Is Investment in Africa Too Low or Too High?
Macro and Micro Evidence[1]

Abstract: *Many analysts decry the lack of sufficient investment in Africa, implying that investment in Africa is "too low." We find no evidence that private and public capital are productive in Africa, either in the cross-country data or in micro data from Tanzania. In this restricted sense, investment in Africa is too high rather than too low.*

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I. Introduction

Anyone concerned about Sub-Saharan Africa's dismal growth performance over the past three decades cannot help noticing that investment, too, was significantly lower in Africa during this period. From 1960-94, Africa invested 9.6 percent of GDP (measured at international prices), while the ratio for other developing countries was 15.6 percent (Hoeffler [1999]). Inasmuch as Levine and Renelt [1992] identified investment as one of the few robust variables in cross-country growth regressions, it is tempting to conclude that Africa's low investment share contributed to its disappointing growth performance—that is, investment in Africa was "too low" (Barro and Lee [1993], Collier and Gunning [1997]).

There are of course several difficulties with this conclusion, as some of these authors have pointed out. First, since private investment at least is endogenous, it is not clear how to increase it in order to stimulate growth. Consequently, several researchers have looked for more fundamental (and presumably more exogenous) factors in explaining Africa's growth. The current list of candidates includes proximity to the tropics, ethnic fractionalization and weak social capital (Sachs and Warner [1997], Easterly and Levine [1997], Collier and Gunning [1997]). In an interesting recent paper, Hoeffler [199] shows that, when the endogeneity of investment and unobserved country-specific effects are allowed for, the so-called "Africa dummy"—the unexplained component of African growth—disappears.

Second, while Africa's total investment rate was below that of other developing countries, public investment rates were about the same in the two sets of countries (about 7 percent of GDP). Any statement about whether African investment is too high or too

low would therefore have to say something about the composition of that investment—and whether more public investment would have benefited the continent.

Third, the cross-country regressions on which most of the analysis on growth and investment is based assume that total factor productivity (TFP) growth is uniform across all countries (Pack [1994]). Yet it is differences in TFP growth that indicate whether investment has been too high or too low in one country or another. Furthermore, in some African countries, TFP growth has been negative, which is difficult to reconcile with regression models that assume it is the same for all countries.

The purpose of this paper is to investigate the productivity of investment in Africa—to answer the question posed in the title—using a variety of methods. In section II, we use cross-country regressions to explore whether public and private investment had a positive and significant effect on growth in Africa. Recognizing that private investment is endogenous, we use the method of instrumental variables (with the level of private investment at the beginning of the period as the instrument). Our basic conclusion is that public investment is not correlated with growth in Africa. Private investment is also not correlated with growth, unless Botswana is included in the sample. A simple scatter plot of the data shows why: Botswana is the only country in Africa to have high private investment rates and high growth.

As we noted earlier, however, these cross-country regressions assume that TFP growth is uniform across all countries. Although difficult to swallow in general, this assumption may be more appropriate in examining manufacturing investment only. For the TFP associated with manufacturing stems from internationally-available blueprints and technology, which are the same for all countries. Hence in section III, we focus on

the productivity of manufacturing investment, and use a case study of Tanzania to explore the different ways investment was or was not productive. We show how a combination of factors, including public policies, insulation from market forces, weak technological capacity all combined to render manufacturing capital in Tanzania unproductive. If Tanzania is representative of other African countries, this analysis could explain what is behind the cross-country regressions reported in section II.

Our paper is by no means the first to examine the productivity of investment in Africa--nor will it be the last. Evidence from a global sample indicates that private investment is consistently associated with long-run growth (Levine and Renelt [1992], DeLong and Summers [1991]). Just how important investment is in the growth process is less clear. Young [1995] famously found that capital accumulation played a huge role in the East Asian growth miracles, with a minor role for TFP growth. Nelson and Pack [1999] dispute these findings, showing that the roles of TFP growth and capital accumulation cannot be disentangled in a general production function without specifying the form of technical progress. Klenow and Rodriguez-Clare [1997] also dispute Young's finding by showing that the cross-country variation in TFP growth rates accounts for 92 percent of the cross-country variation in per capita growth. Easterly and Levine 2000 similarly find that many stylized facts about growth imply that most growth and income differences are explained by the "TFP residual" not by factor accumulation.

The impact of public investment is even less clear-cut. Easterly and Rebelo [1994] find a positive relationship between public infrastructure investment and growth (although not an effect of total public investment on growth), whereas Devarajan et al.

[1997] show that the share of public spending devoted to capital expenditure has a negative association with long-run growth.

Several authors have asked whether a similar pattern emerges when the sample is restricted to African countries. Khan and Kumar [1997] find that private investment is more productive than public investment, both in the global sample as well as when restricted to African countries (i.e., when they use regional slope dummies). Calamitsis et al. [1999] also find that private investment is significant in an African growth regression, while public investment is not robustly significant. These results confirm earlier results by Khan and Rheinhart [1990]. By contrast, Hadjimichael et al. [1995] show that public investment has a higher coefficient in a cross-country growth regression of African countries. Furthermore, they find that the coefficient on private investment is not statistically significant when macroeconomic policy variables are included in the regression. They interpret this result as implying that the only way investment affects growth in Africa is directly through capital accumulation, and not through increased productivity growth. Similarly, in a case study of Kenya, Oshikoya [1992] shows that the only period in which investment had a significant impact on growth was 1980-89, which was the period of financial liberalization. It is interesting to note that almost all of the African samples contain Botswana, and none of them reports the results of excluding Botswana from the sample.

Another set of papers look at the determinants of investment in Africa. Most of these, too, emphasize the role of macroeconomic policies in driving African investment. Oshikoya [1992], [1994] points out that credit availability and low inflation are the major determinants of investment in Africa. Elbadawi et al. [1998] examine the role of

instability in lowering Africa's investment rate. In a study of the SADC countries,

Mlambo and Elhiraika [1997] show that, while favorable macroeconomic policies have a

positive effect on private investment, public investment does not--implying that there

may be some crowding-out in these countries.

II. Cross-country analysis of returns to public and private investment in Africa

This section examines the cross-country evidence on the returns to public and

private investment in Africa.[2] It does this by first examining simple correlations between

public investment and growth, and private investment and growth in Africa. Then a full

regression of growth 1970-97 on the averages of public and private investment to GDP,

initial income, and population growth will be performed. Next, some individual

countries will be analyzed, by way of illustration. Finally, the response of investment to

aid will be analyzed country by country, as indirect evidence as to whether aid meant

higher investment – which it should have if economies were liquidity-constrained and

returns to investment were reasonable.

A. Cross-section results on growth and investment

First, a word about the data. Total investment is easily obtainable from the

national accounts. However, the split between public and private investment is more

problematic. If we define public investment as the sum of investment by general

government and by state enterprises, then we lack a standardized international database

for such data. The Government Finance Statistics of the IMF has data only on general

government (and even then often omitting local governments), and not on state

enterprises. We will return to the GFS in a subsequent section; in this section we use an

imperfect but comprehensive measure of public investment including state enterprises.

