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Gender, Labor, and Prime-Age Adult Mortality: Evidence from South Africa

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Abstract

This paper examines the impact of prime-age adult mortality on the transition from school to the labor market of adolescents and on decisions by female adults to participate in the labor force in South Africa. The analysis focuses on that period—1998–2004—when South Africa experienced excess mortality due to the HIV/AIDS epidemic. We find, first, that deaths of prime-age adults significantly increase both male and female adolescents' labor force participation because they stop their schooling in order to help support their families. Female school enrollment may also decrease because girls are required to stay at home to take care of the sick. Therefore, the total negative impact on schooling is larger among female adolescents than among male adolescents. Second, we find that female adults tend to join the labor force following the death of prime-age adult males. This change could cause a decrease in the time they spend on housework and child rearing. Combined, these findings imply that excess mortality of prime-age adults disrupts human capital formation.

Key words: prime-age adult mortality, schooling, labor supply, gender, South Africa

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1. Introduction

It is increasingly recognized that mortality among adults in the prime of life has grown dramatically in many African countries. Such a drastic demographic change is largely attributed to the AIDS epidemic (see, for example, Epstein 2004). Excess mortality is concentrated among women between the ages of 25 and 39 and among men between the ages of 30 and 44 (Timaeus and Jasseh 2004).[1] An increase in mortality among prime-age adults, unlike mortality in other age groups, directly reduces the capability of households to secure income. It also directly affects their earnings endowment.[2] Here we attempt to assess the impacts of such mortality on human capital formation and labor markets, first, by examining the transition of adolescents from school to the labor market and second, female decisions to join the labor force, using recently available panel data from South Africa.

The issue at hand in this paper is of increasing importance to contemporary Africa. The death of adults in their productive years raises serious concerns about the pervasive impact of the epidemic on household behavior and on human capital development—in particular through education and labor supply decisions. Since the onset of HIV/AIDS two decades ago, mortality rates in many Sub-Saharan African countries have escalated dramatically. According to Statistics South Africa (2005), the number of annual recorded deaths in the 20 to 44 age group more than doubled between 1997 and 2002, from a little over 100,000 to more than 200,000. Most literature that looks at the causes of premature mortality in South Africa identifies HIV/AIDS as the

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1 The microfoundation for such increases in adult mortality is found in studies of the sexual activities and marriage decisions of young adults (Oster 2005; Hallman 2004; Munshi and Myaux 2002).

2 Households can tap government grants (for example, child support or foster-care grants) and formal insurance. They can also engage in some ex ante and ex post risk-coping/mitigating strategies (such as borrowing from the credit market and remittances from relatives) to buffer the shocks. They can develop foster-care arrangements or income diversification strategies (including labor supply). However, if these strategies are imperfect in smoothing consumption, prime-age adult death can decrease child schooling investments and increase labor supply at least in the short run. Moreover, prime-age adult death also reduces the expected future earnings for the household. This, in turn, reduces investments in child schooling, given that the period over which the capital is formed is long and the loan market is imperfect. Having said that, the growth in the number of orphans in a society is taxing on both families and the society (see Kelly 2000, quoted in Bennell 2005, 473).

biggest single reason for such death, compared with other causes (see, for example, Dorrington et al. 2001).

The main focus of our study is on adolescents' transition from school to the labor market and on changes in the allocation of time between household production and labor-market activities, potentially in response to prime-age adult mortality and as part of a household's optimal risk-mitigation strategies. If adult mortality accelerates adolescents' transition to the labor market, it has long-term implications for human capital formation.[3] The transition affects the unemployment rate among the young if, as a consequence of their exit from school, they are insufficiently educated.[4,5] Adult household members who survive the crisis also have to adjust to the mortality shocks, by changing how they allocate their time. For example, female household members who are at home may need to look for earning opportunities in the labor market. In the analysis that follows, we investigate these issues in detail, while acknowledging the possibility that the behavioral response to adult mortality may differ by gender, age, and schooling level.

There are a number of recent studies that attempt to identify the impacts of prime-age adult mortality on child schooling and the labor supply (see, for example, Ainsworth, Beegle, and Koda 2005; Yamano and Jayne 2005). Though Section 2 details these studies' main relevant findings, the point is that they demonstrate the importance of prime-age adult deaths, which creates orphans, in determining child school enrollment and attendance. In the literature, however, the impact on household labor supply is less visible than that on child schooling (Beegle 2005).[6] Because we identify labor supply

[3] To the extent that prime-age adult mortality produces children (for example, orphans) who cannot receive enough education to participate successfully in the labor market, HIV/AIDS creates inequality in human capital (and earnings) between those affected and those unaffected. This may increase unemployment, unless the government intervenes to break this intergenerational effect.

[4] The estimation of schooling participation behavior also identifies labor supply behavior, as those who stop schooling are likely to look for jobs.

[5] At the macro level, it is often argued that prime-age adult mortality due to HIV/AIDS causes labor shortages. However, with high unemployment rates, as observed in South Africa, labor shortages may not occur if the degree of (skill) substitutability between the dying and the unemployed is high. Even in agricultural household production where this causality looks rather straightforward, the degree of substitution between household members and hired labor matters.

[6] Since Beegle's analysis controls for selectivity in wage employment, overall labor supply (which would include both employed and unemployed) is not directly studied.

effects, our contribution to the literature is important in this regard. Also, though most of these studies share motivations similar to ours, they deal with agricultural settings. In contrast, the people in our sample come from a semi-industrialized setting in South Africa, where the dominant income source for households is wage employment, even in rural areas. This difference provides a set of risk-coping and mitigating strategies distinct from those that occur in other Sub-Saharan rural contexts. It also justifies our focus on labor supply and schooling decisions.

