Does the orphan disadvantage "spill over"?
An analysis of whether living in an area with a
higher concentration of orphans is associated
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Saharan Africa

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Abstract

BACKGROUND
Despite considerable concern regarding the social consequences of sub-Saharan Africa's high orphan prevalence, there has been no research investigating how living in a community densely populated with orphans is more broadly associated with children's — including nonorphans' — acquisition of human capital.

OBJECTIVE
We provide a new look at the implications of widespread orphanhood in sub-Saharan Africa by examining whether living in an area with a high concentration of orphans is associated with children's likelihood of school enrollment.

METHODS
We use data from the Demographic and Health Survey (DHS) and the Multiple Indicators Cluster Survey (MICS) among 383,010 children in 336 provinces in 34 sub-Saharan African countries to estimate multilevel logistic regression models to assess whether living in a setting with a higher concentration of orphans is associated with school enrollment.

RESULTS
Orphan concentration has a curvilinear association with children's school enrollment in western and eastern Africa: The initially positive association becomes negative at higher levels. In central and southern Africa, orphan concentration has a positive linear association with children's school enrollment.

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CONCLUSION
In western and eastern Africa, the negative association between living in a setting more densely populated with orphans and children's school enrollment provides suggestive evidence that the orphan disadvantage "spills over" in those communities most heavily affected. Conversely, in central and southern Africa, the positive association between living in a setting more densely populated with orphans and children's school enrollment highlights the resiliency of these relatively wealthier communities with high levels of orphans. Although longitudinal research is needed to confirm these findings and clarify the underlying mechanisms, this study lays the groundwork for a new body of research aimed at understanding the broader social implications of widespread orphanhood in sub-Saharan Africa.

1. Introduction

Sub-Saharan Africa has the highest percentage of orphaned children (12% of the child population) of any world region (The United Nations Children's Fund 2006). An estimated 53 million children in sub-Saharan Africa are orphaned, largely as a result of the high levels of AIDS-related mortality in the region (The United Nations Children's Fund 2006). Policy makers project that the number of orphans in sub-Saharan Africa will continue to increase exponentially.

Despite the high number of orphans in sub-Saharan Africa, Western-style orphanages and child-headed households remain uncommon in the region. In fact, most orphaned children join existing households (Urassa, Boerma, Ng'weshemi, Isingo, Schapink, and Kumogola 1997), and fewer than 5% live in orphanages or in child-headed households (Beard 2005; Monasch and Boerma 2004). The growing burden of orphans has led many researchers to question whether African communities and kinship networks can adequately care for orphans. Some researchers warn that the high prevalence of orphans may erode African societies (Caldwell 1997). Foster and Germann (2002) have argued that the extended family does not have the endless capacity to absorb orphans, and that households and communities may cease to be viable social or economic units as a result of the growing burden (Foster et al.1996).

Although the conventional perspective implies that the high prevalence of orphans has negative ramifications for sub-Saharan African families and communities, there is no population-based evidence that a high concentration of orphans is negatively associated with the well-being of community members. That is, because research on the implications of orphanhood has focused on orphans themselves, it remains unclear whether there are negative consequences for children — including nonorphans — living

in areas highly populated with orphans. To extend the current literature on orphanhood in sub-Saharan Africa, and to contribute to the conversation about the resiliency of African families and communities in coping with high levels of orphans, this paper investigates whether living in an area with a higher concentration of orphans is associated with children's — including nonorphans' — education.

Building on evidence that the concentration of orphans varies within African countries (Weinreb, Gerland, and Fleming 2008), we test whether the province level concentration of orphans is positively, negatively, or curvilinearly associated with children's school enrollment. We use Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) data to estimate a series of multilevel logistic regression models for 383,010 children (7–14 years old) living in 336 subnational provinces in 34 sub-Saharan African countries. Although longitudinal research is needed to confirm the robustness of the relationships established here, this study provides valuable insight into whether the high prevalence of orphans is associated with nonorphaned children's well-being.

2. Concentration of orphans and children's school enrollment

2.1 Support for a negative association between the concentration of orphans and children's school enrollment

Three potential mechanisms may drive a negative association between the concentration of orphans and children's school enrollment: socioeconomic disadvantage, high prevalence of HIV/AIDS, and high prime-aged adult mortality. Beginning with the first, the concentration of orphans and children's likelihood of school enrollment may be negatively associated because areas with a greater concentration of orphaned children are more likely to be poorer than settings where fewer children are orphaned. Although the directionality of the association between orphanhood and poverty remains unclear (i.e., whether orphans entering the household contributes to poverty or whether orphans select into poor households), it is well known that orphans are more likely to live in poorer households (Bicego, Rutstein, and Johnson 2003). Extrapolating this finding to the community level, an orphan-dense population is likely to reflect widespread socioeconomic disadvantage and limited access to infrastructure and development, including educational resources. In light of research showing that community resources are associated with children's likelihood of school enrollment (Mason and Khandker 1997), from this perspective, the higher concentration of orphans may be associated with lower school enrollment as a function of its association with socioeconomic disadvantage.

In addition to the concentration of orphans being associated with children's school enrollment as a result of its relationship with socioeconomic disadvantage, the concentration of orphans may be negatively associated with children's school enrollment through its association with a high prevalence of HIV/AIDS (Bicego, Rutstein, and Johnson 2003). Because the concentration of orphans is highly correlated with the severity of the HIV/AIDS epidemic (Bicego, Rutstein, and Johnson 2003), children — including nonorphans — in areas with a higher concentration of orphans may be more likely to rely on caregivers who are living with HIV/AIDS. Extending evidence that households coping with AIDS strategically increase the quantity of child labor to offset the strain associated with the illness (Rugalema 2000), the greater burden of domestic responsibilities and labor force participation among children in highly affected areas will likely lower their ability to become, or remain, enrolled in formal school. From this perspective, children living in areas with more orphans and more adults living with HIV/AIDS will be less likely to be enrolled in school.

In addition to the greater burden of HIV/AIDS, settings with a higher concentration of orphans may have higher prime-aged adult mortality and, as a result, these settings may have fewer economically active adults in the community. The smaller adult population will likely elevate pressure on the relative population structure, thereby exacerbating the already high dependency ratio in African communities (Eastwood and Lipton 2011). Furthermore, AIDS deaths are common among highly educated and economically active persons, which deprives communities of not only adults in general but, specifically, of economically productive ones (Ntozi and Mukiza-Gapere 1995). Living in an area with a larger cohort of children relative to the adult population is likely to intensify the competition for scarce social and economic resources. From this perspective, the unfavorable dependency ratios in settings highly populated with orphans will exacerbate poverty and, thus, pose considerable barriers to children's school enrollment.

In settings where orphans are more prevalent, the higher concentration of prime-aged adult mortality will also mean that there are fewer adults to ensure a functioning school system. HIV-associated illnesses and excessive funerals contribute to teacher absence, and AIDS-related mortality is a significant cause of teacher attrition in high orphan contexts (Grassly, Desai, Pegurri, Sikazwe, Malambo, Siamatowe, and Bundy 2003). High teacher absence and attrition is likely to decrease school quality, thereby lowering families' willingness to invest in children's education.

2.2 Support for a positive association between the concentration of orphans and children's school enrollment

It is also possible that the concentration of orphans is positively associated with children's school enrollment. Such an association could work through two mechanisms: greater access to socioeconomic resources and organizational benefits. Emerging evidence suggests that, in Malawi, communities more densely populated with orphans are wealthier than communities with fewer orphans (Weinreb, Gerland, and Fleming 2008). This implies that families are strategically placing orphans in the most resource-rich communities. The strategic placement of orphans into relatively wealthier settings suggests that children living in communities with higher concentrations of orphans may enjoy a greater likelihood of school enrollment, simply as a function of these settings being socioeconomically, and potentially educationally, more advantaged than those where few orphans reside.

