Sibship size and education in South Africa: Black–White variations

Yao Lu

(Final version published in *Research in Social Stratification and Mobility*)

Lu, Yao. 2009. "Sibship Size, Family Organization, and Education in South Africa: Black-White Variations." *Research in Social Stratification and Mobility* 27(2):110-125.

Contact information
Yao Lu
Department of Sociology, Columbia University
501 Knox Hall
New York, NY 10027, USA
Phone: 212-854-5442
Email: yao.lu@columbia.edu

Abstract

Recent studies suggest that the generally observed negative sibship size effect on education is much less consistent in developing nations. Using data from a national survey in the early 1990s, this study assesses the effect of number of siblings on education in South Africa for two major population groups with distinctive cultural customs, Whites and Blacks. A negative effect exists for Whites, who have adopted a Western nuclear family system, whereas no effect is shown for Blacks, whose family life operates under extended family arrangements. Several sensitivity analyses suggest that the lack of a sibship size effect for Blacks can be partly explained by their extended family arrangements, in which the responsibilities and financial costs of raising children are shared across a wide circle of relatives. The study further addresses the longstanding debate as to whether the link between sibship size and education is contaminated by endogeneity and a confounding birth order effect. Results suggest that the sibship size effect is not an artifact of the interactive birth order effect. However, the observed negative effect for Whites tends to be exaggerated by endogenous factors – mostly likely parental quality–quantity calculation – a pattern found in several other industrialized societies that conform to western values of childbearing.

Keywords: Sibship size; Education; Quality–quantity tradeoff; Instrumental variable; South Africa

1. Introduction[1]

Sibship size, also referred to as the number of siblings or family size, has been studied as an important aspect of educational stratification in the past two decades (Blake, 1989; Blau & Duncan, 1967; Featherman & Hauser, 1978; Mare & Chen, 1986; Steelman, Powell, Werum, & Carter, 2002). Considerable evidence has documented that sibship size has a negative effect on children's education in developed societies, even controlling for family socioeconomic background; each additional sibling reduces schooling by as much as one-fifth of a year, exceeding many other family origin variables (Blake, 1989; Featherman & Hauser, 1978; Mare & Chen, 1986). The primary mechanism thought to account for this effect is the resource-dilution process: finite family resources are allocated thinly across a larger number of children, meaning that the available resources to each child are diluted (Downey, 1995). The "resources" include non-material assets such as parental time, attention, and emotional support, as well as assets such as financial investments in children's education and study

environments.

In the developing world, however, the negative effect of sibship size is neither universal nor inevitable. The extent to which such a mechanism operates is conditioned by specific cultural, socioeconomic and political contexts, which influence both the availability of educational resources to the family and their allocation within family. For example, evidence suggests that cultural customs as reflected in family organization may mediate the effect of family size on education. Specifically, the extended family arrangements may buffer the detrimental effect of having a large number of siblings because the responsibilities are shared across a wide circle of relatives (Lloyd, 1994; Shavit & Pierce, 1991).

In addition, there is growing evidence, especially from the developed world, that questions the causal link between sibship size and education (Angrist & Evans, 1998; Black, Devereux, & Salvanes, 2005; Guo & VanWey, 1999; Rosenzweig & Wolpin, 1980). The effect of sibship size may be contaminated by endogenous parental quality–quantity tradeoff, which suggests that parents may prefer fewer children in order to provide each of them with better education. This virtually exaggerates the negative impact of sibship size. Such deliberate calculations are found particularly likely to be present in western societies, where parents generally desire fewer children and have higher educational expectations for their children.

The present study is conducted in South Africa, where socioeconomic and political institutions and cultural customs are distinct from those of industrialized societies. In this country, substantial racial disparities exist in almost every socioeconomic aspect, with Whites on top of the hierarchy and Blacks at the bottom. Blacks have experienced disadvantageous socioeconomic conditions, primarily due to resource constraints. Meanwhile, the government consistently shifted educational costs to Black families (Maharaj et al., 2000). Considering the scarce resources available and the larger share of educational expenses for Blacks, one may well expect that children's education is detrimentally affected by sibship size because the already limited resources are even more thinly spread when there are more children. However, in some Black families, the costs of raising children do not fall solely on parents, but are extended to related kin. The effect of sibship size in South Africa may, therefore, exhibit a different pattern compared to what has been generally observed in Western societies, and within the country, the effect for Blacks is likely to different from that for Whites, whose family life is largely organized under nuclear units. In addition, while Blacks in South Africa generally adopt a traditional view of childbearing that values large families (Kaufman, 2000), Whites embrace value systems similar to those in other western societies, rendering them more likely to make deliberate quality–quantity calculations (Black et al., 2005; Guo & VanWey, 1999). This may

have considerable implications for the causal link between sibship size and education.

Using data from a national probability sample survey conducted in 1991–1994, I first compare the sibship size effect on educational attainment for Black and White adults in South Africa. I also carry out additional analyses to provide explanations for the observed effect. In response to the claim that the effect is exaggerated by an interactive birth order effect, I incorporate the birth order component into the analysis. I further assess the possibility that the effect is plagued by endogenous parental quality–quantity calculation using the instrumental variable approach.

2. Sibship size and education in less developed countries

Studies conducted in Western societies show a clear negative effect of sibship size on children's educational attainment. The most widespread explanation for this adverse effect is the resource-dilution hypothesis (Blake, 1989; Downey, 1995), where "resources" include nonmaterial as well as material assets and they are less effective as family size increases. In a study that explicitly tests the resource-dilution theory, Downey (1995) finds strong support for this hypothesis that parental resources account for the inverse relationship between sibship size and educational outcomes. He also finds that material resources such as money saved for college and computers in the home decrease more rapidly with sibship size than do non-material resources. These material resources also have a more direct effect on children's educational attainment (Steelman et al., 2002). By contrast, non-material resources such as parental attention and emotional support are more closely linked to children's intellectual development, which in turn affect educational outcomes (Anastasi, 1956).

