SITUATING MALE FERTILITY: A DEMOGRAPHIC ANALYSIS OF MALE AND FEMALE FERTILITY IN THE UNITED STATES

A Dissertation

by

ROBERT CHRISTOPHER CHERRY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2010

Major Subject: Sociology

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Approved by:

Chair of Committee,	Dudley L. Poston, Jr.
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ABSTRACT

Situating Male Fertility: A Demographic Analysis of Male and Female Fertility in the United States. (December 2010)

Robert Christopher Cherry, B.A., Texas A&M University; M.A., Texas A&M University

Chair of Advisory Committee: Dr. Dudley L. Poston, Jr.

In this dissertation I investigate whether or not a series of social, demographic, and cultural factors affect fertility differently, in either direction or magnitude, for men and women. This work situates the study of male fertility within the existing demographic literature, models and compares male and female fertility through the use of a variety of dependent and independent variables, discovers which of those variables reveal a difference between the determinants of male and female fertility, and extends understanding of how male fertility should be studied in addition to and alongside female fertility. Although there is a significant literature on the biological and anatomic components of male fertility, there is little work published on the social and cultural factors that affect male fertility. Comparisons of male and female fertility are also lacking within the discipline of demography. The National Survey of Family Growth (Cycle 7) provides survey data on both men and women on a number of social, cultural, and demographic variables used either on their own, or as components in the construction of indicator variables. I present the results of models utilizing both direct and indirect measures of fertility. Three models are direct measures of fertility, and three other indirect models examine behaviors as a measure of exposure to the risk of fertility. Only four of these models were significant under the initial analysis. Within each of the models, the respondent's age, poverty level, age at first intercourse, and whether the respondent ever married or cohabited presented the most frequent differences, in either direction, magnitude, or both, between males and females. I discuss the implications of the findings presented in the dissertation, as well as the potential for future research using other data or methods.

To my family

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Finally, thanks to my mother, father, grandparents, siblings, and the rest of my "family of orientation" for their constant support; to my children Ella, Ben, and Number 3, for their encouragement and inspiration; and to my wife Leigh for her patience and love.

TABLE OF CONTENTS

Page

Page

LIST OF FIGURES

LIST OF TABLES

Page

Page

Page

Page

Page

CHAPTER I

INTRODUCTION

The study of male fertility, particularly in comparison to female fertility, is a neglected yet very important avenue of research that begs to be explored. The ready availability of high-quality data makes it even more imperative – there is no excuse not to. When I began my research into the subject, however, I found several issues. First, there was very little or no research comparing males and females with respect to their fertility rates. Also, the bulk of the articles I found on male fertility had a biological focus, on spermatogenesis or anatomical/physiological issues. Very little was written on the sociodemographic factors surrounding male fertility, and I found nothing comparing males and females in this regard. I hope that my research in this dissertation will be a step toward addressing these voids.

This dissertation follows the style of *Demography*.

The initial question that must be addressed is the following: why have scholars avoided discussion of male fertility? Poston et al. (2005) provide an overview of this question, outlining a series of historical, data-driven, and methodological hurdles (perceived or real) that have hindered the incorporation of males in fertility theory and research. The first of these reasons has little to do with science or data, but is instead based on socialization. Researchers have tended to consider men to be ancillary to the fertility process, simply contributors of biological material and earners of income. Women were assumed to have reasonably accurate knowledge of their husbands' fertility intentions, production, and performance (Greene and Biddlecom 2000). It is counterintuitive and contrary to the nature of scientific inquiry to ignore one avenue of research because it has never been explored. Clearly this is not an appropriate reason for ignoring male fertility.

Keyfitz (1977) relates another series of reasons hinging on data quality. Because birth records more frequently have included well-supported data on the mother than on the father, particularly with regard to births outside marriage, inquiries into male fertility suffer a

“John Graunt” problem – how good can analysis be without good quality data? While this may have been a serious issue in the past, modern survey methodology and dedicated surveyors have done much to mitigate the problem. The National Survey of Family Growth (Cycle 6), the General Social Survey, and The National Longitudinal Survey of Youth in the United States, as well as several other large-scale surveys in other countries, now provide high-quality data on both men and women that are amenable to analysis. This is no longer a valid excuse.

The next reason for ignoring male fertility in the past is biological in nature. Women’s childbearing years are within a well-defined range of time, with intervals of a few years between pregnancies, while men can theoretically have hundreds of children throughout their adult lives (Keyfitz 1977). A male’s delay in ejaculating sperm is on the order of hours, thus his theoretical breeding potential is not limited in the same way as that of women. Similarly, in the amount of time it takes for a woman to complete a single menstrual cycle, a man could have ejaculated 100 times (Einon 1998). Some research indicates that the average number of sexual partners of males in the United States is over 12, while the average number for women is just above 3 (Smith 1991). While these arguments are theoretically true, only in a few situations do men experience this kind of access to women and high fertility (Betzig 1986).

The argument has also been made that women remember their fertility better than men, thereby casting doubt on the validity of male-reported fertility data (Poston 2005). Some studies suggest that men may, for example, exaggerate their number of lifetime sexual events (Einon 1994). Recent studies in ethnographic settings, however, have demonstrated that data reported by males on fertility are not significantly different from those reported by females (Ratcliffe, Hill, Harrington, and Walraven 2002b). Rendall et al. (1999) explored the qualities of male reported data, and found that while retrospective recollection of fertility events underreport, panel studies like the British Household Panel Survey and the US Panel Study of Income Dynamics provide accurate, high-quality data on male fertility events. These theoretical roadblocks are not sufficient to prevent the further inquiry into the topic, and data quality issues can be mitigated with the use of appropriate data sources.

A final argument against examining male fertility instead of exclusively female fertility has to do with the incompatibility of their fertility rates. Because males have higher age-specific death rates, marry older and more frequently, and migrate more on average than women, fertility rates that differ are generated (Poston 2005). Without the empirical examination of the determinants causing these differential rates, an important avenue of demographic inquiry is being ignored.

A friend and mentor once related to me some advice that he received from his committee chair when he was developing his dissertation proposal. A research proposal, he explained, has to pass the "who cares? test" – it has to be on a subject that is useful to explore, has promise for adding to the body of literature in the discipline, and has the capability to at least interest your committee members, if not scholars within the discipline at large. As I searched for a topic for my dissertation, I was stumped. I spoke with several colleagues, and one of them suggested I look at the final chapter of the *Handbook of Population*. In that chapter was a listing of suggested areas of “needed research,” one of which was the area of male fertility. The chapter argued that this was a desperately needed line of inquiry, scholars were beginning to understand its importance in the realm of demographic research, and that the field was wide-open. I found that to be an appealing idea, and began my research on the topic.

