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Teenage motherhood and long-run outcomes in South Africa

By Siv Gustafsson and Seble Worku

Abstract Teenage motherhood is very high in South Africa. In 2001, 55 per thousand African South African women and 82 per thousand Coloured South African women were teenage mothers as compared to 8 among Indian South Africans and 3 among White South African women. In this paper we use the South African General Household Survey data of 2002 with complete retrospective fertility history to study teenage childbearing and a number of outcomes in 2002 such as completed high school and satisfaction with life. Our main findings are that teenage childbearing is negatively correlated with completing high school, but most other outcome measures do not show the negative effects from teenage motherhood as has been found in many previous US and UK studies. We estimate a bivariate probit model on the joint determination of the probability of teenage motherhood and completing high school, identifying by abortion rates and the numbers of doctors and nurses by region.

Key words: Teenage motherhood, high school completion, endogeneity, bivariate probit, South Africa

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1. Introduction

Teenage childbearing in South Africa is high. Unites States, Turkey and Brazil have similar levels of around 45 per thousands women having a teenage birth (Table 1). In comparison, countries with less than 10 per thousand include Denmark, Italy, Spain and Sweden. Some African countries included in Table 1 have more than a 100 teenage births per thousand women namely Kenya, Nigeria and Zimbabwe. Transition economies, middle-income countries and large countries with much differing socio-economic classes like the US, Australia and Canada have 2-digits level rates, although in the latter the total fertility rates remain close or below the replacement levels. Teenage childbearing is generally considered a poor life choice since responsibilities of early childbearing have long lasting effects on the socio-economic well being of the mothers involved and children born in this way. The most commonly cited outcomes for teenage mothers are interrupted education, reduced earning potential, reduced career prospects and poor marital outcomes.

Table 1: Teenage fertility and total fertility rates for South African and selected countries in 2002

Country	Teenage fertility	Total fertility rates
Australia	18	1.75
Brazil	44	2.30
Botswana	60	3.20
Canada	22	1.52
Denmark	7	1.72
France	11	1.89
Germany	13	1.31
Italy	7	1.26
Kenya	113	5.00
Mexico	51	2.40
New Zealand	14	1.90
Nigeria	124	5.80
Norway	10	1.75
Poland	15	1.24
Portugal	20	1.47
South Africa	46	2.80
Spain	9	1.25
Sweden	7	1.65
Turkey	49	2.46
United Kingdom	29	1.64
United States	43	2.01
Zimbabwe	104	3.60

Source: Teenage fertility and total fertility rates from Society at a Glance: OECD Social Indicators, 2005, http://www.oecd.org/dataoecd/34/13/34542721.xls; US Bureau of Census; ILO:http//laborsta.ilo.org/
Note: Teenage fertility France and Germany for 2001; Spain and Portugal for 2000; Turkey for 1998.

In many previous studies, it has been shown that teenage motherhood is correlated with adverse adult outcomes. For example Ermisch and Pevalin (2005), studying the British cohort

of women born in 1970, find that having had a teenage birth causes a woman to fare worse in the marriage market, greatly increasing her chances of partnering with poorly educated and unemployment prone men. Using the US NLSY data and their all women sample, Hotz, McElroy and Sanders (2005) perform OLS analysis and find negative and significant effects of a teenage birth on having a high school diploma by age 28, and being a single mother at age 28. Also, teenage mothers have fewer hours of work and lower annual earnings at age 28. These results for the United States reproduce many earlier studies. However, it has been pointed out in recent literature, that such negative correlations can not be interpreted as causal effects in the sense of addressing the counterfactual questions of what would have happened to this particular woman had she not had a teenage birth. The question is then to what extent do we observe negative outcomes because this woman has grown up in a family that has negative outcomes in general and also if there are no teenage births. This reason for finding negative outcomes of teenage births is the selection effect.

Two methods have been used to disentangle the selection effect from the causal effect: one is the sisters' comparison (Germinus and Koreman, 1992; Holmlund, 2005) and the other is using a quasi-experiment as an instrument (Hotz et al, 2005). The quasi-experiment used by Hotz et al (2005) is miscarriages, so that the comparison of teenage mothers is to women who had teenage pregnancies that ended in miscarriages. They did not experience their life as young adults being mothers differently from those who had live births. Ermisch and Pevalin (2005) use information on teenage births, miscarriages and abortions in their study of the British 1970 cohort of women. All studies that have used sisters comparisons and quasi-experiments to control for the selection effect find much smaller negative effects from teenage births on adult outcomes. This study is the first study using South African data to analyse outcomes of teenage motherhood. We use the 2002 General Household Survey which gives complete retrospective fertility histories of women aged less than 50 in 2002. We analyse whether women who had a teenage birth in the past are observed to have negative outcomes in 2002. Further, using a sub-sample of the General Household Survey of women who are aged from 20 to 24 in 2002 we analyse a bivariate probit on having a teenage birth and having completed high school following Ribar (1994). We use this young sample because we have complementary information on abortion rates and the numbers of nurses and doctors by region in 2002 that we will use as identifying instruments.

Further we have information on contraceptive use by population groups in 1998 from the South African Demographic and Health Survey and information about HIV infection rates by the nine regions from the 2002 Human Science Research Council Survey/Nelson Mandela Survey data sets. We use the health survey of 1998 to impute values on the availability of contraceptives to a woman based on her population group, age, whether she lives in an urban area and her education.

This paper is organised as follows. The second section discusses estimation issues and positions our paper in the literature. The third section describes the data. Section 4 presents outcomes of teenage childbearing and section 5 presents results of joint modelling decisions of teenage motherhood and high school completion. Section 6 concludes.

