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Testing Hypotheses of the Demographic Transition in San Borja, Bolivia

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TESTING HYPOTHESES OF THE DEMOGRAPHIC TRANSITION IN SAN BORJA, BOLIVIA

BY

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To my mother, father and Ruth, for your endless support.

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ABSTRACT

Understanding the demographic transition, a trend in which fertility drops after a period of population growth, has been an important area of anthropological and demographic research. This dissertation seeks to understand fertility change by testing five models that have been presented in the literature. The predictions that are unique to each hypothesis are tested in San Borja, Bolivia, a community currently undergoing a fertility transition. 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.

Informational hypotheses explain fertility transition as a change in information. People today have more information about and access to contraceptives, allowing them to control their fertility (known as the Contraceptive Knowledge Hypothesis). Once certain individuals begin to change their fertility strategies, these preferences can propagate

through the population by means of social diffusion (referred to as Diffusion Theory). Economic models explain fertility change as a shift in the cost of children (Wealth Flows Hypothesis) or the impact of more job opportunities for women resulting in higher opportunity costs for having children (Female Labor Force Theory). Finally, evolutionary models explain fertility transition as a shift in the emphasis of producing 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, the rates of progression to each subsequent birth (for example, the progression from 2 to 3 children), their predicted causal pathway and finally, total fertility. Taken together, the results show support for a dual model including the Contraceptive Knowledge Hypothesis and the Embodied Capital Theory.

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Chapter 1: Introduction

Humans are unique in their pattern of reproduction compared with our closest primate relatives. Human children have relatively early ages of weaning, reach sexual maturity late and have high childhood survivorship (Kramer, 2010). This early weaning and late sexual maturity leads to a situation where parents invest in offspring for an extended period of time and human females have multiple dependent young of different ages. Our closest non-human primate relatives typically have only one dependent young at a time and when a female has her next offspring, the previous one is an independent food producer. Chimpanzees have an average birth interval of 5.5 years (Knott, 2001) and gorillas have an average of 3.9 years (Watts, 1991). Non-human primates have longer birth intervals than humans because offspring need to be independent before mothers can start another bout of reproduction. Human mothers have shorter birth intervals, an average of 3.1 years among traditional societies (Alvarez, 2000) and more recently, with greater access to food, even less time between subsequent births. After the onset of the demographic transition, short birth intervals of 18-24 months are common. This allows humans to have higher fertility rates than non-human primates. Human mothers face a unique problem having multiple dependent offspring of differing ages and are able to successfully navigate this situation with the support of others. Evidence has shown that fathers (Kaplan et al., 2000), grandmothers (Hawkes et al., 1997), and older siblings (Kramer, 2005) can help mothers raise multiple offspring. This help can take the form of childcare or the caloric supplementation of mothers so that they can put more energy towards reproduction and supporting dependent young.

In traditional hunter gatherer societies, children are typically born into families of many children and start providing care for siblings at young ages (Kramer, 2010). Within several years of menarche (which is dependent upon time until regular ovulation and exposure to sex), young women typically start reproducing and continue until menopause (Lancaster, 1986). After menopause, older adults commonly help care for grandchildren (Turke, 1989). More recently, the focal point throughout the lifespan has shifted away from children. In many parts of the world, adults are reducing their fertility and may have few offspring throughout their lives. Children have fewer siblings to provide care for and grandparents may not be able to help with care for their grandchildren (especially when individuals are highly mobile and unlikely to live near their parents). This shift from high, natural fertility populations to low fertility populations is termed *the demographic transition* (Davis, 1945).

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. 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 rest 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 men with more status and wealth have more offspring and higher reproductive success (Chagnon, 1979; Irons, 1979). Among hunter gatherers, accomplished hunters have higher reproductive success (Smith, 2004), while among horticulturalists and pastoralists, where polygyny is more common and men provide defense of extra-somatic resources, men who are successful warriors are more likely to have multiple wives and higher reproductive success (Chagnon, 1979).

The study of the demographic transition has been a critical issue in demography, anthropology and economics for the past 50 years (Notestein, 1953; Caldwell, 1982; Borgerhoff Mulder, 1998). Researchers have attempted to understand the factors that have led to fertility reduction. Initially, people looked at wealth, social status, education, religion and cultural explanations (Notestein, 1953). Recently, research has really exploded with many different hypotheses being presented. Some of these models include: economic models incorporating the cost of children (Caldwell, 1982), social models analyzing the impact of the diffusion of ideas (Boyd and Richerson, 1985), and the role of contraceptives in bringing about fertility change (Potts, 1997). A consensus about what causes fertility change has not been reached.

This dissertation will hope to explain variation in fertility among people in a transitioning community. Data was conducted in San Borja, Bolivia, a community currently engaged in a demographic transition. Many of the current demographic transition hypotheses have focused on the external factors that affect people's fertility decisions. These external factors are mostly controlled for within a small community in Bolivia, which allowed for testing of specific predictions of differing hypotheses relating

to the demographic transition. For example, each person has the same access to birth control, but certain people choose to seek out information on how to use it and how to obtain it. This information is available to all, but those with higher levels of education or larger networks may be more likely to have contraceptive knowledge and in turn, use birth control.

Life History Tradeoffs

Individuals face many tradeoffs when considering how to allocate their energy, since energy invested in one activity cannot also be invested in another. One of the fundamental life history tradeoffs is allocating energy towards oneself or allocating energy towards reproduction (Gadgil and Bossert, 1970; Williams, 1966; Stearns, 1976). By investing in self, one puts energy towards growth, immune function, maintenance and skills. It is critical for individuals to invest in self if they hope to have the opportunity to reproduce in the future. Without investment in immune function or maintenance of self, one would not expect to live much longer, which is particularly detrimental to a human mother whose infant offspring are likely to die if she does (Hill and Hurtado, 1996). It is also critical that individuals invest in skills. Without skills, people cannot acquire food or shelter for themselves. In traditional hunter-gatherer societies, men spend many years becoming proficient hunters and women must learn to locate, extract and prepare food. In today's modern market places, skills are critical for obtaining a job. Humans have long periods of learning where they increase their skill sets to be successful in the future.

When one decides to invest in reproduction, a choice is made between the number of children to have (quantity) and the quality of each offspring (Smith and Fretwell, 1974). If parents choose to invest a lot in the quality of each offspring, then they are

reducing the energy that they have to invest in additional offspring. If parents choose to maximize the number of possible offspring, they are reducing the amount of energy they have to invest in the quality of each offspring. Since the quantity of children is decreasing with the demographic transition, one can infer that more energy is being invested either into self or into the quality of offspring (or possibly both).

Significance

Theoretical

The Demographic Transition is an interesting area of research because the shift away from offspring quantity has been so overwhelming. Total Fertility Rates (TFR), defined as the average number of children born to a hypothetical woman if she had the exact age-specific fertility rates throughout her life as the current fertility rates, show that fertility has dropped to below two offspring/woman in many European countries (Chesnais, 1996). Additionally, since wealth is no longer correlated with fertility, it appears that people may not be maximizing their reproductive success. If this is the case, one has to ask: are people acting maladaptively? Kaplan (1996) presented data from a sample of Albuquerque men (born between 1920 and 1939) which demonstrated that the number of grandchildren is maximized by having the maximum number of offspring in the current generation. While those individuals who had the highest levels of fertility in the first generation, had children with lower educational achievement and reduced earning capacity, it did not result in decreased fertility in the next generation. It does not appear that maximizing the offspring in one generation leads to reduced reproductive success in the next, as one would expect if investing less in offspring quality leads those offspring to have fewer reproductive opportunities in the next generation. If parents

invest less in offspring quality in hunter gatherer societies, their children will have lower skill levels (for example, poor hunting skills), which may result in higher mortality rates and reduced fertility because of the direct impact of skill on adequate food consumption. In modern America, even low earning individuals typically have adequate caloric intake to maintain reproductive systems. Based on Kaplan's data, it appears that in modern times, the best evolutionary strategy would be to maximize fertility in each generation, but this is not occurring in today's post-transitional societies.

Short Birth Intervals

An increased understanding of the factors leading to fertility is important for health providers in many developing countries. Very high levels of fertility are usually achieved by having very short birth intervals. Many studies have demonstrated the relationship between short birth intervals on maternal and child mortality and morbidity. Short interbirth intervals are associated with the increased risk of low birth weight (under 2500 grams), preterm births (born before the end of the 37th week of pregnancy), being small for gestational age (under the 10th percentile for weight as compared to babies of the same gestational age), infant mortality (deaths in first year of life), neonatal morality (deaths in first 30 days of life) and child mortality (deaths from age 1 to 5) (Conde-Agudelo et al., 2006; Rutstein, 2005; Fuentes-Afflick and Hessol, 2000; Norton, 2005). There is also evidence that mothers are more likely to experience preeclampsia, high blood pressure, third trimester bleeding, pre-labor rupture of membranes, and anemia during pregnancy after a short birth interval (Razzaque et al. 2005; King 2003).

Maternal nutritional depletion is defined as the negative energy balance and/or micronutrient deficiencies resulting from frequent reproductive cycling (Merchant, 1994).

A woman who is still lactating a child when she gets pregnant is dealing with the energetic requirements of lactation and pregnancy while still trying to maintain herself. This is a large energetic demand and with repeated bouts of short interbirth intervals, it can leave a woman without any energy reserves. If a woman has a longer period of nonpregnancy and nonlactation, it gives her the opportunity to recuperate her energy reserves and leads to improved fetal outcomes (Merchant et al., 1990). Maternal nutrient depletion may contribute to the increased incidence of preterm births and fetal growth retardation among these women as well as an increased risk of maternal mortality and morbidity (King, 2003). Understanding fertility decisions gives population planners and policy makers the ability to try to reduce the incidences of these negative maternal and child outcomes.

Below Replacement Fertility

Recently researchers have begun to focus on nations with fertility below replacement levels. Replacement level fertility is the total fertility rate that is required for a population to replace itself. In developed countries, this is a total fertility rate of about 2.1 offspring per woman. In a country with higher mortality, replacement level fertility would be higher (since more children would need to be born to compensate for those who die). In many westernized countries today, there are very low levels of fertility. In the past 20 years, Europe has had unprecedented low fertility. Total fertility rates at or below 1.3 have been recorded in a growing number of countries. A sustained period of fertility rates below 2.1 offspring per woman (with no migration) will lead to a population decline. With a fertility rate at or below 1.3 offspring per woman (for a sustained period of time), a population can be reduced by half in less than 45 years (Kohler et al., 2006).

Based on Central Intelligence Agency (CIA) estimates for 2011, there are 14 countries below a total fertility rate of 1.3 offspring per woman (Central Intelligence Agency, 2011). Most of these countries are located in Asia (including Singapore, Taiwan, Japan, South Korea) and Eastern Europe (including Belarus, Czech Republic, Ukraine). These countries represent the full range of prosperity. Based on data from 2010, these countries represent countries with strong, average and weak economies (Legatum Institute, 2010). There are 23 more countries below a total fertility rate of 1.5. Most of these countries are located in Europe (both eastern and western Europe) and a few examples include Spain, Switzerland, Russia, Germany and Italy. Spain and Italy were the first countries to hit a very low fertility rate of 1.3 in the early 1990s (Kohler et al., 2006), but have increased their fertility rates since then. Russia has had a declining population since 1992 when mortality rates exceeded birth rates (Zakharov and Ivanova, 1996). Governments are concerned about extremely low fertility and reductions in population size because it leads to a larger percentage of older people, which have to be supported by a smaller working population. A smaller working population may also inhibit economic growth. These concerns have led many governments to formulate public policy to increase fertility rates (just as pre-transitional governments promoted public policy to try to reduce fertility). Many countries have instituted policies to increase fertility, including monthly cash payments for families who have children, maternity and paternity leave provisions (including some percentage of pay while on leave), low-cost childcare options, flex-time, and the option to work part-time (Hyatt and Milne, 1991; Bernardi, 2005). Some government programs have a small but measureable impact on fertility (Hyatt and Milne, 1991). It appears that it is more difficult to increase

fertility rates than to reduce them, but countries like Italy and Spain which had the lowest total fertility rates in the world in the early 1990s (below 1.3 offspring per woman), have slightly increased their total fertility rates to 1.39 and 1.47 respectively (Central Intelligence Agency, 2011). A more thorough understanding of fertility choices may help population planners achieve a stable population.

History of the Demographic Transition Literature

Notestein began writing about the Demographic Transition in the 1930s. He attributed fertility decline to the changing culture. In pre-transitional societies, fertility was high because of religious doctrines, community customs, marriage habits and moral codes (Notestein, 1953). As societies became more industrialized, cities grew, people moved away from their family based way of life, and cultural customs broke down. Notestein believed that these changes lead to reduced fertility. Since that time, researchers from economics, demography, sociology, and anthropology have developed many different hypotheses to explain the demographic transition. These hypotheses fall into four general areas: informational, familial, economic and biological.

Informational models explain fertility decisions with the information that people are exposed to. Potts (1997) hypothesized that knowledge of and access to contraceptives has allowed people to control their fertility throughout the world. Many governments have subsidized the cost of contraceptives to make them affordable. Another way that people's fertility decisions may be determined is by adopting the ideas of others, known as Diffusion Theory. Since high status individuals are successful in other areas of life, people may mimic their fertility decisions. High status individuals reduce their fertility first in a fertility transition, and other individuals may then reduce their fertility as well

(Boyd and Richerson, 1985). Alternatively, people may adopt the ideas of the individuals in their social network (Kohler, 1997). If one's friends are choosing not to have children, then the individual may decide to make a similar reproductive decision.

Familial models analyze how the family influences fertility decisions. Women cannot raise children independent of others. In traditional societies, cooperative breeding was necessary for children to survive until adulthood (Kramer, 2010). Mothers, fathers, grandparents, and older siblings all took part in raising a child. Today, there is an increasing rate of women who are not married when they have children. Single-headed households make it particularly hard to provide both the economic resources and the childcare necessary to raise offspring. In these situations, women may be provided with government assistance or have to pay for childcare services. Many couples live further away from their extended kin members (such as their parents), which make it harder for kin members to help in raising grandchildren. Evidence shows that maternal grandmothers and other matrilineal kin help reduce the risk of child mortality, while paternal relatives reduce the time between successive births (Mace and Sear, 2005). When parents have to pay the high costs of fertility alone, they may delay fertility until they feel they can afford it (Turke, 1989).

Economic models focus on the costs and benefits of children. As women attain more education and get better paying jobs, they are faced with a larger opportunity cost of having children. This is particularly true when employment opportunities are not compatible with childcare (Date and Shimizutani, 2007**)**. In these situations, a woman must either give up her job or (typically) pay for childcare. With the changing roles of

children (for example, mandatory schooling), children produce less for the household and are more expensive. This results in higher costs for parents and necessitates a reduction in the quantity of children produced. Caldwell (1982) focused on the direction that the wealth flows in families. He believed that wealth flows from children to adults in pre-transitional societies, but reverses in post-transitional societies. Finally, the type of economy has been hypothesized to impact fertility. When parents have to prepare children for jobs that require higher levels of education, parents must pay the additional cost of educating their children (Handwerker, 1993). As the cost of children increases, the number of children is expected to decrease. Alternatively, if children's jobs require social connections, having a larger family may facilitate job placement. In this case, having a large family is a benefit and family size is expected to increase.

Finally, biological models focus on maximizing reproductive success. Boone and Kessler (1998) provided a model that shows how higher status may improve survivorship in catastrophes. Reduced fertility during affluent years may help improve chances of long-term survival of the lineage during years of catastrophe, such as years of extreme famine or drought. Kaplan and Lancaster (2000) describe the modern competitive labor markets that require high levels of skill from workers. Their model incorporates some of the basic principles from economic models. Parents have to adapt to this new economy and invest highly in their offspring for them to be successful in the modern era. Those parents with the most skill, can most easily invest in their offspring. This model predicts that highly skilled parents will invest at high levels. To produce a few highly successful offspring, parents have to greatly reduce their fertility.

This project will examine five causal hypotheses and see whether their predictions hold for a community undergoing a demographic transition.

Models to be tested

Of the many hypotheses of the demographic transition, five were chosen to be tested in this study. The models will be tested to compare their ability to predict fertility decisions. Many theories have been developed, but they have not been tested at the same time in the same data set. This project is novel because it is the first study that has a representative sample of women from a population undergoing a fertility transition that tests many different hypotheses at the same time.

Contraceptive Knowledge

Reproductive knowledge gives women the opportunity to control their fertility. The Contraceptive Knowledge Hypothesis (Potts, 1997) points to the availability of low-cost, effective birth control that decouples the desire for sex from the desire for children. Potts believes that humans are predisposed to desire sex and to cherish and support children when they are born. He goes on to state that without abortion or contraceptives, people will have sex, which leads to pregnancy and the birth of offspring. With the availability of contraceptives and abortion, people will still engage in sexual relations, but can reduce their fertility. Potts states, "Access to reproductive technologies is the key to bringing about fertility decline." Three events must occur for women to use contraception. First, they need to have access to it. Second, they need to understand how to use it and finally, they must want to use it. All must be met for there to be fertility transition.

In San Borja, contraceptives are affordable and accessible. At the hospital, women can get free contraceptives. Less than 10% of women (n = 265) reported that their husbands solely made decisions about contraceptive use in their household. The majority of women in San Borja have access to contraceptives and the autonomy to decide whether or not to use them. Additionally, younger women (particularly those under 30) have been taught about contraceptives in school and have the knowledge necessary to be able to use them effectively.

Higher levels of education should lead to more knowledge of contraceptives. One important goal of this project is to determine if contraceptive knowledge is an important factor by itself in reducing fertility or is just a means by which people who have the desire to reduce their fertility can actually achieve that level of fertility. Extensive reduction of family size is challenging without the use of some sort of contraceptive. All of the other hypotheses presented may achieve lowered fertility through the use of contraceptives, but alternate explanations explain the ultimate cause of the shift in fertility. For example, some researchers have argued that individuals use contraceptives so that they can enhance their standard of living (Ravichandran, 2002). Others have suggested that the use of contraceptives is dependent upon parent's desire to invest in offspring (Leonetti et al., 2007). If modern contraceptives are an important factor in and of themselves, the expectation is that when controlling for education, contraceptive knowledge will still be a significant predictor of fertility. There are three predictions for this hypothesis. 1.) As individuals learn about contraceptives, it should lead to a decrease in future fertility. 2.) As individuals learn about contraceptives, it should lead to increase

in their use. 3.) When education is controlled for, contraceptive knowledge should be a significant predictor of fertility.

Diffusion Theory

People are exposed to different types of ideas and may adopt the ideas of others. Boyd and Richerson (1985) suggest that people may be taking on the ideas of high-status individuals. They show that 'imitation' of high-status individuals might evolve if the costs are high for an individual to determine optimal behavior. For example, while birds may be able to learn from one year to the next about optimal clutch size, humans can spend a lifetime trying to determine the optimal fertility decision. Since there is a high cost to determine the best solution for fertility, people may imitate what others do and hope that others are acting adaptively. Even if the trait (like reduced fertility) is not enhancing genetic fitness it may spread through a population if people who are otherwise successful express the trait. Boyd and Richerson (1985) termed this idea, 'indirect bias' and modeled how this process might arise through ordinary evolutionary processes when the cost of reaching the adaptive solution is high. It is costly to make optimal fertility decisions, so people may imitate those people who are more successful in social arenas. High-status (or wealthier) individuals typically reduce their fertility earlier in the demographic transition, so lowered fertility may spread if other individuals mimic their fertility choices. Exposure to high-status individuals will be measured by one's exposure to media. Those individuals who are watching more television from western cultures or accessing the internet are likely being exposed to high-status ideologies. This hypothesis has two predictions. 1.) Those individuals who have more access to media are exposed to high status ideologies and will reduce their fertility. 2.) Those individuals who watch

specific television programming (like soap operas and movies from western cultures) should have more exposure to high status individuals and in turn, reduce their fertility.

Kohler (1997) believes that people are trying to determine the best fertility strategy for their particular life circumstances. Since the best fertility strategy may take a lifetime to determine, people adopt the strategies of others in their social networks. These are the individuals that people are most exposed to, are most similar to, and their optimal fertility strategies are likely to be similar. Behrman et al. (2002) suggest that social networks lead people to start using contraception. They found that Kenyans who were in social networks with someone who used contraceptives were significantly more likely to start using contraceptives themselves. Changing religious beliefs are often cited as an explanation of fertility decline. Pronatalist faiths are religions that have doctrines that teach followers to have large families. One expects that those individuals who are members of pronatalist faiths will have friends' with similar religious beliefs. Those individuals who are pronatalist are expected to have higher levels of fertility because of the diffusion of ideas from their church and other church-going friends. This hypothesis has three predictions. 1.) Members of pronatalist faiths should have friends' with higher levels of fertility. 2.) When asking individuals for the fertility of their closest friends, there should be a correlation between friends' fertility and own fertility. 3.) Those individuals whose siblings have higher average fertility should themselves have higher fertility.

Wealth Flows

Caldwell (1982) theorized that in pre-transitional societies, people believe that children produce net wealth. Children provide old age security, produce easy-to-acquire

foods and help with childcare for siblings in pre-transitional societies. In post-transitional societies, due to mandatory school attendance, children consume more wealth than they produce. Caldwell termed the phrase "wealth flows" to describe the transfer of resources from one generation to another. Pre-transition, children transfer wealth upwards (by producing more resources than they consume), but post-transition, parents transfer wealth downwards (to compensate for children's reduced production of resources). Caldwell compiled interview data and found that when children were not attending school, 59% of parents believed that their offspring had produced as much wealth and given as much assistance as the parents had given them. Fifty four percent of parents agreed with the statement "Children are wealth". Those parents whose children were attending school felt that children were not providing as much to the household and were more costly. The Wealth Flows Hypothesis predicts that the changing cost of children leads to decreased fertility.

Much research has focused on the production and consumption of juveniles to determine how truly 'costly' they are. Cain (1977) studied the consumption and production rates of children in a village in Bangladesh and found that on average a son paid back his own cumulative consumption by age 15, and that of his own and his sister by age 22. This suggests that if sons stay at home until their late teens or early twenties they may be able to eventually provide wealth for the family. Contrasting this idea, recent studies found that children are not able to pay back all the contributions that parents provided to them. Lee and Kramer (2002) found the breakeven point for production and consumption for males to be around 30 years old and about age 31 for females among Maya children. This is long after these individuals would have left their

natal home and started their own family. Similarly, Kaplan (1994) calculated the consumption rates of children among hunter-gatherers. Consumption rates were calculated by the amount of calories children produced and the amount of calories they consumed. He found that children under 18 produce 20-25% of what they consume and never are net producers. Even in old-age, adults produce enough to support themselves and usually produce a surplus which they pass down to offspring and grand-offspring. This study does not hope to add to the discussion about how much children actually produce in comparison to what they consume, but it does predict that when children are consuming more and producing less, they are more expensive and parental fertility should decline.

This study distinguishes between expected contribution and actual contribution of children. Since the age that children begin working occurs after parents have already had children, it is not possible for the age children begin working to impact fertility, but the age of expected contribution can be a factor in parents' fertility decisions. To avoid these causality issues, expected behavior can impact fertility decisions, but actual behavior can only be the result of fertility decisions. This hypothesis has three predictions. 1.) Parents with higher fertility will have children who work and provide resources for the family at younger ages. 2.) Those parents who expect children to start contributing at younger ages will have higher fertility. 3.) Parents who expect children to provide old-age security will have higher fertility.

Female Labor Force

As women gain the opportunity for employment, there is an increased opportunity cost for raising children. Either a woman must give up her job to watch her children or

she must pay someone else to watch her children. Either way, women are paying a cost to have children. This increased cost leads to a decrease in fertility. Women with different earning abilities face different opportunity costs. In post-World War II Great Britain, Ermisch (1988) found that higher wages for women increased the cost of an additional child, reducing the chance of another birth. In Japan, the seniority-based wage system makes it a large opportunity cost for women to have children. If a woman (with a university degree) gives up her job from the ages of 28 to 34 to raise a family, she is expected to lose 85 million yen (a little more than 1 million American dollars) over her lifetime (Date and Shimizutani, 2007). This large financial cost deters women from having children. Careers that are incompatible with childcare will increase the opportunity cost of having children. If a woman can work in a job that allows her to bring and care for her children at the same time as she is working (a job compatible with childcare), she reduces the cost she faces for having children. In many developed countries around the world, few jobs are compatible with childcare. In Bolivia, there are occupations where women can work and take care of her children (for example, washing clothes, baking bread or owning a store). While none of these jobs require high levels of education, they do allow women to make varying amounts of money as those women who manage their own store have the highest reported incomes.

This leads to several predictions. 1.) As a woman's earning potential increases, her fertility should decrease. 2.) Women with non-employed family members in the same community will have decreased cost of childcare and therefore increased fertility (when earning potential is controlled for). 3.) Women who work in jobs that are

compatible with childcare will have higher fertility than women with jobs that are incompatible with childcare.

Embodied Capital Theory

Kaplan and Lancaster (2000) argue that humans evolved psychological and physiological mechanisms that use environmental cues to determine the payoffs in investing in current and future reproduction. They created a model where modern fertility decline is in response to competitive wage labor markets. As the competition for high-paying jobs increases, parents are motivated to invest more in education and job training for themselves and their children. Parents don't detect diminishing returns on investment in children until they reach very high levels. Those parents with more embodied capital (skill and knowledge) can produce embodied capital more efficiently in their children. They reach diminishing returns on investment at a higher-level than lower-earning parents with less embodied capital. Rich, highly-skilled parents have fewer children than poorer, less skilled parents because the time and resources the former put into their offspring are intrinsically more valuable than the time and resources invested by the latter. Parents with more embodied capital find it beneficial to invest highly in their children, while a parent with less embodied capital will invest less in each child, but have more of them. When controlling for a particular level of embodied capital for parents, those who have higher incomes will be able to have more children.

It is important to compare this model with the Wealth Flows model listed above. Both focus on the economics of children and how much parents spend or invest in their children. The Wealth Flows model will focus on the inherent cost that children have so that they will survive. If parents want to reduce the cost of children, they can have them

work at younger ages and have higher expectations for what children will provide to them (particularly in terms of monetary help for the household and old age support). The Embodied Capital Theory is about what parents invest in their children, not just so that they survive, but so that they are successful adults. This model looks at investments that parents do not have to make, but that they choose to make to try to give their children an advantage over others. For example, parents may invest in private education, help children pay for college, a wedding or moving into a new home, they may provide support for them while they finish their education and may expect them to complete a higher level of schooling. The Wealth Flows model will focus more on what children can provide parents, while the Embodied Capital model will focus on what parents invest in children.

The predictions of the Embodied Capital Theory are as follows: 1.) Those parents with more embodied capital (education) will invest more in each offspring. 2.) Those offspring with the most investments will have higher levels of education. 3.) Those offspring which exhibit the most promise (potential embodied capital) will obtain more investments by parents. 4.) If education is controlled for, an increase in income should lead to an increase in fertility.

Below are two charts describing the predictions that have been made above. Table 1.1 presents the independent variables and their expected effect in each of the models. In Figure 1.2, the same information is described using flow charts. This shows the expected path of how each model explains fertility reduction.

