

**ECONOMIC GROWTH IN A CROSS SECTION
OF SUB-SAHARAN AFRICAN COUNTRIES:
THE EFFECTS AND COSTS OF COLONIAL HERITAGE**

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Abstract

Utilizing a cross-country growth framework, this paper investigates the effects of colonial heritage on economic growth for a small sample of countries in Sub-Saharan Africa. The effects of a country's colonial heritage are viewed as distorting the process governing human capital accumulation—that presumably persists even after independence. By including in a cross-country regression model a proxy for a country's colonial heritage, that reflects how colonialism may distort human capital accumulation for an economy, this paper provides evidence that the principal effect of a country's colonial heritage is lower long-run growth for some, but not all former colonies in Sub-Saharan Africa. The adverse growth effects of a colonial heritage are found to depend upon the metropolitan country that former colonies were subjects of. For countries where a colonial heritage has adverse growth effects, estimates of how much output is lost as a result of colonialism are computed to benchmark the potential reparations due to Sub-Saharan African countries that were subject to colonization.

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INTRODUCTION

The Theory of Restitution, as articulated by Richard America (1995), argues that historically, product and factor markets have featured phenomena such as exploitation, exclusion, and discrimination, resulting in the diversion of income and wealth from blacks to whites. If, in principle, such a diversion is in violation of reasonable fairness norms, and can be regarded as wrong, illegal, and illegitimate—the Theory of Restitution concludes that there is a case for restitution. The amount of restitution depends of course upon the amount of reparable damages, in monetary units, associated with the particular mechanism that resulted in an unjust diversion of income and wealth from blacks to whites. In this context, the Theory of Restitution, suggests that the reparable damages associated with any mechanism that diverts income and wealth from blacks to whites, can be determined by auditing the historic pattern of transactions between blacks and whites, and estimate the extent to which the transactions imposed unjust costs on blacks and/or diverted unjust benefits to whites.¹

In this paper, an attempt is made to quantify the effects that colonialism and its legacy has on former colonies in mostly black Sub-Saharan Africa. Taking as serious the Theory of Restitution, this paper is motivated by the following question: *As a historic relationship between white Europeans and black Africans, what reparable costs/damages did*

¹In general, America (1995, p. 42) argues that methodologically, determining reparable damages proceeds by (1) Reconstructing historic economic relations, (2) Specifying fair standards that were violated, perhaps by force, (3) Audit the historic pattern of transactions between the groups, and compare the actual standard with the fair standard, (4) Estimate the deviation from fairness, (5) Designate the deviation from fairness as unjust benefit/cost, and estimate its present value and distribution, and (6) Assign a monetary value to the unjust benefit/cost that will inform a policy of reparations in the form of lump-sum or other redistributive income and wealth transfers, subsidies, or investments in real and human capital.

colonialism impose upon the former Sub-Saharan African colonies? Given the miserable post-independence growth experience of former African colonies, it is a reasonable conjecture that colonial heritage may have imposed a cost on former colonies in the form of reduced long-run economic growth.² If so, the deviations from long-run growth associated with colonial heritage, in monetary units, can serve as a benchmark for reparations to the former colonies. The approach taken in this paper is therefore one of estimating the costs associated with a particular historic income/wealth diverting mechanism—European colonialism in Sub-Saharan Africa.

The conjecture that colonial heritage has effects on economic growth in Sub-Saharan Africa seems reasonable in light of some empirical findings in the cross-country growth literature. Barro (1991) reports that a dummy for Sub-Saharan Africa has a negative and significant effect on the growth of GDP per capita for the 1960 - 1985 period. This suggests that there is something unique to Sub-Saharan African countries that reduces long-run growth. The results of Bertocchi and Canova (1999), conjecturing that a Sub-Saharan dummy may be capturing the effects of colonialism, show that proxies for colonial heritage account for the negative growth performance of countries in Africa relative to countries on other continents for the 1960 - 1988 period. Salai-i-Martin (1997) finds that a dummy variable for being a former Spanish colony is strongly and negatively related to

²The recent growth experience of Sub-Saharan Africa as reported by Sachs and Warner (1997) underscore how miserable growth in Sub-Saharan Africa is. Measuring growth as the the average change in GDP per capita, economic growth for Sub-Saharan African countries averaged just .8 percent per year over the 1965 -1990 time period. This is in contrast to a growth rate of 5.8 percent for the seven fastest growing countries outside of Africa. Even more stark is relative GDP per capita comparisons. In 1960, GDP per-capita in Sub-Saharan Africa was 60 percent of the average of the rest of the developing world. In 1990, GDP per-capita in Sub-Saharan was 35 percent of the average of the rest of the developing world. Thus Sub-Saharan African countries have become poorer over time relative to the rest of the developing world.

economic growth for two million different specifications where the dependent variable is growth. While Sachs and Warner (1997) show that a dummy for Sub-Saharan Africa loses significance in cross-country regression equations when variables accounting for geography, economic policy, and demography are added, they acknowledge that colonial heritage may have some important indirect effects.