2. Causality identification and empirical approaches

There are two methods to distinguish between the causality effect and the selection effect in teenage motherhood studies: the quasi-experimental or treatment studies and the sisters' studies. Ermisch and Pevalin (2005) study teenage fertility in the UK using the 1970 cohort study and examine outcomes in 2000 when the women reach age 30. They use information on pregnancies, miscarriages and abortions for the individual women. They argue that while teenage pregnancy is likely to be an unplanned event the decision to actually give birth is a choice. Therefore comparing the outcomes of women who decided to terminate their pregnancy to those who give birth is a good instrument for treatment effects. Their finding is that at age 30, teenage mothers in Britain are more likely to form partnership with low earning unemployment prone men. But the instrument variable estimators using miscarriages and abortions are not very different from the estimator obtained by comparing teen-mothers to non-teen mothers.

Hotz et al (2005) express the challenge as the "key issue in attempts to estimate the causal effect is to know to estimate reliably the counterfactual state to the observed outcomes of teen mothers". They study US teen-mothers using the National Longitudinal Survey (NLS) data and use miscarriages as a natural experiment outcome. They conclude that the adverse outcomes are much smaller and shorter lived than has been found in most previous studies.

The second method is to analyse sister differences in outcomes. Holmlund (2005) uses Swedish register data and is able to extract a sample of teenage mothers and their sisters who are not teenage mothers. Her outcome variables are years of education completed in 2002 for women born 1974 to 1977. In addition to being able to get rid of the selection effect by studying sister differences, she has information on the pre-pregnancy school grading at age 16 which makes it possible to control for within family heterogeneity. Interestingly, she finds that there are common characteristics that teenage mothers and their sisters share. Both the teenage mothers and their sisters have less education than a control group of women of the same cohort who have no teenage births and have no sisters with teenage births. However, one of Holmlund's most surprising results is that there is an inter-sibling difference in pre-pregnancy school results to the favour of non-teenage sisters. Holmlund concludes that when controlling for pre-motherhood school performance the sibling approach is not more informative than a traditional cross-section.

Many studies have observed that schooling of teenage mothers is less than the schooling of similar women, who had their birth later or have had no birth up to the interview time. References on US studies finding that teenage mothers are less likely to complete high school include Upchurch and McCarthy (1999), Card (1981), Moore and Waite (1977), Mott and Marsiglio (1985). Because teenage motherhood and completing high school education have been found to be negatively correlated although the causal direction is not clear, estimating these two events as simultaneously determined is a solution. Ribar (1994) estimates a bivariate probit on the joint probability of having a teenage birth and completing high school for US women using the NLS. He uses availability of obstetricians and gynecologists by region, woman's age at menarche and the regional abortion rate as instruments for teenage pregnancy.

3. Data and samples

The General Household Survey (GHS) is a household based survey conducted by Statistics South Africa since 2000 around July each year and was preceded by the October Household Survey for the years 1995 to 1999. We are using the General Household Survey of 2002. Information is collected on everyone currently living in the household. Migrant family members for example husbands who live elsewhere in order to get a job or children not living in the household but staying with extended family members (often grandparents or aunts) are not included. However full retrospective information about fertility history for women aged 50 or younger in 2002 is included (Statistics South Africa, 2003). This makes it possible to study long-run outcomes for earlier cohorts and compare outcomes between cohorts. We use the data by including all women aged 18 to 50 in 2002 that we refer to as the "all women" sample and including all women aged 18 to 50 who are mothers in 2002 that we refer to as the "all mothers" sample. These two samples make up 24,973 women and 17,576 mothers. We also use more restricted samples which include all women aged 18 to 50 in 2002 who have completed high school which we refer to as the "completed high school" sample. This sample includes 8,039 women. Lastly, we have all women aged 18 to 24 in 2002 which we refer to as the "young sample" including 7,288 women. The motivation for studying the young sample is because we have additional information on the prevalence of contraceptive use, the HIV prevalence rates, the number of abortions by region and the number of doctors and nurses for recent years.

There are many outcomes in 2002 available including a measure of happiness, wealth, whether the child lives with the mother, her occupation and whether the woman is married in 2002 and if so her husband's occupation.

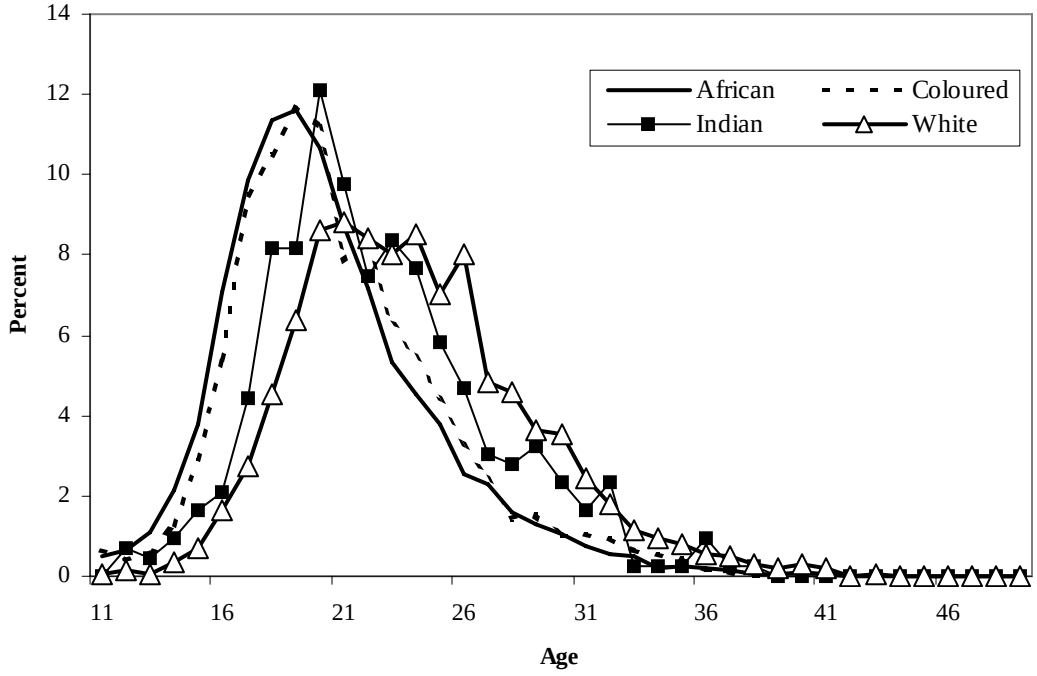
There are unfortunately no inter-generational links in the data that would make it possible to compare sisters. The Swedish data registers used by Holmlund (2005), Björklund, Ginther and Sundström (2007) allow for identifying the family situation during an adult person's childhood. This can be done because Statistics Sweden has created a multigenerational register that contains connections between parents and children via biology and adoption. This register includes all Swedes who were born in 1932 or later and registered as living in Sweden any time from 1961 onwards. Because all Swedes have a personal identifier since 1947, the data of the multigenerational register can be merged to other registers of Statistics Sweden (Björklund, 2006). For example, Holmlund (2005) uses the multigenerational register; the censuses 1975, 1980, 1985 and 1990; the education register and the school registers on data collected from schools, on grade received at age 16, when leaving compulsory school. Researchers are then allowed to buy the custom made data set from which the personal identifiers are deleted but new identifiers linking the data sets are introduced.

