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Schooling, Marriage, and Childbearing in Madagascar

Peter J. Glick

Christopher Handy

David E. Sahn

CERDI
65 BD. F. MITTERRAND
63000 CLERMONT FERRAND - FRANCE
TÉL. 04 73 17 74 00
FAX 04 73 17 74 28
www.cerdi.org

Les auteurs

Peter J. Glick
RAND Corporation, USA

Christopher Handy
Cornell University, Ithaca, New York

David E. Sahn
Cornell University, Ithaca, New York, and Clermont Université, Université d'Auvergne, CNRS, UMR 6587, Centre d'Etudes et de Recherches sur le Développement International (CERDI), F-63009 Clermont-Ferrand, France
Email: David.Sahn@Cornell.edu (corresponding author)

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Abstract

We jointly model the determinants of educational attainment, marriage age, and age of first birth among females in Madagascar, explicitly accounting for the endogeneities that arise from modeling these related outcomes simultaneously. An additional year of schooling results in a delay of marriage by 1.6 years. Marrying one year later delays childbearing by 0.5 years. Parental education and wealth also have important effects on schooling, marriage, and childbearing ages. For example, the women's first birth is delayed by 0.75 years for four additional years of schooling of her mother.

JEL codes: I21, J12, J13

Keywords: education, marriage, fertility

1. Introduction

Low schooling attainment among and early marriage and childbearing are major policy concerns in developing countries. These factors may reduce the opportunities for women over their life course and potentially contribute to the inter-generational transmission of poverty. Early marriage can increase the probability of having children at a younger age and raise total fertility, which can contribute directly to health risks: the high rate of maternal mortality and morbidity, especially among young women and in Africa, remains an urgent development challenge. There is also considerable evidence that early childbearing reduces a woman's employment prospects. This phenomenon goes beyond the short-term costs of temporary disengagement from remunerative work during pregnancy and the post-partum period. The early disengagement from the labor market, or failure to establish labor market credentials, may persist across a woman's life course. (See Joshi and Schultz 2007; Kim and Aassve 2006; and Chun and Oh 2002.)

The role of education is likely to be crucial in this context. Staying in school may serve to delay marriage and childbearing. In addition to the potential health benefits this implies, later marriage can be expected to be associated with smaller age gaps with husbands. This may lead to greater equality within marriage (Engle 1997). And, of course, there are direct benefits to investing in the human capital of women, in the form of higher earnings and status. These in turn may also improve women's positions in the household. A significant body of research shows that women with more education and economic power (based on their actual or potential labor market opportunities) will have a stronger voice in household decision-making. (See Schultz 1990; and Thomas and Chen 1994.) One manifestation of women's power within the household is the direction of more resources for children's health and education (Haddad et al. 1997; Lam and Duryea 1999; Quisumbing and Maluccio 2003; Thomas 1990; and Thomas 1994). Additionally, there is considerable evidence for direct positive effects of women's education to the health outcomes of their children, controlling for income level (Caldwell 1979; Cochrane et al. 1980; Mensch et al.1985; and Rosenzweig and Schultz 1983).

Despite the considerations and evidence noted above, research in African contexts does not always find strong associations between completed education and age at marriage or parenthood. A number of studies of fertility find a negative schooling effect only at relatively high (e.g., secondary) levels of education (Younger 2006; Ainsworth et al. 1996; Thomas and Maluccio 1996). Studies that do find an overall positive effect of education on age at marriage, cohabitation, or parenthood tend to find larger effects at higher education levels (Gangadharan and Maitra 2001; Appleton 1996). One explanation for this, in the African context, is that levels of schooling are generally quite low, with many girls quitting school before childbearing would begin. In these situations, incremental increases in time in school may not impinge strongly on the timing of first birth.

In this study, we examine the relationships among female education, age of marriage, and first birth in Madagascar. Along all three dimensions, Madagascar fares poorly. Among women 30 to 40 years old, the median age at marriage is 19, the median age at first birth is 19.9, and the median education level is only five years. We estimate the impact of schooling on the timing of marriage and childbearing—a key but vexing issue for research in this area. We also investigate the impacts of programs and investments on these outcomes, focusing in particular on the roles of access to schooling and to family planning services. Finally, we

investigate the role of family circumstances and background, such as wealth, on schooling and age at marriage and childbearing.

These issues, of course, have been the subjects of a great deal of research, including for Africa specifically. A number of studies in Africa have used Demographic and Health Surveys (DHS) or other cross-section surveys to examine changes in age at marriage or age at childbearing (Mensch et al. 2005; Mahy and Gupta 2001) that generally found both ages to be rising. But discerning the reasons for these increases in ages at the household level is difficult, because these surveys lack (at least for women living in their own households) data on the characteristics of the women's parents and the communities in which they were raised.

In addition, almost all research considering the impact of education on marriage and childbearing treat schooling as exogenous to fertility (or marriage) decisions. This is a well-recognized problematic assumption. Young women (or their parents) with strong preferences for education and labor market success may have low preferences for a large, traditional family: in other words, schooling and marriage/fertility may be jointly determined, making it improper to infer causality from any (negative) association of the two outcomes. Marriage or early pregnancy may also directly impinge upon schooling; that is, there may be reverse causality in the education-marriage/fertility relationship.

Among the few exceptions that account for schooling endogeneity, Osili and Long (2008) use variation in exposure to Nigeria's universal primary enrollment policy to estimate the impact of schooling on fertility. Increasing education by one year reduces completed fertility by 0.26 births. In a non-African context, Brien and Lillard (1994) explain trends in Malaysia using a multiple equation framework similar to the one we will employ here. They find that higher educational attainment significantly reduces the hazard of marriage. Age at childbearing is also delayed, primarily through delayed marriage. Angeles et al. (2005a, 2005b) also estimate multiple equation models in analyses of Peru and Indonesia. They find that more education delays parenthood in Peru, and increases both the age at marriage and first conception in Indonesia.

In this study we use unusual data from Madagascar, the *Enquête sur la Progression Scolaire à Madagascar* (EPSPAM), to jointly model the relationships of schooling, marriage, and fertility among young women. One advantage of these data is that information—including completed schooling, age at marriage, and age at first childbearing—is gathered on all children under age 30 of household members, whether they live at home or not. In a context where early marriage and leaving home is common, this information is crucially important if one wants to understand the relationship of these outcomes to a woman's family background (including wealth). Second, the household survey is complemented by a richly detailed community survey that provides information on local school and health infrastructure. We use these variables among other methods to control for the endogeneity of schooling in models for marriage and childbearing.

2. Estimation strategy

We use an ordered probit to model completed years of schooling, and we use continuous-time hazard models to describe age at first marriage and age at parenthood. We estimate these equations jointly, and we explicitly account for the endogeneities that arise from modeling these related outcomes simultaneously. We will first outline the specification

of the three equations and then discuss the issues that arise and how our estimation strategy deals with them.

In each equation, we include rich detail about the family background of the young woman. This includes the years of education of each parent, parental mortality, an asset index formed using factor analysis,[1] and indicators of the location, religion, and ethnicity of the head of household. We control of a number of community characteristics, including province indicators; an urban indicator; the availability of electricity service, public water faucets, private water faucets, well water, and surface water; a remoteness index[2]; and transportation costs to the center of the nearest urban area. Each equation includes year of birth as a covariate, and the marriage and parenthood models include an age spline. In this way, basic duration dependencies and time effects are allowed for.

2.1 Completed schooling

We use an ordered probit model to estimate the determinants of educational attainment. The latent variable, *Educ**, has the following specification:

$$Educ^* = \alpha_0 + \alpha_1 Cohort + \alpha_2' School + \alpha_3' Health + \alpha_4' Parents + \alpha_5' Comm + \varepsilon^s$$

For individuals who have completed their schooling, we observe $Educ = s$, where $s \in \{0,1...,17\}$ is the number of completed grades. For individuals still in school, we observe, $Educ \geq s$, where *s* is the number of completed grades at the time of the survey.