These data come from an amalgamation of 2 diverse sources: (1) the IFC series on public

and private investment through 1997; (2) the series on public investment in Easterly

[1999]. The latter in turn was an amalgamation of data in Bruno and Easterly [1998] and

Easterly and Rebelo [1993]. All of these sources use World Bank and IMF reports, and

for a few countries, the United Nations National Accounts. Our data thus have rather

complicated bloodlines; they are more like a mutt rather than a pedigreed dog. We use

the data subject to some reservations about their comparability across countries, but these

data are the best we have for aggregate data on public investment. After constructing a

public investment/GDP series, we subtract it from national accounts' total

investment/GDP to get private investment/GDP.

Figure 1 provides a first look at public investment/GDP and growth in Africa. The

picture is not encouraging for the idea that public investment has a high payoff for

growth. Most of the data is concentrated in a ball with no discernible association

between growth and public investment. Then there are the outliers: Botswana and

Equatorial Guinea had exceptional growth but middling public investment; Zambia,

Comoros, Mozambique and Sao Tome had high public investment but mediocre growth.

The only country with high public investment and exceptional growth is Lesotho.

Figure 2 shows the corresponding picture for private investment/GDP and GDP

growth. The figure seems to show somewhat more of an association between private

investment and growth, although there are outliers like Congo and Gabon. The datapoint

of Botswana looks like it will be influential in calculating the statistical association

between private investment and growth; we will now confirm this suspicion.

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[2] This section draws on Dollar and Easterly [1998].

The table below shows a cross-section regression for 1970-97 for 29 African countries. Private investment has a significant positive and strong effect on growth, even after controlling for its endogeneity. In contrast, public investment has no discernible effect on growth.

Dependent Variable: GROWTH Per Capita
Method: Two-Stage Least Squares
Included observations: 29
Excluded observations: 17 after adjusting endpoints
Instrument list: C PRVINV70 PUBINV POPGROW RGDPCH70

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT TERM	0.000692	0.020264	0.034135	0.9731
PRIVATE INVESTMENT/GDP	0.375311	0.113537	3.305626	0.0030
PUBLIC INVESTMENT/GDP	-0.025896	0.125628	-0.206132	0.8384
POPULATION GROWTH	-0.943977	0.655257	-1.440622	0.1626
INITIAL INCOME 1970	-9.62E-06	5.15E-06	-1.867287	0.0741

R-squared	0.503848	Mean dependent var		0.004151
Adjusted R-squared	0.421156	S.D. dependent var		0.020571
S.E. of regression	0.015651	Sum squared resid		0.005879
F-statistic	5.558181			
Prob(F-statistic)	0.002593			

Unfortunately, the result on the favorable impact of private investment on growth depends heavily on Botswana. Here is the regression omitting Botswana:

Dependent Variable: GROWTH Per Capita
Method: Two-Stage Least Squares
Included observations: 28
Instrument list: C PRVINV70 PUBINV POPGROW RGDPCH70

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.013025	0.015691	0.830119	0.4150
PRIVATE INVESTMENT/GDP	0.160243	0.099032	1.618103	0.1193
PUBLIC INVESTMENT/GDP	0.071218	0.096820	0.735571	0.4694
POPULATION GROWTH	-1.186179	0.500166	-2.371571	0.0265
INITIAL INCOME 1970	-2.71E-06	4.21E-06	-0.644616	0.5256

R-squared	0.552047	Mean dependent var		0.001753
Adjusted R-squared	0.474142	S.D. dependent var		0.016308
S.E. of regression	0.011826	Sum squared resid		0.003216
F-statistic	4.241627			
Prob(F-statistic)	0.010230			

The coefficient on private investment is only a third as large and not even significant at the 10 percent level. The variable that most explains relative growth performance now is population growth.

Does the lack of payoff in investment reflect low human capital in Africa? We tried adding the Barro-Lee years of schooling to the above regression, both as an independent term and as an interaction term with private investment. Schooling was insignificant, confirming results by Pritchett [1996] that the educational expansion in Africa has so far not yielded a high payoff. If the underlying relationship between growth and investment is a non-linear one, then it is not surprising that a linear regression yields no significant coefficients. Furthermore, if public and private capital were complements in the aggregate production function, the relationship between growth and investment

would be nonlinear. However, Devarajan, Swaroop and Zou [1997], among others, have estimated similar non-linear relationships and found public investment to be "too high."

B. Growth accounting

Although the linear investment-growth model is popular in both cross-country regressions and individual country forecasting, it does not have good theoretical foundations. The Harrod-Domar model on which the linear growth model was based is no longer widely accepted because of its unappealing premises of surplus labor and zero substitutability between capital and labor. Some new growth models suggest linearity of growth to a broad concept of capital investment that includes physical capital, human capital, and technological knowledge; these models would not predict a linear relationship between growth and physical capital investment alone.[3] A Solow production function approach would relate growth of output per worker to growth of capital per worker. We consider this approach here.

Figure 3a shows the African observations of capital growth per worker and output growth per worker of Nehru and Dhareshwar [1993]. There is no statistically significant association between capital growth per worker and output growth per worker. The coefficient on capital growth per worker, which is conceptually the share of capital in output, is .21 and is significant only at the 15 percent level. The figure shows such notable outliers as Nigeria and Sudan, which had capital growth per worker of over 4 percent per annum, but had zero or negative growth of output per worker. Outliers in the other direction include Kenya and Mauritius, which had capital growth per worker of

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[3] One exception is the original Romer [1987] model of endogenous growth, which suggested externalities to physical capital investment such that there was a linear relationship between output and physical capital. This model does not have many adherents today, and Romer [1994] himself disavowed it in favor of a

zero (i.e. the capital stock growing at same rate as labor force), but had labor productivity growth of 2 percent per annum.

The picture is even worse if we consider data for a more recent period 1977-94, using data from Bruno and Easterly [1998].[4] Although 10 of the 19 countries with data had positive growth of capital per worker, only 3 had positive per capita output growth (Figure 3b). The correlation between output growth and capital growth is once again insignificant. The R-squared is only .10, indicating that capital growth per worker explains only 10 percent of the variation in growth of output per capita within Africa.

C. Policies and Growth

Lest the reader think that the Africa sample is too small and too noisy to yield significant results on *anything*, we consider here a regression of per capita growth rates on policies. The following parsimonious specification works well for the Africa sample:

Dependent Variable: GROWTH Per Capita
Method: Least Squares
Africa Sample only, 4 year averages, 1970-92
Included observations: 94
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012106	0.004455	2.717516	0.0079
Black Market Premium	-0.004747	0.002381	-1.993464	0.0492
Pub. Sec Balance/GDP	0.002702	0.000602	4.487297	0.0000

R-squared	0.178598	Mean dependent var		-0.005259
Adjusted R-squared	0.160546	S.D. dependent var		0.032664
S.E. of regression	0.029928	Akaike info criterion		-4.148670
Sum squared resid	0.081506	Schwarz criterion		-4.067501
Log likelihood	197.9875	F-statistic		9.893117
		Prob(F-statistic)		0.000130

model of endogenous technical change. See Easterly [1999] for a description of the downfall of the Harrod-Domar model.
[4] They used updated data through 1993 for capital stocks from Nehru and Dhareshwar and World Bank data through 1994 for output per capita.