Long household panels like the US data from the Michigan Panel data (the Panel Study of Income Dynamics, PSID) and the National Longitudinal Survey (NLS); the British Household Panel Study (BHPS) can also be used for example Hotz et al (2005); Björklund et al (2007) for the NLS and PSID, and Ermisch and Francesconi (2001) for the BHPS and Ermisch and Pevalin (2005) for the 1970 Cohort British data.

Because we cannot link generations in the South African General Household Survey our results on outcomes in 2002 will include both the selection effect of belonging to a household, which is prone to adverse outcomes, also in the absence of teenage childbearing and the pure causal effect of having to care for a child, while other young women have a much lower opportunity cost for investing in their human capital.

We use the "all women all cohorts" sample to compute the age profiles of giving first birth in Figure 1. African women and Coloured women are clearly younger at having their first birth than the Indian and White women. The peak age at having first birth is at age 19 for African and Coloured South African women. This "all women all cohorts" includes women who were 50 years old or younger in 2002, which means that they can have been 15 years old as early as in 1967.

Figure 1: First birth by population group



Source: Own computations based on the GHS 2002

In Table 2 we use the births that took place in 2001 to compute the number of births per thousand women by age group. These numbers are directly comparable to the cross-country data in Table 1 above. The African and Coloured South African women have 55 and 82 births per thousand women in the age group 15-19. In comparison Britain has more teenage fertility than any other European Union (EU) country. African South African women aged 15-19 have more than twice as many births as British women aged 15-19. Indian and White South African women have low numbers of teenage mothers and more in line with the Swedish and other low incidence countries figures included in Table 1. Although these rates are already high in South Africa, teenage childbearing might be rising. This is currently the topic of conversation among

politicians, the media and the community at large[1]. Many observers are convinced that the child support grant introduced by the government in 1997 is tempting teenagers to get pregnant[2]. This type of incentive has been extensively discussed by American scholars whereby researchers have established causal links between the size of the monthly AFDC benefits and the decision to give birth (Ellwood and Bane, 1985; Lundberg and Plotnick, 1990; Moffitt, 1992; Klawitter, Plotnick and Edwards, 2000).

The proportion of teenage mothers in the all mother sample is 45%. That means that close to half of all mothers have their first births while teenagers. This fact is also represented if Figure 1 above (see Appendix Table A1). Further, many of these women are likely to be single mothers because Gustafsson and Worku (2006) show that 48% of all mothers in South Africa are single mothers.

Table 2: Births per thousand women in 2001 by age group

ASFR	Britain	Sweden	S.A: African	S.A: Coloured	S.A: Indian	S.A: White
<15	0	0	5	5	0	0
15-19	24	5	55	82	8	3
20-24	69	41	102	117	83	31
25-29	92	100	101	127	136	96
30-34	88	107	83	100	44	78
35-39	42	51	49	40	9	19
40-44	7	10	19	13	11	3
45-49	0	1	7	3	0	0
Total	323	314	422	487	291	229
Number of births	588,819	95,815	1,497	244	30	73
Number of women (thous)	19, 622	2,040	25,103	3,621	780	2,326
TFR	1.61	1.57	2.11	2.4	1.5	1.15

Source: Own computation based on the General Household Survey 2002 (South Africa); Statistics Sweden: Live birth in Sweden by age of the mother and mid-year populations estimates (Sweden); Office of the National Statistics: Maternities, live births and stillbirths by age of mother and occurrence within/outside marriage and mid-year population estimates 2000-2002 (Britain).

Note: Estimated TFR published by Statistics Sweden for 2001 are: 1.63. Estimated TFR published by UK National Statistics Office for 2001 are 1.57. Estimated TFR published Statistics South Africa for South African Africans for 2001 are: 3.0, for Coloureds: 2.4; for Indians: 2.0 and for Whites are 1.7 (Stats SA, 2004).

[1] The public broadcaster (SABC) aired in its weekly Special Assignment Program on July 25 2006, a documentary entitled: Imali Ye Qolo –Rent A Womb. The program discusses the rise in teenage pregnancies and the community members around the country beliefs that the reason for this alarming trend is the child grant.

[2] The child support grant was introduced in 1997 by the government to alleviate poverty. The grant is means-tested and is paid via the primary caregiver of the child, to all children who qualify. It amounts to R170 per month as of 1 April 2004, is currently available for children under the age of 14 years who live in households with an income of below R800 per month, or R1,100 per month if the child and his or her so-called 'primary care-giver' either live in a rural area or in an informal settlement.