In addition to high orphan communities being wealthier, there is evidence that children in these settings benefit from development projects. Communities with high levels of orphaned children often mobilize the support of local organizations, such as religious congregations, women's groups, and national and international governmental and nongovernmental organizations (Foster et al. 1996). Community-based organizations (Bahemuka 1983; Kayongo and Onyango 1991; Suda 1997), alongside international programs, effectively provide economic, social, and educational support to orphaned children (Copson 2000; Hunter and Williamson 2000; Reid 1993). Although these programs specifically target orphans, nonorphaned children often benefit. For instance, research shows that nonorphans benefit from community-based orphan programs including childcare centers in Malawi (Beard 2005) and household assistance programs in Tanzania (Ainsworth, Beegle, and Koda 2005). The mobilization of resources to support orphans, which often benefits children more broadly, further promotes a positive association between the concentration of orphans and children's school enrollment.

2.3 Support for a curvilinear association between the concentration of orphans and children's school enrollment

The relationship between the concentration of orphans and children's school enrollment may also be curvilinear. Although there is little reason to hypothesize that the relationship will initially be negative and then be positive, there is reason to hypothesize that a negative association may emerge only at the highest concentration of orphans. Recent research on the association between community HIV prevalence and child

fostering documents a "tipping point" at which the intensity of the HIV epidemic (and thus intensity of orphan care) is negatively associated with the likelihood of families fostering nonorphaned children (Grant and Yeatman 2012). In other words, this evidence suggests that the orphan burden is reducing African families' capacity to care for nonorphaned children, but only in settings most heavily affected by the high orphan population. Extrapolating this finding, it is possible that there is also a "tipping point" at which the need to care for orphaned children will be negatively associated with children's education more broadly, as evidenced by a curvilinear association.

3. Data and methods

3.1 Data

To document the association between the concentration of orphans and children's school enrollment, we leverage DHS and MICS data that were collected in 34 sub-Saharan African countries between 2000 and 2010.[3] The two surveys use nearly identical multistage stratified random sample designs to select households for participation. The DHS and MICS identify primary sampling units (PSUs) based on sampling frames generated by national statistics offices and then randomly select PSUs with a probability proportional to their population size. Within each PSU, the DHS and MICS randomly select households.[4]

We restrict our analytic sample in three ways. First, we exclude children in the *de facto* sample (i.e., individuals who slept in the house the previous night) and include children only from the *de jure* samples (i.e., usual residents). This restriction allows us to harmonize the data across multiple countries and to ensure that we accurately attribute household characteristics to children who are household members.[5] Second, because we are interested in assessing school enrollment, we restrict the sample to school aged children, who we define here as those aged 7 to 14 years.[6] Third, we

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[3] Recent DHS and MICS data are not available for all sub-Saharan African countries. Notably, data are not available for South Africa, one of the most populated countries in sub-Saharan Africa. Furthermore, we exclude some countries (Mauritania, Equatorial Guinea, Burundi, Sudan (North), Angola, and Comoros) from our analyses due to a large percentage of missing data on key study variables.

[4] Detailed survey information is available in the survey documentation reports for each country. These are available at http://www.measuredhs.com/ and http://www.childinfo.org/mics.html.

[5] With a few exceptions, the DHS collects a *de facto* sample and MICS collects a *de jure* sample.

[6] We focus on children who are at least 7 years old to ensure cross-national comparability, as this is a standard age for initial school enrollment (Ainsworth and Filmer 2006). Furthermore, we focus on children who are 14 years old and younger because each of the surveys collects detailed information on this age group, whereas only some surveys collect school enrollment information on children 15–17 years old. In supplementary analyses, we analyzed the associations among 15–17 year olds in the subsample of countries in which school

exclude less than 2% of children from the sample who have incomplete information on study variables. This results in a final analytic sample of 383,010 children.

Our contextual unit of focus is subnational provinces. What constitutes a "province" varies across countries. In some instances, these subnational boundaries represent political districts, but in other instances they represent administrative or geographical regions. For ease of interpretation, we uniformly refer to these aggregate units as "provinces". See Appendix A for a complete listing of the aggregate units that we utilize by region of sub-Saharan Africa and country.

In light of evidence that the concentration of orphaned children and the implications of orphanhood vary across regions of sub-Saharan Africa (Bicego, Rutstein, and Johnson 2003), we conduct all analyses separately by region. Our four analytic subsamples include (1) 184,541 children in 125 provinces in 15 western African countries, (2) 64,302 children in 84 provinces in 6 eastern African countries, (3) 41,102 children in 45 provinces in 5 central African countries, and (4) 93,065 children in 82 provinces in 8 southern African countries. See Appendix B for further information on the countries included in the study.

3.2 Measures

3.2.1 School enrollment

Current school enrollment is the dependent variable. Interviewers ask the primary household respondent whether each child is currently enrolled in school or, in the case of school not being in session, whether each child was enrolled at the end of the most recent school year. Because we rely on cross-sectional data, we focus on current school enrollment as opposed to educational attainment, as the latter depends more heavily on a child's full school history and investments that occurred before the time of the survey. A limitation of our focus on current school enrollment is that we do not capture the frequency with which a child actually *attends* school. School absenteeism remains a key educational challenge in low-income contexts, which we do not capture in this study.

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enrollment data were collected. In these analyses, we find that results are remarkably similar to those shown for children 7–14 years old. There are two notable exceptions. Among the subsample of 15–17 year olds, we find no significant association between the prevalence of orphans and children's school enrollment in eastern Africa. Furthermore, in southern Africa we find that including the contextual indicators in the model reduces the association between the prevalence of orphans and children's school enrollment to nonsignificance. Full results are available upon request.

3.2.2 Concentration of orphans

To examine the association between the concentration of orphans and children's school enrollment, we calculate what percentage of children (aged 0–17 years) in each province are single or double orphans. To construct this measure, we first use the primary household respondent's report of whether each child's biological mother and father are alive at the time of the survey. We then aggregate this information at the province level to calculate the percentage of children who are orphaned by either one or both of their parents.[7] It is important to note that, because our data are household-based, this aggregate construct reflects only the percentage of children orphaned in the household population of each province and does not capture the approximately 5% of orphaned children who do not live in households (Beard 2005; Monasch and Boerma 2004).

3.2.3 Controls

We account for child and household characteristics that may confound the association between the concentration of orphans and children's school enrollment. Child characteristics include family structure (two-parent family [reference group], single-parent family, single orphan, foster child [child living apart from one or both of his or her living parents], or double orphan)[8], gender, and age (7–14 years old).

At the household level, we control for socioeconomic status using the DHS- and MICS-constructed wealth indices. The wealth index has two important limitations. First, although the DHS and MICS wealth indices are ideal for comparing socioeconomic status within countries, they are less meaningful in a multicountry framework. For instance, a household that is in the top wealth quintile in Nigeria is likely to be much wealthier than a household that is in the top wealth quintile in Guinea-Bissau. Although a wealth quintile that is comparable across countries is ideal for multinational research, such an index is difficult to calculate, as the components are based on household items and materials that are incomparable across country contexts. The wealth index is better equipped to compare household socioeconomic status within countries,[9] and because our country-level fixed effects approach (described in more

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[7] In supplementary analyses, we focused on the prevalence of children who were orphaned between age 7 and 14 years to assess whether the associations shown here are replicated when investigating the concentration of orphaned children among the focal age group (i.e., 7 to 14-year-olds). Results from the supplementary models (available upon request) are statistically consistent with those shown here.

[8] All children in 'two-parent families' and 'single parent families' are non-orphans.

[9] For more information, see Bollen, Glanville, and Stecklov (2007) and Houweling, Kunst, and Mackenbach (2003).

detail below) generates within-country estimates, the wealth index captures important within-country differences between households. Second, even within countries, the wealth index captures economic differences only in terms of dwelling characteristics and asset ownership, not heterogeneity in access to social services or cash. In light of these limitations, the results must be interpreted with caution.