Emerging evidence in the developing world, however, suggests that this effect is not universal; rather, it varies in different socioeconomic, political and cultural contexts, and across different population subgroups (Buchmann & Hannum, 2001; Gomes, 1984; Lloyd, 1993, 1994; Lu & Treiman, 2008; Maralani, 2004; Steelman et al., 2002). This highlights potential of conditions and institutions external to the family in influencing the availability and distribution of family resources. For example, Gomes (1984) shows that sibship size interacts with the level of socioeconomic development over time; and Lu and Treiman (2008) suggest that variations in the political climate can mediate the sibship size effect (for a detailed review, see Lu & Treiman, 2008; Steelman et al., 2002).

Importantly, the sibsize-education association is also likely to differ depending on whether the educational costs fall solely on the parents or are shared by

extended families. In industrialized societies relationships of obligation are generally restricted to the nuclear family and are centered on exchanges between parents and children. In these circumstances sibship size almost always negatively affects educational attainment. However, in some cultures, especially in developing settings, responsibility for supporting children includes extended family members (Gomes, 1984; Shavit & Pierce, 1991). For example, Shavit and Pierce (1991) find that in Israel for Jews, who conform to the western mode of family arrangements (nuclear families), the sibship size effect on educational attainment remains detrimental. However, for Arabs, who have a culture of collective responsibility for supporting children, the negative effect disappears. The Israeli example suggests that an extended kinship system can alleviate the resource competition generated by a large number of siblings. Such a support system enables large families to cope with the burden of high fertility through an increase in the overall resources, both material and non-material, which subsequently leads to more extensive allocation of family resources. Similarly in sub-Saharan Africa and Southeast Asia, where educational costs are often spread among a wide circle of relatives, the number of siblings is also found to have little impact on education (Caldwell & Caldwell, 1987; Desai, 1992; Lloyd, 1993; Pong, 1996), though more elaborate tests of the mediating role of family arrangements are generally unavailable due to data constraints.

3. The South Africa context

South Africa is distinctive not only among African countries, but more generally in the contemporary world because its social and political institutions were organized exclusively on the basis of race until 1994. As a result, the four racial groups constitute a clear socioeconomic hierarchy far more unequal than in any other multiracial countries, with Whites at the top, Blacks at the bottom, and Asians and Coloreds in between (Treiman, Mckeever, & Fodor, 1996). According to the 1999 October Household Survey, Blacks make up 76% of the population, but account for 95% of the poor (Woolard, 2002). Importantly, Blacks are distinct from Whites with respect to fertility, family arrangements, and education.

3.1. Fertility

In South Africa Blacks have the highest fertility rate, while Whites have the lowest and experienced a steady decline over the past few decades (Chimere-Dan, 1997). The Black fertility decline also occurred, but at a much slower pace. By 1990, Black fertility, measured by the total fertility rate (TFR), was around 4–4.5, dropping from about 6.5 some 30 years before, whereas the White fertility has undergone a sustained decline from over 3 to a TFR of 1.9 (Caldwell &

Caldwell, 1993; Swartz, 2002).

Cultural and socioeconomic differences help explain why for Blacks the fertility remains high and a large family is still highly valued. For one thing, Blacks tend to hold different notions about reproduction from Whites: they desire children for emotional and sociocultural reasons, as well as for economic reasons such as dependence on children in old age and need for children's labor (Bledsoe, Banja, & Hill, 1998; Kaufman, 2000; Preston-Whyte, 1988). This pattern is consistently observed in other developing settings (Clay & Vander Haar, 1993). The number of children also depends on what is rational to a woman. Research indicates that women's conjugal life depends heavily on their ability to produce children (Kaufman, 2000). The persistent high fertility may also be due to the oppression of Black women under *apartheid* (Chimere-Dan, 1993): women are not able to achieve autonomy to control fertility, nor are they adequately educated to take advantage of modern birth control. It is also probable that they do not consider government a source of reliable information on these issues under *apartheid*. Consequently, government promotion of low fertility and the diffusion of birth-control information are unlikely to substantially reduce Black fertility (Caldwell, Orubuloye, & Caldwell, 1992).

By contrast, while emotional values of fertility remains high for Whites, they desire relatively fewer children, which has also been observed in many settings adopting a western value system of childbearing. This is partly attributed to the high socioeconomic status of White women, especially with respect to education (Palamuleni et al., 2007). More educated White women have better access to birth control and are more likely to work outside their homes, both of which lead to lower fertility. Additionally, evidence from similar contexts, mostly in Western societies, suggests that in these settings parents are especially apt to make fertility tradeoffs between the quantity and quality of children (Angrist & Evans, 1998; Black et al., 2005; Guo & VanWey, 1999; Rosenzweig & Wolpin, 1980), which may bear important implications for the effect of family size.

3.2. Family arrangements

South Africa is characterized by two prominent family systems: an extended family system, where family obligations are spread beyond nuclear units (parents and their children) to include relatives, is mostly identified with Blacks; a nuclear family system is identified with Whites, a direct adoption of the western belief system through western European settlers; and Coloreds and Asians lie between these two systems (Amoateng, 2004; Thompson, 1990). The nuclear family system adopted by most Whites and some Blacks is based on the cultural value of individualism, whereas African extended family arrangements reflect their cultural

preference for interdependence and collectivism (Siqwana-Ndulo, 1998). The formation and maintenance of these distinct family arrangements is also influenced by socioeconomic and political environments especially during *apartheid*, under which the social security system benefit whites, those who already have the most. Black families, by contrast, face extreme socioeconomic circumstances and therefore adopt the extended family arrangements as a way of coping with vulnerability by pooling resources and providing support in times of need (Amoateng, 1997; Makosana, 2001; Thomas, 1996).

There is considerable controversy as to whether in South Africa Black family patterns are converging towards those of Whites, as a consequence of industrialization and urbanization. Some argue that family unity may have been weakened as a result of migration (the abolition of flux control) and participation in urban wage employment (Amoateng, 1997). The African extended family arrangements may thus evolve into a nuclear type. However, abundant evidence demonstrates that Blacks' extended living arrangements persist in spite of their participation in modernization (Russell, 2004; Ziehl, 2001). As Burman and Fuchs (1986) demonstrated, traditionally just over half of African households were nuclear, whereas most of the rest were extended in structure.

A considerable fraction of Black children live with neither parent but are fostered by other relatives, grandparents and uncles in particular. This fosterage arrangement is another aspect of the African extended family system, resulting partly from high rates of parental absence due to nonmarital childbearing, divorce, labor migration, and more recently death of parents from HIV/AIDS (Gordon & Spiegel, 1993; Niehaus, 1994; Noumbissi & Zuberi, 2001; van de Walle, 1999).