The paper is structured as follows. In Section 2, we explain the motivation for our focus on prime-age adult mortality in South Africa. Section 3 reviews the recent literature on the impacts of prime-age adult mortality on labor supply and child schooling. Section 4 sets the empirical framework for our analysis. Section 5 describes activity transitions in the sample. Section 6 presents our empirical results. The data used for this paper come from the KwaZulu-Natal Income Dynamics Study (KIDS), waves 2 and 3, conducted in the province of KwaZulu-Natal in 1998 and 2004 (May et al. 2006).[7]

Several findings emerge from the analysis. We find, first, that deaths of prime-age working adults significantly increase both the male and female adolescent labor supply by stopping their schooling. Impending deaths of prime-age adults also decrease female school enrollment, suggesting that girls may need to stay at home to take care of the sick or of the household generally, so they often drop out of school before the death actually occurs. Therefore, the total negative impact on schooling is larger for female adolescents than for males. Second, female adults tend to join the labor force after the death of prime-age adult males. The shift might translate into a decline in their time spent on housework, including child rearing. These findings imply that prime-age adult excess mortality disrupts human capital formation in society.

[7] KIDS was a collaborative project between researchers at the International Food Policy Research Institute (IFPRI), the University of KwaZulu-Natal, the University of Wisconsin, London School of Hygiene and Tropical Medicine, the Norwegian Institute of Urban and Regional Studies, and the South African Department of Social Development. In addition to support from these institutions, the following organizations provided financial support: the Department for International Development—South Africa (DfID-SA), the U.S. Agency for International Development (USAID), the Mellon Foundation, and the National Research Foundation/Norwegian Research Council grant to the University of KwaZulu-Natal.

2. Empirical Motivations

The KwaZulu-Natal Income Dynamics Study, Round 3, contains retrospective information on those who died and when in the participating households between 1998 and 2004.[8] Combining this information with the roster information on individuals in 1998, we can identify the age at death.

Our analysis covers the period 1998 to 2004, which corresponds to the time when South Africa experienced substantial increases in prime-age adult mortality (Statistics South Africa 2005). The period covered is, therefore, quite appropriate for identifying the impacts of prime-age adult mortality on the time allocation decisions of children and housewives.

Figures 1a and 1b show the changes in mortality rates during the period under study for males and females. Age-specific pre-AIDS mortality rates for men and women are the benchmark rates against which the increases in mortality are considered. The pre-AIDS mortality data are from the Actuarial Society of South Africa's (ASSA) 2002 model estimates for 1996. Since the sample period we consider spans six years, the mortality rate is converted into annual terms, assuming a constant mortality rate throughout the period. The figures show significant increases in adult mortality in the 20–44 age groups.

Table 1 reports the probit results on individual mortality, controlling for the age-specific pre-AIDS mortality rates. Column 1 uses the pre-AIDS mortality rate available from the ASSA 2002 model. This variable is included to control for the pre-AIDS level of mortality rate. The result confirms that the benchmark pre-AIDS level of mortality significantly explains mortality over the 1998–2004 period. Column 2 introduces age group indicators to capture age-specific changes in mortality during the period considered. With the 15-19 age group omitted, we find significant increases in mortality

[8] To minimize emotional distress, we did not ask the respondent about causes of a death that occurred three months prior to the 2004 survey

