

CIVIL WARS AND ECONOMIC GROWTH: A REGIONAL COMPARISON*

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The paper examines the impact of civil wars on income per-capita growth at home and in neighbors for four regional groupings of countries: Africa, Asia, Latin America, and a pooled Asian and Latin American sample. Both macroeconomic and civil-war influences on growth differ by region. With the use of a distance measure, we demonstrate that the spatial reach from the negative consequences of a civil war are region and time period specific. Generally, there was less dispersion in Africa than in Asia and Latin America. Moreover, Africa demonstrates a greater ability to recover from the adverse effects of civil wars than the other regions tested.

Keywords: Civil wars; Economic growth; Spatial econometrics; Africa; Asia; Latin America

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INTRODUCTION

With the end to the Cold War, the dream of a less conflict-ridden world has not materialized as intrastate wars have replaced interstate wars. Such intrastate conflicts rage in many developing countries during the 1990s (Wallenstein and Sollenberg, 2001), and may stem from ethnic hatreds that manifest themselves in terms of nationalism, separatism, or a fight for an ethnic identity (James and Goetze, 2001). In other situations, civil wars may be rooted in greed as opposing interests vie for resource wealth (Collier, 2000; Collier and Hoeffler, 1998; 2002). Regardless of whether these intrastate wars are grievance or greed based, they may have profound consequences on economic growth, not only at home but also in neighbors from such factors as the diversion of foreign direct investment (FDI), disruption

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to trade, destruction of social overhead capital, loss of human capital, the displacement of people, and the reallocation of resources to less productive activities.¹

In an earlier paper, we have shown that there is a significant impact on economic growth at home and in *contiguous* neighbors in both the short- and long-run for a worldwide sample during 1960–85 (Murdoch and Sandler, 2002). This initial study raises a number of questions, including whether external cost, stemming from a civil war, may extend beyond contiguous neighbors to countries separated by water or intervening countries. Thus, the spatial spread of the negative consequences of a civil conflict was not addressed. Moreover, there arises the issue as to whether the consequences of civil wars and their spatial diffusion are region specific. The initial study with its worldwide sample could not distinguish between regions.

In a second study, we introduced previously absent spatial considerations, so that the diffusion of a civil war's externalities on growth could be examined up to 950 kilometers (km) away from the closest approach to a country in civil conflict (Murdoch and Sandler, 2001). To partly address the regional issue, we contrasted an African sample with a global sample. This study indicated that the dispersion of civil-war influences is well beyond immediate neighbors and reaches as far as 800 km for the worldwide sample and 300 km for Africa in the long run (1960–95). Generally, this dispersion is more localized in the short run than in the long run, particularly for the African sample. In addition, Africa displays a greater ability than the worldwide sample to recover following a civil war owing to convergence, schooling, and other factors. Based on a series of tests, the key channel through which civil wars impact growth was traced to an exogenous shift parameter rather than to such influences as in-migration, investment, or human capital.

The purpose of the current paper is to carry forward our regional comparisons and spatial investigation. To do so, we divide a portion of the global sample into three regions – Africa, Asia, and Latin America.² For each of these regions, we investigate the impact of civil wars at home and in neighbors for both the short and long run, so as to derive some regional comparisons. We also report estimates for a pooled sample of Asia and Latin America to circumvent the limited sample size of these regional estimates. Unlike our earlier study, we do a more systematic investigation of the spatial diffusion of civil wars by estimating runs in 50-km increments from contiguity up to 800 km.³ Only the single best model is reported for each region in the short and long run, based on two alternative measures of civil wars (*i.e.*, the war's presence or absence and its duration in months), so that four best models are presented for each regional composite.

A number of interesting findings derive from the analysis. First, in contrast to Latin America and Asia, Africa displays a greater resilience and ability to grow following the conclusion of a civil war at home or in the vicinity. Second, the negative neighborhood consequences of a civil war on economic growth are stronger than host-country influences for the regions examined. These neighbor spillovers are generally stronger in Asia than in Africa for both long- and short-run estimates. Third, Africa fits the neoclassical growth model better in terms of convergence and schooling than the other regional conglomerates studied. Fourth, spatial dispersion of civil-war spillovers differ by regions. In the short run, Africa displays greater concentration of civil-war spillovers as compared with other regions. In the long run, this same concentration is present but is less clear-cut.

¹On the causes and consequences of civil wars, see Collier and Hoeffler (1998; 2002), Collier and Sambanis (2002), Collier *et al.* (1999), Elbadawi and Ndung'u (2000), Elbadawi and Sambanis (2000; 2002), and Sambanis (2001; 2002). Sambanis (2002) provides an excellent up-to-date overview of the recent literature on civil wars.

²Europe is left out of the regional division owing to degree of freedom considerations.

³Murdoch and Sandler (2001) only report three snapshots – 100 km, 300 km, and 800 km for Africa and a worldwide sample. There was no significant diffusion beyond 800 km.

THEORETICAL MODEL

As a basis for the long-run estimates of the determinants of growth, an augmented Solow (1957) neoclassical growth model is used. Augmentation involves two additions. First, human capital is included as a primary input along with physical capital, labor, and labor-augmenting technological change. Second, civil war is introduced as a determinant of economic growth. Based on our earlier two analyses which tested for the channels by which civil wars influence growth, we shall follow the outcome of these past tests and include civil-war influences as an exogenous shift variable.