3.3. Educational institutions[2]

The implementation of *apartheid* in South Africa institutionalized separate and unequal development by racial groups with respect to education. Legislated by the Bantu Education Act of 1953, educational policies, curriculum and pedagogical practices were designed specifically to ensure the political, economic and social domination of Whites over other racial groups (Constas, 1997). Consequently, until the 1994 transformation, Black children had been provided with limited educational opportunities, and a separate education system of lower quality.

Black schools were provided with drastically less funding than White schools—the government spent at least seven times as much on schooling for each White child as for each African child (Maharaj et al., 2000; Moll, 1996). Until recently, Blacks were the only group that had to pay in full for their education, while White children received quality education virtually for free and education is always compulsory for them up to age fifteen. The unequal

distribution of public educational resources, coupled with preexisting economic constraints in Black families, resulted in limited educational opportunities and lower attainment for Blacks (Lam, 1999; Thomas, 1996; Treiman et al., 1996; Treiman, in press: chapter 10). Moll (1996) and Zungu (1977), for example, find that Blacks start school later than other racial groups, they have much lower enrollment rates, and most of those who attend do not progress to secondary school. Costs of education are often reported by Blacks as the primary reason for not attending school (Case & Deaton, 1999). By contrast, most Whites complete twelve years of schooling.

Toward the end of the *apartheid* period, the government attempted to rectify the imbalances in education through an expansion of Black education (making it possible for Blacks to enroll in previously all-white schools) and providing full or partial fee waivers to low-income families. This effort led to a major increase in Black primary school enrollment, but it did not fully resolve the problem, in part because some schools tried to restrict their applicant pool to those who can afford to pay the full school fees (Fiske, 2004). As a result, improved opportunities were limited to the small fraction of well-off Black families, and racial differences were replaced by class differences, which continue to favor Whites. Theattendance rates of blacks remained far below those of whites and the increase did not extend to the secondary level (Maharaj et al., 2000). Only as recently as 1995 was education made compulsory for Blacks between age seven and sixteen, but this goal has yet to be achieved in reality (Nkabinde, 1997).

3.4. Sibship size, family arrangements, and education

In the absence of adequate state funding of Black schools in South Africa, in particular under the *apartheid* regime, the burden of funding education has fallen entirely on families. Considering the scarce resources available to Black families, and the larger share of educational expenses placed on them, we may expect that sibship size has a large negative effect on education. However, among some South African Blacks, the responsibilities and financial costs of raising children are not borne exclusively by biological parents, but are shared by extended family members. Extended family arrangements may benefit children in many ways: they help provide a pool of adults who can supervise children, offer positive reinforcement, and help them with school work (enhancing non-material resources); and importantly, they help offer financial assistance by pooling resources (enhancing material resources). As a result, the extended families may mitigate the resource-dilution process by raising available resources to the entire sibship set, enabling a greater number of children to be educated than if only the resources of the children's parents are used. Under such circumstances, sibship size may be less consequential in determining children's education. By contrast,

in nuclear families, where educational costs are restricted to parents, no additional resources are available to attenuate the resource dilution process, making familial resources more thinly diluted as sibsize increases.

4. Sources of bias

The bias regarding the sibship size effect may arise from two sources: the possibility that the observed effect simply reflects other aspects of family composition, in particular, birth order effects; and the possibility that the effect is plagued by endogeneity.

4.1. Birth order and its confounding effect

There has been an increasing interest in the effects of sibling configurations other than sibship size, birth order in particular. A variety of plausible, but contradictory, hypotheses regarding the influence of birth order on children's outcomes have been advanced: some predict that earlier-borns will be higher achievers (Behrman & Taubman, 1986; Black et al., 2005), some predict that later-borns will do better (Powell & Steelman, 1995; Steelman & Powell, 1991), while still others expect a curvilinear advantage for both the oldest and youngest siblings (Hanushek, 1992; van Eijck & De Graaf, 1995). Empirically, however, the birth order effect has been much less reliably documented than the sibship size effect, and has often been shown to be negligible (Hauser & Sewell, 1985; Kessler, 1991; Kuo & Hauser, 1997). Even where an effect of sibling configuration is observed, this often is in studies that fail to account for the strong association between birth order and sibship size (e.g., van Eijck & De Graaf, 1995). That is, being early in the birth order is sometimes advantageous, but this may be due to the higher probability of being in a small family. Some other studies, conversely, have claimed that the effect of sibship size has been exaggerated by the confounding effect of birth order (Black et al., 2005). That is, being in a small sibship is found to be advantageous, but this may be due to the higher probability of being early in the birth order. According to this claim, the negative sibship size effect is actually an artifact of the negative birth order effect. Studies of this kind, however, are problematic because they include both birth order and sibship size in a single model without accounting for the multicolinearity between the two (correlations of 0.7 between such measures are not uncommon). This multicolinearity tends to moderate the sibship size effect. But if both measures are thought to be influential, leaving one out results in the model being underspecified.

An alternative way to study the effects of both factors is to represent the sibship size effect by birth order effects. As demonstrated by Chu, Yu, and Tsay

(2004) and Post and Pong (1998), this strategy can be implemented by separating the number of siblings into the number of older siblings vs. younger siblings. By including in the prediction equation both birth order measures, the net effect of sibship size has been virtually controlled for. We can infer a sibship size effect net of the impact of sibling configuration by studying the signs of the paired coefficients (e.g., the number of older and younger siblings). If the sibsize effect remains stable after incorporating birth order, it is unlikely to be a simple artifact. Both aforementioned strategies are implemented in the present study.

4.2. *Quality–quantity tradeoff*

The causal relationship between sibship size and education may result from joint determination: parents make fertility decisions based on their expectations regarding the cost of children, in particular on how many children they can afford given their resources and educational aspirations for their children. This is often referred to as the quality–quantity tradeoff (Steelman et al., 2002). In other words, parents may choose to have fewer children in order to provide each of them with better education. In this case, the true effect of family size on educational attainment would be greatly attenuated. Several studies take account of potential endogeneity using longitudinal data, or using exogenous fertility events such as twin births or sibling sex composition, implemented via an instrumental variable approach. Some find little or no effect of sibship size on education (Angrist & Evans, 1998; Black et al., 2005; Guo & VanWey, 1999; Rosenzweig & Wolpin, 1980), whereas others find the effect to be real (Conley & Glauber, 2004). In South Africa, this tradeoff may be particularly evident among Whites, for reasons discussed in the previous section.