In a pooled regression of four-year average per capita growth rates 1970-92 for African countries, the black market premium and the public sector balance/GDP are both significant with the expected sign. (The investment share is still insignificant when added to this regression.) The black market premium and the public sector balance have been at the center of the policy debate in Africa. The poor incentives created by foreign exchange market distortions and high budget deficits could help explain why investment has not been productive in Africa. These adverse policies may have more fundamental determinants, like the ethnic polarization discussed by Easterly and Levine (1997).

D. Country examples

Regressions like those done above suppose a linear relationship between investment and growth. Another way of showing the weakness of such a relationship in Africa is by examining the variation within countries over time. Did countries that appeared to have a linear relationship of investment with growth maintain that relationship over time?

Figure 4 shows the example of Kenya. We choose the coefficient on investment so that it fits the initial period, and then we extrapolate this relationship for the rest of the period. We see that the investment-growth relationship that held in the 70s did not extrapolate well into the 1980s and 1990s. Per capita income should have kept growing at a rapid clip after 1980; instead it stagnated.

An analogous country exercise for growth accounting would be to assume a "normal" productivity growth of say, 1 percent per annum, and add it to .4 (capital share) * capital growth per worker to predict output growth per worker. Figure 5 shows the results of such an enterprise for Nigeria. Given its rapid capital growth per worker and a

normal TFP growth of 1 percent, Nigerian output worker should have more than doubled over 1960-88. Instead it hardly increased at all. Capital growth was not productive in Nigeria over this period.

D. Indirect evidence from aid and investment

Another way to assess whether returns to capital were high or not is to calculate the response of investment to foreign aid. Under prevailing assumptions in the foreign aid business, capital in poor countries has good returns but investment remains too low because of liquidity constraints and low domestic saving. The answer is thought to be foreign aid, which relieves the liquidity constraint and supplements domestic saving. Does aid pass into investment in practice in Africa? The table below gives the answer from regressing investment/GDP on overseas development assistance/GDP country by country for the period 1960-95.

Results of regressing Gross Domestic Investment/GDP on ODA/GDP country by country in Africa, 1965-95

Coefficient of Investment on ODA	Number of countries	Percent of Sample
Total	34	100%
Positive, significant, and >=1	0	0%
Positive and significant	8	24%
Positive	17	50%
Negative	17	50%
Negative and significant	12	35%

No country in Africa had a one for one pass-through of aid into investment, as would have been expected from the liquidity constraint idea. Eight out of 34 African countries had a significant and positive relationship between aid and investment; more (12) had a *negative* and significant relationship. There is no evidence from the aid-investment relationship of high returns to investment frustrated by lack of liquidity.[5]

To give another country example, Figure 6 shows how high investment would have been in Madagascar if aid had passed into investment one for one since 1960. Investment would have reached 18 percent of GDP; instead actual investment to GDP hovered around 2 percent.

We have documented here two failures of conventional analysis: the failure of the linear growth-investment relationship and the failure of the one for one aid-investment relationship. What if we combine these two models to create a counterfactual for a given country? Easterly 1999 does such a calculation for Zambia. If all aid had gone into investment and investment had yielded an average payoff for growth (ICOR of 3.5), then Zambia's per capita income by 1995 would have reached $20,320; instead it declined to around $600. The counterfactual of an income 34 times higher than actual shows how badly the linear investment-growth and aid-investment models failed in Africa.

E. Composition of public investment

The finding that public investment is unproductive in Africa, which seems to be robust to various specifications and data sets, could be troubling to those who decried the cutbacks in government investment brought on by adjustment programs. Had these

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[5] This finding is in line with that of Boone [1994, 1996], who finds a zero coefficient across countries between aid (suitably instrumented) and investment.

cutbacks been avoided, and public investment increased, our results show that Africa's growth would not have been any higher. A possible response would be that it is the composition, and not the level, of public investment that is important. Had African governments invested in health, education and infrastructure, for instance, the effects on per capita GDP growth would have been favorable. To test this hypothesis, we need to use data from the IMF's Government Finance Statistics, which is the only internationally-comparable database on the components of public expenditure. The total public investment figure would not be consistent with that used in the previous regressions in this section. Nevertheless, the data from the GFS give qualitatively the same result for a regression of per capita GDP growth on private and public investment. When public expenditure more generally is broken down into its components, none of the individual expenditure items has a statistically significant association with growth. Furthermore, the coefficient on private investment is generally not statistically significant when controlling for these different components of public expenditure. In other words, given the levels of public spending in health, education, and infrastructure, additional private investment would not have benefited African growth. Finally, in assessing the determinants of private investment in Africa, we find that public investment has a negative coefficient-- strengthening the possibility that there was more crowding out than crowding in.

F. Implications

The direct and indirect evidence of overall poor returns to investment in Africa in the cross-country data contradict the notion that investment was too low in Africa. Higher investment would not have had a high payoff. The much-denigrated capital flight out of Africa may well have been a rational response to low returns at home. Collier et al

[1999] find 39% of African private wealth is held abroad. Indeed Africans are probably better off having made external investments than they would have been if they had invested solely at home!

III. Evidence from Tanzanian manufacturing on the productivity of capital

The tenuous relationship between investment and growth can be illustrated with evidence from the evolution of Tanzania's manufacturing sector. Focusing on the manufacturing sector of one country provides useful insights. Manufacturing technology is closer to being universally available than in other sectors: equipment and the knowledge to utilize it are purchasable on the world market unlike that in many of the non-traded sectors. Thus, differences in national production functions which may affect cross country results are less severe in manufacturing. It is likely that both output and inputs are measured more accurately than in other sectors, at least in formal manufacturing. Sectoral shifts that may affect aggregate productivity are less than those resulting from movements from subsistence agriculture to the modern sector. Finally, unlike other sectors such as agriculture and construction, the sector is relatively immune to natural forces such as drought or excessive rain that continue for several years and affect output.

Prins and Szirmai [1998] in collaboration with Tanzanian statistical agencies have recalculated the Tanzanian national accounts figures. Although the revised absolute numbers for value added differ from the official ones, both the levels and the intertemporal profile are similar. Value added and value added per worker, VA/N, in manufacturing rose from Independence 1964 to 1975, then began a sustained decline, VA/N, falling 38% between 1975 and 1990.

A. Sources of the Decline in Labor Productivity

VA/N in Tanzania fell between 1975 and 1990 for the entire manufacturing sector and its component branches (Table 1). There are several potential sources of the decline that are depicted in Figure 7.

1. A decrease in the capital-labor ratio along the 1975 production function - the move from A to B. This move could result from several causes: (a) a decline in the wage-rental ratio, w/P, leading firms to reduce their capital- labor ratios, implying a decline in VA/N unless TFP increased; (b) the hiring of unnecessary labor, particularly in public enterprises acting as employers of last resort; (c) a reduction in the flow of capital services (from the diminished capital stock) as capacity utilization declines due either to fall in demand or to the unavailability of complementary inputs, the latter due to foreign exchange constraints in the aggregate economy that forces firms to decrease production even where there is a potential for profitable sales. Ndulu 1986 also considers the possibility that output growth has not matched capacity growth due to a decline in utilization rates.