The human-capital augmented Solow model has two essential ingredients – a neoclassical production function and transition equations for the two forms of capital (Mankiw *et al.*, 1992). The relevant Cobb-Douglas production function that relates output (income), $Y(t)$, at time t to physical capital, K , labor, L , and human capital, H , is:

$$Y(t) = K(t)^\alpha H(t)^\beta [A(t)L(t)]^{1-\alpha-\beta}, \quad 0 < \alpha + \beta < 1, \quad (1)$$

where α and β are the elasticities of output with respect to physical and human capital, respectively. In Eq. (1), $A(t)$ denotes labor-embodied technical change, while $(1-\alpha-\beta)$ represents the output elasticity of effective units of labor, $A(t)L(t)$. Labor grows at the exogenous natural rate of n , while technological progress grows at the exogenous rate of g . The production function in Eq. (1) displays the neoclassical properties of constant returns to scale (*i.e.*, the same proportional change in the three inputs results in the same proportional change in output), diminishing marginal product for a single varying input, and the Inada conditions. The latter means that an input's marginal product approaches infinity (zero) as the input approaches zero (infinity).⁴

Given the assumption of constant returns to scale, we can divide both sides of Eq. (1) by AL and express income per capita ($y = Y/AL$) as:

$$y(t) = k(t)^\alpha h(t)^\beta, \quad (2)$$

in effective labor, where $k = K/AL$ and H/AL .

The second essential ingredient of the growth model involves the transition equations for physical and human capital that accounts for the growth of capital per capita (\dot{k}) and human capital per capita (\dot{h}), respectively. For physical or human capital, savings (s_k or s_h) earmarked to physical or human capital accumulation (*i.e.*, investment) augments \dot{k} or \dot{h} , respectively, while capital depreciation, δ , decreases the growth of either form of capital. The savings shares s_k and s_h indicate the share of income per capita devoted to the respective source of capital. Because everything is measured in effective labor units, a rise in either component of $A(t)L(t)$ also decreases \dot{k} and \dot{h} by increasing their denominators. That is, the sum $n + g$ operates in an identical fashion to depreciation in reducing the growth of physical and human capital per capita.⁵ The transition equations are:

$$\dot{k}(t) = s_k y(t) - (n + g + \delta)k(t), \quad (3)$$

⁴The Inada condition rules out corner solutions, so that all inputs are used in equilibrium.

⁵For a derivation of the transition equations displayed in Eqs. (3) and (4), see Mankiw *et al.* (1992) or Murdoch and Sandler (2002).

and

$$\dot{h}(t) = s_h y(t) - (n + g + \delta)h(t). \quad (4)$$

Based on the standard representation in the literature, depreciation is assumed to be at an identical rate for physical and human capital.

To derive the long-run growth equation, we must first find expressions for the steady-state physical and human capital per capita where $\dot{k} = \dot{h} = 0$, so that stationary values for k and h are maintained in perpetuity. Based on these steady-state values and a constant rate of convergence, the steady-state transition equation and the production function can be combined to represent steady-state long-run growth of income per capita (gr) as:⁶

$$gr = a + b_1 \ln(s_k) + b_2 \ln(s_h) - b_3 \ln(n + g + \delta) - b_4 \ln y(0), \quad (5)$$

where \ln denotes the natural logarithm, a is a constant, b_i are coefficients, and $y(0)$ is the initial level of income per capita. The b_i coefficients capture the output elasticities and other influences, now suppressed.

The long-run income per-capita growth in (5) depends positively on savings devoted to either form of capital, insofar as savings shares are equivalent to the associated investment shares along the steady-state growth path.⁷ Long-run income per-capita growth, however, falls with an increase in $(n + g + \delta)$ or with a higher initial level of income per capita. Either an increase in the natural rate of labor growth or in labor efficiency raises the denominator of income per capita, thereby reducing its level at a point in time or over time. Similarly, depreciation also limits income growth by curbing the growth of various forms of capital as depreciation must be offset by positive accumulation. Finally, the initial level of income per capita creates a negative influence on income growth, known as *convergence*, owing to diminishing returns of capital accumulation. If countries are similar with respect to structural parameters regarding technology and depreciation, poor countries with smaller initial incomes will grow faster than richer countries (Barro, 1991; Barro and Sala-i-Martin, 1992). Convergence hinges on diminishing returns to the various types of capital, for which poor countries possess smaller ratios of capital to labor, so that they also have a higher marginal product for the alternative forms of capital. These higher marginal products of physical and human capital promote catch-up with a higher corresponding growth rate. Convergence is an essential consideration for investigating the influence of a civil war. In the aftermath of a civil war, a country will be starting at a relatively low income per capita, where catch-up through convergence is an important factor. Convergence can create a "Phoenix" effect as a civil-war-torn nation rises out of its ashes [Organski and Kugler (1980) first introduced this effect].