At a theoretical level, Bertocchi and Canova (1999) have provided a model of economic growth where colonization imposes economic and institutional distortions on colonies. The intensity of the distortions of colonial heritage are captured by a parameter measuring the loss of total output in an optimal growth framework. They also offer a model of growth where a rapid infusion of colonialist physical capital creates an imbalance between physical and human capital. If the technological scale parameter on the production is proportional to the ratio of human to physical capital, the effect of colonization is reduced growth, that can persist even after independence. This effect of colonial heritage on an economy can be viewed as an extension of the theory of threshold externalities in human capital accumulation developed by Azariadis and Drazen (1990). In the absence of a high ratio of human capital to per capita income, a threshold externality where human capital has increasing returns is not realized, reducing the rate of growth of income per capita. Although the results of Azariadis and Drazen (1990) were not specifically derived for a economy with a colonial heritage, the theoretical framework they provide suggests that if a colonial heritage inhibits human capital accumulation, a consequence could be a lower long-run growth path.³

This paper provides and estimates a cross-country regression specification where colonial heritage is hypothesized to affect growth indirectly through its effects on human capital accumulation. Underlying the specification is a simple Solow growth model, augmented to include human capital. A testable implication of the model is that where colonial heritage distorts by inhibiting human capital accumulation, steady state income per capita is

³Other theoretical analyses underscoring the importance of human capital accumulation for economic growth include Lucas (1988), Becker, Murphy, and Tamura (1990) and Romer (1990).

lower. Recognizing the possibility that the effects of colonial heritage may depend upon the metropolitan country a former colony was subject to, a cross-country regression model is estimated to test the effects of having a colonial legacy associated with a particular metropolitan country.

The remainder of this paper is organized as follows. In the first section that follows below, a simple model of economic growth that can accommodate the effects of colonial heritage is provided. In the second section, the data, sample and empirical specifications to be estimated are discussed. used to test the model are presented. Estimates of cross-country regression models are reported in the third section, along with benchmark computations of the costs of colonial heritage for former Sub-Saharan African colonies. The last section concludes.

A MODEL OF ECONOMIC GROWTH UNDER COLONIAL HERITAGE

To examine the impact of colonial heritage on a country's economic growth, this paper adopts the approach of Mankiw, Romer, and Weil (1992), in assuming that output in the economy evolves over time according to:

$$Q(t) = K(t)^\alpha H(t)^\beta (A(t)L(t))^{1-\alpha-\beta}$$

where Q is output, K is the stock of physical capital, H is the stock of human capital, A is the level of technology, and L is the stock of labor. Among the wide variety of institutional and economic distortions that can be associated with colonization experiences, a plausible one is where the initial and persisting effects of colonization inhibits the processes governing human capital accumulation, which in the manner proposed by Azariadis and Drazen (1990), prevented the former colonies from reaching a threshold of human capital necessary for rapid growth. Bertocchi and Canova (1999) note for example, that it is plausible that among former colonies, colonial domination generated dysfunctional institu-

tions, rent-seeking elites, and corrupt bureaucracies. While these phenomena can plausibly affect physical capital accumulation and technology, the low levels of literacy and educational attainment in Sub-Saharan Africa, relative to the rest of the world, suggests that if a colonial legacy distorts at all, it seems equally plausible that it had a significant effect on human capital accumulation.⁴ Suppose, following Bertocchi and Canova (1999) that both the initial and persisting distortions associated with colonial heritage can be captured with a simple parameter $\delta \in (0,1]$, the production function above can then be expressed as:

$$Q(t) = K(t)^\alpha H(t)^{\beta(1-\delta)} (A(t)L(t))^{1-\alpha-\beta(1-\delta)} \quad (1)$$

In general $(1 - \delta)$ captures the impact that a colonial heritage has on output indirectly through its effect on human capital. Assume physical and human capital depreciate at the same rate μ , and that $\dot{K} = s_k Q + \mu K$, $\dot{H} = s_h Q + \mu H$, $A(t) = A_0 e^{gt}$, and $L_0 = L_0 e^{nt}$. Let s_k and s_h be the share of income invested in physical and human capital respectively; then the evolution of the stock of physical and human capital per effective worker are determined by:

$$\dot{k} = s_k k^\alpha h^{\beta(1-\delta)} - (n + g + \mu)k \quad (2)$$

$$\dot{h} = s_h k^\alpha h^{\beta(1-\delta)} - (n + g + \mu)h \quad (3)$$

The steady state equilibrium values of k and h from equations (3) and (4) are:

⁴If we measure the stock of human capital as the mean number of years of education completed by individuals between the ages of 15 - 64 at the either primary, secondary, or post-secondary level, Nehru, Swanson, and Dubey (1995) report that the average for Sub-Saharan Africa was 2.54 years in 1987. This average is approximately 43 percent of the world average, 25 percent of the average of industrial countries, and 56 percent of the average for developing countries.

$$k^* = \left(\frac{s_k^{1-\beta(1-\delta)} s_h^{\beta(1-\delta)}}{n+g+\mu} \right)^{1/1-\alpha-\beta(1-\delta)} \quad (4)$$

$$h^* = \left(\frac{s_k^\alpha s_h^{1-\alpha}}{n+g+\mu} \right)^{1/1-\alpha-\beta(1-\delta)} \quad (5)$$

Equations (1) - (5) are essentially the growth model of Solow (1956) modified to capture the distortionary effects of colonial heritage on an economy. An equation for steady state equilibrium per capita income follows from substituting equations (4) and (5) into the production function, and taking logs:

$$\begin{aligned} \ln q^* = \ln A_o &+ gt + \frac{\vartheta}{1-\vartheta} \ln(n+g+\mu) + \frac{\alpha}{1-\vartheta} \ln(s_k) \\ &+ \frac{\beta}{1-\vartheta} \ln(s_h) - \frac{\delta\beta}{1-\vartheta} \ln(s_h) \end{aligned} \quad (6)$$

where $\vartheta = \alpha + \beta(1 - \delta)$, and q^* is steady-state income per capita. Equation (6) indicates how steady state equilibrium per capita income is inversely related to population growth n , and positively related to the equilibrium stock of physical (s_k) and human capital (s_h). Equation (6) also indicates that for an economy subject to a colonial heritage that reduces the equilibrium stock of human capital, $\delta > 0$, and the effect is to reduce steady state equilibrium income per capita.