Male fertility is also, surprisingly, a topic of interest to the general public. Popular culture abounds with extreme examples of high male fertility. The popular television program “Jon and Kate Plus Eight” provided a window into the lives of Jon Gosselin, his wife, and their multiple children. Another television program, “19 Kids and Counting,” related the ongoing saga of the Duggar family, whose adherence to the extreme pro-natal and anti-family planning Quiverfull movement within fundamentalist Christianity and extreme high fertility made them a television ratings favorite. These men and their families have become tabloid celebrities, gracing the covers of magazines at grocery checkout counters on a weekly basis. While these examples are clearly at the far end of the distribution of male fertility in the United States, they give credence to the idea that the topic of male fertility is of more than just academic interest.

Additionally, this field is of personal interest to me. As a BA and MA student in the Department of Anthropology here at Texas A&M University, my primary focus was cultural anthropology, human behavioral ecology, and its correlates in the animal kingdom. I completed a considerable number of courses in a variety of departments on this subject, and learned a great deal. There is a body of behavioral-ecological literature, both on animals and humans, regarding differential fertility between males and females. A wonderful example from the animal kingdom is the elephant seal; in this species, single bulls dominate harems of females, with the rest of the male elephant seal population exiled away from the mating beaches. This leads to wide disparities in the total fertility rates of these unusual animals. The *Guinness Book of Records* reports that Moulay Ismail, the last Emperor of Morocco, was said to have sired 888 children (McWhirter 1998). King Sobhuza II of Swaziland, who lived from 1899-1982, is said to have fathered 210 children between 1920 and 1970 (Patricks 2000). Another interesting example of why male fertility is of interest comes from China and India. Because of the confluence of low fertility, repressive fertility policies, and son-preference in society, there is a “marriage gap” in many regions of both these countries. In the year 2020, there are projected to be upwards of 55 million “bare branches,” men in China without marriageable partners (Poston 2010). A similar situation is developing in India’s “wild west” of Uttar Pradesh (Hudson and den Boer 2004). The sociopolitical results of this will be far-reaching, but the fertility results will be equally interesting. Just like in the elephant seal example, there will be a broad and deep disparity regarding the fertility of the male population: who will have the opportunities to maximize their fertility, and who will not? With my education steeped in these types of stories, I find male fertility to be a remarkable and promising subject for research.

This field is also of interest because high-quality data have now become available on male fertility. While several data sources, both national and international, have recently been compiled, the National Survey of Family Growth (NSFG) is a particular standout. It includes excellent data on large samples of both males and females, with information about a variety of social and demographic factors. Cycle 7 of the NSFG was released in late May of 2010, and is an excellent new source of data upon which future research can be built. It is with these high-quality data that I will undertake my dissertation research.

Finally, my personal interest in male fertility stems from the fact that I am currently involved in "the fertility process." I have one 3-year-old daughter and a 1-year-old son, and my wife and I were very recently overjoyed to discover that we are going to add another child to our count in February of 2011. These issues are particularly near and dear to me, and I think about them every day.

In this dissertation, I will investigate whether or not a series of social, demographic, and cultural factors affect fertility differently, in either direction or magnitude, for men and women. The three central goals of my dissertation are 1) to situate the study of male fertility within the existing demographic literature; 2) to model and compare male and female fertility through the use of a variety of dependent and independent variables and discover which of those variables reveal a difference between the determinants of male and female fertility; and 3) to extend our understanding of how male fertility should be studied in addition to and alongside female fertility.

In Chapter II, I review the relevant literature on male fertility. As mentioned before, there is a significant literature on the biological and anatomic components of male fertility. Little work, however, has been published on the social and cultural factors that affect male fertility. Comparisons of male and female fertility are also lacking within the discipline of demography.

In Chapter III, I discuss the data and methods I will utilize. The high-quality National Survey of Family Growth (Cycle 7) datasets containing survey data on both men and women provide a number of social, cultural, and demographic variables that will be used either on their own, or as components in the construction of indicator variables. I will use two different types of regression models: Poisson models for count dependent variables, and logistic regression models for binary (yes/no) dependent variables.

Chapter IV will present the results of models utilizing direct measures of fertility. First, I will examine the relationships between male and female fertility with respect to number of children ever born. I will then proceed to an examination of male and female fertility through a logistic regression model of whether or not the respondents have ever had a live-born child. The chapter will conclude with the use logistic regression to examine recent fertility by modeling whether the respondents have had a child within the last 12 months.

After examining the three direct-measure series of models, I will proceed to the evaluation of three indirect-measure series in Chapter V. First, I will examine the determinants that influence age at first intercourse, and how they differ between men and women. I will then examine the determinants that influence the number of lifetime sexual partners, and the ways that those determinants differentially affect men and women. Chapter V will conclude by examining the determinants of whether an individual had sexual activity within the last 12 months, and whether there are differences between males and females. All three of these indirect models examine behaviors as a measure of exposure to the risk of fertility.

The final chapter, Chapter VI, will discuss the conclusions and needed further research. Implications of the findings presented in the preceding chapters, as well as the potential for future research using other data or methods will be presented.

CHAPTER II

REVIEW OF LITERATURE

Introduction

As I already mentioned in the first chapter of this dissertation, certain historical and methodological hurdles have hindered the study of male fertility in the demographic sense, as well as the incorporation of males into fertility theory. As some have suggested, the bulk of the literature involving male fertility has largely focused on medical or family-planning issues.

The extent of this avoidance of male fertility in the social sciences is immediately evident in a cursory computerized survey of the literature. A recent (June 2010) search in POPLINE for peer-reviewed articles on fertility retrieved over 6,100 entries. A narrowing of that search to peer-reviewed articles on fertility in conjunction with the keywords “male,” “man,” or “men” returned only 199 entries. A listing of these articles indicated that the bulk of them (over 2/3rds) dealt with either 1) family planning (Guest 2003; Mesfin 2002; Pearson 2003), fertility control (Colvard, Habenicht, and Harper 2008; Darroch 2008), contraception and condom use (Belfield 2005; Marsiglio 1993), abortion (Klebanoff, Shiono, and Rhoads 1991; Singh and Williams 1983), vasectomy (Deneux-Tharaux, Kahn, Nazerali, and Sokal 2004; Jamieson, Costello, Trussell, Hillis, and Marchbanks 2004; McVicar, O'Neill, McClure, Clements, and McCullough 2005), or vasectomy reversal (Fuchs and Alexander 1983; Fuchs and Burt 2002; Qiu, Yang, and Wang 2004; Requeda, Charron, Roberts, Chapdelaine, and Bleau 1983); or 2) medical subjects including spermatogenesis (McVicar et al. 2005), semen quality (Alemnji, Thomas, Oyelese, and Ojedije 2002), the relationship between diseases including cancer (Chapple, Salinas, Ziebland, McPherson, and Macfarlane 2007), herpes (Cherpes, Meyn, Krohn, and Hillier 2003), chlamydia (Chacko and Lovchik 1984), and HIV/AIDS and fertility (Jewkes, Dunkle, Nduna, Levin, and Jama 2006; Rutenberg, Kaufman, Macintyre, Brown, and Karim 2003), Down syndrome and fertility (Pradhan, Dalal, Khan, and Agrawal 2006), infertility treatments (Barden-O'Fallon 2005; Isidori, Latini, and Romanelli 2005), secondary sexual characteristics (Guvenc, Aygun, Yenioglu, and Akarsu 2005), as well as chemical, serological, and molecular influences on fertility (Gennart, Buchet, Roels, Ghyselen, Ceulemans, and Lauwerys 1992; Mantovani and Maranghi 2005; Zhang, Xu, and Qian 1987). Only around a third of these articles dealt with the social, demographic, or cultural context of fertility, and a substantial number of those articles incorporated information on both women and men.