Figure 1a—Mortality rate—Male

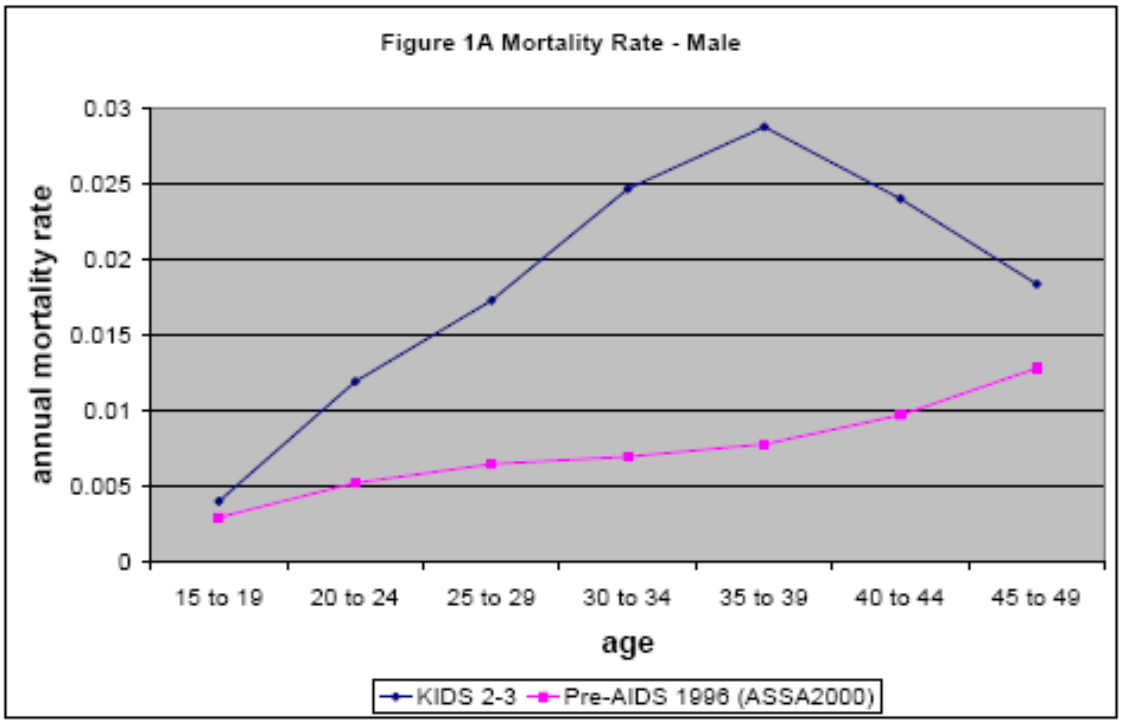

Figure 1b—Mortality rate—Female

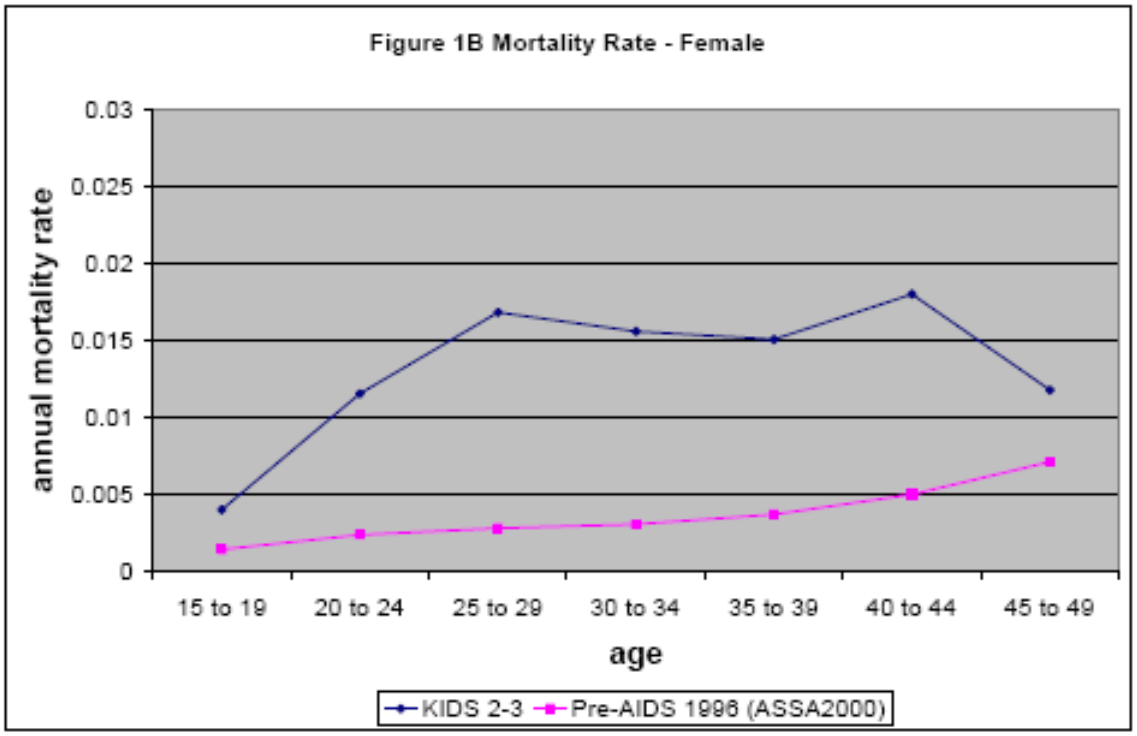

Table 1—Mortality changes, 1998–2004

Dependent: 1 if died in 1998-2004, 0 if alive in 2004

	Estimation									
	Probit				Household random-effect Probit			Household fixed-effect linear		
Sample: Age 15 to 64 in 1998	**Both (1)**	**Both (2)**	**Male (3)**	**Female (4)**	**Both (5)**	**Male (6)**	**Female (7)**	**Both (8)**	**Male (9)**	**Female (10)**
Pre-AIDS mortality rate [1996a]	34.197	48.252	37.986	46.188	46.437	53.384	59.445	11.008	-2.5718	7.5971
	(7.64)	(2.65)	(0.92)	(0.79)	(2.62)	(1.41)	(1.00)	(2.74)	(0.21)	(0.52)
Age 20-24		0.4246	0.4568	0.4582	0.4069	0.3794	0.4045	0.0251	0.0729	0.0532
		(3.50)	(2.44)	(2.60)	(3.52)	(2.10)	(2.43)	(1.77)	(2.08)	(2.26)
Age 25-29		0.5641	0.5870	0.6014	0.5663	0.5106	0.5700	0.0342	0.0966	0.0603
		(4.38)	(2.72)	(3.24)	(4.78)	(2.48)	(3.31)	(1.84)	(1.89)	(1.95)
Age 30-34		0.6327	0.7737	0.5987	0.6328	0.6722	0.5462	0.0517	0.1191	0.0643
		(4.69)	(3.27)	(2.96)	(5.05)	(3.03)	(2.89)	(2.39)	(2.02)	(1.81)
Age 35-39		0.6664	0.9305	0.5589	0.6182	0.7383	0.4472	0.0556	0.1903	0.0324
		(4.73)	(3.51)	(2.53)	(4.62)	(2.99)	(2.09)	(2.450	(2.77)	(0.80)
Age 40-44		0.5567	0.7130	0.5073	0.5266	0.4832	0.4762	0.0442	0.1243	0.0718
		(3.32)	(2.11)	(1.74)	(3.34)	(1.54)	(1.71)	(1.51)	(1.34)	(1.17)
Age 45-49		0.2607	0.4213	0.2142	0.2215	0.1940	0.1053	-0.0345	0.0710	-0.0085
		(1.26)	(0.92)	(0.55)	(1.13)	(0.46)	(0.27)	(0.99)	(0.57)	(0.10)
Age 50-54		0.2395	0.4024	0.2941	0.1929	0.0339	0.1292	-0.0418	0.1930	-0.0278
		(0.85)	(0.59)	(0.51)	(0.72)	(0.05)	(0.22)	(0.79)	(0.98)	(0.21)
Age 55-59		0.2379	0.3491	0.4034	0.1886	-0.0891	00.1482	-0.0554	0.2322	0.0090
		(0.64)	(0.38)	(0.49)	(0.54)	(0.10)	(0.18)	(0.74)	(0.89)	(0.05)
Age 60-64		-0.0358	0.4655	-0.0924	0.0121	-0.0697	-0.3428	-0.1171	0.4348	-0.0510
		(0.08)	(0.37)	(0.08)	(0.03)	(0.06)	(0.30)	(1.25)	(1.16)	(0.19)
Male	0.0155	-0.0357			-0.0413			-0.0095		
	(0.29)	(0.37)			(0.42)			(0.55)		
Cluster fixed effects	Yes	Yes	Yes	Yes						
Household random effects					Yes	Yes	Yes			
Household fixed effects								Yes	Yes	Yes
Number of observations	4,532	4,532	1,950	2,272	4,549	2,086	2,509	4,549	2,086	2,509
Pseudo R squared	0.0557	0.0770	0.1081	0.0637	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Notes: Numbers in parentheses are absolute asymptotic *t*- values, using robust standard errors with household clusters. Ages are those as of 1998. n.a. indicates not available.