In addition to the household wealth index, we control for the household's location in a rural versus urban area and the household head's educational attainment (i.e., no school, primary, or secondary), gender, and age. We also account for household structure by controlling for the total number of household members, the number of members aged 14 and younger, the number of members older than 64 years, and the child's relationship to the household head (i.e., biological child [reference group], grandchild, relative, sibling, spouse, self, nonrelative). Furthermore, because we leverage surveys collected across an 11-year period (2000–2010) and because children's likelihood of school enrollment has increased over time in sub-Saharan Africa, we control for survey year to account for the confounding nature of the date of data collection.

In addition to controlling for child and household characteristics, in order to evaluate whether the observed associations between the concentration of orphans and children's school enrollment is due to the selection of orphans into communities with particular socioeconomic profiles, we create a series of aggregate-level controls that characterize the 336 provinces in our sample. More specifically, we aggregate information from the household level to the province level to control for (1) the percentage of household heads that have no formal education, (2) the percentage of households that are headed by women, and (3) the average household size in each province.

4. Analytic strategy

We begin our analyses by demonstrating the high variability in the concentration of orphans across the 336 provinces in our sample. These analyses further motivate our focus on explaining the educational implications of variation in the orphan population at the province level. Next, we provide descriptive statistics to highlight the characteristics of the children, households, and provinces in our sample. Finally, to evaluate the association between the concentration of orphans and children's school enrollment, we estimate a series of multilevel logistic regression models for the odds of P_{ij} that child i in province j is enrolled in school.

Model 1

$$\log\left(P_{ij}/\left(1 - P_{ij}\right)\right) = b_0 + b_1 S_j + b_2 X_{ij} + b_3 C_j + U_j$$

S_j is an indicator for the province level concentration of orphans; X_{ij} is a vector of controls for child and household characteristics. C_j represents country dummies, which allow us to control for unobserved country-level characteristics. U_j is the level-2 error term, which we allow to vary by province; it reflects the unobserved province level characteristics that are unrelated to the other regressors in the model.

Model 2

$$\log\left(P_{ij}/\left(1 - P_{ij}\right)\right) = b_0 + b_1 S_j + b_2 S_j^2 + b_3 \mathbf{X}_{ij} + b_4 C_j + U_j$$

Model 2 extends Model 1 by including a squared term of the province level concentration of orphans to determine if there is a curvilinear association between the province level concentration of orphans and children's school enrollment.

Model 3

$$\log\left(P_{ij}/\left(1 - P_{ij}\right)\right) = b_0 + b_1 S_j + b_2 S_j^2 + b_3 \mathbf{X}_{ij} + b_4 \mathbf{Y}_j + b_5 C_j + U_j$$

Model 3 adds $\mathbf{Y}_j$, which is a vector of controls for province level characteristics used to determine whether the observed associations are explained by socioeconomic factors.[10]

5. Results

Figure 1 displays the mean and the distribution of the percentage of the child population that is orphaned in each province within the 34 countries in our sample. As shown, there is considerable variation in the distribution of the orphan population across provinces within each country, particularly in those countries with an overall high concentration of orphans. Beginning with western Africa, the results reveal considerable within-country variability in the concentration of orphans, particularly in Guinea-Bissau, where it ranges from as low as 7% of children orphaned in one province

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[10] Based on the evidence that the association between the province level concentration of orphans and children's school enrollment is linear in central and southern Africa, we exclude the squared term from Model 3 for these regions.

to as high as 20% of children orphaned in another. Additionally, in Burkina Faso the concentration of the orphan population ranges from less than 5% of children in one province to nearly 15% of children in another. As shown, the overall concentration of orphaned children is generally low in central Africa, although there is considerable variation across provinces in the Central African Republic, ranging from as low as 8% in one province to as much as 20% in another province. In eastern and southern Africa there are overall higher percentages of orphaned children across all provinces than in western and central Africa. In eastern Africa, there is the most variability in the concentration of orphans in Somalia, ranging from 2% to 17%. Furthermore, in southern Africa there is a high concentration of orphaned children, particularly in Lesotho and Namibia, where it ranges from less than 10% in one province to greater than 30% in another. The high variability in the concentration of orphaned children across provinces further motivates our analyses of the childhood implications of living in a province with a higher concentration of orphaned children.

Figure 1: **The provincial concentration of orphans by country and region of sub-Saharan Africa**
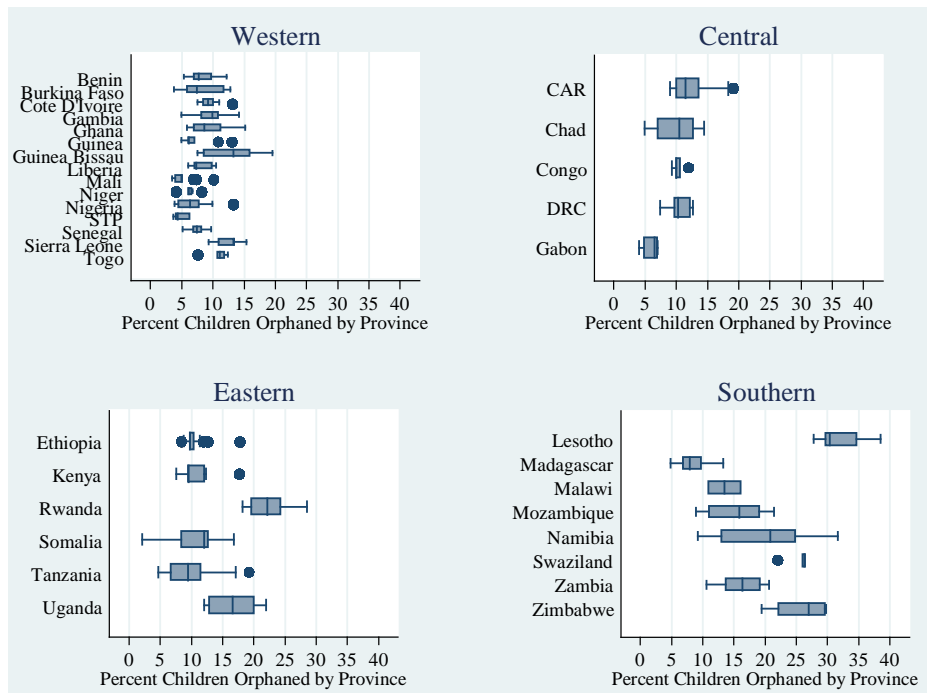
Table 1 displays the characteristics of children in western, eastern, central, and southern Africa (estimates are weighted). As shown, the percentage of children enrolled in school varies considerably across the four regions of sub-Saharan Africa. In each region the majority of children (7–14 years old) are enrolled in school; however, enrollment ranges from as low as 63.01% of children in western Africa to as high as 87.78% of children in southern Africa. The descriptive results further show that the characteristics of the provinces vary across regions of sub-Saharan Africa. Whereas 59.88% of household heads lack formal education in the average province in western Africa, this is true for merely 20.46% of household heads in the average province in southern Africa. The concentration of female-headed households also varies from as little as 16.01% in the average province in western Africa to as much as 30.43% in the average province in southern Africa.