In this second chapter of my dissertation I review the literature on male fertility, particularly literature focusing on social, cultural, and demographic factors involved in male fertility. My review will cover several topics. First I will provide an overview of the literature on male fertility from the perspective of human behavioral ecology, as particularly informed by evolutionary theory. I will then proceed to a discussion of the ethnographic literature on male fertility. Next, I will discuss the previous contributions to the literature with respect to men's fertility intentions and attitudes. I will then discuss the current state of strictly demographic approaches to male fertility, fertility measurement, and the incorporation of male data in general fertility modeling. Finally, I will conclude the literature review by extending the discussion presented in the previous chapter regarding questions of data quality as they pertain to the measurement of male fertility.

The Study of Male Fertility from the Perspective of Human Behavioral Ecology

While issues of male fertility clearly have not been examined as extensively as those of female fertility, there is a body of literature from which this inquiry draws. Behavioral-ecological approaches to male fertility utilize evolutionary theory to explore the subject. Within this neo-Darwinian paradigm, loosely known as "sociobiology," a number of researchers over the last thirty years have become interested in the intersection of biological and sociological parameters of male reproduction (Wilson 1975).

In the late 19th century Charles Darwin, considered to be the father of evolutionary theory, contributed the idea of sexual selection. This idea, centered around the "struggle between the individuals of one sex, generally the males, for possession of the other sex," i.e., the females, became the powerful starting point of the analysis of sex differences through an evolutionary lens (Darwin 1871). He noted that mate choice on the part of females, and male-male conflict over access to mates were important characteristics of many species. He also explained that secondary sexual characteristics, like broad antlers on deer for fighting or elaborate plumage on peacocks for displays, were important cues in understanding the sexual behavior of a sweeping variety of organisms.

In the 1940s, A.J. Bateman undertook a series of experiments on captive male and female *Drosophila melanogaster* fruit flies, and observed some interesting results that fit well within the evolutionary framework envisioned initially by Darwin. When supplied with sufficient food resources, the total offspring of a male fruit fly scaled up with the number of female fruit flies with whom he was incarcerated as follows; *n* offspring with 1 female, 2*n* with 2 females, 3*n* with 3 females, and so forth. This same relationship, however, did not hold true for a female fruit fly: her fertility remained the same whether she was housed with 1, 2, or more males (Bateman 1948). This discovery begins to inform our modern understanding (and misunderstanding) of human male fertility. As mentioned in the previous chapter, one common argument against studying male fertility is that the rates are dramatically different between males and females.

Bateman further hypothesized that these types of asymmetries, including the differential investment of time and care in offspring, resulted from disparities in gamete size: the sex with the larger, more energetically expensive gametes would be the one with limited fertility. This formulation predicted that females, the producers of larger, rarer, and more energy-intensive ova, would be differentially more invested in offspring care than males, with their smaller, plentiful, and energetically cheaper sperm.

Robert Trivers (1972) followed this up with a refinement: instead of the focus resting on gamete asymmetry, he argued that the question was one of relative investment of parental attention between the sexes. The sex that provided more care to the offspring, he claimed, would be the sex over which the other sex would compete. According to Trivers' model, females spend more energy on parenting effort, while males spend more of their time and effort attempting to gain access to females through courtship, intrasexual competition, or guarding mates. Not only did this model fit well with observations on most animal species, but also there were a few exceptions (where the male of the species provided the greater share of care to the offspring) that proved the rule (Trivers 1972).

Hillard Kaplan (1996) approached the differences between male and female fertility from an optimization perspective. The energy and time required for male gamete production is very low, whereas the costs for female gamete production are much steeper. He argued that this disparity is at the root of male-female behavioral differences with respect to fertility and investment in children. In subsequent literature, he and colleagues explored this issue further; they expanded the discussion to include dimensions of extrasomatic wealth in the optimization process (Kaplan, Lancaster, Tucker, and Anderson 2002). Others tempered this purely evolutionarily-informed approach with discussions of attitudinal and social factors that change the dynamics of reproduction through the conscious use of strategy and compromise (Walsh 1993)Several authors have utilized ethnographic approaches to address the study of male fertility issue within an evolutionary framework. Heath and Hadley (1998) used historical U.S. Census data on polygynous 19th-century Latter-Day Saints populations in Utah to explore these paternal reproduction/investments in an ethnographic setting. They discovered a dichotomous strategy depending on income level, with wealthier men attracting more spouses than lower-income men, thereby extending their reproductive careers and having more children overall. Betzig (1986) analyzed a series of historical datasets on male fertility through an evolutionary lens, discovering again that those males with higher wealth and influence gained more access to mates, thereby increasing their overall fertility. Others within the behavioral-ecological viewpoint have reviewed reports of male reproductive hyper-success with a critical eye by taking into account the possible frequency of intercourse, the probability of fecundity, and the realities of constraints on reproductive physiology. One author evaluated the claims surrounding Moulay Ismail, the storied Moroccan emperor with notably high reproductive success, and discovered that his offspring count was almost certainly highly inflated (Einon 1998).

Ethnographic Studies of Male Fertility

Although evolutionary approaches to male fertility sometimes incorporate social factors and ethnographic data, there is a rich literature on male fertility that takes more traditional participant-observer ethnographic approaches. I now review some of this literature.

One of the earliest ethnographers and anthropologists, Lewis Henry Morgan, wrote within a framework of social evolution with societies existing on a continuum from primitive to modern – with modern, of course, finding its most perfect form in western European and American culture. Morgan claimed that maternity was a universal fact, natural and invariant among cultures from the most primitive to the most advanced. He argued, however, that fatherhood was different: it was recognized as neither a biological nor social fact in primitive society; primitive, "savage" males, he said, had no real clue about the biological nature of fertility or impregnation. Paternity was closely conflated with family and consanguinity, but not as a biological reality. In societies further along Morgan's evolutionary continuum, the ideas of both the biological and social realities of paternity became part of the cultural fabric of "civilized" societies (Morgan 1907).

