# Testing Hypotheses of the Demographic Transition in San Borja, Bolivia

**Introduction**
Understanding the demographic transition, a trend in which fertility drops after a period of population growth due to a decline in mortality, has been an important area of anthropological and demographic research. Education has long been recognized as a determinant of fertility although the reasons for its strong influence have been less explored. This study analyzes how education influences age at first birth and overall fertility by testing three models of the Demographic Transition. The unique predictions of each hypothesis are tested in San Borja, Bolivia, a community currently undergoing a fertility transition. Different models of the Demographic Transition are rarely tested simultaneously against one another in the same population. Low modern fertility seems counter-intuitive given the increase of individual wealth, but there have not been sufficient tests to lead to an understanding of why this occurs.

The three types of fertility models that are explored in this research are: labor force participation, embodied capital theory and contraceptive knowledge. These models are not mutually exclusive and can have additive effects in their influence on fertility. People today have more information about and access to contraceptives, allowing them to control their fertility (described here as the contraceptive knowledge hypothesis). The impact of job opportunities for women results in higher opportunity costs for reproduction (labor force participation). Finally, fertility transition may be explained as a shift in emphasis to producing high quality offspring in response to a competitive labor market which motivates highly-skilled parents to invest greatly in themselves and their offspring, leading to higher levels of education and reduced fertility (embodied capital theory).

These models are evaluated by their ability to predict age of first birth and total fertility. Taken together, the results show that contraceptive knowledge is important in predicting age at first birth and that embodied capital theory predicts overall fertility.

**Background**
The demographic transition is defined as a significant drop in fertility that occurs after mortality rates have declined and there has been a period of population growth (Davis, 1945). The demographic transition was first observed in 19th century Europe (Thompson, 1929) and has been repeated throughout the developed world (Borgerhoff Mulder, 1998). The features of a demographic transition include a significant decrease in the number of offspring produced with high-status individuals reducing their fertility first and then, after some period of time, the remainder of the population reducing their fertility (Borgerhoff Mulder, 1998). After a transition has occurred, there is typically low variance in fertility across a population. Low modern fertility, even to the point of below replacement (less than 2.1 offspring per woman), seems puzzling because people are becoming wealthier, yet are choosing to reduce their fertility. This is opposite of what is observed in natural fertility societies, where individuals with more status and wealth have more offspring and higher reproductive success (Chagnon, 1979; Irons, 1979).

Many different models have been proposed to explain this puzzle. Evidence has shown that higher levels of education promote delays in marriage and reproduction (Castro Martin & Juarez, 1995) and are a crucial factor influencing reduced family size (Caldwell, 1980; Zurack, 1977). The pathway by which education influences fertility is analyzed using three models of the Demographic Transition: labor force participation, embodied capital theory and contraceptive knowledge.

Since young offspring require extensive time from their mothers and modern labor force activities typically draw a woman outside of the home; these commitments tend to compete with each other for a woman's time. Education increases the ability of a woman to enter into the workforce (and one would expect, increases her earnings), which directly competes with childrearing activities. Research has documented the bi-directional inverse relationship between having young children and female labor-force participation. Some studies examine the negative effect of fertility on female labor-force participation (Chun & Oh, 2002; Schultz, 1978; but see Aguero & Marks, 2011), while others focus on the effect of wage labor on decreased likelihood of progression to next birth (Date & Shimizutani, 2007; Ermisch, 1988). For many women, there is an inflexible tradeoff between having young children and working in the labor force. This hypothesis predicts that higher educational success results in a higher opportunity cost of having children and will cause a delay in age at first birth for women who have to pay high childcare costs. Additionally, the increased opportunity cost of children will result in an overall decrease in children born.