Following the approach of Mankiw, Romer and Weil (1992), if we let q_o be income per effective worker at some initial time period, by approximating about the steady state, where $d \ln q(t)/dt = \lambda[\ln(q^*) - \ln(q_o)]$, equation (6) implies economic growth is determined by:⁵

$$\begin{aligned} \ln(q^*) - \ln(q_o) &= -\theta \ln q_o + \theta \ln A_o + gt - \theta \left(\frac{\vartheta}{1-\vartheta} \right) \ln(n+g+\mu) \\ &+ \theta \left(\frac{\alpha}{1-\vartheta} \right) \ln(s_k) + \theta \left(\frac{\beta}{1-\vartheta} \right) \ln(s_h) - \theta \left(\frac{\delta\beta}{1-\vartheta} \right) \ln(s_h) \end{aligned} \quad (7)$$

⁵See Ghura and Hadjimicheal (1996) for similar treatment of growth dynamics in Sub-Saharan African economies.

where $\theta = 1 - \exp(-\lambda t)$, and $\lambda = (n + g + \mu)(1 - \alpha - \beta(1 - \delta))$ is the rate at which a country converges to its steady state income per capita.

SAMPLE, DATA, AND EMPIRICAL SPECIFICATIONS

The primary data for this paper come from that compiled by Mankiw, Romer and Weil (1992), which were extracted from the Penn World Table Data constructed by Summers and Heston (1988, 1991). The sample of 40 Sub-Saharan countries are those considered by Feng (1996). The Feng sample is utilized because it includes data on political variables, not available in the sample of Sub-Saharan countries considered by Mankiw, Romer, and Weil (1992), that may add explanatory power to a cross-country growth regression model. Sachs and Warner (1997) note that the addition of variables such as those that index political institutions are important if there is unobserved variation in total factor productivity across countries. To omit them when they are important can bias the parameter estimates of regression specifications based on steady state per capita income relationships such as equation (6) above. Below, two versions of a regression specification based on (6) are estimated. The first one is based solely on what equation (6) explicitly suggests—factor shares, and population. A second specification is estimated that includes variables that captures geography, political, and policy phenomena that may be correlated with total factor productivity. To accommodate these additional variables, the sample data are supplemented with data on country-specific geographical, political, and policy variables from Sachs and Warner (1997) and Feng (1996).

An initial empirical version of equation (6)—the simple Solow version—is obtained by assuming that $\ln A_o = a$ where a is a constant:

$$\ln(q^*) - \ln(q_o) = \theta a - \theta \ln q_o - \theta \left(\frac{\vartheta}{1 - \vartheta} \right) \ln(n + g + \mu) + \theta \left(\frac{\alpha}{1 - \vartheta} \right) \ln(s_k)$$

$$+ \theta \left(\frac{\beta}{1-\vartheta} \right) \ln(s_h) - \theta \left(\frac{\beta}{1-\vartheta} \right) \delta \ln(s_h) + \varepsilon \quad (8)$$

where ε is an error term. The dependent variable is measured as difference between the log of real GDP per member of the working age population in 1985 and the log of GDP per member of the working age population in 1960 ($\ln Q60$). Following Mankiw, Romer, and Weil (1992), it is also assumed that $g + \mu = .05$, and n is measured by the average growth rate of the working age population.⁶ The measure for s_k is the average share of real investment in real GDP (PKAP), and s_h is measured by the percentage of the population aged 12 - 17 enrolled in secondary school multiplied by the fraction of the population aged 15 - 19 (HKAP). All four of these variables are from Mankiw, Romer, and Weil (1992), and cover the period 1960 - 1985.

To measure the effects of colonial heritage on steady-state GDP per capita, the parameter δ is measured as a dichotomous dummy variable (COLONY) indicating the colonial heritage of a country. The construction of the dummy variables are based upon the classifications provided by Bertocchi and Canova (1999) listed in Table 1. Countries that are identified as being a dependency are treated as not having a colonial heritage. Six dummies are initially constructed, and added separately to the empirical specifications below. The first one is a composite dummy that does not account for the metropolitan country a former colony was a subject of. The other five dummies are for particular metropolitan countries: Belgium, France, Italy, Portugal, and England (United Kingdom).

To the extent that the level of technology and efficiency in an economy is a function of country-specific factors, the parameter estimates of the simple Solow model will be biased, perhaps even providing misleading estimates of sign on parameters. Sachs and Warner (1997) note that this bias can be reduced, but not eliminated completely by including as

⁶The assumption that $g + \mu = .05$ is invoked by Mankiw, Romer and Weil (1992) on the basis of its correspondance with data from a sample of U.S and non-U.S countries.

many determinants of technology and efficiency as possible. As the interest of the analysis of this paper are the effects of colonial heritage on an economy, the simple Solow specification could provide estimates of the parameters δ and β that could change in significance and/or sign in a specification that accounts for country-specific factors that influence technology and efficiency. Thus, an estimation of the simple Solow model could lead to misleading conclusions about the effects of colonial heritage on steady state income per capita.