Civil wars can adversely affect economic growth at home and in neighbors through similar channels. First, such conflicts destroy physical, human, and social overhead capital at home and abroad (through collateral damage). Second, a civil war can divert FDI flowing to the region because of heightened perceived risks that make investment opportunities appear more attractive elsewhere. Third, civil wars can result in a displacement of people that creates refugees within a country and the outflow of refugee migrants to neighbors. These migrants not only increase population growth, but also put pressures for government-provided resources for food and shelter. The home versus neighborhood effects of such displacements

⁶These substitutions can be found in Mankiw *et al.* (1992), Barro (1997), and Barro and Sala-i-Martin (1992).

⁷As is standard, this assumes full employment.

is an empirical question that requires a better tracking of refugees than was available. Fourth, daily market activities including trade may be disrupted by civil wars (*e.g.*, input supply lines may be severed). Fifth, governments must mobilize resources to quell conflicts at home or to bolster border defense for conflicts in neighbors. In both scenarios, resources must be diverted from potentially more productive activities, especially from a growth viewpoint.

Based on the above discussion, there are four potential channels – human capital, migration, investment, and intercept shifter – through which civil war at home or nearby can adversely impact economic growth. In two previous studies, we discerned no impact of civil wars on growth stemming from human capital, migration, or investment when applying statistical tests; hence, we shall treat civil war at home and in the vicinity as a potential shift parameter in the growth equation. As such, a civil war reduces human capital, displaces people, curtails investments and destroys output, all of which decreases the level of income per-capita growth as a shift to a lower equilibrium path takes place.

There are a number of factors that can create different regional responses from civil wars. First, these responses may vary owing to cultural factors (*e.g.*, language similarity) within regions that allow a society to endure conflict. Second, the terrain in a region may influence the spatial spread of civil war impacts. Third, regional transportation networks (*e.g.*, roads and waterways) may affect the manner in which a civil war in one place spreads to another within regions. Different network configurations may result in different regional diffusion patterns. Fourth, the shapes and sizes of nations in a region may affect the impact of civil wars. A region with smaller nations may experience more diffusion. Other such factors may also be at play.

EMPIRICAL SPECIFICATION AND DATA

Equation (5) is the foundation for the empirical representation. From a particular initial point ($t = 0$) and an observation period (where time = t), the theoretical model can be parameterized as:

$$gr = \zeta_0 + \zeta_1 \ln(y_0) + \zeta_2 \ln(invest) + \zeta_3 \ln(school) + \zeta_4 \ln(n + g + \delta), \quad (6)$$

where gr is the rate of income per-capita growth in the observational period, y_0 is the income per capita in the initial year of the period, $invest$ and $school$ are, respectively, the shares of physical and human capital in the observational period, and $(n + g + \delta)$ is the effective growth rate of labor plus depreciation. In (6), the ζ coefficients are similar for regional groupings of countries to allow for a cross-sectional estimation. The associated regression model for (6) that includes civil war influences at home (*civil*) and nearby (*w_civil*) is:

$$gr_i = \zeta_0 + \zeta_1 \ln(y_0) + \zeta_2 \ln(invest_i) + \zeta_3 \ln(school_i) + \zeta_4 \ln(n_i + g_i + \delta_i) + \zeta_5 civil_i + \zeta_6 w_civil_i + \varepsilon_i. \quad (7)$$

In (7), the i subscript denotes the country, and ε_i indicates an unmeasured random country-specific effect.

Both long- and short-run estimates are presented for the various regional samples. For the long-run estimates, the growth of income per capita is for 35 years (1961–95) and corresponds to the steady-state convergence behind the theoretical model. The underlying steady-state convergence captured by (7) is unlikely to apply to the short-run estimates involving a panel of five-year observational periods. Like the literature (Burnside and Dollar, 2000; Forbes, 2000), the theoretical underpinnings of our short-run estimates are somewhat tenuous.

For g and δ , we follow Mankiw *et al.* (1992) and set $g + \delta$ equal to 0.05 for all sample countries. Income per capita, y , is measured as the real gross domestic product

(GDP) per capita in constant dollars, and is available in the Penn World Tables Mark 5.6 (PWT) for the years 1960–92 (<http://pwt.econ.upenn.edu>) and from the World Bank (<http://www.worldbank.org/research/growth/GDNdata.htm>) after 1992.⁸ These same sources are used for population (in thousands) and the real investment share of GDP for each year. To distinguish the *various* years, we attach the last two digits of the year to the variable; for example, y_{60} is the measure of income per capita in 1960. Similar expressions apply to investment per capita (e.g., i_{65} for 1965) and population (e.g., pop_{65}). To find the growth rate of income per capita, gr , we take the difference between the natural logarithm of income per capita at the end and at the start of the relevant period, so that this growth for 1961–95 is $\ln(y_{95}) - \ln(y_{61})$. A similar difference in natural logarithms divided by the number of years gives the *annual* population growth, n . Thus, the annual growth of labor during 1961–95 is $[\ln(pop_{95}) - \ln(pop_{61})]/35$.