To address potential endogeneity, I estimate instrumental variable (IV) models and compare them to corresponding OLS regressions that assume no bias due to endogeneity: if results are consistent, endogeneity is unlikely to account for the sibship size effect. The IV approach has been widely used as the formal treatment for endogeneity (Greene, 2005). Two-stage least-squares method (2SLS) is often used for implementing the IV approach with continuous outcomes, educational attainment in the present case. Under 2SLS, in the first stage, each endogenous covariate is regressed on valid instrument(s) and the full set of exogenous covariates used in the main regression. In the second stage, the regression is estimated as usual, except that each endogenous covariate is replaced with its approximation estimated in the first stage. The IV approach gives unbiased estimates under two conditions: the IV must not be related with the error term (exogeneity criterion), and it must be sufficiently correlated with the endogenous variable (sibship size) net of the other exogenous covariates (relevance criterion). The first condition is generally not directly testable unless

more than one instrument is available for each endogenous regressor. The second condition is testable through the use of first stage regressions.

Following some of the earlier work, I use twin births (whether the focal child is from a twin birth, including multiple births) as instrument to capture exogenous variation in sibship size. Twin birth has been used in previous studies (Black et al., 2005; Rosenzweig & Wolpin, 1980) as a natural experiment because it is often positively related to the number of siblings, but independent of preferences for family size. No demographic or socioeconomic factors have been found to be consistently associated with the incidence of twin births. Sibling sex composition is considered less appropriate as an instrument because, although it may affect later fertility (and thus total fertility), it tends to affect a range of household characteristics that are associated with children's well-being (Dahl & Moretti, 2004). In addition, the use of it as an instrument requires the sex of children to be randomly assigned, which may not a problematic assumption in the case of South Africa but tends to be so in many developing settings with prevalent male preference.

Before conducting the IV analysis, I test for weak instrument (relevance) using the first stage regression. I also examine whether twin birth is likely a random event by studying whether the occurrence is connected to a set of parental characteristics. Moreover, although twin births tend to be a natural shock to fertility, it can be endogenous to children's well-being. For example, once there is a twin birth, parents who desire fewer children may stop having more or begin to limit future fertility, which in turn can affect children's outcomes. I assess this aspect of endogeneity by studying whether having twin birth has a negative impact on subsequent fertility and conclude that the instrument is not likely to be endogenous.

5. Data, variables and methods using survey data

5.1. Data

The data come from a national probability sample survey of the adult population in South Africa conducted between 1991 and 1994 (including the TVBC states), the Survey of Socioeconomic Opportunity and Achievement (SSOA) (Treiman, Moeno, & Schlemmer, 1998).[3] Completed interviews were obtained from a stratified random sample of 9086 persons age 20 and older. After excluding a Black elite sample (which was not randomly selected) and appropriately weighting the data, a total sample of 8714 can be regarded as representative of the South Africa adult population of the early 1990s. This survey collected extensive life history information, including family background and residential status when respondents were age 14.

An advantage of the data set is that it permits studying the effect of family size and other socioeconomic attributes when respondents were growing up on their ultimate educational attainment. This largely mitigates the temporal ambiguity problem. Studying completed education has another advantage: it is of essential interest in educational stratification research, whereas measures such as current enrollment may obscure differences between permanent school leaving and short-term interruption or delays in schooling for reasons that may not affect an individual's ultimate attainment. Additionally, the data include adults of several cohorts who experienced different educational and socioeconomic environments, thus permitting the study of the sibship size effect over a longer time span. An important limitation of the data, however, is that no retrospective information was collected on respondent's living arrangements when he or she grew up. Therefore, no direct test is available to examine the mediating role of family arrangements in the sibsize-education relationship.

5.2. Variables

The dependent variable is the total years of schooling completed, ranging from 0 to 17. It is treated as a continuous variable.[4] Explanatory variables include basic demographic characteristics, such as gender, race and residential status. Rural/urban residence is defined based on the place of residence at age 14. Town/city, squatter and peri-urban areas are coded as urban; villages, farms and mines are coded as rural; and other unknown or unreported information is coded as other. Because SSOA sampled respondents of several cohorts who experienced different educational environments, even under the *apartheid* regime, I adjust for secular differences by including cohort as a discrete variable with 10-year intervals from age 20 to 79.

I also control for family socioeconomic background. Parental education is measured by the total years of schooling completed by either father or mother, whichever is higher. Similarly, I include parental ISEI when the respondent was 14, measured by ISEI score of either father or mother, whichever is higher. ISEI is a scale of occupational status, ranging in principle from 0 to 100 (Ganzeboom, De Graaf, & Treiman, 1992). Since no retrospective information on family arrangements is available, the best I can do is to include a discrete variable of parental presence when the respondent was 14 (one parent vs. two parents vs. no parent). About 10% of the data on parental education, occupation and economic condition are missing. Hence, the mean level of these variables is substituted for the missing responses, and a separate dummy variable is created for each of the three variables indicating whether they are missing.[5]

Household economic condition, a direct indicator of material resources, may be an important determinant of educational attainment in developing countries

(Filmer & Pritchett, 1999). Because no such measure is directly provided, I construct a scale to represent the household economic condition when the respondent was 14. Ten items are included in the scale construction (water supply, toilet facilities, kitchen facilities, availability of dictionary, atlas, camera, telephone, gas/electric stove, refrigerator and servants when respondents were 14). These items constitute a single factor, all with high factor loadings (Cronbach's alpha is 0.85). To construct a final economic scale, I standardize and average the items, and then transform the scale to a range from 0 to 1, with 1 indicating the highest level of economic status. There is enough variability in this scale for both racial groups as well as over time.

The key independent variable is sibship size. It was obtained from a question directly asked in the survey: "how many siblings did you have when you were young?". I truncate the values at sibship size 6 to reduce the leverage of the very small number of children from very large families. Sensitivity analyses show that results are similar no matter where the sibship size is truncated. It is treated as a continuous variable in the analysis.