Subsequent authors and ethnographers have spent a great deal of time and energy studying the kinship structures of "primitive" societies. The anthropologists

Radcliffe-Brown and Forde, for example, collected and edited a classical work of anthropology dealing with the structure and cultural context of kinship in a number of African societies. In this collection, they reported the research of several authors who brought attention to the variety of potential paternal roles available in these societies. In matrilineal groups, the father-child relationship was deemed less important, while the uncle-niece relationship was of utmost cultural import (Radcliffe-Brown and Forde 1950). Since then, a number of authors have utilized a participant observation methodology to study family and kinship in a variety of settings, with particular attention to the role(s) played by males in the social groups under study (Chagnon 1983; Furstenberg, Levine, and Brooks-Gunn 1990; Gray and Anderson 2010; Hewlett 1992; Ruz 2000; Toulemon and Lapierre-Adamcyk 2000 for a few examples).

Dodoo and Frost (2008) have surveyed the literature on sub-Saharan Africa to identify how gender inequality and power have factored into explaining fertility levels and behavior. They have argued that fertility research continues to focus almost exclusively on women and treats gender as a property of individuals instead of as a system of inequality. They have posited that efforts to empower women will be ineffective without addressing the underlying unequal cultural distributions of power between men and women.

Male Fertility Intentions and Attitudes

Intention and attitudes toward fertility is yet another avenue of research on male fertility that has been explored. Nelson (2004) addressed the disjunction between research on male fertility intentions and paternal involvement, and suggested that the two are strongly interrelated. Males with strong desires to have multiple offspring are substantially more likely to be highly involved with the care and upbringing of their children. Voas (2004) also examined fertility intentions and conflicts about preferred family size. This body of research has suggested that disagreement between males and females about family size often ensures that desired family size and actual family size will not coincide.

Hakim (2003) has suggested that "preference theory" strongly informs the determinants of male and female fertility behaviors. Preference theory, an approach to explaining patterns of employment and fertility among women in modern societies, often demonstrates that there are three distinct lifestyle preference groups: the voluntarily childless individual whose focus is on work; the individual who chooses home and family life to the exclusion of employment; and an adaptive group that balances the two extremes. Marciano (1979) argued that male fertility preference has been ignored or confounded by female income and education levels, and deserves additional research. Rogers and colleagues (2001) discovered through a historical twin study that there is a difference in the effect of age at first intercourse on completed fertility between men and women. Underwood (1998) utilized ethnographic data on pre-World War Chamorro populations and found that preference on early termination of the reproductive career has a strong effect on completed fertility.

Studies of the Accuracy of Male Fertility Data

It is, of course, critical that the quality of fertility data gathered from men be assessed. In addition to the usual concerns of non-response and under-coverage inherent in the implementation of surveys and their subsequent use, data on male fertility have their own difficulties (Bachu 1996). Because women are obviously more physically involved in demographic events, like pregnancies, births, and infant mortality, it is generally considered that their data are vastly superior and much more reliable (Yaukey, Roberts, and Griffith 1965).

As mentioned in the first chapter, one of the most contentious and problematic issues surrounding the study of male fertility is the issue of counting offspring: do men know how many children they have, and are all these children their biological offspring? In many cases, the data used to study male fertility are often gathered from the respondent's self-reported answer to the question dealing with his number of "living children"; this is indeed a social construction both in the sense of what it means to "have children", and in the sense of the record itself. These two are often hard to reconcile; the data quality is far from what researchers in the "hard sciences" like biology would study (Guyer 2000).

One component of this problem with reported offspring data is, broadly speaking, what it means for a man to "have children." First, the idea of "having children" is culturally constructed, and varies from social group to social group. The ethnographic record is rich with examples of how fertility frameworks differ throughout the world. In Botswana, for example, a man was asked how many children he had. He responded, "Eighteen, *not counting the little ones*" (Bledsoe, Lerner, and Guyer 2000). In this context of high infant mortality, "having children" means having children that have survived past infancy, or some arbitrary young age.

In addition to the problems arising from cultural context, other difficulties often develop with the destruction of old child-producing unions and the construction of new relationships. Many surveys, including the United Kingdom Household Panel Survey, indicate that data on paternity before and outside of marriage is incomplete (Coleman 2000). High illegitimacy rates and large numbers of births taking place outside of marriage often confound the survey results. In most nations (Sweden, Denmark and Norway are notable exceptions), data on fathers are only recorded for legitimate births or when a birth outside marriage is jointly registered (Coleman 2000).

In the west, and in the United States in particular, divorce and remarriage rates are high, often leading to step-parenthood and families composed of children from several different relationships. Furthermore, men often commit “errors and evasions” after entering new unions; paternity admitted before a marriage or a new partnership often is no longer admitted after the formation of a new partnership, particularly if the paternity occurred outside the bonds of a marriage or long-term relationship (Coleman 2000). One study indicated that the children from prior relationships living elsewhere tend to be drastically underreported in men’s reports compared to women’s reports (Cherlin, Griffith, and McCarthy 1983). One analysis of U.S. and U.K. survey data indicated that between a third and a half of men’s non-marital births, or births from previous marriages or relationships, are undercounted when reported by men (Rendall, Clarke, Peters, Ranjit, and Verropoulou 1999).

My extended family provides an excellent anecdotal example. My wife has seven siblings, but none of them share both her mother and her father. Both her mother Marilyn and father Don were each married three times to different partners, and five of the six unions produced children. All the children at one time or another resided with Don. If Don were asked at different points throughout his lifetime, he would most likely have different responses to the question "how many children do you have?" These "recombinant families" often tend to muddy the waters with regard to offspring reporting (Guyer 2000).

Another problem with this type of data is the confounding effect of paternity uncertainty. Broadly speaking, paternity certainty is the confidence a man has that the child he is claiming as his own is truly his own biological child; he is confident he has not been cuckolded by his partner. Naturally, a father reporting that he is the parent of someone else's child would tend to muddy the quality of the data. The law surrounding this issue of false paternity is complex. Under English common law, for example, children born within a marriage were legally the offspring of the husband, unless he were deemed to be "impotent, sterile, or beyond the four seas" (Coleman 2000). Recent advances in DNA technology and paternity testing have brought this issue into sharp relief, but it does not solve the existing data problem (see Padawer 2009 for a series of anecdotal examples).

There are varying estimates on the frequency of false paternity in the existing literature. Some reports suggest that as many as one in 10 children born within relationships are not the offspring of the putative male parent (Alfred 2002; Stewart 1989). However, this assertion is not well-supported by empirical data. A broad cross-cultural survey of reported non-paternity rates suggests that a true value is somewhere around 2 percent (Anderson 2006; Anderson, Kaplan, and Lancaster 2006; Anderson, Kaplan, and Lancaster 2007). In the United States, the best estimates range from 2 to around 12 percent, with a large variation based on location, socioeconomic status, or race (Gray and Anderson 2010). To place this number in an understandable context: of the 48,702 students at Texas A&M University in the fall of 2009, between 1,022 and 5,746 of their putative fathers might be expected to not be the real biological father.