[a] The pre-AIDS mortality rate is taken from the Actuarial Society of South Africa Model 2002.

[a] Pre-AIDS mortality rate is taken from the Actuarial Society of South Africa Model 2002.

among the 20–44 age groups. This is consistent with our hypothesis that households faced some exogenous changes in the prime-age adult mortality rate in the 20–44 age group during this period.

To distinguish age-specific mortality changes between men and women, columns 3 and 4 report the results of separate estimations by gender. The results show that there are larger increases in mortality among men than among women. However, during the period under study, those aged between 20 and 44, across both groups, experienced significant increases in mortality.

Given that these findings might have been generated from unobservable household-specific factors, which are correlated with the household demographic structure, we alter the model specifications. Columns 5 to 7 examine the within-household incidence of mortality with household random effects. Columns 8 to 10 use household fixed effects in linear models. Both the random-effect and fixed-effect estimates show quite similar effects of the age indicators as well as of individual characteristics. Yet, the significance of parameter estimates in the fixed-effect estimations is slightly lower than that for the random-effect probit results.

These results confirm that those who were between 20 and 44 years old in 1998 were more likely to die than others in a household. Increases in the incidence of mortality among prime-age adults should cause a reallocation of resources within the household, including changes in time allocation among household members. This effect arises as household members seek to mitigate the negative impacts of adult mortality on household welfare.

3. Impact of Prime-Age Adult Mortality on Schooling and Labor Supply

Effects on the Labor Supply

A handful of studies have examined the impact of prime-age adult mortality on the labor supply. With the HIV/AIDS epidemic mostly striking men and women in their prime, an investigation of this phenomenon is important in developing countries

generally and in South Africa in particular. While some studies focus on the impact of HIV/AIDS in countries where labor is largely employed in the agricultural sector, very few studies have considered the effects on the nonagricultural sector. Having said that, it is important to bear in mind that this paper is not concerned about the distinction between the agricultural and nonagricultural sectors as sources of employment. Its main focus is on changes in how adolescents and female adults allocate their time when adults in the household die or are ill. In order to smooth household consumption and income, adolescents frequently leave school and enter the labor market (as employed or unemployed) and female household members alter their labor force participation.

Among the studies that empirically examine the impact of AIDS mortality on the labor supply is an analysis of two Labor Force Surveys (1990/91 and 2000/01) in Tanzania, undertaken by Wobst and Arndt (2004). The data suggest a dramatic increase in labor force participation rates for children aged 10 to 14, increasing from 23 to 46 percent, implying a tendency to drop out of primary schools (Wobst and Arndt 2004, 1832). The authors interpret the change to be a consequence of the rising need to secure household income as prime-age adult mortality increased over the period. Our paper is similar to theirs in that we focus on adolescents' time allocation. However, we explore this issue based on microlongitudinal data, instead of aggregate measures as are used in their analysis

Using panel data from Tanzania, Beegle (2005) explores how prime-age adult mortality affects the time allocation of surviving household members and the portfolio of household farming activities. The author, who analyzes hours spent farming and doing household chores across demographic groups, finds small and insignificant changes in the labor supply of individuals in households that experience a prime-age adult death. While some farm activities are temporarily scaled back and wage employment falls after a male death,[9] households did not shift cultivation away from subsistence farming. Moreover,

[9] It is important to bear in mind that, since Beegle's analysis of employment does not include unemployment, she does not directly focus on labor force participation.

they did not appear to reduce their diversification of income sources more than six months after a death.

Donovan et al. (2003), who analyze the effects of prime-age adult morbidity and mortality in rural Rwanda, show that loss of agricultural labor was most pronounced for cropping and animal husbandry. This effect was found when the household experienced a prime-age death without (chronic) illness. A decline in savings and an increase in indebtedness were common effects for households that experienced prime-age mortality after a period of illness.

Our empirical setting is different from that of these two studies in that most of the sample households supply labor in the nonagricultural sector. Therefore, we focus on labor force participation decisions without distinguishing between the agricultural and nonagricultural sectors.