To reduce the possibility of making erroneous inferences about the effects of colonial heritage on economic growth in Sub-Saharan Africa, a second specification is estimated where, following the approach of Ghura and Hadjimicheal (1996), the level of technology at time t is specified as:

$$A = A_o \exp \left(gt + \sum \Phi_i X_i \right)$$

where X_i is a variable that can affect the level of technology and efficiency for an economy, and Φ_i is its coefficient. An extended Solow model is therefore specified as:

$$\begin{aligned} \ln(q^*) - \ln(q_o) = & \theta a - \theta \ln q_o - \theta \left(\frac{\vartheta}{1 - \vartheta} \right) \ln(n + g + \mu) + \theta \left(\frac{\alpha}{1 - \vartheta} \right) \ln(s_k) \\ & + \theta \left(\frac{\beta}{1 - \vartheta} \right) \ln(s_h) - \theta \left(\frac{\beta}{1 - \vartheta} \right) \delta \ln(s_h) + \theta \sum \Phi_i X_i + \varepsilon \end{aligned} \quad (9)$$

Three variables included in $\sum \Phi_i X_i$ are those considered by Sachs and Warner (1997). ACCESS is a dummy variable that indicates whether or not a country is completely land-locked. OPEN is a variable that measures the proportion of years between 1965 and 1990 in which the economy is rated as an open economy. The variable TROPIC measures the approximate fraction of a country's land area that is subject to a tropical climate. The last two variables are those considered by Feng (1996). DEMOC is a variable that measures the extent of democracy in a country on a scale of zero to ten, averaged over the period 1960 - 1992. Finally, AVGAUT is a variable that measures the number of years a country was subject to authoritarian rule over the period 1960 - 1992.

Rationales for the expected sign on the coefficients of ACCESS, OPEN and TROPIC have been provided by Sachs and Warner (1997). To the extent that geographically isolated countries have a cost structure of production that inhibits the division of labor, ACCESS is expected to have a negative coefficient. OPEN is expected to have a positive coefficient. The more open an economy is to trade, efficiency increases as a result of exploiting the comparative advantages associated with trade. As labor productivity is compromised by disease, if there is a higher prevalence of parasitic disease in tropical countries, TROPIC is expected to have a negative coefficient. To the extent that democracy is associated with decentralized decisionmaking that increases the efficiency of resource allocation, both DEMOC and AVGAUT are expected to have positive coefficients.

RESULTS

Table 1 reports a list of the countries in the sample along with their colonial heritage, the metropolitan European country they were colonized by, and the date of independence. Table 2 reports the period average and standard deviation of the variables utilized to estimate the empirical specifications of equations (8) and (9).⁷ The pattern of the averages conditioned on the colonial heritage of the Sub-Saharan African country are suggestive. Clearly, the implied growth rate of income per capita given by $\ln(q^*) - \ln(q_o)$ is higher for countries without a colonial heritage. In general, Sub-Saharan African countries without a colonial

⁷Due to some missing values for countries, several imputations were made. For the country of Gambia, GDP per working age adult in 1985 was imputed from the GDP per adult in 1960 on the basis of and the growth rate of GDP over the period. The growth rate of the working age population was imputed as the average for the sample. For the country of Guinea, the SCHOOL variable was imputed as the sample average. For Swaziland, GDP per adult in 1985 was imputed on the same basis as for Gambia, and the growth rate of the working age population was imputed as the sample average.

heritage grew at a rate that was approximately three times higher than countries with a colonial heritage. A similar, but less dramatic pattern holds for the average stock of human and physical capital. In addition, relative to countries with a colonial heritage, Sub-Saharan African countries without a colonial heritage are apparently more landlocked and democratic, and less tropical.

Table 3 reports Ordinary Least Squares parameter estimates of a specification based on equation (8). To insure valid inferences on parameters given the possibility of heteroscedastic errors when estimating parameters with cross section data, all reported standard errors are heteroscedastic consistent. Column (0) reports the results of a test for unconditional convergence. Both the constant and the coefficient on the GDP per capita in 1960 are insignificant, implying that there is no tendency for poorer countries to grow faster than richer countries in Sub-Saharan Africa.⁸ The regressions reported in columns (0) - (7) are estimates of the simple Solow model that differ only with respect to how the dummy term COLONY measures the colonial heritage for a country. In column (1), the COLONY dummy equals one if a country in the sample has a colonial heritage associated with any of the colonial powers in Europe. The regression reveals that all of the variables are significant and have plausible signs, except for the variable measuring colonial heritage, which is negative, but insignificant. Judging solely by the results in column (1), colonial heritage does not affect growth in Sub-Saharan Africa.