In spite of the aforementioned problems, there is a body of literature that suggests that data on male fertility, gathered from men in particular social contexts, can indeed reflect the same accuracy as data gathered from women. A variety of reports suggest that men can provide quality information on total number of offspring, as well as the record, timing, and spacing of the births of those offspring, with the same degree of accuracy that their spouses can provide (Fikree, Gray, and Shah 1993; Zarate 1967). Indeed, some argue that combining data from both men and women will lead to better predictions of behavior than data from just one respondent (Becker 1996). In several non-Western contexts similar results have been obtained (Ratcliffe, Hill, Harrington, and Walraven 2002a). Some research even indicates that males are relatively accurate when answering questions about their partners' general health and number of living children (Lerner-Geva, Frenkel, Lusky, Farhi, and Rabinovici 2008).

In summation, while there are some problems, the news is not all bad for male fertility data. A number of large-scale surveys, such as the National Survey of Family Growth and the Great Britain Longitudinal Study provide detailed information on male fertility (Coleman 2000). A growing body of research indicates that the responses provided by males with respect to their fertility careers, particularly married males, are almost as accurate as the data provided by their female partners. A growing number of statistical and census offices in Europe, Asia, and North America are beginning to embrace the idea that asking males about their own fertility is an idea whose time has come.

CHAPTER III

DATA AND METHODS

Introduction

In this Chapter I describe and discuss the data and methods I will use in later chapters to estimate models of male and female fertility in the U.S. I first discuss the history and development of my dataset, namely, the most recent Cycle 7 release of data from the National Survey of Family Growth (NSFG). I then discuss the models I use to compare male and female fertility, and then go on to describe my variables, including the variables used as components in the construction of indicator variables. I then proceed to describe the two types of regression models that I utilize to analyze my data, namely, Poisson models for count dependent variables, and logistic regression models for binary dependent variables measuring yes/no responses. Finally, I will discuss the statistical methodology I will use to compare the male and female models, a test for equality of regression coefficients.

The National Survey of Family Growth (NSFG) is a survey undertaken by the Institute for Social Research of the University of Michigan, and sponsored by the National Center for Health Statistics and the United States Department of Health and Human Services. Personal interviews are conducted on a national sample of civilians in the U.S. between the ages of 15-44. In addition to the recently completed Cycle VII NSFG survey, NSFG surveys have also been conducted in 1973 (Cycle I), 1976 (Cycle II), 1982 (Cycle III), 1988 and 1990 (Cycle IV), 1995 (Cycle V) and 2002 (Cycle VI). The NSFG is a significant source of public health information on infertility and fertility, whether intended or unintended; sexual intercourse and partners; marriage and cohabitation; and health conditions and behavior. Through Cycle V (1995), data were gathered only from women. Beginning with Cycle VI in 2002, however, questions for many of the same variables for women were also included in a separate survey of men. Cycle VII was released in May 2010, and was the result of continuous interviewing performed between 2006 and 2008. Composed of responses from 7,286 women and 6,062 men, Cycle VII is the source of data utilized in this dissertation. This release of data is excellent for the purposes of my research because the NSFG provides “crosswalk” information for matching one-to-one analogues and relationships between variables in both the male and female datasets. Because the NSFG oversamples Hispanics, teens, blacks, and women, I will also use the appropriate sampling weights to compensate. In this regard, the Cycle VII dataset will approximate a population size of around 124 million respondents.

In my dissertation I develop two main general lines of inquiry about male and female fertility. The first is whether there is a fertility difference between males and females? Since we know that both a male and a female are required to produce offspring, any significant differences in fertility between males and females indicate a point at which focus on a second line of inquiry can be brought to bear. If a significant difference in fertility between men and women can be discerned, are the magnitudes of those differences significant? The second feature of my research involves investigating the effects on the fertility of males and females of several different independent variables and ascertaining whether they are notable and different or similar in value.

To test these general hypotheses, I utilize data from the male and female respondent datasets of the National

Survey of Family Growth (Cycle 7). The hypothesis, that the differences between males and females on demographic variables are statistically significant, will be tested by estimating the same regression models with both the individual male and female data and then comparing the coefficients from each model for significance. This procedure will be followed for each of the six specific tests of hypothesis which will be reported in subsequent chapters.

I present six separate sets of models to specifically test the general hypothesis that there are fertility differences between men and women. The models may be divided into two categories. First, fertility may be examined through a “counting babies” approach. This is a direct means of assessing the differences in fertility between men and women through estimating regression models using children and childbirth as the dependent variable. Secondly, fertility differentials between men and women may be examined indirectly, through proxy measures of fertility, namely, age at first intercourse, number of lifetime sexual partners, and recent sexual activity. These indirect measures do not examine the fertility process specifically. Instead, they are assessments of exposure to the risk of fertility. I describe the six models below.

Direct Models

The first series of models that I estimate are direct measures of fertility. The first null hypothesis (Hypothesis 1) is that there is no difference between men and women with respect to the reported count of children ever born. I will estimate a regression model to test the hypothesis, and if the null hypothesis is rejected, I will examine the direction and magnitude of those differences. This model is explored in Chapter IV.

The next series of models (Hypothesis 2) are also direct measures of fertility. I estimate a logistic regression model of whether or not the respondent has ever had a child, and then compare the magnitude and direction of the differences between males and females with respect to several key variables. The results of this inquiry will also be discussed in Chapter IV.

The third series of models also are based on direct measures of fertility. The null hypothesis (Hypothesis 3) is that there is no difference between men and women with respect to their *recent* fertility. By utilizing a logistic regression model with whether the respondent had a child in the past 12 months as the dependent variable, this question can be examined. I proceed again to test formally the direction and magnitude of the model differences. This discussion will also be found in Chapter IV.

Indirect Models

After examining the above hypotheses in the three direct-measure series of models, I proceed to the evaluation of three indirect-measure series. Hypothesis 4 examines those determinants that influence age at first intercourse, and whether and how they differ between men and women. I again formally test the direction and magnitude of any differences between coefficients in the male and female models. These results are reported Chapter V.

The second indirect-measure approach (Hypothesis 5) examines the determinants that influence the number of lifetime sexual partners, and the ways that those determinants affect men and women. Examination of the coefficients and their differences between the male and female datasets proceeds. The results of these tests are also presented in Chapter V

The final series of models (Hypothesis 6) also use indirect measures: this time, the determinants of whether an individual had sexual activity within the last 12 months and separate models are estimated for males and females. The coefficients are examined for significant difference. This is another metric indicating exposure to the risk of fertility, but it also serves as a means to avoid the simultaneity problem (Goldberger and Duncan 1973). This will be discussed and reported in Chapter V.