Our data includes rich information about the primary school closest to the center of the community, and we use two indices to summarize much of this information. We use factor analysis to create a pedagogy index that includes information on blackboards per student, textbooks per student, and an indicator of whether the school has a library. The facilities index is likewise formed from factor analysis on indicators of the availability at the school of electricity, medicine, toilets, separate toilets, recreation grounds, and clean water.

In addition to these indices, we include information on whether the school is private, the school director's years of education and experience, the proportion of teachers who have a teaching degree, and the proportion of teachers with at least five years of experience. For secondary school, we have information on if there is a collège (junior secondary, grades 6–9) in the community and, if so, when it opened. We include an indicator of whether there was a secondary school in the community when the girl was age 8, to capture in a time varying fashion the accessibility of secondary school. A secondary school close to home may act as a powerful incentive for enrolling and staying in school, given the costs (transportation or boarding, and loss of domestic labor) of enrolling a daughter at a distant secondary school. It is also possible that there is a demonstration effect operating; it is not just that the costs of continued education are lower when there is a secondary school in the community, but that there may be a greater recognition of the benefits of attending secondary school, which in turn encourages primary school enrolment and continuation.

[1] For more details on the construction and appropriate use of the asset index, see Sahn and Stifel (2003).
[2] The remoteness index is obtained by factor analysis on community distances to health services, banks, post offices, schools, taxis, courts, markets, inputs, extension services, and veterinarians, as well as access to national and provincial roads, utilities, media and other markets, and several measures of access to transport.

We include three indicators of the presence of nutrition programs in a girl's school or community. One is an indicator for the presence in school of Seecaline, a government sponsored community- and school-based nutrition program. It broadly targeted the health and nutrition of pregnant and lactating women and children under 3 years of age in the community, as well students 6–14 years of age. In the case of community-based program, it included growth monitoring, micronutrient supplementation, take-home supplementary feeding for the undernourished, referral of severe cases for therapeutic feeding and intensive care, as well as counseling on child feeding and nutrition education. The school-based portion of the program was intended to reduce the prevalence of anemia and helminthic infection, and included teacher training, iron supplementation every three months, deworming every six months, nutrition education, personal and environmental hygiene. The other two nutrition variables are indicators of the presence of any child nutrition program in the community at birth and at age 10. The availability of these services potentially improves health and thus the potential returns to education, and also acts as an incentive to increase enrollment and remaining in school.

The main concern with including information on the presence of these programs in the community is that its rollout was not randomized. As such, there is the possibility of endogeneity of program placement, suggesting caution in any causal interpretation of the relationship between the presence of a program and the outcomes of interest. To address endogenous program placement, we attempted to predict the presence of these health programs using the method of Pörtner et al. (2011). In a study of the effects of family planning availability on completed fertility, they note that most community characteristics are unlikely to meet the instrumental variables exclusion restriction; but the within-country *ranks* of some community characteristics may plausibly affect government program placement decisions while having no direct effect on fertility. We attempted to predict program presence using ranks of population, remoteness, and transport and shipping costs from the 2001 Madagascar commune census, but did not find any sufficiently strong predictors. This could indicate that program introduction is somewhat random, but we do not put much weight on the estimated effects. Instead, the health program data (in all three equations) serves primarily as control variables.

2.2 Marriage

We model the timing of marriage decision as a continuous time hazard. Specifically, we estimate the following model:

$$\ln h^m(t) = \beta_0 + \beta_1 Cohort + \beta_2' Age(t) + \beta_3 Educ(t) + \beta_4' OOS(t) + \beta_5' Health(t) +$$

$$\beta_6' Parents(t) + \beta_7' Comm + \beta_8' SexRatio + \beta_9' MarrShare + \varepsilon^m$$

We assume that a young woman becomes at risk of marriage beginning at age 12. The variable *Educ(t)* gives the completed years of schooling at time *t*. Unlike most related studies, we have detailed grade repetition information so that we do not have to assume that each grade completed took one year in school, an important consideration in a context where primary grade repetition is common. On average, the individuals in our sample took about three years to complete two grades. Having information on actual years in school allows us to also account for the time since leaving school, not just completed schooling. *OOS(t)* is a spline function for years since stopping schooling and thus allows the marriage hazard to vary

in a flexible way depending on time out of school. The spline includes nodes at three and six years after leaving school.

The variable *Nutrition(t)* is a time-varying indicator of the presence in the community of child nutrition programs at time *t*, as in the schooling model. In addition to the family background characteristics detailed at the beginning of this section, we include in the vector *Parents* information about the age at marriage and age at parenthood of both parents. By doing so we further control for parental characteristics and preferences that may affect marriage choices of their children and thus reduce the potential for unobserved heterogeneity affecting the estimates. We include two sets of variables describing marriage market characteristics within the young women's communities. These variables are calculated for individuals from five years younger than the women to 20 years older.[3] We choose these bands because women are almost certain to marry a man within that relative age range. The first characteristic is the ratio of men to women within the cohort. Since the nature of marriage markets may be different in rural and urban areas, we use two indicators: *ruralSR* for individuals in rural communities, and *urbanSR* for urban communities. The second characteristic is marriage shares. We include the share of women in the cohort married less than five years and the share of women in the cohort married between five and ten years. This latter variable captures information on marriage norms and practices. Both shares are calculated as of the survey date and are calculated after excluding the woman herself.[4]

2.3 Parenthood

The age at first parenthood model is very similar to the marriage timing model. We estimate the following continuous time hazard model:

$$\ln h^p(t) = \gamma_0 + \gamma_1 Cohort + \gamma_2' Age(t) + \gamma_3 Educ(t) + \gamma_4' MarDur(t) + \gamma_5' Health(t) + \gamma_6' Parents(t) + \gamma_7' Comm + \varepsilon^p$$

We assume that a young woman becomes at risk of parenthood beginning at age 12. The variable *Educ(t)* gives the completed years of schooling at time *t*. The parenthood model includes the duration of marriage, as well as information on schooling, to capture the key relationships of interest. The spline *MarDur(t)* allows the parenthood hazard to depend flexibly on the duration of marriage. The spline includes nodes at three and six years after marriage.

The vector *Health(t)* includes the child nutrition program indicator discussed above in the marriage model, as well as indicators of the availability of birth control and the presence of family planning programs in the community at time *t*. We attempted the same prediction method for these variables as discussed for the nutrition variables in the school model. Here, too, the health variables should be interpreted as controls. Also, as in the marriage model, we include in the vector *Parents* information about the age at marriage and age at parenthood of both parents, in addition to the background characteristics listed at the beginning of the section.

[3] We explored several different age ranges (for example, using 10, 15, or 25 years older) to define the cohort that defines the potential marriage market. The results are robust to these options.
[4] We experimented with other plausible age bands, and the results were robust to different specifications.

2.4 Estimation and endogeneity

Following Brien and Lillard (1994), estimation of the joint model relies on the independence of outcome probabilities conditional on the vector of heterogeneities. This allows the conditional outcome probabilities to be multiplied to form the joint conditional (on heterogeneities) likelihood. Integrating the joint conditional likelihood over the range of the heterogeneity components forms the joint marginal likelihood. Estimates are achieved by maximizing the joint marginal likelihood.[5]

In the estimations presented here, we assume that each of the heterogeneity terms—ε^s, ε^m, and ε^c—is normally distributed with a mean of zero and a standard deviation to be estimated. As in Brien and Lillard (1994), these heterogeneity terms are drawn at the household level, reflecting the fact that sisters are likely to share many unobservables. We assume that conditional on this shared family component, the outcomes of sisters are independent. Of 1,343 households in our sample, 696 have one girl in the sample, 400 have two girls, 168 have three girls, and the remaining 79 households have between four and seven girls. To estimate the heterogeneity distributions, we use Gauss-Hermite Quadrature with ten points of support in single-equation models and six points of support in the joint model.