Effects on Child Schooling

It is widely believed that the death of a parent has serious repercussions for the well-being and future of children—their schooling in particular. Moreover, the negative impact of adult mortality across developing countries appears to have worsened, in spite of programs designed to help pay for schooling for orphaned children and other children affected by the death of a parent. Hence, parental death is a serious threat to the hard-won gains in raising school enrollment in most developing countries.[10]

It appears that the situation is worsened by the high prevalence of HIV/AIDS, which leaves many children orphaned. According to Ainsworth, Beegle, and Koda (2005), school attendance is significantly affected by the death of an adult in the household. They also show that when an adult is mortally ill, school attendance of children decreases; that is, a death occurs four to six months after a child drops out.

[10] The argument on this is, however, complex. Young (2005) shows two opposite effects of HIV/AIDS adult mortality on child schooling: a positive indirect effect through a decrease in the fertility rate (increasing the resources available per child), and a negative direct effect through increased orphanhood. In his calibrations, the positive effect dominates the negative effect. He thus concludes that HIV/AIDS promotes net human capital formation in the long run.

School attendance is disrupted ex ante. In the context of HIV/AIDS, it appears that children's schooling may be affected because there are new demands on their time, if they must care for, or substitute for the work of, the critically ill adult. School attendance is also affected by a series of other factors: the inability to pay for schooling costs in the face of high medical and funeral bills; a lack of interest by the caregivers in investing in the welfare of orphans; emotional and psychological damage to the child after witnessing his/her parent's death after a long period of illness. For a variety of reasons, we believe the education of a child is adversely affected by the death of an adult in the household.

In terms of the magnitude of the impact of AIDS-related working-age mortality on primary school attendance, results from Yamano and Jayne (2005) for rural Kenya suggest that children experiencing working-age mortality are about 3 percent less likely to attend school than children who did not experience adult mortality. These findings were based on the 1997, 2000, and 2002 panel surveys. However, the results are sensitive to the gender of the child and to the wealth status of households. That is, girls in poor households were found to be less likely than boys to attend school prior to an adult death. In contrast, boys in poor households are less likely than girls to attend school some time after experiencing adult mortality in their households.

There are several studies on the impact of HIV/AIDS on schooling among orphans. Case, Paxson, and Ableidinger (2004) examined the impact of orphanhood on children's school enrollment in 10 Sub-Saharan African countries. They showed that orphans are less likely to be enrolled than nonorphans with whom they live.

Ainsworth, Beegle, and Koda (2002), in their examination of the impact of adult mortality on primary school enrollment in Kegara, in Northwest Tanzania, found schooling of orphans and other children who have experienced adult mortality in their households is particularly threatened. They argue that "families affected by an adult death may be less able to afford direct and indirect costs of schooling, and the child's opportunity cost of time may rise in household and farm activities" (Ainsworth, Beegle, and Koda 2002, 22).

Unlike many other studies, Bennell (2005) found complex relationships between parental status and the child school attendance. His study is based on the impact of the AIDS epidemic on the schooling of orphans and other children directly affected by the AIDS epidemic in Botswana, Malawi, and Uganda. He concludes by suggesting that the impact of the epidemic is overstated. For example, his findings suggest low school dropout rates for orphaned children in Botswana. "[L]ow household demand for child labor, a strong schooling culture, a comprehensive school feeding programme, and difficult home environments" keep children in schools in Botswana (Bennell 2005, 477). He also provides evidence from the three countries in question that living arrangements depend on orphanhood types—namely, how many parents died and which parent died.

Boler's (2006) work is the most relevant to this paper, given that she uses the same data set and looks at the situation of children between the ages of 7 and 20 in 2004. In her work, which focuses on the educational consequences of the HIV/AIDS pandemic on orphans, she contrasts the educational outcomes of orphans with those of nonorphaned children.[11] Though her analysis does not deal with labor supply responses, she finds that the educational outcomes of orphans vary across age groups as well as with the gender of the child and that of the parent who has died. When the parent died also seems to matter in her analysis. In terms of gender impact, she finds that repetition of grades and dropouts are common for girls only. Dropout occurs in the 16–20 age group only as a medium- to long-term response.

It is worth noting, first, that although many findings point to the negative impact of adult mortality on the decision for a child to stay in school, empirical evidence suggesting that adult mortality has a long- or short-term impact on children's schooling progression is limited. That is, it is not clear whether the negative impacts are associated with a permanent or temporary withdrawal of children from school. Second, most of these studies focus on children in the primary-school stage. In this paper, we examine, instead, the impact of prime-age death on adolescents, at the secondary-school stage or

[11] She also considers whether cash grants positively alter the educational outcomes of the two groups of children. She further shows that the type of orphanhood matters for the living conditions of orphans.

higher. Therefore, our interest is to understand their decision to complete their investment in schooling or their transition to the labor market.

4. Empirical Framework

This section describes our empirical methodology. The behavioral equation of interest to us is as follows:

$$y_{ijt} = \alpha + x_{jt}\beta + \gamma s_{it0} + \delta a_{it0} + \mu_i + \eta_j + \varepsilon_{ijt}, \quad (1)$$

where y_{ijt} is an activity indicator for individual i in household j at time t (for example, labor supply, school, housewife, and so forth), x_{jt} is a vector of household-level factors including the demographic composition of the household, s_{it} is the highest grade completed, a_{it} is age, μ_i is individual fixed effect, η_j is household fixed effect, and ε_{ijt} is an error term.