Dependent Variables

Before these questions can be explored, it is necessary to generate variables of interest upon which the analysis can be performed. The first variable, COMPREG, is a measure of the total number of completed pregnancies of the female respondent, or the total number of completed pregnancies fathered for the male respondent. Responses range from zero (no children) to 33 (thirty-three children) for males and, from zero to 18 children for women, with a mean of 1.13 completed pregnancies for the male dataset and 1.69 for the female dataset. This is the critical dependent variable for the first set of models (Hypothesis 1) assessing the differences between males and females with respect to the first direct measure, the children ever born variable.

The dependent variable in the second set of models (Hypothesis 2) is a binary variable, HADKID. This is an indicator variable coded 1 if the respondent had any biological offspring, and coded 0 if the respondent reported no biological children. In my data, 45.3% of males and 61% of females report that they have indeed had a biological offspring. Use of this variable provides another method for examining direct measures of fertility.

The dependent variable of interest for the next direct-measure set of models (Hypothesis 3), HADKIDLAST12, is a measure of whether the respondent had a completed pregnancy (or completed pregnancy fathered for male respondents) within the twelve months prior to the date of the NSFG interview. This variable is constructed for both men and women by comparing the century month of the latest birth with the date of the interview. Individuals whose latest birth fall into the twelve-month range prior to the interview were coded as 1, with individuals with births earlier than that or with no births at all coded as 0. In the Cycle VII NSFG data, 6.15% of all males reported a fatherhood event within the last 12 months prior to interview, and 7.39% of all women reported a completed pregnancy within the last twelve months prior to interview. Using this variable, within a tightly constrained time frame, is a method for examining recent-life events, but within the context of events that have occurred throughout the respondent's lifetime.

The NSFG provides a wealth of information on sexual activity for both men and women, and several of those variables will be included in this analysis. VRY1STAG is one of those variables and represents the reported age at first intercourse for the respondent. For the purposes of this dissertation, I have restricted the population to those individuals who report their age at first sex as thirteen years of age or older. Doing so removes 284 observations from the male dataset, and 199 observations from the female data.

The responses range from 13 to 42, with a mean age of first intercourse of 17.2 for the males in the dataset and 17.4 for females in the dataset. Individuals who have been sexually active longer have been at risk of pregnancy for longer. This serves as both a dependent variable for the first indirect-measure set of models (Hypothesis 4) and as an independent variable in other models. The second indirect-measure set of models (Hypothesis 5) examines a variable LIFPRTNR indicating the number of lifetime sexual partners the respondent reports as the dependent variable. Since the assumption is that individuals who have more lifetime sexual partners are exposed to a risk of higher fertility, this serves as another indirect metric of exposure to fertility. The values range from zero partners to 50 partners, and with a mean for the male dataset of 8.8 and a mean for the female dataset of 5.2. LIFPRTNR also serves as an independent variable in several of the other models.

The third and final indirect-measure set of models (Hypothesis 6) uses another metric indicating exposure to the risk of fertility, but it also serves as a means to avoid the simultaneity problem. HADSEXLAST12 is a constructed measure of whether the respondent engaged in opposite-sex sexual activity within the past year. Again, those individuals who have been exposed to sexual activity are at a higher risk of experiencing a fertility event. This is a dichotomous dummy variable scored 1 if the respondent had sex in the last year and 0 if the respondent did not. In my data, 63.6% of women and 78.8% of men report having opposite-sex sexual activity within the past 12 months.

Independent Variables

I now discuss the various independent variables I use in my models. AGER represents the respondent’s age in calendar years at the time of interview. The responses to this question range from 15 to 45, with a mean of 29.4 for the males and 29.6 for the females. Inclusion of this variable allows for control of the respondents age in the analyses, since it would be expected that older individuals on average have more opportunities to produce offspring than younger respondents (Coale 1971).

The variable representing the education of the respondent is labeled EDUCAT, with the recorded values representing the number of years of formal schooling the respondent completed. The distribution ranges from 9 (up to including ninth grade) to 19 (seven or more years of college or graduate school), with a mean of 13.0 years of education for the males, and 13.2 years of education for the females. By including this item it is possible to control for education, since we know from the demographic literature that individuals with higher levels of education tend to have fewer offspring compared to individuals with lower levels of education (Martin 1995; Rindfuss and Bumpass 1978; Rindfuss, Morgan, and Offutt 1996).

Race and ethnicity have commonly been examined as important demographic variables (Goldscheider and Uhlenberg 1969; Kennedy 1973; Saenz and Morales 2005). In calculating these variables for my dissertation analysis, I first identify all the Hispanic persons and set them aside as a separate group; then among the non-Hispanics, I then differentiate between whites and blacks and others. Thus, my Hispanic, white, black, and other race respondents are all mutually exclusive from one another. The male dataset is composed of 62.4% White respondents, 18.7% Blacks, 12.3% Hispanics, and 6.5% Others. Within the female dataset, there are 62.5% Whites, 14.3% Blacks, 16.8% Hispanics, and 6.3% Others.

It is important to control for income level when undertaking fertility analyses particularly since there is disagreement in the literature on the effects of income on different aspects of fertility. For my dissertation models, I include a variable called POVERTY for that purpose. POVERTY is a measure of family income, operationalized as percentage of poverty level. The values range from 6 to 500, with individuals who are at exactly the poverty level scoring 100%, people with income of twice the baseline poverty level scoring 200%, and so on. The values range from 7 to 500, with a mean value of 266.4% of poverty for male respondents and 242.9% of poverty for female respondents.

The variable URBAN is an indicator of location of residence. Respondents who reside in Metropolitan Statistical Areas (MSAs) (82.3% of males and 81.3% of females) are coded as 1. Respondents who reside outside MSAs are coded with a value of 0 (17.7% of males and 18.7% of females).

VRY1STAG is a variable representing the age at first intercourse for the respondent. The responses range from 13 to 42, with a mean age of first intercourse of 17.2 for male respondents and 17.4 for female respondents. Individuals who have been sexually active longer have been at risk of pregnancy for longer. As mentioned before, this serves as both a dependent variable for the first indirect-measure set of models (Hypothesis 3) and as an independent variable in other models.

Individuals who have ever been married or who have ever cohabited with a member of the opposite sex are coded with a 1 for the variable EVMARCOHX, and those who have never cohabited or married are coded with a 0. In my data, 57% of males and 67.4% of females indicate that they have cohabited or been married in their lifetime. LIFPRTNR again indicates the number of lifetime sexual partners the respondent reports as the dependent variable. Since the assumption is that individuals who have more lifetime sexual partners are exposed to a risk of higher fertility, this serves as an indirect measure of fertility as well as an independent variable in several other models. The values range from zero partners to 50 partners, and with a mean for the male dataset of 8.8 and a mean for the female dataset of 5.2.