The most serious concern about the validity of our estimates is endogeneity of several key explanatory variables. To make the discussion concrete, we can focus on the potential for education to be endogenous in the marriage model. For example, parents with unobserved preferences for employment success among their children may favor both more education and delayed marriage. Similarly, "career-minded" young women may be those with strong preferences for rewarding work and low preferences for traditional family life. In this case, the bias arises through correlation between years of education and the heterogeneity component of the marriage hazard. That correlation occurs because education is itself a decision partly based on unobservable factors such as the preferences described above.

In the foregoing example, the heterogeneity terms in the education and marriage models will have a negative correlation, due to an increased propensity for education and a reduced hazard of marriage. As Brien and Lillard (1994) argue, one can address this consequence directly by allowing for correlation of heterogeneities across equations in our joint model.

We use exclusion restrictions and time-varying exogenous variables to strengthen identification. Our exclusion restrictions consist of using the detailed primary school data in the schooling equation, but not in the marriage and parenthood equations, and using the sex ratio and marriage share variables described above only in the marriage equation, and using the birth control and family planning indicators only in the parenthood equation. An advantage of using these community-level variables is that it allows us to avoid making any exclusion restrictions based on household-level covariates that are more likely to be endogenous to the outcomes of interest.[6] Not all authors who have done similar work have had this luxury of such extensive community-level data. For example, in Brien and Lillard the

[5] To perform the estimation, we used aML, now free software developed by Lee Lillard and Constantijn Panis to estimate very general multiprocess and/or multilevel models.

[6] In contrast, Brien and Lillard (1994) exclude father's occupation and income from the fertility model to aid identification.

only community-level variable common to all equations is an urban indicator, so there is a concern that household-level variables used for exclusion restrictions are correlated with observed or unobserved household or community characteristics that are not controlled for in the other equations. While all community-level exclusion restrictions suffer this risk, we are able to lessen it by including province and urban indicators, several health program variables, and a vector of detailed infrastructure controls in all three equations.

Further, Angeles et al. (2005a) describe how over-identification can be obtained in dynamic models by exploiting time variation in exogenous variables. This is important in their context because of the relative lack of individual-level information available in their data, which could be used to make plausible exclusion restrictions. They rely heavily on time variation in student-teacher ratios, government expenditures, regional income per capita, and health program availability. They use no exclusion restrictions on exogenous variables to distinguish the marriage and fertility outcomes. Even though we employ plausible exclusion restrictions as just described, we also use time-varying covariates, as in Angeles et al. (2005a). These include the health and nutrition programs, father's and mother's mortality, and community electricity service. (As discussed above, we include a number of indicators in the schooling model intended to capture changes over time, but the model itself is static.)

In some cases in our joint model, we appear to include multiple endogenous variables on the right hand side of a particular equation. For example, we include a marriage duration spline in the parenthood hazard, which, with an intercept and one node, necessitates estimating three parameters on terms that are related to the marriage outcome. However, the intercept term in the marriage duration spline acts as an indicator of marriage. Conditional on the inclusion of this term, which fixes the timing of the spline, the remaining terms are exogenous.

3. Data

We use the data from the *Enquête sur la Progression Scolaire à Madagascar* (EPSPAM) which was conducted by the Malagasy Ministry of Education (MENRS), the Malagasy National Institute of Statistics, and Cornell University in 2004–2005. The main survey instrument of EPSPAM is the household survey of 2,100 households in 73 communities. For each household, we have detailed data on the number and characteristics of all the household members, including on educational outcomes, as well as related information such as household wealth and assets and detailed demographic information. Although the survey covered all the regions in Madagascar, it cannot be strictly considered as nationally representative of all households in Madagascar. The reason is that the sample design involved returning to 48 randomly selected communities that were initially part of a larger education study, the 1998 PASEC (Programme d'Analyse des Systemes Educatifs de la CONFEMEN), conducted in 1998 in 120 clusters (defined by the catchment areas of the primary school in which the tests took place).[7] The sampling design was further adjusted to account for an important issue that the median size of the 1998 PASEC primary schools was greater than the typical school in Madagascar. That is, in the 1998 study, the choice of schools was dictated in

[7] Our motivation for re-surveying the original PASEC villages was related to another paper that looks at the impact of early school performance on subsequent attainment and cognitive outcomes. The sample in that paper, however, is limited to children who were initially enrolled in the school-based sample. In this paper, we are interested in looking at the cognitive skills of all children, regardless of whether they were ever enrolled, and regardless of where they attended early primary school.

part by the requirement that each school have at least 20 students in both the 2nd and 5th grades. Given high dropout rates and small overall school size, many schools, especially in remote rural areas, do not have 20 children in the 5th grade.[8] Given the desire to obtain a more general understanding of education behaviors as well as the impacts of recent policies, we therefore supplemented our 48 clusters with an additional randomly selected 12 clusters from small rural communities with small primary schools. "Small" was defined as a school having fewer students than the national median of about 140. These additional schools were randomly selected from the list of schools in the MENRS database after stratifying on province.

The EPSPAM survey defined a community as the catchment area for a primary school. It collected information on all nearby schools of any level, and if no lycée was in the community, for example, it asked the distance to the nearest such school. While almost the entire sample has a nearby primary school, the secondary schools can be very far away, especially in rural areas. The average distance to a collège is about one kilometer among urban residents, but rises to nearly eight kilometers among rural residents. Urban residents are on average 10 kilometers from the nearest lycée, while rural residents are on average over 40 kilometers away.

The community- and school-level data collected consisted of information on the nature and characteristics of existing infrastructure. This included the experience and credentials of the principal and management of the school, as well as the number of teachers, their qualifications, and pedagogical practices, and building and classroom conditions. In total, 140 schools were interviewed in the 73 clusters (i.e., communities) where the survey was conducted. These are used as control variables in the analysis that follows. In addition we have information about the availability of family planning services, the availability of contraceptive devices, and child nutrition information, all of which was collected as part of the community survey. In each community, it was determined whether each service type was available and, if so, when it first became available.

As noted in the Introduction, the survey also collected information on children of the head of household who live outside the household and are younger than 30, and we include these individuals in our sample. This is important because many young women leave home relatively earlier, typically for marriage, so that the sample living at home in the age range studied would be highly self-selected.

The actual sample used in our analysis consists of 2,686 females between 12 and 25 years of age. All results are weighted to correct for the non-representative design of the survey (see Glick et al. 2005). Descriptive statistics for variables used in this paper are reported in Table 1 and indicate that 18 percent of the sample is married, and 17 percent are parents. About 30 percent of the 18-year-olds in our sample are married, and about one quarter are parents. At the time of the survey, the legal marriage age was 14 for girls and 17 for boys, but many children marry before these ages, especially in rural areas where traditional marriage ceremonies are common. Giving birth before marriage is not very common, occurring for only five percent of our sample.

[8] Given the objective of following up on children in the original PASEC communities for our other paper mentioned above, there were obviously limits on what could be done to address the issue while still achieving the main study objective.

Women in the sample have an average of 5.7 years of schooling, although, just over one-half of the women are still in school. Thus, mean completed school among this cohort will be higher. Even so, this number is higher than their mothers whose education levels average 4.8 years; fathers have more education, averaging 5.5 years. Not surprisingly, the previous generation tended to marry and have children earlier: mothers of women in our sample on average married at age 19.8 years and had a child at age 21.

4. Results

We next turn to a discussion of the results of the education, marriage, and fertility models in Table 2.

4.1. Education

A girl's family background has strong impacts on her school attainment. Education of the mother and father increases years of schooling. Given the non-linearity of the ordered probit, the parameters of the model are not equal to comparative static effects, that is, the change in the probability of continuing in school resulting from a change in an independent variable. Table 4 presents the marginal effects of key covariates on the probabilities of achieving completed primary and lower secondary (collège) school. The effects of the father's and mother's educations are quite similar. An additional year of maternal education increases the likelihood of a girl completing lower secondary school by 2.3 percentage points, while the impact of an additional year of father's education contributes 1.6 percentage points. This implies that relative to having no education, completed primary schooling of the mother (5 years) increases the probability of primary completion by 11.5 percentage points (though this should be regarded as approximate because this is not a marginal change in the covariate). In a context where female primary completion is still low (just 57 percent among women ages 30–40), this is a large impact.