Table 1: **Descriptive statistics for children age 7-14, by region of sub-Saharan Africa**

	Western[1]	Eastern[2]	Central[3]	Southern[4]
Currently enrolled (% children 7-14 years old)	63.01	70.27	72.31	87.78
Level 2 - Province				
Children orphaned by province (%)	8.14 (3.04)	13.45 (5.43)	10.16 (3.07)	16.89 (7.92)
Household head has no formal education (%)	59.88 (23.31)	37.93 (22.44)	25.97 (20.86)	20.46 (11.46)
Female headed household (%)	16.01 (9.37)	23.87 (7.80)	19.27 (5.06)	30.43 (12.48)
Mean household size	8.84 (2.69)	6.65 (0.74)	7.67 (1.04)	6.36 (0.68)
Level 1 - Individual				
Family structure				
Resides with both parents[5]	48.15	50.68	42.39	46.73
Single parent	15.42	14.49	20.15	18.08
Single orphan	5.08	9.58	5.85	8.82
Foster child	30.36	22.31	29.82	22.34
Double orphans	0.99	2.94	1.79	4.03
Female	49.37	49.52	49.43	49.95
Age	10.27 (2.31)	10.34 (2.29)	10.32 (2.31)	10.41 (2.29)
Relationship to household head				
Parent[5]	73.25	77.26	70.25	65.39
Grandparent	9.86	10.91	11.78	19.45
Relative	8.02	6.49	9.49	8.18
Sibling	2.42	1.88	2.86	2.23
Spouse	0.30	0.09	0.18	0.28
Child head	0.01	0.03	0.01	0.07
Non-relative	6.14	3.34	5.43	4.40
Education of household head				
No formal education[5]	60.84	39.96	26.38	21.37
Primary	18.66	45.09	32.31	53.51
Secondary	20.50	14.95	41.31	25.12
Female headed household	16.77	26.38	20.15	31.93
Age of household head	49.05 (13.06)	45.99 (12.76)	45.36 (12.07)	46.48 (14.14)
Household wealth	2.85 (1.39)	2.94 (1.45)	3.01 (1.44)	2.87 (1.41)
Household size	9.08 (5.18)	6.85 (2.61)	7.88 (3.78)	6.48 (2.65)
Total # household members under age 15	5.02 (3.56)	3.91 (1.89)	4.41 (2.39)	3.67 (1.81)
Total # household members over 64	0.25 (0.53)	0.15 (0.40)	0.15 (0.42)	0.18 (0.45)
Rural household	62.79	80.56	52.00	79.24

Sources: DHS & MICS.
Note: All values are weighted, and values in parentheses are standard deviations.
[1] N=184,541 children in 125 provinces in 15 countries.
[2] N=64,302 children in 84 provinces in 6 countries.
[3] N=41,102 children in 45 provinces in 5 countries.
[4] N=93,065 children in 82 provinces in 8 countries.
[5] Reference group.

The descriptive results further show that, on average, most children live with both of their parents, although there is considerable variation in family structure. Slightly less than half of the children are female, and they are, on average, approximately 10 years old. Most household heads have completed some primary school, are typically

male, and are an average of 45 to 50 years old. In general, children live in large households with several young household members in rural areas.

Turning to the multivariate findings, the results in Table 2 (expressed as odds ratios) address our central question of whether the concentration of orphans is associated with children's school enrollment and, if so, whether the association is positive, negative, or curvilinear. The results show that there are indeed significant associations between the concentration of orphans and children's school enrollment, and that the nature of the association varies markedly across the four regions. Beginning with the findings from western Africa, Model 1 shows that there is a positive association between the concentration of orphans and children's school enrollment. That is, each percentage increase in orphans at the province level is associated with a 7% increase in the likelihood that a child is enrolled in school, net of their own orphan status, living arrangements, and sociodemographic controls. Model 2 includes the squared term for the concentration of orphans to test whether there is evidence of a curvilinear association. As shown, the results demonstrate that there is a significant curvilinear association between the concentration of orphans and children's school enrollment. Although the concentration of orphans is initially positively associated with children's school enrollment, there is a tipping point. In the western African communities most heavily populated with orphans, children — including nonorphans — experience a *lower* likelihood of school enrollment.

Model 3 includes the socioeconomic characteristics of the provinces to determine if these factors help to explain the curvilinear association between the concentration of orphans and children's school enrollment. Although the reduction in the variability across provinces (from 0.47 in Model 2 to 0.44 in Model 3) demonstrates that the inclusion of these characteristics helps to explain differences in school enrollment between provinces, these characteristics do not attenuate the association between the concentration of orphans and children's school enrollment. The provincial socioeconomic characteristics are independently associated with children's school enrollment as expected; however, there continues to be a strong curvilinear association between the concentration of orphans and children's school enrollment.

In eastern Africa, the association between the concentration of orphans and children's school enrollment is strikingly similar to the association found in western Africa. Whereas Model 1 shows a strong positive association between the concentration of orphans and children's school enrollment, Model 2 demonstrates that the association is curvilinear: in communities with the highest concentration, the percentage of orphaned children is negatively associated with children's school enrollment. Again, this finding confirms that the negative association between the concentration of orphans and children's school enrollment emerges only in settings with the highest prevalence of orphans.

Table 2: **Results of multilevel logistic regression models estimating the association between the contextual prevalence of orphans and children's school enrollment**

	Western[1]						Eastern[2]					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Level 2 - Province												
Children orphaned by province (%)	1.07**	0.02	1.34***	0.11	1.25***	0.09	1.09***	0.03	1.24***	0.03	1.12	0.06
Children orphaned by province (%, Sqrd)			0.99**	0.00	0.99*	0.00			0.99*	0.00	0.99*	0.00
Household head has no formal education (%)					0.99***	0.00					0.97	0.00
Female headed household (%)					1.00	0.01					1.05	0.01
Mean household size					0.98	0.03					1.01	0.09
Level 1 - Individual												
Family structure												
Resides with both parents[5]												
Single parent	1.08***	0.02	1.08***	0.02	1.08***	0.02	0.92*	0.04	0.92*	0.04	0.92*	0.04
Single orphan	0.92**	0.03	0.92**	0.03	0.92**	0.03	0.94	0.04	0.94	0.04	0.94	0.04
Foster child	0.96**	0.02	0.96**	0.02	0.96**	0.02	0.65***	0.03	0.65***	0.03	0.65***	0.03
Double orphans	0.67***	0.04	0.67***	0.04	0.67***	0.04	0.64***	0.05	0.64***	0.05	0.64***	0.05
Female	0.69***	0.01	0.69***	0.01	0.69***	0.01	0.81***	0.02	0.81***	0.02	0.81***	0.02
Age	1.05***	0.00	1.05***	0.00	1.05***	0.00	1.15***	0.01	1.15***	0.01	1.15***	0.01
Relationship to household head												
Parent[5]												
Grandparent	1.07**	0.03	1.07**	0.03	1.07**	0.03	1.46***	0.07	1.46***	0.07	1.46***	0.07
Relative	0.65***	0.02	0.65***	0.02	0.65***	0.02	0.68***	0.04	0.68***	0.04	0.68***	0.04
Sibling	0.49***	0.02	0.49***	0.02	0.49***	0.02	0.73***	0.06	0.73***	0.06	0.73***	0.06
Spouse	0.37***	0.04	0.37***	0.04	0.37***	0.04	0.26***	0.08	0.26***	0.08	0.26***	0.08
Child head	0.28	0.20	0.28	0.20	0.28	0.20	0.36	0.19	0.36	0.19	0.36	0.19
Non-relative	0.56***	0.01	0.56***	0.01	0.56***	0.01	0.31***	0.02	0.31***	0.02	0.31***	0.02
Education of household head												
No formal education[5]												
Primary	2.19***	0.04	2.19***	0.04	2.19***	0.04	2.02***	0.05	2.02***	0.05	2.02***	0.05
Secondary	3.66***	0.08	3.66***	0.08	3.66***	0.08	2.96***	0.13	2.96***	0.13	2.96***	0.13
Female headed household	1.48***	0.03	1.48***	0.03	1.48***	0.03	1.26***	0.04	1.26***	0.04	1.26***	0.04
Age of household head	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Household wealth	1.41***	0.01	1.41***	0.01	1.41***	0.01	1.36***	0.01	1.36***	0.01	1.36***	0.01
Household size	1.02***	0.00	1.02***	0.00	1.02***	0.00	1.03**	0.01	1.03**	0.01	1.03**	0.01
Total # household members under age 15	0.95***	0.00	0.95***	0.00	0.95***	0.00	0.94***	0.01	0.94***	0.01	0.94***	0.01
Total # household members over 64	1.04**	0.01	1.04**	0.01	1.04**	0.01	1.01	0.03	1.01	0.03	1.01	0.03
Rural household	0.74***	0.01	0.74***	0.01	0.74***	0.01	0.57***	0.02	0.57***	0.02	0.57	0.02
Survey Year	0.83	0.13	0.87	0.14	0.95	0.14	1.29***	0.07	1.29***	0.07	1.29***	0.05
Country dummies (not shown)												
Random effects												
Level 2 (Province)												
Variance intercept	0.49		0.47		0.44		0.74		0.72		0.52	
Model fit												
Likelihood-ratio test	6147.98***		5361.67***		3568.03***		2953.31***		2859.59***		1808.30***	