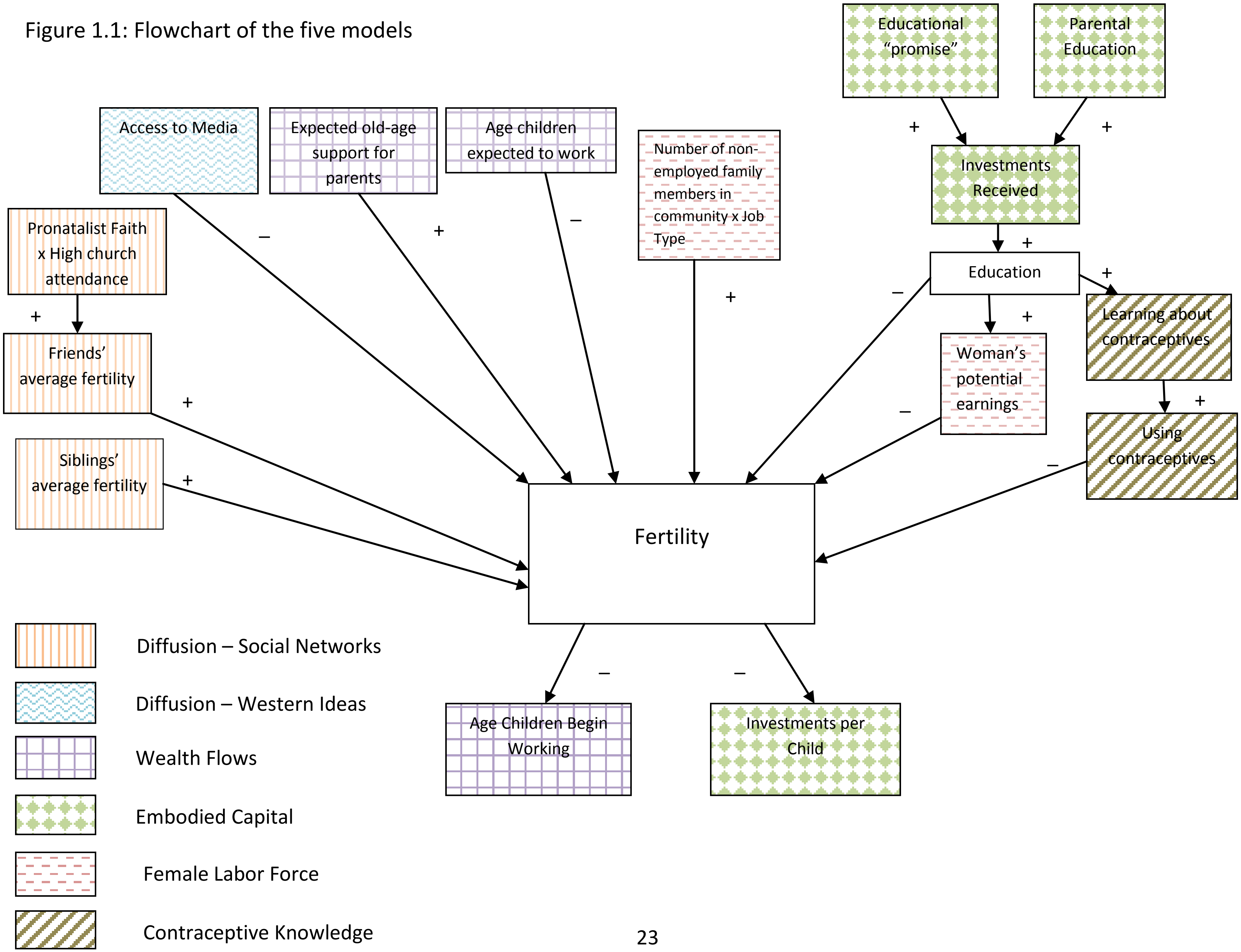
Table 1.1: Predictions from the five models

	Contraceptive Knowledge	Diffusion Theory: Western Ideas	Diffusion Theory: Social Networks	Wealth Flows	Women's Labor Force	Embodied Capital
Learning about Contraceptives	Increases contraceptive use	No effect	No effect	No effect	No effect	No effect
Using Contraceptives	Reduce likelihood of future births	No effect	No effect	No effect	No effect	No effect
Access to media (yrs watching TV, hrs of TV watching/day)	No effect	More access to media should reduce fertility	No effect	No effect	No effect	No effect
Friends' / Siblings’ average fertility	No effect	No effect	A reduction in friends’ / siblings’ fertility leads to reduction in own fertility	No effect	No effect	No effect
Pronatalist religion (with high church attendance)	No effect	No effect	Should lead to high average fertility for friends’	No effect	No effect	No effect
Age children expected to begin working	No effect	No effect	No effect	If children are expected to work at younger ages, it leads to higher fertility	No effect	No effect

Table 1.1 (cont): Predictions from the five models

	Contraceptive Knowledge	Diffusion Theory		Wealth Flows	Women's Labor Force	Embodied Capital
		Western Ideas	Social Networks			
Children expected to provide old-age support for parents	No effect	No effect	No effect	If children are expected to provide old-age support, fertility should be higher	No effect	No effect
Number of non-employed family members in the community	No effect	No effect	No effect	No effect	For a given earning potential, should increase fertility	No effect
Woman's potential earnings	No effect	No effect	No effect	No effect	Should reduce fertility	No effect
Interviewee's Education	When controlling for education, contraceptive knowledge should reduce fertility	No effect	No effect	No effect	Should increase women's potential earnings	Should increase investments in offspring
Parental investments in offspring	No effect	No effect	No effect	Investments that do not impact child survival should not impact fertility	No effect	Should reduce fertility
Children with the most "promise"	No effect	No effect	No effect	No effect	No effect	Should receive more investments

Figure 1.1: Flowchart of the five models



Outline

This dissertation will be organized as follows: chapter two will address the research site and the sampling methods. A description of the ways that fertility is reduced will be discussed in chapter three, along with an analysis of the age of first and last birth in San Borja, Bolivia. Chapter four will discuss the models of parity progression. Parity progression describes the transition to the next birth. This analysis will allow for all women who have had x number of births to be compared to see the likelihood of their progression to their x+1 birth. Chapter five will test and analyze the five models to determine their ability to predict total fertility and to test the path model of each hypothesis. A summary and conclusion is presented in Chapter six.

Chapter 2: Research Site, Sampling Method & Cultural Context

Introduction

Data was collected between January and May 2008 in San Borja, Bolivia, which is located in the Beni region of central Bolivia. In 2008, there were approximately 20,000 people living in San Borja, based on the 2001 census of 16,891 and a predicted population in 2010 of 24,610 (Helders, 2005). The community is relatively isolated from any other large communities as it is approximately 140 miles to Trinidad (the capital of the Beni region). The roads from one town to the next are not paved and typically in poor condition. A trip to Trinidad is likely to take 8-12 hours by car.

San Borja is part of the Bolivian Amazon. It is typically hot and humid. There are two seasons in San Borja: the rainy and the dry season. The rainy season runs from November to April and the dry season occurs from May to October. The average rainfall for this area is approximately 180 cm/yr. It is not uncommon to have strong enough downpours that the town becomes flooded.

Motivation for Research Site

San Borja, Bolvia is a community undergoing a demographic transition. The choice of San Borja, Bolivia as a research setting was motivated by several factors. First, a population was needed that is undergoing a demographic transition so that a sample could be collected of individuals who are changing their fertility patterns that can be compared to people who are retaining a more traditional model. By collecting information on both strategies of reproduction, a valid set of comparisons can be made regarding which independent variables are actually

influencing the change from the traditional high fertility pattern to a more recent low fertility pattern. A pilot study was conducted in the summer of 2005, which showed that older women had on average larger families (about 6 living children), less education (about 4 years of schooling) and used contraceptives at a lower rate (1/3 had ever used) than younger women (about 2.3 children, 9 years of education and 55% had used contraceptives). Women under 30 typically stated that they did not want to have large families. The preliminary data showed that the average fertility for women under 30 was 2.3 children. When asked how many additional children the interviewee hoped to have, approximately 2/3 stated that they did not want to have any additional children, while 1/3 stated they wanted only 1 additional child. If desired fertility correlates with actual fertility, these women will have low completed family size compared to older women living in their community.

Second, a population is needed that is significantly isolated to control for many factors, including availability of contraception and access to education. Trying to determine causal pathways with human subjects is particularly challenging because the other differences between individuals may be accounting for the observed response instead of the factor that the researcher is trying to test. Many confounding variables are controlled for in a small community that is relatively isolated. For instance, everyone has access to internet. There are several internet cafes throughout town that are relatively inexpensive to use. Even though internet is available to all, very few women actually use it. Additionally, everyone has access to contraceptives which are low-cost at any of the local pharmacies or can be obtained free at the hospital, but only those

who have the education to understand how to use them and the desire to control their fertility will seek them out.

Third, a community is needed that incorporates employment by personal connections and employment gained through education. San Borja has both types of economies. Some jobs require education, while others require personal connections. Many men in San Borja are involved in a temporary manual labor job market. They work when there are employment opportunities and will do whatever work is available. These men rely on personal connections to gain temporary employment opportunities. At the same time, there are some individuals who are educated and obtain permanent full-time employment. This provides people the opportunity to choose a strategy that best fits their particular situation. The economy is similar for women. Some women are educated and obtain jobs that require high levels of skill, while others work at home, washing clothes or baking bread, which requires no formal education.

Sampling Method

There were approximately 20,000 people living in San Borja in 2008. The sample consisted of 510 women. With an attempt to get a good representative sample of the community, every third East-West and North-South street were sampled. At every third house a list of every woman who lived in the household was recorded. One woman was selected to be interviewed (randomly at first, then particular women were selected to meet sampling goals in terms of age and ethnicity). If there was no woman living at the home who was over the age of 18, the fourth house was selected. After sampling each third house on every third East-West and North-South street, there were still 60 interviews that needed to be conducted. The remaining interviewees

were selected by approaching every 5th house on every 5th East-West street until a sample size of 500 interviewees was met. A stratified sample was employed, where one third of the sample was under the age of 30, another third between 30 and 45 and the final third was over 45. Figure 2.1 shows the sample size for each age group. There are two ethnic groups in San Borja; Colla and Cambas (see Ethnicity, this chapter). Since there are fewer Colla women, a goal was set to interview 100 Colla women, but a sample size of 88 was accomplished. The rest of the interviews were conducted with Camba women. By traveling east to west and north to south, many different wealth ranges were sampled since wealthier people live in the center of town, with poorer people living in the outskirts. Interviews were also conducted in more rural areas, like east of the airport and south of the highway, so that the sample was not over-represented by people living in the urban areas of the community. Figure 2.2 displays the frequency distribution for number of children (living until at least age 1) for all women and for women over 40 (who have completed their fertility).

Figure 2.1 Proportion of Interviewees by age

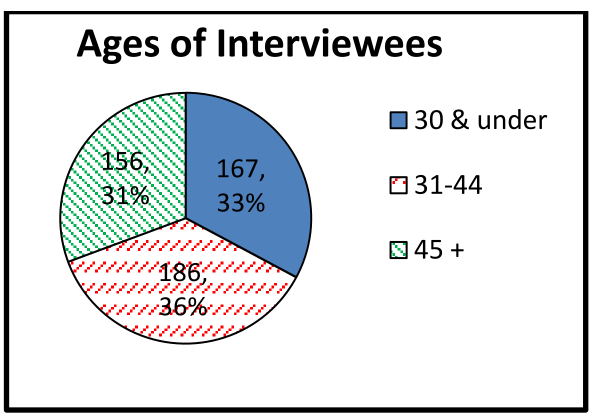
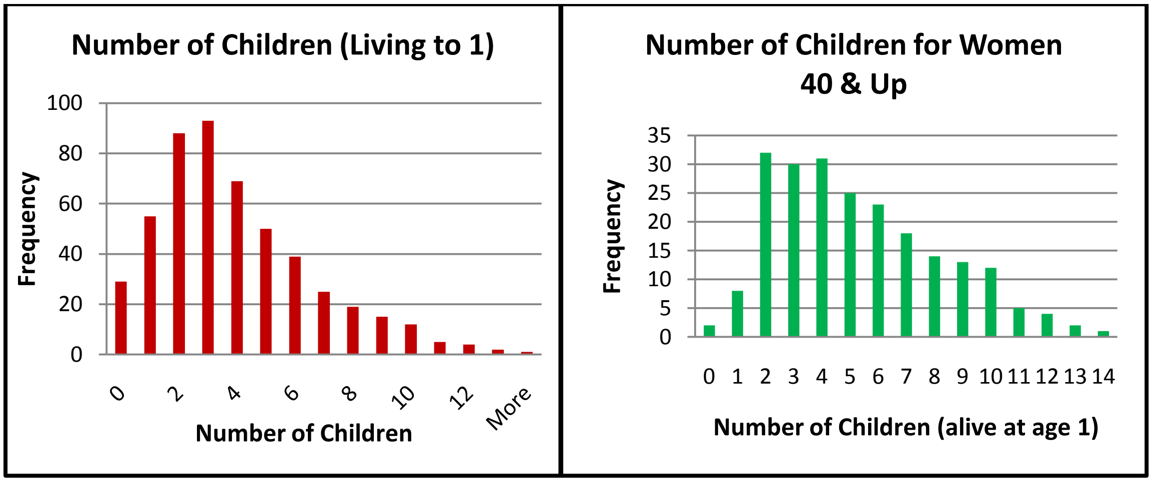


Figure 2.2 Frequency Distribution for number of offspring



Interviews were conducted at interviewees' homes (or places of work), so as to reduce any inconvenience to interviewees. Upon arrival, women were explained the purpose of the study and were told that their answers would remain confidential, that no surnames would be recorded and that they did not have to answer any question they felt uncomfortable with. If the interviewee stated that she needed to be interviewed at another time, an appointment would be made for the interview.

Data Collected

Women were interviewed on a range of topics to test the differing hypotheses of the Demographic Transition and potential confounding variables. The interviews first recorded a household roster, including roster member's relationship to the interviewee, occupation and income. Then data were collected on household items: whether or not the family owned a car, bicycle, scooter or television. This provides information on wealth along with exposure to western ideologies. Information about the woman's access to media was collected, including

whether or not she watched television, what type of programming she preferred, the length of time she watched (both in hours/day and number of years) and whether or not she used the internet. A parental history was taken that included the age of her mother and father, their level of education, occupations, and number of offspring. A sibling history was recorded that included their birthdates, marital status, occupation, education, number of offspring and number of spouses. An inventory of the interviewee's work history was taken. This included information about all of her jobs, her salary and how she got the job (by social connections and/or whether education was necessary). Parental investment questions were asked that included whether or not her parents helped with her homework, how many years they supported her and whether or not they helped pay for university, a wedding, or a new house. The most in-depth part of the interview was questions about the interviewee's children, including investments, expectations, responsibilities, occupations, their fertility and their success in school. Information about contraceptive use was recorded; including when and how she learned about contraceptives, the types she used and how much they cost. A spousal history was recorded to include the type of relationship, its length, his education, occupation, income and how he attained his job. Finally, information was collected on the fertility of close friends and religion; including current and past religion, level of religiosity and frequency of church attendance. This survey took approximately 1-2 hours to complete (dependent on the number of siblings and offspring).

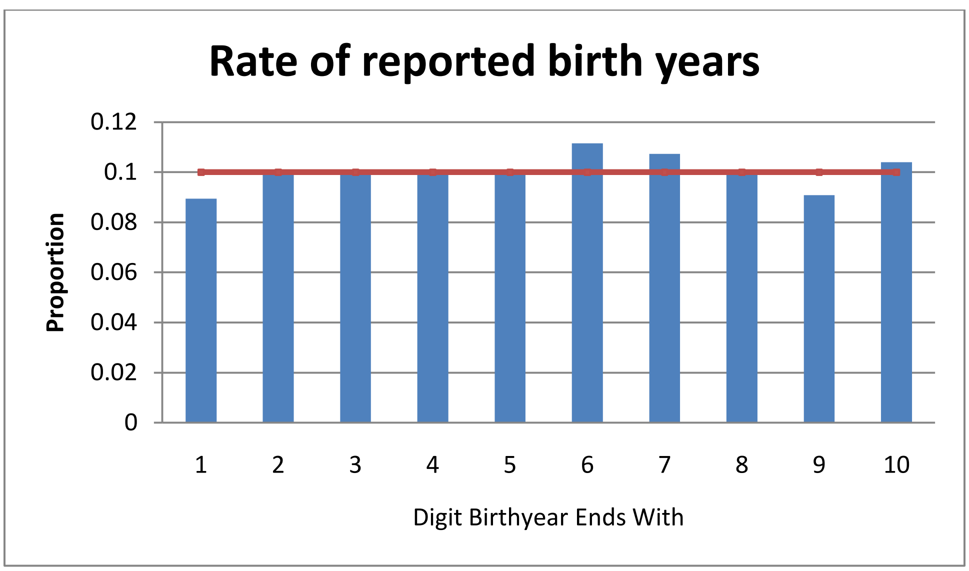
Data Quality and Accuracy

Retrospective interviews provide many benefits over longitudinal studies. Longitudinal studies require extensive data collection (which may take decades in a longitudinal fertility study) and interviewees need to be tracked from one interview to the next. Unfortunately, there are also known issues with retrospective interviews. First, there is evidence that the passage of time results in memory decay (Beckett et al., 2001). Some events can be forgotten, while for others the details may become blurred. Socially undesirable events may be underreported, which may include contraceptive use or abortions. Data heaping may occur, where the timing of specific events is not accurately remembered and a larger percentage of events are described as occurring in even numbered years. Finally, events that are more salient are more easily remembered.

To deal with these data accuracy issues, a few methods were used during the interview. First, alternative questions were asked. If a woman could not remember the birth year of one of her children, alternative questions were asked like, "at what age did you have this child" or "how old was the previous child when this child was born". This allowed for women to determine birth years based on other events in their life. Another method to improve data quality was to ask questions about total number of pregnancies and then have the interviewee go through each child from first pregnancy to last and answer several detailed follow up questions. If the number of pregnancies originally reported differed from the number reported in the detailed section, then the respondent would be prompted to determine why the discrepancy occurred.

There were still several areas of the interview where women were not confident in their answers. These include: the birth years of their children, siblings and husband. While in most developed societies, birthdates are constantly repeated for identification purposes, in rural areas of Bolivia, women do not report the birthdates of their children with any frequency. While most women remembered their own birthdates, they typically struggled to remember those of their immediate family. Beckett et al. (2001) found that data heaping is more common among individuals with less education that lived in more rural areas. In San Borja, women with more education were typically able to report birthdates for their immediate family without alternate questioning.

Figure 2.3 Rate of reported birth years



A chi-square goodness of fit test was conducted to see if individuals were more likely to report birth years in even numbered years for their offspring. Figure 2.3 shows the proportion of reported birth years for children categorized by the final digit of the year of birth. This allows

for a visual inspection to see if particular years are reported more often. The “10” group represents individuals reported as being born in the XXX0 year. The expected proportion for each category is 0.1. This figure shows that while there is some variation across the different years, there does not appear to be a systematic trend where even number years are overrepresented. The chi-square goodness of fit test is not significant, meaning that there is no significant difference between the different birth years ($X^2 = 8.52$, p-value = .48). There is no evidence of data heaping in the data set.

Another interview question that raised concerns was the interviewee’s and her immediate family’s income. There were some women who did not know how much their husband earned, but there were still others who reported suspicious salaries. This may be because individuals were concerned about being taxed based on their reported incomes. Interviewees were informed that their information was confidential and would not be used for any governmental purpose, but it is likely to some individuals in San Borja were unwilling to give accurate income information. To account for this, information about the type of flooring in their home was recorded, along with the number of household items, like televisions, cars, scooters and bicycles. This provides another way to measure wealth.

Another area that might lead to biased responses is the expectations of children. It is particularly hard for individuals to remember what they previously thought would happen. It is easy for people to alter their expectations based on what has actually happened. One interview question asked mothers if they expected their children to graduate high school and whether they expected them to attend college. The results showed that of those children who have completed

their education, 73% of them were expected to attend university, while only 7% of them actually did. This suggests that (for this particularly question), mothers were able to distinguish between their expected educational achievement for children from what they actually achieved.

To check for data quality, interviewees were asked at what age they had their first child and then were asked, at a later point, to provide birth years for each of their children. This allowed for a comparison to see how the reported age of first birth compared with the calculated age of first birth (from the subtraction of mother and child's birth years). The results show that older women are more likely to provide inconsistent birth years and age of first birth. Comparing the reported age of first birth from the calculated value, about 25% of women over 60 were inconsistent by 5 or more years. Inaccuracies were reduced to 18% for women 50 to 59, 7% for women 40-49, 3% for women 30-39 and 0% for women under 30. This demonstrates how difficult it is for women to remember birth years accurately. Since it is more likely that interviewees remember their age of first birth (over the birth year of their children), this value was used in the analysis of age at first birth.

It is believed that infant mortality is commonly underreported. While it is hard to determine the rate at which something is not reported, one can look at the rates of infant mortality through time and by gender. The expectation is that infant mortality should decrease through time (given improving health standards) and that males should have a slightly higher infant mortality than females (Drevenstedt et al., 2008). If infant mortality rates are increasing through time, it is an indication that as time passes, individuals are less likely to report the death of an infant. Table 2.1 shows the mortality rates through time by gender. The male infant

mortality rate is higher than the female infant mortality rate except for births between 1970 and 1979 and after 2000. While this is unexpected, it may be due to small sample sizes. In the overall infant mortality rate, male mortality is higher than female mortality. Looking at the overall fertility rates (which are not necessarily the sum of the male and female values because of individuals who stated they could not remember the sex of their child), the highest mortality rate occurred for children born between 1980 and 1989. It is unlikely that the mortality rate increased in the 1980s, so this likely represents underreporting of offspring deaths before the 1980s.

Table 2.1 Offspring mortality rates by decade of birth and gender

	Male			Female			All		
	Infant deaths	Total births	Infant mortality rate	Infant deaths	Total births	Infant mortality rate	Reported deaths	Total births	Infant mortality rate
Before 1970	4	75	5.33%	1	87	1.15%	7	164	4.27%
1970-1979	7	150	4.67%	8	164	4.88%	15	317	4.73%
1980-1989	14	258	5.43%	8	210	3.81%	26	472	5.51%
1990-1999	13	318	4.09%	6	334	1.80%	24	657	3.65%
After 2000	5	240	2.08%	5	224	2.23%	10	464	2.16%
Total	**43**	**1041**	**4.13%**	**28**	**1019**	**2.75%**	**82**	**2074**	**3.95%**

While every attempt was made to get accurate data, there are systematic errors that occur in retrospective interviews. This will impact results, so it is important to be aware of the effect these errors have on data. For instance, since reported income does not seem to be an accurate representation of wealth, other wealth indicators were used in analyses. Individuals have difficulty remembering birth years, so the reported age of first birth is used instead.

Economy

There is a high level of male under-employment in this region. The largest business in the community is the cattle industry, which employs approximately 21% of men (n=624). Since there are more men than job opportunities, many men work as independent taxi drivers (13%) where they can be their own boss and make their own hours. Since cars are not common (only about 10% of families reported owning a car), most taxis are scooters. Men also work in areas where they can gain employment for a few weeks or months at a time. For instance, 13% of men work in construction and 6% work as loggers. Approximately 2% of men "do everything" and will do whatever job is available to them at the time. The number of men who work in full-time careers that require education is limited, only about 7% of men work in occupations such as teachers, pharmacists, doctors, lawyers, accountants or veterinarians.

Women typically work in jobs that are compatible with childcare. Of the 509 women who provided information about their occupation, approximately 37% of women describe themselves as 'housewives'. An additional 15% work at home, bringing money into the household by making, tailoring or washing clothes, baking bread or selling cosmetics. This allows women to be at home with their children while also contributing something to the household income. The most frequent profession for women is working as a merchant or a shopkeeper. Approximately 30% of women report that they work at a store, own a store, or sell something (such as food, drinks or cosmetics). Only 7% of women work in jobs that are not compatible with childcare and about 5% work in occupations that require education, such as nurses, teachers, administrators or pharmacists.

Ethnicity

Of the two ethnic groups in San Borja, Collas have ancestral roots to highland locations (such as La Paz or Cochabamba) while Cambas are from the lowlands of Bolivia (many are natives to San Borja). Eighty six percent of Colla women work in the market, owning a store or a cart, and selling goods (n = 88). Since most Colla women work, they have an elevated income (average family income of $24/day) compared to Camba families (average of $13/day), even though Colla families have fewer household members on average than Cambas. Camba women tend to work in domestic occupations including "housewives", housekeepers or cooks (56%). Although Collas are the minority in San Borja, they number at least 2000 (and 88 were interviewed for this project). Colla women tend to have chosen a reduced fertility strategy as compared to Camba women. Looking at completed fertility (women over 45), the average number of children born to Colla women is 4.0, while the average number of children born to Camba women is 6.6.

Religion

Originally, San Borja was founded by a Jesuit missionary, San Francisco de Borja in 1693 (Chicchon, 1992). These original Catholic roots continue today as 78% of the women in San Borja describe themselves as Catholic (n=501). Another 16% consider themselves Evangelical Christians. Less frequent religions include: Mormons, Seventh Day Adventists, Jehovah's Witness and Jewish, each of which constitute 1% or less of people in San Borja. Approximately 5% of women in San Borja do not affiliate themselves with any religion.

Religion is an important part of life in San Borja. Approximately 87% of women sampled consider themselves "religious" or "very religious". Almost half (47%) of women

surveyed stated that they attend church at least weekly. Religion can influence fertility by the religious teachings and the social diffusion with other religious believers. Of people sampled, 39% of Catholics believe that the church supports members having large families. If followers of a particular religion have larger families, the interaction with those people may cause one to increase their own fertility by adopting the fertility ideas of those pronatalist individuals.

Marriage

Of the 509 women sampled, 82% are currently married (or in a marriage-like arrangement). Six percent of women are single mothers and 5% are single women who have not had any children. Less than 3% are divorced (without remarriage) and less than 4% are widowed (without remarriage). Among those women who are cohabiting with a man in a marriage-like arrangement, 50% have had a marriage ceremony and 50% have not. In San Borja, people do not need an official marriage ceremony to be considered 'married'.

Polygamy is not an accepted form of marriage in San Borja, but there are men who openly have 'multiple families'. Additionally, serial relationships are common. Forty percent of women reported their fathers having children with another woman before or after the relationship with their mother. An additional 5% reported their fathers having children with another woman during the relationship with their mother. Forty two percent of women reported that their husbands had children in relationships before or after their relationship and that 3% of them had children with another woman during their relationship. Lifelong monogamy only accounts for about 50% of marriages.

Of the 509 women sampled, 22% of them stated that they had been in at least two relationships that resulted in children. Thirty three percent of these first marriages lasted less than three years. While almost ¼ of women stated that they had been in multiple marriages, only 3% of women stated that they had been in more than two marriages. While many women have children with two partners, it is uncommon to see women with more than that. This may affect fertility because couples are likely to have another child after remarriage, regardless of the number of children they have already had in other relationships (Griffith et al., 1985). Couples may feel that having a child together confirms their married status. Among women who are choosing a low fertility strategy, having multiple spouses may lead to increased fertility in comparison to those women who only marry once. For those women who are choosing a higher fertility strategy, divorce and remarriage may reduce the amount of time available for procreation and lead to lowered fertility.

Divorce and remarriage may also affect children. About 60% of fathers did not contribute financially to the welfare of their children after they separated from the child's mother. This may limit the investments that children receive since their biological father is contributing less than would be expected if the couple remained together. It is possible that investments the child loses from his/her biological father may be somewhat compensated by a step-father, but many studies document that children receive lower levels of care and investment from step-fathers than they would from biological fathers (Daly and Wilson, 1981; Flinn 1988; Lancaster and Kaplan, 1999). Children whose parents divorce are expected to receive fewer investments throughout their lives.

There is a relatively small percentage (approximately 6%) of children whose mothers stop supporting them before the age of 10 (n=726). Of the 45 children whose mothers stopped supporting them before the age of 10, 35 (78%) saw their parents get divorced and their mothers remarried early in their lives. These children were often raised by their father (37%) or a grandparent. Divorce can have negative impacts on children in San Borja, given that many children lose the investment of at least one parent and some children lose the support of both if they are forced to move in with a grandparent.

Patterns of Residence

Residence patterns (whether a couple lives with her family, with his family or start their own household) can affect fertility. Data shows that paternal grandparents increase the fertility of a daughter-in-law (but do not affect child survivorship), while maternal grandparents improve the health of their daughter and grandchildren, but do not increase fertility (Mace and Sear, 2005). Data from India shows that when a woman is isolated from her kin members, she may be pressured to increase fertility and less likely to use contraceptives (Dyson and Moore, 1983). Approximately 57% of women reported that they live with their nuclear family in a neolocal residence pattern (n = 464). An additional 9% live with the wife's parents in a matrilocal residence pattern and 8% live with the husband's parents in a patrilocal residence pattern. The remaining 25% of interviewees lived in a residence pattern that was not matrilocal, patrilocal or neolocal. For example, a couple may live with his or her siblings, or they may live with friends. The majority of couples in San Borja live in a neolocal pattern, and for those that choose to live with their parents, it is evenly split between matrilocal and patrilocal residence patterns.

Conclusion

This chapter provides information about the research site, San Borja, Bolivia, including data on the economy, ethnicities of the residents, their religion, occupations, and marriage information. It provides insight into the culture of San Borja and provides background for interpreting the results of their fertility transition. The economy of San Borja, which has a large percentage of women who work at home or do work that is compatible with childcare, allowed for interviews to take place during work hours. The small percentage of women who worked in jobs where they could not be interviewed during work hours, such as teachers, were few enough that they could be interviewed in the evening or during the weekends.