Household assets also have expected positive impacts. More specifically, our calculation of the marginal effects indicates that a one standard deviation increase in the asset index contributes to an 8.9 percentage point increase in the probability of completing primary school and an 11.2 percentage point increase in the likelihood of completing lower secondary school.

Dummy variables are included to capture the religion of the household. Those who report following a traditional religion have lower school attainment than the omitted category of being Protestant, but there is no difference between being Protestant and Catholic, the two largest categories. Among the ethnic dummies, the one for the Betsileo is positive and significant, indicating that educational achievement is statistically greater in that group than all others in Madagascar. We also enter into the model indicator variables that capture whether or not the father and mother were no longer alive by the time the girl reached age 5 and age 10, respectively. Results indicate that the death of a mother before her daughter turned 10 years of age is associated with a 18.1 reduction in the probability of completing primary school.

Among the schooling infrastructure and community characteristics, we find that years of schooling is positively associated with attending a private primary school. We also find

that the presence of a school-based health program, Seecalene, increases schooling duration. All else equal, exposure to Seecalene raises the probability of completing primary school by 11.9 percentage points (Table 4).

We control for province, and add an indicator to capture whether the household resides in an urban area. The omitted province is Antananarivo, the home to the capital. Conditional schooling attainment is lower in Toliara, but not significantly different among the other provinces relative to the capital. The urban dummy is negative, but also not statistically significant.

Estimates for the characteristics of the major primary school in the village suggest overall that there are positive impacts of aspects of quality on school attainment of girls. There is a positive and significant impact of the proportion of the teachers holding a teaching degree on schooling attainment, with our simulations indicating that a 10-percentage point increase in the share of teachers with a teaching degree in the school will increase the probability of completing primary and lower secondary school by 5.9 and 7.4 percentage points, respectively. Similarly, a 10-percentage point increase in the proportion of teachers with more than five years of experience leads to 3.7- and 4.6-percentage point increases in the probability of completing primary and secondary school, respectively.

The education of the school director is not significant, but the director's years of experience is negatively and significantly associated with years of schooling. While this seems counterintuitive, it is possible that long-standing and entrenched school directors are less creative, energetic, and motivating than their younger counterparts. We also use factor analysis to create school classroom facilities and school infrastructure indexes. In the former, we include information on the presence of blackboards per student, textbooks per student, and the presence of a library. This index is positive and significant. The facilities index, which includes the presence of electricity, toilets, separate toilets for boys and girls, a recreation facility on the school grounds, and access to clean water and some basic health services, is not significant.

As noted, there is concern that the school characteristics are capturing the effect of the wealth or other characteristics of the village or urban community that positively affect schooling, so that community heterogeneity is driving the results. While we cannot rule this out, we take advantage of two sources of information to include a range of community controls that should at least partially deal with this problem. The first is a commune census that was conducted separately from our survey in 2001 in over 1385 of the 1395 communes in Madagascar.[9] From this survey, we include two variables—the first is a remoteness index, and the second is an index that captures transport costs. The second source of community covariates is the community survey that was conducted in concert with the household survey. Included are indicators variables for the presence of various types of water sources—public water faucets, private water faucets, well water, and surface water—in the community at the time of the survey. We also include an indicator for whether or not there was electricity in the community, as well as child nutrition information—both when the individual was born and at age 10. Some of these parameters are significant in the education and other models; for example, the availability of nutrition information when the child was born has the expected

[9] The variables in the census are designed to capture the level of development, overall characteristics of the commune, public services, physical and socio-economic infrastructure, production and insecurity risk, agricultural production and livestock, transport, social capital, and welfare. More information and the full data set can be found at http://www.ilo.cornell.edu.proxy.library.cornell.edu/ilo/data.html.

positive effect (unlike when the child turns 10 years of age). Likewise, the more remote the region, as measured by the index, the lower the predicted level of education. However, we include these as controls, and caution is required in their interpretation.

4.2 Marriage

Turning next to the marriage hazard model, we focus first on the role of the young woman's education. The statistically significant parameters on the hazard function indicate that there is an increasing instantaneous probability of marriage from 12–19 years of age, and thereafter, the instantaneous probability actually declines.[10] Our main interest, however, is in the effects of schooling, and following Brien and Lillard, we include both the years of education and the related variables that capture years out of school.[11] These enter as a spline, where the slopes on the years out of school differ for 0 to 3 years, 3 to 6 years, and beyond 6 years out of school. These parameters, all of which are statistically significant at the 1 percent level, combined with the normal life course progression captured separately by the age splines, affect the timing of marriage. To better understand the complex impacts of completed education level and the timing of leaving school, we simulate the effects of two additional years of completed education in the survivor function in Figure 1. These simulations incorporate the related changes in years out of school that would be impacted by staying in school longer. We see from the baseline marriage survival function that there is a very low hazard of marriage for young women, especially below age 16. This changes rapidly around the time that most girls are leaving school, as approximately half the women are married by around age 21, and 80 percent married within the next five years. More education also contributes to a lower hazard of marriage, as can been seen in the survivor functions. Simulations indicate that two more years of schooling of women results in an increase in the median marriage survival time of 3.2 years (Table 5).

As expected, the asset variable, which is statistically significant at the 1 percent level in the models, indicates that wealth contributes to a decline in the hazard of getting married (Table 2). To get a more complete picture of the impact of assets, we simulate a one standard deviation increase in assets. In doing so, we take into account the indirect effect of higher assets on the individual's years of education, not just the partial effects that are represented in the parameter estimates in the marriage model in Table 2. The marriage survival function indicates that, for example, the predicted change in the median survival time as a consequence of a one standard deviation increase in assets is 3.1 years (which can be read off the graph in Figure 2 as the horizontal distance between "Baseline" and "Simulated" in the survival function). These are clearly economically meaningful impacts.

As expected, the marriage hazard is reduced by more education of the mother and father. Figure 3, which again takes into account the total jointly determined effect of parental education, including how it works through the women's schooling, indicates that an increase of 4 years of schooling by the mother would increase the median time to marriage by 1.5 years, versus 0.7 years for the effect of father's education. We also note that the dummy indicating that the women's mother died reduced the hazard of marriage. This may occur because the daughter assumes her mother's roles and responsibilities in home production,

[10] Note that there is an additional parameter that captures the hazard at 12 years of age. This is actually acting as an intercept term.

[11] Years of education actually fully determines the "zero date" for the out of school spline, so, we do not have a problem with endogeneity of these variables conditional upon including years of education.

which could contribute to delays in marriage. Supporting this interpretation is the absence of any such effect for father's death. In terms of other individual characteristics, there are no significant differences in marriage hazards across religious groups, and few impacts of ethnicity on the hazard of marriage, with the clear exception of Merina.

A final set of parameters includes two types of community-level indicators designed to capture local marriage markets (availability of potential partners) and customs, described in Section 2. The within-group (5 years younger to 20 years older) ratios of unmarried men to unmarried women at the time the individual was 12 (that is, the first period of observation for the marriage hazard) are not statistically significant. However, there are large effects associated with marriage behavior among within-group females (again, 5 years younger to 20 years older). The hazard of marriage increases markedly with the share of women in the cluster that are married. To provide some sense as to magnitude of these effects, we find that an increase in the share of women married less than 5 years of 10 percentage points (from about 0.1 to about 0.2) is associated with a decrease of three-quarters of a year in median survival time (although this share variable is not significant in the model). A 10-percentage point increase in the share of women in the cohort married 5 to 10 years is associated with a decrease of median survival time of 1.5 years. We take this in part to reflect social norms and attitudes toward the age of marriage. Indeed, eventually almost all women in Madagascar marry, but the timing differs. So, controlling for the age of the women, the share married in their community captures the extent to which women have already entered into marriage, and thus represents important underlying characteristics of the marriage market in terms of timing. The results could also be capturing unobserved community characteristics, such as economic opportunities, that affect community-level cohort-specific marriage rates and the individual time to marriage, despite the inclusion of a large number of controls, including those such as the remote index, which has the expected effect of increasing the hazard of early marriage.