4. Outcomes in 2002 from having had a teenage birth in the past

The cross sectional data from GHS 2002 allows us to analyse correlations between having had a teenage birth in the past and various outcomes in 2002. However, we do not have access to neither sisters' information nor to quasi-experiment information. We estimate regressions of the following type:

$$Y_i = \alpha_0 + \alpha_1 T_i + \alpha_2 X'_{2i} + \varepsilon_i \quad (1)$$

where Y_i is an outcome variable of a woman *i* in 2002; T_i is a dummy variable which equals 1 if the woman had a teenage birth in the past and 0 otherwise; X'_{2i} is a matrix representing other control variables X_2 for woman *i* affecting outcomes in 2002. These are primarily the birth cohort of the woman and her population group; α_0, α_1 and the vector of α_2 are parameters to be estimated. If the true model instead is:

$$Y_{ij} = \beta_0 + \beta_1 T_{ij} + \beta_2 X'_{ij} + f_j + U_{ij} \quad (2)$$

where we can observe the outcome of individual *i* in family *j. S*isters data would allow the researcher by differencing over siblings to get rid of the unobserved family component f_j. This means that our estimates will also include this selection effect. Our analysis below therefore includes both the potential effect of belonging to a family prone to adverse outcomes, the selection effect and the proper causal effect of teenage motherhood on outcomes.

We follow King, Tomz and Wittenberg (2000) to simulate short-term outcomes at age 24 in 2002 and long-term outcomes at age 40 in 2002 for African women, who had teenage birth in comparison to those who did not for the different samples described earlier. We use a program called CLARIFY developed by King et al (2002) and is a set of macros written in STATA. Once we have estimated the model in equation (1) we obtain the estimated coefficients and variance matrix:

$$\hat{\gamma} = \begin{bmatrix} \hat{\alpha}_1 \\ \hat{\alpha}_2 \\ \hat{\alpha}_0 \end{bmatrix} \quad \hat{V} = \begin{bmatrix} V\hat{\alpha}_{11} & V\hat{\alpha}_{12} & V\hat{\alpha}_{1\hat{\alpha}} \\ V\hat{\alpha}_{21} & V\hat{\alpha}_{22} & V\hat{\alpha}_{2\hat{\alpha}} \\ V\hat{\alpha}_0\hat{\alpha}_1 & V\hat{\alpha}_0\hat{\alpha}_2 & V\hat{\alpha}_0 \end{bmatrix} \quad (3)$$

where $\hat{\alpha}_2$ is a vector of several coefficients.

To simulate one value of Y_i from equation 1, we consider an African woman aged 40 who had a teen birth. We then generate *k* random draws of the parameters from the multivariate normal distribution $\tilde{\gamma} \sim N(\hat{\gamma}, \hat{V})$ that are stored in *k* new variables. Thus each draw is a vector of simulated parameters such that:

$$\tilde{\gamma} = \begin{bmatrix} \tilde{\alpha}_{11} \\ \tilde{\alpha}_{21} \\ \tilde{\alpha}_{1} \end{bmatrix} \begin{bmatrix} \tilde{\alpha}_{12} \\ \tilde{\alpha}_{22} \\ \tilde{\alpha}_{2} \end{bmatrix} \cdots \begin{bmatrix} \tilde{\alpha}_{1k} \\ \tilde{\alpha}_{2k} \\ \tilde{\alpha}_{k} \end{bmatrix} \quad (4)$$

The default number of simulations is 1, 000. After simulating the parameters, the program set values for the explanatory variables and calculates bounds on the values of the explanatory variables. Then one can simulate various quantities of interest such as predicted values, expected values and first differences. Simulated expected values are equivalent to simulated probabilities for all discrete choice models (probit and ordered probit) used in our analysis. In these models, the quantities presented are the *Probability (Y=1)* for the probit model and the *Probability (Y=j) for all j* for the ordered probit model. For the OLS model, the expected value of Y or *(E(Y))* is estimated. We use four different sub-samples in our estimation of (1) and simulation exercise. Means for variables used in the four different sub-samples are shown in Appendix Table A1.

For estimating the long-run effects of teenage motherhood we use different methods. We use OLS for wealth owned by the woman in 2002, probits for dummy dependent variables and ordered probits for ordered dependent variables. In all the outcomes analyses the control variables included in X_i above are the four population groups: African, Coloured, Indian and White which are obtained in the survey by self-assignment of the interviewed individuals. Appendix Table A1 reveals that 78% of all women are African. Further included in X_i are birth years grouped into five years cohorts and regional dummies. We entered age linearly because we wanted to predict outcomes at age 40 or 24 rather than for an age interval. We also run the outcomes analysis using the 7 cohorts groups presented in Table A1. This specification change showed that the effect of the dummy for having had teenage birth did not change and was therefore robust to this specification change.

In Table 3, the coefficient on having had a teenage birth in the past in various analyses is shown. The results in Table 3 show some significant and negative results from having had a teenage birth. Women with teenage births are less likely to have completed high school. They have less wealth. We constructed the wealth variable as an index by combining the main type of material used to construct the roof and walls of the house the woman lives in with the condition of the walls and roofs, the number of rooms and ownership status of the house. Highest scores are allocated to the main materials used to construct the roof and walls of the house. The details of the construction of this variable are shown in Appendix B. Furthermore, women with teenage births are less likely to be employed or have a good occupation if employed. The employment history, the probability of being married and whether her spouse lives with her are not negative to teenage mothers.

In Table 4a and 4b, we show predicted outcomes for African mothers aged 40 in 2002 for the "all mothers all cohorts aged 18-50" sample and the "all women all cohorts aged 18-50 and who completed high school" sample whereas we predict outcomes for African mothers aged 24 in 2002 for the "young women aged 18-24 " sample based on the analysis in Table 3.