5.3. Methods

Ordinary least square (OLS) techniques are used in the analysis. Respondents older than 79 as well as those missing in all the other variables (about 2%) are dropped, resulting in a sample of 8438 (2385 Whites and 4429 Blacks). Stata survey estimation procedures are utilized to adjust for the multi-stage stratified probability design (the sample contains multiple cases drawn from a single magisterial district within a subpopulation group, which are potentially correlated), by treating subpopulation groups as strata and magisterial district as PSU (StataCorp, 2003). The data are appropriately weighted to represent the general White and Black population in South Africa.

The model specification for racial differences in the sibship size effect on educational attainment is as follows:

$$EDU_{ij} = \beta_{0j} + \beta_{1j} SIB_{ij} + \sum_{p=1}^{P} \beta_{pj} X_{pij} + \varepsilon_{ij}$$

where EDU_{ij} refers to the highest educational level achieved for the i th respondent in the j th racial group (j identifies the racial group membership of either Whites, $j = 1$, or Blacks, $j = 2$), SIB_{ij} refers to the number of siblings,

X_{pij} refers to covariate p in the model such as age, gender, residential status and parental socioeconomic status with associated coefficient β_{pj}, and ε_{ij} is a random component.

To study the confounding birth order effect, I first construct a continuous birth order measure, using the question directly available in the data: "How many siblings are older than you?" I then examine whether controlling for this variable significantly alters the effect of sibship size. I also decompose the sibship size into two measures, the number of older siblings and number of younger siblings. A similar set of models is estimated by including both the number of older and the number of younger siblings.

Corresponding to the OLS models, I estimate IV models to assess potential bias due to endogeneity, using twin birth as the instrument for sibship size. The data do not provide direct measure of twin birth but collected information on one of respondent's siblings who is closest to the respondent in age. I construct a dichotomous instrumental variable, with 1 indicating that the sibling was born in the same year as the respondent, and 0 otherwise. I should acknowledge that siblings born in the same year are not necessarily from twin birth, but may result from very close birth spacing. This, however, is a rare situation given the increasing birth intervals observed in South Africa. Also, I expect that only a very small fraction of children born in the same year are not from twin births, because it requires that the older sibling was born in the first one or two months of the year, and the younger siblings in the last few months of that year. However, no birth date information is available to evaluate this possibility. Even if the siblings are not from twin birth, it may not pose a major concern because close spacing also tends to be positively related to total fertility, thereby satisfying the relevance criterion of the IV approach. But before making such a statement and performing the analysis, I conduct a series of tests to examine the validity of the instrument.

6. Results

6.1. Descriptive statistics

Table 1 presents unweighted sample means and percentages for the survey data. The general patterns are as expected. The racial gap in socioeconomic background is large, favoring Whites in almost every aspect. Take the economic condition scale for example: while Whites achieved an average score of 0.8 out

of 1, Blacks scored only a little more than 0.2. Differential educational opportunities by race are also pronounced. The total years of schooling for Whites averaged almost twice as that for Blacks. With respect to living arrangements,Blacks were less likely to live with both parents when they grew up. The racial difference in fertility is evident: Black respondents had about four siblings on average, in comparison to about 3 for Whites.

6.2. Sibship size and educational attainment

Table 2 reports OLS regressions predicting educational attainment separately for Blacks and Whites. Examination of correlation matrices confirms that multicolinearity is not substantial. I first estimate a model including interactions with race and sibship size. An adjusted-Wald test suggests that the interaction terms are jointly significant at the 0.05 level ($F(3,349) = 2.76$. I thus estimate separate models for Whites and Africans to uncover racial variations.

I first study the gross effect of sibship size without controlling for other covariates. The coefficients are0.346 (S.E. = 0.043, p-value < 0.001) for Whites, and0.019 (S.E. = 0.047, p-value < 0.68) for Blacks. This suggests that Whites with three siblings on average complete 1 year less schooling than do Whites with no siblings. For Blacks, however, sibship size barely has any impact.I next adjust for demographic and socioeconomic status. Results show that family background has a positive effect on educational attainment, in particular when it comes to parental education and household economic condition. The gender gap in ultimate attainment does not exist for Blacks, which is consistent with previous findings (Case & Deaton, 1999; Lam, 1999; Thomas, 1996). Educational attainment appears to be stable across different cohorts for Whites, but for Blacks younger cohorts receive significantly more schooling. This is in line with the persistent White advantages in education, as well as the steady improvements in Black education over time (Malherbe, 1977). There is no clear effect of parental absence presumably because this measure has little variability.

As expected, sibship size has a negative effect for Whites but not for Blacks. The coefficient is about −0.15 for Whites, a finding coherent with previous studies showing that each additional sibling reduces schooling by as much as one fifth of a year. I also estimate a similar set of models treating sibship size as aggregated discrete variables (0, 1–2, 3–5, 6+). This set of analysis gives similar results and is thus not repeated here. For Whites, the coefficients of the sibsize dummy variables are mostly significant and negative and usually become more so in larger families. But for Blacks, the coefficients are mostly insignificant and do not show a clear pattern in magnitude. In addition, I carry out sensitivity analysis using a different educational outcome—highest level of education, which has seven categories (“none”, “lower primary”, “higher primary”, “some

secondary", "complete secondary", "post-secondary", "university degree and more"). OLS regressions give essentially the same conclusion: family size is negative related to highest level of education for Whites ($\beta = -0.10$, S.E. = 0.023) but not for Blacks ($\beta = -0.001$, S.E. = 0.013). I do not make further distinctions by region, ethnicity, etc., as this is not the focus of the paper and that the sample size of the survey does not permit further disaggregation.

6.3. Explanations of the sibship size effect for Blacks

The lack of a sibsize effect for Blacks may be due to their extended family arrangements. While direct tests using the survey data are unavailable, I conduct additional analysis using the 10% sample of the 1996 census, which permits studying how current living arrangements mediate the effect of sibship size on school attendance of children. Specifically, I estimate logit models predicting children's secondary school enrollment on family size and other control variables, separately for Black children in different types of households (nuclear, extended, and fostering). The measure of family arrangement is constructed using information from the household roster. Results show that traditional patterns of family arrangements persist, as those documented in previous studies: the majority of White children live in nuclear families, which is true of about half of Black children, with most of the rest living in extended or fostering households. Regression results demonstrate noticeable variations across different types of Black households. The effect of sibship size holds for Black children in nuclear families and in fostering families,[6] but it is negligible for those in extended families. While this census analysis lends support to the buffering role of Black extended families, it is not entirely comparable to the survey data analysis because the outcome measure is different, the sibship size and other variables are constructed somewhat differently given the nature of the data, and the data were gathered during a different time period (shortly after the breakdown of *apartheid*). The results, therefore, should be interpreted with caution.