To examine the possibility that the effects of colonial heritage on a Sub-Saharan African economy depends upon the metropolitan country of the colonizer, columns (2) - (6) in Table 3 report estimates of the simple Solow model where the dummy varies by metropolitan

⁸This rejection of the hypothesis of unconditional convergence for Sub-Saharan African countries is consistent with the findings of Ghura (1995) and Ghura and Hadjimicheal (1996). The failure of unconditional convergence is nonetheless exactly what the Solow model predicts. Mankiw, Romer, and Weil (1992) note that what the Solow model predicts is "conditional convergence"—countries converge in growth rates only after controlling for the determinants of steady-state GDP per capita.

country. Disaggregating the COLONY dummy in this manner reveals that colonial heritage has a negative impact on growth for every colonial heritage except for countries with a Portuguese colonial heritage where the dummy is insignificant, and for countries with a French colonial heritage in column (3) where the effect is, perhaps paradoxically, positive. Column (7) in Table 3 retains the COLONY dummy without distinguishing metropolitan country, and the simple Solow model is estimated deleting the Sub-Saharan African countries with a French colonial heritage. The results reveal that all the coefficients are significant with plausible signs and more particularly—the colonial heritage variable is negative and significant. Given the consistent significance and sign of the colonial variable across the non-French colonial heritage dummy variable specifications in columns (2) - (6), the results in column (7) suggest that having a non-French colonial heritage is a source of reduced economic growth for Sub-Saharan African countries. The fact that both R^2 and adjusted R^2 are highest for the specification in column (7) suggests the extent to which a non-French colonial heritage has explanatory power for growth in Sub-Saharan African countries over alternative classifications of colonial heritage.

Table 4 reports the parameter estimates of a specification based on equation (9). Columns (1) - (7) are the results of changing the specification of the colonial heritage dummy variable in the exact manner of the results reported for the simple Solow model in Table 3. The pattern of the results in Table 4 are similar to the results reported in Table 3, and judging by the increase in adjusted R^2 across the dummy variable specifications, the inclusion of ACCESS, OPEN, TROPIC, DEMOC, and AVGAUT adds explanatory power. Similar to the results in Table 3, the results in Table 4 again suggest that having a non-French colonial heritage is a source of reduced economic growth for Sub-Saharan African countries. The results reported in column (7) also indicate the extent to which, openness, climate and the extent of democracy matter for economic growth in Sub-Saharan Africa. In general, the positive and significant coefficients on OPEN, and DEMOC indicate that having an open economy and extensive democracy increase economic growth. The negative and significant

coefficient of TROPIC indicates that a tropical climate tends to reduce economic growth. Being landlocked doesn't appear to matter for economic growth in Sub-Saharan Africa, as the coefficient of ACCESS is insignificant in every dummy variable specification reported in Table 4. The coefficient on AVGAUT is also insignificant in every specification, however this may reflect the fact that DEMOC is a more effective measure of the extent of democracy and freedom.

Tables 3 and 4 also report for each specification the implied rate of convergence λ . Comparing in each Table the results of column (3) and column (7), a perspective emerges as to how colonial heritage, through impacting upon human capital accumulation, affects the rate at which an economy reaches its steady state income per capita. In both Tables 3 and 4, the implied rate of convergence in column (3) is less than the rate in column (7). This implies that countries with a colonial heritage that inhibits human capital accumulation reach their steady state faster. This of course is what one should expect, as a lower stock of human capital reduces equilibrium income per capita, thus shortening the growth path that must be traveled.

The results of column (7) from Tables 3 and 4 permit an assessment of the quantitative impact that a non-French colonial heritage has on economic growth for Sub-Saharan African countries, *ceteris paribus*. For example, utilizing the results from column (7) of Table 4 at the mean of the log of human capital (.53), a non-French colonial heritage results in a reduction of .185 in the log difference of GDP per capita between 1960 - 1985. Translated into economic growth, this implies that in the absence of a colonial heritage, income per capita in 1985 would have been approximately 20 percent higher.⁹ In terms of

⁹This interpretation follows from the fact that if say .185 is added back to the log difference of GDP per capita in 1960 and 1985, then $e^{.185} = 1.20$ (approximately), implying that that GDP per capita in 1985 would be approximately 20 percent higher in the absence of a non-French colonial heritage. The implied increment to the annual growth rate for this incremental 20 percent of 1985 GDP per capita (q^*) is determined by solving $q^*e^{rt} = 1.27q^*$ for r when $t = 25$.

the annual growth rate between 1960 - 1985, a colonial heritage results in approximately a one percentage point reduction in the annual growth rate. For the results in column (7) of Table 4, the same computation reveals that a colonial heritage results in approximately a one percentage point reduction in the annual growth rate.

Given that the effects of a colonial heritage are to reduce the growth rate of GDP per capita, the costs can be viewed as the lost output per head. In Table 5, the lost output per head due to a colonial heritage is estimated and itemized for the countries in the sample with a non-French colonial heritage. The estimates are based upon the results in column (7) of Table 4, which on the basis of an R^2 of .89, explain most of the variation in growth rates for the Sub-Saharan African countries in the sample. The cost is based upon the product of two measures for each Sub-Saharan African country. The first measure is the difference between what GDP per capita in 1985 would have been in the absence of a colonial heritage and the actual 1985 GDP per capita. The second measure is the size of the adult population in 1985.¹⁰

Table 5 reports the lost output due to having a non-French colonial heritage for the relevant 17 Sub-Saharan countries in the sample. All estimates are in millions of purchasing power dollars.¹¹ On a per country basis the costs of a colonial heritage range from 58 million

¹⁰The measure of the cost of colonial heritage is computed as follows. Let q^{**} = 1985 GDP per capita in the absence of a colonial heritage, q^* = actual 1985 GDP per capita, and $p85$ = the size of the adult population in 1985. The cost of a colonial heritage is simply $(q^{**} - q^*) \times p85$, where $q^{**} = q^* \times \exp[\beta \ln(s_h)]$. The $\exp[\beta \ln(s_h)]$ term is the absolute value of the coefficient on the COLONY $\times \ln(s_h)$ variable from column (7) in Table 4.