In Table I, we display the variables, names, and descriptions that appear in subsequent empirical Tables when results are reported. The average investment share (*invest*) is the arithmetic average of the investment share of per-capita income for the corresponding period. Following Barro and Lee (2000), human capital accumulation, s , corresponds to the percentage of population older than 25 that has attained secondary schooling in a given year (e.g., s_{60} is the schooling variable for 1960). The *school* variable is the schooling percentage for the initial year of the relevant period. Mankiw *et al.* (1992, p. 418) indicate that the human-capital-augmented growth may rely on either the rate of accumulation or the level attained, and that some care must be exercised when interpreting the associated coefficient.⁹ The attainment data are available quinquennially.

Under the appropriate conditions, the data on y_0 , *invest*, *school*, $(n + g + \delta)$, and economic growth can be used to estimate the coefficients of (6). Our interest goes beyond estimating the theoretical relationship between the standard determinants of growth. Instead, we take the economic structure as set and seek civil-war influences that may directly affect

TABLE I Variable Names and Descriptions for the Derived Data.

<i>Variable</i>	<i>Description</i>
$\ln(\cdot)$	Denotes natural logarithm.
<i>gr</i>	Growth in income per capita over the relevant sample period.
<i>invest</i>	Average annual share of investment over the relevant sample period.
$n + g + \delta$	Average annual population growth over the relevant sample period plus 0.05 for $g + \delta$.
<i>school</i>	s_{xx} , where xx is the starting year of the relevant sample period.
<i>civ</i>	Civil war dummy, equal to one if $months_{xx}$ is greater than zero during any years of the sample period, and zero otherwise.
<i>tmonths</i>	Total months of civil war during the relevant sample period.
<i>w</i>	Row standardized weight matrix where the weights are determined by the neighbors matrix. These are weight matrices based on contiguity and distance. See text for specific definitions.
<i>w_civ</i>	w_{civ} : The "spatial average" of <i>civ</i> , indicating civil wars in neighboring countries over the relevant sample period.
<i>w_tmonths</i>	$w_{tmonths}$: The "spatial average" of <i>tmonths</i> , indicating the total months of civil war in neighboring countries over the relevant sample period.
<i>asia</i>	Dummy variable, equal to one if the country is in Asia, and zero otherwise.

Note: We consider two observational periods corresponding to long run and short run. In the long-run estimations, the initial year ($time = 0$) is 1960 and the final year is 1995 so that $gr = \ln(y_{95}) - \ln(y_{61})$. In the short-run estimations, we use five-year observational periods with initial years of 1960, 1965, 1970, 1975, 1980, 1985, and 1990. Thus, gr in the first short-run observational period is $\ln(y_{65}) - \ln(y_{61})$ and similarly for the other observations.

⁸In PWT 5.6, this variable is listed as "RGDPCH".

⁹Our model corresponds most closely to Eq. (12) in Mankiw *et al.* (1992).

long- and short-run economic growth in various regions. In so doing, we are removing such factors from the all-encompassing error term.

Two alternative indicators of civil wars are applied during the observational periods and regions: (i) a (0, 1) dummy denoting whether or not a country or its *neighbors* experienced a civil war (*civ* and *w_civ*, respectively); and (ii) the number of months, if any, that a country or its neighbors experienced a civil war during the relevant period (*tmonths* and *w_tmonths*, respectively). The data on the *civ* variables are drawn from Singer and Small (1993), *Correlates of War Project* (COW), for 1960–92 and on the updates to COW data available in Collier and Hoeffler (2002) for 1993–95. For *tmonths* and *w_tmonths*, we rely on the monthly totals from Collier and Hoeffler (2002).

To construct *w_civ* and *w_tmonths*, we must define “neighboring” countries. To this goal, we employ two different “neighbors matrices” that account for the presence or absence of contiguity (**Nc**) and the actual distance of closest approach between two countries (**Nd**) for arbitrarily chosen distances, varied by 50-km intervals. In any neighbors matrix, the entries in the rows and columns correspond to the countries of the relevant region (*i.e.*, Africa, Asia, Latin America, or a pooled Asian and Latin American sample) arranged in alphabetical order in the rows and columns. In the case of **Nc**, an entry $N_{c_{ij}}$ equals 1 if the *i* and *j* countries are contiguous and 0 otherwise. Since a country cannot be contiguous to itself, the diagonal entries of **Nc** are all 0s. The neighbors matrix is then used to define the spatial weight matrix, **Wc**, whose elements are row standardized by dividing each row of **Nc** by its row sum (Gleditsch and Ward, 2000), so then the *ij* entry of **Wc** is $N_{c_{ij}} / \sum_j N_{c_{ij}}$. For **Nd**, a similar procedure is followed. Consider **Nd** for 100 km, where the neighbors “distance” matrix also involve 0 and 1 entries. If country *j* is 100 km or less from the nearest approach to country *i*, then $N_{d_{ij}}$ is 1, otherwise it is 0. **Wd** is the row standardized matrix of **Nd**, where each entry is $N_{d_{ij}} / \sum_j N_{d_{ij}}$.