2. A decline in TFP, a movement from A, the position in 1975, to C or D in 1990, implying technological forgetting or an increase in the weight of low productivity sectors or firms, particularly public enterprises.

B. Changes in Capital per Worker and Incentives to alter the capital-labor ratio

Tanzania experienced a significant decline in the wage rental ratio, w/PK during the last quarter century. The user cost of capital rose as the cost of imported equipment increased due to devaluations and local building costs went up as well. For most firms and industries, the optimal capital-labor ratio should have fallen, as depicted in Figure 8,

causing a decrease in labor productivity unless this was offset by a rise in TFP. The decline in VA/N shown in Table 1 is the expected outcome of factor price movements. Surprisingly, Tanzanian data imply that the capital-labor ratio for the entire sector grew, considerably in some periods, despite the decline in the wage-rental ratio. Such movements could be due to a shift in the composition of output towards sectors with greater capital-labor ratios but sector specific capital-labor ratios are not available to allow a test of this.

Table 2 shows the nominal wage in Tanzanian manufacturing along with the major components of the user cost of capital, the price indices for non-residential structure and equipment. The expression for the user cost of capital, ignoring any capital gains, is

$$PK = CK [(i-p^*) + d)] \quad (1)$$

where PK is the user cost of capital, CK is the price of new capital goods, i the nominal rate of interest, p^* the growth rate of the general price index, and d the depreciation rate. A major component of PK is the cost of capital goods which rose very rapidly. The appropriate value of $(i-p^*)$ is difficult to determine empirically. Although p^* is available, the correct value of the nominal interest rate that firms could earn is not clear. We assume that firms have the alternative of lending in the grey market at a fixed premium above the rate of inflation and therefore this remains constant. Unless the "true" value declined very rapidly, w/PK would still have declined.

For three of the five year sub-periods, the wage-rental ratio was unambiguously decreasing, the price deflator for both investment components increasing more rapidly than wages. Only in 1980 to 1985 would the movement in w/PK depend on the particular

function used to aggregate the investment components. This indicates that optimal capital/labor ratios should have been declining which would imply a decrease in VA/N unless there was an offsetting growth in TFP. Yet as we will show in the next section, available data indicate that the capital-labor ratio was increasing through most of the period for the entire sector.

Van Engelen [1996, p. 55] presents the annual investment/VA ratio in Tanzanian manufacturing for the period 1966 to 1994. We have calculated averages for consecutive five year periods, shown in Table 3. The values in several periods are quite startling, e.g., in 1986-90 investment exceeded value added originating in manufacturing and in 1977-1979 the ratio was close to unity. The I/VA rates can be converted into gross capital stock growth rates by noting that $K^* = (I/VA)/(K/VA) = i/\theta$ where θ is the marginal capital-output ratio. Subtracting the depreciation rate, d, yields the growth rate of net capital stock, $Kn^* = K^* - d$. This exercise is carried out in Table 3 using two values for θ and d.6

Even making the assumptions least favorable to finding a substantial value of K, θ = 6 and d = .05, the growth rate of the capital stock was positive over the last 20 years (column 7). For θ = 3 and d = .05, the capital stock growth rate would have exceeded 17 percent over the last two decades (column 4), much greater than that of the growth of the labor force shown in column 3. For the period 1976 to 1990, Tanzanian manufacturing's capital-labor ratio grew substantially for all sets of assumptions yet the constant price

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6 We are not using the measured values of θ which are themselves endogenous and reflect inefficiency in the use of capital. Rather, the values used, 3 and 6, reflect the boundaries of experience in relatively efficient economies over time. Insofar as θ is greater and the actual growth of the capital stock is lower than that recorded, the low growth of K^* is not due to the lack of investment but to inefficiency. Note that if cost minimizing behavior prevailed, the optimal output capital ratio, $(VA/K)^* = [(\alpha/1-\alpha)(w/P_K)]^{\alpha-1}$ using the Cobb-Douglas. With w/P_K declining, $\theta = K/Q$ as well as K/L should have declined and the value of K^* for a given investment rate should have increased.

value added per worker declined by about 40 percent![7] To take one period when value added per worker was decreasing, 1976-90, any set of assumptions about θ and d still yields a considerable increase in the capital-labor ratio. This suggests that capital-shallowing is not a plausible explanation of the observed decline in labor productivity in Tanzania. Indeed, in two periods of falling VA/N, 1976-80 and 1981-85, the lowest implied growth rates of the capital-labor ratio are .034 and .112. Perhaps just as surprising is the continuing growth in the absolute size of the labor force over the years despite stagnation or decline in constant price value added. Both phenomena together imply that firms were not minimizing costs, a result not surprising in an environment in which large numbers of government interventions assured that inefficient firms survived.

Using the least favorable assumptions, θ = 6 and d = .05, the average growth rate of k was about 8 percent per annum between 1976 and 1990. With α = .4, this implies that v should have increased by 3.2 percent per year rather than decline by that amount. Using the relation $v^* = A^* + \alpha k^*$, the value of A* over the period is – 6.4. Tanzania thus provides an interesting case in which to look for the sources of declining labor productivity quite apart from low investment. The absence of competitive pressures in product markets and policies to encourage firms to maintain employment for political purposes can perhaps explain low levels of both VA/N and TFP. But the continuing decline of the latter over a very long period of time remains a major puzzle.

C. *Explanations of the Decline in Productivity*

A number of hypotheses about the factors that could explain the combination of a rapidly growing capital-labor ratio and declining labor productivity have been

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[7] See Table 3.

considered. Several were noted above in motivating Figure 8. Two sets of causes can be cited that reduce labor productivity, broadly reallocative and efficiency reducing. Among the former, the reallocation of labor from high to lower (labor) productivity sectors within manufacturing is a plausible candidate. However, calculations of the change in productivity due to reallocation of labor among manufacturing branches with differing VA/N turns up a miniscule effect in explaining the large decline VA/N between 1975 and 1990. Similarly, estimates of the productivity losses from the expansion of Tanzania's state owned manufacturing enterprises suggests this was not a source of the decline in manufacturing wide VA/N. Indeed, it is not clear that the SOE sector has lower TFP levels than the private sector, perhaps as a result of its favored access to imported inputs and the resultant higher rates of capacity utilization.

A change in the rate of capacity utilization is one candidate. It is known that throughout much of sub-Saharan Africa factories operate one shift at most and there is a perception that the rate of utilization has gone down due to a shortage of imported inputs upon which local industry depends. The evidence available in Tanzania suggests a decline of about 3.2 percent a year between 1976 and 1990. If the underlying production function were Cobb-Douglas with $\alpha = .4$, about 1.3 % of the annual decline of 3.5 could be explained.

The full set of determinants of the decline in Tanzanian labor productivity cannot be found. In countries that experience a growth in income, there is usually a positive residual, TFP growth, that is left unexplained. The reverse also appears true in the case of decline. Such a tautological result is unsatisfying though there are clues, particularly the abandonment of some major enterprises which may go some way in explaining the result.