4.3 First birth

We next consider the determinants of age at first childbearing. The coefficients on age suggest that the hazard of conception increases across the entire relevant range of 12–26 years, although, the rate of increase in the hazard falls after 19 years of age. We also consider how the time since marriage affects the timing of first birth, by entering a spline for the years since marriage. The positive and significant effect of being married for 0–3 years, and negative and significant parameter estimate on being married 3–6 years, indicate that the hazard of having a first birth increases with time during the first three years of marriage, and thereafter, the hazard decreases. To help interpret these significant parameter estimates, we present the simulated hazard and survivor function in Figure 4. The interpretation is that, for example, a delay of marriage by one year is associated with an increase in the median time to parenthood of 0.5 years. This is seen by reading off the horizontal distance between the baseline and simulated survival probability at the median survival time (i.e., 0.5).

The coefficient on the asset index is negative and statistically significant, indicating that greater wealth increases the time to first birth (Table 5). A one standard deviation increase in assets is associated with an increase in the time to first birth of 2.2 years,

somewhat less than the effect of assets on the timing of marriage.[12] Education of the mother and father delays first birth as well. The magnitude of the effect of father's education is again smaller than for mothers; in the case of the former, four additional years of schooling is associated with an increase in the age of parenthood by 0.5 years, and in the case of mothers, 0.75 years. It should be noted once again that this is the total effect, and includes the indirect effects through the influence on education and marriage. Interestingly, the hazard model also indicates that the individual's own education does affect the hazard directly, and when we simulate the total impact, we observe that two additional years of education are associated with first childbirth that is 1.6 years later.

In the first birth models we have added additional covariates on the availability of family planning services as well as contraceptive devices. We find none of them to be statistically significant.

4.4 Heterogeneity correlations

Table 3 presents the heterogeneity standard deviations and correlations for the joint model reported in Table 2. Each of the correlations is statistically significant, indicating that dealing with endogeneity is very important. As expected, the heterogeneity correlation between schooling and both marriage and parenthood is negative: individuals who tend to attain more schooling also tend to marry later (lower marriage hazard) and have a later first birth (lower parenthood hazard). As we discussed above, this is consistent, for example, with preferences for labor market success among some of the sample. Also as expected, the heterogeneity correlation between marriage and parenthood is positive: individuals who tend to marry later also tend to have a later first birth.

5. Conclusions

The relationships of women's age of marriage, first birth, and education is complex, and these outcomes are jointly determined. In this paper, we attempt to provide new insights into these relationships, with a particular focus on the role played by increases in years of schooling on the timing of marriage and childbearing. We use techniques that allow us to deal with the endogeneities that arise from modeling these related outcomes simultaneously. In addition to the relation of education to marriage and childbearing, we investigated the impacts of access to schooling and to family planning services on these outcomes, and the role of family background.

Our results confirm that additional schooling delays marriage and the start of childbearing among women. An additional year of education results in a sizable delay of marriage of approximately one and a half years and also contributes to delays in first birth of about half a year. Schooling of the mother also has impacts controlling for family assets, with an additional year of maternal schooling increasing a young woman's age at marriage by about a one-fourth the amount of an additional year of own schooling. We also find important effects of family wealth on marriage and fertility. For example, a one standard deviation

[12] As with the marriage model, these simulations capture the total effects of assets, including the indirect effect operating through the impact of assets on education and marriage.

increase in the asset index results in a woman marrying nearly 3 years later and having a first birth nearly 2.5 years later.

While the direction of the impacts of own education is not surprising, the large magnitudes are particularly noteworthy. Our results add to the very limited literature that methodologically addresses the endogeneity of schooling to marriage and fertility decisions. These robust results have clear a policy implication: interventions that increase the time in school for girls will delay marriage and the start of parenthood.

Further, the findings for parental schooling impacts on daughter's education and the timing of marriage and fertility reported in this paper confirm the presence of important positive intergenerational impacts of investments in education. Finally, we also identify various school characteristics that contribute to greater attainment. These include the quality of facilities in the classroom, as well as the qualifications of the teachers. Additionally, the relative geographical accessibility of secondary schools, as well as the availability of private as well as public primary school alternatives, contribute to greater attainment and thus, to later marriage and fertility.

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Table 1
Descriptive statistics

	Mean	Standard deviation
Personal characteristics		
Birth year (cohort)	1986	3.70
Age at survey	17.30	3.73
In school at survey	0.56	0.50
Years of education at survey	5.71	2.62
Married at survey	0.18	0.38
Parent at survey	0.17	0.38
School characteristics		
Private	0.30	0.46
Seecaline	0.45	0.50
Director years of education	11.09	2.09
Director experience	10.03	8.70
Proportion of teachers with teaching degree	0.52	0.32
Proportion of teachers more than 5 years experience	0.70	0.28
Pedagogy index	-0.03	0.46
Facilities index	-0.01	0.77
Secondary school in community at age 8	0.85	0.36
Secondary school in community at age 14	0.88	0.32
Health program exposure		
Birth control in community at age 0	0.05	0.21
Birth control in community at age 10	0.16	0.37
Birth control in community at survey	0.37	0.48
Family planning info in community at age 0	0.06	0.24
Family planning info in community at age 10	0.28	0.45
Family planning info in community at survey	0.65	0.48
Child nutrition info in community at age 0	0.03	0.16
Child nutrition info in community at age 10	0.14	0.35
Child nutrition info in community at survey	0.65	0.48
Parent characteristics		
Asset index	0.10	0.97
Father's years of education	5.52	3.72
Missing	0.06	0.24
Father died before girl age 5	0.01	0.12
Father died before girl age 10	0.04	0.19
Father died before survey	0.08	0.27
Father age at marriage	25.43	5.25
Missing	0.40	0.49
Father never married	0.02	0.15
Father age at parenthood	26.10	5.68
Missing	0.29	0.46
Mother's years of education	4.81	3.35
Missing	0.04	0.20
Mother died before girl age 5	0.01	0.07
Mother died before girl age 10	0.01	0.12
Mother died before survey	0.03	0.18
Mother age at marriage	19.81	3.93

Missing	0.28	0.45
Mother never married	0.04	0.20
Mother age at parenthood	20.93	5.15
Missing	0.17	0.38
Religion		
Traditional	0.10	0.30
Catholic	0.38	0.49
Protestant	0.41	0.49
Other	0.11	0.31
Ethnicity		
Antandroy	0.07	0.25
Betsileo	0.18	0.39
Betsimisaraka	0.11	0.31
Merina	0.25	0.43
Tsimihety	0.07	0.25
Other	0.32	0.47
Community characteristics		
Urban	0.29	0.46
Province		
Antananarivo	0.21	0.41
Fianarantsoa	0.25	0.43
Toamasina	0.18	0.39
Mahajanga	0.13	0.33
Toliara	0.13	0.34
Antsiranana	0.10	0.30
Electricity in community at age 0	0.25	0.43
Electricity in community at age 10	0.32	0.47
Electricity in community at survey	0.37	0.48
Public water faucet	0.49	0.50
Private water faucet	0.25	0.43
Well water	0.58	0.49
Surface water	0.73	0.45
Remoteness index (1=least remote; 5=most remote)	2.38	1.29
Transportation cost (10,000 FMG)	5.31	6.18
Marriage market (within cohort)		
Rural sex ratio	1.11	0.24
Urban sex ratio	0.99	0.12
Share women married less than 5 years	0.11	0.05
Share women married 5 to 10 years	0.09	0.04