The relationship between fertility and religiosity is discussed widely in the literature (Hayford and Morgan 2008; Mosher, Williams, and Johnson 1992; Potter and

Mundigo 2002). The NSFG provides data on factors measuring religiosity and religious participation. RELIGIONX asks about the respondent’s current religion. I recode it with the value 1, if the respondent claimed any current religion, and with 0 for no religion. In my data, 77.6% of men and 83.3% of women indicate that they have a current religion. RELDLIFEX asks about the import of religion in the respondent’s daily life. I recode it with 0 if the respondent refused to answer, or claimed that religion was either not important or not applicable. If the respondent indicated that religion was either very or somewhat important, I scored them with a 1 for this variable. In my data, 69.4% of male respondents and 79.2% of female respondents indicate that religion has an importance in their daily lives.

I have chosen to add measures of conservatism in my models for a variety of reasons. First I discuss how I created the variable. There are a variety of complex and statistically sound data reduction techniques available, including principal component factor analysis. There is also a simpler approach: scale the variables in such a way that low values on each of them mean something similar, and then sum the scores. For example, if one were to construct a new variable based on three Likert-type variables scored from 1-5, the newly created summed variable could range from 3 (a score of one on each of the three variables) to 15 (a score of five on each of the three variables). Which approach is best?

First, we should examine the assumptions inherent in each method. For factor analysis, we have to assume that each variable is measured as an interval variable, with the difference between values of 1 and 2 being equivalent to the difference between values of 2 and 3. We then subject the variables to factor analysis, examine the generated eigenvalues, and choose a rule-of-thumb by which we decide how to extract a factor as a new variable. For the summing method, we must again assume that each variable is on an interval range. However, in order to justify the approach of summing the scores, we must also assume that each variable is on the *same* interval range: the difference between values of 1 and 2 on any given variable is equivalent to the difference between values of 2 and 3 on any other given variable.

It seems that the factoring approach is slightly more conservative in its initial assumptions. However, it has its own difficulties. If I choose to subdivide the data and estimate models on the reduced dataset, it is necessary to generate new variables for/with each subdivision because the factor loading will be different depending on the constituent cases within the dataset - factor scores for a respondent in the full dataset will be slightly different from factor scores generated for a respondent in a reduced dataset.

There is no clear statistical reason for opting for a methodological approach using factor analysis or an approach using a simple summing approach. Do the two methods yield different results? In order to answer this question, I selected the measures of conservatism, Likert-scaled variables from the NSFG Cycle 7 male and female datasets, and subjected them to both methods. I then examined the correlation between the two variables. I realize this is not an exhaustive and authoritative strategy; it is, however, an attempt to discern whether there is any appreciable quantitative difference between the two methods. For the female dataset, the correlation between the variable created by summing and the variable created by factor analysis was .9773. The value for the comparison in the male dataset was .9772. Clearly the end results for both methods are very similar. With these results in mind, I chose to use the simpler summing method.

Because there is both a literature and a common perception that there is a relationship between degree of conservatism or liberalism and fertility behavior and attitudes, I decided to use in my models an independent variable related to conservative/liberal attitudes (Carbone 2007; Fuchs Ebaugh and Haney 1978). The NSFG (Cycle 7) provides data on a series of attitudinal variables that lend themselves to this type of analysis. All the attitudinal variables are scored on a pseudo-Likert scale, with responses “Strongly agree,” “Agree,” Disagree,” “Strongly Disagree,” and “if respondent insists, neither agree nor disagree.” I modified each variable to a Likert scale, since the responses were out of interpretable order. Since in some variables, “Agree” was the more conservative response and “disagree” was more conventionally liberal, and vice versa, I adjusted the scales in all cases in a generally liberal to generally conservative direction.

- SAMESEX asks “Sexual relations between adults of the same sex are all right.”
- BETTER asks “It is better for a person to get married than to go through life being single.”
- OKCOHAB asks “A young couple should not live together unless they are married. “
- ACHIEVE asks “It is much better for a man to earn a living and a woman to stay at home.”
- STAYTOG asks “Divorce is usually the best solution when a couple can’t seem to work out their marriage problems.
- ANYACT asks “any sexual act between two consenting adults is all right.”
- CHSUPPOR asks “it is okay for an unmarried woman to have a child.”
- GAYADOPT asks “Gay or lesbian adults should have the right to adopt children.”
- WARM asks “A working mother can establish just as warm and secure a relationship with her children as a mother who does not work.”

When I combine the scores of all the above variables, they range for both males and females from 9 (a score of zero on all questions) to 45 (a score of 5 on all questions), with a mean of 23.2 for women and 25.6 for men. Cronbach's alpha score for these variables in the male dataset is 0.724, and 0.7607 for the female dataset.

Methods

Two types of dependent variables are to be evaluated in subsequent chapters: count variables (number of offspring, and number of sexual partners), and dichotomous or binary outcome variables (such as whether the respondent had children, or had sexual activity in the last year). Because the assumptions and methodologies appropriate to each type of variable are different, each requires careful treatment and explanation. The methodology for estimating logistic regression equations is rather straightforward and well-represented in the literature (Long and Freese 2006; Vittinghoff, Glidden, Shiboski, and Mccullough 2005). Procedures are slightly more complex when evaluating the appropriate method for estimating regression models with count data. I now discuss methods for estimating count models.

Since the value of the number of children, for example, is a count variable, the assumptions for Ordinary Least Squares regressions are not met. Thus, a count-specific regression, like a Poisson or negative binomial regression is instead appropriate. The variance reported for the COMPREG variable hints at significant overdispersion in the data. In cases where this overdispersion occurs, the commonly used Poisson estimates will be consistent but inefficient, resulting in falsely large z-values. This can result in overestimation of the significance of effects of the independent variables. Statisticians therefore recommend that the model be estimated with negative binomial regression when there is overdispersion in the count data (Poston & McKibben, 2003).

To determine which technique is the right one to use, the appropriate procedure is to estimate a negative binomial regression using the dependent variable in question with all the other variables of interest as independent variables. If the resulting alpha value measuring overdispersion is not equal to zero, the Poisson model should not be used. If the chi-squared value for the likelihood ratio test of alpha is significant, it is clear that the negative binomial regression model approach is appropriate for these data.

A second problem arises when we review the values of the dependent variable and note that a large number of the respondents report a value of zero. Because of this, it may be appropriate to estimate a zero-inflated negative binomial regression (instead of an ordinary negative binomial regression) with the dependent variable of interest, and all other pertinent independent variables.

The Vuong statistic, which compares the zero-inflated negative binomial model to a regular negative binomial model (or the zero-inflated Poisson model to a regular Poisson model), is the appropriate tool for determining whether a zero-inflated model is more appropriate.