¹¹The Purchasing Power Parity (PPP) method uses standardized international dollar price weights to compute a country's GDP. When evaluated at PPP, a dollar will buy the same amount of goods and services anywhere in the world. The estimates in Table 5 were based on PPP computations of 1998 GDP reported in the *World Factbook 1998*, compiled by the U.S. Central Intelligence Agency. The size of the adult population in 1985 was also estimated by utilizing the fraction of the population between the ages of 15 and 16 in 1998 reported in the *World Factbook 1998*.

dollars (Somalia) to 18.3 billion dollars (Nigeria). For the 1960 - 1985 time period, having a non-French colonial heritage cost these countries 51.8 billion dollars in lost output per adult. Itemized by metropolitan country, the colonial heritage of England was responsible for approximately 82 percent of the lost output. While these estimates seem modest, when viewed as a percent of GDP in 1985, the output losses are in some cases dramatic. For example, the output losses in Angola and Mauritius constitute approximately 50 and 63 percent respectively, of GDP in 1985. Moreover, if these estimates are projected forward to say 1998, the output losses would be higher for all countries. Nor do they account for the effects of a colonial heritage prior to 1965. The itemized costs of 51.8 billion reported in Table 5 can therefore be viewed as tentative and provisional estimates of the costs associated with European colonialism in Sub-Saharan Africa—and a benchmark for the amount of any restitution considered.

CONCLUSION

Taking as serious the Theory of Restitution, this paper utilized a cross-country growth methodology to estimate the costs that European colonialism may have imposed upon former colonies in black Sub-Saharan Africa. By hypothesizing that a colonial legacy distorts by inhibiting the accumulation of human capital, estimates from a cross-country regression model indicate that the costs of a colonial heritage is reduced growth for countries with a non-French colonial heritage. The results show that for the 17 countries in the sample with a non-French colonial legacy, the costs borne by the former colonies was 51.8 billion dollars over the 1960 - 1985 time period. To the extent that European colonialism in Sub-Saharan Africa was in violation of reasonable fairness norms, and can be regarded as wrong and illegal, restitution is warranted. In this context, the results reported here can be viewed as a provisional and tentative benchmark for the dollar amount of reparations to compensate the former colonies in Sub-Saharan Africa.

There are some limitations of both the results and methodology of this paper. In general, the cross-country growth models upon which the costs of colonial heritage were based, could suffer from specification error, endogeneity problems, and data measurement errors.¹² With regard to specification error, it could be the case that a colonial legacy distorts an economy some other way. For example, it could be the case that a colonial heritage inhibit the level of technology and efficiency. If so, and if this effect is in addition to the effects that a colonial legacy has on human capital accumulation, the results reported here could be biased downward.¹³ The results provided here could also suffer from small sample bias. This is especially important, if as Temple (1999) notes, there is unobserved heterogeneity in the initial level of efficiency. Estimation of cross-country regressions with panel data, in addition to permitting more degrees of freedom on parameter inferences, would allow the investigator to control for possible heterogeneity in the initial level of efficiency. If the initial level of efficiency is determined to some extent by country-specific geographical, political, and policy factors, the cross country regression models estimated above may account for some, if not all of the heterogeneity in initial efficiency. Finally, to the extent that a

¹²Temple (1999), provides a good overview of these and others problems that can occur when estimating cross-country growth models with cross section data.

¹³To the extent that the decentralized decisionmaking mechanisms associated with democracy increase the efficiency of resource allocation, if colonialism engendered dysfunctional and undemocratic political institutions, a colonial legacy can effect growth indirectly through its effect on efficiency. The period averages reported in Table 2 suggest that non-colonies are more than two times more democratic than colonies. As DEMOC has a positive effect on economic growth, it could be the case that a colonial legacy also inhibits growth by inhibiting the democratic mechanisms that promote efficiency. This possibility was explored in regressions, not reported above, by adding to the specification of the level of technology the term COLONY \times DEMOC. The results were not conclusive, as the term COLONY \times DEMOC, was always positive but never significant, and its inclusion rendered the human capital variable insignificant in just about all the regressions reported in Tables 3 and 4. This effect of colonial heritage may be a fruitful avenue of future research.

colonial legacy imposed a cost on former colonies in Sub-Saharan Africa by inhibiting the stock of human capital, the results reported here could be biased if the variable used to measure human capital does not appropriately measure a stock. Gemmell (1996) argues that human capital measures based on school enrollment rates cannot fundamentally distinguish between stocks and flows, and the human capital measure utilized in this paper is based on school enrollment rates. The bias will be mitigated if stocks and flows are proportional to one another. Given these limitations, the estimate of the cost borne by the former non-French colonies in Sub-Saharan Africa—51.8 billion dollars over the 1960 - 1985 time period—should be interpreted with caution.