Table 3: Outcomes in 2002 for having had a teenage birth in the past, estimated coefficient of the dummy variable

	Aged 18-50		Mothers aged 18-50		Aged 18-50 & Compl. High school		Aged 18-24 Young sample		
All women all cohorts who are:	Coeff	Z	Coeff	Z	Coeff	Z	Coeff	Z	Method
Completed high school or higher	-0.516	-25.8	-0.487	-21.6	-	-	-0.615	-15.4	Probit
Wealth	-0.017	-7.2	-0.013	-4.9	-0.007	-1.5	-0.026	-5.7	OLS
Married/Cohabiting	0.287	15.4	0.032	1.6	0.308	7.8	0.713	17.1	Probit
Employed in 2002	0.047	0.3	-0.036	-1.8	-0.025	-0.6	0.175	3.9	Probit
Ever worked	0.171	8.8	0.080	3.6	0.111	2.7	0.243	6.2	Probit
Woman's occupation	-0.087	-5.1	-0.129	-6.9	-0.097	-2.7	0.112	2.6	Oprobit
Spouse's occupation	0.181	11.1	-0.043	-2.4	0.206	5.6	0.636	15.9	Oprobit
Satisfaction with life	-0.029	-2.0	-0.027	-1.6	0.037	0.9	-0.019	-0.7	Oprobit

Source: Own computations based on the General Household Survey 2002 data
Note: We also controlled for

The main impression in Tables 4a and 4b is the small differences in outcomes between teenage mothers and other mothers. The proportion who completed high school differs substantially between those who had a teenage birth and those who did not. Having completed high school increases wealth and the probability of employment which can be seen by comparing the outcomes for the high school completed sample to the outcome of the all mothers sample. There are no differences in being married or cohabiting in 2002, or being employed between mothers who had a teenage birth and mothers who had their children at a later age. We also analyse separately the sub-sample of women who have completed high school because this outcome is the one with the largest difference between teenage mothers and those who had their first birth child later. Tables 4a and 4b reveal that this sample of relatively high educated women have no better probabilities of being married and living with their spouse. They have a little more wealth and are a bit more likely to be employed in 2002 than less educated women. The women comprising the "high school completed" sample have better jobs, with 30% of them in professional or senior management positions. However, also for women who completed high school, 50% of them have no spouse and another 6% of them have a spouse who does not live in the household. In addition, Table 4b show that happiness is not granted by completion of high school. While 22% of women who at least completed high school are dissatisfied or very dissatisfied with life, this is true for 29% of the samples where all mothers are included. Satisfaction with life is not dependent on whether the woman had a teenage birth or not. Having teenage births is so common in South Africa that it does not single out these women as particularly disadvantaged. Caldwell and Caldwell (1993) quote research done in the 1990s in Natal where schoolgirls are cited saying that "pregnancy is not the end of the world". Our results seem to confirm that they were right. However, teenage mothers are less educated than non-teenage mothers and there is a conflict between the desirability of increasing human capital among the population and the high propensity of teenage births in South Africa. We will therefore turn to an analysis of who becomes a teenage mother.

Table 4a: Simulated outcomes for African women in 2002

	Completed high school or higher		Wealth	
	If teen birth	If not teen birth	If teen birth	If not teen birth
All women all cohorts who completed high school (aged 18-50)	1.00 -	1.00 -	0.70 (0.005)	0.71 (0.003)
All mothers all cohorts (aged 18-50)	0.13 (0.004)	0.28 (0.006)	0.62 (0.002)	0.63 (0.002)
All women young cohorts (aged 18-24)	0.29 (0.015)	0.52 (0.013)	0.60 (0.005)	0.62 (0.004)
	Married/cohabiting in 2002		Employed in 2002	
All women all cohorts who completed high school (aged 18-50)	0.67 (0.014)	0.54 (0.011)	0.64 (0.015)	0.64 (0.011)
All mothers all cohorts (aged 18-50)	0.57 (0.007)	0.56 (0.006)	0.44 (0.007)	0.46 (0.006)
All women young cohorts (aged 18-24)	0.40 (0.017)	0.17 (0.010)	0.24 (0.014)	0.19 (0.010)

Source: Own computation based on the General Household Survey 2002 data

Table 4b: Simulated outcomes for African women in 2002

	All mothers all cohorts (aged 18-50)		All women all cohorts who completed high school (aged 18-50)	
All women who are:	If teen birth	If not teen birth	If teen birth	If not teen birth
Woman's occupation				
1. Professional/Senior official	0.06 (0.002)	0.08 (0.003)	0.27 (0.012)	0.30 (0.009)
2. Clerk and service worker	0.10 (0.003)	0.12 (0.003)	0.24 (0.006)	0.25 (0.006)
3. Skilled agric., craft /mach operator	0.04 (0.002)	0.05 (0.002)	0.03 (0.002)	0.03 (0.002)
4. Elementary occupation/Domestic worker	0.20 (0.003)	0.21 (0.003)	0.07 (0.003)	0.07 (0.003)
5. No work	0.59 (0.006)	0.54 (0.006)	0.38 (0.014)	0.35 (0.010)
Spouse's occupation				
1. Professional/Manager/Senior official	0.05 (0.002)	0.06 (0.002)	0.23 (0.011)	0.16 (0.007)
2. Clerk and service worker	0.05 (0.002)	0.05 (0.002)	0.09 (0.004)	0.08 (0.004)
3. Skilled agric. or craft /mach. operator	0.14 (0.003)	0.15 (0.003)	0.14 (0.005)	0.12 (0.004)
4. Elementary occupation/Domestic worker	0.07 (0.002)	0.07 (0.002)	0.02 (0.002)	0.02 (0.002)
5. Spouse unemployed	0.11 (0.002)	0.11 (0.002)	0.06 (0.003)	0.06 (0.003)
5. Spouse does not live in household	0.10 (0.002)	0.10 (0.003)	0.06 (0.003)	0.06 (0.003)
5. Not married	0.49 (0.006)	0.46 (0.006)	0.40 (0.014)	0.50 (0.010)
Satisfaction with life				
1. Very satisfied	0.11 (0.003)	0.12 (0.003)	0.14 (0.008)	0.13 (0.006)
2. Satisfied	0.27 (0.004)	0.27 (0.004)	0.33 (0.006)	0.33 (0.006)
3. Indifferent	0.33 (0.004)	0.33 (0.004)	0.32 (0.006)	0.32 (0.006)
4. Dissatisfied	0.17 (0.004)	0.17 (0.003)	0.13 (0.006)	0.13 (0.005)
5. Very dissatisfied	0.13 (0.004)	0.12 (0.003)	0.08 (0.005)	0.09 (0.004)