The “spatial lag” of the two alternative civil-war indicators are identified by taking the dot product of $\mathbf{Wk}(\mathbf{k} = \mathbf{c}, \mathbf{d})$ and the appropriate vector of the civil-war measure for the regional sample. The spatial lag refers to observations *removed in space* from an observation under consideration. Let **TMONTHS** denote the $N \times 1$ vector of civil-war months that each of the *N* countries of a region endured within the sample period. $\mathbf{Wc} \cdot \mathbf{TMONTHS}$ is then the $N \times 1$ vector whose entries reflect the weighted sum for a sample country of its neighbors’ civil-war episodes. Row standardization allows the economic spillovers from a civil war to be in proportion to the “share” of contiguity with its war-torn neighbors through which refugees, rebels, and other negative externalities can pass. A similar construction holds for $\mathbf{Wd} \cdot \mathbf{Civ}$, where **Civ** is the $N \times 1$ vector of 0s and 1s, owing to the absence or presence of a civil war. Different **Nk** and **Wk** must be constructed for each regional sample.

To construct **Nc**, we consult the *CIA* (2000) *Factbook*. In those cases where a country’s borders changed during an observational period, the country is dropped from the sample of that period. The borders in the *CIA Factbook* are irrelevant for some countries prior to 1990 because of later division. To include these cases in the early observational periods, we apply the independent states definition in Gleditsch and Ward (2000) and consult various paper atlases to reconstruct the geography in terms of borders of the countries during each sample period. As a consequence, the number of observations per sample period is not always the same.¹⁰ For the various **Nd** distance matrices, we use the raw distance matrices developed by Gleditsch and Ward (2000; 2001), which provide the minimum distance between all country pairs up to 950 km. The dot products, $\mathbf{Wd} \cdot \mathbf{Civ}$ and

¹⁰The issue concerning the number of observations is only relevant when pooling over five-year periods. Some countries may not exist in all of the periods. When we examine long-run growth, we are restricted to those countries that existed for the entire 1960–95 period.

Wd · TMONTHS, provide the spatial spillovers from civil wars when distance is used. With data on *civ*, *tmonths*, and the various definitions of *w_civ* and *w_tmonths*, we can simply insert combinations of these variables as regressors in Eq. (7) and then test variations of the model for various regional conglomerates and distances.

RESULTS

We begin by presenting the long-run estimates for the four regional samples, followed by the short-run panel estimates for the four regional samples. For each region, we estimate the model with the closest distance of approach beginning with contiguity and increasing by 50-km increments, up to and including 800 kilometers. This is accomplished for both civil-war measures, so that there are 17 empirical representations for each empirical specification (*i.e.*, for a specific region, time frame, and civil-war measure). To focus the presentation of the empirical results, we report just eight representations – two per regional conglomerate – that are the “best fitting model” for the region in terms of the spatial reach for civil-war spillovers during the relevant time period. The best fitting model is the one that maximizes the likelihood function. For each specification, all estimations have the same number of observations and parameters. The only change, as the spatial reach is varied for a specific empirical specification, is the weight matrix used in the calculation of *w_civ* and *w_tmonths*. Thus, the identification of the best fitting models is simply a matter of finding the reach measure that maximizes the *R*-squared for each specification. For the long- and short-run, a single such model is identified for each region and each of the two civil-war measures.

In Table II, sixteen best fitting models are indicated in terms of spatial reach for the various regions and the alternative time periods of analysis. Some interesting spatial diffusion can be inferred from Table II.¹¹ First, there is some evidence of greater spatial spillovers from civil wars in the long run as compared with the short run, in keeping with our priors. For Africa, Latin America, and Asia, there is at least one representation that performs better at a greater distance in the long run. The pooled sample shows the opposite tendency with a greater dispersion in the short run. Second, regions display diverse spatial diffusion of civil-war externalities. There is a clear tendency for this diffusion to be *less disperse* in Africa in the long and short run than in either Latin America or Asia. The pooled Latin American and Asian sample supports this tendency towards greater dispersion in the short run, but not in the long run.¹²

TABLE II Best Fitting Models in Terms of Spatial Reach.

Sample	Long-run Regression		Short-run Regression	
	<i>civ</i>	<i>tmonths</i>	<i>civ</i>	<i>tmonths</i>
Africa	500 km	contiguity	100 km ^a	100 km ^a
Latin America	700 km	contiguity	300 km ^a	contiguity ^a
Asia	contiguity	800 km	600 km	500 km
Pooled Latin America and Asia	contiguity ^a	contiguity	700 km	700 km

^aAlso some evidence of “second-order” effect at greater reach.

¹¹We do not display the binary Asia variable for the pooled estimates. Country fixed effects that are dummies are not estimated to avoid a potential identification problem.

¹²There is no way to test between models for the same regime but different time periods (*i.e.*, short and long run), because there is no way to define the restricted (or pooled) model. The spatial weight matrix is different between such comparison models. For the same reason, there is no way to statistically compare the models between regions for the same time period.

