *a priori* reason to assume that this will bias our results in any particular direction. The diversification index is calculated as:

⁸ We restrict ourselves to the export structure towards the OECD countries in order to obtain more reliable data. The export data is taken from OECD sources on imports of OECD countries.

$$Div_t = \frac{1}{\sum_{i=1}^N \left(\frac{x_{i,t}}{X_t} \right)^2}$$

Where $x_{i,t}$ is exports of product i (at a three digit level) in year t and X_t is total exports in year t . The *inverse* of Div takes on a maximum value of 1, when the entire amount of exports is derived from one single product and it tends towards 0 when there is an infinite number of equally weighted products for exports. In other words, Div stretches from unity for the completely specialized case when a country concentrates all its exports to one product, and is increasing with the degree of diversification. The index excludes exports of combustibles such as petroleum products and natural gas. This is done in order to limit the mechanical impact of terms of trade shocks. For instance, if oil is included in the index, a sharp increase in oil prices, exemplified by the oil crises in the 1970s, will automatically lead to an increase of the relative importance of the oil sector in the economy without necessarily providing any information of any structural change⁹.

The estimation proceeds as follow. First, we estimate the production function defined as GDP per unit of labor force, as a function of the capital/labor ratio and of the various determinants of TFP discussed above. This equation can be considered as a long-term (co-integration) relationship, describing the determinants of potential output of the economies, inasmuch as the dependent variable and explanatory variables are I(1), while the regression residual is stationary. Further, in order to deepen the analysis we proceed to study the short term dynamics of output by estimating an error correction model:

$$\Delta \frac{Y}{L} = \left(\Delta \frac{K}{L} \right)^{a_1} * u_{-1}^{b_1} Z^{b_2}$$

where Δ is a first difference operator, u_{-1} is the lagged residual from the long term co-integration relation, capturing the transient effect of an exogenous shock in the previous period, and Z is a vector consisting of the lagged dependent variable, the firsts difference of independent variables, and the inflation rate, which we have added to take account of the potential short term impact of macro-economic instability.

Subsequently (section 6) we investigate the determinants of capital accumulation (or rather, the variation in the capital to labor ratio). Capital accumulation will depend on factors from two categories: first, variables influencing the capacity to finance investments. Particular

⁹ In an attempt to overcome the issue of the impact of the terms of trade on the diversification index, the latter was regressed on the former leaving the residuals free from terms of trade influence. However, we did not manage to obtain significant results using these residuals in the production function. In any case, the influence of export prices remaining after having excluded oil exports from our calculation of the index does not imply any serious flaw in the index, for two reasons: first, the impact would only be of short term nature. Secondly, while an improvement in the terms of trade might induce a mechanical decrease in the diversification index, it is associated with an increase in economic growth. Hence, terms of trade fluctuation could only understate the impact of diversification on productivity.

emphasis will be given to the role of foreign aid, be it through grants or through net debt flows. The other category is factors affecting the incentives to invest. These variables include infrastructure, risk and the overall efficiency of the economy, measured by the estimated TFP from the long term production function. The idea is that a low productivity level implies low return to capital, which means low incentives for investment. Moreover, a low productivity level implies high transaction costs, which reduces the profitability of investments in the economy as a whole. In this way productivity gains or losses turn out to have a double effect on the economy - a direct effect on growth as well as an indirect effect through the impact on investment incentives. The estimated investment function is hence of the following form:

$$\Delta \frac{K}{L} = f(dll, debtaid, ToT, TFP, risk, roads)$$

where *dll* is the growth of the active population, *debtaid* is the flows of debt and aid, *ToT* is the terms of trade, *TFP* is the productivity level estimated from the production function, *risk* is a variable capturing country risks, and *roads* measures the availability of physical infrastructure. The interaction between investment and productivity underlines the importance of a balanced growth path based both on capital accumulation and productivity gains.

PANEL DATA ESTIMATION OF THE PRODUCTION FUNCTION

A number of authors have already estimated production functions based on panel data (e.g. Collier and Gunning, 1997 on African data). Estimating a production function on a country time series is often impossible for African economies, for lack of sufficient information (e.g. attempts on Senegal in Berthélemy, Seck and Vourc'h, 1996). Using a panel data set combining cross-section and time series information leads to substantially better econometric results. This is what we propose in this paper, while accepting that there are some differences among countries.

Unit root tests have been performed, following the method proposed by Levin and Lin (1993). This method consists in computing a Dickey-Fuller statistic aggregated across countries (see **Appendix 3**). The dependant variable (GDP/Labor), the capital stock divided by labor, the diversification index and the export/labor ratio are I(1), while the black market premium is stationary. Moreover, although not conclusive, our tests appear to indicate that the human capital is I(1).

The results reported below are obtained under the assumption that the production function exhibits constant returns to scale. Testing this hypothesis was impossible due to the high correlation existing between labor, capital and trend series. The least-square dummy variable method (fixed effects method) used here appeared to be preferable to the random effect method, according to the Hausman test.

Table 1 - Panel Data Estimates of the Production Function

Dependent variable: LYLA

Variable	Coefficient	Standard error	t-statistic
LKL	0.448	0.036	12.38
LBMPCFA	-0.027	0.162	-0.16
LBMPCFA	-0.067	0.015	-4.62
LH	0.279	0.042	6.70
LXL	0.096	0.022	4.45
LDIV	0.066	0.014	4.73
WAR	-0.033	0.015	-2.13

Estimation method: within (fixed effects)

Number of observations: 763

Number of countries: 27

Adjusted R-squared: 0.99

Hausman test: $\chi^2(7)=2548$

LYLA= $\ln(\text{GDP/Labor})-\ln(\text{Reallocation effect, see above})$,

LKL= $\ln(\text{Capital stock/Labor})$,

LH= $\ln(\text{average number of schooling years in active population})$, LBMPCFA/NCFA= $\ln(1+\text{black market premium in forex market})$ for CFA and non CFA countries respectively, WAR=dummy for civil or international wars, LDIV= $\ln(\text{diversification index})$,

LXL= $\ln(\text{Exports/Labor})$.

Trends and fixed effects are not reported.

We find an elasticity of GDP to capital equal to 0.45, which is rather high as compared with empirical estimates available on larger sets of countries, but seems plausible given the extremely low level of capital endowment of African economies. We also find a positive and significant impact of human capital on GDP, with a rather high elasticity (0.28). Moreover, the black market premium turned out negative and significant for the non CFA countries and non significant for the CFA countries. The non significance of the black market premium for the CFA countries is logical due to the guaranteed convertibility supported by France. Moreover, conflicts have a negative impact on GDP as observed by the negative and significant coefficient for the dummy for war and civil war. Furthermore, exports divided by labor is positive and significant for labor productivity. All in all, the properties of this estimated equation look reasonable.