Source: Own computation based on the General Household Survey 2002 data

5. High school completion and teenage motherhood

We cannot distinguish whether teenage motherhood inhibits a woman to complete high school or whether women who would not complete high school any way are more likely to become teenage mothers. To eliminate the bias that may arise from the use of single equation models we estimate a bivariate probit model in which the probability of teenage motherhood and the probability of high school completion are simultaneously estimated. This model is equivalent to an instrumental variable model and is preferred when both the dependent variable and the endogenous variable are binary. Assuming that the teenage motherhood decision is determined by an observed latent variable:

$$T_i = \delta_1 Z_i + \delta_2 S_i + u_i \tag{3}$$

where Z_i is a vector of individual and geographical characteristics, S_i is 1 if the person has completed high school and 0 otherwise; δ_1 and δ_2 are parameters to be estimated and u_i is the error term. Similarly we assume that the high school completion decision is determined by an observed latent variable:

$$S_i = \theta \varpi_i + e_i \tag{4}$$

where S_i is a vector of observed variables, ϖ_i are the exogenous identifying instruments and e_i is the error term. If u_i and e_i are not independent due to endogeneity of S_i, the motherhood equation parameters will not be consistent if estimated by a univariate probit model. Bivariate probit leads to consistent estimates if u_i and e_i are correlated. In this case, u_i and e_i are distributed as bivariate normal with mean and variance both equal to zero. The covariance is $\rho=\text{Corr}(u_i, e_i)$. The bivariate probit model is appropriate when $\rho=0$ (Green, 2003).

The choice of ϖ_i is very important. We use a number of instruments as suggested by the literature: abortion rates by region, attributed contraceptive use, number of doctors per 1,000,000 of the population by region and number of nurses per 1, 000,000 of the population by region. These variables are most likely to affect childbearing but not educational attainment and thus represent acceptable potential instruments. Appendix Table A1 shows the means and standard deviations of these variables and appendix Table A3 shows their values across the nine regions. Unfortunately the variations of these variables are only across the nine regions.

In this analysis we use the young cohort sample because we have some complementary information for recent years. One of the variables that one would like to have when studying teenage pregnancy is the availability of contraceptives to the young woman. We do not know which contraceptives the individual women use in our GHS 2002 data. But if we had had such information it would definitely had been endogenous to fertility. Instead, we want to construct a variable which is an individual identification of her individual access to contraceptives. This is obtained by the 1998 Demographic and Health Survey data set. Using this data set the rates of using different kinds of contraceptives are computed by population group, age group, education and geography (urban/rural). These rates are shown in Table A2 of the Appendix. The Table shows that there are racial variations regarding the choice of methods. The Depo-

Provera is mostly used among Africans and Coloureds whereas the pill is used the most by the Whites. The injectible contraceptive also known as the Depo-Provera is a long-acting progestin form of birth control manufactured by Pfizer. It is injected once every three or six months and its estimated effectiveness in preventing pregnancy is 99%. Depo-Provera has long been controversial because of its health risks. It can cause infertility, lack of bone density, increase in body weight, excessive bleeding or no bleeding and it does not protect against the transmission of HIV [3]. We used the full appendix Table A2 to impute a value on the probability of using a type of contraceptive by population group (4); age group (8); urban/rural (2) and education (4). This means that the probability of each of the four contraceptive uses can have 4x8x2x4=256 different values depending on which group the woman belongs to.

South Africa has a very high rate of HIV infected people estimated to be 11.4 % of the population in 2002 (Shisana and Simbayi 2002; Shisana et al, 2005). There is a recent discussion about the negative effects of HIV on fertility (United Nations, 2002; Zaba and Gregson, 1998; (Allen et all 1993; Batter et al, 1994; Carpenter et al 1997). The negative effects of HIV on fertility occur through miscarriages, spontaneous abortions and stillbirths (Gray et al, 1997). The HIV prevalence is however only available for the nine provinces (see Table A3).

In Table 5 are presented single equations probit models of high school completion and teenage motherhood compared to the bivariate model of a simultaneous decision of high school completion and teenage motherhood where we control for population group, age, HIV prevalence rates and contraceptive use. From models (1) we can see that teenage childbearing has strong negative impacts on completing high school. Making contraceptives available to young women has a strong positive effect on high school completion rates and negative effects on teenage childbearing.

In model (2) we take into account the endogeneity problem of teenage motherhood and observe the effect of teenage childbearing on high school completion risk increases. In fact, once we control for endogeneity, the woman is close to 100% less likely to complete high school. Also the model shows that high school completion rate increases much more if we control for contraceptive usage and especially the use of modern contraceptive would significantly increase the high school completion rates and diminishes the risk of teenage childbearing. In addition, high HIV prevalence rate increases the probability of completing high school, but show very weak effect on teenage motherhood. Among the instruments, only the availability of nurses is significant although it has very weak affects. However we need to test for endogenity and we do this by using a Hausman test that reflects on the null hypothesis that the potentially endogenous repressor is exogenous. The test rejects the hypothesis and thus we conclude that teenage birth is endogenous[4]. Similarly a likelihood ratio test of the estimate of Rho from the bivariate probit model is large, significant and negative, indicating negative correlation in the residuals from the high school completion and teenage motherhood models. Thus all tests confirm that modeling high school completion and teenage motherhood jointly is more appropriate than treating teenage fertility as given to high school non-completion.