To return to our broad theme, however, it is clear that the relation between growth of per capita income and investment may be tenuous in the one sector in which we would expect the most stable relation, as it is unaffected by phenomena such as variable weather. As much of the investment in Tanzanian manufacturing is undertaken by private firms, the socialist orientation of the Nyerere period cannot be blamed directly though the policies that may have discouraged effective use of capital may well have played a role.

Until the sources of declining productivity are better understood, advocacy of more investment as a source of growth is premature. Improving utilization rates, for example, offers a much less expensive and more certain path to sustained growth in production.

IV. Conclusions

Our goal in this paper was to investigate the relationship between Africa's weak growth performance and low investment rates. The cross-country evidence suggests that there is no direct relationship.   The positive and significant coefficient on private investment appears to be driven by the presence of Botswana in the sample. Allowing for the endogeneity of private investment, controlling for policy, and positing a nonlinear relationship makes no difference to the conclusion. Higher investment in Africa would not by itself produce faster GDP growth. Africa's low investment and growth rates therefore, seem to be symptoms of underlying factors.

To investigate these factors, and to correct for some of the problems with cross-country analysis, we undertook a case study of manufacturing investment in Tanzania. We attempted to identify the reasons why output per worker declined while capital per

worker increased. Some of the usual suspects, such as shifts from high to low productivity subsectors, the presence of state-owned enterprises, or poor policies, did not play a significant role in this decline. Rather, low capacity utilization (possibly the by-product of poor policies) and absorptive capacity constraints in skill-acquisition seem to be critical factors. If Tanzania is not atypical of Africa, the low productivity of investment was not due to any single factor, but to a combination of factors, all of which occurred simulataneously.

What are the implications of these results? First, we should be more careful about calling for an investment boom to resume growth in Africa. Unless some or all of the underlying factors that made investment unproductive in the past are addressed, the results may be disappointing. We should also be more circumspect about Africa's low savings rate. Perhaps the low savings rate was due to the fact that the returns to investment were so low. Also, the relatively high level of capital flight from Africa may have been a rational response to the lack of investment opportunities at home.

Secondly, our results suggest that there is no single key to unlocking investment and GDP growth in Africa. Just as a combination of factors contributed to investment's low productivity in the past, the solution lies in addressing this set of factors simultaneously.

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Table 1

Percentage Decline in Constant Price Value Added per Worker in

Tanzanian Manufacturing Sectors, 1975-90

Sector	Percentage Change
Food, Beverages and Tobacco	-62
Textiles and Leather	-24
Wood Products, Furniture, Paper Products, Printing, Publishing	-67
Chemicals, Petroleum, Rubber, Plastic Products	-22
Non-Metallic Minerals	-05
Basic Metal Products, Machinery & Equipment, Other Mfg.	-22
All Manufacturing	-39

Source: I.M. Prins and A. Szirmai, 1998, Table 6.2.

Table 2
Relative Factor Prices for Tanzanian Manufacturing

| Year	Index of ManufacturingWages	Index of Equipment Prices	Index of non-residential structures
1975	100	100	100
1980	127	151	287
1985	306	220	340
1990	582	2421	1474

Source: United Republic of Tanzania, Economic Survey, various issues; The World Bank, 1996.

Table 3
Capital and Labor Growth Rates in Tanzania

Years	Rate of Growth of VA/L	I_M/GDP_M	Rate of Labor Force Growth	Rate of Growth of Capital Stock:			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				$\theta=3$ d=.05	$\theta=3$ d=.03	$\theta=6$ d=.05	$\theta=6$ d=.03
1966-70	.046	31.0	.068	.05	.07	.0	.02
1971-75	.012	29.7	.079	.05	.07	.0	.02
1976-80	-.071	79.9	.066	.22	.24	.08	.10
1981-85	-.008	65.0	-.032	.17	.19	.06	.08
1986-90	.010	106.8	.027	.31	.33	.13	.15
1991-94	NA	99.3	NA	.28	.30	.12	.14