Chapter 3: Age of First Birth

Introduction

There are three main ways in which fertility reduction can take place. First, the age of first birth can be delayed. Second, the number of higher-order (second or more) births can be reduced (and typically age of last birth is earlier). Third, birth intervals can be increased. By delaying the age of first birth, women have a shorter reproductive span and cannot produce as many offspring. Before modern contraceptives, delaying the age of first marriage, and correspondingly, the age of first birth was one method of reducing fertility. In Western Europe, this method was employed to keep fertility low in the absence of modern contraceptives (Coale, 1991). Since the advent of modern contraceptives, people have more control over the timing of fertility decisions. There has been a postponement of reproduction (and an increase in age of first birth) in many countries today. In the United States, the average age of first birth has increased from 21.4 years in 1970 to 25.0 years in 2006 (Mathews & Hamilton, 2009). There has been an increasing age of first birth in all geographical areas and across all ethnicities in the United States. The age of first birth has increased consistently for the developed nations of the world as well, including Japan, Switzerland, France, Canada, Denmark, Italy, Ireland and Greece (Mathews & Hamilton, 2009).

The second way that one can reduce fertility is by reducing higher-ordered births. This can be achieved by having an earlier age of last birth or having larger birth intervals near the end of one's reproductive career. This "truncation of childbearing" has been observed in German villages at the end of the 19th century (Knodel, 1987). Compared with natural fertility

populations, when family limitation is practiced, couples generally terminated childbearing activities at older ages and concentrated their reproductive careers towards the earlier part of a wife's fertile period (Knodel, 1987). Anderton (1986) analyzed fertility transition data from 19th century Utah. He found that average age of last birth declined from 40.3 years in 1845 to 35.2 in 1890 and was accompanied by increasing birth intervals.

If a woman can increase the spacing between her births, she can reduce her overall fertility. This has been documented in conjunction with reduced age of last birth. In Utah, the interbirth interval increased from 1845 to 1890 (Anderton, 1986). More recently, Ghana women have shifted their birth spacing (based on data collected in 1979 and 1980) where older women have, on average, a longer interval from marriage to first birth, but shorter birth intervals between each birth compared to younger women who have, on average, a shorter interval from marriage to first birth, but longer intervals between each subsequent reproductive event (Oheneba-Sakyi, 1989). This may represent the beginning stage of Ghana's demographic transition, which Oheneba-Sakyi attributes to efficient contraceptive use and mass formal education for younger women.

An additional way that the total fertility rate of a country can be reduced is with an increasing number of women who remain childless. In pre-industrial Europe, over 10% of 50 year old women had remained unmarried and therefore did not have children (Coale, 1986; Anderson, 1976). In developed countries today, there has been an increase in the percentage of women who choose to remain childless or who are delaying reproduction so long that they are unable to conceive once they try (Rowland, 2007). Toulemon (1996) states that, without therapy

20% of women who try to start their reproductive careers at age 35 will not succeed. In Bolivia, there are very few women who remain childless. For women over age 30, only 2.4% (n = 362) have not had any children.

There are two questions that this chapter hopes to answer: 1.) How has the age of first birth changed through time in San Borja? 2.) What factors impact age of first birth? To answer the first question, data will be analyzed to see if age of first birth is increasing, as has been documented in developed countries around the world. To understand the factors that affect age of first birth, the five models will be analyzed to see what predictions they make regarding the start of a woman's reproductive career. These predictions will be analyzed to see how well they fit with the observed results.

Life History Tradeoffs

The age of first birth is a tradeoff between continued growth (including the accumulation of resources) and beginning reproduction (Kozlowski and Wiegert, 1986; Charnov, 1993). If one chooses an earlier age of first birth, the individual may be able to maximize his/her reproduction span and possibly increase fertility, but this may be at a cost of growth or the accumulation of necessary resources for reproduction. Without adequate size and resources, one may not be able to support offspring, be able to fight off predators or provide offspring with necessary investments. If one starts reproducing too soon, it may result in a shorter lifespan, increased offspring mortality or reduced reproductive opportunities. If one starts reproducing too late, it may result in a shortened reproductive period, which would result in reduced fertility. It is important organisms optimize their age of first birth to maximize reproductive success. Among

a Gambian population, data shows that when controlling for height at age 13 (which controls for genetic and environmental differences), those that have a later age of first birth are taller, and being taller leads to reduced infant mortality (Allal et al., 2004). This shows the tradeoff between waiting to start reproduction, which allows an individual to get taller, and therefore increases infant survivorship versus starting reproduction earlier, which will increase a woman's reproductive span but possibly reduce the number of surviving children. One would expect that the age of first birth has been selected for. The data from Gambia suggests that women are having their first birth at almost the exact age that is mathematically predicted (Allal et al., 2004).

Hypotheses

Predicting Age of First Birth throughout Time

There are three hypotheses to explain how fertility has changed through time. The first states that women are delaying fertility similar to what has been documented in the United States and Europe because they are investing more in themselves. In developed societies, this is not just adequate height and fat reserves, but developing skill by getting educated or working to accumulate resources that will be necessary for investments in offspring. The prediction is that age of first birth is increasing.

The second hypothesis states that there are multiple strategies in San Borja. Some individuals may be delaying age at first birth while others are maintaining a relatively early age of first birth. Some African American women in urban U.S. cities choose to begin having

children early in their reproductive careers when a kin network is available to help with the needs of the child. Additionally, offspring outcomes decline when mothers are slightly older (Geronimus, 2003). This is in contrast to other women in the same country who choose to delay their fertility. It is possible that there are dual strategies in San Borja as well. There may be women who choose to procreate early and have the support of their family to help them raise their offspring and then others who delay fertility because they are investing in their own education before beginning reproduction.

The third hypothesis states that age at first birth is not changing. This is similar to the trends documented in 19th century Germany and modern Ghana, where fertility reduction begins with a reduction in higher-parity births instead of changes in the age of first birth.

Predicting Factors that Influence Age of First Birth

The five models that were discussed in Chapter 1 can also make predictions about age of first birth.

Contraceptive Knowledge

Contraceptive Knowledge states that knowledge of contraception and access to low-cost birth control is the main factor affecting fertility reduction. Based on this model, the prediction for the age of first birth is**: If a woman learns about contraceptives before her first pregnancy, it should delay her age of first birth.**

Diffusion Theory

Diffusion Theory states that people choose their fertility based on strategies they are exposed to. Boyd and Richerson (1985) suggest that people are most influenced by access to

high status individuals. Based on this hypothesis, the prediction for age of first birth is: **Women who are exposed to high-status individuals (by access to television and internet) before their first birth, should delay their fertility.**

Kohler (1997) predicts that individuals adopt the fertility strategies of people in their social network. The prediction of this hypothesis is that: **Age of first birth should be correlated with the age of first birth of one's social network.**

Wealth Flows

Wealth Flows states that people choose fertility rates based on the cost of children. When children cost more, parents should limit their fertility. There is no prediction as to when individuals should have these children (earlier or later in life).

Female Labor Force

Female Labor Force Theory predicts that fertility will decline when women pay a higher cost of having children because of lost job opportunities or higher childcare costs. Women who work in occupations where they cannot bring their child to work have to decide to quit their job or pay someone to care for children if they have offspring. This leads to the prediction that: **women who work in jobs that are not compatible with childcare should delay fertility compared to women who either do not work or work at a job compatible with childcare.**

Embodied Capital

Embodied Capital Theory posits that parents with more education and skill will invest highly in their offspring to prepare them for the competitive wage labor market. These offspring will receive large investments from their parents and will achieve higher levels of education.

This leads to the following prediction: **Those individuals who have received higher levels of investments from parents and those interviewees who are investing highly in their own education (to enter into the competitive wage labor market) should delay age of first birth. Those individuals who are not investing in their skills will not delay reproduction.**

Methods

Data was collected from 510 women in San Borja, Bolivia. Retrospective interviews were completed at the woman's home, which typically took between 1 and 2 hours. Refer to Chapter 2 for a description of the data collected. Information related to analyzing age of first birth was collected on the following: interviewee's age of first birth, age learned about contraceptives, age began using contraceptives, age began watching television, number of hours of television watched per day, internet usage (per month), current and past employment (including who cares for children when a mother is working), investments in offspring (including whether parents read to a child, helped a child with homework, provided money for a wedding, helped pay for higher education, age that parental support is terminated) and age of first birth of interviewee's sisters.

Results

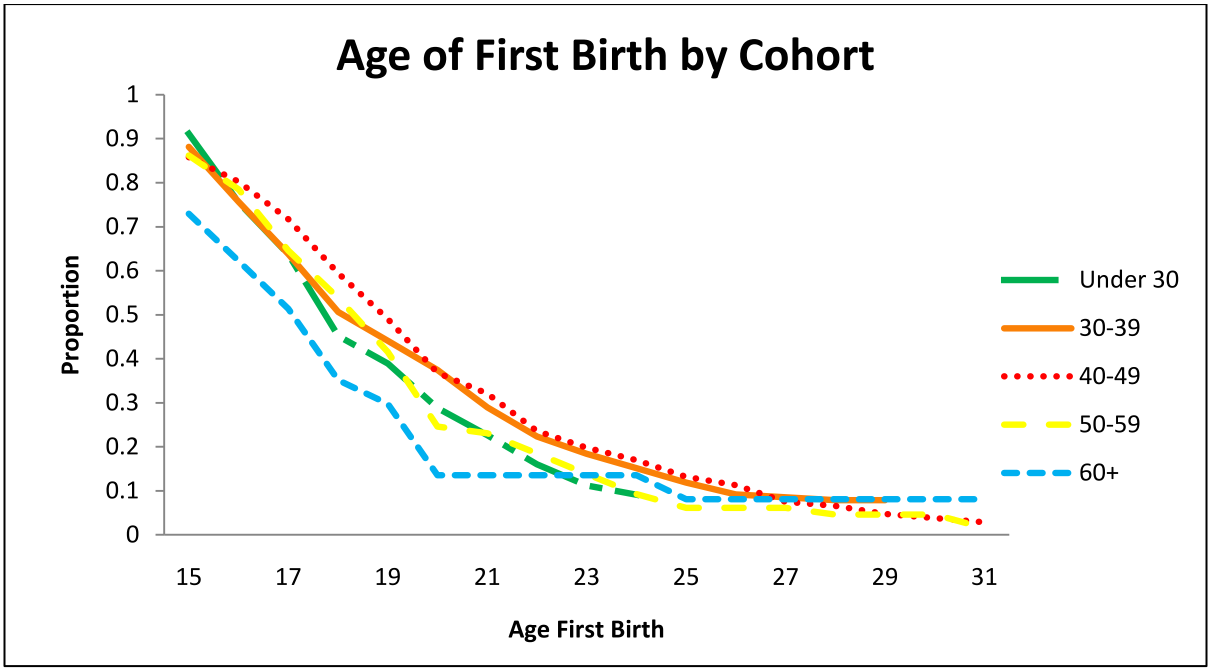
How has the age of first birth changed through time?

Age cohorts are groups of individuals who were born in the same time period. They experience similar historical circumstances at the same age. Figure 3.1 shows the age of first birth by age cohort. The vertical axis shows the percentage of people who have not had their first child. For example, at age 15, most people have not had their first child yet, so the lines start between 75% - 92%. As years pass, the percentage of women that have their first child increases

until about age 31, where all of the cohorts are below 10% (meaning less than 10% of people have not had their first child). This graph is not subject to censoring problems for younger women. Women who have not had their first child yet are included for each year they haven't had a child and then not included past their current age. The most interesting result from this graph is that cohort does not seem to have any impact on age of first birth. Age at first birth for women under 30 is quite similar to women from age cohorts 30-39, 40-49 and 50-59. This suggests that in San Borja, age of first birth has not changed with recent fertility decline. Women in the over 60 age cohort have significantly earlier age of first birth compared to the other cohorts, but San Borja does not seem to be following the same pattern as developed countries, where age of first birth continues to increase decade after decade.

Table 3.1 shows the descriptive statistics for age of first birth by cohort. Median age allows for a comparison of all women, even those who remained childless or have not yet had their first child. This chart shows that there has not been a recent shift in median age of first birth as it is the same for women aged 30-39, 40-49 and 50-59. Women under 30 have a median age of 18.5 years while those women over 60 have a median age of 18. Average age of first birth shows a similar trend, except that the mean age of women under 30 years old is biased because only those women who have had their first birth are included. There is no trend for standard deviation by age group. Women in the 40-49 age cohort have the largest standard deviation, while those in the younger age group have the smallest, partially because of those individuals who are being excluded.

Figure 3.1 Age of First Birth by Cohort



While it doesn't appear that age of first birth has changed recently for the entire community, it is possible that particular individuals have begun to delay their fertility to invest in increased training/education for themselves. Also, since fertility reduction typically begins among wealthier individuals first, it is possible that they are the first to increase age at first birth. In Table 3.2, the results from three different regression analyses are presented. The first analysis looks at those women whose immediate families received 25% or more of their jobs from educational attainment. There are about 20% of individuals in San Borja who fit this criterion. The evidence suggests that those women whose family members may be investing more in education are not delaying their fertility at all and actually have lower age of first births compared with older women.

Table 3.1 Descriptive Statistics of Age of First Birth by Cohort

Age cohort	Sample Size	Median	Mean	Standard Deviation
Under 30	126	18.5	18.55	2.85
30-39	145	19	19.43	3.86
40-49	106	19	20.31	4.84
50-59	64	19	19.25	3.68
60+	37	18	17.84	3.61

Table 3.2 Cohort effects of Age of First Birth

	a. Educational Jobs > 0.25			b. Tile Floors			c. Individuals with reported income in top 25%		
Parameter	Param Est	Sig.	Partial Eta Squared	Param Est	Sig.	Partial Eta Squared	Param Est	Sig.	Partial Eta Squared
Intercept	20.25	<.001	0.694	17.333	<.001	0.646	18.714	<.001	0.582
Under 30	-0.987	0.562	0.004	1.542	0.515	0.01	0.598	0.718	0.001
30-39	0.99	0.547	0.004	2.889	0.189	0.042	1.043	0.529	0.004
40-49	-0.295	0.859	0	4.967	0.035*	0.103	0.75	0.655	0.002
50-59	-0.3	0.859	0	2.524	0.298	0.026	1.286	0.472	0.005
Over 60	0	.	.	0	.	.	0	.	.
	R Squared = .031 (Adjusted R Squared = -.012)			R Squared = .145 (Adjusted R Squared = .061)			R Squared = .007 (Adjusted R Squared = -.029)		

In Table 3.2b and 3.2c, wealthier women were analyzed to see if their age at first birth has been increasing. In Table 3.2b, wealth is operationalized by individuals who have tile flooring. In San Borja, only 10% of houses have tile flooring (the rest of the population either has dirt or concrete floors). In this analysis the group with the oldest age of first birth is the 40-49 age cohort. The younger age groups (Under 30 and 30-39) do not have significantly different age of first births (compared to the over 60 group) and have not increased their age of first birth

compared with the women aged 40-49. In Table 3.2c, wealth is measured by reported daily incomes. The top 25% of individuals were analyzed (with an average daily income of 131 bolivianos or higher). There are no significant differences between cohorts.

Even in the different subpopulations of San Borja, there does not seem to be any trend in age of first birth through time other than earlier age of first birth for women over 60. Evidence from other locations suggests that age of first birth may not be the first thing to change in a demographic transition, an earlier age of last birth and larger birth intervals may change first (Knodel, 1987; Anderton, 1986).

Table 3.3 Age of Last Birth by Cohort

Dependent Variable: Age of last birth

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	37.289	1.103	<.001	.883
Age = 45 to 59	-2.617	1.271	0.041**	.027
Age = 60+	0	.	.	.

R Squared = .027 (Adjusted R Squared = 0.021)
n = 154
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Since age of first birth does not seem to be changing, it leads to the question of whether age of last birth is decreasing. The sample of individuals that can be looked at for this analysis has to be women who have completed their fertility, so only those women over 44 are included, which makes this analysis less powerful since the sample size is much smaller (n=154). Figure 3.3 shows the analysis of age of last birth for women over 44. There is a significant difference between women from 45-59 and those over 60. Women between 45 and 59 have on average an earlier age of last birth by 2.6 years. The predicted age of last birth for women 60 and over is

37.3, while the predicted age is 34.7 for those between 45 and 59. This evidence suggests that while age of first birth may not be changing, there is some evidence that age of last birth is decreasing.

What factors affect age of first birth?

Table 3.4 presents the best model of Age of First birth. This model will be discussed in reference to each of the hypotheses below.

Table 3.4 Multiple regression analysis modeling age of first birth

Dependent Variable: Age of First birth

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	20.140	1.426	<.001	.328
Age = Under 30	-1.440	.375	<.001****	.035
Age = 30 +	0	.	.	.
Ethnicity = Camba	-2.087	.405	<.001****	.061
Ethnicity = Colla	0	.	.	.
Education	-.231	.136	.091	.007
Education Squared	.020	.008	0.021**	.013
Learned contraceptives = before first pregnancy	2.069	.354	<.001****	.077
Learned contraceptives = after first pregnancy	0	.	.	.
Age parents terminate support	-.228	.164	.165	.005
Age parents terminate support squared	.015	.005	0.002***	.022

R Squared = .321 (Adjusted R Squared = .309)
n = 417
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Contraceptive Knowledge

In San Borja, contraceptives are available at the hospital and at local pharmacies (located throughout town). Women were asked how much contraceptives cost and 40% stated that they received contraceptives for free at the local hospital. For women who live on the outskirts of town, it would be a long walk to the hospital, but the hospital would be easy to get to with a bike

or with a short taxi ride. Given the easy access of contraceptives within San Borja, it is assumed that all women who have a strong desire to use contraceptives will be able to access them. Control variables, such as distance from the center of town and income, were included in all analyses to assess the possible influence of these variables on contraceptive use.

Figure 3.2 shows the rate at which women in San Borja learn about contraceptives through time by cohort. Women over 60 have a lower rate of learning about contraceptives at every age. For each cohort, there is an increase in the rate women are learning about contraceptives. The youngest women (those under 30) have all learned about contraceptives. Today, sexual education is taught in school, which has led to a dramatic increase in the knowledge of contraceptives.

Figure 3.2 Rate at which women learn about contraceptives by cohort

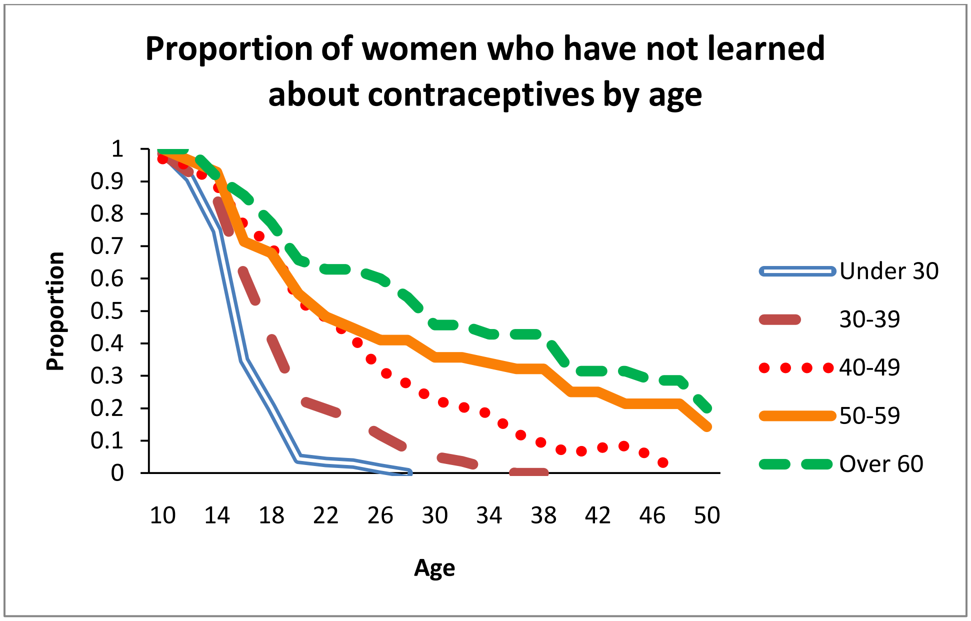


Figure 3.3 shows the rate at which women have ever used contraceptives by age. This chart has a similar trend as the curve for learning about contraceptives. Those in the oldest cohorts have lower levels of ever using contraceptives, while those at younger cohorts have higher rates of use. Unlike the graph on learning about contraceptives, there is no cohort where all individuals have used contraceptives. For women under 30, about 70% of women have used contraceptives, while for women over 60, less than 20% have used them.

Contraceptive Knowledge predicts that learning about contraceptives (and in turn, using contraceptives) before one's first pregnancy should delay the age of first birth. In Figure 3.4, the average age of first birth is compared for women who learned and used contraceptives before and after their first pregnancy. This chart displays that as predicted, those women who learn about (and use) contraceptives before their first pregnancy appear to have a later age of first birth.

Figure 3.3 Rate at which women ever used contraceptives by age

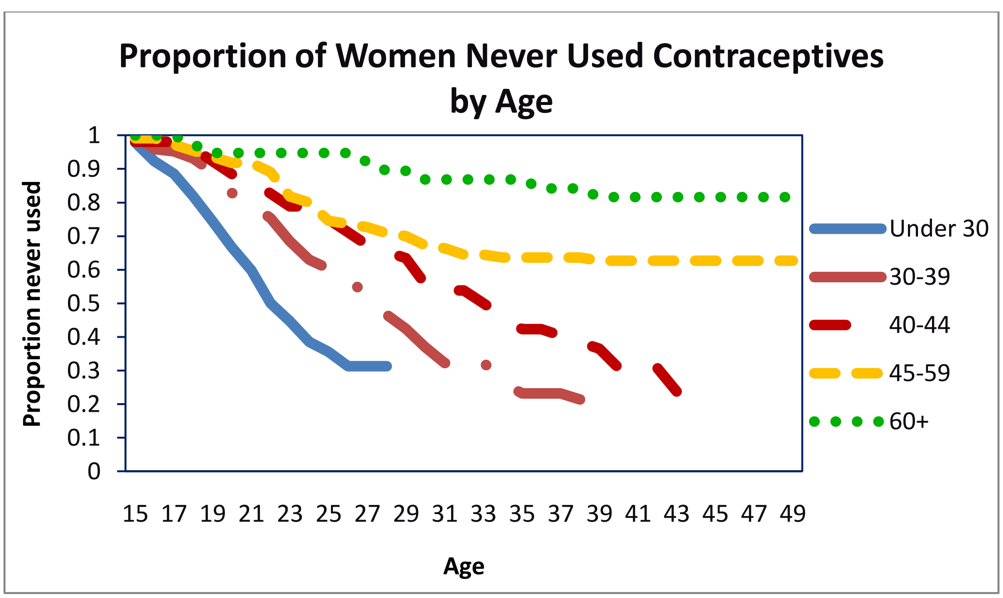


Figure 3.4 Average Age of First Birth based on when one learned (and uses) contraceptives

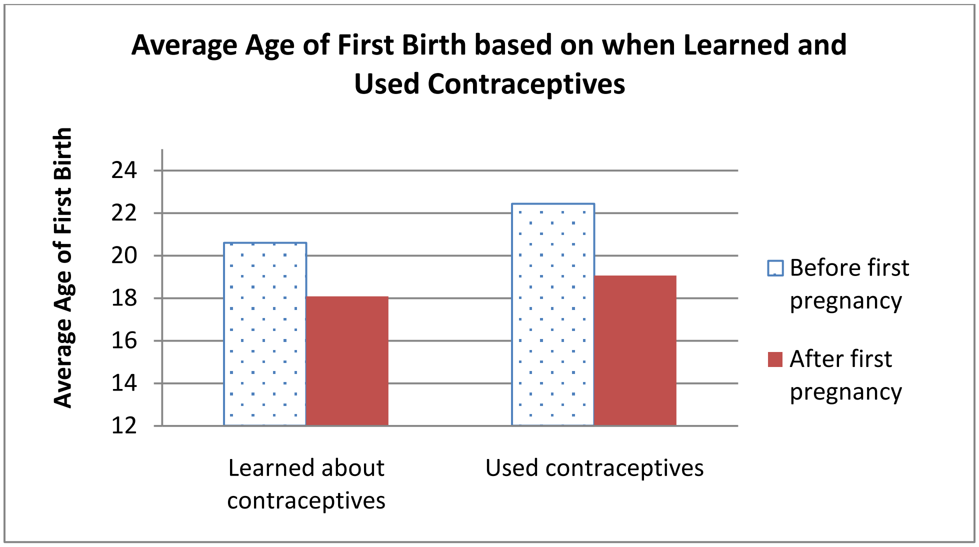


Table 3.5 displays the model of the effect of contraceptive knowledge variables on the age of first birth. Both when one learns about contraceptives and when one uses contraceptives (as defined as before or after first pregnancy are significant). Additionally, education and education squared are significant predictors of age of first birth. As education increases above the fifth grade, each additional year of schooling delays average age of first birth. Ethnicity is also a significant predictor, as Camba women typically have an earlier age of first birth. Analyses were also conducted using the actual age a woman learned about and started using contraceptives. These were significant as well, but in the non-predicted direction. The interpretation of this result is that those women who learn and use contraceptives at earlier ages have earlier ages of first births. This is the opposite conclusion of the categorical variable of whether a woman learned or used before her first pregnancy. This unusual result may be because women who get pregnant young are quickly taught about contraceptives and begin using them. Approximately 12% of women learned about contraceptives during the same year as they

had their first birth. These women had an average age of first birth of 16.2 years as compared with 19.2 for the general population. This suggests that those women who learn early, learn because they got pregnant and not the other way around. These women with early ages of first birth are also more likely to learn and use contraceptives at a young age and one would predict that this knowledge should prevent their second or third pregnancy. This will be discussed in more detail in the next chapter on parity progressions.

Table 3.5 Multiple regression analysis of the effect of contraceptive knowledge on age of first birth

Dependent Variable:Age of First birth

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	20.523	.576	<.001	.754
Age = Under 30	-1.820	.389	<.001****	.050
Age = 30+	0	.	.	.
Ethnicity = Camba	-2.300	.426	<.001****	.066
Ethnicity = Colla	0	.	.	.
Education	-.244	.141	.085	.007
Education Squared	.026	.009	0.003***	.021
Used Contraceptives = before first pregnancy	1.639	.732	0.026**	.012
Used Contraceptives = after first pregnancy	0	.	.	.
Learned Contraceptives = before first pregnancy	1.946	.379	<.001****	.060
Learned Contraceptives = after first pregnancy	0	.	.	.

R Squared = .258 (Adjusted R Squared = .248)
n = 422
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Table 3.4 displays the full regression analysis of the effects of contraceptive knowledge on age of first birth after controlling for other significant variables from the other models. Wealth indicators were also included, but were not significant, so were removed for the final

model. There is one categorical contraceptive knowledge variable that remained significant in the final model: whether a woman learns about contraceptives before or after her first pregnancy. This variable is significant at $\alpha = 0.01$ level. If a woman learns about contraceptives before her first pregnancy, it is predicted that it will increase her age of first birth by 2.069 years.

The categorical variable of whether a woman used contraceptives before or after her first birth was significant in partial models that only included contraceptive knowledge variables (Table 3.5), but was not significant when variables from other models were included (Table 3.4).

Diffusion Theory

To look at the effect of the diffusion of high status ideas on age of first birth, several variables were analyzed including: age the interviewee began watching television, the number of years before 25 that she started watching TV (to deal with the issue of censoring for younger women), a categorical variable for when a woman started watching TV (before, during or after her reproductive career), number of hours of TV watched per day, whether or not the interviewee watched either soap operas or movies and the number of times (per month) that she accessed the internet. Figure 3.5 shows the relationship between watching soap operas/movies by age. There is a strongly negative correlation, where younger women are most likely to watch soap operas/movies and the oldest women are least likely. A 'media' factor was created using the variables: age started watching TV, amount of TV watched and internet usage. This was also used in the analysis. Several models were created to see if media had any impact on age of first birth. The only mildly significant term in any of the models was: Watching western TV (soap operas or western movies), but the result was not in the predicted direction and when controlling for wealth it was no longer significant. Several of the models are shown below in Table 3.6.