[3] Pfizer Inc Depo-Provera label , 2004, NY, USA.
[4]Test statistics is chi2(7) = 17.60 with Prob>chi2 = 0.0139

Table 5: Univariate probits and bivariate probit models of high school completion and teenage childbearing young sample age 18-24 in 2002

	Model (1):Univariate Probits				Model (2): Bivariate probit			
	High school completion		Teenage motherhood		High school completion		Teenage motherhood	
	Coef.	z	Coef.	z	Coef.	z	Coef.	z
Intercept	-2.132	-21.9	-0.286	-3.1	-1.923	-7	-0.166	-1.2
Coloured	0.861	14.7	-0.105	-1.8	0.829	10.8	0.034	0.5
Indian	1.533	9.3	-0.727	-3.7	1.414	6.3	-0.631	-3.1
White	2.200	22.5	-1.238	-10.1	2.033	8.8	-1.097	-8.7
Teenage mother	-0.524	-13.1			-0.949	-2.3		
HIV prevalence rate	0.045	7.2	-0.006	-1.0	0.043	6.3	0.013	1.8
Propensity of Depo Provera use	3.953	6.7	-1.378	-2.0	1.575	7.6	-0.193	-1.1
Propensity of modern contraceptive use	1.663	10.2	-0.331	-1.9	3.744	5.8	-1.401	-2.0
Regional abortion rates							0.057	0.2
Number of doctors per 1,000,000							0.002	1.7
Number of nurses per 1,000,000							-0.003	-3.5
Rho							0.263	0.3
Number of observations	7,288			7,288				7,288
Log likelihood	-3997.76			-4060.33				-8036.6

Note: Model (2): Likelihood-ratio test of rho=0: chi2(1) =0.66842 Prob>chi2=0.4136
References: African, No contraceptives
Source: Own computation based on the GHS 2002 data

Some empirical problems that must be mentioned are the issue of omitted variables. Due to the availability of limited number of variables, we are only able to control for exogenous characteristics like population group, propensity of contraceptive use and HIV prevalence although several other characteristics may influence the decision to complete high school like parents' education level, their income and whether the teenager comes from an intact family among others.

8. Conclusion

Teenage motherhood has adverse outcomes as have been previously found in the US and British studies. In South Africa, teenage birth is not a minority but half of all first births. This paper shows that teenage mothers in South Africa experience adverse predicted long-term outcome on selected events, especially in the proportion completing high school and the labour market. We model teenage motherhood as being endogenous to high school completion. By using three instruments that are regional abortion rate, number of doctors and nurses per 1,000,000 populations and by region, we are able to study the causal effect of teenage motherhood on high school completion in South Africa. Using the GHS 2002 micro data, we create a sample of young women aged 18 and 24 to estimate outcome of teenage childbearing on high school completion.

Our finding indicates that when modeling the two processes simultaneously, teenage motherhood has a strong negative effect on the high school completion rate which is almost

twice of the effect observed when teenage motherhood is treated as exogenous. However, once endogenised, the effect of fertility on high school completion is negative and highly significant. These results suggest that public policies that successfully reduce teenage childbearing can result in increased high school completion rate among young African and Coloured women in South Africa and much higher economic prospects for the young women and their families. These include increased availability of contraceptive to schoolgirls, much more effective sex education and increase awareness of the negative consequences of early childbearing to mothers and children. Also government policies focused on reducing poverty should be attained through economic incentives such as income subsidies, reduction of school fees or bursaries for those willing to attend.

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Table A1: Means and standard deviation of variables

All women who are:	Aged 18-50	Mothers aged 18-50	Aged 18-50 & comp. high school	Aged 18-24
African	0.77	0.77	0.66	0.81
Coloured	0.12	0.13	0.10	0.11
Indian	0.03	0.02	0.05	0.02
White	0.08	0.08	0.20	0.05
Born in 1950-1954	0.06	0.07	0.04	0.00
Born in 1955-1959	0.10	0.14	0.07	0.00
Born in 1960-1964	0.14	0.18	0.12	0.00
Born in 1965-1969	0.14	0.17	0.15	0.00
Born in 1970-1974	0.16	0.19	0.20	0.00
Born in 1975-1979	0.17	0.15	0.23	0.24
Born in 1980-1984	0.22	0.10	0.20	0.76
Western Cape	0.11	0.11	0.12	0.10
Eastern Cape	0.13	0.13	0.10	0.13
Northern Cape	0.05	0.05	0.03	0.04
Free State	0.08	0.08	0.07	0.08
KwaZulu-Natal	0.17	0.17	0.15	0.18
North West	0.10	0.10	0.10	0.10
Gauteng	0.15	0.14	0.22	0.13
Mpumalanga	0.09	0.09	0.09	0.10
Limpopo	0.12	0.13	0.11	0.13
Urban	0.59	0.58	0.75	0.55
Age	31.62 (9.31)	34.28 (8.55)	30.59 (8.30)	20.79 (1.97)
Teen birth	0.31	0.44	0.18	0.26
HIV prevalence rate				11.31 (2.66)
Propensity of no contraceptive use				0.53 (0.18)
Propensity of Depo Provera use				0.45 (0.19)
Propensity of modern contraceptive use				0.06 (0.05)
Number of doctors per 1,000,000				61.97 (47.27)
Number of nurses per 1,000,000				210.14 (79.05)
Regional abortion rates				0.13 (0.12)
Completed high school	0.32	0.29	1.00	0.32
Wealth	0.64 (0.18)	0.63 (0.18)	0.71 (0.17)	0.63 (0.18)
Married/cohabiting	0.42	0.53	0.41	0.13
Child does not live with mother	0.13	0.19	0.10	0.05
Employed	0.37	0.42	0.48	0.14
Ever worked	0.59	0.68	0.64	0.24
Lives with spouse	0.35	0.44	0.37	0.11
Woman occupation	1.82	1.92	2.50	1.31
Man occupation	2.43	2.80	2.79	1.43
Satisfaction with life	3.24	3.24	3.46	3.20
Number of observations	24,973	17,576	8,039	7,288

Source: Own computation based on the GHS 2002 data.
Note: Standard deviation in brackets.