Sources: Column 1, calculated from Prins and Szirmai, cited above; Column 2, calculated from Van Engelen, 1996; Column 3, calculated from Prins and Szirmai, ibid. p. 40; Columns 4-7, calculations of author.
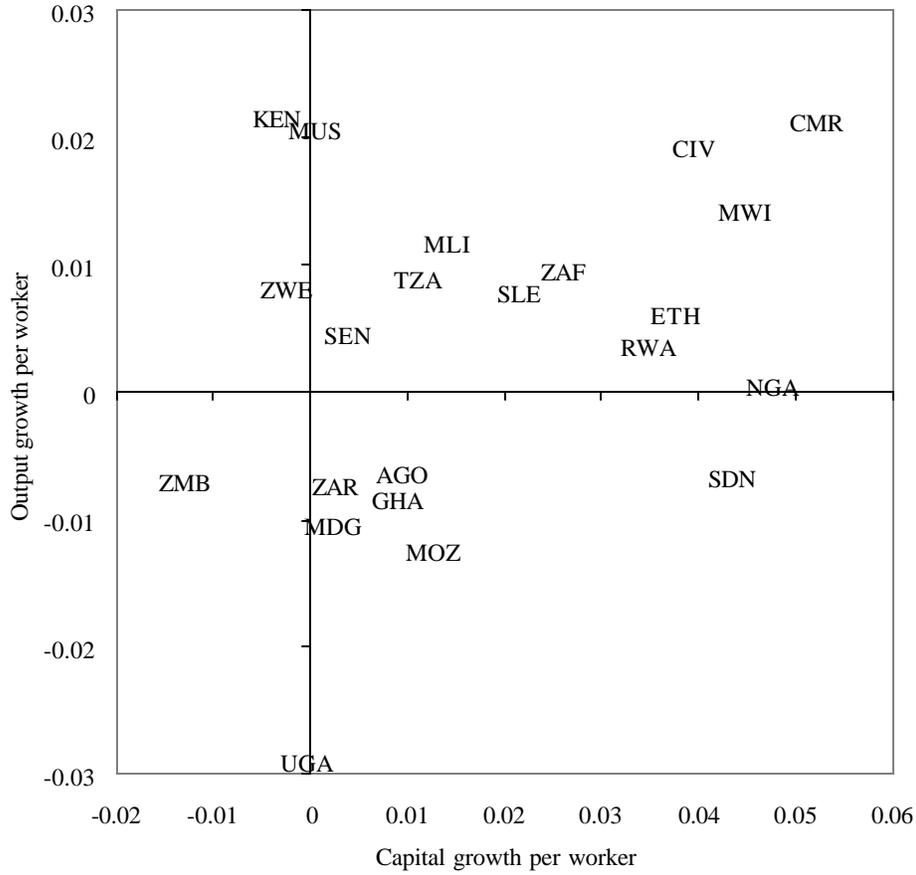
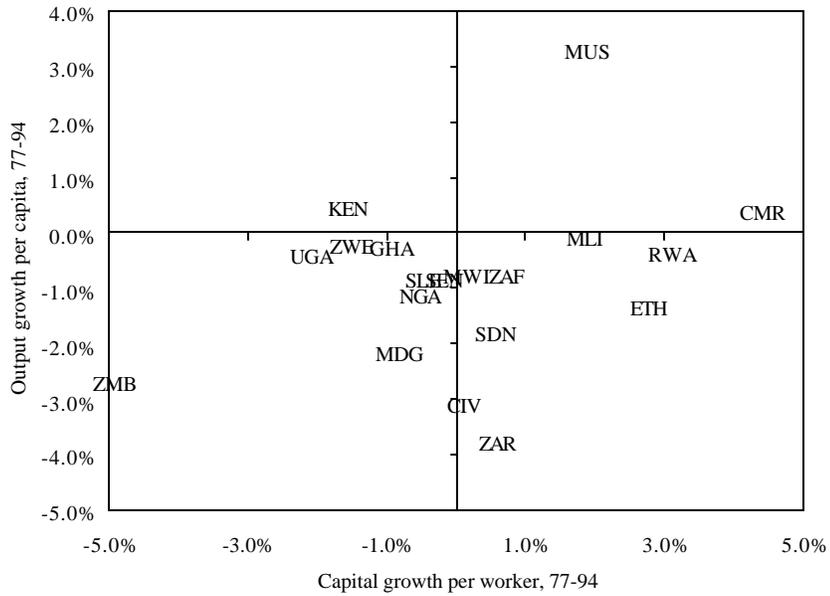**Figure 1: Public investment/GDP and GDP Growth, 1970-97**