Figure 3.5 Access to Media by Age

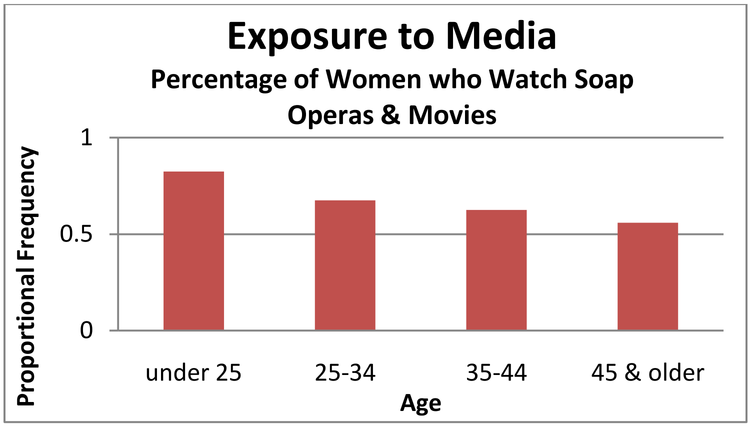


Figure 3.6 Women's exposure to TV by age and her average age of first birth

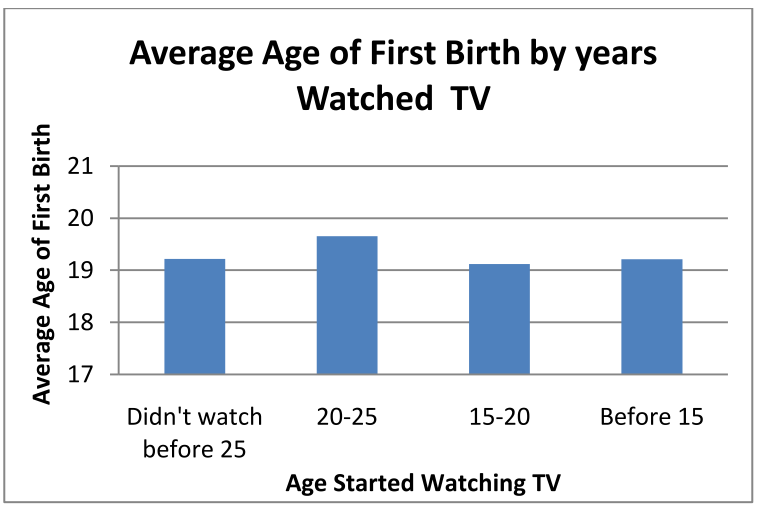


Figure 3.6 shows the relationship between age of first birth and when the interviewee began watching TV. No trend can be seen in this figure. Regardless of a woman's exposure to media, her average age of first birth is between 19 and 20 years old.

Table 3.6 Multiple regression analysis of the effect of media access on age of first birth

Table 3.6a				Dependent Variable: Age of First birth
Predictors	**Parameter Est**	**Std. Error**	**Sig.**	**Partial Eta Squared**
Intercept	19.066	0.412	<.001	0.833
Watch western TV = no	0.733	0.425	0.085	0.007
Watch western TV = yes	0	.	.	.
Hrs of TV (per day)	-0.068	0.127	0.595	0.001
Num of Yrs (before 25) watched TV	0.009	0.026	0.735	0
Internet use (monthly)	0.05	0.068	0.457	0.001
R Squared = .011 (Adjusted R Squared = .002)				
N = 433				

Table 3.6b				
Predictors	**Parameter Est**	**Std. Error**	**Sig.**	**Partial Eta Squared**
Intercept	19.113	1.75	<.001	0.236
Watch western TV = no	0.301	0.412	0.466	0.001
Watch western TV = yes	0	.	.	.
Started TV Watching before Reproductive	-0.911	1.284	0.478	0.001
Started TV Watching during Reproductive	-0.087	0.84	0.917	0
Started TV Watching after Reproductive	0	.	.	.
Floor = Dirt	-0.018	0.652	0.978	0
Floor = Concrete	0.641	0.638	0.316	0.003
Floor = Tile	0	.	.	.
Ethnicity = Camba	**-3.13**	**0.519**	**<.001*** **	**0.086**
Ethnicity = Colla	**0**	**.**	**.**	**.**
Education	**0.332**	**0.055**	**<.001*** **	**0.087**
Hours of TV (per day)	-0.177	0.124	0.154	0.005
Internet use (monthly)	-0.042	0.064	0.51	0.001
Age started watching TV	0.033	0.028	0.247	0.003
R Squared = .182 (Adjusted R Squared = .161)				
N = 397				

Table 3.6c				
Predictors	**Parameter Est**	**Std. Error**	**Sig.**	**Partial Eta Squared**
Intercept	19.762	0.934	<.001	0.536
Doesn't watch western TV	0.302	0.405	0.456	0.001
Does watch western TV	0	.	.	.
Started TV Watching before Reproductive	-1.343	0.819	0.102	0.007
Started TV Watching during Reproductive	-0.334	0.624	0.593	0.001
Started TV Watching after Reproductive	0	.	.	.
Floors = Dirt	-0.01	0.65	0.988	0
Floors = Concrete	0.652	0.636	0.306	0.003
Floors = Tile	0	.	.	.
Ethnicity = Camba	**-3.128**	**0.518**	**<.001*** **	**0.086**
Ethnicity = Colla	**0**	**.**	**.**	**.**
Education	**0.33**	**0.053**	**<.001*** **	**0.09**
Media Factor	-0.578	0.276	0.037	0.011
R Squared = .182 (Adjusted R Squared = .165)				
N = 397				

Table 3.6a shows a multiple regression model that includes only media variables. None of the variables included in the model were significant. Whether or not the interviewee watches western TV (including soap operas or movies) is marginally significant at predicting age of first birth, but in the non-predicted direction.

In Table 3.6b, control variables were included, such as income variables, education and ethnicity. Both education and ethnicity are significant predictors of age of first birth, but the media variables are not significant. In Table 3.6c, the media factor is included, which is significant, but not in the predicted direction. It appears that those women who have more exposure to media have earlier age of first birth, not later.

The second part of diffusion theory is the diffusion of ideas from members of one's social network. To examine this, the average age of first birth for each interviewee's set of sisters was calculated. If the interviewee did not have any sisters or did not know the age of first birth for her sisters, she was excluded from these analyses. In Figure 3.7, the relationship between sisters' average age of first birth and interviewee's age of first birth are compared and the graph shows that there is a positive relationship between them, although the R^2 value is relatively low at 0.0711.

Table 3.7 depicts the partial model analyzing social network variables on age of first birth. In this model, sisters' average age of first birth is a highly significant factor in predicting age of first birth. For each additional year in average age of first birth for sisters, the interviewee is predicted to increase her own age of first birth by 0.237 years. Education is also significant in this model, predicting an increase in age of first birth for each additional year of schooling.

Table 3.4 displays the full multiple regression analysis estimating age of first birth. Sisters' average age of first birth was not a significant predictor when other variables were included in the model. This suggests that when controlling for other variables, sisters' average age of first birth is not a large contributor to interviewee's age of first birth.

Figure 3.7 Scatter plot of sisters' average age of first birth by interviewee's age of first birth

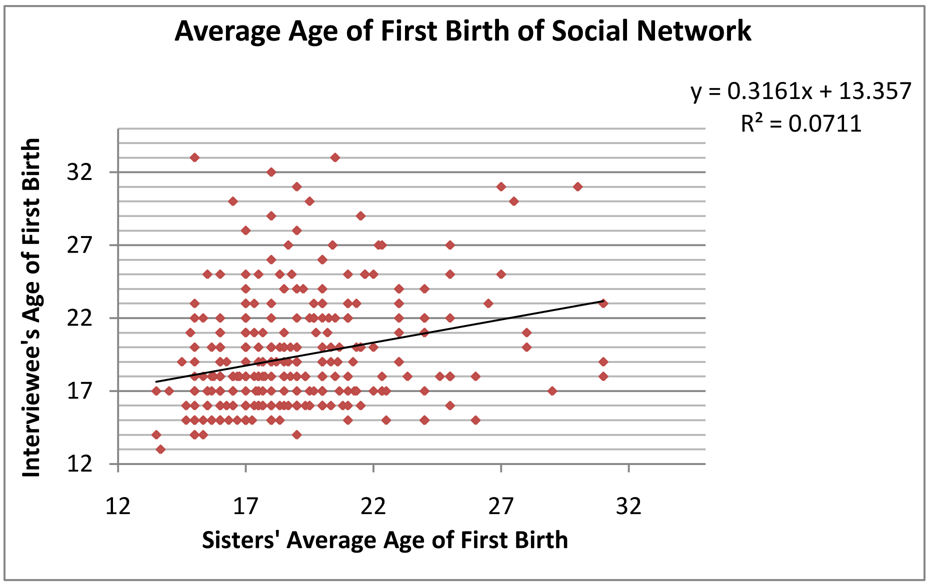


Table 3.7 Multiple regression analysis of social network diffusion on age of first birth

Dependent Variable:Age of First birth				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	14.931	1.366	<.001	.287
Age = Under 30	-1.557	.480	0.001***	.034
Age = 30+	0	.	.	.
Ethnicity = Camba	-1.927	.570	<.001****	.037
Ethnicity = Colla	0	.	.	.
Sisters' (Average) at of first birth	.237	.064	<.001****	.044
Education (years)	.253	.054	<.001****	.070

R Squared = .183 (Adjusted R Squared = .172)
n = 301
* p < 0.10, ** p<0.05, *** p<.01, ****p<0.001

Labor Force

Labor Force theory predicts that women who have a higher opportunity cost for working will delay their age of first birth. This can be measured in several ways. First, opportunity cost is measured as either a woman's income (if she is working) or the amount she believes she could earn (if she is not working). Those women who believe their time is worth more have a higher opportunity cost for raising families and this hypothesis predicts that they are more likely to delay their age of first birth. Another measure that was analyzed is a woman's percentage of the family income. If she is earning a larger percentage of the family income, she may have a higher (opportunity) cost of having children and therefore may delay her reproductive career. Finally, the type of employment that a woman has was analyzed. There are 4 categories that were created to describe a woman's work experience: 1) no work, 2) work at home, 3) work outside the home, but compatible with childcare and 4) working outside the home in a job that is incompatible with childcare. Figure 3.8 shows the percentage of women who work in each job category and it's relation to age cohort. There are a small percentage of women who work in jobs not compatible with childcare (across different age cohorts). It is hypothesized that women who work outside the home in a job that does not allow them to simultaneously take care of their children should postpone their reproductive careers. Figure 3.9 displays the relationship between the type of work (and whether it is compatible with childcare) and the average age at first birth. Those women who work at home or do not work have the earliest ages of first birth, while those who work outside the home have later ages of first birth. Jobs that are more compatible with childcare allow women to have slightly earlier ages of first birth than those who have jobs that are less compatible with childcare. One of the main issues with job compatibility is that it is

highly correlated with education. Those women who work in jobs that are incompatible with childcare have an average of 12.933 years of education, while those in jobs that are compatible with childcare have an average of 7.09 years of education.

Opportunity cost (the actual or believed salary a woman feels she can earn) is not a significant predictor of age of first birth. Additionally, the percentage of the family income that is earned by the woman is not a significant predictor of age of first birth (and was not in the predicted direction). Table 3.8 shows the analysis of women's work on age of first birth. The results show that when controlling for education and education squared, women's work and whether it is compatible with childcare is not significant. In the full model (Table 3.4), none of the Female Labor Force variables are significant

Figure 3.8 Women's Work by Age Cohort

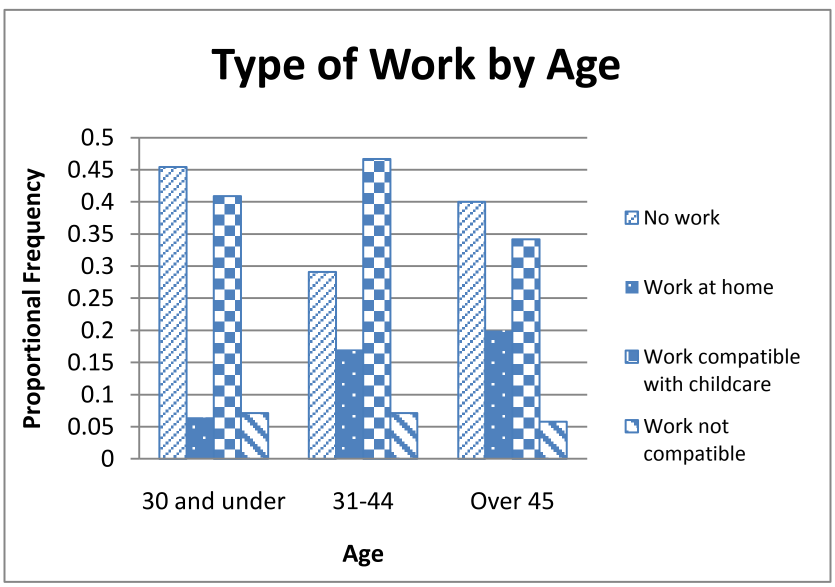


Figure 3.9 Women's Work by Average Age of First Birth

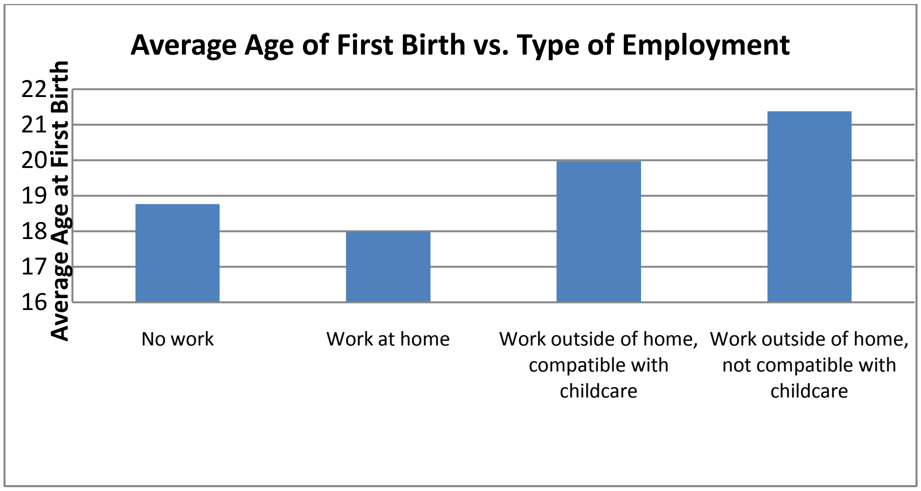


Table 3.8 Multiple regression analysis of Female Labor Force variables on age of first birth

Dependent Variable:Age of First birth

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	20.908	.572	<.001	.747
Age= Under 30	-1.447	.392	<.001****	.029
Age = 30+	0	.	.	.
Ethnicity = Camba	-2.527	.430	<.001****	.071
Ethnicity = Colla	0	.	.	.
Education	-.136	.142	.337	.002
Education Squared	.024	.009	0.007***	.016
Work = Not compatible with childcare	.854	.730	.242	.003
Work = Compatible with childcare	0	.	.	.

R Squared = .176 (Adjusted R Squared = .167)
n = 457
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Ninety-four percent of female employment in San Borja is compatible with childcare (n = 501), so the effect of work may be dampened since women can easily work while taking care of

children. In a society where work is typically not compatible with childcare, the effect of the type of women's work on age of first birth may be larger than is seen in this community.

Embodied Capital

Embodied Capital Theory predicts that those individuals who invest highly to compete in the labor market are likely to delay reproduction to invest in self and receive investments from parents. To analyze this, many different variables were measured. Interviewees were asked about parental investments from childhood, including whether or not her parents read to her as a child (a variable scored from 0-2 with 0 representing parents who never read to the interviewee and 2 representing parents who read daily), whether they helped her with her homework (same scoring) and whether they sent her to public or private school. Adult investment variables were also recorded, including whether parents helped the interviewee pay for her wedding (if she is married), helped her move into a new home when she moved out or helped her pay for higher education (if she attended). The age that parents stopped supporting the interviewee, the age the interviewee began paying for her own food and when she began working were all analyzed. A parental investment variable was created to look at the average investment from parents on the three adult parental investment variables: helping pay for a wedding, a new home and higher education. A value from 0-1 was calculated based on how many of these variables parents invested in. For example, if an interviewee's parents helped pay for her wedding and helped pay for her college education, but did not help her when she moved into a new home, the investment score would be 2/3 or 0.67. Since many women are not married or did not attend college, the percentage of investment is only based out of the number of 'potential' investments. If an interviewee is not married and did not attend college, then her parents could only invest in her

moving into a new home (which would lead to a value of 1 if they invested and a 0 otherwise). Table 3.9 displays the descriptive statistics for the investment variables.

Table 3.9 Descriptive statistics of parental investment variables

Sample Sizes for Parental Investment Variables					
Investment					**Sample Size**
Schooling	Public = 438	Private = 35			473
Higher Education	Yes = 28	No = 14			42
Wedding	Yes = 191	No = 85			276
New House	Yes = 399	No = 54			448
	None	**Sometimes**	**Daily**		**Sample Size**
Reading	299	106	95		500
Homework	237	132	132		501
	Mean	**Min**	**Max**	**St Dev**	**Sample Size**
Parental Investment	0.1954	0	1	0.346	464
Age parents stop supporting	16.71	6	35	3.9	480
Age started paying for food	16.23	6	51	4.8	453
Age began working	17.606	7	64	7.4	437

Table 3.10 Multiple regression analysis of Embodied Capital Theory variables on age of first birth

Dependent Variable:Age of First birth

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	19.928	1.470	<.001	.295
Age = Under 30	-1.085	.377	0.004***	.019
Age = 30 +	0	.	.	.
Ethnicity = Camba	-2.355	.411	<.001****	.070
Ethnicity = Colla	0	.	.	.
Education	-.139	.135	.305	.002
Education Squared	.020	.008	0.019**	.012
Age parents terminate support	-.177	.167	.290	.003
Age parents terminate support squared	.014	.005	0.005***	.018

R Squared = .262 (Adjusted R Squared = .252)
n = 446

* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Table 3.10 shows the partial model with significant parental investment variables. The only variable that is significant is the age at which parents stop supporting the interviewee. This variable does not have a linear effect, but a quadratic one, which is why the squared term is included in the model as well. The full model is shown in Table 3.4 and the age at which parents stop supporting is significant when the variables from the other models are included as well. The other investment variables were not significant in predicting age of first birth.

The one concern with this variable is that the direction of causality may be reversed. It is possible that when a young woman gets pregnant, her parents decide to stop supporting her. If this is the case, then when parents decide to terminate support does not predict age of first birth, age of first birth would predict the termination of parental support. To investigate this further, all interviewees who had their first birth within one year of termination of support were removed from the analysis. (This was about 50% of the sample). The analysis of first birth was reanalyzed (see Table 3.11) and age that parents terminate support is still a significant predictor of age of first birth (although the squared term is no longer significant). The predicted effect for each additional year of support by parents is 0.185 year increase in age of first birth. The education squared term is only marginally significant in this reduced model.

In Figure 3.10 the predicted age of first birth is displayed based on the age that parents terminate support and education (based on the model from Table 3.4). Those individuals who lose support from their parents at young ages (16 or younger) and have lower levels of education (less than high school) have a predicted age of first birth between 17.7 to 18.7 years old. For individuals whose parents support them longer or have higher levels of education (which typically occur together), the predicted age of first birth is 20 years or older. The squared terms

means that a change in education from 14 to 15 years of schooling increases age of first birth more than the change in education from 9 to 10 years of schooling. Similarly, the change from age 22 to 24 for the age that parents terminate support increases age of first birth more than a change from age 16 to 18. The figure shows the predicted ages for a Camba woman, under the age of 30, who learned about contraceptives before her first pregnancy. As these factors change, the line shifts vertically by a constant amount.

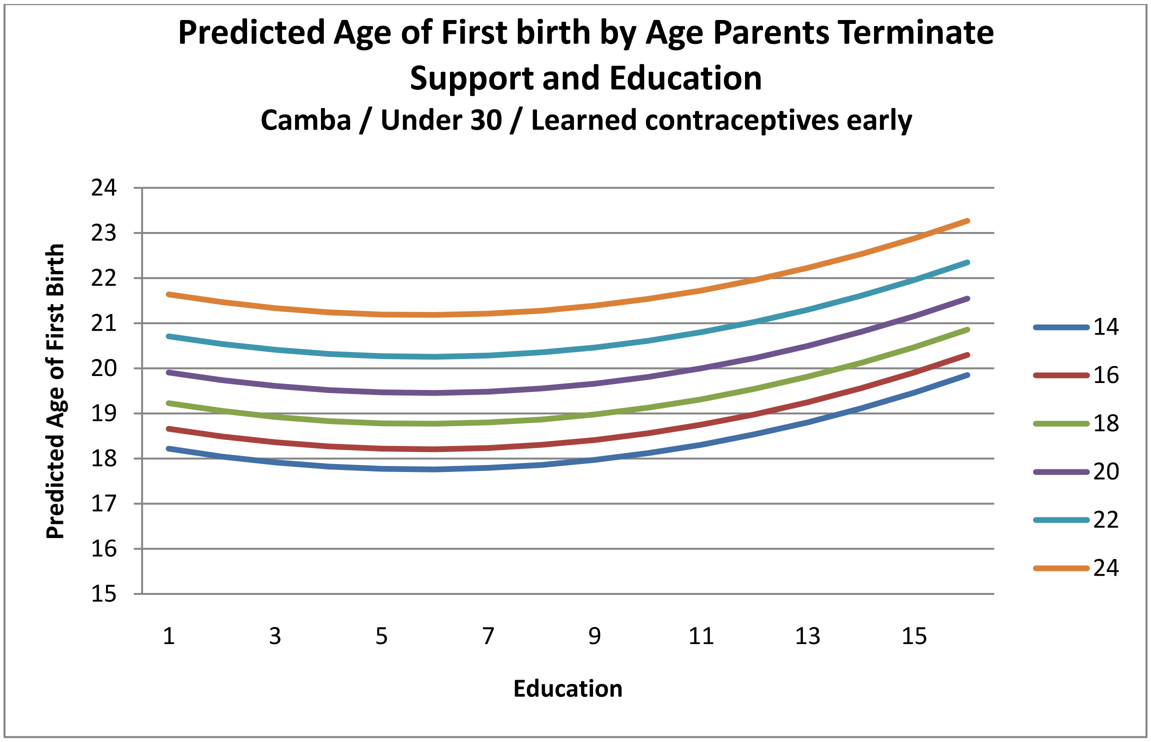
Table 3.11 Multiple regression analysis of the effect of age parents terminate support on age of first birth, excluding potentially biased individuals

Dependent Variable:Age of First birth

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	18.285	1.064	<.001	.574
Age= Under 30	-1.912	.604	0.002***	.044
Age = 30+	0	.	.	.
Ethnicity = Camba	-2.049	.577	<.001****	.054
Ethnicity = Colla	0	.	.	.
Age parents terminate support	.185	.055	<.001****	.049
Learned contraceptives = before first pregnancy	2.527	.551	<.001****	.087
Learned contraceptives = after first pregnancy	0	.	.	.
Education	-.228	.200	.255	.006
Education Squared	.021	.012	0.095*	.013

R Squared = .265 (Adjusted R Squared = .245)
n = 226
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Figure 3.10 Predicted Age of first birth by parental support and education



Age at last birth

Since there is some evidence that age at last birth may be changing through time (see Table 3.3), an analysis was conducted on women ages 45 or older to see if these variables included above also predict age at last birth. None of the variables related to the models are significant when age of last birth is analyzed. The only significant factor is the age category of above or below 60 years old. This suggests that there are not any strong factors that were measured in this study affecting the age at last birth for women over 45. This may be partially due to the small sample size of women in post-reproductive ages.

Discussion

Understanding what factors affect age at first birth is important to understand fertility transition since it is one of the ways that fertility is reduced in a population. Extensive delaying of first birth has been documented in the developed world and these analyses help us understand the factors that affect the age at first birth in rural Bolivia.

Table 3.12 Cox proportional hazard model of time until first birth

Variables in the Equation

	B	SE	Sig.	Exp(B)
Age = Under 30	.324	.125	0.009***	1.383
Ethnicity =Camba	.599	.137	<.001****	1.821
Education	.141	.045	0.002***	1.151
Education Squared	-.009	.003	0.002***	.991
Learned about Contraceptives before 1st pregnancy	-.645	.117	<.001****	.525
Age parents terminate support	.142	.065	0.029**	1.152
Age parents terminate support Squared	-.006	.002	0.002***	.994
Chi Square = 109.794 df = 7 Sig. <.001****				
n = 433				
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001				

Another possible way to analyze age at first birth is to conduct a Cox proportional hazard model. This model is a type of survival analysis that relates the time that passes before some event occurs to one or more covariates (in this case, the event is ‘time until first birth’). The benefit of this type of model is that it allows for censored variables. Table 3.12 shows the results from the Cox proportional hazard analysis modeling age of first birth. The results are similar to the multiple regression model presented in Table 3.4 with the same significant factors influencing the age of first birth (although the parameters refer to likelihoods instead of ages). Ethnicity, education, learning about contraceptives and age parents terminate support continue to

be significant predictors for the likelihood of having a first birth. A positive beta (B) value means that the event is more likely to occur. For example, Camba women are more likely to have a first birth than Colla women.

The Contraceptive Knowledge hypothesis and the Embodied Capital Theory have strong support for impacting the age at first birth. Learning about contraceptives before one's first pregnancy increases the expected age of first birth by 2.069 years, this is about the same effect as parents delaying the age that they terminate support from age 16 to age 22. Education is highly correlated with (and likely predicts) both learning about contraceptives and the age that parents terminate support, but education is still significant even beyond these two effects. At this point, it is unknown if contraceptive knowledge is a route to delaying first birth or if knowing about contraceptives is an ultimate explanation in itself (this will be revisited in Chapter 5). When one learns about contraceptives (before or after first pregnancy), age that parents terminate support and education are significant predictors of age of first birth. The square terms of 'age parents terminate support' and 'education' mean that as individuals have higher levels of education or an older age that parents terminate support, the predicted age of first birth increases at a faster rate.

Social network diffusion has moderate support, with a significant result in the partial analysis, but not significant when other variables are included. The hypotheses with no support are the Diffusion Theory of high-status ideas and Female Labor Force theory. None of their operationalized variables significantly predicted age at first birth.

One of the most interesting parts of this analysis is the variables that were not significant. As discussed previously, the age that a woman learns about contraceptives does not significantly increase age at first birth. This may be a poor measurement to determine how learning impacts age at first birth. Using the age of learning can be confounded when looking at age of first birth because early learning may be before or after first pregnancy and any learning that occurs after first pregnancy cannot impact previous events. The analysis of Female Labor Force theory was interesting because many of the income variables and opportunity cost variables were not significant. In San Borja, it may be inaccurate to look at opportunity cost because so many jobs are compatible with childcare, which suggests that even women who think they could make a lot of money may not be giving up that opportunity to have children. Only 6% of the women surveyed had jobs that were not compatible with childcare. In a society where most jobs are not compatible with childcare, this opportunity cost or the percentage of family income may be a much better indicator of age at first birth. Another possible issue for the Female Labor Force analysis is that age of first birth is predicted by current employment, even though employment varies with time. A better method may look at employment for the time that the woman is deciding whether or not to have children (this variable will be looked at as a time-varying variable in the next chapter).

In the Embodied Capital Theory, many of the parental investment variables were not significant. One of the variables measured whether women went to public or private school. The result was in the opposite direction than was predicted. Those women who attended private school actually had earlier age of first birth (average of 17.34) compared to those who went to

public school (average of 18.29). This was a surprising result. In addition, many parental investment variables were not significance (except age parents terminated support). These parental investment variables may be impacting total fertility instead of age of first birth or mediated through the effects of education. This will be analyzed in future chapters.

Additional research should be conducted in geographical areas where employment is mutually exclusive of childcare. This will be important in truly understanding the opportunity cost women experience when trying to decide between producing more children or engaging in employment.

Conclusion

This chapter set out to answer two questions. First, how has age of first birth changed through time in San Borja, Bolivia? Evidence shows that although there has been a significant increase in age of first birth in many developed countries around the world, San Borja, Bolivia has yet to follow the same trend. The proportion of people who have their first birth is not significantly different from one cohort of women to the next except for women over age 60, who have a significantly earlier age of first birth than the other age cohorts. In the analyses, the variable over/under 30 showed a significant difference with younger women having a predicted earlier age of first birth, when controlling for contraceptive learning, termination of parental support and education, all of which predict later ages of first birth. The analysis only includes women who have had their first birth, which censors young women who haven't started reproducing. This also decreases the expected age of first birth for women under 30. Since the

model has both positive and negative influences on age of first birth for younger women, this leads to similar patterns of age of first birth today as women decades before them.

The second question that this chapter answered was: What factors impact age of first birth? This question was answered by analyzing the predictions of the five hypotheses. The data shows that Embodied Capital Theory and Contraceptive Knowledge hypothesis are strongly supported and there is some marginal support for Diffusion Theory of ideas through one's social network. There is no evidence to support Diffusion Theory of high status individuals or Female Labor Force Theory. The variables that were significant in the final model of age of first birth were: when an individual learns about contraceptives, age that parents terminate support, educational achievement, ethnicity and age (under or over 30 years old). Educational achievement and the age that parents terminate support had non-linear effects on the model.

Chapter 4: Parity Progression

Introduction

The next step to understanding fertility is to determine the factors that lead people to have each subsequent birth. In this chapter, models will analyze the progression from no children to first child, and the subsequent progressions to second, third, fourth and finally to five or more births. Parity progression is a phrase used by demographers to describe the transition to having an additional child. Analyzing parity progression rates is particularly useful in examining cohort changes and the factors that impact each birth in a way that is not biased by women who have not completed their reproductive careers. This allows for the determination of which factors are important at each stage of reproduction. To conduct this analysis each woman has data for each year of her life (starting with age 13). This allows for the inclusion of time-varying data. For example, income changes over time. It is inaccurate to use income from today to predict past events, so in this analysis income from a particular year will be used to predict fertility in that year.