Table 2: (Continued)

	Central[3]						Southern[4]					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Level 2 - Province												
Children orphaned by province (%)	1.08**	0.03	1.31*	0.14	1.05	0.03	1.06***	0.01	1.12**	0.04	1.04**	0.01
Children orphaned by province (%, Sqrd)			0.99	0.01					1.00	0.00		
Household head has no formal education (%)					0.98**	0.01					0.98***	0.00
Female headed household (%)					1.00	0.01					1.02**	0.01
Mean household size					0.99	0.09					1.10	0.11
Level 1 - Individual												
Family structure												
Resides with both parents[5]												
Single parent	0.89**	0.04	0.89**	0.04	0.89**	0.04	0.73***	0.03	0.73***	0.03	0.73***	0.03
Single orphan	0.73***	0.04	0.73***	0.04	0.73***	0.04	0.75***	0.04	0.75***	0.04	0.75***	0.04
Foster child	0.95	0.04	0.95	0.04	0.95	0.04	0.46***	0.03	0.46***	0.03	0.46***	0.03
Double orphans	0.69***	0.07	0.69***	0.07	0.69***	0.07	0.48***	0.04	0.48***	0.04	0.48***	0.04
Female	0.61***	0.02	0.61***	0.02	0.61***	0.02	1.19***	0.03	1.19***	0.03	1.19***	0.03
Age	1.10***	0.01	1.10***	0.01	1.10***	0.01	1.03***	0.00	1.03***	0.00	1.03***	0.00
Relationship to household head												
Parent[5]												
Grandparent	1.08	0.06	1.08	0.06	1.08	0.06	1.84***	0.11	1.84***	0.11	1.84***	0.11
Relative	0.60***	0.03	0.60***	0.03	0.60***	0.03	1.05	0.07	1.05	0.07	1.05	0.06
Sibling	0.66***	0.05	0.66***	0.05	0.66***	0.05	1.15	0.10	1.15	0.10	1.15	0.10
Spouse	0.38***	0.10	0.38***	0.10	0.38***	0.10	0.85	0.16	0.85	0.16	0.85	0.16
Child head	1.09	1.41	1.09	1.41	1.09	1.40	0.79	0.29	0.79	0.29	0.79	0.29
Non-relative	0.65***	0.04	0.65***	0.04	0.65***	0.04	0.56***	0.03	0.56***	0.03	0.56***	0.03
Education of household head												
No formal education[5]												
Primary	1.86***	0.07	1.86***	0.07	1.86***	0.07	1.83***	0.05	1.83***	0.05	1.83***	0.05
Secondary	3.76***	0.16	3.76***	0.16	3.76***	0.16	3.31***	0.13	3.31***	0.13	3.31***	0.13
Female headed household	1.47***	0.06	1.47***	0.06	1.47***	0.06	1.35***	0.04	1.35***	0.04	1.35***	0.04
Age of household head	1.00	0.00	1.00	0.00	1.00	0.00	0.99**	0.00	0.99**	0.00	0.99**	0.00
Household wealth	1.44***	0.02	1.44***	0.02	1.44***	0.02	1.37***	0.02	1.37***	0.02	1.37***	0.02
Household size	1.03**	0.01	1.03**	0.01	1.03**	0.01	1.04***	0.01	1.04***	0.01	1.04***	0.01
Total # household members under age 15	0.96**	0.01	0.96**	0.01	0.96**	0.01	0.94***	0.01	0.94***	0.01	0.94***	0.01
Total # household members over 64	1.05	0.04	1.05	0.04	1.05	0.04	1.03	0.03	1.03	0.03	1.03	0.03
Rural household	0.79***	0.03	0.79***	0.03	0.79***	0.03	0.84***	0.03	0.84***	0.03	0.85***	0.03
Country dummies (not shown)												
Survey Year	0.56***	0.02	0.56***	0.03	0.56***	0.04	0.19***	0.03	0.19***	0.03	0.19***	0.03

Table 2:   (Continued)

	Central[3]			Southern[4]		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Random effects						
Level 2 (Province)						
Variance intercept	0.38	0.37	0.33	0.42	0.42	0.34
Model fit						
Likelihood-ratio test	501.67***	439.24***	282.73***	1016.45***	562.28***	

Sources: DHS & MICS.
Note: [1] N=184,541 children in 125 provinces in 15 countries.
[2] N=64,302 children in 84 provinces in 6 countries.
[3] N=41,102 children in 45 provinces in 5 countries.
[4] N=93,065 children in 82 provinces in 8 countries.
[5] Reference group.
* p < .05, ** p < .01, *** p < .001.

Model 3 extends Model 2 to determine whether the socioeconomic characteristics of the provinces help to explain the curvilinear association between the concentration of orphans and children's school enrollment. Paralleling the findings for western Africa, Model 3 shows that the inclusion of province level characteristics does not help to explain the association between the concentration of orphans and children's school enrollment in eastern Africa. Net of these factors, the concentration of orphans is independently associated with children's school enrollment.

When shifting to the results for central and southern Africa, a different story emerges. Beginning with central Africa, Model 1 shows a strong positive association between the concentration of orphans and children's school enrollment. Model 2 shows that, unlike in western and eastern Africa, there is no evidence of a curvilinear association between the concentration of orphans and children's school enrollment. Instead, there is a positive linear association. Because Model 2 provides no evidence of a nonlinear association between the concentration of orphans and children's school enrollment, we omit the squared term for the concentration of orphans from Model 3 and include province level socioeconomic characteristics to determine if these factors help account for the positive linear association shown in Model 1.[11] The results show that including the province level socioeconomic characteristics reduces the association between the concentration of orphans and children's school enrollment to nonsignificance. This demonstrates that central African provinces with a higher concentration of orphans are socioeconomically advantaged communities, which *fully* explains why children in these settings have a greater likelihood of school enrollment.

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[11] In supplementary analyses, we included the squared term in Model 3 to test whether the nonlinear association becomes statistically significant with inclusion of province level socioeconomic controls. The supplementary models confirm that there is no evidence of a nonlinear association between the prevalence of orphans and children's school enrollment in central Africa (results available upon request).

The results in southern Africa are strikingly similar to the findings for central Africa. Model 1 demonstrates a strong positive association: each percentage increase in orphans is associated with a 6% increase in children's likelihood of school enrollment. Model 2 extends Model 1 to determine whether the association is curvilinear. As shown, there is no evidence of a curvilinear relationship between the concentration of orphans and children's likelihood of school enrollment. Similar to our approach for central Africa, because there is no evidence of a curvilinear association in Model 2, we omit the squared term for the concentration of orphans from Model 3.[12] In Model 3 we include socioeconomic controls at the province level to determine whether these characteristics help account for the positive linear association in Model 1. The inclusion of the socioeconomic controls significantly reduces the size of the association by two-thirds. This finding suggests that, as in central Africa, living in a province with a higher concentration of orphans in southern Africa is positively associated with children's school enrollment as a result of these settings being socioeconomically advantaged.