Unit root tests performed on residuals of the above reported equation show that these residuals are I(0). This equation can therefore be interpreted as a long term co-integration relation. In order to deepen the analysis, we have also attempted to estimate a short term equation through an ECM method. This equation, reported in **Table 2**, has reasonable properties. It is of interest to note that capital accumulation is significant for growth, whether measured as the variation of the capital stock used in the long term relation, or as

its usual proxy - the investment rate¹⁰. It should also be observed that the variation in the capital stock provides a better measure than the investment rate, as demonstrated by the higher adjusted R-squared. Furthermore, macroeconomic stability, proxied inversely by the inflation rate, as well as growth in exports play an important role for growth. Moreover, the low coefficient for the lagged residual indicates that economic adjustment is slow in Africa. In addition, we found evidence of a conditional convergence effect, measured by the lagged level of GDP/Labor. The negative and significant coefficient for this variable indicates that -after having controlled for investment, macroeconomic stability, export growth, market distortions and the fixed effects- countries with a lower GDP per capita converge towards richer countries.

It may be of interest to note that we did not find a significant impact of diversification in the short run. This is consistent with the results of Amin Gutiérrez de Piñeres and Ferrantino (1997), who found that diversification actually had a negative effect on growth in Chile due to short term costs of structural change.

Table 2 - Error Correction Model for the Production Function

Dependent variable: DLYLA

Variable	Standard			Standard		
	Coef.	error	t-statistic	Coef.	error	t-statistic
RESLYL(-1)	-0.173	0.035	-4.93	-0.122	0.038	-3.23
DLXLFIT	0.036	0.015	2.36	0.057	0.016	3.61
DLBMP	-0.038	0.008	-4.57	-0.035	0.008	-4.17
LYLA(-1)	-0.049	0.012	-4.04	-0.075	0.014	-5.48
INF	-0.067	0.019	-3.58	-0.081	0.019	-4.35
DLKL	0.582	0.059	9.88			
LINVY				0.034	0.008	4.45
Estimation method: within (fixed effects)				Estimation method: within		
Number of observations: 673				Number of observations: 673		
Number of countries: 27				Number of countries: 27		
Adjusted R-squared: 0.35				Adjusted R-squared: 0.24		
Hausman test: $\chi^2(6)=19.1$				Hausman test: $\chi^2(6)=39.4$		

RESLYL(-1)=lagged residual of the long term equation (**Table 1**),

DLXLFIT= logarithmic growth rate of exports per capita (instrumented with all exogenous variables from **Table 2** as well as the variation in GDP in the OECD countries divided by labor and the variation in exchange rate misalignment as measured by Sekkat and Varoudakis (1997),

DXXX=variation of XXX,

LYLA(-1)=lagged level of $\ln(\text{GDP/Labor})-\ln(\text{Reallocation effect, see above})$,

INF=inflation,

LINVY= $\ln(\text{Gross domestic investment/GDP})$.

Fixed effects are not reported.

¹⁰ We consider capital accumulation as exogenous. After having instrumented GDP growth, it did not turn out to be significant for capital accumulation.

In what follows, we use the estimated value of the elasticity of GDP to capital reported in **Table 1** to assess the contributions of capital and total factor productivity to growth in the 12 selected growth episodes.

GROWTH ACCOUNTING FOR ECONOMIES WITH HIGH GROWTH EXPERIENCE

Out of the 27 countries which make up our database, 11 have experienced rather long periods of fast growth. **Table 3** reports their growth performances as well as contributions of capital and TFP to growth for the relevant periods of time. As explained earlier we consider two sub-periods of strong growth for Côte d'Ivoire,- 1960-1978 (Côte d'Ivoire I) and after the CFA franc devaluation (Côte d'Ivoire II), although we realize that the second period, starting in 1994, is not long enough to be considered as a period of long run growth. Moreover, although Botswana's strong growth record can be counted since 1960, we only consider the period starting in 1970 due to lack of data for the diversification index during the 1960s.

We display contribution to growth of labor productivity (GDP/labor) rather than GDP growth, because in our sample of growth episodes active population growth plays a significant role, and a role which differs among countries. Although this is not the standard way of presenting growth accounting, this method is preferable because it cancels out the consequences of vast differences in population growth, which would bias country comparisons.

Table 3 reveals a distinct difference between the current growth periods and the earlier periods which ended in the 1970s or the 1980s. The early growth episodes relied much more on capital accumulation than the current growth periods. In Cameroon, Côte d'Ivoire I, Egypt, South Africa and Tunisia, capital deepening explained between 53 and 67 percent of GDP per capita growth, while the corresponding figure exceeded 135 percent in Algeria.

Although the share of capital accumulation to total contribution to growth is somewhat lower in Kenya, there are similarities with the other earlier growth periods in the sense that Kenya relied on a high investment ratio (36.6 percent on average), which could not be easily sustained. The fact that this high investment ratio did not lead to capital deepening to the same extent as in the previously analyzed countries was due to the fact that the initial capital ratio was initially much higher in Kenya¹¹ than in the other economies considered. Moreover, Kenya exhibited a very high rate of growth in its labor force.

¹¹ Using the Harberger method based on the 1960-70 period, we estimated the initial capital output ratio at 3.2 (see further appendix 1). This estimate looks rather high, but is substantially lower than the estimate proposed by Nehru and Dhareshwar (1993).

Table 3 - Growth Accounting for Selected Economies

Country	Period	Memo		Average annual growth (%)			Contribution to growth (%)	
		GDP growth	Labor growth	GDP/Labor	Capital ratio	TFP	Capital ratio	TFP
<i>Failed take-offs</i>								
Algeria	1973-85	5.7	4.4	1.3	3.9	-0.5	135.6	-35.6
Cameroon	1972-86	7.7	2.1	5.6	7.3	2.3	58.5	41.5
Côte d'Ivoire I	1960-78	9.5	3.1	6.4	8.0	2.8	55.9	44.1
Egypt	1964-85	7.1	2.3	4.9	6.8	1.8	62.6	37.4
Kenya	1961-79	6.9	3.3	3.6	2.7	2.4	33.3	66.7
South Africa	1960-74	5.1	2.8	2.4	3.5	0.8	66.7	33.3
Tunisia	1970-81	7.0	4.6	2.4	2.8	1.1	52.9	47.1
Average		7.0	3.2	3.8	5.0	1.6	66.5	33.5
<i>Current growth periods</i>								
Côte d'Ivoire II	1994-96	6.7	2.3	4.4	-0.9	4.8	-9.3	109.3
Botswana	1970-96	10.1	3.0	7.1	8.2	3.4	52.4	47.6
Ghana	1983-96	4.8	2.9	1.9	0.0	1.9	-0.4	100.4
Mauritius	1980-96	5.5	2.1	3.4	1.4	2.8	18.0	82.0
Uganda	1987-96	6.9	2.6	4.3	-0.6	4.6	-6.4	106.4
Average		6.8	2.6	4.2	1.6	3.5	10.9	89.1

Source: Authors' calculations. Note: logarithmic rates.