Hypotheses

Each of the five models will be revisited to determine the specific predictions for parity progression. These will be similar to those from previous chapters, but will allow for specificity for this particular analysis. Table 4.1 provides an overview of all of the models, their predictions and the measurements that will be used to analyze them.

Contraceptive Knowledge

The contraceptive knowledge hypothesis predicts that **having contraceptive knowledge (and using it) will reduce future births**. Last chapter demonstrated that the knowledge of

contraceptives can delay age of first birth. Now, the impact of learning and using contraceptives will be analyzed to see its impact for the progression of each birth. There are several ways to analyze the impact of contraceptive knowledge. The first variable is the age one learns about contraceptives. To remove the censoring issue with some women who may not have learned about contraceptives yet, the variable was transformed to measure the number of years before 30 that the interviewee used contraceptives. This reduces the number of missing values because all women over 30 will have a value for this variable. Second, a categorical variable of whether a woman learned about contraceptives before or after her first pregnancy will also be used. This allows for the analysis of how learning before the start of one's reproductive career can impact all future births. Third, a categorical variable will be used stating whether or not the individual has learned about contraceptives or not. Since each woman has information for each year of her life, a categorical variable can be used describing whether at age x she has or has not learned about contraceptives before age x. The same three variables are used to describe a woman's use of contraceptives (number of years before 30 used contraceptives, whether contraceptives were used before or after first pregnancy and categorical variable describing whether she has ever used previously).

Diffusion

High Status Individuals

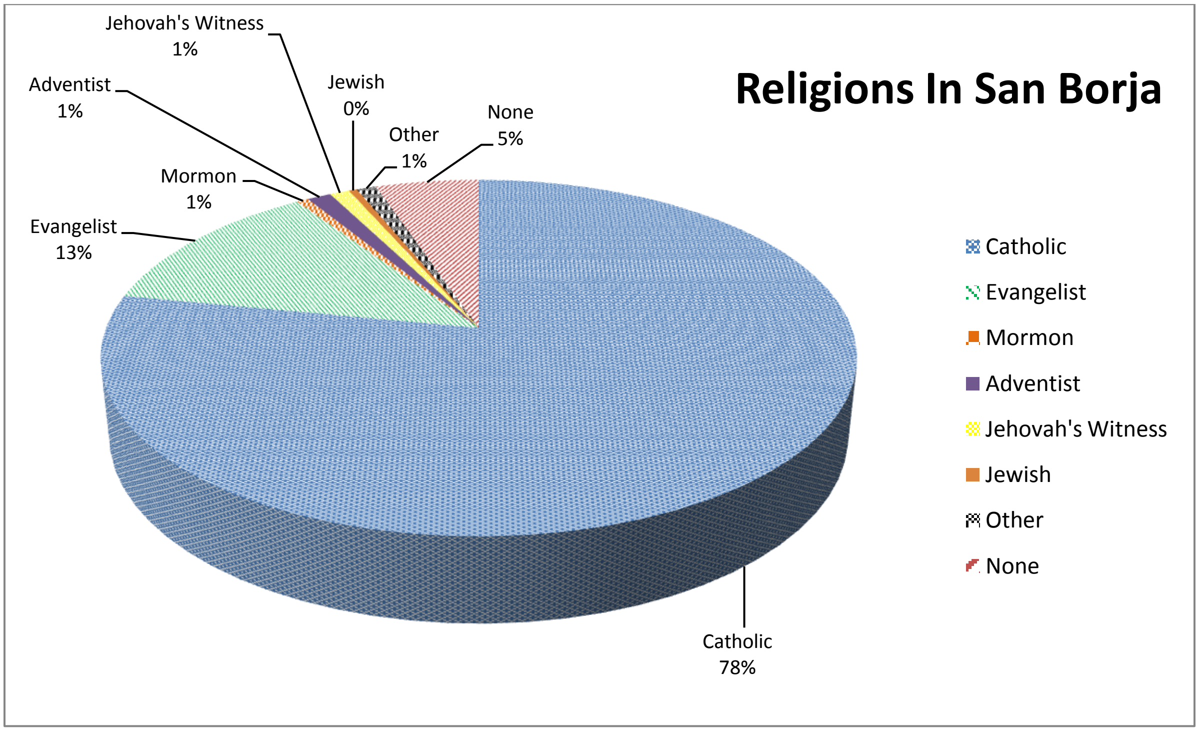
The diffusion from high status individuals predicts that **those who have the most access to high status individuals should reduce their fertility**. To determine the exposure to high status individuals, one's access to western media is assessed. To measure this, the age at which one started watching television was recorded and transformed to assess the number of years

before age 25 the individual began watching television. As mentioned previously, this removes the number of missing values for women who have never watched television. A categorical time-varying variable of whether or not the interviewee watched television was included. This allows for the analysis of whether or not previous exposure to television has an impact on fertility. Another categorical variable about whether or not the woman watches western television, like movies or soap operas was included. The number of hours (per day) that a woman reported watching and her internet usage (per month) was also analyzed.

Social Network Diffusion

The diffusion of ideas from one's social network predicts that (1) **people will have fertility similar to that of those people in their social network**. Additionally, those people who are members of pronatalist religions are likely exposed to ideas about high fertility and are members of social networks with other pronatalist individuals. This leads to the prediction that (2) **those individuals who are members of pronatalist faiths should have higher fertility.** To analyze the first prediction, interviewee's reported the number of children for (up to) five of their closest friends. An average was calculated for their friends' fertility. Additionally, women reported the number of offspring for each of their brothers and sisters. An average was calculated for the number of living children for all of the interviewee's siblings. San Borja is predominantly Catholic (about 82%) and another 13% describe themselves as Evangelicals. The remaining religions, such as Mormon, Adventist and Jewish each only constitute 1% or less of the population of San Borja (see Figure 4.1). To look at the effects of being a member of a pronatalist faith, a categorical variable for religion was created (Catholic, Evangelical, other or not religious), since the sample size of many of the religions is six or less interviewees.

Figure 4.1 Religious affiliations in San Borja, Bolivia

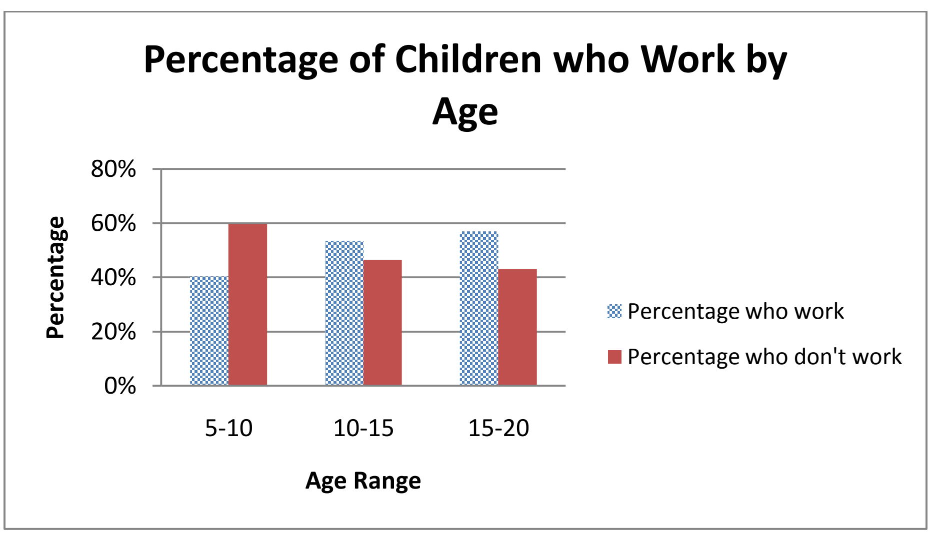


Wealth Flows

Wealth Flows predicts that that (1) **fertility is reduced because of the increased cost of children**. San Borja is a great place to test this hypothesis because children work. They are often seen shining shoes, selling nuts or bread and helping their parents in family-owned businesses. In the interviews, women stated that some children started working as young as four or five years old. There are other children who do not work until their late teens or early twenties. This can lead to very different costs for parents. Another important component of Caldwell's Wealth Flows hypothesis is the impact of old age security. This leads to the prediction that (2) **those parents who expect their children to provide old age security will have higher fertility than those who do not**. To analyze the first prediction, interviewee's reported the age at which they

expected their children to start contributing monetarily to the household. They also reported the actual age that children started contributing and an average was calculated (among all of their offspring). This calculation may be biased because if a woman has four children and two of them start contributing early and the other two have yet to start contributing, only the two who have already started contributing will be included, resulting in an inaccurately low value. To deal with this, the percentage of children who contributed monetarily from age 5-10 (n=1667), 10-15 (n=1309) and 15-20 (n=820) was determined. Figure 4.2 shows the percentage of children who work by age range. For the second prediction, interviewee's reported who they expected to care for them in old age. A categorical variable of children versus other was created. About 75% of interviewees stated that they expected one of their children to help care for them in old age and the remaining 25% stated that they did not know, believed it would be a different family member (like a spouse or a sibling) or were saving to pay for a retirement home (n=495).

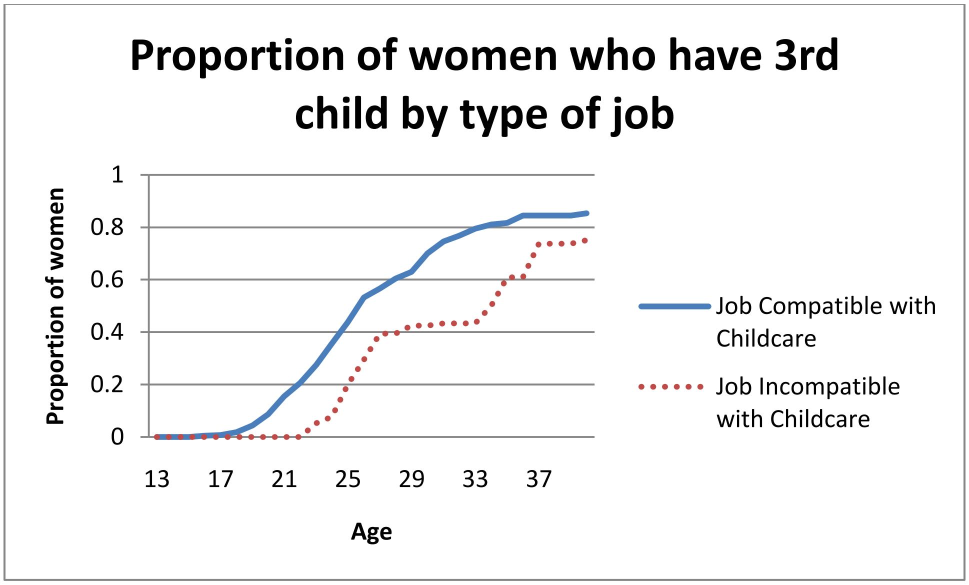
Figure 4.2 Percentage of children who work by age.



Female Labor Force

Female Labor Force theory predicts that **when women are faced with a larger opportunity cost of working, they will reduce their fertility**. This can be measured in several different ways. First, opportunity cost is the amount of money a woman reports that she believes that she can make if she were to obtain a job or how much she currently makes if she is employed. A second way to determine opportunity cost is to look at the type of employment a woman has for each year of her life. If a woman is working in a job that is not compatible with childcare, one would expect that she would be less likely to have an additional child. The advantage of this analysis over looking at age of first birth is that when age of first birth was analyzed the job the interviewee had at the time of interview was analyzed as opposed to the job that the woman had at the time of her first birth. This allows for the analysis of the progression of each birth in relation to the job that she had at each year of her life.

Figure 4.3 Rates of progressing to third birth by compatibility of job and childcare



In Figure 4.3, the rate of parity progression to three births is displayed. Women who are working in a job that is incompatible with childcare show a lower rate of progression to the third birth at all ages. Over 85% of women in jobs compatible with childcare (which also includes not working) progress to a higher parity, while only 75% percent of women in non-compatible jobs make this progression.

The third variable that measures women's opportunity cost is a woman's income by year. As her income increases, her opportunity cost is increased for having children. Total income per year was determined so that a woman's percentage of income could be calculated. Those women who make a larger percentage of the family income (on a year by year basis) are expected to have a higher opportunity cost of having an additional child.

Embodied Capital

Embodied Capital Theory predicts that those individuals who invest highly in their own skills and the skills of their children will shift towards the quality side of the quantity-quality tradeoff and reduce their fertility. When parents decide to spend more of their energy (or invest more) in each offspring, they have less energy to invest in more offspring. These offspring that have received more investments and are able to spend more time investing in their education and skills. As individuals have higher levels of skill, they are able to enter the competitive labor force. When these highly skilled individuals plan their own fertility strategies, they are likely to invest highly in their own offspring (since parents who have high levels of skill and embodied capital can more easily teach their offspring these skills). This results in another generation of reduced fertility and higher levels of investment. This leads to two predictions. First, **those who**

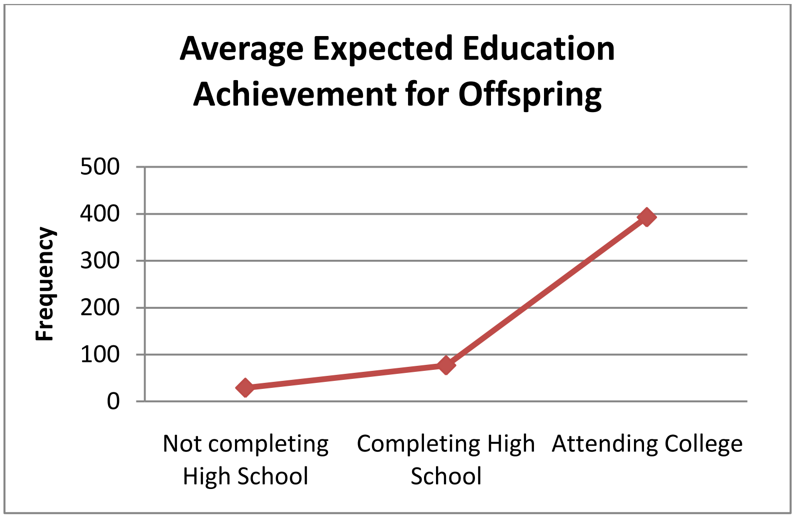
receive higher investments from their parents should reduce their fertility. Second, **those who expect to invest highly in their own offspring should reduce their fertility.** To analyze the first prediction, data was collected on the age interviewees were no longer supported by their parents. In the last chapter, the age with which parents terminated support was a significant predictor of age of first birth. For the parity progression analysis, this variable has been transformed into a time-varying categorical variable where each year the interviewee can either be supported or not supported by her parents. The next variable is a categorical variable that records the interviewee's schooling type: public or private. This does not vary with time and is the same throughout an interviewee's life. The level of investment from parents in terms of reading and help with homework is included and is a scale from none (0) to everyday (2). Adult parental investment was also measured using the same parental investment variable as Chapter 3 (see previous description). This is an average of monetary help by parents to pay for higher education, wedding costs and the costs of moving into a new home. To look at expected investments in children, the expected educational achievement was measured. If parents expect their children to achieve a higher level of education, they are necessarily going to have to invest longer and at a higher rate for those children. This measure is a score for average expected educational achievement from not attaining a high school degree (0) to expecting all children to attend university (2). Figure 4.4 shows the frequency of each of these categories. Most mothers (n =393) stated that they expected their children to attend college. This is much higher than the rate of individuals in San Borja who are actually attending college today.

In Table 4.1 an overview of the models, their predictions and the variables used to analyze them are described.

Table 4.1 Predictions and Measurements of the models

Models	Contraceptive Knowledge	Diffusion		Wealth Flows	Female Labor	Embodied Capital
		High Status	Social Network			
Predictions	Having contraceptive knowledge (and use) will reduce future births	Those that have the most access to high status individuals by exposure to western media should have reduced fertility	1. People will have fertility similar to those in their social network. 2. Those in pronatalist faiths should have higher fertility.	When children cost more fertility should decline.	When women are faced with a larger opportunity cost of working, they will reduce their fertility	1. Those who received high levels of investment should reduce their fertility. 2. Those who expect to invest highly in offspring should reduce fertility.
Measurements	1. Number of years before 30 learned 2. Learned before or after first birth *3. Learned about contraceptives (categorical) 4. All of the above with using contraceptives	1. Number of years before 25 began watching TV *2. Has watched TV (categorical) 3. Watching western TV (soap operas /movies) 4. Hours of TV/day 5. Internet usage/month	1. Average fertility of closest friends 2. Average fertility of siblings 3. Religion 4. Level of religiosity 5. Church Attendance (as child and adult)	1. Expected age for child contribution 2. Expected old age support 3. Percent of children who contribute money between 5-10, 10-15 and 15-20 4. Average age of offspring contribution	1. Stated believed value of time *2. Women's percentage of income *3. Type of employment (compatible with childcare?)	*1. Age parent's terminated support. 2. Attended private or public school. 3. Parents helped with homework / reading. 4. Parental investment in high education, wedding, new home. 5. Expected educational achievement of offspring.
	* Time varying variable					

Figure 4.4 Average Expected Educational Completion for Children



Methods

The Interview

Refer to Chapter 2 for a description of the data collected during each interview. For this chapter, several pieces of data were collected retrospectively over a woman's lifetime. These included, all of her employment, including her starting and ending wage, the years she worked in that particular job, if someone helped her get the job and whether she needed education to obtain the position. This data was used to get a retrospective value for her income during each year of her life. The type of job for each year of her life was determined (using the categorical variable described in Chapter 3 for no work, work from home, work outside the home but compatible with childcare and lastly, work not compatible with childcare). If a woman had multiple jobs simultaneously, the highest job category was recorded. Additionally, data on all of her previous spouses was collected, including the years they were together, his job(s) while they were together, his income and how he obtained his employment. This provided information about the

years that the interviewee was married, her husband's income, their combined income and her percentage of the family income.

While this provides a lot of data and avoids the issues of using current income and employment data to predict past events, it also comes with issues of its own. First, people may not accurately remember previous jobs or incomes for themselves or their spouse. This may lead to a large percentage of inaccurate or missing data. For older women, the time since particular jobs may be quite long and are more likely to be underreported. Finally, people may underreport their income because of a fear of taxation. In an attempt to reduce their fears, interviewees were repeatedly explained that their information would remain confidential, that their last names were not being reported and that no one, other than myself, had access to their interview sheets.

Data Analysis

The data were analyzed using logistic regression with repeated measures. To organize the data in a way so that it could be analyzed, the data had to be changed from one line per woman to a line for each year of a woman's life from age 13 to her current age. This allows for the time varying variables to change from year to year and allows all women to be compared in the same way for a given age. This analysis eliminates censoring issues because younger women can be included in the analyses up to their current age and compared with all other women who have achieved the same age. A computer program was written using Turbo Pascal 7.0 to convert the data. SPSS Version 19 was used to complete the analysis. The general estimating equation function was used to generate the repeated measures logistic regression models for this chapter. This allows for a separate logistic regression model for each parity progression. For

example, to analyze the progression to the second birth, all women who have had their first birth are included. If a woman has her first child, but up until the interview has not had a second child, she is included in the analysis for each year since her first birth that she has not had her second birth.

Results

The evidence suggests that younger women are progressing to higher births at a slower rate than women in older cohorts. Figure 4.5 shows the rate at which women have their fourth child by age cohort. This graph shows that women in the oldest cohort (60 years old or older) progress to their fourth child at a faster rate than any other cohort. Those women between 50 and 59 have the second highest rates of progressing to their fourth birth. The cohorts of women 30-39 and 40-49 have almost the identical progression to fourth birth and those women who are under 30 have the lowest rate of progressing at each age. Even though women under 30 have not completed their reproductive careers, a comparison can be made using the proportion of women at a given age who have progressed to their fourth child. At age 29, 65% of women born before 1949 (60+ age cohort) had progressed to their fourth child, while 38% of women born between 1959 and 1968 (the 40-49 age cohort) had, and only 29% of women born since 1978 (the under 30 cohort) have had their fourth child.

Progression to first birth

The first model analyses the progression to first birth. This is similar to the analyses that were conducted in the last chapter, except that the logistic regression model reports a probability for progressing to the first birth, while the last chapter predicted the actual age of first birth. Table 4.2 shows the results of the analysis for the progression to first birth.

Figure 4.5 Chart of Progression to fourth birth by cohort

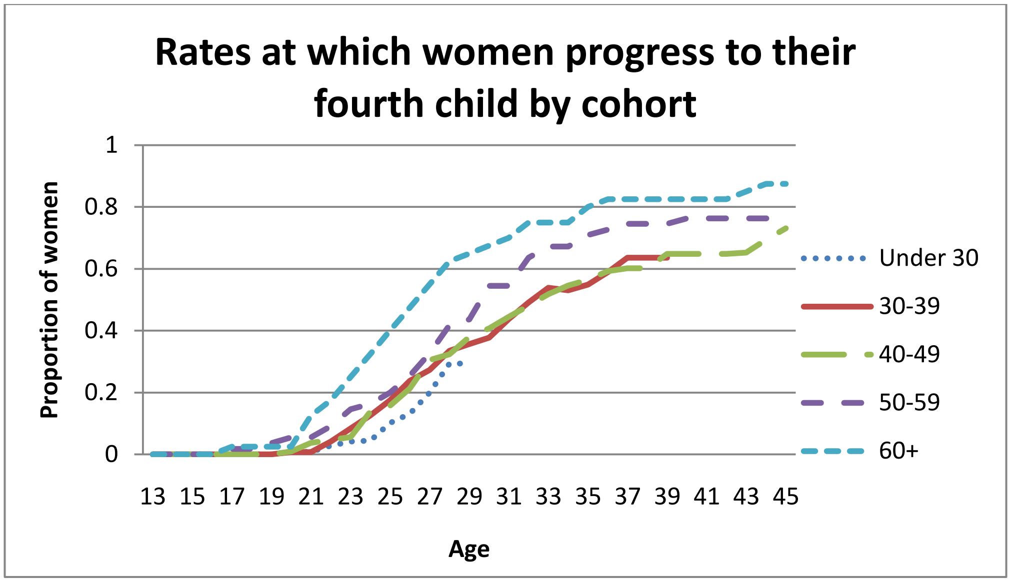


Table 4.2: General estimating equations analysis of the progression to first birth

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	-14.281	11.5228	.215	.000
Age	.024	.0191	.210	1.024
Year of birth	.008	.0058	.193	1.008
Ethnicity = Camba	**.550**	**.1705**	**.001*** **	**1.734**
Ethnicity = Colla	**0**	**.**	**.**	**1**
Education (in yrs)	-.014	.0200	.491	.986
Married = NO	**-2.777**	**.1668**	**<.001********	**.062**
Married = YES	**0**	**.**	**.**	**1**
Learned about contraceptives = before 1st pregnancy	**-.587**	**.1677**	**<.001********	**.556**
Learned about contraceptives = after 1st pregnancy	**0**	**.**	**.**	**1**
Ever used contraceptives before = NO	-1.204	.2837	<.001	.300
Ever used contraceptives before = YES	0	.	.	1
Friends' Average Fertility	.020	.0462	.664	1.020
Average expected educational achievement of children: from 0 (fail to complete HS) to 2 (university)	-.152	.1267	.229	.859
Parents terminated support = NO	**-1.170**	**.1849**	**<.001********	**.310**
Parents terminated support = YES	**0**	**.**	**.**	**1**

QIC = 1563.996

n=2972, unique ID = 395

* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

This analysis is informative because both age (at a point in her life – not her current age) and year of birth (to look at cohort effects) can be controlled for. Whether or not the woman is married is also included as a control variable, since progressing to the next birth is more likely for married women. Ethnicity is included in the model as Camba women typically have more children than Colla woman. Finally, education is included. Although education is not a significant predictor for the progression to first birth, it is significant in the transition to higher parities. Education squared was not significant in any model and was therefore excluded from the analysis.

The significant predictors for the progression to first birth include: when the women learned about contraceptives (before or after first pregnancy) and whether or not parents have terminated support. Two control variables: ethnicity and marriage are also significant. This is very similar to the results from the last chapter, where both 'age parents terminate support' and 'contraceptive learning' are significant predictors. In these models, sisters' average age of first birth was not included since it is unlikely that age of first birth will impact anything other than progression to first birth, but average sibling fertility was analyzed and found not to be significant and therefore removed from the final model.

Being married makes one 16 times more likely to progress to first birth than someone who is not married. Ethnicity is also a significant predictor of progressing to first birth. Camba women are 1.7 times more likely to have a first child than Colla woman. Those that have not learned about contraceptives before their first pregnancy are 1.8 times more likely to progress to their first birth and individuals whose parents are no longer supporting them are 3.2 times more likely to have their first child. These results are not surprising. One would expect those that are

married and/or independent of their parents to be more likely to start reproducing. Also, those women who have learned about contraceptives are delaying fertility as demonstrated in Chapter 3.

Whether a woman has ever used contraceptives is also significant, but in the non-predicted direction. Those who have never used contraceptives are about a fourth as likely to progress to first birth. This is similar to the results from last chapter with the age one learns and uses contraceptives. It appears that those women, who have a child at a young age, quickly learn and start using contraceptives.

Progression to second birth

The analysis of the progression to second birth for all women with a first birth is shown in Table 4.3. In general, there are few significant predictors for the progression from first to second birth. As one would predict, those who are married are more likely to have a second child than those who are not. The odds ratio is 0.259 for non-married women, meaning that they are one-fourth as likely to have a second child as someone who is married. Age and year of birth are also significant. For age, as a woman ages ten years, she is only 68.5% as likely to progress to her second birth. The greater one's year of birth (the younger cohorts) are less likely to progress to their second birth. A woman who was born ten years before another is only 87% as likely to progress to her second child. This provides more evidence that younger women are reducing higher order births. The only non-control variable that is marginally significant in this model is whether the individual learned about contraceptives before her first pregnancy, which makes her only 74% as likely to progress to her second birth.

Table 4.3: General estimating equations analysis of the progression to second birth

Parameter	B	Std. Error	Sig.	Odds Ratio
(Intercept)	27.643	12.9573	.033	1.01E+12
Age	**-.037**	**.0136**	**0.006*** **	**.963**
Year of birth	**-.014**	**.0065**	**0.032** **	**.986**
Ethnicity = Camba	.141	.1741	.419	1.151
Ethnicity = Colla	0	.	.	1
Education (in yrs)	.000	.0186	.979	1.000
Married = NO	**-1.352**	**.1909**	**<.001**** **	**.259**
Married = YES	**0**	**.**	**.**	**1**
Learned about contraceptives = before 1st pregnancy	**-.266**	**.1537**	**0.083* **	**.766**
Learned about contraceptives = after 1st pregnancy	**0**	**.**	**.**	**1**
Ever used contraceptives before = NO	-.036	.1609	.821	.964
Ever used contraceptives before = YES	0	.	.	1
Friends' Average Fertility	.047	.0457	.302	1.048
Average expected educational achievement of children: from 0 (fail to complete HS) to 2 (university)	-.154	.1009	.128	.858
Parents terminated support = NO	-.248	.3947	.530	.781
Parents terminated support = YES	0	.	.	1

QIC = 1487.427

n=1342, unique ID = 395

* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

The general trend for the progression to second birth is that most people who have their first child progress to a second child. Other than control variables, there aren't any truly significant factors impacting the change from one to two children. Higher parity progressions will reveal more interesting results.

Progression to third birth

Table 4.4 shows the results for the progression to the third child for all women who have had a second child.

In this model, age, year of birth and marital status are all significant as they were in the previous model. As an individual gets older, if she is from a younger cohort or if she isn't married, she is less likely to have a third child. Ethnicity is also a significant predictor of the progression to third birth. Camba women are 1.668 times more likely to progress to a third child than Colla woman. Although learning about contraceptives is not a significant predictor of progressing to a third birth, whether or not a woman has ever used contraceptives is a significant predictor. As one would expect, if a woman has never used contraceptives, she is about 1.5 times more likely to progress to her third birth. Those women who have used (or are using) contraceptives are significantly less likely to progress to the third child.