Because these analyses are based on the full sample of children, including orphans and nonorphans, the observed associations could be driven by the orphaned children in the sample. In other words, the concentration of orphans may be associated with the school enrollment only of children who are themselves orphaned. To analyze the robustness of our findings among the nonorphaned child population, we performed each set of analyses among the subsample of nonorphans (see Appendix C). As shown, the results are statistically similar to those for the full sample. That is, in western and eastern Africa, there is a negative association between the concentration of orphans and nonorphaned children's school enrollment in the most heavily affected provinces. Conversely, in central and southern Africa, there is a positive linear association between the concentration of orphans and nonorphaned children's school enrollment.

To summarize, the results demonstrate that the concentration of orphans varies considerably between subnational provinces in sub-Saharan Africa. Corroborating prior studies, the concentration of orphans is generally higher in eastern and southern Africa than in western and central Africa; however, there is striking variation in the prevalence of orphans across provinces both within these regions and within individual sub-Saharan African countries. Utilizing the variation in the concentration of orphans across subnational provinces, we demonstrate that living among a greater concentration of orphans is associated with children's school enrollment and, therefore, their acquisition of human capital. Our findings show that in western and eastern Africa, the concentration of orphans and children's (including nonorphans') school enrollment are

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[12] We also performed supplementary analyses that included the squared term in Model 3 among the southern African sample. As shown for central Africa, the supplementary models confirm that there is no evidence of a nonlinear association between the prevalence of orphans and children's school enrollment in southern Africa (results available upon request).

negatively associated in settings with the highest levels of orphans. Conversely, in central and southern Africa, the concentration of orphans and children's (including nonorphans') school enrollment is positively associated, which is largely explained by these areas having more favorable socioeconomic profiles than provinces with fewer orphaned children.

6. Summary and conclusions

For decades scholars have concluded that the high concentration of orphans in sub-Saharan Africa is placing great strain on African communities (Caldwell 1997; Foster, Makufa, Drew, Mashumba, and Kambeu 1997). However, although considerable research highlights the negative implications of orphanhood for the affected children, it remains unknown whether the concentration of orphans interferes with other children's well-being. To better understand the broader social implications of widespread orphanhood, we investigate, for the first time, how living among a higher concentration of orphans is associated with children's education.

In line with the perspective that the concentration of orphans has negative social consequences, we find that in western and eastern Africa both orphaned and nonorphaned children in communities highly populated with orphans are less likely to be enrolled in school than their peers in communities less populated with orphans. That is, children in these settings are less likely either to ever enroll or to remain enrolled in school.

Conversely, although orphans themselves are educationally disadvantaged by their parental loss, we find no evidence in central and southern Africa that living in a setting more highly populated with orphans is negatively associated with children's school enrollment. In fact, our results demonstrate that living in a central or southern African province with a higher concentration of orphans is positively associated with children's school enrollment due to these provinces' more favorable socioeconomic profiles.

Before discussing the implications of these findings, we first highlight three notable study limitations. First, the study focuses on one dimension of children's education: current school enrollment. Although school enrollment provides a useful snapshot of a child's opportunity to acquire human capital, it reflects only one dimension of educational progress. Further research is needed to identify how the concentration of orphans is associated with additional aspects of children's education (e.g., frequency of school attendance, academic performance, and educational attainment).

Second, the study is limited in its ability to control for important provincial characteristics. Although our modeling strategy accounts for country-level factors that

may influence the results, at the province level we only account for socioeconomic characteristics. These characteristics are insightful, as they help to explain between-province variance in school enrollment and the positive association between the concentration of orphans and children's school enrollment in central and southern Africa. However, the measures do not capture important province level factors, such as educational policies or access to school resources, which may further explain the relationships shown here.

Third, and most notably, the study relies on cross-sectional data. The absence of longitudinal data prohibits us from gaining a causal understanding of the associations shown here. For instance, although we find that living in a setting with a greater concentration of orphans is associated with lower school enrollment in western and eastern Africa, it is unclear whether this is due to the orphan disadvantage spilling over or whether the association is a byproduct of these provinces being socioeconomically and educationally disadvantaged. Similarly, we find clear evidence that the positive association between the concentration of orphans and children's school enrollment in central and southern Africa is driven by the fact that such areas are wealthier and relatively educationally advantaged: socioeconomic characteristics explain the *entire* positive association in central Africa and two-thirds of it in southern Africa. Thus, although the need to understand whether the high prevalence of orphans is associated with educational disadvantage merits the careful analysis of cross-sectional data, future longitudinal studies that address the problem of time-ordering and selection are needed to better understand the nature of the associations.

Even if the associations are a product of orphans selecting into communities with particular socioeconomic and educational profiles, it is puzzling why the results in western and eastern Africa differ from those in central and southern Africa. In other words, why is the concentration of orphans negatively associated with children's education in western and eastern Africa but not in central and southern Africa? Although the nature of the associations (e.g., selection vs. a causal effect) is unclear, this finding highlights the importance for future research on orphanhood to recognize the differing local circumstances that lead to high levels of orphaned children in the former versus the latter regions of sub-Saharan Africa. Examining the distribution of orphans across provinces (Figure 1) reveals that many of the countries in western and eastern Africa with dense orphan pockets have experienced severe armed conflicts (e.g., Côte d'Ivoire, Sierra Leone, Rwanda, Uganda). Armed conflict has lasting impacts on community structure and governance, which make it particularly difficult for communities to obtain and leverage local and international resources to promote school enrollment. Conversely, in southern Africa, and to some extent in central Africa, the high concentration of orphans is patterned by the severity of the HIV/AIDS epidemic. Not only are these regions wealthier (particularly southern Africa), but international

donors have also generously supported efforts to assist "AIDS orphans." Future research should consider the possibility that the differing circumstances driving the concentrated pockets of orphans across sub-Saharan Africa may result in distinct experiences for children in highly affected areas.

Although more sophisticated data are needed to gain a better understanding of the associations shown here, these findings are relevant to policies aimed at increasing children's school enrollment in sub-Saharan Africa. First, the results demonstrate that there is a need for more resources in orphan-dense settings in western and eastern Africa. In these settings, policies and programs should broadly define "vulnerable children" to encompass the nonorphaned children living in these educationally disadvantaged, orphan-dense areas. In other words, rather than targeting beneficiaries by parents' vital status, policies identifying children's vulnerability as a function of where they live have the potential to benefit a large number of vulnerable children.

Second, the results show that orphaned children have poorer educational outcomes than their nonorphaned peers in all regions of sub-Saharan Africa. This suggests that, although community-based approaches will identify a broader swath of educationally vulnerable children in western and eastern Africa, programs targeting orphans specifically are needed across the entire subcontinent.

In sum, this study provides a valuable first look at the broader social implications of the high concentration of orphans in sub-Saharan Africa. Lending preliminary support to both the perspective that the negative ramifications of orphanhood extend beyond orphans themselves, and the perspective that African communities are coping with the challenges associated with orphan care, the results highlight the need for future research to better understand these complex and varied associations. By extending beyond the traditional focus on orphaned children, the study lays the groundwork for a new body of research focused on understanding the broader social implications of widespread orphanhood in sub-Saharan Africa.