Long-run Estimates

In Table III, the eight best long-run models for the four regional samples are displayed. Variables are indicated in the left-hand columns, while the relevant spatial reaches are listed at the top of the columns. The Latin American estimates perform poorly even for the best models and our remarks are focused on Africa, Asia, and the pooled sample of Latin America and Asia. For these three samples, *invest* is a positive and significant, at the 0.05 level, determinant of long-run income per-capita growth. These *invest* coefficients are of similar magnitudes for the regions, with the African sample possessing the smallest values. Investment accounts for between 0.43 and 0.75 of a percent in additional growth in income per capita. For example, in the African sample, the mean of *invest* is 10.24 percent, while the mean of *gr* is 26.09 percent over the observational period. An increment of 1.0 in the invest ratio (to 11.24 percent) would be associated with an increment in the long-run growth rate of approximately 0.05 (from a mean of 0.2609 to approximately 0.311) in the 500-km specification ($0.546 \times [\ln(11.24) - \ln(10.24)]$). Thus, an approximate 10 percent change in the investment ratio yields an approximate 20 percent change in the growth rate in this model. The role of investment is striking when we compare across regions. The *average* growth in per-capita income in the Asian sample is a whopping 107.7 percent for the entire period, while the average investment ratio is slightly greater than 18 percent. Clearly, this investment influence is dominant in Asia.

Unlike the other regions, *school* is a positive and significant determinant of economic growth in Africa. For the African sample, the mean of *school* is just 5.9 percent. Thus, an increment of 1.0 to the school ratio gives an increase of 0.042 to the long-run growth, implying that an approximate 15 percent change in secondary school attainment rates yields an

TABLE III Estimated Coefficients of Long-run Growth Regressions by Region. *t*-ratios (in Parentheses) are Computed with White's Robust Standard Errors.

Variable	Africa		Latin America		Asia		Pooled ^b Latin America and Asia	
	500 km	contiguity	700 km	contiguity	contiguity	800 km	contiguity	contiguity
ln(<i>y</i> ₀)	-0.581 (-4.21)	-0.502 (-3.54)	0.078 (0.24)	0.157 (0.49)	-0.047 (-0.42)	-0.056 (-0.38)	-0.106 (-0.83)	-0.037 (-0.25)
ln(<i>invest</i>)	0.546 (5.33)	0.436 (3.81)	0.332 (0.80)	0.371 (0.92)	0.600 (2.13)	0.588 (3.37)	0.753 (3.56)	0.688 (3.92)
ln(<i>n + g + δ</i>)	-1.199 (-1.16)	-0.446 (-0.42)	0.300 (0.19)	0.618 (0.42)	-0.780 (-0.87)	-1.375 (-2.07)	-0.680 (-1.14)	-0.677 (-1.18)
ln(<i>school</i>)	0.270 (3.70)	0.293 (3.88)	-0.051 (-0.38)	-0.016 (-0.07)	0.074 (0.39)	0.075 (0.91)	-0.141 (-1.15)	-0.110 (-1.05)
civ	-0.102 (-1.01)		-0.082 (-0.38)		-0.391 (-1.25)		-0.117 (-0.86)	
w_civ	-0.525 (-1.84)		-0.455 (-0.84)		-0.754 (-2.61)		-0.600 (-2.53)	
tmonths ^a		-0.130 (-1.60)		-0.059 (-0.49)		-0.116 (-2.91)		-0.032 (-0.76)
w_tmonths ^a		0.200 (1.01)		-0.331 (-0.96)		-0.786 (-5.03)		-0.366 (-3.90)
constant	-0.265 (-0.11)	1.118 (0.43)	0.035 (0.01)	0.033 (0.01)	-2.083 (-0.80)	-3.558 (-1.51)	-2.081 (-1.19)	-2.557 (-1.58)
R-square	0.68	0.67	0.22	0.27	0.89	0.88	0.68	0.70
Observations	31	31	20	20	14	14	34	34

^atmonths and w_tmonths coefficients are multiplied by 100 for presentation.

^bIncludes a binary variable for Asia.

approximate 15 percent change in long-run growth. There is no such evidence of returns to additional schooling in the Asian sample, where the average attainment rate over the 35-year period is over 27 percent.

Evidence of convergence only characterizes the African sample in the long run, where the coefficient of $\ln(y_0)$ is negative and significant. Moreover, only one of the Asian empirical models indicates a negative and significant coefficient for the labor augmentation and depreciation determinant of economic growth. As indicated above, the Asian growth process appears to be dominated by the investment ratio.

The host-country civil-war influence on economic growth is negative for either *civ* or *tmonths* for all long-run representations, but is only significant at the 0.05 level for the 800-km model of Asia. There is evidence for the African, Asian, and pooled samples that nearby civil wars have a negative impact on economic growth. For both civil-war measures, this negative spillover influence is greatest in Asia and is large in comparison to host-country impacts of civil wars on income per-capita growth. The negative impact of neighboring civil wars in Asia is almost eight-tenths of a point of income per-capita growth. A more modest spillover effect characterizes the pooled sample – six-tenths or four-tenths of a point of growth of income per-capita growth for *civ* and *tmonths*, respectively. For Africa, the neighborhood effect is only significant at the 0.05 level (one-tail test) and just for *civ*, where it reduces growth by a half of a percent.

The spillover results presented in Table III are somewhat curious, insofar as they seem to suggest an inconsistency in the sign of the effect and the magnitude of the spatial reach. *A priori*, we anticipated a negative sign and relatively long distance in these long-run models. In the duration specification of the African sample, however, there is a positive sign on *w_tmonths*, with the best fit at zero distance. Additionally, the Asian estimates on *w_civ* and *w_tmonths* suggest totally different conclusions about the spatial reach of civil wars' influence on growth.