Correlations between x_{jt} and (μ_i, η_j) bias naive estimates (such as ordinary least squares) of β. To solve this problem, we focus on changes in activity (for example, transition from school to labor market) over time. More specifically, we take the difference of equation (1) between two points in time to eliminate μ_i and η_j. Thus, we estimate

$$\Delta y_{ij} = \alpha' + \Delta x_j \beta + \Delta \varepsilon_{ij}, \quad (2)$$

where Δx_j captures changes in household demographic composition. In our setting, it represents the death of prime-age adult members. In the main analysis, we estimate β using a fixed effects logit model (Chamberlain 1984).

In equation (2), the endogeneity of adult mortality is not perfectly resolved, as we may have

$$E\left[\Delta x_j \varepsilon_{i1}\right] = E\left[x_{j2}\varepsilon_{ij1}\right] \neq 0;^{12}$$

for example, a decline in household income causes dropouts from school. This may worsen living conditions, which can increase adult mortality. Although this possibility can be minimized if the sample consists of children enrolled in the initial period, we allow this problem to remain in the analysis that follows because of the difficulty of instrumenting Δx_j.

This concern also calls for the need to balance the factors that potentially explain adult mortality. However, we do not pursue the approach of propensity score matching, since it is difficult to find predetermined factors that satisfy the strong ignorability (compoundedness) condition, and since the outcome of interest is discrete in the logit or probit model.[13]

In the case of HIV/AIDS-related mortality, it is possible that foreseeing the death of AIDS-infected members causes other members to adjust to the negative impacts ex ante, that is, by increasing the labor supply to secure household income. The question is who, in the household, changes his or her time allocation in the face of shocks. For example, if girls are more likely to care for the sick at home than boys, girls' enrollment rate should be lower than that of boys, even before the death of the ill person.[14] To check

[12] See also Beegle (2005) for a detailed discussion on potential endogeneity problems of adult deaths.

[13] Imai and van Dyk (2004) and Hirano and Imbens (2004) investigate propensity score matching with continuous treatment effects. Woodridge (2005) analyzes an alternative approach to this issue, using instrumental variables estimation. In the second stage of assessing average treatment effects, both methods are formulated in the regression framework with a continuous dependent variable. Besides the problem on the types of dependent variable, the age distribution provides a possible set of variables that may satisfy the strong ignorability condition in propensity score matching. In the first differenced specification, we also difference out the household-level fixed factors as well as the predetermined factors.

[14] If some household members (including school-age children) have already changed their time allocation as they anticipate the death of some adult member, it would not be necessary for other members to accommodate the negative impacts of adult death by making additional changes in time allocation decisions. This would lead to an underestimation of the impacts on the labor supply and on schooling in our framework. We have not detected the causality from enrollment in the initial period to the number of prime-age adult deaths in the following six years. In the analysis that is carried out next, we examine the effect of future adult death (over a six-year time span) on the initial-period enrollment by gender.

this ex ante response, we use a sample of individuals aged 14 to 19 in 1998, irrespective of their school enrollment status.

In our empirical setting, however, most adolescent transitions are a one-way process. The adolescent transfers from school to the labor market.[15] Though those who were recorded with labor-force activities do not move back to school after the six-year interval of our panel data, the fact that we ignore the heterogeneity in the initial state causes a selectivity bias in the estimates. Therefore, we do not restrict the sample to those who were enrolled in school but also incorporate those already in the labor market. We also investigate how future mortality affects the initial state. If household members acknowledge the possibility of the future death of a household member, they may adjust their behavior beforehand in order to accommodate for the negative shocks that arise after the fact. Finally, in the analysis of adult labor supply, we focus on women's time allocation between in-house and labor-market activities. In the KIDS data, labor force status consists of three categories of employment (regular employment, casual employment, and self-employment) as well as unemployment.

5. Activity Transitions

The KIDS surveys provide information about the activities of household members by employment status as reported above. The KIDS data also specify whether an individual is unemployed, a housewife, involved with childcare, in-school (including at university), at a crèche or at preprimary school, retired, or other. Combining the two survey rounds, it is possible to establish the transitions in activity from 1998 to 2004, though details of activities within the period are not available. For our research purposes, we restrict our sample to those who were enrolled in school and aged 14 to 19 in 1998, and examine their schooling continuation and labor-force participation in 2004. Thus, we

[15] It is not possible, in our data, to identify whether the decision is temporary.

only use employment and unemployment status (both coded as zero) and in school (coded as one).

Table 2a and Table 2b show the activity transitions from 1998 to 2004. Table 2a covers individuals aged 20 to 64 in 1998. The data show, first, that many housewives moved to enter the labor force, either as employed or unemployed, in 2004. Second, though the unemployed tend to become employed, the majority remained unemployed even in 2004. Overall, the transition matrix shows a relative stability in the activities over time.

Table 2b shows the situation for adolescents (aged 14 to 19) in 1998. Two main trends emerge from the data. First, it is interesting to find that among those who transferred to the labor market, the majority were unemployed. This tendency reflects the current labor-market conditions in South Africa, where the unemployment rate is high, particularly among the young. Second, the transition from school to the labor force

Table 2—Activity transitions

A: Adult

Activity 2004	Regular employment	Casual employment	Self-employment	Housewife	Unemployed	Education	Retired	Others
Activity 1998								
Regular employment	223	71	22	20	93	0	38	2
Casual employment	21	26	6	7	40	0	7	1
Self-employment	6	12	23	12	26	3	9	0
Housewife	9	14	18	84	65	1	38	3
Unemployed	63	79	32	36	330	8	35	15
Education	37	28	5	1	106	10	1	3
Retired	1	0	2	1	8	0	12	2
Others	1	0	2	1	8	0	12	2

Notes: Number of observations. The sample consists of residents aged 20–64 in 1998.