7. Acknowledgements

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Appendices

Appendix A: Aggregate units included in the study (N=336), by region and country

Western Africa (N=125)

Benin (12)
Alibori, Atacora, Atlantique, Borgou, Collines, Couffo, Donga, Littoral, Mono, Quémé, Plateau, Zou

Burkina Faso (13)
Centre, Boucle de Mouhoun, Centre-Sud, Plateau Central, Centre-East, Centre-Nord, Centre-Ouest, Est, Nord, Cascade, Hauts Bassins, Sahel, Sud-Ouest

Cote d'Ivoire (11)
Centre, Centre-Nord, Nord-Est, Centre-Est, Sud (excluding Abidjan), Sud-Ouest, Centre-Ouest, Ouest, Nord-Ouest, Nord, City of Abidjan

Gambia (8)
Banjul, Kanifing, Brikama, Mansakonko, Kerewan, Kuntaur, Janjanburay, Basse

Ghana (10)
Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper West, Upper East

Guinea (8)
Boké, Conakry, Faranah, Kankan, Kindia, Labé, Mamou, N'Zérékoré

Guinea Bissau (9)
Autonomous Sector of Bissau, Bafata, Gabu, Biombo, Cacheu, Oio, Tombali, Quinara, Bolama

Liberia (6)
Monrovia, North Western, South Central, South Eastern (a), South Eastern (b), North Central

Mali (9)
Kayes, Koulikoro, Sikasso, Segou, Mopti, Tombouctou, Gao, Kidal, Bamako

Niger (8)
Agadez, Diffa, Dosso, Maradi, Tahoua, Tillaberi, Zinder, Niamey

Nigeria (6)
North Central, North East, North West, South East, South West, South South

Senegal (11)
Dakar, Diourbel, Fatick, Kaolack, Kolda, Louga, Matam, Saint-Louis, Tambacounda, Thiés, Zuguinchor

Sierra Leone (4)
Eastern, Northern, Southern, Western

Sao Tome and Principe (4)
Regiao Centro, Regiao Sul, Regiao Norte, Regaio de Principe

Togo (6)
Lome, Maritime (excluding Lome), Plateaux, Centrale, Kara, Savanes

Eastern Africa (N=84)

Ethiopia (11)
Tigray, Afar, Amhara, Oromiya, Somali, Ben-Gumz, Southern Nations Nationalities and People's Region, Gambela, Harari, Addis Abeba, Dire Dawa

Kenya (8)
Nairobi, Central, Coast, Eastern, Nyanza, Rift Valley, Western, North Eastern

Rwanda (12)
City of Kigali, Kigali Ngali, Gitarama, Butare, Gikongoro, Cyangugu, Kibuye, Gisenyi, Ruhengeri, Byumba, Umutara, Kibungo

Somalia (18)
W/Galbeed, Awdal, Sanaag, Sool, Togdhere, Mudug, Nugal, Bari, Bakool, Bay, Gedo, Middle Juba, Kiran, Middle Shabelle, Lower Shabelle, Banadir, Galguduud, Lower Juba

Tanzania (26)
Dodoma, Arusha, Kilimanjaro, Tanga, Morogoro, Pwani, Dar es Salam, Lindi, Mtwara, Ruvuma, Iringa, Mbeya, Singida, Tabora, Rukwa, Kigoma, Shinyanga, Kagera, Mwanza, Mara, Manyara, Zanzibar North, Zanzibar South, Town West, Pemba North, Pemba South

Uganda (9)
Central 1, Central 2, Kampala, East Central, Eastern, North, West Nile, Western, Southwest

Central Africa (N=45)

Central African Republic (16)
Ombella Mpoko, Nana Mambere, Haute Kotto, Lobaye, Mambere Kadei, Sangha Mbaere, Nana Mambere, Ouham, Ouham Pende, Ouaka, Baminigui Bangoran, Haute Kotto, Mbomou, Basse Kotto, Haut Mbomou, Bangui

Chad (9)
Bar Azoum, Borkou-Ennedi-Tibesti, Centre East, Chari Baguirmi, Logone Occidental, Mayo Kebbi, Moyen Chari, Ouaddai Est N'Djaména

Congo(Brazzaville) (4)
Brazzaville, Pointe Noire, Sud, Nord

Democratic Republic of the Congo (11)
Kinshasa, Bas-Congo, Bandundu, Equateur, Orientale, Nord-Kivu, Maniema, Sud-Kivu, Katanga, Kasai Oriental, Kasai Occident

Gabon (5)
Libreville (Port-Gentil), North, East, West, South

Southern Africa (N=82)

Lesotho (10)
Butha-Bothe, Leribe, Berea, Maseru, Mafeteng, Mohale's Hoek, Quthing, Qacha's-nek, Mokhotlong, Thaba-Tseka

Madagascar (22)

Analamanga, Vakinankaratra, Itasy, Bongolava, Haute Matsiatra, Anamoroni'I Mania, Vatovavy Fitovinany, Ihorombe, Atsimo Atsinanana, Atsinanana, Analanjirofo, Alaotra Mongoro, Boeny, Sofia, Betsiboka, Melaky, Atsimo Andrefana, Androy, Anosy, Menabe, Diana, Sava

Malawi (3)

Northern, Central, Southern

Mozambique (11)

Niassa, Cabo, Delgado, Nampula, Zambezia, Tete, Manica, Sofala, Inhambane, Gaza, Maputo Province, Maputo City

Namibia (13)

Caprivi, Erongo, Hardap, Kara, Kavango, Khomas, Kunene, Ohangwena, Omaheke, Omusati, Oshana, Oshikoto, Otjozondjupa

Swaziland (4)

HHohho, Manzini, Shiselweni, Lubombo

Zambia (9)

Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, North Western, Southern, Western

Zimbabwe (10)

Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Matebeleland North, Matebeleland South, Midlands, Masvingo, Harare, Bulaway

Appendix B: Data source and sample characteristics, by country

	Data source	Survey year	Complete sample of children age 7-14	Incomplete Cases (%)	Final sample of children age 7-14	Portion of final analytic sample (%)	Provinces (#)
Western Africa							
Benin	DHS	2006	20,953	1.63	20,611	11.17	12
Burkina Faso	MICS	2006	9,452	2.29	9,236	5.00	13
Cote d'Ivoire	MICS	2006	12,359	1.34	12,194	6.61	11
Gambia	MICS	2006	10,545	0.60	10,482	5.68	8
Ghana	DHS	2008	10,099	0.40	10,059	5.45	10
Guinea	DHS	2005	9,516	0.76	9,444	5.12	8
Guinea Bissau	MICS	2006	8,751	4.25	8,379	4.54	9
Liberia	DHS	2007	7,792	1.75	7,656	4.15	6
Mali	DHS	2006	16,887	1.79	16,584	8.99	9
Niger	DHS	2006	11,993	1.38	11,828	6.41	8
Nigeria	DHS	2008	33,386	2.61	32,516	17.62	6
Senegal	DHS	2005	15,004	2.14	14,683	7.96	11
Sierra Leone	DHS	2008	10,453	1.85	10,260	5.56	4
Sao Tome Principe (STP)	DHS	2008	2,985	0.27	2,977	1.61	4
Togo	MICS	2006	7,750	1.52	7,632	4.14	6
Total				1.64	184,541	100	125
Eastern Africa							
Ethiopia	DHS	2005	16,258	0.66	16,150	25.12	11
Kenya	DHS	2003	8,041	0.96	7,964	12.39	8
Rwanda	DHS	2005	10,572	0.67	10,501	16.33	12
Somalia	MICS	2006	7,518	8.91	6,848	10.65	18
Tanzania	DHS	2010	11,363	0.89	11,262	17.51	26
Uganda	DHS	2006	11,721	1.23	11,577	18.00	9
Total				2.22	64,302	100	84
Central Africa							
Central African Republic (CAR)	MICS	2006	10,979	2.23	10,734	26.12	16
Chad	DHS	2004	6,968	0.95	6,902	16.79	9
Congo	DHS	2005	6,568	2.74	6,388	15.54	4
Democratic Republic of the Congo (DRC)	DHS	2007	10,775	1.01	10,666	25.95	11
Gabon	DHS	2000	6,620	3.14	6,412	15.60	5
Total				2.01	41,102	100	45
Southern Africa							
Lesotho	DHS	2009	8,488	2.33	8,290	8.91	10
Madagascar	DHS	2009	20,597	3.22	19,934	21.42	22
Malawi	DHS	2010	29,067	4.06	27,886	29.96	3
Mozambique	DHS	2009	6,099	10.12	5,482	5.89	11
Namibia	DHS	2007	8,640	4.27	8,271	8.89	13
Swaziland	DHS	2006	5,004	1.80	4,914	5.28	4
Zambia	DHS	2007	8,628	0.82	8,557	9.19	9
Zimbabwe	DHS	2005	9,855	1.26	9,731	10.46	10
Total				3.49	93,065	100	82

Sources: DHS & MICS.