By contrast, in the current growth periods, capital accumulation has only accounted for approximately 11 percent of growth on average, as opposed to 67 percent for the earlier periods. Côte d'Ivoire II, Ghana and Uganda show declining or stagnant capital ratios. In other words, their growth processes rely entirely on productivity, while capital accumulation does not contribute at all. The only countries among the current growth periods relying both on capital accumulation and productivity gains are Botswana and to a much less extent Mauritius.

The moderate contribution of capital accumulation in Mauritius can partially be explained by the fact that Mauritius invested substantially prior to its take-off. According to our data, Mauritius' capital stock increased by nearly 5 percent annually on average during the decade preceding the studied period. Moreover, the trend of the investment rate has again increased recently, from 19 percent of GDP on average during the first part of the studied

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period to 24 percent on average during the last decade. This is a result of increasing labor costs, inducing many firms to use more capital intensive technologies. Hence, one will expect an increasing contribution of capital accumulation for growth in the future.

For the sake of comparison, **Table 4** below shows GDP and capital stock growth rates for a few Asian economies from 1960 to 1990, and the associated contribution of capital to growth, assuming a conservative value of 0.4 for the elasticity of output to capital. It appears that for all 5 economies considered, capital accumulation has contributed to 60-80 percent of their economic growth during their take-off process.

Table 4 - Growth Performances of Selected Asian Economies

	Period	Memo:		Average growth rates (%)			Contribution to growth (%)	
		GDP	Labor	GDP/	Capital	TFP	Capital	TFP
		growth	growth	Labor	ratio		ratio	
Korea	1960-90	8.4	2.6	5.8	9.3	2.1	64.1	35.9
Taiwan	1960-90	8.5	2.9	5.6	9.0	2.0	64.3	35.7
Malaysia	1960-90	6.3	3.1	3.2	6.3	0.7	78.8	21.3
Singapore	1960-90	7.9	2.8	5.1	10.1	1.1	79.2	20.8
Thailand	1960-90	7.3	2.6	4.7	7.1	1.9	60.4	39.6
Average		7.7	2.8	4.9	8.4	1.5	69.4	30.6

Source: See appendix.

At first sight, the East Asian success stories resemble the early growth episodes in our sample to the extent that they relied heavily on capital accumulation, contrary to the current growth periods. The question is therefore why these episodes ended much earlier in Africa than in East Asia. Although there are serious non-economic explanations in a number of cases (such as the social and political unrest in South Africa), some economic factors may be considered.

In Côte d'Ivoire I, when coffee and cocoa prices collapsed on the international market, one main source of savings disappeared, precipitating an economic crisis. A similar issue emerged in Algeria, Cameroon and Egypt when oil prices declined (Cameroon becoming an oil exporting country in the late 1970s). In the late 1970s the rapid growth episode in Kenya came to an end for reasons similar to Côte d'Ivoire I: after the end of the coffee boom saving resources dried up (Azam and Daubrée, 1996). This, in conjunction with increasing real interest rates put a brake on investment in the late 1970s. The notion that most -if not all, with the exception of South Africa and perhaps Tunisia- of the studied historic growth periods were induced primarily by surges in investment, fuelled by temporary commodity booms, will be studied further below (section 0), where the impact of the terms of trade on investment is analyzed.

Another possible explanation lies in the lack of productivity gains. As argued earlier, productivity is likely to have a double effect on growth. Besides its direct effect, a low

level of productivity may create disincentives for investment, by reducing returns on capital. This hypothesis will be tested econometrically in section 0. The following section will aim at explaining the contrasting developments of productivity in the recent and earlier periods, while trying to relate this to the economic performance of the countries in the sample.

ANALYZING THE SOURCES OF TFP GROWTH

Table 5 provides a picture of the evolution of productivity in the studied countries during their respective periods by dividing the TFP growth into its main sources. Again, there are some clear differences between the earlier and the current growth periods.

Table 5 - Sources of TFP Growth (Percentage points, annual averages)

Country	Period	TFP total	Contribution					Memo: GDP Acceleration	
			BMP	Human Capital	Exports/labor	Diversification	Reallocation		Other
<i>Failed take-offs</i>									
Algeria	1973-85	-0.5	-0.6	1.2	-0.3	0.4	0.7	-1.9	-0.02
Cameroon	1972-86	2.3	0.0	1.5	0.7	-0.1	1.3	-1.2	0.02
Côte d'Ivoire I	1960-78	2.8	0.0	2.9	0.4	0.0	1.2	-1.7	0.01
Egypt	1964-85	1.8	0.0	0.6	0.2	0.2	0.3	0.6	-0.01
Kenya	1961-79	2.4	0.0	1.1	0.2	-0.2	0.6	0.7	-0.01
South Africa	1960-74	0.8	0.0	0.5	0.0	0.1	0.5	-0.2	0.05
Tunisia	1970-81	1.1	0.1	1.4	0.5	-0.1	0.2	-1.0	-0.06
Average		1.6	-0.1	1.3	0.2	0.1	0.7	-0.7	0.00
<i>Current growth periods</i>									
Botswana	1970-96	3.4	0.0	1.0	0.9	0.3	2.0	-0.8	-0.05
Côte d'Ivoire II	1994-96	4.8	0.0	0.6	0.8	-0.3	0.5	3.1	0.60
Ghana	1983-96	1.9	1.6	0.5	0.6	0.4	0.1	-1.2	-0.04
Mauritius	1980-96	2.8	0.2	0.5	0.5	0.5	0.2	0.9	0.00
Uganda	1987-96	4.6	1.1	0.8	0.7	0.2	0.3	1.5	0.02
Average		3.5	0.6	0.7	0.7	0.2	0.6	0.7	0.11

Source: Authors' calculations. Note: logarithmic rates.