B: Adolescent

Activity 2004	Regular employment	Casual employment	Self-employment	Housewife	Unemployed	Education
Activity 1998: Education (school)						
Age 14-19	29	56	8	5	276	174
Male	13	33	5	0	131	94
Female	16	23	3	5	145	80

Notes: Number of observations. The sample consists of residents aged 14 to 19 in school in 1998.

occurs in a similar manner for both men and women.[16] In the next section, we provide the empirical results on the impact of prime-age adult death on adolescents' schooling continuation or transition to the labor supply.[17]

6. Empirical Results

Adolescent Transition to Labor Market

We detail, in this section, the main findings on the impact of prime-age adult mortality on the time allocation of adolescents. In the analysis below, we use two different definitions of prime-age adults: those between the ages of 15 and 64, and those between the ages of 20 and 44. The former corresponds to the widely used definition of age range for labor-force participation, while the latter focuses on the age range in which, as shown in Section 1, we found substantial increases in the mortality rate. We consider a variety of measures of prime-age adult mortality: the total number of deaths in the household, prime-age adult death (15–64 or 20–44), death of working members and of prime-age working adult members, differentiated by gender.

Table 3 shows how prime-age adult mortality in the future (that is, between 1998 and 2004) affects school enrollment. If future mortality among prime-age adults in the household is preceded by the need for home care, it may change the time allocation of adolescents. Columns 1 to 4 show the estimation results using both male and female adolescents. In column 1, the total number of deaths in ages 15–64 does not affect enrollment significantly. Column 2, which distinguishes the effects for male and female adolescents, shows a significant negative effect of future prime-age adult mortality on female adolescents. For men, the effects cancel out, meaning that there is no impact on

[16] With limited access to schools and inability to afford school inputs and other factors, some children may only begin their primary education after the ages of 6 and 7.

[17] We only use the sample of individuals that we observed in both 1998 and 2004. Even though tracking individuals who moved away from survey sites was extensively pursued, it was necessary to drop individuals who had died and whom we could not follow up. As to the selectivity problem that may arise from mortality during the period, the results for adolescents are robust to prime-age adult mortality in general, and those for female adults are robust to prime-age male adult deaths.

enrollment. In column 3, we restrict the definition of prime-age death to those aged 20–44, reflecting the fact that this group has experienced significant excess mortality (Table 1). Female adolescents' enrollment is again significantly decreased when they face subsequent prime-age adult mortality. In contrast, their time allocation is not altered by the death of working adults (column 4). This suggests that their time is allocated in response to an in-house labor demand associated with the caring of the very sick, irrespective of whether the dying were working.

Table 3—Impact of future mortality on adolescent enrollment in 1998

Dependent: 1 if in school, 0 if otherwise

	Estimation: Probit						
	Male and female				**Female**		
Sample	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Total prime-age death (age 15–64)	-0.1593 (1.29)	-0.3709 (2.37)			-1.3843 (3.92)		
Total prime-age death (age 15–64) × male		0.3066 (1.74)					
Total prime-age death (age 20–44)			-0.3809 (2.05)			-1.1250 (3.24)	
Total prime-age death (age 20–44) × male			0.3387 (1.81)				
Total working prime-age death (age 20–44)				-0.0799 (0.25)			-0.5957 (1.34)
Total working prime-age death (age 20–44) ×male				0.0978 (0.32)			
Age 1998 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grade 1998 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	554	554	554	554	239	239	239
Pseudo R square	0.3641	0.3868	0.3854	0.3787	0.5738	0.5588	0.5199

Notes: Numbers in parentheses are absolute z-values. Robust standard errors are used with household-level clusters. The sample uses the individuals aged 14–19 in 1998, with highest completed years of schooling strictly above zero. All specifications also include male dummy, respective numbers of household members in 1998 in ages 0–4, 5–9, 10–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, and 65 or above who lived more than 15 days in the previous month.

Columns 5 to 7 report the results for the sample of female adolescents only. The results confirm the previous findings that future prime-age adult mortality decreases the enrollment of female adolescents. Female time allocation is altered prior to the realization of adult mortality in order to accommodate possible morbidity shocks associated with future mortality.

Table 4 shows the estimation results in the fixed-effects logit model, which essentially adopts the first-differenced specification. Column 1 uses the total number of deaths in the household between 1998 and 2004. We also interact the prime-age adult mortality measure with the male adolescent indicator to check for gender differences. It emerges that an increase in the total number of deaths promotes labor supply among adolescent males as well as adolescent females. This finding is also confirmed when we use the prime-age adults aged between 15 and 64 in column 2.

Table 4—Impact of prime-age adult mortality on adolescent transition from school to the labor market

Dependent: 1 if labor force, 0 if school

	Estimation: Fixed-effect Logit						
Prime-age mortality (PAM) variable	**Total death (1)**	**Age 15-64 (2)**	**Age 15-64 (3)**	**Age 20-44 (4)**	**Age 20-44 (5)**	**Working age 20-44 (6)**	**Working age 20-44 (7)**
PAM	2.8885	2.7864		3.0883		2.0777	
	(6.33)	(5.49)		(5.20)		(2.73)	
PAM × male	-0.0852	0.1325		0.2858		1.0749	
	(0.22)	(0.29)		(0.50)		(1.06)	
Male PAM			3.0589		3.7227		1.8692
			(5.19)		(4.86)		(2.31)
Male PAM × male			0.2357		0.3565		1.3557
			(0.37)		(0.45)		(1.02)
Female PAM			2.5514		2.7806		2.3095
			(3.73)		(3.48)		(1.67)
Female PAM × male			-0.0436		0.1438		0.8073
			(0.07)		(0.20)		(0.57)
Number of observations	1,041	1,041	1,041	1,041	1,041	1,041	1,041
Pseudo R square	0.3257	0.2492	0.2504	0.1987	0.2204	0.0503	0.0504

Notes: Numbers in parentheses are absolute z-values. Robust standard errors are used with household-level clusters.