Although lacking an explicit test of the mediating role of family arrangements using the survey sample, I perform a series of indirect assessments by evaluating the plausibility of other potential explanations, which are eventually ruled out as the major contributing force. First, the low levels of development and extremely limited opportunities for Blacks may contribute to the absence of a sibsize effect because only very few children get more than minimal education. In such settings, parents may be unable or unwilling to invest family resources in education for any of their children. As the situations of Blacks improved and education became more available over the past few decades, families may initiate resource-allocation process for children's education. If this is true, we would

expect to see a temporal change in the effect of family size over time, with little or no effects in early cohorts but larger effects in younger cohorts. This, however, is not supported by the data. The effects of family size are highly similar, and are essentially zero for all six cohorts of Blacks.

Second, a positive connection between family income and sibship size, often observed in traditional societies, may buffer the negative effect of a larger number of siblings. The South African story, however, seems to suggest the opposite: family economic condition is not positively and even marginally negatively associated with sibship size for Blacks ($\beta = -0.59$, S.E. = 0.35, $p$value < 0.097), which holds true for all cohorts. Lastly, having more siblings may sometimes benefit children because older siblings serve as a source of support for younger siblings. The way the process works is that since parents expect to receive direct income returns from the educational investments they make in their children, they tend to provide older children with educational resources to obtain early returns whatever the ultimate family size. But then older siblings provide remittances to supplement family resources, permitting the education of younger siblings. This possibility implies a positive effect of the number of younger siblings as well as that of older siblings. As shown in the next section, however, this does not seem to be the case: in fact, neither measure is associated with education for Blacks.

All these evidence lends further support to the protective role of the extended family arrangements, which characterize a large fraction of Black families and have largely persisted to this day. In other words, the negligible sibsize effect for Blacks may be mostly driven by the large proportion of respondents living in extended families. Extended families may provide a pool of resources, both financial and non-financial such as attention and time spent with children, and hence help attenuate the resource-dilution process associated with high fertility. By contrast, in nuclear families, the arrangements clearly identified with the vast majority of whites, educational costs are mainly restricted to parents. Thus, familial resources tend to be more thinly diluted as sibship size increases.

6.4. Test for confounding birth order effect

To disentangle the possible interactive effects of sibship size and birth order, I estimate a similar set of OLS regression models similar to those presented in Table 2, with only the sibship size variable changed. Results are shown in Table 3. The correlation between birth order and sibship size is about 0.5, not high enough to create a multicolinearity problem. Therefore, I estimate Models 1 and 3 by including both sibship size and birth order. Models 2 and 4 further explore the confounding effect by breaking down sibship size into its birth order components. To maintain consistency, all the sibset variables are truncated at 6.

Compared to Table 2, the effects of other covariates on educational attainment more or less hold, and are thus not reported here.

The effects of sibship size in Models 1 and 3 are similar to those in previous models without controlling for birth order: it is negative and large for Whites, but small and insignificant for Blacks. Coefficients of birth order are indistinguishable from zero, suggesting the absence of a clear birth order effect on educational attainment in South Africa. This further casts doubt on the existence of a real birth order effect. When I separate the effect of sibship size in Models 2 and 4, I find that both the number of older and the number of younger siblings have negligible effects for Blacks, but their effects are detrimental in White families. Considered together, the negative effects of both the number of younger and older siblings for Whites essentially reflect an overall adverse family size effect. This is consistent with earlier results in Table 2. Overall, there is strong evidence that the effect of sibship size is robust, independent of the birth order effect.

6.5. Test for endogeneity

The IV approach is used to assess potential endogeneity due to parental quality–quantity tradeoff. As a crude test of whether the tradeoff is present, I examine the relationship between sibship size and mother's education on the ground that mothers with higher education tend to have fewer children but higher expectations of children's schooling. The data show that, in fact, for Whites mother's education has a negative impact on total fertility ($\beta = -0.29$, S.E. = 0.04). The effect for Blacks, however, is close to zero ($\beta = -0.05$, S.E. = 0.02). Since such an effect may be largely driven by highly educated Black women, a very small proportion of the population, I look at the relationship between women's education and fertility for those with an education of 9 years and less (which accounts for more than 90% of Black women). Results show that the association becomes negligible ($\beta = -0.03$, S.E. = 0.02). These findings seem to confirm the speculation that the tradeoff is far less common among the majority of Black families, whereas it is quite prevalent among Whites. However, because mother's education may reflect only limited aspects of parental calculation, a more accurate assessment is obtained via the IV approach.

Twin birth, as measured by whether the respondent had a sibling born in the same year, is used as the instrument. 167 respondents (among Whites and Blacks) reported having siblings born in the same year, which accounts for about 2.5% of the sample. This is generally in line with previous studies showing that the rate of multiple births is usually between 0.5% and 3% (Martin & Park, 1999). I first examine whether twin birth is likely a random

event by studying whether a range of parental characteristics are associated with the occurrence of such an event for both Blacks and Whites. Most of these traits reflect family conditions prior to respondent's birth, with the exception of parental occupation and economic condition, which were measured when the respondent was 14. Results in Table 4 show that none of the contrasts by twin status is statistically significant at the 0.05 level, and the absolute values of the differences are usually small. Therefore, it is reasonable to treat twin birth as a random event. What these results also seem to suggest is that families with twins did not experience different conditions (i.e., resource constraints), in particular with respect to parental occupation and economic status. In other words, twin birth does not appear to have substantial implications for children's well-being. This finding lends some support to the exogeneity of the instrument.As a next step, I assess the relevance of the instrument by modeling sibship size as a function of twin birth, also including all other covariates. Twin births turn out to contribute to high total fertility (β = 0.68, S.E. = 0.14). The estimate is significant at the 0.001 level and the corresponding *F*-test is larger than 20, which, according to threshold of a *F*-test of 10, suggests that it is not a weak instrument. Similar tests are carried out separately for Whites and Blacks, which demonstrate the validity of the instrument for both groups (β = 0.39, S.E. = 0.16 for Whites; β = 0.84, S.E. = 0.24 for Blacks).