To investigate these findings further, we construct additional weight matrices that facilitate additional spillover terms in each specification. Consider the *tmonths* specification for the African sample. Because the best fit is contiguous, we include an extra term that measures the spatial average of *tmonths* in African countries beyond contiguous up to 800 km. The new estimate, while insignificant, is negative. Focusing on the best fit in terms of this second term, we indeed find that the best representation includes the 800-km reach. When coupled with the results from the *civ* specification, this finding appears to support that the positive sign on *w_tmonths* is probably an anomaly, suggesting that the African data are really more in line with our priors.

Similar tests performed on the Latin American and Asian samples are less convincing. The likelihood function of the Latin American specifications is very flat in terms of spatial reach. There is simply no evidence to support conclusions about the distance (or sign) of the spillover term in these specifications. Interestingly, the results for Asia appear to hold up even when we add further terms. That is, *w_tmonths* with a reach of 800 km outperforms any breakdown of this spillover term (e.g., less than 400 km and greater than or equal to 400 km). Similarly, the *w_civ* term based on contiguity outperforms any other two-variable breakdown of this effect.

For the long-run estimates, the African empirical results best display the standard determinants of growth, while indicating some weak tendency toward negative host-country civil-war influences. The Latin American and Asian samples do not perform as well, owing to the small degrees of freedom; thus, there is a need to pool these two samples. The failure of the schooling term to indicate a significant influence is due to a lack of variation in this term among the Latin American and Asian sample nations. This lack of variation is particularly a problem for the determinants of growth in the Latin American sample. The strong convergence result for Africa implies its ability to recover following a civil war, an ability

that is bolstered by the schooling influence.¹³ For the other regions, this same "Phoenix" effect is not present in the long run.

Short-run Estimates

In Table IV, the short-run estimates of income per-capita growth are displayed for the two best fitting models as spatial reach is varied for each of the regional groupings. The reported estimated coefficients are based on panel estimations for seven five-year time periods, commencing with 1961–65 and concluding with 1991–95. The value of y_0 is y_{60} in the first period, y_{65} in the second period, and so on. For the eight empirical models displayed, the time fixed effects are suppressed to conserve space. The dependent variable is the relevant five-year growth of income per capita.

Except for Africa, there is again no evidence of convergence. The African convergence coefficient is understandably much smaller in absolute value, and is only significant at the 0.10 level in the short run. The African, Latin American, and pooled samples display a positive and significant investment influence on the growth of income per capita that varies between 0.054 and 0.107 of a percentage point of growth. The composite labor growth and depreciation term is negative and significant as anticipated for just the Asian and the pooled samples. For Africa, this labor influence is negative, but is well short of being significant. Analogous to the long-run estimates, only Africa has a positive and significant

TABLE IV Estimated Coefficients of Short-run Growth Regressions by Region.^a *t*-ratios (in Parentheses) are Computed with White's Robust Standard Errors.

Variable	Africa		Latin America		Asia		Pooled ^c Latin America and Asia	
	100 km	100 km	300 km	contiguity	600 km	500 km	700 km	700 km
$\ln(y_0)$	-0.047 (-1.92)	-0.048 (-1.95)	0.014 (0.40)	0.008 (0.25)	-0.007 (-0.39)	-0.005 (-0.28)	-0.018 (-1.09)	-0.015 (-0.93)
$\ln(\text{invest})$	0.064 (4.30)	0.066 (4.26)	0.102 (3.01)	0.107 (3.01)	0.017 (0.73)	0.016 (0.69)	0.054 (2.62)	0.055 (2.58)
$\ln(n + g + \delta)$	-0.194 (-1.49)	-0.172 (-1.23)	-0.143 (-0.79)	-0.107 (-0.57)	-0.583 (-4.11)	-0.589 (-3.96)	-0.384 (-3.52)	-0.397 (-3.53)
$\ln(\text{school})$	0.029 (2.26)	0.029 (2.28)	-0.058 (-1.95)	-0.046 (-1.53)	-0.015 (-0.43)	-0.022 (-0.60)	-0.035 (-1.25)	-0.039 (-1.36)
civ	-0.084 (-2.73)		-0.040 (-1.42)		-0.038 (-1.11)		-0.035 (-1.46)	
w_civ	-0.109 (-2.31)		0.045 (0.68)		-0.219 (-2.12)		-0.178 (-2.06)	
tmonths ^b		-0.121 (-1.70)		-0.035 (-0.51)		-0.047 (-0.93)		-0.043 (-1.07)
w_tmonths ^b		-0.151 (-1.40)		-0.301 (-1.44)		-0.420 (-1.23)		-0.350 (-1.20)
constant	-0.358 (-0.93)	-0.315 (-0.78)	-0.476 (-0.99)	-0.383 (-0.78)	-1.31 (-3.33)	-1.336 (-3.19)	-0.819 (-2.84)	-0.875 (-2.89)
R-squared	0.21	0.18	0.39	0.39	0.34	0.32	0.32	0.32
Observations	235	235	109	109	126	126	235	235

^aEach model also includes fixed effects for time periods.