Table 4.4: General estimating equations analysis of the progression to third birth

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	25.988	14.2921	.069	1.9E+11
Age	**-.075**	**.0125**	**<.001******	**.928**
Year of birth	**-.013**	**.0072**	**0.077***	**.987**
Ethnicity = Camba	**.512**	**.2136**	**0.017****	**1.668**
Ethnicity = Colla	**0**	**.**	**.**	**1**
Education (in yrs)	-.035	.0216	.105	.966
Married = NO	**-1.116**	**.2540**	**<.001******	**.328**
Married = YES	**0**	**.**	**.**	**1**
Learned about contraceptives = before 1st pregnancy	-.150	.1716	.382	.861
Learned about contraceptives = after 1st pregnancy	0	.	.	1
Ever used contraceptives before = NO	**.363**	**.1702**	**0.033****	**1.438**
Ever used contraceptives before = YES	**0**	**.**	**.**	**1**
Friends' Average Fertility	.015	.0392	.700	1.015
Average expected educational achievement of children: from 0 (fail to complete HS) to 2 (university)	**-.337**	**.1182**	**0.004*****	**.714**
Parents terminated support = NO	-.555	.6145	.366	.574
Parents terminated support = YES	0	.	.	1
QIC = 1293.642				
n=1445, unique ID = 349				
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001				

The average expected educational achievement of offspring is also a significant predictor of progression to third birth. Those mothers who expect their children to attain higher education are significantly less likely to progress to their third offspring. A woman is half as likely to progress to her third child if she believes her children will attend college in comparison to a woman who doesn't believe that her children will complete high school. This provides support for the Embodied Capital Theory as those parents who expect to invest highly in their offspring's educational achievements will reduce their fertility.

Progression to fourth birth

Table 4.5 shows the results from the analysis of the parity progression to fourth child of all women who have had three offspring.

Table 4.5: General estimating equations analysis of the progression to fourth birth

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	21.531	15.9271	.176	2.2E+09
Age	**-.083**	**.0150**	**<.001******	**.920**
Year of birth	-.011	.0080	.169	.989
Ethnicity = Camba	**.707**	**.3274**	**0.031****	**2.029**
Ethnicity = Colla	**0**	**.**	**.**	**1**
Education (in yrs)	**-.057**	**.0246**	**0.020****	**.945**
Married = NO	**-1.302**	**.4184**	**0.002*****	**.272**
Married = YES	**0**	**.**	**.**	**1**
Learned about contraceptives = before 1st pregnancy	-.092	.2137	.667	.912
Learned about contraceptives = after 1st pregnancy	0	.	.	1
Ever used contraceptives before = NO	**.430**	**.1814**	**0.018****	**1.537**
Ever used contraceptives before = YES	**0**	**.**	**.**	**1**
Friends' Average Fertility	.031	.0469	.510	1.031
Average expected educational achievement of children: from 0 (fail to complete HS) to 2 (university)	.216	.1980	.275	1.241
Parents terminated support = NO	-1.270	1.3697	.354	.281
Parents terminated support = YES	0	.	.	1

QIC = 1052.088
n=1347, unique ID = 281
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

In this model, our control variables: age, ethnicity, and marital status are still significant as they have been in previous models. The model shows that Colla women, those who are older and those who are not married are less likely to progress to their fourth offspring. Education is a significant predictor of the progression to fourth birth. Those women with more education are less likely to progress to their fourth child. For an increase in an additional four years of education, a woman's likelihood of progressing to her fourth child is only 80% of a woman with less education.

Using contraceptives is a significant factor in predicting the progression to fourth child. Women who have never used contraceptives are 1.5 times more likely to progress to their fourth child than women who have used contraceptives. When a woman learned about contraceptives does not have a significant impact on progressing to a fourth child (at this point, the knowledge itself is not enough, women must use the knowledge that they have to reduce the likelihood of future births).

Progressing to five or more births

The most interesting model for Bolivian fertility is the progression to five or more births. Approximately 53% of women over 40 had 5 or more births. Table 4.6 shows the results of the analysis of the progression to five or more children. The variable 'number of children' was included to see if the number of previous offspring had an effect on likelihood to progress to higher parities. It was not significant and therefore excluded from the model displayed.

As with previous models: age, cohort and marital status are all highly significant. Those who are older, from a younger cohort, or not married are significantly less likely to progress to a higher parity. Education is highly significant in this model. The most educated women are the

least likely to progress to their fifth or higher parity. For each additional four years of education, a woman's likelihood of progression is reduced by 25%.

Table 4.6: General estimating equations analysis of the progression to five or more births

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	41.936	12.7481	.001	1.6E+18
Age	**-.127**	**.0081**	**<.001******	**.881**
Year of birth	**-.020**	**.0064**	**0.002*****	**.980**
Ethnicity = Camba	.282	.2560	.270	1.326
Ethnicity = Colla	0	.	.	1
Education (in yrs)	**-.072**	**.0221**	**0.001*****	**.931**
Married = NO	**-.855**	**.2900**	**0.003*****	**.425**
Married = YES	**0**	**.**	**.**	**1**
Learned about contraceptives = before 1st pregnancy	.148	.1581	.350	1.159
Learned about contraceptives = after 1st pregnancy	0	.	.	1
Ever used contraceptives before = NO	**.385**	**.1492**	**0.010****	**1.469**
Ever used contraceptives before = YES	**0**	**.**	**.**	**1**
Friends' Average Fertility	**.091**	**.0367**	**0.013****	**1.095**
Average expected educational achievement of children: from 0 (fail to complete HS) to 2 (university)	**-.375**	**.1010**	**<.001******	**.687**
Parents terminated support = NO		.	.	
Parents terminated support = YES		.	.	

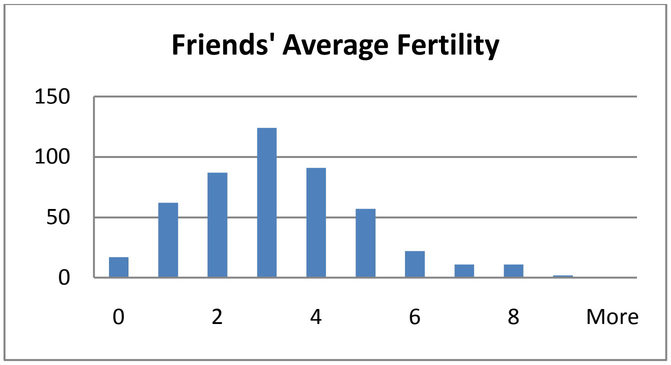
QIC = 2290.392
n=3628, unique ID = 206
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

As seen in previous models, those women who have never used contraceptives are more likely (1.469 times) to progress to higher parities. The average expected educational achievement is highly significant in this model. Mothers who expect their children to attend college are only 47% as likely to progress to higher parities as mothers who do not expect their children to graduate from high school.

Friends' average fertility is significant at the alpha = 0.05 level. If friends' average fertility increases, a woman is more likely to progress to higher parities. Figure 4.6 shows the frequencies (and range) of values for friends' average fertility.

The variable indicating whether parents have terminated support does not have any parameter estimates because there are no women who were still being supported by their parents at five or more births.

Figure 4.6 Friends' Average Fertility



Discussion

Contraceptive Knowledge

The evidence for the contraceptive knowledge hypothesis is significant for parity progressions. For the progression to first birth, whether a woman learned about contraceptives before her first pregnancy (or not) is a significant predictor. The other variables related to contraceptive knowledge are not significant in predicting the progression to first birth. Interestingly, 'ever using contraceptives' actually increases one's likelihood of progressing to first birth. It is possible that those women who get pregnant early typically start using contraceptives as soon as they have their first child. This was supported by the calculation done in the last chapter that those women whose age of first birth is the same as the year they learned or start using contraceptives, have a much earlier age of first birth than the rest of the community. When one learned about contraceptives has a marginal effect in predicting the

progression to two children, but is not significant in predicting any higher order births. Using contraceptives is a significant predictor of the progression to third and higher births. Those women who have used contraceptives at some point are less likely to progress to higher-order births.

Diffusion Theory

High-Status

None of the variables analyzed to test the relationship between diffusion of high status ideas through the media were significant predictors for the progression to any birth.

Social Networks

The data offers some support for Diffusion Theory through one's social network. To analyze the effect of one's social networks on parity progressions, friends' average fertility and siblings' average fertility were analyzed. Additionally, all variables related to religion, religiosity and church attendance were not significant. The only significant variable was friends' average fertility in predicting progression to five or more births. As friends' fertility increased, there was an increase in interviewee's likelihood of progressing to five or more children.

Wealth Flows

There is no evidence supporting the Wealth Flows hypothesis. The age at which children are expected to start contributing the household, the percentage that work at different age ranges, the actual average age that children start working and the expectation of old-age support are all non-significant predictors of any parity progression.

Female Labor Force

There is no support of the Female Labor Force Theory in predicting parity progressions, even though the measurements are more fine-tuned for this analysis than predicting age of first birth. A woman's income, her percentage of family income, and her job type were not significant predictors in the final models of parity progression, even after considering how these predictors varied for each year of her life. Her income at age 18 was used to predict her parity progression at that age, but it was still not significant.

Embodied Capital

There is evidence to support the Embodied Capital model for parity progressions. Those individuals who were still supported by parents were significantly less likely to have their first child. This was the only parity where parental support was a significant predictor. In the progression to third birth and five or more births, the average expected educational achievement of children was a significant predictor. Those mothers who had higher educational expectations of children were less likely to progress to higher parities (third and fifth or more births). All other parental investment variables were not significant, including reading and homework help, investments in a wedding and a new home or being sent to public or private school. This is not particularly surprising, since our causal pathway from Figure 1.1 predicts that those investments will be mediated through educational achievement. Education is a significant predictor of the progression to four or more children. As education increases, the likelihood of progressing to four or more births decreases.

Another prediction from the Embodied Capital model is that when education and income are both in the model, income should increase as education is controlled for. This is a unique

prediction as many models predict that as income increases, fertility decreases. In Table 4.7 a model is presented that looks at the progression to fourth birth. In this model, only the control variables, education, and the logarithm of income are included. Income has been log-transformed to deal with non-normal data. After logarithmic transformation of this variable, the data look normally distributed. This is the only parity progression during which both education and income are significant. One can see that as education increases, the progression to fourth child significantly decreases, but that for an increase in income, there is an increase in likelihood of progression, just as Embodied Capital Theory predicts.

Table 4.7 General estimating equations analysis of the effect of education and income on having a fourth birth

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	32.965	18.2694	.071	2.072E+14
Age	-.095	.0158	<.001****	.909
Yr Birth	-.017	.0092	0.062*	.983
Ethnicity = Camba	.968	.4377	0.027**	2.631
Ethnicity = Colla	0	.	.	1
Married = No	-1.835	.6498	0.005***	.160
Married = Yes	0	.	.	1
Educ	**-.085**	**.0278**	**0.002*** **	**.919**
Log Income	**.514**	**.2435**	**0.035** **	**1.672**
QIC = 798.819				
n = 1100, unique ID =238				
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001				

Conclusion

This chapter analyzed parity progressions to first, second, third, fourth and five or more births. The evidence shows that when one learns about contraceptives and when parents terminate support are important predictors in the likelihood of having a first child. There are few

significant predictors in the transition to second birth, although learning about contraceptives before first pregnancy is marginally significant. In the progression to third or more births, those who have never used contraceptives are more likely to have an additional child. In the progression to third and five or more births, those that have higher educational expectations for their children are less likely to have additional children. Beginning with progression to the fourth birth, higher levels of education result in reduced likelihood of additional children. For five or more births, there is the largest number of significant variables, including a positive relationship between friends' average fertility. Throughout the analysis, as one's age increases, the likelihood of progressing to the next birth decreases. Younger cohorts are less likely to progress, as are those who are not married. Finally, in many of the parity progressions, Camba women were more likely to progress to the next birth than Colla women.

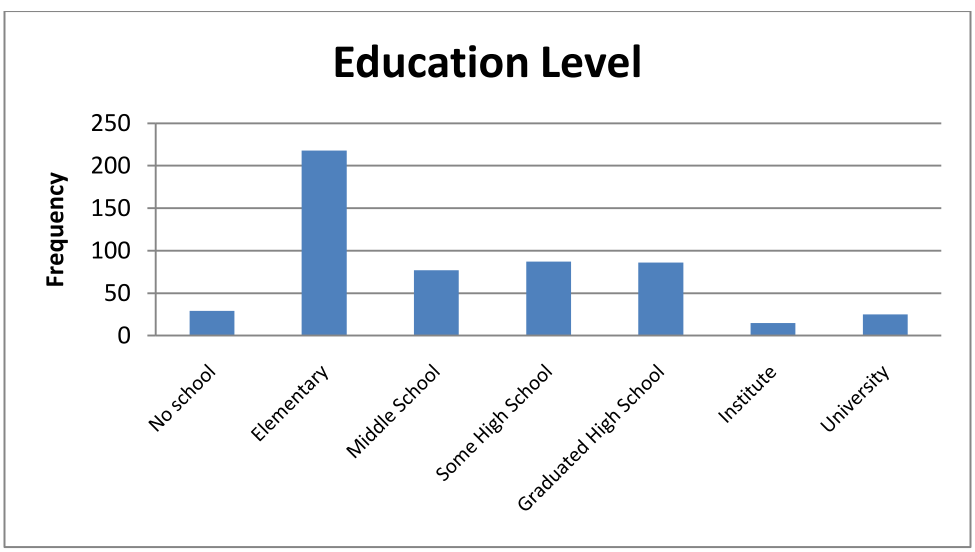
There is significant support for the Contraceptive Knowledge Hypothesis and the Embodied Capital Theory. The Female Labor Force Theory, the diffusion of high status ideologies and the Wealth Flows Hypothesis have no support. The diffusion of ideas through one's social network has some support at very high parities (five or more births).

Chapter 5: The Models

Introduction

The five models discussed previously provide not only information about which factors are expected to influence fertility, but also which factors impact fertility through their effect on female education. Female education is a variable consistently found to influence fertility for women around the world (Caldwell, 1967; Zurack, 1977; Jeffrey and Basu, 1996). Caldwell (1967) tried to understand how fertility was mediated through female education and surmised that it was because women with more education delayed marriage and had higher levels of contraceptive knowledge. Others have attributed female education to its influence on female autonomy, which allows women more power to decide the number of children they will have (Hogan et al., 1999).

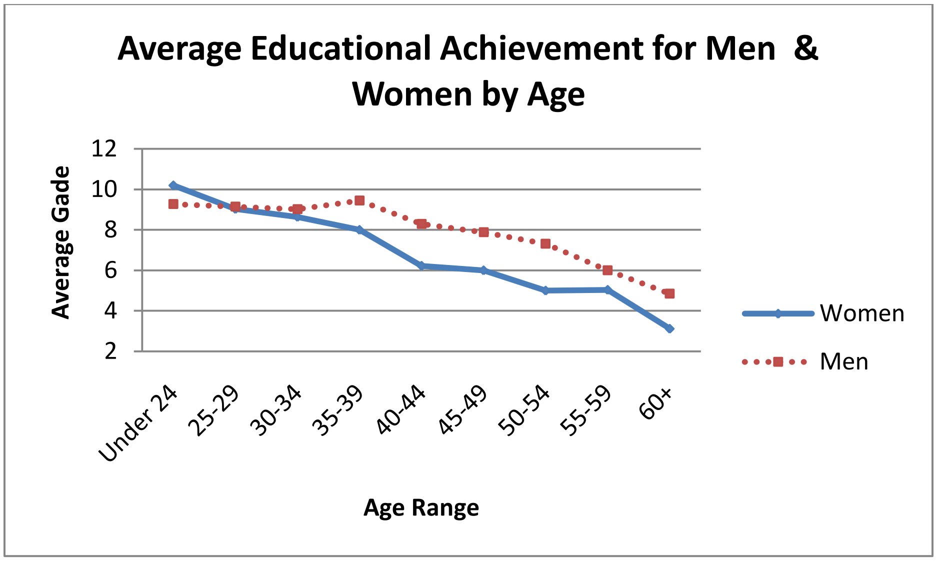
Figure 5.1 Frequency distribution of educational achievements in San Borja



Education of women has been increasing in San Borja over the past 50 years, although it is still low compared to developed countries. Figure 5.1 shows the frequency of different educational achievements for women in San Borja. Elementary school education is defined as grade levels 1-5. Middle school is grades 6-8 and high school is grades 9-12. The largest proportion of women have an elementary school education (n=218). There are also a large number of women with a high school education, although they are divided in this graph by those who have completed high school (n=86) and those who have not (n=87). Institute is similar to a trade school where individuals earn a certificate for particular occupations. Women in San Borja reported attending institute to get trained as a secretary, beautician or administrator. There are institutes located in San Borja and approximately 15 women reported attending this type of higher education. There are only 25 women who reported attending university. There is not a university located in San Borja, so people have to move to another city to attend university (typically Trinidad or La Paz).

Figure 5.2 shows average educational achievement by age for women (interviewees) and men (from sibling data) in San Borja. For women over 60 years of age, the average woman only has an elementary school education. For younger women, under 30, the average completed education is 9th or 10th grade. For men, there is a similar trend, men from older cohorts have an elementary school education on average, but education levels have increased through time. Today, men attain a 9th grade education on average.

Figure 5.2 Average Education by Age



As expected, education is a significant predictor in many of the models that have been developed in the last two chapters. Education was a significant non-linear predictor of age at first birth and it was a significant predictor in the progression to fourth or higher births. As expected, when education increases (above middle school), age of first birth increases, probability of progression to higher births decreases, and overall fertility declines.

Hypotheses and Predictions

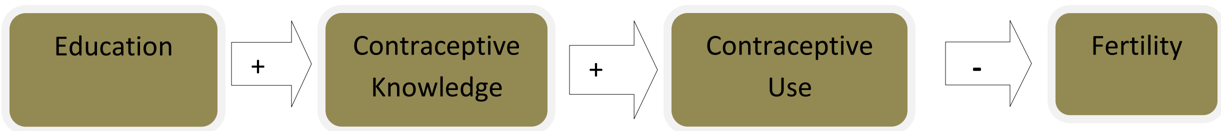
Each of the models makes specific predictions about the expected causal pathway of fertility. These paths were shown in Chapter 1, but will be reviewed briefly here.

Contraceptive Knowledge

Contraceptive Knowledge theory predicts that higher levels of education lead to contraceptive learning. Learning about contraceptives will lead to contraceptive use. With the

use of contraceptives, fertility should decline (specifically for future births). The pathway is shown in Figure 5.3.

Figure 5.3 Contraceptive Knowledge Causal Pathway

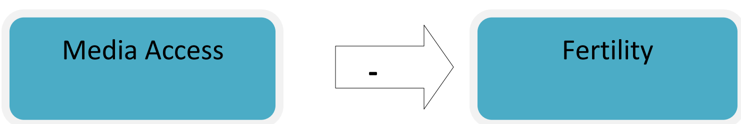


Diffusion Theory

High Status Ideas

The diffusion of high status ideas predicts that those people with access to high status ideas will reduce their fertility, since high-status individuals typically reduce their fertility first in a demographic transition. The exposure to high status ideas is measured by one's access to media (including television and internet exposure). This causal pathway is shown in Figure 5.4.

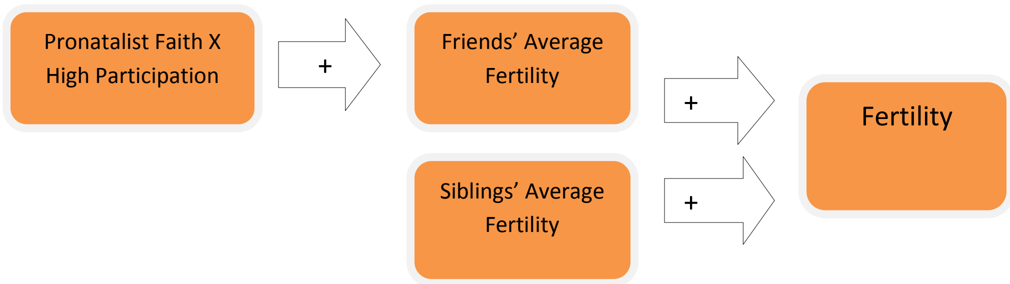
Figure 5.4 Causal Pathway of the diffusion of high-status ideas



Social Network

The diffusion of ideas throughout a social network hypothesizes that friends' average fertility will predict one's own fertility. Membership in a pronatalist religion along with a high level of participation in that religion should impact one's social network. This social network should have higher fertility and in turn, increase the likelihood of high fertility for oneself. Finally, siblings' average fertility should also predict own fertility, since siblings (unless one is adopted) are necessarily an individual's first social network. The causal pathway for the diffusion of ideas from one's social network is shown in Figure 5.5.

Figure 5.5 Diffusion of Social Network Causal Pathway



Wealth Flows

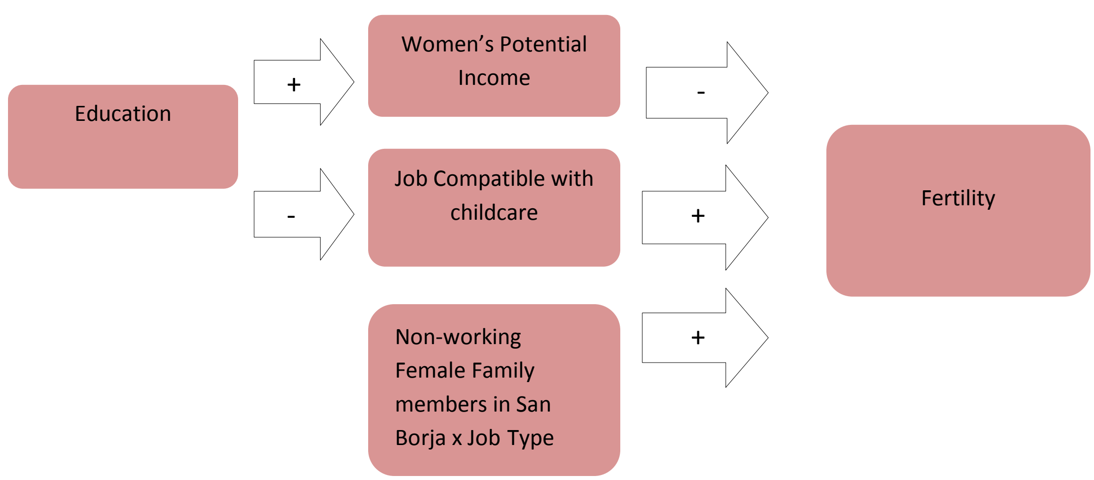
The Wealth Flows hypothesis focuses on the cost of children. If children cost more, then fertility should be reduced. If parents expect their children to work at younger ages, they will offset their overall cost and fertility will increase. If parents expect children to not work until later ages, they will cost more and fertility will decrease. If fertility decreases, then parents can afford for children to not work until later ages, so fertility should predict the age at which children actually work. Additionally, old age care can be costly in modern societies. If parents expect their children to care for them in old age, children are offsetting their cost at younger ages with reducing costs that parents have to pay in old age. When parents expect their children to care for them in old age then fertility should increase. Figure 5.6 depicts the Wealth Flows pathway.

Figure 5.6 Wealth Flows Causal Pathway

Female Labor Force

Female Labor Force Theory predicts that women who have higher levels of education will have a higher opportunity cost for having children (they will also make up a higher proportion of the family income and be more likely to work in a job incompatible with childcare), which will result in reduced fertility. For those women who have a larger number of non-working female relatives in the community, those family members may be able to help with childcare. If women face a reduced cost of childcare, they may be able to keep fertility high even when they are working in a job that is incompatible with childcare. The causal pathway is shown in Figure 5.7.

Figure 5.7 Female Labor Force Causal Pathway

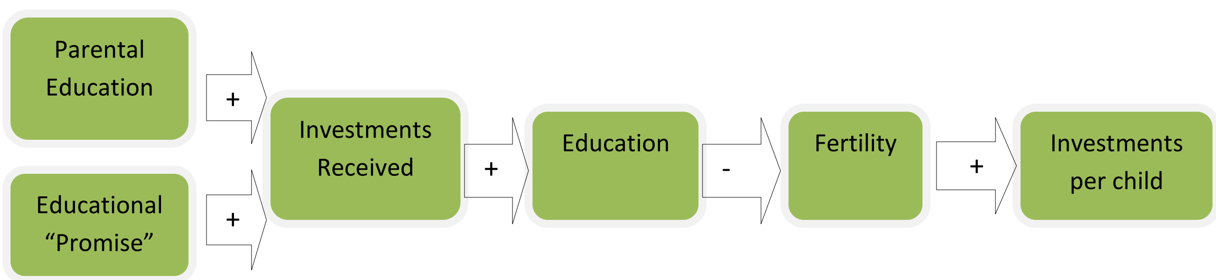


Embodied Capital

Embodied Capital Theory predicts that those parents who have higher levels of embodied capital (skills, education and training), will invest highly in their offspring and, in turn, their offspring will achieve high levels of education. This high level of education will lead to reduced fertility as individuals expect to invest highly in offspring and know that they will need to reduce

fertility to invest at the levels they intend to. Those children who exhibit high levels of promise, meaning that they work hard, learn quickly and get along with others will have a higher return on any educational investments. It is predicted that these children will receive higher levels of investment and therefore achieve higher levels of education. Figure 5.8 shows the predicted causal pathway for Embodied Capital Theory. The pathway starts with the interviewee's parent's education, which leads to her parent's investing in her, which impacts her education and her fertility. This fertility impacts the investments she makes in her own children.

Figure 5.8 Embodied Capital Theory Causal Pathway



Methods

To analyze the causal pathways, multiple regression analyses will be conducted using SPSS Version 19.0.   To analyze whether or not an individual has used contraceptives, a logit model is developed by running a binomial logistic regression in SPSS. Some of the predictions from the Embodied Capital Theory use the variable 'educational potential'. This variable was collected on the interviewee's children. To analyze this, the children's data had to be compiled and compared with interviewee's education and investments. Since a set of siblings are not independent data points, the general estimating equations model is used because it allows for sets of siblings to be analyzed as repeated measures.

Results

In this section, the causal pathways will be analyzed to determine each model's predictive ability. Then, a model of overall fertility will be presented and the implications for the models will be discussed.

Contraceptive Knowledge

The first test of contraceptive knowledge is whether or not contraceptive knowledge predicts contraceptive usage. To analyze this, a model was created to predict contraceptive use. This is measured as the number of years before 30 that one used contraceptives. This is a preferred way to analyze the contraceptive use variable because it limits a potential censoring issue with women who have yet to use contraceptives. Those women who have never used (and are above 30) are given a value of 0. Table 5.1 shows the multiple regression analysis of using contraceptives. Both income and distance from town were included to determine if they had an impact on women's use of contraceptives, but were not significant and removed from the model. The age that one learned about contraceptives is a significant predictor of using contraceptives. This model predicts that for each additional year that an individual learned about contraceptives, one expects that person to use contraceptives about .24 years earlier. Other significant variables include education and education squared. This means that as education increases, one expects an increase in the number of years of contraceptive use, but that at high levels of education, this effect actually decreases. This is somewhat surprising, but may be linked to the fact that those women who are attending college may be postponing marital status and therefore not need contraceptive until later years. For women who learn about contraceptives around age 17, having a tenth grade education predicts that she will start using contraceptives around age 25, but

if she progresses through four years of college, the model predicts that she will start using contraceptives around age 26. Finally, when controlling for other factors, cohort also impacts age at which one begins using contraceptives. Women under the age of 30 are using contraceptives about 1.5 years earlier than women over 30.

Table 5.1 Multiple regression analysis of the effect of learning about contraceptives on years using contraceptives

Dependent Variable: Number of years before 30 used contraceptives				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	-.856	.624	.171	.004
Education	.535	.184	0.004***	.019
Education squared	-.028	.011	<.001****	.015
Learned contraceptives (Yrs before 30)	.240	.042	<.001****	.068
Age = Under 30	1.585	.493	0.001***	.023
Age = 30+	0	.	.	.
R Squared = .214 (Adjusted R Squared = .207) n = 449 * p<0.10, ** p<.05, *** p<.01, **** p<.001				

Another way to analyze the relationship between using contraceptives and learning about contraceptives is to analyze whether or not a woman has ever used contraceptives (before age 30). Those women who start using contraceptives after the age of 30 have already passed through a significant part of their reproductive careers. For contraceptives to make a large effect, it is necessary for women to learn and start using them early in their reproductive careers. Table 5.2 shows the binomial logit model predicting use of contraceptives before age 30 (and only those women 30 or older are included in the model). This model shows similar results as the last

table. The earlier that one learns about contraceptives, the more likely she is to begin using contraceptives before age 30. Age and education are also significant predictors of using contraceptives.

Table 5.2 Logit analysis of the effect of learning about contraceptives on ever using contraceptives

Dependent: Ever used contraceptives before age 30				
	B	Std. Error	Sig.	Exp(B)
Constant	-4.224	.611	.000	.015
Ethnicity =Camba	.740	.342	.031	2.096
Ethnicity = Colla	0	.	.	1
Age = 30-39	.642	.277	.020	1.901
Age = 40+	0	.	.	1
Learned Contra (yrs before 30)	.085	.025	.001	1.088
Education	.533	.140	.000	1.704
Education squared	-.022	.008	.005	.978
n = 316				
* p<0.10, ** p<.05, *** p<.01, **** p<.001				

These two analyses show that learning about contraceptives is a significant predictor of using contraceptives. The next part of the analysis focuses on whether using and learning about contraceptives reduces ones fertility.