Although a formal test of exogeneity of the instrument is impossible, I perform an indirect assessment based on the idea that twin birth is endogenous when its occurrence potentially has direct effects on children's outcomes—that is, if the event is associated with preferences for family size. This can partly be evaluated by studying whether families adjust their subsequent fertility to compensate for the unexpected extra birth. I model subsequent fertility, as measured by the number of respondent's younger siblings (excluding the twin sibling), on the instrument. For Whites, the instrument turns out to be even positively related to later fertility (β = 1.18, S.E. = 0.32); for Blacks, however, it no longer has an impact (β = 0.17, S.E. = 0.23). Since having twins does not seem to curtail later fertility, it is not likely to be seriously plagued by fertility preferences.

Results from corresponding IV regressions are reported in Table 5. We see that the effects of most predictors are similar to those in the OLS models. The effect of sibship size, however, reveals a different pattern. There is no sibship size effect for Blacks, as observed in the OLS model. But the negative effect previously documented for Whites disappears after I take account of potential endogeneity. The coefficient is largely reduced while the standard error grows dramatically. This implies that the effect of sibship size for Whites tends to be largely exaggerated by endogenous factors, most likely parental calculation,

as speculated for populations that adopt western values of childbearing.

7. Summary and discussion

The present study examines the effect of sibship size on education in South Africa, focusing specifically on Black–White differences. It also seeks to contribute to the debate in the educational stratification literature as to whether sibship size has a causal effect on education. South Africa is drawn on as the case study, given its racially stratified socioeconomic hierarchies and cultural customs reflected in childbearing practices and family arrangements. Research on South Africa, therefore, enhances our understanding of the educational stratification process in a racialized context.

In general, sibship size has differential impacts on the education of Blacks and Whites in South Africa: it is negatively related to educational attainment for Whites but not for Blacks. Various sensitivity analyses point to racial differences in family arrangements as the main explanation for the null effect among Blacks. A large fraction of Blacks live in extended families, where costs of childrearing are shared beyond the nuclear units. This arrangement tends to increase the availability of family resources and subsequently attenuate the resource-dilution process. In contrast, Whites in South Africa largely conform to the family system widely adopted in many western societies, and rely almost exclusively on resources from the nuclear family.

Additional analyses are carried out to examine how endogeneity and confounding birth order effect may alter the observed sibship size effects. Contrary to some claims, I find that the sibship size effect is not a simple artifact of the birth order effect for both Whites and Blacks. The effect of birth order itself proves to be negligible after adjusting for family size. However, there is unambiguous evidence of endogenous quality–quantity calculations made by White parents, as suggested by different sets of analysis including the IV models. The observed negative effect tends to be inflated by endogeneity. It essentially becomes zero for Whites after endogeneity is taken account of in the IV model, whereas the effect for Blacks remains largely negligible.

The finding of a spurious sibship size effect for Whites is in line with several earlier studies finding no such effect in Western societies once adjusting for endogeneity (Black et al., 2005 in Norway; Guo & VanWey, 1999 in the U.S.). It calls into question the causal relationship between sibship size and education, especially for populations that adopt Western values of childbearing, and highlights the importance of addressing potential endogeneity when studying this effect.

While providing rich information on education and sibling composition, the survey data fail to include information on the family arrangements when the

respondent was young. This limitation is faced by most social surveys. Although they often collect complete household rosters, the usual practice is to collect information on the current household, which provides no information about the household composition when the respondent was growing up. This limitation prevents more explicit analysis of the role of family arrangements in affecting individual early-life outcomes. Collecting an additional, retrospective, household roster focusing on when the respondent was young would be highly desirable in any survey designed to investigate intergenerational status transmission or status attainment.

This research has contributed to our understanding of how cultural customs may mediate educational resource constraints in developing settings and especially in the context of high fertility. In contrast to many developed nations, where the detrimental effect of family size appears to be universal, in South Africa sibship size effects have varied across racial groups. The evidence from South Africa clearly illustrates how socioeconomic and cultural institutions and ideologies affect family dynamics, which consequently mediate the role of sibship size as a determinant of educational outcomes. To the extent one accepts the beneficial role and ability of extended families in coping with constraints and in minimizing the negative impact of high fertility, the persistence of such arrangements would have considerable favorable implications for improving the well-being of Black children among this generation of South Africans during the post-*apartheid* recovery period.

FOOTNOTES

1 South Africa has four official racial groups: Blacks (indigenous Africans), Whites (mostly of European origin), Coloreds (mixed-race people) and Asians (Indian descendants). They constitute 76%, 13%, 8% and 3% of the population, respectively. The present study focuses on Whites and Blacks in South Africa, who together account for almost 90% of the total population and offer the clearest contrast. Also, I restrict the sample this way because the survey data do not provide sufficient cases for the other two racial groups.

2 In South Africa, for each racial group, primary school takes 7 years (substandards A and B, standards 1–5) beginning at age 6 or 7, and secondary school 5 years (standards 6–10).

3 The data and documentation can be downloaded from http://www.sscnet.ucla.edu/issr/da/.

4 I test for normality of the dependent variable. Results suggest that the data points do not systematically deviate from normality. I also carry out sensitivity analysis using poisson, negative binomial, and zero-inflated regressions, which operate under somewhat different assumptions. All three sets of models tell a very similar story: that is, there is a negative sibship size effect for Whites but not for Blacks. Because the interpretation of these models is less straightforward than that of OLS models, I report results from the OLS regressions in the text to facilitate interpretation and also comparison with earlier studies, which almost always used OLS models.

5 I estimate corresponding models by restricting the analysis to complete cases, which give qualitatively the same results. However, because this procedure reduces the sample size by about 1000 cases, I stay with the models with mean substitution.

6 Fostering families (households with children and relatives but neither parent), another form of extended arrangements, do not seem to buffer the negative sibship size effect. This may reflect the possibility that families tend to invest and usually invest a greater amount in more closely related children since these children are considered more likely to provide transfers to the households later in life (Anderson, 2005). As a result, unequal allocation favoring biological children often occurs in these families.

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TABLES

Table 1.
Sample means and percentages separately for Whites and Blacks, SSOA 1991-1994.