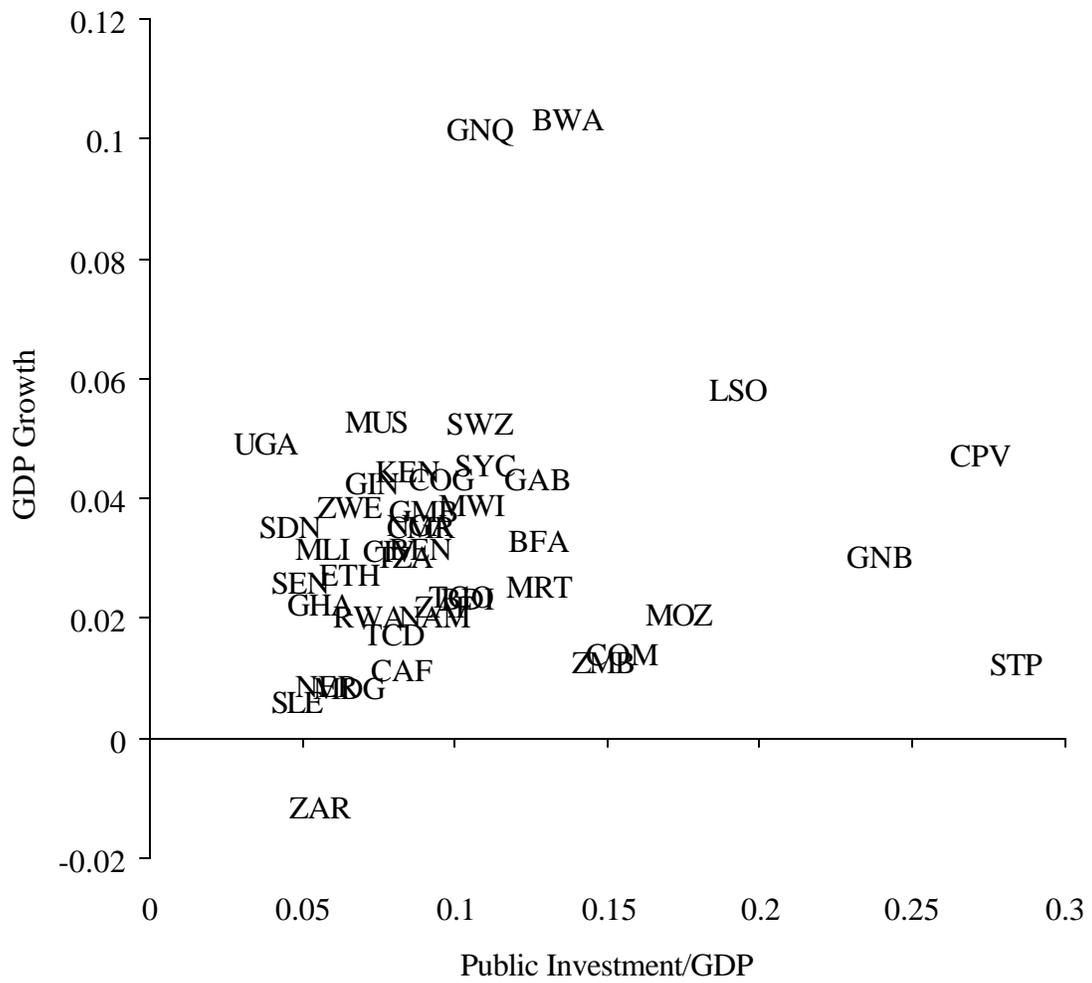
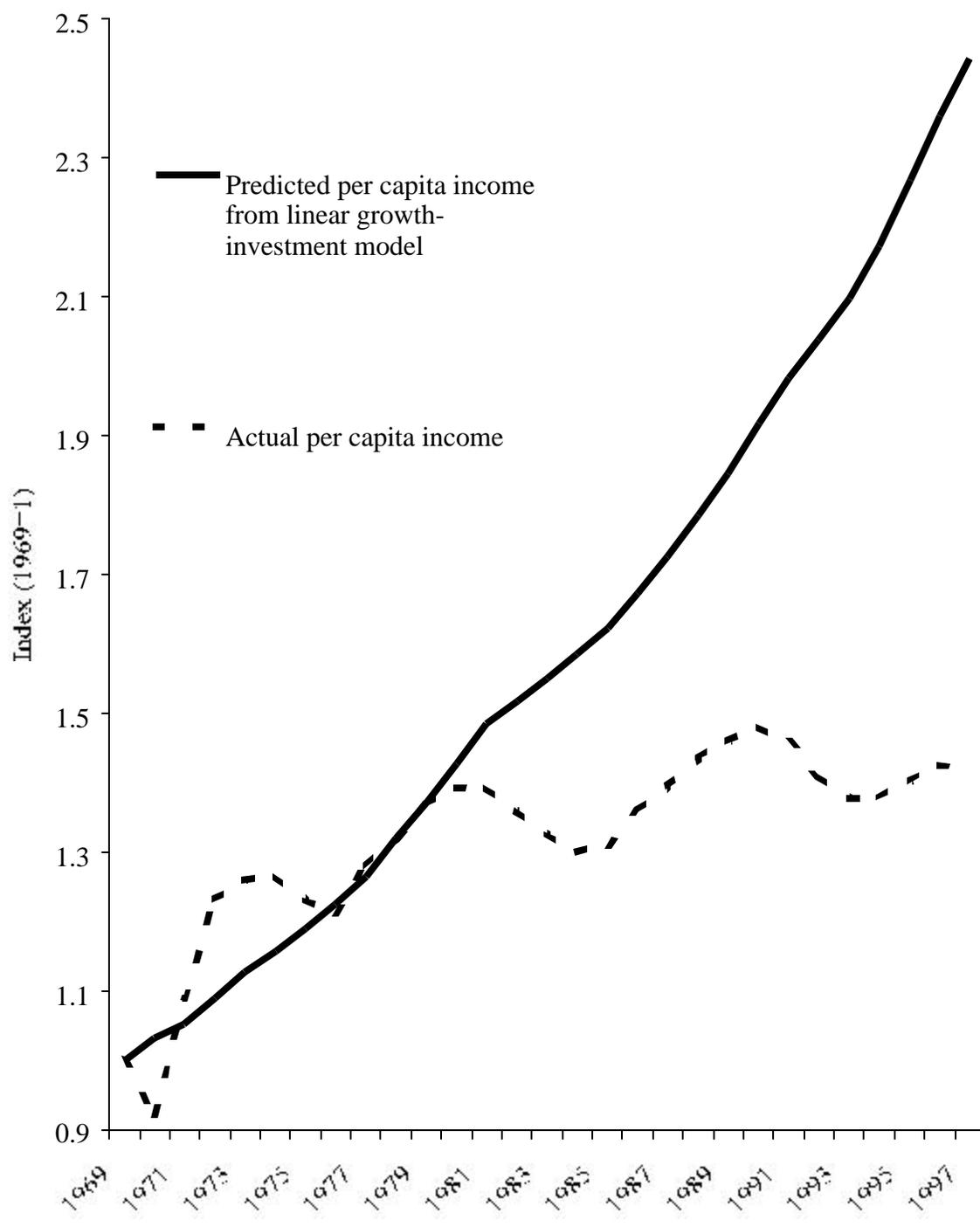**Figure 2: GDP Growth and Private Investment/GDP, averages 1970-97**
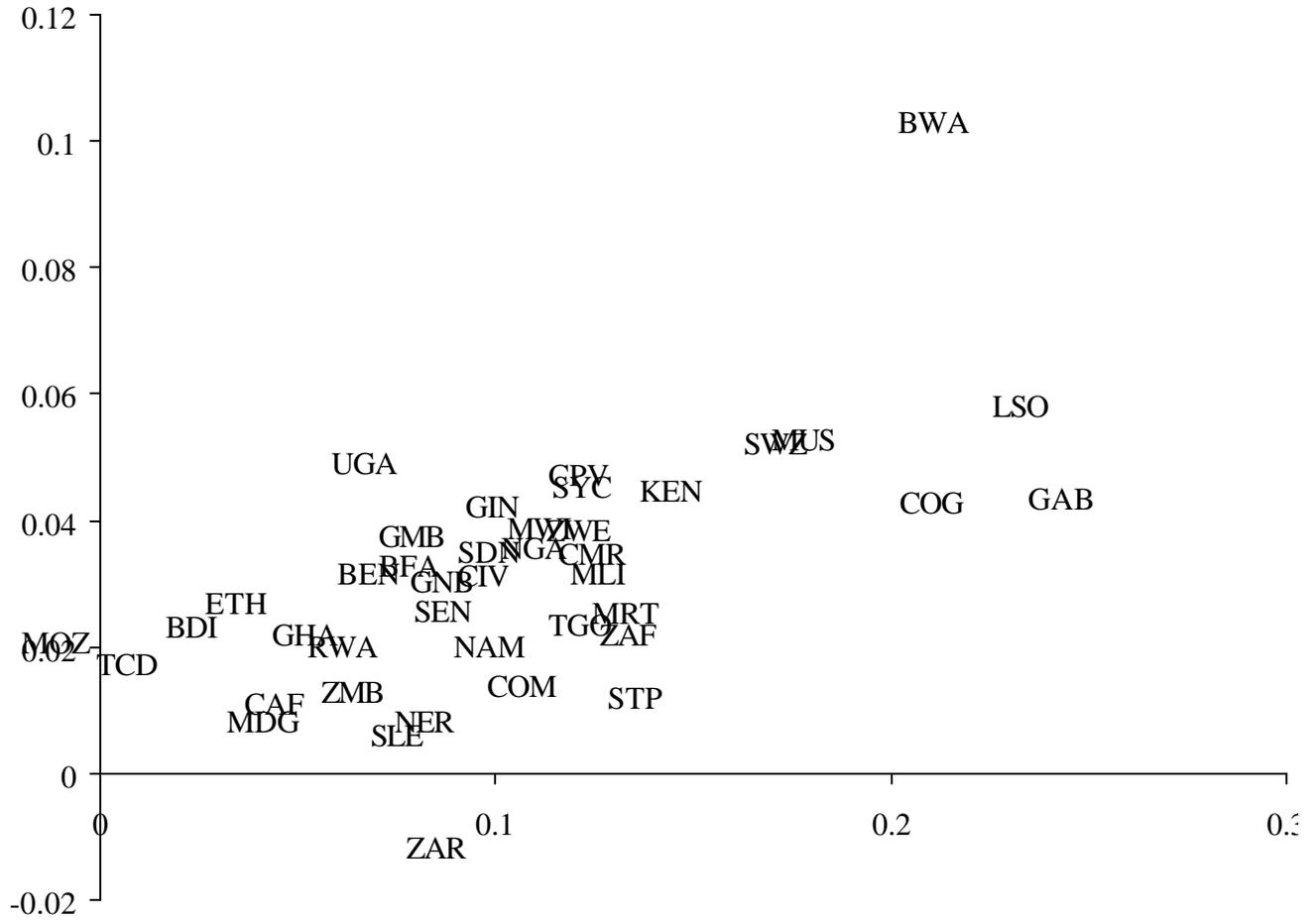
Figure 3a: Output growth per worker against capital growth per worker, 1960-88
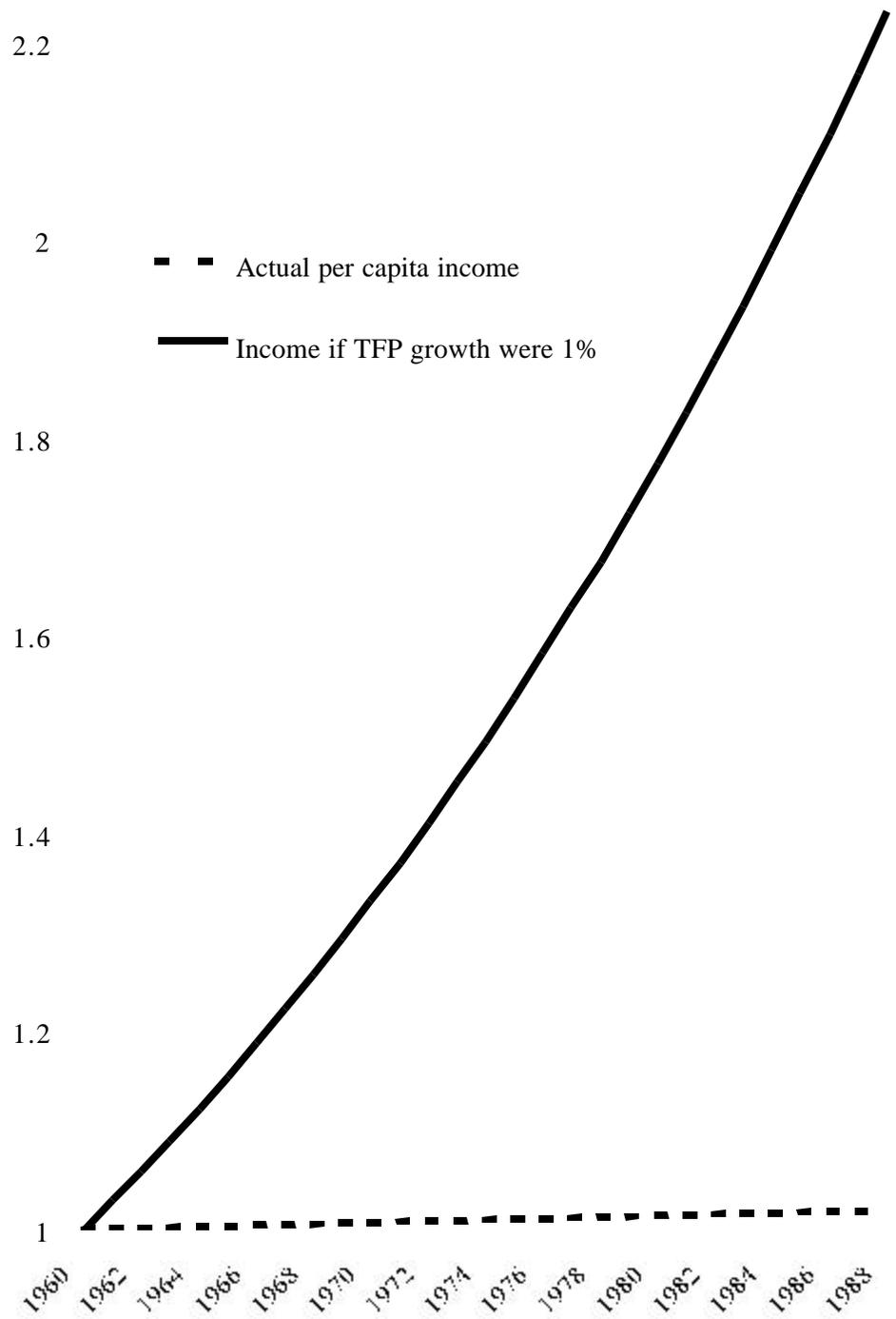