First, reduction of distortions on the foreign exchange market has played an important role in the recent period and this is a good proxy for successful adjustment policies implemented in some African economies. The black market premium has been all but eliminated in Ghana and Uganda, from levels of approximately 2000 percent and 380 percent respectively during the relevant periods (in Uganda, the black market premium peaked at

920 percent before the studied period, in 1978). Reduction of the black market premium has in many cases coincided with broader measures of structural adjustment. The variable is therefore likely to catch some of the generally beneficial effects of macro economic stabilization programs. This may lead to an exaggeration of the effect from black market premium reductions in extreme cases like Ghana and to some extent Uganda. The difference in the unexplained part of TFP growth between Ghana and Côte d'Ivoire in **Table 5** could be justified by the fact that the effect of the structural adjustment program in Ghana is caught by the BMP variable, while it passes to the residual in Côte d'Ivoire, where a significant part of TFP growth appears to be derived from improved utilization of existing capacity. In Côte d'Ivoire, the exchange rate is fixed and the currency convertibility is guaranteed by the French Treasury. However, the overvaluation of the CFA Franc led to a substantial under-utilization of production capacities, the competitiveness of which has been restored to a large extent by the devaluation. In the case of Uganda, the economy lay in ruins at the beginning of the period under review, devastated by civil war and extreme economic mismanagement. Hence, there is a significant catch up effect which can not be captured by the variables used in our regression, which explains the large positive residual in the growth accounting exercise.

Among structural change indicators, a fact appearing in **Table 5** is that human capital accumulation seems to have played a more important role in the earlier periods than in recent growth episodes. However, one should keep in mind that nearly all Sub-Saharan countries started from extremely low levels in the 1960s, which partly explains the high rate of growth of human capital. Nevertheless, investment in education did decrease significantly in the 1980s, leading to slower growth in the human capital stock. We see that human capital accumulation has played an important role in Algeria, Botswana, Cameroon, Côte d'Ivoire, Kenya, Tunisia and Uganda. The most impressive case is Côte d'Ivoire I, where the improvement of human capital contributed 3.4 points of annual average productivity growth. Mauritius' seemingly moderate growth in human capital is due to the fact that it started from a relatively high level. The country is currently at the highest level of human capital in our sample, with nearly 8 years of schooling on average. Therefore, regarding human capital accumulation, there is still much room for improvement in the years to come, in particular for the least advanced economies in the sub-sample. Assuming that they would attain the current level of human capital of Mauritius, Côte d'Ivoire and Uganda would gain around 25 percent of TFP while the corresponding figure for Ghana and Botswana is about 10 percent. These potential gains are significant, but they will be obtained only slowly, since the accumulation of human capital through education is a long and costly process.

Export growth has contributed significantly to labor productivity in several cases both during the earlier and the current growth periods, although its contribution is more modest on average for the earlier periods. Export growth has particularly been an important contributor to labor productivity gains for Botswana, Cameroon, Côte d'Ivoire II, Uganda and Ghana. Further, there is progress to be made in terms of promoting exports as an engine for growth. In spite of substantial progress in trade liberalization in many cases, Africa remains relatively closed. There is ample evidence that openness and exports, in particular of manufactured goods, enhances productivity through mechanisms of increased competition, technology transfer, learning-by-doing and economies of scale (see e.g. Lucas

1993, Edwards 1998, de Melo and Robinson 1990, Biggs, Shah and Srivastava 1995). But, insofar as exports are not diversified, this cannot be considered as a major source of potential growth for the future.

Reallocation of labor from the agriculture sector to more productive sectors of the economy has contributed significantly to growth both in the current and the earlier periods analyzed here. The most spectacular case is Botswana, where reallocation away from agriculture has induced an improvement in productivity of 2 percentage points on average during the studied period. In this context, the results from Mauritius merit further explanations. The modest contribution of reallocation is somewhat misleading seeing the fact that the country's economy was dominated by sugar production up until the 1970s. In Cameroon, the discovery of oil in the late 1970s provoked a substantial reallocation of labor from the agricultural sector in favor of production of petroleum production. Similarly, the cocoa and coffee booms resulted in a transfer of labor mainly to the food processing industry in Côte d'Ivoire and Kenya. It should be noticed, however, that in the cases of Cameroon, Côte d'Ivoire and Kenya, this reallocation did not result in an increase in diversification of the economy. In fact, the respective commodity booms induced increased specialization in these economies.

Generally speaking, diversification is a recent phenomenon in Africa, constituting an important source of growth primarily for the countries currently in a phase of rapid growth, with Mauritius as the most prominent example. One exception from the earlier growth period is Algeria, where excessive amounts of investments supported by high oil prices did in fact result in a considerable increase in diversification¹². However, the direction of these investments was determined by government decree rather than economic rationale and the outcome was consequently highly inefficient. As a result, the dependence on capital accumulation for growth was magnified by a negative TFP performance. Algeria's growth process proved unsustainable after the decline in oil prices in 1985. Another exception is Côte d'Ivoire II, where the degree of diversification actually decreased during the studied (current) period. However this apparent decrease in diversification occurs at a time when Côte d'Ivoire comes out of a long period of recession. The economic rebound was to a large extent induced by an improved performance of the cocoa industry, helped by favorable terms of trade. However, the studied period is too short to draw any firm conclusions about the diversification trend of this economy. If these two exceptions, Algeria and Côte d'Ivoire, are excluded from the analysis, a clear difference can be seen between the recent and the earlier growth periods. In this case, the average contribution of diversification to growth equals approximately 0.4 percentage point on average in the current periods, as opposed to no contribution in the earlier periods.

The analysis above provides some indication as to what caused the low levels of productivity in the countries for which the growth experiences were interrupted. In several cases, the main reason was no doubt policy related. Algeria followed a socialist path of command economics; Tunisia's socialist period ended before the studied period but

¹² We remind the reader, however, that oil exports are excluded from the calculation of the diversification index. Including oil in the index reveals a significant specialisation during the studied period. A similar remark can be made regarding the other oil exporting countries in the sample.

government policies remained heavily interventionist; commodity booms in Cameroon and Côte d'Ivoire led to wasteful investment and rent seeking behavior. This is illustrated by the substantial negative residuals in the growth accounting exercise in **Table 5** for the countries in question.

Another important explanation is most likely related to the fact that capital accumulation did not promote economic diversification. This lack of diversification in the African economies stands in stark contrast with the East Asian experiences. This is the case both in countries which initially had a manufacturing base (South Africa and Tunisia) and in primary goods producers. In South Africa, as shown by McCarthy (1998), capital accumulation was used to build an increasingly capital intensive manufacturing industry, while the comparative advantages of this country was presumably in (unskilled) labor intensive manufacturing. Similarly, in Tunisia, manufacturing investment did not provide any significant diversification of the industrial structure. The other countries considered above, Cameroon, Côte d'Ivoire I and Egypt, faced a similar lack of diversification: they remained exporters of traditional primary products. The only countries for which diversification can be considered to have contributed substantially to growth are all from the recent period: Mauritius, Botswana, Ghana, and to some extent Uganda. In the case of Mauritius, diversification added as much as 0.5 percentage points to growth on average during the studied period. Industrial diversification in Mauritius started with the development of textile and clothing productions (Mauritius is the largest textiles exporter in sub-Saharan Africa and the third exporter in the world for woolen goods), and continued recently with electronic products. Moreover, services have been developed and diversified, in particular tourism and financial services. This has played a major role to sustain economic growth.