Appendix C: Results of multilevel logistic regression models estimating the association between the contextual prevalence of orphans and non-orphaned children's school enrollment

	Western[1]						Eastern[2]					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Level 2 - Province												
Children orphaned by province (%)	1.08**	0.03	1.33*	0.15	1.17	0.12	1.10***	0.03	1.26**	0.10	1.12	0.07
Children orphaned by province (%, Sqrd)			0.99*	0.00	0.99	0.02			0.99*	0.00	0.99*	0.00
Household head has no formal education (%)					0.98***	0.00					0.97***	0.00
Female headed household (%)					1.01	0.01					1.05***	0.01
Mean household size					1.06*	0.03					1.00	0.09
Level 1 - Individual												
Female	0.69***	0.01	0.69***	0.01	0.69***	0.01	0.81***	0.02	0.81***	0.02	0.81***	0.02
Age	1.06***	0.00	1.06***	0.00	1.06***	0.00	1.18***	0.01	1.18***	0.01	1.18***	0.01
Relationship to household head												
Parent[5]												
Grandparent	1.05	0.03	1.05	0.03	1.05	0.03	1.15**	0.06	1.15**	0.06	1.15**	0.06
Relative	0.63***	0.02	0.63***	0.02	0.63***	0.02	0.49***	0.03	0.49***	0.03	0.49***	0.03
Sibling	0.46***	0.02	0.46***	0.02	0.46***	0.02	0.75*	0.09	0.75*	0.09	0.75*	0.09
Spouse	0.42***	0.05	0.42***	0.05	0.42***	0.05	0.19***	0.08	0.19***	0.08	0.20***	0.08
Child head	1.24	1.48	1.24	1.48	1.25	1.48	1.84		1.84		1.84	
Non-relative	0.54***	0.02	0.54***	0.02	0.54***	0.02	0.25***	0.02	0.25***	0.02	0.25***	0.02
Education of household head												
No formal education[5]												
Primary	2.23***	0.04	2.23***	0.04	2.23***	0.04	2.04***	0.06	2.04***	0.06	2.03***	0.06
Secondary	3.81***	0.08	3.81***	0.08	3.79***	0.08	3.07***	0.15	3.07***	0.15	3.05***	0.15
Female headed household	1.54***	0.03	1.54***	0.03	1.54***	0.03	1.21***	0.04	1.21***	0.04	1.21***	0.04
Age of household head	1.00	0.00	0.99***	0.00	0.99***	0.00	0.99*	0.00	0.99*	0.00	0.99*	0.00
Household wealth	1.42***	0.01	1.42***	0.01	1.42***	0.01	1.38***	0.02	1.38***	0.02	1.38***	0.02
Household size	1.02***	0.00	1.02***	0.00	1.02***	0.00	1.02*	0.01	1.02*	0.01	1.02*	0.01
Total # household members under age 15	0.96***	0.00	0.96***	0.00	0.96***	0.00	0.95***	0.01	0.95***	0.01	0.95***	0.01
Total # household members over 64	1.06***	0.01	1.06***	0.01	1.06***	0.01	1.02	0.04	1.02	0.04	1.02	0.04
Rural household	0.74***	0.01	0.74***	0.01	0.74***	0.01	0.55***	0.03	0.55***	0.03	0.55***	0.03
Country dummies (not shown)												
Survey Year	1.52***	0.13	1.55***	0.13	1.28*	0.13	1.37***	0.08	1.37***	0.08	1.37***	0.06
Random effects												
Level 2 (Province)												
Variance intercept	0.81		0.80		0.70		0.82		0.80		0.58	
Model fit												
Likelihood-ratio test	1200.04***		1100.04***		942.04***		3190.63***		3111.20***		1989.05***	

Appendix C: (Continued)

| | Central[3] | | | | | | Southern[4] | | | | | |
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Level 2 - Province												
Children orphaned by province (%)	1.08**	0.03	1.28*	0.14	1.05*	0.02	1.07***	0.01	1.12**	0.05	1.04**	0.01
Children orphaned by province (%, Sqrd)			0.99	0.00					1.00	0.00		
Household head has no formal education (%)					0.98**	0.01					0.98***	0.00
Female headed household (%)					1.00	0.01					1.03**	0.01
Mean household size					0.99	0.09					1.16	0.12
Level 1 - Individual												
Female	0.61***	0.02	0.606***	0.02	0.606***	0.02	1.18***	0.03	1.18***	0.03	1.18***	0.03
Age	1.12***	0.01	1.12***	0.01	1.12***	0.01	1.03***	0.01	1.03***	0.01	1.03***	0.01
Relationship to household head												
Parent[5]												
Grandparent	1.05	0.06	1.05	0.06	1.05	0.06	1.08	0.05	1.08	0.05	1.08	0.05
Relative	0.57***	0.03	0.57***	0.03	0.57***	0.03	0.55***	0.03	0.55***	0.03	0.55***	0.03
Sibling	0.64***	0.06	0.64***	0.06	0.64***	0.06	0.61	0.06	0.61	0.06	0.61	0.06
Spouse	0.53*	0.17	0.53*	0.17	0.53*	0.17	0.37***	0.08	0.37***	0.08	0.37***	0.08
Child head	1.01	1.30	1.01	1.30	1.01	1.29	0.62	0.31	0.62	0.31	0.62	0.31
Non-relative	0.65***	0.05	0.65***	0.05	0.65***	0.05	0.36***	0.02	0.36***	0.02	0.36***	0.02
Education of household head												
No formal education[5]												
Primary	1.84***	0.07	1.84***	0.07	1.84***	0.07	1.88***	0.05	1.88***	0.05	1.88***	0.05
Secondary	3.73***	0.17	3.73***	0.17	3.73***	0.17	3.35***	0.15	3.35***	0.15	3.35***	0.15
Female headed household	1.42***	0.06	1.42***	0.06	1.42***	0.06	1.18***	0.04	1.18***	0.04	1.18***	0.04
Age of household head	1.00	0.00	1.00	0.00	1.00	0.00	0.99***	0.00	0.99***	0.00	0.99***	0.00
Household wealth	1.46***	0.02	1.46***	0.02	1.46***	0.02	1.39***	0.02	1.39***	0.02	1.39***	0.02
Household size	1.03**	0.01	1.03**	0.01	1.03**	0.01	1.07***	0.01	1.07***	0.01	1.07***	0.01
Total # household members under age 15	0.96**	0.01	0.96**	0.01	0.96**	0.01	0.91***	0.01	0.91***	0.01	0.91***	0.01
Total # household members over 64	1.07	0.05	1.07	0.05	1.07	0.05	1.06***	0.04	1.06***	0.04	1.06***	0.04
Rural household	0.79***	0.03	0.79***	0.03	0.79***	0.03	0.79***	0.04	0.79***	0.04	0.79***	0.04
Country dummies (not shown)												
Survey Year	0.55***	0.02	0.55***	0.03	0.55***	0.04	0.18***	0.04	0.18***	0.04	0.18***	0.03
Random effects												
Level 2 (Province)												
Variance intercept	0.36		0.35		0.31		0.42		0.42		0.33	
Model fit												
Likelihood-ratio test	392.83***		347.75***		195.22***		817.4***		817.03***		430.04***	

Sources: DHS & MICS.

Note: [1] N=166,173 non-orphaned children in 125 provinces in 15 countries.

[2] N=52,915 non-orphaned children in 84 provinces in 6 countries.

[3] N=35,921 non-orphaned children in 45 provinces in 5 countries.

[4] N=74,747 non-orphaned children in 82 provinces in 8 countries.

[5] Reference Group.

* p < .05, ** p < .01, *** p < .001.