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Table 1
Colonial Heritage of Sample Countries

<u>Country</u>	<u>Heritage</u>	<u>Metropolitan Country</u>	<u>Independence</u>
<i>Angola</i>	<i>C</i>	<i>Portugal</i>	<i>1962</i>
<i>Benin</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Botswana</i>	D	<i>England</i>	<i>1966</i>
<i>Burkina Faso</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Burundi</i>	<i>C</i>	<i>Belgium</i>	<i>1962</i>
<i>Cameroon</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Central African Republic</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Chad</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Congo</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Ethiopia</i>	I		
<i>Gabon</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Gambia</i>	<i>C</i>	<i>England</i>	<i>1965</i>
<i>Ghana</i>	<i>C</i>	<i>England</i>	<i>1957</i>
<i>Guinea</i>	<i>C</i>	<i>France</i>	<i>1958</i>
<i>Ivory Coast</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Kenya</i>	<i>C</i>	<i>England</i>	<i>1963</i>
<i>Lesotho</i>	D	<i>England</i>	<i>1966</i>
<i>Liberia</i>	I		
<i>Madagascar</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Malawi</i>	<i>C</i>	<i>England</i>	<i>1964</i>
<i>Mali</i>	<i>C</i>	<i>France</i>	<i>1959</i>
<i>Mauritania</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Mauritius</i>	<i>C</i>	<i>England</i>	<i>1968</i>
<i>Mozambique</i>	<i>C</i>	<i>Portugal</i>	<i>1975</i>
<i>Niger</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Nigeria</i>	<i>C</i>	<i>England</i>	<i>1960</i>
<i>Rwanda</i>	<i>C</i>	<i>Belgium</i>	<i>1962</i>
<i>Senegal</i>	<i>C</i>	<i>France</i>	<i>1959</i>
<i>Sierra Leone</i>	<i>C</i>	<i>England</i>	<i>1961</i>
<i>Somalia</i>	<i>C</i>	<i>Italy</i>	<i>1960</i>
<i>South Africa</i>	D	<i>England</i>	<i>1961</i>
<i>Sudan</i>	<i>C</i>	<i>England</i>	<i>1956</i>
<i>Swaziland</i>	D	<i>England</i>	<i>1968</i>
<i>Tanzania</i>	<i>C</i>	<i>England</i>	<i>1964</i>
<i>Togo</i>	<i>C</i>	<i>France</i>	<i>1960</i>
<i>Tunisia</i>	<i>C</i>	<i>France</i>	<i>1956</i>
<i>Uganda</i>	<i>C</i>	<i>England</i>	<i>1962</i>
<i>Zaire</i>	<i>C</i>	<i>Belgium</i>	<i>1960</i>
<i>Zambia</i>	<i>C</i>	<i>England</i>	<i>1964</i>
<i>Zimbabwe</i>	D	<i>England</i>	<i>1965</i>

Notes: *C*, *D*, and *I* denote colony, dependency and independent respectively.

Source: Bertocchi and Canova (1999)

Table 2
Period Average and Standard Deviation Of Variables*

Variable	All Countries	Colonies	Non-Colonies
$\ln(q^*) - \ln(q_o)$.243 (.481)	.171 (.450)	.548 (.538)
$\ln q_o$	6.81 (.485)	6.79 (.415)	6.89 (.778)
$\ln(n + .05)$.904 (.322)	.863 (.286)	1.09 (.427)
$\ln PKAP$	2.51 (.515)	2.44 (.493)	2.80 (.551)
$\ln HKAP$.534 (.793)	.451 (.826)	.951 (.455)
ACCESS	.375 (.490)	.333 (.479)	.571 (.534)
OPEN	.062 (.175)	.063 (.181)	.060 (.159)
TROPIC	.870 (.311)	.948 (.187)	.500 (.500)
DEMOC	1.94 (2.46)	1.57 (1.94)	3.72 (3.87)
AVGAUT	.766 (.321)	.787 (.289)	.668 (.463)
<i>N</i>	40	33	7
Average growth rate**	.009	.007	.022

Notes:

* Standard deviations are in parentheses.

** The average continuous growth rate of GDP per capita over the 1960 - 1985 period

N = number of countries

Table 3
Estimates Of The Strict Solow Model

Regressand: Log difference of GDP per working-age person 1960 - 1985

Colonial Heritage	(0) <i>Europe</i>	(1) <i>Europe</i>	(2) <i>Belgium</i>	(3) <i>France</i>	(4) <i>Italy</i>	(5) <i>Portugal</i>	(6) <i>England</i>	(7) <i>Europe*</i>
Regressors:								
Constant	1.03 (.920)	1.71 (.969) ^c	1.95 (1.09) ^c	1.45 (1.14)	1.39 (1.07)	1.62 (1.17)	1.34 (.960)	2.33 (.772) ^a
<i>lnQ60</i>	-.115 (.136)	-.351 (.122) ^a	-.411 (.151) ^a	-.355 (.156) ^b	-.335 (.142) ^b	-.367 (.161) ^b	-.309 (.126) ^b	-.369 (.100) ^a
<i>ln(POP + .05)</i>	-	-.458 (.188) ^b	-.399 (.167) ^b	-.344 (.149) ^b	-.341 (.171) ^b	-.389 (.177) ^b	-.416 (.166) ^b	-.657 (.175) ^a
<i>lnPKAP</i>	-	.494 (.137) ^a	.529 (.134) ^a	.578 (.135) ^a	.555 (.140) ^a	.557 (.144) ^a	.524 (.132) ^a	.365 (.141) ^a
<i>lnHKAP</i>	-	.342 (.182) ^c	.219 (.104) ^b	.021 (.097)	.109 (.096)	.139 (.105)	.197 (.102) ^c	.460 (.161) ^a
<i>COLONY</i> × <i>lnHKAP</i>	-	-.229 (.159)	-.430 (.117) ^a	.234 (.111) ^b	- 5.33 (.901) ^a	-.462 (.503)	-.281 (.145) ^b	-.527 (.185) ^a
<i>R</i> ²	.013	.441	.466	.465	.439	.415	.472	.562
\bar{R}^2	-.012	.358	.388	.387	.357	.329	.394	.425
<i>Implied λ</i>	-	.017	.021	.017	.016	.018	.014	.018
<i>Sample Size</i>	40	40	40	40	40	40	40	22