The progress in terms of diversification in Ghana and Uganda should be interpreted with care. Uganda started from an extremely low level at the beginning of the studied period, and the sustainability of the diversification –based on new agricultural products such as flowers rather than on manufacture– is therefore not certain. In the case of Ghana, diversification gains seem to be derived from a diminishing relative importance of cocoa to the benefit of aluminum, gems and low end wood processing. In other words, contrary to Mauritius, the diversification in these two countries does not appear to imply a significantly increasing importance in high value added industries. This is probably due to the lack of capital deepening, without which these economies could not really diversify their industrial structure. As a matter of fact, these countries are still at a very low productivity level, as will be shown in section 5. Up to now they have partially recovered towards the productivity level that they had attained in the 1960s. Therefore, it appears unlikely that these countries will be able to pursue a growth path similar to the ones experienced by Mauritius or Botswana.

An indication as to whether or not the current growth processes have reached a point where the gains of adjustment have started tapering off is provided by the acceleration of the GDP. A negative acceleration suggests that GDP growth is slowing down, which may be necessitating stronger measures in order to induce more far reaching structural change and increased investment. Among the current periods, acceleration is negative for Botswana

and Ghana¹³. Botswana's performance has been somewhat less impressive on average since 1990 than in the previous two decades. This is primarily a cyclical effect of the diamond industry. Moreover, capital accumulation has decreased dramatically since 1990, after a surge in the late 1980s, again linked to the diamond cycles. According to Leith (1997), the mining industry peaked at 53 percent of GDP in 1988/89 before declining to 33 percent in 1994/95. However, lack of structural change can not be considered to be at the root of this recent decrease in growth in Botswana. By contrast, the relative slowdown in Ghana is more likely to be a result of moderate progress in structural change. Growth decreased gradually from over 8 percent in 1984 to 3.6 percent in 1994 and rebounded somewhat in the following two years, as in several other African countries. GDP acceleration is zero in Mauritius, and positive in Uganda and Côte d'Ivoire. Côte d'Ivoire's economic rebound is too recent to make useful analysis of its GDP acceleration. Growth in Uganda was on an upward trend during the last few years of the studied period, possibly indicating that the country has not yet reached the point where all benefits from adjustment have been reaped. The lack of capital formation and the moderate structural change in the economy are nevertheless, worrisome for the near future.

A tentative conclusion may be that -with the exception of Botswana and Mauritius- the economic take-off is not necessarily sustainable in the currently fast growing economies, inasmuch as capital accumulation and accelerated structural change are needed in such a process. At the opposite end of the spectrum, we have argued that low levels of productivity may have eclipsed the sustainability for investment driven growth in the earlier periods.

SAVINGS AND INVESTMENT

The poor contribution of capital to economic growth in the countries with a current strong growth experience corresponds to low investment rates. Moreover, it is noticeable that investments are significantly lower in the current growth periods than in the earlier ones. This is particularly true for Ghana, Uganda and Côte d'Ivoire II, as shown in Table 6. To a large extent, investment performance in these countries is determined by foreign capital inflows, due to exceptionally low levels of local savings, be it defined as national savings or as domestic savings.

By contrast, Mauritius has a reasonably high investment ratio, averaging over 21 percent of GDP during the studied period, while the corresponding figure is 35 percent for Botswana. Mauritius' lower investment rates, as compared to Botswana, can partially be explained by the country's much smaller endowment in natural resources.

Table 6 shows that savings performance is generally rather weak. Again this is particularly obvious in the current periods. Among the countries currently enjoying strong growth, this is flagrant in the cases of Ghana and Uganda and for Côte d'Ivoire II. Domestic savings are usually higher than national savings, particularly in the current growth periods. The principal reason for this is that these economies owe large amounts of interest payments

¹³ This may also have contributed to the negative unexplained part of TFP growth (see above).

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and other capital income to foreign creditors. Domestic savings in Côte d'Ivoire covers over 100 percent of investments but the country pays substantial amounts of factor income and private transfers (notably remittance from migrant workers) to the rest of the world. As a result, its national savings cover only a fraction of its investment. By contrast, national savings are higher than domestic savings in Ghana and Uganda. This is attributable to the fact the two countries have received significant amounts of grants and other transfers during their respective reform periods. As will be demonstrated below, foreign aid has been an important source for financing of investments.

Table 6 - Savings and Investment Performance

Country	Period	National Savings / Investment	Domestic Savings / Investment	Domestic Investment / GDP (%)	National Savings / GDP (%)
<i>Failed take-offs</i>					
Algeria	1973-85	1.05	0.94	41.7	43.3
Cameroon	1972-86	0.79	1.11	20.2	16.0
Côte d'Ivoire I	1960-78	0.84	1.36	21.1	17.7
Egypt	1964-85	0.47	0.85	16.1	8.6
Kenya	1961-79	0.49	0.55	36.0	17.5
South Africa	1960-74	1.05	1.31	22.2	25.3
Tunisia	1970-81	0.98	0.96	26.1	24.7
Average		0.81	1.01	26.2	21.9
<i>Current growth periods</i>					
Botswana	1970-96	1.11	1.10	35.3	35.0
Côte d'Ivoire II	1994-96	0.22	1.26	15.5	3.6
Ghana	1983-96	0.61	0.35	15.0	8.8
Mauritius	1980-96	1.07	1.06	21.4	23.1
Uganda	1987-96	0.42	0.18	12.7	5.5
Average		0.69	0.79	20.0	15.2

Source: See appendix. Note: National savings data unavailable for Côte d'Ivoire before 1965 and for 1996, for Egypt before 1967, for Kenya before 1965 and for South Africa before 1967.

Again, the two exceptions among the current high growth episodes are Botswana and Mauritius. In the case of Botswana, investment is more than fully covered by savings whether it is measured as national or domestic savings. Botswana does not have a heavy debt burden and the country is actually a creditor to the World Bank, which is rather exceptional in an African context. Moreover, national savings cover close to the totality of investments in Mauritius.

Among the earlier growth periods, savings rates can only be considered low for Egypt and modest for Côte d'Ivoire I, Cameroon and Kenya, although savings dropped substantially in South Africa after 1974 and in Kenya after 1977. Apparently, low savings rates can only take part of the blame for the unsustainability of the investment driven growth in several of our selected countries. Again, it appears that low levels of productivity may have impeded continued high investment rates, a hypothesis that will be tested econometrically below. As argued earlier, a high level of productivity is an incentive for investment. Moreover, higher productivity -and hence higher profitability- facilitates financing of investments. An analysis of the determinants of capital accumulation is shown in **Table 7** below. In order to be consistent with the long run production function above, we use the variation in capital stock divided by labor as dependent variable, rather than the investment ratio. The variation in the capital ratio is influenced by the growth in the active population on one hand and capital accumulation on the other. Capital accumulation is in turn a function of variables affecting investment incentives as well as access to financing. **Table 7**, reports the determinants of capital deepening that results from this analysis.