Figure 3b: Output growth per worker against capital growth per worker, 1977-94

Figure 4: Predicted income from linear investment-growth model and actual per capita income in Kenya, 1970-97

Figure 5: Per capita income in Nigeria if productivity growth had been 1% as against actual per capita income (1960=1.0)

Legend:
- - - Actual per capita income
—— Income if TFP growth were 1%

Figure 6: Madagascar's actual investment to GDP and that predicted by aid-financed investment model

Investment if aid had gone into investment one for one

Actual investment

Investment/GDP

20
18
16
14
12
10
8
6
4
2
0

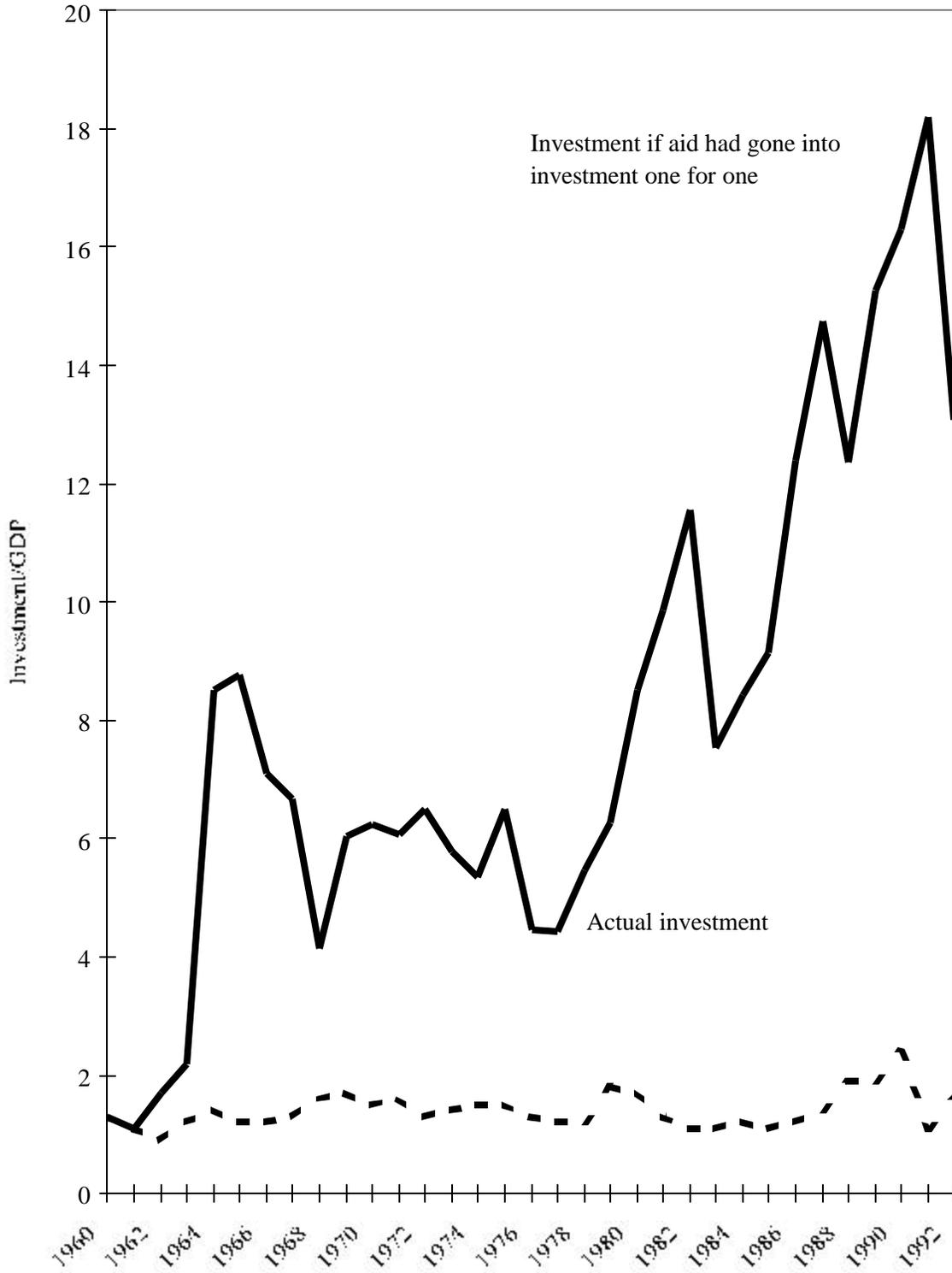1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992

Figure 7
Possible sources of change in labor productivity