Discrete variables	Whites	Blacks
Gender		
Male	57.8	50.6
Cohort		
20-29	28.1	41.1
30-39	23.5	24.0
40-49	21.2	14.9
50-59	13.1	10.0
60-69	9.6	6.8
70-79	4.7	3.3
Residential status at age 14		
Urban	68.6	49.5
Rural	9.5	37.3
Other	21.9	13.3
Parental presence at age 14		
No parent	5.3	6.7
One parent	6.9	16.9
Two parents	87.8	76.5
Missing on parental education		
Yes	11.1	7.8
Missing on parental ISEI when r was 14		
Yes	7.8	21.5
Missing on household economic condition when r was		

14		
Yes	7.8	14.3

	Whites		Blacks	
Continuous variables	Mean	S.D.	Mean	S.D.
No. of siblings (excluding focal children)	3.2	2.48	3.9	2.61
R's total years of schooling	12.3	2.26	6.4	4.25
Parental education	10.8	3.10	4.3	3.93
Parental ISEI when r was 14	44.2	16.23	28.3	11.38
HH economic condition when r was 14	0.80	0.22	0.24	0.20
N	2385		4429	

Table 2.
OLS regressions of years of schooling on sibship size and control variables for Whites and Blacks, SSOA 1991-1994 (standard errors in parentheses).

Independent variables	Whites	Blacks
No. of siblings	-0.140*** (0.036)	0.001 (0.038)
Male (ref. female)	0.324** (0.116)	0.232 (0.175)
Cohort (ref. 20-29)		
30-39	0.232 (0.186)	-0.841*** (0.211)
40-49	0.351* (0.151)	-2.009*** (0.265)
50-59	0.102 (0.174)	-2.076*** (0.314)
60-69	0.511** (0.207)	-3.515*** (0.323)
70-79	-0.036 (0.287)	-3.492*** (0.371)
Residential status (ref. urban)		
Rural	0.210 (0.168)	-0.505* (0.242)
Other	-0.102 (0.161)	-0.311 (0.264)
Parental education	0.288*** (0.026)	0.331*** (0.026)
Missing on parental education	0.266 (0.148)	-1.281* (0.532)
Parental ISEI when r was 14 [a]	0.037 (0.052)	0.227** (0.073)
Missing on parental ISEI when r was 14	-0.014 (0.234)	-0.456* (0.222)
Economic condition when r was 14	1.996*** (0.274)	5.263*** (0.570)
Missing on economic condition at 14	0.620*** (0.190)	-1.165*** (0.258)
Parent present at age 14 (ref. not present)		
One parent	-0.487* (0.238)	-0.173 (0.341)
Two parents	-0.097 (0.209)	-0.079 (0.314)
Intercept	7.565*** (0.401)	4.801*** (0.505)
R^2	0.291	0.438

N	2,385	4,429

[a] The ISEI variable was divided by 10 to allow for more significant digits in the coefficient, which shows the effect of a 10 point change in the ISEI scale score.

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

Table 3.
OLS regressions of years of schooling on sibship size, birth order and control variables for Whites and Blacks, SSOA 1994 (standard errors in parentheses).

Sibset variables	White		Black	
	Model 1	Model 2	Model 3	Model 4
No. of siblings	-0.143** (0.045)		-0.035 (0.082)	
Birth order	-0.040 (0.030)		0.054 (0.080)	
No. of younger siblings		-0.150*** (0.036)		0.001 (0.046)
No. of older siblings		-0.128*** (0.036)		-0.041 (0.067)
R^2	0.303	0.303	0.431	0.431
N	2,385		4,429	

Note Only coefficients of sibship size and birth order are shown. Other covariates are the same as in Table 2 and are omitted here.
* p < .05, ** p < .01, *** p < .001

Table 4.
Differences in means and proportions for basic demographic and socioeconomic characteristics by twin status for Whites and Blacks, SSOA, 1991-1994.

Variables	Non-twin birth	Twin birth
Whites		
Parental education	10.8	10.7
Parental ISEI when r was 14	44.2	44.5
Economic condition when r is 14	0.80	0.76
Place of residence at birth		
Urban	0.70	0.67
Rural	0.10	0.15
Don't know	0.20	0.17
N	2302	83
Blacks		
Parental education	4.9	5.3
Parental ISEI when r was 14	29.6	28.4
Economic condition when r is 14	0.31	0.33
Place of residence at birth		
Urban	0.33	0.33
Rural	0.58	0.59
Don't know	0.09	0.08
N	4345	84

Note None of the contrast is significant at the 0.05 level.

Table 5.
IV regressions of years of schooling on sibship size and control variables for Whites and Blacks, SSOA 1991-1994 (standard errors in parentheses).

Independent variables	Whites	Blacks
No. of siblings	0.485 (1.116)	1.032 (0.573)
Male (ref. female)	0.394** (0.134)	0.213 (0.205)
Cohort (ref. 20-29)		
30-39	0.045 (0.419)	-0.797** (0.250)
40-49	0.414* (0.178)	-1.629*** (0.404)
50-59	0.187 (0.194)	-1.526*** (0.474)
60-69	0.516* (0.228)	-2.547*** (0.660)
70-79	-0.203 (0.486)	-2.397** (0.750)
Residential status (ref. urban)		
Rural	0.084 (0.258)	-0.562 (0.314)
Other	-0.076 (0.202)	-0.212 (0.316)
Parental education	0.348** (0.124)	0.379*** (0.037)
Missing on parental education	0.250 (0.228)	-1.358* (0.582)
Parental ISEI when r was 14 [a]	0.090 (0.076)	0.187* (0.091)
Missing on parental ISEI when r was 14	0.280 (0.599)	-0.332 (0.253)
Economic condition when r was 14	3.327(2.210)	5.642*** (0.776)
Missing on economic condition at 14	0.939 (0.633)	-1.042*** (0.320)
Parent present at age 14 (ref. not present)		
One parent	-0.140 (0.123)	-0.857 (0.563)
Two parents	-0.499 (0.216)	-0.669 (0.510)
Intercept	3.856 (6.568)	1.446 (1.995)
R^2	0.074	0.204

N	2385	4429

[a] The ISEI variable was divided by 10 to allow for more significant digits in the coefficient, which shows the effect of a 10 point change in the ISEI scale score.

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