Table 7 - Determinants of Capital Deepening*Dependent variable: DLKL*

Variable	Std.			Std.			Std.		
	Coef.	error	t-stat.	Coef.	error	t-stat.	Coef.	error	t-stat.
DLL	-0.584	0.282	-2.07	-0.594	0.265	-2.25	-0.408	0.242	-1.69
REVCOAVG	-0.013	0.008	-1.68	-0.009	0.007	-1.25	-0.006	0.008	-0.81
LROADCAP	0.092	0.012	7.90	0.084	0.012	7.21	0.069	0.012	5.87
LAIDFLOW	0.154	0.042	3.68	0.167	0.045	3.71	0.170	0.044	3.82
LTFP				0.088	0.017	5.12	0.088	0.018	4.97
LTOT							0.030	0.010	3.12
Estim. method:	within (fixed effects)			within			within		
Number of obs:	520			520			518		
Number of countries:	23			23			23		
Adjust. R-squared:	0.34			0.39			0.41		
Hausman test:	$\chi^2(3)=110.4$			$\chi^2(2)=166.2$			$\chi^2(2)=74.5$		

DLKL=variation in $\ln(\text{Capital stock/Labor})$,DLL=variation in $\ln(\text{Labor})$,REVCOAVG=moving five year average of number of revolutions and coups d'état, LROADCAP, $\ln(\text{Road length per capita})$,LAIDFLOW= $\ln(\text{net transfer on debt/GDP}+\text{grants/GDP})$.LTFP = $\ln(\text{GDP/labor})-0.45*\ln(\text{Capital stock/Labor})$.

Fixed effects are not reported.

On the incentive side, political stability, infrastructure and the general efficiency of the economy are factors influencing investment decisions. Political instability appears to influence investments negatively, as seen by the variable representing the five year moving average of the number of revolutions and *coups d'état*. However, after having controlled for the level of productivity, this variable is no longer significant. Risk is an important and complex issue in Africa. According to Collier (1998), Africa was ranked the riskiest

continent by the Institutional Investor risk rating. The lack of robustness of our explanatory variable may be attributable to the fact that political instability is just one of many facets of risk. It needs to be considered in conjunction with other variables such as macroeconomic stability, the quality of institutions, the reversibility of policies, the risk of expropriation by the state, the possibility to recourse in court, the availability of insurance and forward markets etc. Exploring these dimensions would go beyond the scope of this article, due to lack of systematic long time series information on African institutions.

As argued earlier, the incentives for investments are also influenced by the overall efficiency of the economy. A low level of productivity limits potential profits and translates into lower return on capital. Investment incentives are also dependent on the availability of transport infrastructure. The variable for road length per capita turned out positive, significant and robust. This is of particular importance in Africa seeing that transportation costs are considered the highest in the world (Amjadi and Yeats, 1995). Such high transport costs mean high transaction costs in general, which act as a disincentive to investment in the African region.

Rapid productivity gains in Botswana promoted high investment performances which consequently lead to a significant capital deepening as well. This process was admittedly facilitated by the country's rich endowment in natural resources, but this is not a sufficient explanation. South Africa has similar endowments but its fast growth episode proved to be unsustainable. Mauritius is another example where high levels of productivity have promoted investment. The fact that investment is still rather weak in Côte d'Ivoire, Ghana and Uganda can partially be explained by their lower TFP levels. Another reason is, as we have seen above, that weak national savings have made these countries highly dependent on external financing.

As far as variables influencing the financial capacity are concerned, we found that investments were strongly dependent on debt flows. The variable LAIDFLOW is the logarithm of total net aid flows (i.e. new official loans less debt service plus grants) divided by GDP. The dependence on foreign aid is rather worrisome in some cases, seeing that several African countries are struggling to reduce their debt burden – with support from the Highly Indebted Poor Countries (HIPC) initiative in the cases of Côte d'Ivoire and Uganda. In addition, the level of aid flows is declining, due to budget constraints in donor countries. Hence, African countries will not be able to rely on debt flows and foreign aid as sources for financing an increase in investment. As mentioned earlier, debt is not an issue in the case of either Botswana or Mauritius, making their prospects for sustainable growth substantially brighter.

The significance of the terms of trade variable provides an important insight in the earlier growth processes. With the exception of South Africa and possibly Tunisia, the historic growth episodes all correspond to commodity booms. The surge in export prices had a double effect on investment, through increased financial resources –both from export receipts and improved access to international capital markets– in conjunction with enhanced incentives. However, when export prices collapsed, these countries were left with economies where essentially no positive structural change had taken place but where distortions began to increase dramatically.

Other factors likely to affect investment by mobilizing domestic savings include, in particular, the strength of the financial sector (see Berthélemy and Varoudakis, 1996). Although we did not succeed in establishing statistically significant relationships in this respect, partly for lack of adequate data, these factors should also be kept in mind¹⁴.

CONCLUDING REMARKS

In conclusion, extended periods of rapid growth in Africa starting in the 1960s or 70s relied heavily on capital accumulation. In all but one case –Botswana– the high investment rates proved unsustainable, due in large part to inefficiencies in the economies, ending the strong performance record. Without denying the role of a poor policy environment, we attribute part of these inefficiencies to a lack of economic diversification.

By contrast, the countries currently in a phase of rapid growth have relied primarily on TFP gains, while investment rates remain low. We have indicated that the prospects for future growth without a substantial increase in capital accumulation are not encouraging. In particular, the fast growth period of Ghana and Uganda may prove unsustainable if these economies do not manage to increase their domestic savings rates. In the absence of an increase in local savings, capital accumulation will be hampered, which will stifle growth in the future. In particular, significant investments will be needed in order to increase the degree of diversification in these economies, as well as to facilitate labor reallocation out of low productivity agriculture to other, higher productivity, activities. Côte d'Ivoire may be in a better position after the CFA franc devaluation, inasmuch as this economy has already demonstrated its capacity to mobilize more domestic savings for growth. However, Côte d'Ivoire will face the issue of substantial outflows of resources through capital income and private transfers.

The two other countries in our sample which still enjoy strong growth, Mauritius and Botswana, are likely to stand a better chance in maintaining their growth. The only example among the 27 countries making up our database, of strong growth consistently underpinned by both capital accumulation and productivity growth is found in Botswana. Mauritius enjoyed rather healthy growth, accompanied by some degree of diversification during the 1970s, but was subject to a setback towards the end of the decade. It was not until the diversification process was accelerated during the 1980s that the economic growth became more stable. Moreover, this stability seems to have stimulated an increase in investments from the end of the 1980s which will enhance the role of capital accumulation for growth in the future.