Table 2
Joint estimation

	Schooling	Marriage	Parenthood
Personal characteristics			
Constant	-247.44 ***		
	(19.35)		
Birth year (cohort)	0.13 ***	0.11 ***	-0.07
	(0.01)	(0.03)	(0.05)
Age spline			
Age 12 intercept		-231.89 ***	128.12
		(69.98)	(99.64)
Age 12-14.8 slope		1.00 *	1.35 ***
		(0.53)	(0.66)
Age 14.8-17.6 slope		-0.50 ***	1.16 ***
		(0.15)	(0.18)
Age 17.6-20.4 slope		-0.19 *	0.23 *
		(0.11)	(0.13)
Age 20.4-23.2 slope		-0.35 **	0.29 *
		(0.17)	(0.18)
Age 23.2-26 slope		-0.33	-0.40
		(0.38)	(0.51)
Endogenous outcomes			
Years of education		0.46 ***	0.01
		(0.09)	(0.08)
Out of school spline			
0-3 years		0.082 ***	
		(0.12)	
3-6 years		0.33 ***	
		(0.11)	
6+ years		0.40 ***	
		(0.09)	
Marriage duration spline			
0-3 years			2.03 ***
			(0.18)
3-6 years			-1.94 ***
			(0.64)
6+ years			1.53
			(1.09)
School characteristics			
Private	0.57 **		
	(0.23)		
Seecaline	1.19 ***		
	(0.09)		
Director years of education	0.02		
	(0.03)		
Director experience	-0.02 ***		
	(0.01)		
Proportion of teachers with teaching degree	0.59 **		
	(0.28)		
Proportion of teachers more than 5 years experience	0.37 *		
	(0.21)		

Pedagogy index	0.98 ***		
	(0.15)		
Facilities index	-0.10		
	(0.08)		
Secondary school in community at age 8	-0.10		
	(0.13)		
Health program exposure			
Birth control in community (time-varying)			0.49
			(0.34)
Family planning info in community (time-varying)			-0.02
			(0.31)
Child nutrition info in community at age 0	0.70 *		
	(0.39)		
Child nutrition info in community at age 10	-0.31 **		
	(0.15)		
Child nutrition info in community (time-varying)		0.32 *	0.21
		(0.19)	(0.24)
Parent characteristics			
Asset index	0.89 ***	-0.43 ***	-0.46 *
	(0.07)	(0.14)	(0.27)
Father's years of education	0.16 ***	-0.02	-0.05
	(0.01)	(0.03)	(0.05)
Missing	-0.11	0.86 **	1.39 **
	(0.12)	(0.44)	(0.59)
Father died before girl age 5	0.20		
	(0.38)		
Father died before girl age 10	0.24		
	(0.30)		
Father died (time-varying)		-0.20	1.08
		(0.59)	(0.70)
Father age at marriage		-0.03	0.03
		(0.02)	(0.04)
Missing		-0.05	1.25
		(0.49)	(0.86)
Father never married		-0.40	-1.66 **
		(0.53)	(0.75)
Father age at parenthood		0.03	0.00
		(0.02)	(0.04)
Missing		-0.40	-1.60 *
		(0.60)	(0.94)
Mother's years of education	0.23 ***	-0.01	0.00
	(0.01)	(0.04)	(0.06)
Missing	-0.68 ***	-1.63 ***	-0.60
	(0.17)	(0.49)	(0.68)
Mother died before girl age 5	0.40		
	(0.67)		
Mother died before girl age 10	-1.80 ***		
	(0.56)		
Mother died (time-varying)		-1.04 **	0.23
		(0.48)	(0.65)

Mother age at marriage		0.00	0.02
		(0.03)	(0.04)
Missing		0.17	-1.18
		(0.48)	(0.84)
Mother never married		-0.54	0.13
		(0.53)	(0.80)
Mother age at parenthood		-0.01	-0.01
		(0.02)	(0.04)
Missing		1.75 ***	2.36 **
		(0.60)	(0.93)
Religion			
Traditional	-0.69 ***	0.41	0.26
	(0.17)	(0.28)	(0.47)
Catholic	0.12	-0.01	0.29
	(0.09)	(0.19)	(0.31)
Other	-0.20	0.05	0.29
	(0.17)	(0.28)	(0.57)
Ethnicity			
Antandroy	1.26 ***	0.21	-0.12
	(0.22)	(0.45)	(0.67)
Betsileo	0.56 ***	0.15	0.07
	(0.16)	(0.31)	(0.51)
Betsimisaraka	-0.84 ***	0.46	0.46
	(0.19)	(0.35)	(0.62)
Merina	-0.31 *	0.87 **	0.82
	(0.18)	(0.37)	(0.62)
Tsimihety	-0.02	0.22	-0.40
	(0.22)	(0.36)	(0.61)
Community characteristics			
Urban	-0.07	0.19	0.36
	(0.18)	(0.36)	(0.59)
Province			
Fianarantsoa	-0.28	0.31	0.66
	(0.24)	(0.46)	(0.73)
Toamasina	-0.02	0.21	0.35
	(0.23)	(0.46)	(0.72
Mahajanga	-0.97 ***	0.77	0.50
	(0.26)	(0.52)	(0.75)
Toliara	-0.08	0.67	1.60 **
	(0.23)	(0.45)	(0.72)
Antsiranana	0.25	0.89	2.48 ***
	(0.25)	(0.55)	(0.84)
Electricity in community at age 0	-0.18		
	(0.14)		
Electricity in community at age 10	0.47 ***		
	(0.16)		
Electricity in community (time-varying)		-0.07	-0.04
		(0.28)	(0.38)
Public water faucet	-0.24 **	-0.07	-0.09
	(0.11)	(0.21)	(0.36)

Private water faucet	-0.96 ***	0.15	0.33
	(0.23)	(0.41)	(0.71)
Well water	0.80 ***	-0.05	0.12
	(0.16)	(0.27)	(0.44)
Surface water	-0.35 ***	-0.06	-0.50
	(0.13)	(0.22)	(0.37)
Remoteness index (1=least remote; 5=most remote)	-0.21 ***	0.21 **	0.24
	(0.06)	(0.10)	(0.17)
Transportation cost (10,000 FMG)	0.03 ***	-0.01	-0.01
	(0.01)	(0.02)	(0.03)
Marriage market			
Rural sex ratio		-0.15	
		(0.36)	
Urban sex ratio		0.62	
		(0.72)	
Share women married less than 5 years		2.75	
		(2.15)	
Share women married 5 to 10 years		5.83 **	
		(2.58)	

Note: BHHH standard error in parentheses.
* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 3
Heterogeneity standard deviations and correlations

	ε^s	ε^m	ε^p
ε^s	1.93 ***		
	(0.04)		
ε^m	-0.38 ***	1.06 ***	
	(0.13)	(0.17)	
ε^p	-0.18 *	0.65 ***	2.18 ***
	(0.10)	(0.10)	(0.25)

Note: BHHH standard error in parentheses.
* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 4
Schooling model marginal effects

	Probability of finishing…	
Variable	Primary (grade 5)	Collège (grade 9)
Additional year of father's education	0.016	0.020
Additional year of mother's education	0.023	0.029
1 SD increase in asset index	0.089	0.112
Seecaline	0.119	0.149
10% increase in teacher degrees	0.059	0.074
10% increase in teachers with >5 years experience	0.037	0.046
Mother's death before child age 10	-0.181	-0.227

Table 5
Predicted median survival times

	Median survival time	Difference from baseline
Marriage equation		
Baseline	21.35	
4 more years of father's education	22.03	0.68
4 more years of mother's education	22.82	1.47
1 SD increase in assets	24.43	3.08
2 more years of own education	24.55	3.20
10% increase share women in cohort married <5 years	20.61	-0.74
10% increase share women in cohort married 5-10 years	19.82	-1.53
Parenthood equation		
Baseline	21.31	
4 more years of father's education	21.81	0.50
4 more years of mother's education	22.05	0.74
1 SD increase in assets	23.49	2.18
2 more years of own education	22.86	1.55
1 more year of marriage	21.82	0.51