^btmonths and w_tmonths coefficients are multiplied by 100 for presentation.

^cIncludes a binary variable for Asia.

¹³The strong convergence effect in Africa derives from the large variation in the data and the associated small standard error, resulting in high significance.

schooling effect on short-run income per-capita growth. The standard growth factors generally perform better for the short-run panel estimates of the *non-African regions*, with their larger number of observations, when compared with the long run estimates for the non-African regions. Typically, these growth coefficients are less than one-seventh of the corresponding long-run coefficients, indicating that the standard short-run growth determinants are more than proportionally smaller than their long-run counterparts. This less than proportional impact also characterizes the short-run coefficients y_0 , *invest*, and *school* in the two best fitting empirical models for the African sample.

The two most reasonable looking estimates are those for the African and pooled samples when *civ* and *w_civ* are used as the civil-war indicators. In fact, *civ* and *w_civ* appear to out-perform *tmonths* and *w_tmonths* in the short run, when the division of the entire period into five-year intervals limits the longevity of the civil war in the sample period. Thus, the poorer performance of the duration measures is easy to comprehend, and we direct our discussion to the four models where civil-war spillovers are in terms of *w_civ*. For the African, Asian, and pooled samples, the negative neighborhood influence of civil wars is significant at the 0.05 level. The largest neighborhood effect is in Asia, where about one-fifth of a percent of income per-capita is lost, while the smallest influence is in Africa, where about one-tenth of a percent of income per-capita growth is lost. For the pooled sample, 0.178 percent of income per-capita growth is lost through these neighborhood consequences from civil wars. When compared with the long-run estimates, all three of these short-run estimates are proportionally higher than their long-run counterparts. This implies that the collateral damage from nearby civil wars are a proportionally greater determinant of income per-capita growth in the short than in the long run. This is plausible, because the Phoenix effect is not so likely to be operative in the short run. Neighborhood consequences of civil wars are a more important determinant of reduced short-run economic growth than host-country civil wars, as in the long-run estimates. This may arise because civil wars tend to be concentrated in geographical areas, so that a nation may be impacted by multiple civil wars.

The short-run estimates underscore that regions respond differently to both standard growth factors and civil-war measures. Africa indicates the greatest ability to rebound from conflict owing to its convergence response and the schooling factor. Additionally, the diffusion is more concentrated in Africa than for other regions. This suggests some policy recommendations.

POLICY RECOMMENDATIONS

Unfortunately, the post-Cold War era has brought with it numerous intrastate wars, concentrated in some of the poorest countries of the world (Wallenstein and Sollenberg, 2001). Those most in need of assistance are those nations most apt to suffer directly or indirectly through spillovers from growth-inhibiting civil wars. If donor countries and multilateral institutions are to allocate their aid effectively, the impact of civil wars must be understood. The findings here indicate that the proper policy must be tailored to the region by adjusting for different responses to macroeconomic and civil-war influences. In the case of Africa, donors must be aware that this region possesses a greater facility to grow following civil conflicts.¹⁴ Aid providers must also be cognizant that neighborhood consequences from intra-state wars are generally more diffused in Latin America and Asia than in Africa. A knowledge of the extent of diffusion is especially important when evaluating the effectiveness of past aid.

¹⁴The negative and significant coefficient of *civ* indicates that growth is on average negatively influenced by ongoing civil wars.

This study and its predecessors demonstrate that countries near to conflicts may grow by less through no fault of their own. Thus, such evaluations of recipients' use of foreign assistance must make an allowance for reduced growth owing to their propinquity to conflicts.

The proportionally large short-run spillover effects from civil wars have implications for both the amount of aid needed to offset these negative consequences and the speed by which to restore peace. Aid needs to flow quickly to countries close to regional conflicts, where close is as far as 800 km away in Asia and less disperse in Africa. These significant and large neighborhood consequences mean that peacekeeping has regionwide public benefits. The degree of this publicness varies by region and the length of the time frame applied. Thus, the payoff from peacekeeping extends well beyond the venue of the civil war, thus bolstering the argument for international intervention. Given the large impacts in the short run, there is an urgency to respond to peacekeeping needs quickly – an ability not currently possessed by the international community. The persistence of long-run consequences from civil wars at home and a goodly distance away suggests that actions to offset these adverse influences have generally not been taken.

CONCLUDING REMARKS

This analysis shows that civil wars can have strong negative impacts on the growth of income per capita at home and in neighboring nations. The consequences for growth of macroeconomic variables and civil-war measures differ by regions. By using a distance measure, we can identify the spatial diffusion stemming from intrastate conflicts. Of particular interest is the finding that the spatial dispersion of negative spillovers from civil wars are region specific. Another difference involves the ability of regions to recoup losses sustained from civil wars – Africa appears to have the best recovery capabilities of the three regions tested.

As more years of data become available, the precision of the estimates can be improved, especially for Latin America and Asia, where degrees of freedom are minimal. New data also hold out the hope that more appropriate measures of civil-war severity (*e.g.*, deaths per year) can be used as the measure.

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