Notes:

*Europe** denotes having a non-French colonial heritage

^a Significant at the .01 level

^b Significant at the .05 level

^c Significant at the .10 level

Table 4
Estimates Of The Extended Solow Model

Regressand: Log difference of GDP per working-age person in 1960 - 1985

Colonial Heritage	(1) <i>Europe</i>	(2) <i>Belgium</i>	(3) <i>France</i>	(4) <i>Italy</i>	(5) <i>Portugal</i>	(6) <i>England</i>	(7) <i>Europe*</i>
Regressors:							
Constant	3.31 (1.09) ^a	3.62 (1.06) ^a	3.24 (.905) ^a	3.26 (1.09) ^a	3.30 (1.09) ^a	2.79 (.859) ^a	3.89 (.327) ^a
<i>lnQ60</i>	-.513 (.136) ^a	-.575 (.129) ^a	-.533 (.105) ^a	-.512 (.136) ^a	-.512 (.141) ^a	-.429 (.115) ^a	-.553 (.094) ^a
<i>ln(POP + .05)</i>	-.469 (.221) ^b	-.482 (.205) ^b	-.441 (.167) ^a	-.435 (.207) ^b	-.474 (.213) ^b	-.523 (.198) ^a	-.615 (.188) ^a
<i>lnPKAP</i>	.446 (.145) ^a	.427 (.137) ^a	.456 (.122) ^a	.448 (.144) ^a	.444 (.148) ^a	.426 (.122) ^a	.242 (.083) ^a
<i>lnHKAP</i>	.079 (.190)	.199 (.086) ^b	-.118 (.059) ^b	.079 (.089)	.097 (.102)	.156 (.098)	.240 (.090) ^a
<i>COLONY × lnHKAP</i>	.021 (.201)	-.410 (.106) ^a	.484 (.082) ^a	-4.76 (1.02) ^a	.017 (.498)	-.411 (.105) ^a	-.411 (.115) ^a
ACCESS	-.072 (.142)	-.060 (.111)	.101 (.107)	-.106 (.120)	-.078 (.124)	-.062 (.096)	.035 (.072)
OPEN	-.009 (.382)	-.117 (.257)	.142 (.263)	-.028 (.284)	.011 (.282)	.666 (.324) ^b	.565 (.312) ^c
TROPIC	-.529 (.164) ^a	-.478 (.163) ^a	-.528 (.111) ^a	-.501 (.171) ^a	-.522 (.179) ^a	-.423 (.153) ^a	-.403 (.104) ^a
DEMOC	.054 (.049)	.062 (.042)	.088 (.031) ^c	.056 (.043)	.052 (.043)	.038 (.033)	.079 (.041) ^c
AVGAUT	.094 (.221)	.156 (.216)	.089 (.156)	.102 (.213)	.094 (.224)	.026 (.184)	.115 (.258)
<i>R</i> ²	.549	.595	.698	.569	.549	.625	.892
\bar{R}^2	.393	.456	.594	.421	.393	.495	.794
<i>Implied λ</i>	.028	.034	.030	.029	.029	.022	.032
<i>Sample Size</i>	40	40	40	40	40	40	22

Notes:

* Non-French colonial heritage

^a Significant at the .01 level

^b Significant at the .05 level

^c Significant at the .10 level

Table 5
Itemized Costs of Colonial Heritage

<u>Country</u>	<u>Metropolitan Country</u>	<u>Cost of Colonial Heritage*</u>	<u>% of 1985 GDP</u>
<i>Angola</i>	<i>Portugal</i>	3780.5	.50
<i>Burundi</i>	<i>Belgium</i>	510.1	.14
<i>Gambia</i>	<i>England</i>	58.0	.05
<i>Ghana</i>	<i>England</i>	4791.8	.14
<i>Kenya</i>	<i>England</i>	6923	.17
<i>Malawi</i>	<i>England</i>	776.6	.10
<i>Mauritius</i>	<i>England</i>	2370.9	.63
<i>Mozambique</i>	<i>Portugal</i>	1124.1	.08
<i>Nigeria</i>	<i>England</i>	18381	.15
<i>Rwanda</i>	<i>Belgium</i>	939.13	.34
<i>Sierra Leone</i>	<i>England</i>	290.9	.12
<i>Somalia</i>	<i>Italy</i>	50.9	.01
<i>Sudan</i>	<i>England</i>	4066.8	.16
<i>Tanzania</i>	<i>England</i>	2812.8	.15
<i>Uganda</i>	<i>England</i>	186.56	.01
<i>Zaire</i>	<i>Belgium</i>	4510.1	.27
<i>Zambia</i>	<i>England</i>	1764.9	.22
<u>TOTALS:</u>			
	Belgium	5559.33	
	England	42423.26	
	Italy	50.9	
	<u>Portugal</u>	<u>3780.5</u>	
	Europe	51813.99	

Notes:

* Millions of Purchasing Power Parity dollars