Figure 1

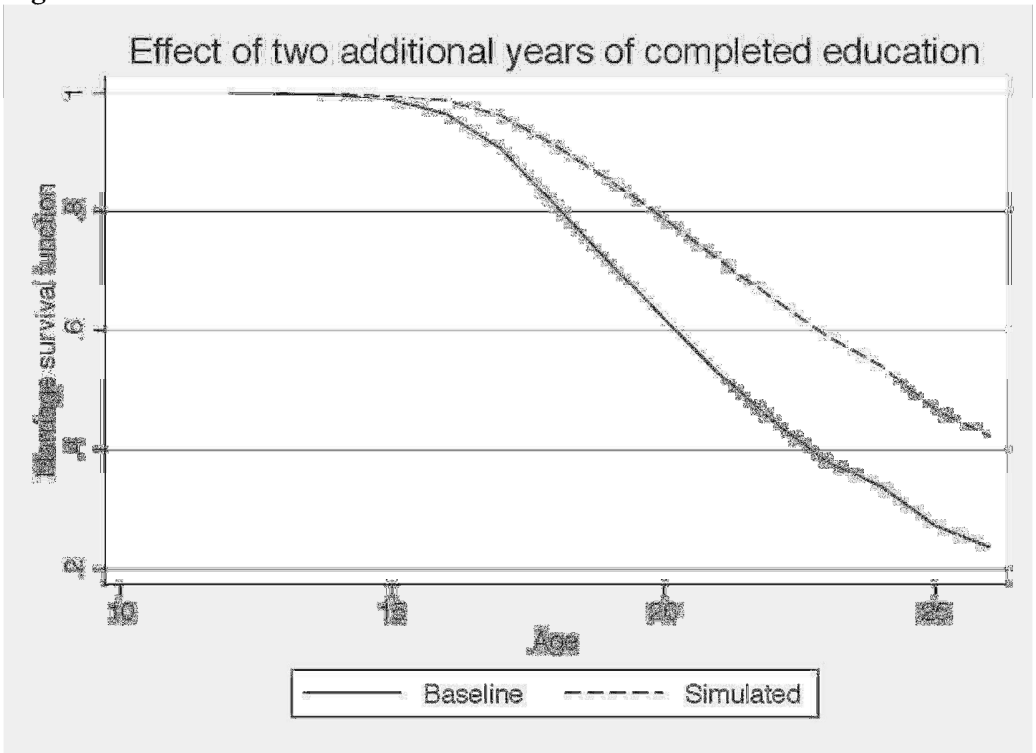


Figure 2

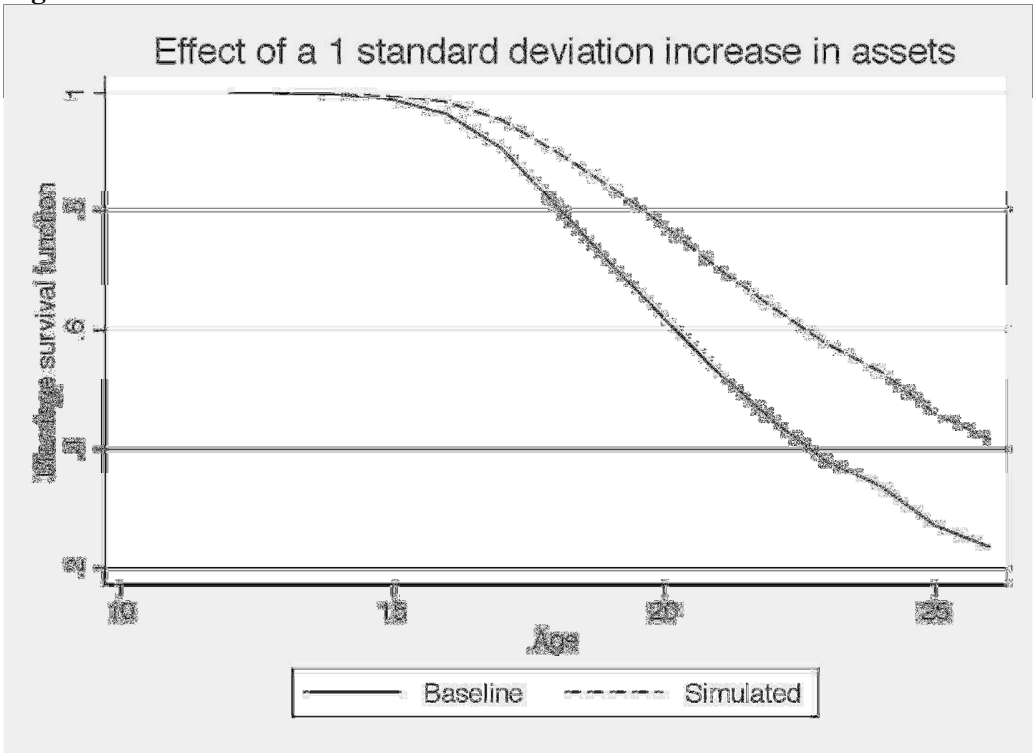


Figure 3

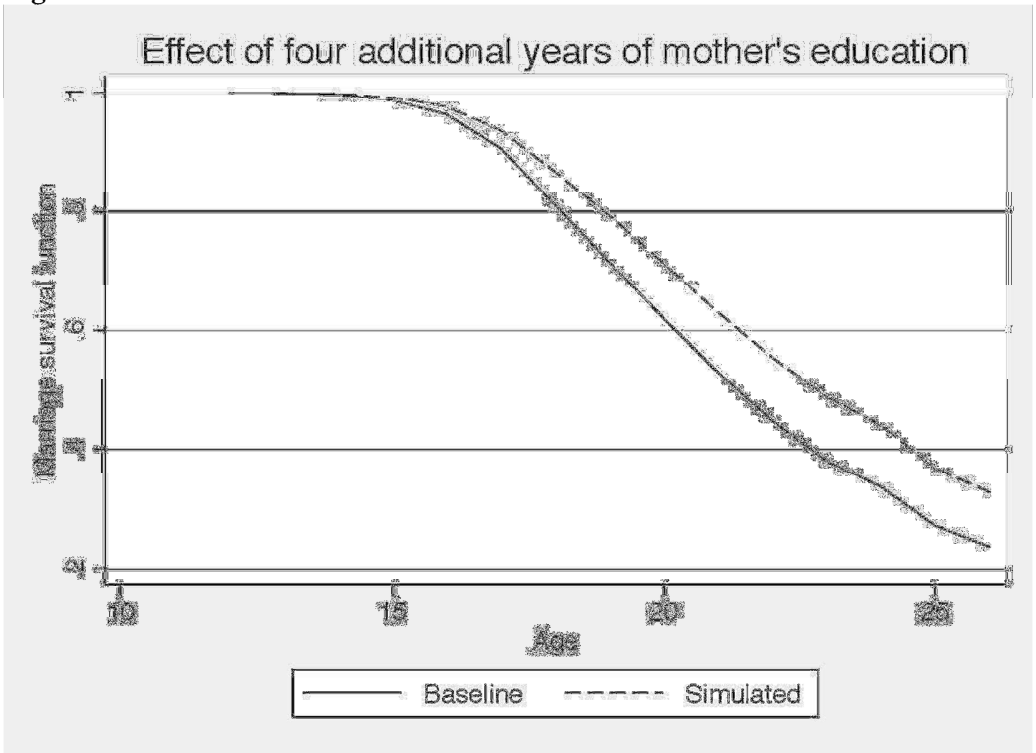
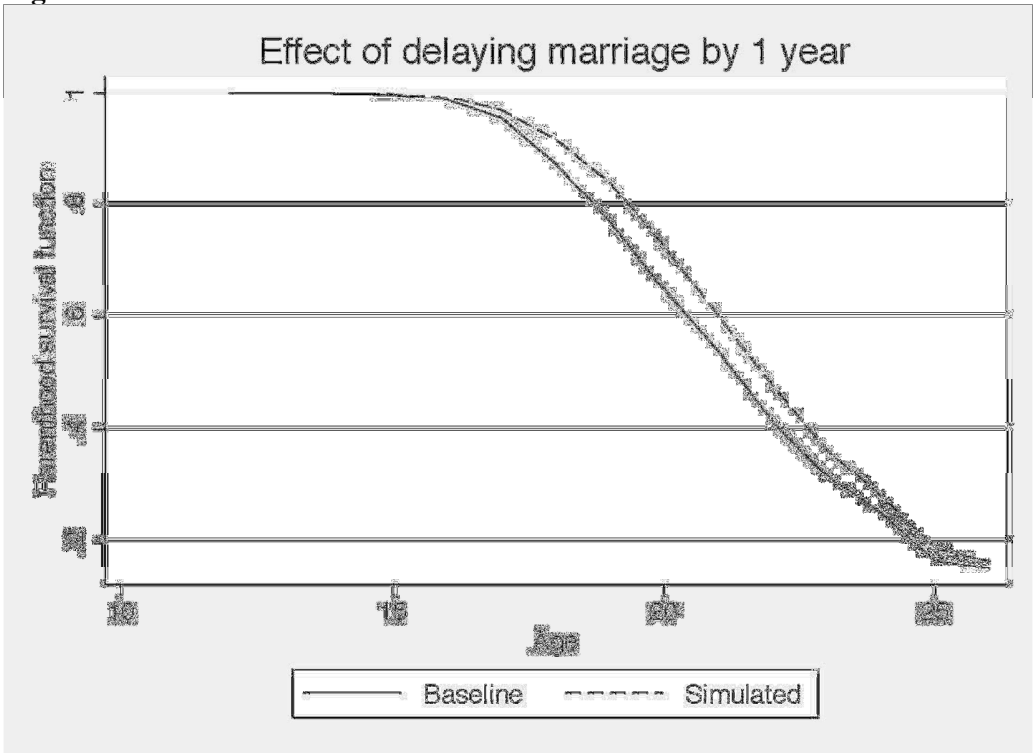