In the last chapter on parity progressions, both “Ever used contraceptives” and “Learning about contraceptives before or after first pregnancy” were included in the model. Learning about contraceptives before one’s first pregnancy was a significant predictor of age of first birth, marginally significant at predicting regression to second birth, and not significant at predicting any other parity. To determine if there may have been an effect that was obscured by the more powerful ‘using contraceptives’ variable, using contraceptives was removed from the analysis and learning about contraceptives still was not significant for higher parities. Learning about

contraceptives before one's first pregnancy reduces the likelihood of progressing to first and second birth only. For higher order births, learning about contraceptives is not a significant predictor of parity progression (regardless of how it is measured). Using contraceptives was a significant predictor of parity progression for third or higher parity progressions. This suggests that while learning about contraceptives significantly impacts early births, using contraceptives impacts the higher parity births.

Table 5.3 shows the multiple regression analysis of fertility with contraceptive knowledge variables. The dependent fertility variable is the number of children living until at least age one. This is because of the high rate of infant mortality in San Borja. Of the 2074 live births that interviewee's reported having, 82 died before their first birthday. This is a 4% infant mortality rate (the CIA reports a rate of 4.2% for Bolivia) compared to a 0.6% mortality rate in the United States (Central Intelligence Agency, 2011). Among the remaining 1992 children, only 30 perished in the next seventeen years (a rate of 1.5%). Since there is a relatively high infant mortality rate, only those children who make it to their first birthday are included in a mother's fertility calculation. This allows us to analyze the number of children who are likely to survive and avoids counting children who die young and are quickly replaced by another child.

In Figure 5.3, the significant predictors of fertility are presented. Whether a woman uses contraceptives before her first pregnancy is a significant predictor of overall fertility. If a woman uses contraceptives before her first pregnancy it reduces her overall fertility by about .958 children. Education is also significant and actually explains a higher proportion of the variance. For each additional year of schooling, a woman's fertility is reduced by .188 offspring. Another

model used the categorical variable: ever used contraceptives before 30. This was not a significant predictor of total fertility.

Table 5.3 Multiple Regression analysis of the effect of Contraceptive Knowledge variables on total fertility

Dependent Variable: Number of children living to 1

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	6.566	.408	<.001	.383
Age = Under 30	-3.523	.407	<.001****	.152
Age = 30-39	-2.152	.389	<.001****	.068
Age = 40-49	-1.647	.395	<.001****	.040
Age = 50-59	-1.273	.422	0.003***	.021
Age = 60+	0	.	.	.
Ethnicity = Camba	1.388	.251	<.001****	.068
Ethnicity = Colla	0	.	.	.
Education	-.161	.028	<.001****	.075
Learned about contraceptives = before 1st pregnancy	-.607	.220	0.006***	.018
Learned about contraceptives = after 1st pregnancy	0	.	.	.
Used contraceptives = before 1st pregnancy	-.789	.406	0.053*	.009
Used contraceptives = after 1st pregnancy	0	.	.	.

R Squared = .459 (Adjusted R Squared = .448)
n = 426
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Learning about contraceptives before first pregnancy is a significant predictor of overall fertility. Using contraceptives before first pregnancy is a marginally significant predictor of overall fertility. This analysis was also conducted with the number of years (before 30) that one learned about and used contraceptives. These variables were not significant, regardless of whether they were included in the model separately or together.

The evidence for the Contraceptive Knowledge hypothesis shows that learning about contraceptives does increase the likelihood of using them and that early learning seems to impact total number of births.

Diffusion Theory

High Status Ideas

Diffusion theory predicts that as people are exposed to the ideas of high status individuals, they will reduce their fertility. None of the variables related to access to media were significant in predicting fertility (measured as number of children living until age 1). Table 5.4 displays the media variables that were included in the model.

Table 5.4 Access to media variables

	How the variable is measured		
Variable	#1	#2	#3
Years Watching Television	Actual Age began watching TV	Yrs before 25 started to watch TV	Began watching TV before, during or after reproductive years
Hours Watching TV	Hours Watching TV	Categorized into 0 hrs, <=1 hr, <=2 hrs, >2 hours	
Internet Access	Times per month used Internet	Categorized into 0 times, 1-2 times, 3 or more times per month	
Watching Soap Operas or Movies	1 = Yes, 0 = No		

Based on the different analyses conducted with the diffusion of high status ideas, there does not seem to be any evidence that people's access to media and high status ideologies are impacting their fertility decisions.

Social Networks

The diffusion of ideas from one's social network predicts that friends' average fertility and siblings' average fertility will influence an individual's own reproductive choices. Table 5.5 shows the multiple regression model predicting fertility from social network variables. Siblings' average fertility is not a significant predictor of interviewee's number of children living until age one and was removed from the model. Friends' average fertility is a significant predictor, even when controlling for potential confounding variables. This analysis shows that for an increase in friends' average fertility by one child, it increases interviewee's fertility by 0.309 children. Religion variables were also included in this analysis, including religion, level of religiosity, current church attendance and childhood church attendance, but none of these variables were significant in predicting overall fertility levels.

Table 5.5 Multiple regression analysis of the effect of social network variables on fertility

Dependent Variable: Number of children living to age 1				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	4.85	0.429	<.001	0.217
Age = Under 30	-2.475	0.318	<.001****	0.116
Age = 30-39	-1.247	0.285	<.001****	0.04
Age = 40-49	-0.741	0.294	0.012**	0.014
Age = 50+	0[a]	.	.	.
Ethnicity = Camba	1.067	0.255	<.001****	0.036
Ethnicity = Colla	0[a]	.	.	.
Education (years)	-0.193	0.025	<.001****	0.111
Friends' Average Fertility	**0.309**	**0.065**	**<.001******	**0.047**
R Squared = .483 (Adjusted R Squared = .476) n = 469 * p<0.10, ** p<.05, *** p<.01, **** p<.001				

The causal pathway presented in Figure 5.5 shows that friends' fertility may be dependent upon one's religion if that individual is highly involved in her faith. To analyze this, a multiple regression model was developed to analyze the variables that predict friends' average fertility. This model is displayed in Table 5.6. None of the religion variables were significant in predicting friends' average fertility, but siblings' average fertility and mother's average number of children does predict friends' average fertility. This suggests that individuals, who grow up among people who have chosen larger family size, typically have friends who have chosen larger family size and, in turn, choose larger family sizes for themselves. Friends' average fertility is negatively correlated with education and positively correlated with distance from the center of town. Those individuals who spend time with individuals who have chosen a particularly fertility strategy are likely to have similar educational backgrounds and live a similar distance from the center of town.

Table 5.6 Multiple regression analysis of the effect of social networks on friends' average fertility

Dependent Variable: Friends' Average fertility				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	2.909	0.306	<.001	0.178
Age = Under 30	-1.24	0.203	<.001****	0.082
Age = 30-39	-0.424	0.174	0.015**	0.014
Age = 40+	0[a]	.	.	.
Education	-0.106	0.018	<.001****	0.075
Distance from center of town	0.053	0.011	<.001****	0.051
Siblings' average num of children	0.155	0.048	0.001***	0.025
Mom's number of children	0.053	0.026	0.043**	0.01
R Squared = .385 (Adjusted R Squared = .376) n = 424 * p<0.10, ** p<.05, *** p<.01, **** p<.001				

An individual's fertility is most correlated with friends' average fertility (.517), then siblings' fertility at .396 and mother's fertility at .095. All of these variables are significantly correlated with each other. This provides evidence that an individual is likely to have fertility outcomes similar to those of the people that she spends time with; her friends, siblings and mother.

From previous chapters, we have seen that sisters' average age of first birth predicts an individual's age of first birth and that friends' average fertility significantly predicts the likelihood of progressing to a fifth or higher birth. These results, in addition to the evidence provided in this chapter for total fertility, suggests that individuals do adopt the fertility patterns of those in their social network.

Wealth Flows

The Wealth Flows hypothesis predicts that if parents expect their children to contribute at younger ages, fertility should be higher. Once parents have made fertility decisions, if they have chosen a higher fertility strategy, children will contribute to the family income at younger ages. Finally, those parents who expect their children to help support them in old age will have higher fertility than parents who do not. Table 5.7 shows the multiple regression analysis of the effect of Wealth Flows variables on fertility.

The expected age of child contribution is not a significant predictor of fertility, so it was removed from the model. Women who reported that they expected their children to provide old age support have on average about .515 more children than women who do not (when controlling for other variables). A possible confounding issue is that nulliparous women are less likely to state that they expect their children to care for them when they are older. To remove this

potential bias, the same analysis was done, but only for women who have at least one child. The analysis is shown in Table 5.8. It shows that while the p-value increases in this analysis, old age support is still a marginally significant predictor of fertility and expecting children to provide old age support increases average number of children.

Table 5.7 Multiple regression analysis of the effect of Wealth Flows variables on fertility

Dependent Variable: Number of children living to age 1

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	6.419	.420	<.001	.331
Age = Under 30	-3.940	.400	<.001****	.171
Age = 30-39	-2.293	.384	<.001****	.071
Age = 40-49	-1.613	.389	<.001****	.035
Age = 50-59	-1.102	.414	0.008***	.015
Age = 60+	0	.	.	.
Ethnicity = Camba	1.224	.260	<.001****	.045
Ethnicity = Colla	0	.	.	.
Education (years)	-.190	.025	<.001****	.112
Distance (blocks)	.037	.016	0.021**	.011
Old Age Support = Not Children	-.515	.214	0.016**	.012
Old Age Support = Children	0	.	.	.

R Squared = .470 (Adjusted R Squared = .461)
n = 479
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

The second part of the causal pathway predicts that fertility impacts actual age of contribution. Table 5.9 shows the multiple regression analysis of the effect of fertility on the percentage of children who work between ages 5 and 10. Fertility is a significant predictor of the percentage of children who work at young ages. For an increase in one child, there is an expected increase of 3% of children who work between ages 5 and 10 (while controlling for other variables). Age was not a significant predictor in this model and was therefore removed.

Table 5.8 Multiple regression analysis of the effect of old age support on fertility for women who have children

Dependent Variable: Number of children living to age 1

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	6.621	.421	<.001	.357
Age = Under 30	-3.948	.404	<.001****	.177
Age = 30-39	-2.424	.384	<.001****	.082
Age = 40-49	-1.839	.387	<.001****	.048
Age = 50-59	-1.261	.411	0.002***	.021
Age = 60+	0	.	.	.
Ethnicity = Camba	1.183	.264	<.001****	.043
Ethnicity = Colla	0	.	.	.
Education (years)	-.179	.025	<.001****	.102
Distance (blocks)	.033	.016	0.041**	.009
Old Age Support = not children	-.425	.217	0.051*	.009
Old Age Support = children	0	.	.	.
R Squared = .452 (Adjusted R Squared = .442) n = 455 * p<0.10,** p<0.05, *** p<0.01, **** p<0.001				

Table 5.9 Multiple regression analysis of the effect of fertility on the percentage of children who work at young ages

Dependent Variable: Percentage of children who work from age 5-10				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	0.407	0.079	0	0.061
Education	-0.015	0.006	0.009***	0.017
Ethnicity = Camba	-0.136	0.058	0.019**	0.013
Ethnicity = Colla	0	.	.	.
Fertility (number of children)	0.033	0.01	0.001***	0.029
R Squared = .089 (Adjusted R Squared = .083) n = 409 * p<0.10, ** p<.05, *** p<.01, **** p<.001				

While fertility does predict the percentage of children who work from age 5-10, it is not a significant predictor in the percentage of children who work from ages 10-15 or 15-20. Additionally, fertility is not a significant predictor in average age children begin working.

The Wealth Flows hypothesis has some marginal support. It appears that expectation of old age support is significant in predicting overall fertility. The expected age of contribution is not a significant predictor of fertility. While the percentage of children between ages five and ten is predicted by fertility level, the percentage of children who work between ages 10-15 and 15-20 and the average age of contribution are all not significantly predicted by fertility. This suggests that cost of children may play a role in fertility levels. At a certain point, a high level of fertility necessitates that children earn money at young ages, but it isn't the strongest predictor of fertility decisions.

Female Labor Force

Female Labor Force predicts that a woman's potential income, her actual income, her percentage of the family income, and her job type can influence her fertility decisions. Also, if a woman has non-employed family members in town, this may help her reduce the high cost of childcare, which may allow her to have higher fertility and still maintain a career. To look at these factors, a multiple regression analysis was conducted to look at the effect of Female Labor Force variables on fertility rates. To analyze the effect of non-employed family members, the number of non-employed sisters in San Borja was calculated for each interviewee. Additionally, a categorical variable of "grandmother available" was created with a value of 1 if the interviewee's mother is still alive and living in San Borja (and a 0 otherwise). Table 5.10 shows the output of one of these analyses. Regardless of the variables that are included in the analyses, none of the Female Labor Force variables were significant in any of the models.

There is no evidence for the Female Labor Force hypothesis. Predictions related to age of first birth were not confirmed. The type of job a woman had at the time of the birth of a child

did not predict the likelihood of reproduction. Both opportunity cost and proportion of family income were not significant predictors of any fertility measure.

Table 5.10 Multiple regression analysis of the effect of Female Labor Force variables on fertility

Dependent Variable: Number of children living to age 1

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	7.028	.508	<.001	.331
Ethnicity=Camba	1.360	.290	<.001****	.054
Ethnicity=Colla	0	.	.	.
Education	-.217	.029	<.001****	.124
Age = Under 30	-4.139	.465	<.001****	.170
Age = 30-39	-2.538	.449	<.001****	.076
Age = 40-49	-1.872	.445	<.001****	.044
Age = 50-59	-1.627	.463	<.001****	.031
Age = 60+	0	.	.	.
Grandmother support = No	.115	.225	.608	.001
Grandmother support = Yes	0	.	.	.
Work = Not compatible with childcare	-.134	.424	.752	.000
Work = Compatible with childcare	0	.	.	.
Number of unemployed sisters in San Borja	.051	.113	.654	.001
Interviewee's income per day	-.001	.002	.679	.000

R Squared = .488 (Adjusted R Squared = .475)
n = 398
* p<0.10, ** p<.05, *** p<.01, **** p<.001

Embodied Capital Theory

Embodied Capital Theory predicts that education is the main factor in fertility transition. An individual's educational achievements are based on their parent's investments. A parent decides to invest in children when the parent has a high level of education, skill and training and can more easily invest in developing these skills in offspring compared to parents with little lower levels of education. Those parents with little education and training will struggle to help their children educationally and will therefore invest less in each offspring. This reduced investment will lead to lower educational achievement and finally, higher fertility.

The previous models have shown that education is a significant predictor of total fertility. To understand the role of parental investments a variable was created called "Educational Investments" which is an average of investments in homework, reading, private school and monetary help with college. Since homework and reading are based on a 2 point scale (2=everyday, 1 = sometimes, 0=never), they are weighted twice as heavily as private school (1=yes, 0=no) and monetary help with college (1=yes, 0=no). If an individual did not attend college, then the parental investment score only averages the values from the other categories. The highest value that someone can have is a 1 (meaning that the parent read to the interviewee daily, helped with homework daily, sent the interviewee to private school and parents helped with college if the interviewee attended). The lowest value possible is a 0. Another variable "Non-educational investments" is a categorical variable of whether or not the interviewee received monetary help for either her wedding or to move into a new home.

First, the relationship between parental education and investment in education will be analyzed. Figure 5.11 is the multiple regression analysis of the effect of parental education on investments in education. Mother's education level, father's education and non-educational investment are all significant at predicting investment in education. The reason that non-educational investment was included in the model is that embodied capital predicts that parents who invest highly in education also invest highly in activities not associated with education. For example, many highly investing parents in the United States today spend enormous amounts of money helping their children be successful in sports and music, even when the likelihood of a professional career in the activity is almost zero. It is likely that those parents who are investing

highly in an offspring's educational success will also invest highly in other activities, such as help paying for a wedding or help in moving to a new home.

Table 5.11 Multiple regression analysis of the effect of parental education on investment in offspring's education

Dependent Variable: Educational Investments

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	.226	.033	<.001	.129
Mother's Educational Level	.101	.017	<.001****	.104
Father's Educational Level	.049	.014	<.001****	.038
Non-educational Investments = No	-.113	.032	<.001****	.037
Non-educational investments = Yes	0	.	.	.

R Squared = .276 (Adjusted R Squared = .269)
n = 323
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

Figure 5.12 shows the multiple regression analysis of the effect of parental investments on education. Parental investments in both educational and non-educational items results in a higher level of education, even after controlling for mother's and father's education. When parents invest highly in education, it is expected that the offspring will achieve on average 1.556 additional years of education. Non-educational investments result in an average of 1.255 additional years of education.

Table 5.13 shows the multiple regression analysis of the specific type of investments on education. Parental education is still a strong predictor of education, but whether a child goes to public or private school and financial support of wedding are both predictors of education. The age that parents terminate support of offspring is also a significant predictor of education, but

since parents do not usually terminate support until after education is completed, it was not included in this model.

Table 5.12 Multiple regression analysis of parental investments on educational achievement

Dependent Variable: Education (yrs) of interviewee				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	5.247	0.62	<.001	0.189
Age = Under 30	3.489	0.544	<.001****	0.118
Age = 30-39	2.559	0.507	<.001****	0.077
Age = 40-49	1.295	0.521	0.014**	0.02
Age = 50+	0	.	.	.
Distance (blocks)	-0.113	0.029	<.001****	0.049
Mother's Education Level	1.363	0.219	<.001****	0.112
Father's Education Level	0.623	0.171	<.001****	0.042
Parental Investment in Education	1.556	0.682	0.023**	0.017
Parental Investment in Non-Education = No	-1.255	0.4	0.002***	0.031
Parental Investment in Non-Education = Yes	0	.	.	.

R Squared = .521 (Adjusted R Squared = .509)
n = 316
* p<0.10, ** p<.05, *** p<.01, **** p<.001

The age parents terminate support is another investment that parents can make in offspring. Table 5.14 displays the multiple regression analysis of the effect of parental education and other parental investments on the age parents terminate support. Investment in educational activities, non-educational activities, age the individual began working and mother's educational level all significantly predict age that parents terminate support. These analyses suggest that when parents choose a high investment strategy, they typically invest in educational activities, non-educational activities, and keep supporting offspring until older ages. All investment variables (educational activities, non-educational activities, age parents terminate support) are correlated with each other and significantly correlated with mother's education.

Table 5.13 Multiple regression analysis of the effects of specific parental investments on educational achievement

Dependent Variable: Education (yrs) of interviewee				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	8.123	1.02	<.001	0.266
Age = Under 30	1.927	0.659	0.004***	0.047
Age = 30-39	1.893	0.572	0.001***	0.059
Age = 40+	0	.	.	.
Distance (blocks)	-0.116	0.042	0.006***	0.042
Mother's Educ Level	1.433	0.279	<.001****	0.131
Father's Educ Level	0.676	0.215	0.002***	0.054
Public School	-1.495	0.855	0.082*	0.017
Private School	0	.	.	.
Help with Wedding = NO	-1.162	0.495	0.02**	0.031
Help with Wedding = YES	0	.	.	.

R Squared = .488 (Adjusted R Squared = .468)
n = 183
* p<0.10, ** p<.05, *** p<.01, **** p<.001

One additional prediction of the embodied capital model is that a child's educational potential should impact the investments that he or she receives. A child that appears to learn quickly and work hard should receive more educational investments from parents than a child who is lazy and not as bright. To conduct this analysis, the interviewees reported on the educational achievement of her offspring, the investments that she provided to her offspring (both educational and non-educational investments) and her offspring's potential. Offspring potential was measured by mother's report of offspring's abilities on a 5 point scale of 1) ability to get along with peers, 2) learning quickly, 3) working hard and 4) excelling in studies. Table 5.15 shows the result of the analysis of the effect of parental education (which is the interviewee's education) and child potential on a child's educational outcomes. A general

estimating equation was used to analyze this model because sets of siblings are not independent. This model allows for the analysis to be conducted as a repeated measures design.

Table 5.14 Multiple regression analysis of the effect of parental education and parental investments on the age parents terminate support

Dependent Variable: Not supported by parents (age)				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	13.491	1.063	<.001	0.321
Distance (blocks)	-0.084	0.032	0.008***	0.021
Mother's Education Level	0.746	0.215	0.001***	0.034
Age began working	0.273	0.079	0.001***	0.034
Age began working squared	-0.003	0.001	0.016**	0.017
Investment in Education	1.452	0.736	0.049**	0.011
Investments in Non-Education = NO	-0.769	0.456	0.093*	0.008
Investments in Non-Education = YES	0	.	.	.

R Squared = .167 (Adjusted R Squared = .153)
n = 348
* p<0.10, ** p<.05, *** p<.01, **** p<.001

Table 5.15 shows that the offspring's potential is not a significant predictor in the amount of investments that he or she will receive when controlling for other variables. Additionally, father's education was not a significant predictor either and was removed from the model. The analysis was conducted with each of the four components (working hard, learning quickly, etc) of the potential variable and none of them significantly predicted educational investments. Mother's education (in this case, mother represents the women who was interviewed) is a significant predictor of investments in education for her children. Table 5.16 shows the final model with educational potential removed.

Table 5.15 General estimating equations analysis of the effect of educational potential and parental education on investments in education

Dependent: Educational Investments

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	.348	.0876	<.001	1.417
Mother's education	.035	.0058	<.001****	1.035
Non Educational Investments	.097	.0376	0.01**	1.102
Educational Potential	-.003	.0177	.864	.997

QIC = 69.897

n = 648 (194 Independent Mothers)

* p<0.10, ** p<.05, *** p<.01, **** p<.001

Table 5.16 General estimating equations analysis of parental education on investment in children (using child data)

Dependent: Educational Investments (for offspring)

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	.336	.0424	<.001	1.399
Mother's Education	.035	.0058	<.001****	1.035
Non Educational Investments	.097	.0387	0.012**	1.102

QIC = 65.207

n = 652 (194 Independent Mothers)

* p<0.10, ** p<.05, *** p<.01, **** p<.001

Educational potential may not be a significant predictor of educational investments because the data were collected from a retrospective interview, so children who did well in school may be remembered now as having higher educational potential, even when they might not have appeared to have such great potential when they were small children. To look at this possibility further, a model to investigate the effect of educational potential on age that parents terminate support was analyzed. Table 5.17 shows the results of this analysis and offspring

potential is a significant predictor of this type of parental investment. This suggests that educational potential may reflect an offspring's potential at slightly older ages and parents respond with investments to help children at older ages than investments to help children at younger ages.

Table 5.17 General estimating equations analysis of the effect of educational potential on the age parents terminate support

Dependent: Age Parent's Terminate Support

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	12.514	1.0678	<.001	272215.117
Educational Potential	.846	.2353	<.001****	2.330
Educational Investments	1.600	.9602	0.096*	4.953
Non Educational Investments	1.234	.4586	0.007***	3.434
Father's Education	.148	.0538	0.006***	1.159

QIC = 5325.663

n = 477 (139 Independent Mothers)

* p<0.10, ** p<.05, *** p<.01, **** p<.001

Table 5.18 General estimating equations analysis of the effect of educational investments on education

Dependent: Educational Achievement (for offspring)

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	4.154	1.2689	.001	63.699
Ethnicity = Camba	-2.620	.8988	0.004***	.073
Ethnicity = Colla	0	.	.	1
Non Educational Investments	1.562	.4872	0.001***	4.768
Educational Potential	1.328	.2212	<.001****	3.775
Educational Investments	3.504	1.0177	<.001****	33.239

QIC = 6070.393

n = 556 (169 Independent Mothers)

* p<0.10, ** p<.05, *** p<.01, **** p<.001

The next model analyzes the effect of the interviewee's investments on her children's educational outcomes. Only children who have completed their schooling are included. General Estimating Equations were used so that sets of siblings were analyzed as repeated measures. Table 5.18 shows the results of this analysis. Educational investments, non-educational investments and offspring potential are all significant predictors of offspring's educational achievements. In this model, parental education was excluded. If both mother's and father's education are included, they cause educational achievements to become insignificant. This is because educational investments, non-educational investments, mother's education and father's education are all highly correlated. The model including parental education is shown in Figure 5.19.

Table 5.19 General estimating equations analysis of the effect of parental education and educational investments on education

Dependent: Educational Achievement (for offspring)

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	3.435	1.2963	.008	31.039
Ethnicity = Camba	-1.646	.9063	0.069*	.193
Ethnicity = Colla	0	.	.	1
Educational Investment	1.251	1.0047	.213	3.495
Non Educational Investment	1.318	.4400	0.003***	3.736
Educational Potential	1.120	.2268	<.001****	3.063
Mother's Education	.242	.0757	0.001***	1.273
Father's Education	.199	.0585	<.001****	1.221
QIC = 4491.385				
n = 483 (141 Independent Mothers)				
* p<0.10, ** p<.05, *** p<.01, **** p<.001				

There is significant evidence to support Embodied Capital Theory. Analyses in this chapter show that parental education is a significant predictor of investments in children. Investments in children (along with parental education) predict children's educational achievements. Education is a strong predictor of fertility outcomes. The age that parent's terminate support is a strong predictor of age of first birth and the probability of progressing to first birth. Rarely are education and income significant in the same model. One situation in which this did occur was in predicting the transition to fourth birth. When looking at the effects of education and income (see Table 4.7), education reduced the likelihood of progressing to fourth birth, but when controlling for education, income actually increased the likelihood of transition to fourth birth, as Embodied Capital Theory would predict. The one prediction that had marginal support that educational potential should predict educational investments. Based on the analyses conducted, it does not appear that this is the case for investments at young ages, but it does predict age at which parents terminate support.

Best Model of Fertility

The best model of fertility is presented in Table 5.20. This model includes the contraceptive knowledge variables of learning and using contraceptives before first pregnancy, friends' average fertility, and education, along with the confounding variables: age and ethnicity. Education squared and ever using contraceptives before age 30 are both non-significant predictors of total fertility. Education has routes to fertility through by learning about contraceptives, using contraceptives and an independent effect. Looking at the effect through all of these routes, the standardized regression weight for education is -0.257.

Table 5.20 Multiple regression analysis of fertility

Dependent Variable: Number of children living to 1

Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	6.083	0.541	<.001	0.241
Age = Under 30	-3.146	0.444	<.001****	0.112
Age = 30-39	-1.931	0.41	<.001****	0.053
Age = 40-49	-1.414	0.411	<.001****	0.029
Age = 50-59	-0.983	0.443	0.027**	0.012
Age = 60+	0	.	.	.
Ethnicity = Camba	1.156	0.265	<.001****	0.046
Ethnicity = Colla	0	.	.	.
Education	-0.158	0.029	<.001****	0.07
Learned contraceptives before 1st preg = YES	-0.52	0.228	0.023**	0.013
Learned contraceptives before 1st preg = NO	0	.	.	.
Used contraceptives before 1st preg = YES	-0.817	0.408	0.046**	0.01
Used contraceptives after 1st preg = NO	0	.	.	.
Friends' Average Fertility	0.129	0.069	0.064*	0.009

R Squared = .464 (Adjusted R Squared = .452)

n = 408

* p<0.10, ** p<.05, *** p<.01, **** p<.001

Since fertility is incomplete for women under the age of 40, expected fertility is reduced for women in younger age cohorts. Women under the age of 30, have (at the time of interview) about 3.146 fewer children than women over 60. For Camba women, they have on average 1.156 more children than Colla women (when controlling for other variables). As education increases, fertility declines. For an additional four years of education, fertility is predicted to decrease by 0.632 children. Friends' average fertility is marginally significant in predicting total fertility. The model predicts that an increase by one child for friends' average fertility predicts an increase in interviewee's fertility by about 0.129 children when controlling for other

variables. Learning about contraceptives before one's first pregnancy reduces overall fertility by .52 offspring while using contraceptives before one's first pregnancy reduces overall fertility by 0.817 offspring.