Column 3 distinguishes the death of male and female household members. First, both male and female deaths significantly increase the labor supply of adolescents. Second, the marginal impact is greater when male rather than female members die. Third, the impacts on male and female adolescents are not statistically different, irrespective of the gender of the member who has died.

We obtain qualitatively similar results in columns 4 and 5 when using prime-age adults ages 20–44, and in columns 6 and 7 using working adults. Interestingly, the marginal impacts are largest when we use the 20–44 age group rather than a broader age group. Based on the results of column 4, the odds ratio is estimated to be 21.94 for male and female adolescents.

The above results support the hypothesis that excess prime-age adult mortality in a society decreases the investment in human capital in the young population. However, the timing of this impact differs between female and male adolescents; female schooling decreases early, that is, before the death of a prime-age adult in the household occurs. This is possibly because of the increased need for home care. Also, we find both male and female schooling decreasing after the death of a prime-age adult. Therefore, we can conclude that the magnitude of the negative impact is greater among female adolescents than among male adolescents.

Female Labor Supply

Table 5 reports the results estimating the impacts of prime-age adult mortality on female time allocation. Our basic conjecture is that women who work at home may have to support the household by earning in the labor market, or they may have to concentrate their time on caring for the ill at home before prime-age adult members die, or doing housework after a death.

Table 5—Female labor supply

Dependent: 1 if labor force, 0 if housework

	Estimation: Fixed effect logit			
	Sample: Female age 20-39			
PAM variable: Number of deaths in	Age 15–64 (1)	Age 15–64 (2)	Age 20–44 (3)	Age 20–44 (4)
PAM	0.1097		0.3864	
	(0.35)		(0.88)	
Male PAM		1.3119		1.4298
		(2.17)		(2.13)
Female PAM		-0.6903		-0.2895
		(1.50)		(0.47)
Number of observations	275	275	275	275
Pseudo R square	0.0006	0.0367	0.0040	0.0287

Note: Numbers in parentheses are absolute *z*-values.

We estimate the impact by a conditional (fixed effects) logit model, which is robust to the correlation between unobserved fixed components at the community and household levels and prime-age adult mortality. The estimates are, however, subject to a bias due to selective[18] survivals during the 1998–2004 period and to survey attritions. We presume that, since the dependent variable takes the value of one if the female household member is in the labor market and zero otherwise, the potential bias would be upward if the healthy are unlikely to die and likely to work in the labor market. However, since we restrict the sample to female adults (aged 20–39), this selectivity is important to the female adult mortality, not to the adult male mortality on the right-hand side of equation (1).

Column 1, which uses the prime-age adult mortality age 15–64, shows that it has no significant effect on female time allocation. Column 2 distinguishes between male and female mortality to see its differentiated effect on female labor-supply behavior. Interestingly, we find that male death significantly increases the labor supply of female adults, while female death has no significant effect. In columns 3 and 4, where we use adults of prime age 20–44, we obtain a qualitatively similar result: female time allocation significantly responds to the death of prime-age adult males. The estimates in

[18] Selective in the sense that individual characteristics and decisions affect it.

column 4 provide an odd ratio of 4.18 when a male adult of age 20–44 dies. This magnitude is smaller than that identified in the analysis of adolescents' transition from school to labor force.

The above result is reasonable in the sense that the death of adult males is more likely to adversely affect the income of a household than the death of adult females. This happens if men's earnings are, on average, higher than those of women. This finding shows that female adults are likely to supply their labor to the market in the case of the death of an adult male. This could decrease the time spent on housework, including time spent on child rearing and home education. This might have important development implications in the sense that prime-age adult mortality could, indirectly, curtail investments in human capital for the next generation. This effect is in addition to that of the negative impact death has on adolescents' human capital investments.

7. Conclusions

Our empirical results show that prime-age adult mortality has had an impact on adolescents' transition from school to the labor market and on female labor-supply decisions during the 1998 to 2004 period. This six-year period coincided with an increase in prime-age adult mortality in South Africa.

A few clear findings emerge from our research. First, the death of a prime-age adult in the household significantly promotes the transition of adolescents to the labor market. Adolescents leave school in order to compensate for a possible loss or reduction of household income and to smooth consumption. Female schooling is likely to be disrupted in the period prior to the death of a prime-age adult in the household. This is, most probably, because they take care of either the sick within the household or the household generally. Therefore, the total negative effect on adolescents' schooling is greater among females than among males. Second, female adults tend to go to the labor market after the death of a prime-age adult male, which may cause a decrease in the time spent on housework and child rearing.

These results suggest that excess mortality among prime-age adults causes a reduction of human capital investments at school as well as at home. Thus, the AIDS epidemic has negative effects on the formation of human capital for the next generation, not only by disrupting child schooling, as many studies have shown, but also by discouraging the continuation of investment in education for adolescents and possibly reducing the time females allocate to housework and child rearing.

Generally, when there is a death in the family, *z* household income may be constrained due to medical and funeral costs and limited access to formal arrangements (such as credit) and to foster-care grants (Meintjes et al. 2003 for South Africa); therefore, the well-being of surviving household members, including orphans, is a challenge to be addressed. As the economy confronts an increasing number of young who experience prime-age adult mortality in their households, it will be up to the South African government, civil society, and communities to meet this challenge.

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