Figure 4



Appendix Table 1
Single-equation estimation

	Schooling	Marriage	Parenthood
Personal characteristics			
Constant	-280.79 ***		
	(18.65)		
Birth year (cohort)	0.14 ***	0.00	-0.04
	(0.01)	(0.03)	(0.03)
Age spline			
Age 12 intercept		-7.26	66.45
		(58.31)	(62.94)
Age 12-14.8 slope		1.55 ***	1.27 ***
		(0.38)	(0.41)
Age 14.8-17.6 slope		0.91 ***	1.07 ***
		(0.11)	(0.13)
Age 17.6-20.4 slope		0.20 **	0.31 ***
		(0.08)	(0.08)
Age 20.4-23.2 slope		0.03	0.11 *
		(0.12)	(0.12)
Age 23.2-26 slope		0.06	-0.36
		(0.32)	(0.37)
Endogenous outcomes			
Years of education			
Out of school spline			
0-3 years			
3-6 years			
6+ years			
Marriage duration spline			
0-3 years			
3-6 years			
6+ years			
School characteristics			
Private	0.05		
	(0.32)		
Seecaline	1.24 ***		
	(0.13)		
Director years of education	0.09 **		
	(0.04)		
Director experience	-0.02 *		
	(0.01)		
Proportion of teachers with teaching degree	0.69 *		
	(0.41)		
Proportion of teachers more than 5 years	-0.32		
experience	(0.34)		

Pedagogy index	1.03 ***		
	(0.19)		
Facilities index	0.09		
	(0.13)		
Secondary school in community at age 8	-0.13		
	(0.15)		
Health program exposure			
Birth control in community (time-varying)			0.20
			(0.20)
Family planning info in community (time-varying)			0.05
			(0.20)
Child nutrition info in community at age 0	0.31		
	(0.46)		
Child nutrition info in community at age 10	-0.20		
	(0.17)		
Child nutrition info in community (time-varying)		0.30 *	0.32 *
		(0.16)	(0.16)
Parent characteristics			
Asset index	0.73 ***	-0.38 ***	-0.43 ***
	(0.10)	(0.12)	(0.13)
Father's years of education	0.15 ***	-0.03	-0.05 *
	(0.02)	(0.03)	(0.03)
Missing	-0.14	1.20 ***	1.50 ***
	(0.12)	(0.35)	(0.33)
Father died before girl age 5	0.53		
	(0.42)		
Father died before girl age 10	0.07		
	(0.33)		
Father died (time-varying)		0.06	0.87 **
		(0.49)	(0.40)
Father age at marriage		-0.03 *	0.01
		(0.02)	(0.02)
Missing		-0.31	0.44
		(0.44)	(0.53)
Father never married		-0.24	-0.85
		(0.49)	(0.57)
Father age at parenthood		0.03	0.00
		(0.02)	(0.02)
Missing		-0.26	-1.08 *
		(0.51)	(0.56)
Mother's years of education	0.25 ***	-0.03	-0.01
	(0.02)	(0.03)	(0.03)
Missing	-0.87 ***	-1.28 ***	-1.19 ***
	(0.17)	(0.42)	(0.45)
Mother died before girl age 5	-0.19		
	(0.80)		
Mother died before girl age 10	-1.18 *		
	(0.67)		
Mother died (time-varying)		-1.20 ***	-0.35
		(0.42)	(0.37)

Mother age at marriage		-0.01	0.01
		(0.02)	(0.02)
Missing		0.45	-0.21
		(0.44)	(0.52)
Mother never married		-0.54	-0.45
		(0.45)	(0.47)
Mother age at parenthood		-0.02	-0.01
		(0.02)	(0.02)
Missing		1.37 ***	1.73 ***
		(0.52)	(0.56)
Religion			
Traditional	-0.64 **	0.32	0.58 **
	(0.28)	(0.25)	(0.27)
Catholic	-0.09	-0.10	0.00
	(0.15)	(0.17)	(0.18)
Other	-0.83 ***	0.09	0.09
	(0.26)	(0.27)	(0.31)
Ethnicity			
Antandroy	0.28	0.06	-0.40
	(0.41)	(0.36)	(0.36)
Betsileo	0.51 **	0.19	0.15
	(0.25)	(0.29)	(0.32)
Betsimisaraka	-0.10	0.38	0.34
	(0.29)	(0.31)	(0.34)
Merina	0.05	0.77 **	0.70 **
	(0.29)	(0.33)	(0.34)
Tsimihety	0.69 **	0.24	-0.02
	(0.35)	(0.32)	(0.36)
Community characteristics			
Urban	-0.20	0.18	0.53 *
	(0.27)	(0.30)	(0.31)
Province			
Fianarantsoa	0.30	0.19	0.27
	(0.36)	(0.40)	(0.42)
Toamasina	0.18	0.12	0.17
	(0.37)	(0.39)	(0.43)
Mahajanga	-0.62 *	0.59	0.49
	(0.37)	(0.42)	(0.45)
Toliara	-0.08	0.54	0.99 **
	(0.40)	(0.40)	(0.43)
Antsiranana	-0.05	0.60	1.56 ***
	(0.40)	(0.48)	(0.48)
Electricity in community at age 0	-0.11		
	(0.14)		
Electricity in community at age 10	0.25		
	(0.19)		
Electricity in community (time-varying)		-0.06	-0.11
		(0.23)	(0.23)
Public water faucet	-0.02	-0.11	-0.12
	(0.18)	(0.18)	(0.21)
Private water faucet	-0.80 **	0.25	0.12

	(0.35)	(0.33)	(0.36)
Well water	0.69 ***	-0.13	0.16
	(0.23)	(0.24)	(0.26)
Surface water	-0.44 **	0.00	-0.24
	(0.21)	(0.19)	(0.21)
Remoteness index (1=least remote; 5=most remote)	-0.46 ***	0.21 **	0.29 ***
	(0.09)	(0.09)	(0.09)
Transportation cost (10,000 FMG)	0.06 ***	-0.01	-0.01
	(0.02)	(0.02)	(0.02)
Marriage market			
Rural sex ratio		-0.27	
		(0.32)	
Urban sex ratio		0.60	
		(0.59)	
Share women married less than 5 years		6.24 ***	
		(2.02)	
Share women married 5 to 10 years		8.18 ***	
		(2.46)	
Heterogeneity			
Standard deviation	2.07 ***	0.95 ***	1.12 ***
	(0.06)	(0.17)	(0.18)

Note: BHHH standard error in parentheses.
* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.