Figure 5.9 Predicted Fertility by Contraceptive Knowledge and Education

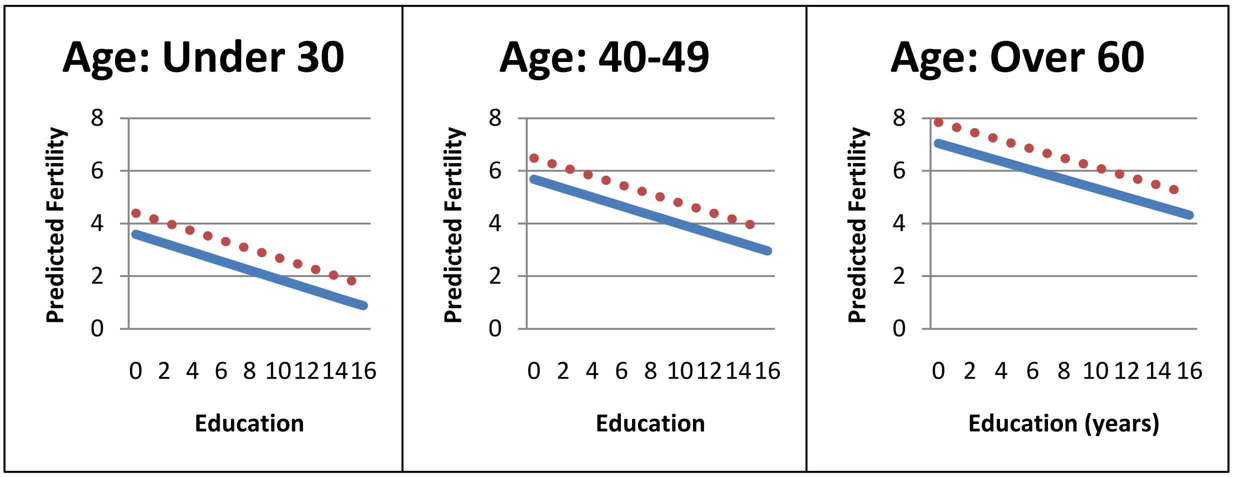


Figure 5.9 shows the predicted fertility for a Camba woman, under 30, between ages 40 and 49 and over the age of 60, who either learned about contraceptives before (solid line) or after (dotted line) her first pregnancy (based on a multiple regression model that does not include using contraceptives). These figures show that fertility is expected to decline as the level of education increases and that learning about contraceptives before one's first pregnancy reduces overall fertility. This allows for a comparison of the effects of education and contraceptive knowledge on fertility.

Discussion

The causal pathway of the Contraceptive Knowledge hypothesis does have support. Contraceptive knowledge does predict contraceptive usage, which leads to reduced fertility. In

the final model of fertility, learning and using contraceptives before one's first pregnancy had a significant impact on total fertility. The way that variables are defined can have a large effect on whether contraceptive knowledge has an effect on fertility outcomes. When the variable 'number of years before age 30' is used, the results typically are either not significant or are significant in the opposite direction the hypothesis predicts. This is because early contraceptive use may be an indication of early sexual activity and may occur after first pregnancy.

Table 5.21 Multiple regression analysis of the effect of education on contraceptive knowledge

Dependent Variable: Number of yrs before 30 learned about contraceptives				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	4.837	.483	<.001	.181
Education	.728	.056	<.001****	.274
R Squared = .274 (Adjusted R Squared = .272) n = 457 * p<0.10, ** p<.05, *** p<.01, **** p<.001				

One of the major issues still remaining is whether contraceptive knowledge is just a result of other variables or is a significant determinant of fertility reduction by itself. To analyze this, Table 5.21 displays a model to determine the amount of variation in contraceptive knowledge that can be explained by education alone. Approximately 27% of the variation in contraceptive knowledge can be explained by educational achievement alone.

To investigate this relationship further, an instrumental variable was created to estimate the effects of contraceptive knowledge in our causal pathway. At this point, it is impossible to determine if variables like education and age cohort leads to contraceptive knowledge, which impacts fertility or if contraceptive knowledge on its own has a significant role in fertility. To

determine this, a model predicting contraceptive knowledge was created. Table 5.22 shows the multiple regression model predicting the age that an individual learns about contraceptives (or their current age if they haven't learned yet). The predicted values were saved for each individual and whether their predicted age occurred before their first pregnancy was calculated.

Table 5.22 Multiple regression analyses predicting the age one learns about contraceptives

Dependent Variable: Age learned about contraceptives				
Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	35.149	1.953	<.001	0.43
Education	-1.918	0.392	<.001****	0.053
Education Squared	0.073	0.023	0.001***	0.023
Friends' Average Fertility	0.686	0.294	0.02**	0.012
Age = Under 30	-9.334	1.494	<.001****	0.083
Age = 30-39	-8.53	1.344	<.001****	0.086
Age = 40-49	-5.356	1.357	<.001****	0.035
Age = 50+	0	.	.	.

R Squared = .387 (Adjusted R Squared = .378)
n = 437
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001

This 'predicted learned about contraceptives before or after first pregnancy' variable was then used to replicate the models throughout this dissertation. Table 5.23 shows a comparison between the original cox proportional hazard model predicting likelihood of having a first birth and one using the predicted values for learning before first pregnancy. The model shows that the predicted 'learning about contraceptive' values have an even stronger effect on reducing the likelihood of progressing to first birth. This suggests that learning about contraceptives is an even larger contributor to progression to first birth. Another interesting result of this analysis is that the cohort effects become more significant for the all age groups under 50. This suggests

that there are cohort effects that are not explained by changes in education, investment in offspring or contraceptive knowledge.

Table 5.23 Comparison of cox proportional hazards analyses with actual contraceptive learning vs. predicted contraceptive learning

	B	SE	Wald	Sig.	Exp(B)		B	SE	Wald	Sig.	Exp(B)
Age = Under 30			9.292	0.026**		Age = Under 30			41.139	<.001****	
Age = 30-39	0.351	0.173	4.106	0.043**	1.42	Age = 30-39	1.042	0.181	32.998	<.001****	2.834
Age = 40-49	0.108	0.158	0.47	0.493	1.115	Age = 40-49	0.647	0.162	15.964	<.001****	1.91
Age = 50+	-0.123	0.159	0.601	0.438	0.884	Age = 50+	0.145	0.16	0.817	0.366	1.156
Ethnicity	0.579	0.139	17.454	<.001****	1.785	Ethnicity	0.528	0.144	13.42	<.001****	1.696
Education	0.136	0.048	8.01	0.005***	1.145	Education	0.126	0.048	6.816	0.009***	1.135
Education squared	-0.009	0.003	9.046	0.003***	0.991	Education squared	-0.006	0.003	3.892	0.049**	0.994
Age parents terminate support	0.139	0.066	4.493	0.034**	1.149	Age parents terminate support	0.058	0.063	0.851	0.356	1.06
Age parents terminate support squared	-0.006	0.002	9.166	0.002***	0.994	Age parents terminate support squared	-0.004	0.002	4.746	0.029**	0.996
Learned Contraceptives after first pregnancy	**-0.658**	**0.118**	**31.18**	**<.001******	**0.518**	**PREDICTED learned contraceptives before 1st pregnancy**	**-1.668**	**0.15**	**124.255**	**<.001**	**0.189**
Chi-Square = 114.188 df = 9 Sig. <.001**** n = 433						Chi-Square = 218.406 df = 9 Sig. < .001**** n = 416					
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001											

Similar results are found when comparing the actual and predicted values of learning about contraceptives on total fertility (seen in Table 5.23) The variable 'using contraceptives before first pregnancy' was not included in this model because it is endogenous of learning about contraceptives. To separate these effects, only learning about contraceptives was included in the model. The predicted value of learning about contraceptives is more significant than the model

with the actual contraceptive learning variable. Additionally, the cohort effects are larger in the model with the predicted contraceptive learning variables.

Table 5.24 Comparison of multiple regression analyses of total fertility for actual contraceptive learning vs. predicted contraceptive learning

Dependent Variable: Number of children living to 1

Parameter	B	Std. Error	Sig.	Partial Eta Squared	Parameter	B	Std. Error	Sig.	Partial Eta Squared
Intercept	5.696	.533	<.001	.212	Intercept	5.668	.531	<.001	.212
Age = Under 30	-2.903	.435	<.001****	.095	Age = Under 30	-2.925	.433	<.001****	.097
Age = 30-39	-1.602	.402	<.001****	.036	Age = 30-39	-1.650	.401	<.001****	.038
Age = 40-49	-1.079	.402	0.008***	.017	Age = 40-49	-1.187	.402	0.003***	.020
Age = 50-59	-.726	.435	0.096*	.007	Age = 50-59	-.952	.437	0.03**	.011
Age = 60+	0	.	.	.	Age = 60+	0	.	.	.
Ethnicity = Camba	1.158	.256	<.001****	.046	Ethnicity = Camba	1.081	.256	<.001****	.040
Ethnicity = Colla	0	.	.	.	Ethnicity = Colla	0	.	.	.
Education	-.169	.028	<.001****	.079	Education	-.140	.030	<.001****	.051
Learned about contraceptives = before 1st pregnancy	**-.649**	**.224**	**0.004*****	**.019**	**PREDICTED Learned about contraceptives = before 1st pregnancy**	**-.963**	**.257**	**<.001******	**.032**
Learned about contraceptives = after 1st pregnancy	0	.	.	.	PREDICTED Learned about contraceptives = after 1st pregnancy	0	.	.	.
Friends' Average Fertility	.183	.068	0.008***	.017	Friends' Average Fertility	.185	.068	0.007***	.017
R Squared = .491 (Adjusted R Squared = .481) n=433					R Squared = .495 (Adjusted R Squared = .485) n = 434				
* p<0.10,** p<0.05, *** p<0.01, **** p<0.001									

The parity progression analyses show a similar trend. The predicted learning of contraceptives is a significant predictor for the progression to first, second and third birth, while the actual learning of contraceptives is significant for the progression to first birth and marginally significant for progression to second birth. Again, the predicted value of contraceptive learning is more predictive of progressing to second and third birth than the actual value of contraceptive

learning. Taken together, these analyses show that contraceptive learning is a significant factor in predicting fertility even after controlling for its endogeneity.

The diffusion of high status ideas has not been a significant predictor of fertility throughout. The causal pathway had no support regardless of how the 'access to media' variables were defined. This may mean that one's access to media is not the way that high status ideas propagate throughout a society. Perhaps actual interaction with high status individuals is required before their ideologies pass from one person to another, but based on the analyses conducted here, there is no support for the diffusion of high status ideas.

The diffusion of ideas through a social network does have marginal support. Friends' average fertility is a marginal predictor of overall fertility, even after controlling for other important factors that may explain this relationship, like wealth or distance from the center of town. There is a significant correlation between friends' fertility, mother's fertility, siblings' fertility and own fertility. This provides evidence that people adopt the fertility strategies of those around them. Religious views were included in the analyses, but did not appear to have any impact on one's social network or fertility. A woman's social network was defined as a woman's five closest friends, but this may not be the best way to determine a woman's social network. No information was collected about her husband's friends, the frequency of contacts with social network members or the actual distance from social network members. These different factors pertaining to one's social network may have more of an influence on overall fertility than the average number of children for close friends.

The Wealth Flows hypothesis did not have much support for the age that children were expected to contribute to the household, which is a major blow to this hypothesis. If parental expectations of contribution from children do not predict fertility, then it is hard to envision that parents are solely concerned with how much their children will be able to produce for the household. The variable of whether or not children were expected to provide old age support was a significant predictor in the partial model of overall fertility, but was only marginally significant when adults without children were excluded. In the final model of total fertility, it was not a significant predictor. Overall, it does not appear that there any evidence supporting the Wealth Flows hypothesis.

In the parity progression models, expected educational achievement was significant at predicting the transition to third child and five or more children. This could be interpreted as supporting either the Wealth Flows hypothesis (since this suggests the costs that parents expect to face) or the Embodied Capital Theory (since it may represent investments that parents expect to provide offspring). Reviewing the analyses from this chapter, it appears that the investments that parents expect to bestow upon their children is a better predictor of actual educational achievements and fertility than the age that children are expected to contribute to the household. Since there is more support for the causal pathway of the Embodied Capital Theory instead of the Wealth Flows Theory, the effect of expected educational achievement is interpreted as investments parents expect to make.

The Female Labor Force Theory did not have any significant results in predicting overall fertility. As mentioned before, this may be because women have the opportunity to work in jobs

where they can simultaneously provide childcare. This removes much of the opportunity cost that women in San Borja may face.

Evidence strongly supports the Embodied Capital causal pathway. Parental education predicts investment in offspring, which influences a child's education, and therefore affects fertility. This pathway was analyzed over two generations: with the interviewee's parents' education, their investments in her, the impact on her education and finally, her fertility. The relationship between the interviewee and her children was also analyzed and the results were the same. Offspring potential was analyzed to see if those offspring who appear to have more potential will obtain more investments from parents. While those children with more potential were not read to more often or more likely to attend private school, they were supported to a later age and attained higher levels of education.

One of the main issues with conducting retrospective interviews is the accuracy of the data collected. There is evidence that as women age, it may be harder for them to remember events that occurred further in the past, like the correct age (or year of birth) of their offspring. There were many times when women reported their year of birth and their mother's year of birth and the years are less than 15 years apart or over 40 years apart. This is a reflection of a culture where fewer people memorize the years of births for each of their children, their parents, or their siblings. To try to deal with these inaccuracies, data were collected in several ways. For example, not only were years of birth recorded for offspring, women were also asked how old they were when they had their first child. This allowed for comparison during the interview to try to make any necessary corrections while still in the presence of the interviewee. In addition

to not being able to remember certain dates, women would sometimes lie about certain things. While it is hard to know if a woman is lying, questions were asked in several different ways to try to make sure the information that was collected was reliable. If a woman stated that she had four siblings, she would have to go through each one and give their name, birthdate, father's name, etc. This hopefully reduced the ability of women to lie and helped them remember any individuals they may have forgotten. Fortunately, unless there is systematic lying among the interviewees, one would expect lying to reduce effects. Regardless of the way that fertility is analyzed (age of first birth, parity progressions and total fertility), similar trends are seen throughout the analyses, giving additional credibility to the collected data.

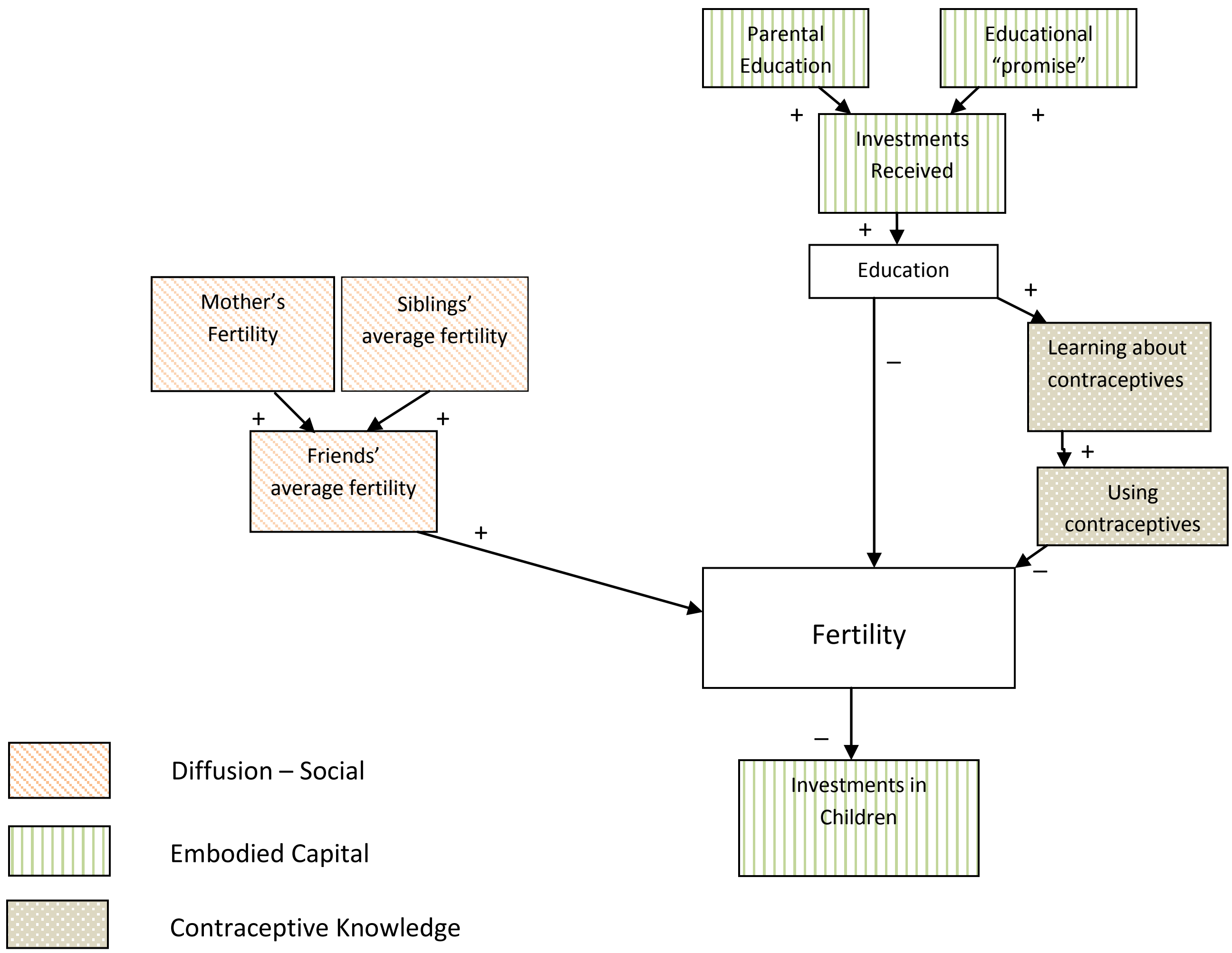
It appears that a dual model of fertility is the best interpretation of fertility change. Embodied Capital Theory and Contraceptive Knowledge are both strong predictors of fertility. The age of first birth is driven by parental investment, contraceptive learning and education. Education has multiple routes to fertility reduction. It affects contraceptive learning and also predicts fertility when contraceptive learning is controlled for. Education may impact contraceptive learning in two possible ways. First, more education may lead individuals to have access to contraceptive knowledge or second, women who have higher levels of education may be more likely to seek out information about contraceptives. Further research is needed to understand the link between education and contraceptive knowledge. Total fertility is predicted by contraceptive learning and education. Parental education is the primary driver of offspring education. Higher parental education leads to higher levels of investment in offspring. These Embodied Capital variables impact an offspring's education, which impacts overall fertility. The

links between all of the education, investment and fertility variables are very strong. Those parents who have the most education are investing highly in their offspring, which results in higher education and reduced fertility. This explains how female educational achievement impacts fertility.

Diffusion Theory appears to have a weak effect in predicting fertility. Friends' average fertility predicts the progression to five or more births and is a marginal predictor of total fertility. A woman who spends a lot of time with women who have high fertility is likely to have higher fertility than a woman who spends a lot of time with women who have fewer children. Social diffusion may impact one's decision to have additional children or to begin using contraceptives. Diffusion of ideas through a social network does not explain changing fertility patterns, but with Embodied Capital Theory and Contraceptive Knowledge, as a few women begin to change their fertility strategies, those choices may propagate throughout a community.

The updated causal pathway is shown in Figure 5.10.

Figure 5.10: Results of Causal Pathway Analysis



Conclusion

The results of this chapter show the strongest support a dual model of fertility change incorporating the: Embodied Capital Theory and Contraceptive Knowledge. There is evidence that contraceptive knowledge leads to contraceptive use which reduces fertility, and the analyses of the instrumental variables shows that these effects cannot be explained away by other variables. For Embodied Capital Theory, parental education leads to investments in children, which improves their educational achievement and reduces fertility. There is some marginal support for the diffusion of ideas through one's social network as an additive effect. Friends' average fertility is a marginal predictor of fertility and mother's and siblings' average fertility predicts friends' average fertility. The Wealth Flows hypothesis, Female Labor hypothesis and the diffusion of ideas from high status individuals (through exposure to media) did not have any evidence to support their causal pathways.

Total fertility is best predicted by education, age, ethnicity, learning and using contraceptives before first pregnancy, and friends' average fertility. As education increases, the model predicts a reduction in completed fertility. If friends' average fertility is higher, the interviewee's fertility is expected to increase. When a woman learns about or uses contraceptives before her first pregnancy, her fertility is expected to decline.

Chapter 6: Conclusion

Summary

The goal of this dissertation is to understand the factors influencing fertility transition in a community actually undergoing the change in fertility. Five models that have been discussed in the Demographic Transition literature were tested to examine their ability to predict: age at first birth, parity progressions, and the causal pathway of fertility.

The first model tested was the Contraceptive Knowledge theory which states that access and knowledge of contraceptives is the key to bringing about fertility reduction. The second model tested was Diffusion Theory. The diffusion of ideas from two types of people were analyzed, those that are high status individuals and those that are part of one's social network. These hypotheses state that individual's will adopt the ideas of others (either those that are high status or those in their social network). The third model, Wealth Flows Theory, looks at the changing costs of children and the shift from relatively inexpensive children to more expensive children with schooling requirements. Female Labor Force Theory posits that the opportunity costs of having children force women to reduce their fertility or to give up their job. Finally, Embodied Capital Theory states that parents are changing their investments in children to prepare them for a skill-intensive, competitive labor force. To be able to increase investments in children, parents must reduce their fertility. Predictions that were unique to each model were tested.

Review of Results

In Chapter 3, the average age of first birth was analyzed. Age of first birth is not changing in San Borja. Older women and younger women all have a median age of 18-

19 years old for age at first birth. The analyses of age of first birth show that younger women are learning about and using contraceptives at higher rates than women decades before them. Learning about contraceptives before one's first pregnancy significantly increases a woman's age of first birth. The age that parents terminate support has a non-linear effect on age of first birth. If parents terminate support after the age of 14, for each additional year that parents support the offspring there is a positive effect on age of first birth. Education also has a non-linear effect on age of first birth. For educational achievements above middle school, each additional year of education has a positive effect on age of first birth. As the age that parents terminate support and level of education increase to higher levels, there is an increasingly larger impact on age at first birth. This section shows support for the two models: Contraceptive Knowledge and Embodied Capital. Diffusion of ideas through one's social network had some marginal support in the partial model, but was not significant in the overall model of age of first birth.

Chapter 4 analyzes the parity progression for each birth. These analyses benefit from not being biased from censoring problems with women who have not finished their fertility. Data show that women in younger cohorts are progressing to higher order births (four or higher) at a lower rate than women in older cohorts. This evidence suggests that younger women are less likely to progress to higher order births. For the progression to first birth, learning about contraceptives before first pregnancy is a significant predictor in reducing the likelihood of progressing to first birth. Additionally, if parents have yet to terminate support, the likelihood of progressing to first birth is reduced. The control variables of ethnicity and marriage are also significant, showing that Colla women and unmarried women are less likely to progress to first birth.

Only control variables are significant for the progression to second birth. As age and year of birth increases, one is less likely to progress to second birth. This means that as women age they are less likely to continue having children and that younger cohorts of women are less likely to continue having children. Learning about contraceptives before first pregnancy is marginally significant and suggests that contraceptive learning reduces the likelihood of progressing to second birth.

For the progression to third and fourth births, the control variables age, year of birth and marital status are all significant. If a woman has never used contraceptives, she is significantly more likely to progress to her third child. If expected educational achievement of offspring is higher, women are significantly less likely to progress to third and fifth or higher births. An increase in education is significant in reducing the rate of progression to fourth birth.

The progression to five or more births has the most significant predictors. Control variables age, year of birth and marital status are all still significant. Those women who are older, from a younger age cohort or are unmarried are all less likely to have progress to five or more offspring. Additionally, an increase in education, use of contraceptives or higher expected educational achievement of children significantly reduces the rate of progression to five or more children, but as friends' average fertility increases, so does the probability of having five or more children.

This chapter provided support for the Contraceptive Knowledge Hypothesis, where learning impacts early births and using contraceptives impacts higher order births. Diffusion of social network is supported because friends' average fertility is significant in

the progression to five or more births. Additionally, Embodied Capital Theory is supported because age parents terminate support significantly predicts first birth and expected educational achievement predicts third, and fifth or more births.

Chapter 5 analyzed total fertility and the causal pathways described by each model. The evidence supported the causal pathway for the Contraceptive Knowledge hypothesis, that contraceptive knowledge leads to use which impacts fertility. Evidence showed that the Embodied Capital causal pathway of parental education impacting parental investments, which leads to increases in education and reduced fertility, was supported. Those parents with the more education are most likely to invest highly in their offspring. Parents who invest highly in the educational interests of their children also invest highly in non-educational interests. High parental investment and the willingness of parents to support children until later ages, allows children to attain higher levels of education. Having higher educational achievement significantly reduces fertility, because those individuals are investing in themselves and expect their children to have high educational achievement as well, which will also require high levels of investment. The diffusion of social network ideas had weak support as friends' average fertility is a marginally significant predictor of total fertility. Mother's fertility and siblings' average fertility also predicted friends' fertility and they were all significantly correlated.

From these tests, evidence supports a dual model including the Contraceptive Knowledge Hypothesis and the Embodied Capital Theory in predicting fertility reduction. There is some weak support for Diffusion Theory through one's social network. These models can work together by having a few highly educated parents who

desire to reduce their fertility and invest highly in offspring. They are able to accomplish this by learning about and using contraceptives. Once a few individuals start to change their fertility strategy, it begins to spread through the community by diffusion through social networks. Other highly educated parents want to know how they can control their fertility, which allows them to invest more in each offspring.

Generalizability

This research was conducted in San Borja, Bolivia because they are currently undergoing a fertility transition. While San Borja may be a good representation of a community undergoing fertility change, the factors that influence fertility may be very different in post-transitional societies. Evidence seems strong that female opportunity cost is an important factor for women to have children in many westernized societies where having a child strongly impacts one's current earning ability and possibly one's future earning ability as well. In San Borja, where women can combine work and care for children, they are not faced with the high tradeoff that women in other parts of the world may face.

The results of this study are unlikely to be exactly the same in a different society undergoing the demographic transition because there are culture-specific differences from one area to another. Throughout the analyses, there was a significant difference between Colla and Camba women in their fertility decisions. This could not be explained by the variables included in the model. Cultural differences along with different costs and benefits will occur from one community to the next and will likely have some impact on how fertility decisions are explained.

Future Research

There are many areas for future research. The biggest weakness of this study is that it focuses primarily on females and does not account for the impact of fathers and others (like grandparents) in fertility decisions. Analyzing fertility decisions from the standpoint of the family and not the mother as an isolated actor will provide more depth to understanding fertility transition. There are likely differing desires and goals within a family and understanding how family members interact will provide a better understanding of the Demographic Transition.

Conducting similar surveys in parts of the world with higher contraceptive costs, fewer jobs compatible with childcare or marriage systems that include polygamous unions would provide interesting comparisons with this analysis. These differences may provide differing amounts of support for the models presented here.

While this study focused only on women who lived in San Borja, a future study could look at those women who move away from San Borja and chose to live in more urban areas like La Paz or other countries like Spain. These individuals chose to relocate and typically have reduced fertility. It would be interesting to get information on their parents' investments and their expectations of their own children to see how these individuals differ from those who have stayed in San Borja.

The relationship between education and contraceptive knowledge can be explored further in the future. There is evidence that education leads to contraceptive knowledge, but is this because those that have more education are exposed to ideas about contraceptive knowledge or because they seek information on contraceptives.

Understanding the relationship between contraceptive knowledge and education will provide additional insight into fertility transition.

There is a significant difference in fertility strategies of Camba and Colla women. Future studies can investigate what leads to these differences. It is interesting that even controlling for a large number of confounding variables, the ethnic difference remains.

Conclusion

Through evolutionary time, humans have evolved a system of reproduction where multiple dependent young of different ages are supported by kin (Kramer, 2010). Humans have short birth intervals and a long reproductive period where total fertility rates can reach between 4.7 and 8.3 (Kramer, 2010). As child mortality rates declined and nutritional status increased, fertility rates increased and population exploded. Beginning with 19th century Europe, people began making an active effort to reduce fertility rates. This lead to technological advancements in contraceptives, which has allowed even more individuals the ability to control their fertility. The shift from high-fertility to low fertility has been termed *the demographic transition* (Davis, 1945). Understanding the demographic transition has been a goal for many demographers, economists, anthropologists, sociologists and public policy planners.

This dissertation set out to analyze five models that had been described in the literature. The evidence shows strong support for the Contraceptive Knowledge Hypothesis and Embodied Capital Theory. It appears that both play a role in fertility reduction. Highly educated parents have a desire to reduce their fertility so that they can invest highly in the offspring to prepare them for a competitive wage market. The

investments that offspring receive from parents allow them to become highly educated and this has the effect of reducing their fertility as well. For parents to reduce their fertility, contraceptive technology must be available, affordable, and properly employed. Those who are more educated have higher levels of contraceptive knowledge. Those individuals with more contraceptive knowledge have a higher likelihood to use contraceptives and, in turn, reduce their fertility (particularly at higher parities). It appears that contraceptive knowledge is a significant predictor of fertility, even when the effects from other variables are controlled for.

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