Increased investments in self and offspring have been cited as an important reason for a reduction and delay of fertility. Kaplan argues that in societies with competitive wage labor markets, parents are motivated to invest more in education and job training for themselves and their children (Kaplan, 1996). Individuals reach diminished returns on their investment at different rates depending on their own *embodied capital* (skills and knowledge). Those parents with more knowledge are better able to invest in their offspring and are predicted to invest at a higher rate than individuals with less knowledge (Kaplan & Lancaster, 2000). Mace has modeled reproductive decision making in a subsistence system and found that large increases in parental investment can lead to decreases in fertility (Mace, 2000). This hypothesis predicts that women who achieve high education are investing more highly in themselves and are predicted to invest greater in their children. This higher expected investment should delay age at first birth and reduce overall fertility as individuals are focusing on education and saving resources to invest highly in offspring in the future.

One of the main goals of education is to provide individuals with knowledge. Exposing women to information about and access to contraceptives is one route by which women may reduce their fertility (Potts, 1997). Evidence has shown that women with higher levels of education are significantly more likely to know of a modern contraceptive source (Castro Martin & Juarez, 1995) and that family planning programs have a negative impact on aggregate fertility levels (Anderson & Cope, 1987). Others have been critical of the role of contraceptive knowledge showing that fertility declines can occur before modern contraceptives are available in some regions (Livi-Bacci, 1986; Shenk, 2009) and that fertility declines may not occur despite the availability of contraceptives in others (Jones et al., 1997). Given this hypothesis, we expect that women who attain higher levels of education will have more contraceptive knowledge (either from exposure through school or a greater

competence to seek out information from complex institutions), which will result in a delay in age at first birth and reduced overall fertility. Since contraceptive usage is a clearly proximate mechanism for reduced fertility, this analysis will focus on the role contraceptive knowledge may have as an ultimate explanation of fertility decisions.

**Methods**
Interviews were conducted with 360 women over the age of 30 in San Borja, Bolivia. The main industry in San Borja is cattle ranching. Women have many employment options, both working in the home or outside the home. The community is predominantly Catholic. Interviews were conducted to gather information on family information, work history, marriage history, parental investment, expectations and responsibilities of children, and finally, contraceptive knowledge and use. Data were then analyzed using structural equation modeling, multiple regression (for number of children born), and Cox proportional hazard models (for age at first birth).

Latent variables were constructed to measure each variable of interest in the three hypotheses: contraceptive knowledge, expected investments in offspring and opportunity cost. Contraceptive knowledge was measured by the number of years before age 30 that a woman learns about contraceptives and whether she learned about contraceptives before her first pregnancy. Another component of contraceptive knowledge was whether the interviewee learned about contraceptives from formal instruction (such as a teacher or a doctor) versus an informal method (such as a family member or the radio). The expected investment in offspring was a factor of both the expected educational achievement of an interviewee's children and the age that those children were expected to contribute to the household. Finally, opportunity cost was measured by a woman's income the year before her first birth and the type of job that she had (categorized as working inside the home, outside the home in a job where she could bring her child or a job outside the home where childcare would be needed).

**Results**
The structural equation model shows that contraceptive knowledge is the best indicator of age at first birth. Expected investment in offspring is the best predictor of overall fertility, but not a significant predictor of age at first birth. Opportunity cost is not significantly correlated with education. This is particularly surprising, but may be the result of living in a community where women can easily find work where they can combine their childcare and working responsibilities. Many women own shops or work at home, which reduces the conflict between work and childcare. Additionally, results from the Cox proportional hazard model show that contraceptive knowledge is a significant factor influencing age at first birth. The other significant variable in the model is age that parents terminate support, suggesting that when women are still obtaining investments from parents they delay reproduction. The results of the multiple regression analysis show that expected investment in education is the best predictor of overall fertility.

**Conclusion**
Understanding the demographic transition has been a goal for many demographers, economists, and anthropologists. This research set out to analyze three models of the Demographic Transition. The evidence shows strong support for contraceptive knowledge and embodied capital theory. It appears that contraceptive knowledge influences the timing of first birth while expected investment in offspring reduces the

number of children born.  In this community, the opportunity cost of children does not significantly influence age at first birth or overall fertility.

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