¹⁴ Berthélemy and Varoudakis (1997) argue also that in a fixed effect model estimation, the role of financial development is to a large extent incorporated in the country fixed effects: the principal impact of poor financial development is that it locks the economy in a low equilibrium trap.

APPENDIX 1 - DESCRIPTION OF THE DATA

The data for GDP, capital stock, investments (1960-90) and human capital (1960-87) stock for were collected from Nehru and Dhareshwar (1993) and Nehru, Swanson and Dubey (1993). The capital stock was extended to 1996 (or 1995 dependent on availability) using investment series from African Development Indicators (World Bank, 1997) and IFS (IMF, 1997) and a 5 percent depreciation rate¹⁵. The GDP was extended with data from African Development Indicators (World Bank, 1997). For the extension of the human capital after 1987 and the construction of the human capital for Burkina Faso see below.

For three countries (Burkina Faso, Tunisia and Liberia), capital stock data was not available in the Nehru and Dhareshwar database. Moreover, in the case of Kenya the data given by Nehru and Dhareshwar seemed exceedingly high. Hence, we constructed the initial capital stock (1965) from investment series using the Harberger method. According to this method, the capital stock in year $t-1$ can be approximated by the investment in year t divided by the sum of the long term GDP growth rate and the depreciation rate. We used the average annual GDP growth rate, average investments for the 1960s and a depreciation rate of 5 percent to calculate the initial capital stock.

The labor series were collected from World Development Indicators (World Bank, 1994) and African Development Indicators (World Bank, 1997).

The black market premium was calculated from Wood (1988) for data up until 1984. For later data, the World Currency Yearbook (various editions) and African Development Indicators were used.

The terms of trade were calculated from import and export prices in World Development Indicators (World Bank, 1994), complemented by IFS (IMF, 1997) and African Development Report (African Development Bank, 1997). Data on exports and imports was taken from World Development Indicators (World Bank, 1998), complemented by IFS data (in current dollars, deflated by import/export prices, see above).

The diversification index was calculated from OECD Data (see section 0 for information on the method used). The share of labor and value added in agriculture was taken from World Development Indicators (World Bank, 1998) and complemented by the African Development Report (African Development Bank, 1998).

Information on wars, civil wars, revolutions and coups d'états was gathered from Banks (1995) and complemented by Balencie and de la Grange (1996) and Easterly and Levine (1996).

Debt and aid flows are derived from Global Development Finance (World Bank, 1999).

¹⁵ The depreciation rate was estimated by regressing the variation of the capital stock on investments, using the available data from Nehru and Dhareshwar.

Data on road length was gathered from World Development Indicators (World Bank, 1994) and African Development Indicators (World Bank, 1997) and completed from the World Development Report (World Bank, various issues). This resulted in data covering only approximately every five years before 1985. The series were subsequently interpolated.

The OECD GDP per capita was taken from World Development Indicators (World Bank, 1998).

Data on exchange rate misalignment is taken from Sekkat and Varoudakis (1997).

The main source for inflation is IFS (IMF, 1997), complemented by World Development Indicators (World Bank, 1994), African Development Indicators (World Bank, 1997) and local sources in some cases.

Extension and Construction of the Human Capital Series (h1)

We tried a few different methods to extend the human capital series generated by Nehru, Swanson and Dubey beyond 1987. Further, Burkina Faso is not included in the Nehru, Swanson and Dubey database and consequently we needed to calculate its human capital stock for the entire period 1960-1996. Since the human capital derived from primary school (h1) averages over 90 percent of total human capital for Africa, we concentrated our efforts to this part of the human capital and extended h2 (secondary school) and h3 (higher education) by simple extrapolation. For h1 we used three different methods:

1. extrapolation;
2. a method based on the literacy rates;
3. a method based on an estimated relation between primary school enrolment rates and the variations in the human capital stock.

For the first method we extrapolated the data after 1987 using the estimated 1977-87 trend. This method provided us with the least satisfactory results out of the three and it was subsequently used only for h2 and h3.

The second method assumes that the literacy rate is proportional to the average years of primary school education (h1). Hence, we calculated an average literacy rate to h1 ratio and applied the ratio to extend the h1 series beyond 1987 or to construct it entirely if necessary. The literacy rates were derived from World Development Indicators (World Bank, 1994) and African Development Indicators (World Bank, 1997) and missing values were interpolated. This method gave results similar to method 3.

The third method is the most elaborated and it also proved to give the most reliable results and was hence the method retained for our study. h1 is defined as the average number of years of primary school education for the population over 15 years.

$$h1_{it} = Yedu_{it} / L_{it} \tag{1}$$

where,

L_{it} = Population 15 years old and over for country i at year t

$Yedu_{it}$ = total years primary education of 15+ population for country i at year t

If one defines δ as the mortality rate for the 15+ population and L_{15} the population aged 15 years, one has the following relation:

$$L_{it} = L_{it-1} (1-\delta_{it}) + L_{15_{it}} \quad (2)^{16}$$

The part of $h_{1_{it-1}}$ that carries over to $h_{1_{it}}$ can be approximated by

$$Yedu_{it-1} (1-\delta_{it}) / L_{it} = h_{1_{it-1}} L_{it-1} (1-\delta_{it}) / L_{it} \quad (3)^{17}$$

and the part of $h_{1_{it}}$ that is represented by new entrants to the age group can be assumed to be derived from people who received primary school education on average five years earlier. This 'new' part of $h_{1_{it}}$ will here be approximated by,

$$\left\{ L_{15_{it}} DUR_i (1-\gamma_{it}) enr_{it-5} + L_{15_{it}} DUR_i \gamma_{it} \beta_{it} enr_{it-5} \right\} * (1-\eta_{it}) / L_{it} \quad (4)^{18}$$

where

DUR_i is the duration of primary school in country i , assumed constant through time

enr_{it-5} is the gross enrolment rate for primary school in country i , at year $t-5$

γ_{it} is the portion of $L_{15_{it}}$ that did not complete primary school

¹⁶ Migration is ignored here.

¹⁷ This ignores the fact that while the mortality rate is higher for older people, they are likely to have a lower level of education. In other words there is a downward bias in our estimate of the carryover effect.

¹⁸ This formula ignores the portion of people represented in enr_{it-5} that died before the age of 15.

β_{it} is the average portion of the primary school duration that was actually completed

η_{it} is the portion of enr_{it-5} that was represented by students repeating one or several years of primary education.