Appendix B: Construction of the wealth variable

We constructed the wealth variable using the following variables:

the roof material=0 if it is plastic, cardboard, asbestos or mud;
the roof material=1 if it is a mixture of mud and cement, wattle and daub or thatching;
the roof material=2 if is corrugated iron zinc, or mud or wood;
the roof material=3 it is brick, cement block/concrete, wood and tile.

the wall material=0 if it is plastic, cardboard or asbestos;
the wall material=1 if it is corrugated iron zinc, mud or thatching;
the wall material=2 if it is a mixture of mud and cement, wattle and daub or thatching;
the wall material=3 it is brick, cement block/concrete or wattle and daub.

the roof condition=0 if it is very weak or weak;
the roof condition=1 if it needs minor repairs;
the roof condition=2 if it is good;
the roof condition=3 if it is very good.

the wall condition=0 if it is very weak or weak;
the wall condition=1 if it needs minor repairs;
the wall condition=2 if it is good;
the wall condition=3 if it is very good.

the ownership status=0 if the house is occupied rent free not as part of employment contract of a family member;
the ownership status=1 if the house is rented or occupied rent free as part of employment contract of a family member;
the ownership status=2 if the house is owned but not yet fully paid;
the ownership status=3 if the house is owned and fully paid for.

the number of rooms=0 if the number of rooms is one (excluding bathrooms and toilets); the number of rooms=1 if the number of rooms is 2 to 4;
the number of rooms=2 if the number of rooms is 5 to 6;
the number of rooms=3 if the number of rooms is 7 or more.

Finally the wealth index is computed as:

Wealth= ((roof material x 30) + (wall material x 30) + (roof condition x 15) + (wall condition x 15) + (ownership x 10) + (room x 20))/360.

If the index is close to 1 then the wealth status is high.

Table A2: Contraceptive use in 1998

	African				Coloured				Indian				White			
Age	None	Depo	Modern	Tradi-tional	None	Depo	Modern	Tradi-tional	None	Depo	Modern	Tradi-tional	None	Depo	Modern	Tradi-tional
15-19	66.8	26.6	5.9	0.8	78.6	18.8	2.5	0.0	93.7	1.6	4.8	0.0	86.2	2.6	11.2	0.0
20-24	41.9	45.0	12.5	0.6	50.8	39.1	10.1	0.0	60.7	4.9	34.4	0.0	54.1	12.2	33.8	0.0
25-29	41.2	43.6	14.2	1.0	40.7	39.3	20.0	0.0	36.7	2.0	61.2	0.0	33.0	9.7	56.3	1.0
30-34	42.3	37.9	18.6	1.2	37.9	30.8	31.3	0.0	15.9	7.9	73.0	3.2	27.7	2.5	68.9	0.8
35-39	48.1	26.6	24.5	0.8	31.6	25.0	43.0	0.4	28.1	5.3	66.7	0.0	22.6	3.2	74.2	0.0
40-44	56.4	17.5	26.0	0.1	42.9	13.5	42.9	0.6	35.8	0.0	64.2	0.0	20.2	0.9	75.4	3.5
45-49	69.9	6.9	22.9	0.3	50.0	6.4	43.6	0.0	34.0	0.0	66.0	0.0	37.1	1.0	61.9	0.0
Total	51.5	31.8	15.9	0.8	48.5	26.4	25.0	0.1	44.5	3.3	51.7	0.5	39.3	4.1	55.8	0.8
Urban	44.0	35.9	19.6	0.6	48.8	24.5	26.5	0.2	44.2	3.4	51.9	0.5	38.8	4.1	56.1	0.9
Rural	58.3	28.2	12.6	0.9	47.4	32.5	20.1	0.0	62.5	0.0	37.5	0.0	42.7	4.2	53.1	0.0
None	68.9	17.2	12.7	1.3	49.4	21.8	28.7	0.0	80.0	0.0	20.0	0.0				
Low	59.8	24.9	14.6	0.7	47.7	25.8	26.5	0.0	16.7	0.0	83.3	0.0	75.0	0.0	25.0	0.0
Medium	48.7	35.1	15.5	0.7	48.3	28.0	23.6	0.1	44.4	3.3	51.7	0.6	41.8	4.5	53.2	0.4
High	32.4	36.3	30.5	0.8	53.0	9.1	36.4	1.5	53.8	5.1	41.0	0.0	33.5	3.3	61.6	1.7

Source: Own computation based on the south African Demographic and Health Survey 1998

Note: The 1998 South African Demographic and Health Survey (SADHS) is a national two-stage stratified household survey and included approximately 12,000 women aged 15-49. It was designed principally to produce reliable estimates of demographic rates (particularly fertility and childhood mortality rates), maternal and child health indicators, and contraceptive knowledge and use for the country as a whole, the urban and the non-urban areas separately, and for the 9 provinces. Contraceptive use rates are calculated for women aged 15 to 49 by education level: none, low, medium and high; population group: African, Coloured, Indian and White; age groups: 15-23, 24-28, 29-33, 34-38,39-43,44-48,49-50; by geography urban, rural. None include all those with no education, low include all those up to grade 6 (standard 5), medium from grade 7 to 12 and high more than high school education.

Table A3: HIV prevalence rate, abortion rates, the number of doctors and nurses

Province	HIV prevalence rate	Abortion rates	Number of doctors	Number of nurses
Western Cape	0.107	0.13	153.1	309.8
Eastern Cape	0.066	0.07	30.7	180.2
Northern Cape	0.084	0.01	43.0	189.9
Free State	0.149	0.10	56.5	253.9
KwaZulu-Natal	0.117	0.15	54.4	191.8
North West	0.103	0.03	24.6	165.4
Gauteng	0.147	0.41	135.4	353.6
Mpumalanga	0.141	0.06	33.6	128.9
Limpopo	0.098	0.03	14.8	110.4
Total	0.114	0.13	64.7	214.8

Source: Human Science Research Council Survey/Nelson Mandela Survey, 2002-Department of Health 1997-2000.

Note: The Nelson Mandela/HSRC survey is a representative national household survey which consists of close to 10 000 households stratified by province and urban/rural. It is the first household based survey designed principally to produce estimates of HIV prevalence and to track, knowledge, attitudes and practices related to HIV. Respondents' specimens of oral transudate and the ELISA test was used to test nearly 8,500 participants in the survey. The overall response rate for the survey is 62.3%.