Adding (3) and (4), combining with (2) and rearranging gives,

$$h1_{it} = h1_{it-1} L_{it-1} (1-\delta_{it}) / L_{it} + [L_{it} - L_{it-1} (1-\delta_{it})] / L_{it} DUR_i enr_{it-5} (1-\gamma_{it} + \gamma_{it} \beta_{it}) * (1-\eta_{it})$$

If we assume that the term $(1-\gamma_{it} + \gamma_{it} \beta_{it}) * (1-\eta_{it})$ remains fairly stable over time and across countries we can approximate this term by a constant, which we call α .

In this case, we obtain the following relation:

$$d h1_{it} = h1_{it} - h1_{it-1} = [L_{it} - L_{it-1} (1-\delta_{it})] DUR_i / L_{it} \{ \alpha enr_{it-5} - h1_{it-1} \}$$

This relation can now be used to estimate the relation between lagged enrolment rates and the variation in h1. The mortality rate δ_{it} was approximated by the inverse of the life expectancy for lack of more precise data. Data on enrolment ratios, life expectancy, and 15+ population was extracted from World Development Indicators (World Bank, 1994) and African Development Indicators (World Bank, 1997) and primary school duration from World Development Indicators (World Bank, 1997).

For Burkina Faso, we used method 2 in order to get data for 1960-65 and then method 3 to prolong the series to 1996. We further calculated an average h2 to h1 ratio and h3 to h1 ratio for available Sub Saharan African countries and applied this ratio in order to obtain h2 and h3 values.

APPENDIX 2 - METHOD USED FOR UNIT ROOT TESTS

We applied the method for unit root tests for panel data developed by Levin and Lin (1993). The method is a panel version of an augmented Dickey-Fuller (ADF) test examining the null hypothesis that all individuals (countries in our case) have a unit root. It can be summarized as follows (see Levin and Lin, 1993 for more detailed information):

In order to obtain independence across individuals we start by subtracting cross section averages from the data.

The ADF method consists in regressing the first difference of the tested variable on the lagged level and a number of lagged first differences. Further, a constant and a deterministic time trend may or may not be included in the regression. Testing the null hypothesis that there is a unit root consists in testing whether the coefficient for the lagged level (here called d_i) is equal to zero.

Hence, three models are possible:

$$\text{Model 1: } \Delta y_{it} = d_i y_{it-1} + x_{it}$$

$$\text{Model 2: } \Delta y_{it} = a_{0i} + d_i y_{it-1} + x_{it}$$

$$\text{Model 3: } \Delta y_{it} = a_{0i} + a_{1i}t + d_i y_{it-1} + x_{it}$$

where α_0 is a constant, t a country specific trend and x is a disturbance term.

The ADF regression is equivalent to making two auxiliary regressions of the first difference and the level on the lagged first difference and then regressing the estimated residuals from the first regression (the orthogonalized innovations, here called e_{jt}) on the ones from the second regression (the orthogonalized lagged levels, here called v_{jt-1}). This procedure is performed for each individual separately. The orthogonalized innovations (the e 's) and the orthogonalized lagged levels (the v 's) are subsequently normalized by dividing by the standard deviation of the individual regressions. This is done in order to control for heterogeneity across individuals. We then use the normalized values and perform a pooled regression of the e 's on the v 's and test whether the coefficient for v (δ) is significantly inferior to 0.

Levin and Lin demonstrate that under the null hypothesis of presence of unit root for all individuals ($\delta=0$), the t-statistic has a standard normal limiting distribution for model 1, while an adjusted test statistic -also following a standard normal distribution- needs to be calculated for models 2 and 3. They further note that if a deterministic element is present in the observed data, while it is absent in the model used, the unit root test will be

inconsistent. By contrast, if a deterministic element is absent in the observed data, while it is present in the model used, the unit root test will be consistent but statistically weaker. However, no method for selection of model is indicated for panel data. In fact, the method allows for heterogeneity in terms of model used and number of lags included. For simplicity, we opted for a regression using one lag and the same model for all individuals, with one exception: since the human capital variable is likely to contain a significant amount of inertia, we also performed the test with five lags. We tested all three models with a few exceptions:

- since both fixed effects and country specific trends are included in the co-integration regression, the residuals are considered to be explained by model 1;
- unless model 3 is relevant for a variable in levels, only model 1 is tested for the first difference of the variable, given that any constant would be eliminated when taking the first difference. If model 3 is used for the variable in levels, model 2 should be used to test the first differences;
- since the black market premium is common to all CFA countries, only model 1 is tested.

In case the different models provide contradictory results, we perform a simple test regressing the variable on its lagged level and country specific trends and constants. Although this method is not statistically rigorous, it provides an intuitive idea of which model to employ. Moreover, theoretically, δ lies between -2 and 0 ; a value greater than 0 would imply that the variable is explosive. We are therefore skeptical to model specifications giving a test statistic significantly greater than 0 . The results are shown in **Table 8** below. Globally, the tests provide reasonable and conclusive results. It may be noted that the tests of the human capital variable were not entirely successful.

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Table 8 - Unit Root Tests

Variable	Test Stat			Model preferred	Explanation
	Model 1	Model 2	Model 3		
RESLYL	-10.79				I(0) Residual, long term production function
LYL	-0.53	1.35	5.12		I(1) ln (GDP/labor)
LYLA	0.97	1.98	3.45		I(1) ln (GDP/labor)-ln(Reallocation effect)
DLYL	-24.16				I(0) Variation in ln (GDP/labor)
DLYLA	-21.74				I(0) Variation in LYLA
LKL	-0.58	-0.62	5.37		I(1) ln (Capital stock/labor)
DLKL	-9.88				I(0) Variation in ln (Capital stock/labor)
LBMPCFA	-10.95				I(0) ln (1+black market premium), CFA
LBMPCFA	-5.30	-1.02	4.87	1	I(0) ln (1+black market premium), non CFA
LH	-6.14	-8.86	1.12	3	I(1) or I(2) ln (human capital stock)
LH (5 lags)			19.07		
DLH	-4.07	1.21		2	I(0) or I(1) Variation in human capital stock
DLH (5 lags)		-1.81			
DDLH	-24.11				I(0) Second difference in human capital stock
LTOT	-8.69	-0.87	6.47	1	I(0) ln (terms of trade)
LXL	-1.27	-0.64	2.26	1 or 2	I(1) ln (Exports/labor)
DLXL	-23.22				I(0) Variation in ln (Exports/labor)
LML	-1.17	-1.09	4.14	1 or 2	I(1) ln (Imports/labor)
DLML	-21.50				I(0) Variation in ln (Imports/labor)
LDIV	-3.51	1.29	4.91	2	I(1) ln (diversification variable, excluding oil)
DLDIV	-24.59				I(0) Variation in diversification index
LROADCAP	-7.05	-5.15	2.15	2	I(0) ln (road length per capita)
INF	-10.56	1.55	5.55	1	I(0) ln (1+inflation rate)

Source: Authors' calculations.

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