In the next two substantive chapters, the appropriate regression method will be used to estimate the effects of the independent variables on the dependent variable of interest. After estimating the two models, the regression coefficients will be compared and evaluated for significance following this test of Paternoster and colleagues for the equality of regression coefficients:

$$Z = \frac{b_1 - b_2}{\sqrt{(SEb_1^2 + SEb_2^2)}}$$

where b_1 and b_2 are the regression coefficients, and SEb_1 and SEb_2 are the standard errors for those coefficients. The results obtained from the estimation of equivalent models are subjected to this equation, and a Z score is generated. This is the appropriate and conservative strategy for evaluating the regression coefficients in two models and determining whether they are equivalent (Paternoster, Brame, Mazerolle, and Piquero 1998).

In conclusion, the National Survey of Family Growth is a robust and useful dataset, invaluable for research into questions about male and female fertility and their comparisons. A substantial number of independent and dependent variables are available for analysis, both in the male and in the female datasets. The next two chapters, with the use of appropriate regression and evaluation methodologies, will proceed to shed some light on the differences between models of male and female fertility in the United States.

CHAPTER IV

ANALYSES OF MALE AND FEMALE FERTILITY USING DIRECT MEASURES

Introduction

This chapter is concerned with estimating models of male and female fertility using direct fertility measures as dependent variables. It thus approaches male and fertility in a substantive fashion by evaluating whether there are, in fact, any differences in the way social, cultural, and demographic factors affect fertility in men and women using a series of direct measures of fertility (in Chapter V I will estimate several models using indirect measures of fertility). The simplest, most direct measures of fertility are straightforward counts of children ever born. Although there may be problems with reporting and data quality, counting offspring remains a method of critical importance in evaluating fertility.

In this chapter, I will estimate fertility models using three separate direct measures of fertility: 1) a simple count of children ever born; 2) a measure of whether the respondent ever had any live born children; and 3) a measure of whether the respondent had any live born children within the last 12 calendar months. Each of these measures will be used as the dependent variable in models estimated on age-graded subsets of the sample population, namely, respondents who are under the age of 30.

Combined Models

I first examine whether there are any differences between men and women at all with respect to each of these three measures of fertility. This is accomplished by estimating a series of models on a combined dataset consisting of both the male and female data, with a dummy variable MALE, coded 1 if the respondent is male and 0 if the respondent is female. If this MALE variable is statistically significant in the models, then there is indeed a statistically significant difference by sex in fertility worth examining. If there is a significant difference, I then proceed to estimate the same models using both the male and female datasets and compare the coefficients. The truly interesting results of this dissertation will obtain when there are significant differences between the coefficients produced in the male models and female models. Three sets of models are estimated below in Table 1, Table 2, and Table 3, on a combined dataset utilizing the three direct metrics of fertility. In each table, the results of two regression equations are reported; the first equation is based on all respondents (see Chapter III), and the second equation is based on a reduced sample, namely, persons under the age of 30.

Evaluation

Coefficients for the MALE variable are highlighted in the following three tables. The results from the combined male and female models are mixed. For the equations estimated using both the full dataset and the under-thirty dataset, the coefficient for the MALE variable is significant in both of the first models, measuring the count of children ever born, and in both of the second models, a logistic regression equation of whether the respondent had ever had a child. However, the MALE

Model 1

Table 1 – Negative binomial regression equation estimating the number of children ever born, males and females, U.S. 2006-08

	Coef**	se	Coef***	se
Whether R is male	**-0.224**	**0.027**	**-0.449**	**0.064**
R's age at interview	0.038	0.002	0.086	0.009
R's education (number of years of schooling)	0.004	0.006	-0.062	0.023
Whether R is Black	0.107	0.032	0.329	0.082
whether R is Hispanic	0.041	0.034	0.082	0.079
whether R is other race	0.116	0.058	0.179	0.094
R's poverty level	-0.002	0.000	-0.002	0.000
whether R is urban resident	0.050	0.039	-0.073	0.082
R's age at first sex	-0.041	0.005	-0.107	0.011
Whether R ever married/cohabited	-1.198	0.095	-1.064	0.123
Number of opposite-sex partners in lifetime	0.005	0.001	0.010	0.004
Whether R belongs to a religion	0.106	0.076	0.098	0.223
How important is religion to R's daily life	0.017	0.075	-0.009	0.207
R's score on conservative/liberal scale	0.014	0.002	0.017	0.005
Constant	1.280	0.159	1.669	0.402
alpha	-3.428	0.435	-2.317	0.366

** These coefficients are from an equation estimated for the complete samples of males and females

***These coefficients are from an equation estimated for samples of males and females under the age of 30

Model 2

Table 2 Logistic regression equation estimating whether the respondent has ever had any biological children, males and females, U.S. 2006-08

	Coef**	se	Coef***	Se
Whether R is male	**-1.128**	**0.083**	**-1.358**	**0.128**
R's age at interview	0.158	0.009	0.273	0.023
R's education (number of years of schooling)	-0.078	0.020	-0.237	0.031
Whether R is Black	0.593	0.163	0.749	0.175
whether R is Hispanic	0.410	0.127	0.348	0.146
whether R is other race	0.469	0.191	0.162	0.263
R's poverty level	-0.003	0.000	-0.003	0.000
whether R is urban resident	-0.105	0.116	-0.176	0.154
R's age at first sex	-0.129	0.013	-0.181	0.026
Whether R ever married/cohabited	-2.605	0.115	-2.075	0.130
Number of opposite-sex partners in lifetime	-0.001	0.005	0.001	0.009
Whether R belongs to a religion	0.130	0.167	0.251	0.271
How important is religion to R's daily life	0.389	0.161	0.314	0.269
R's score on conservative/liberal scale	0.036	0.009	0.016	0.010
Constant	2.198	0.417	2.133	0.664

** These coefficients are from an equation estimated for the complete samples of males and females

***These coefficients are from an equation estimated for samples of males and females under the age of 30

Model 3

Table 3 - Logistic regression equation estimating whether the respondent has had any biological children born in the past 12 months, males and females, U.S. 2006-08

	Coef**	se	Coef***	Se
Whether R is male	**-0.031**	**0.135**	**-0.222**	**0.154**
R's age at interview	-0.090	0.010	-0.011	0.028
R's education (number of years of schooling)	-0.002	0.032	-0.120	0.040
Whether R is Black	0.359	0.216	0.379	0.207
whether R is Hispanic	0.141	0.132	0.046	0.179
whether R is other race	0.092	0.230	0.077	0.369
R's poverty level	-0.001	0.000	-0.002	0.001
whether R is urban resident	-0.274	0.132	-0.323	0.203
R's age at first sex	0.024	0.023	-0.014	0.031
Whether R ever married/cohabited	-2.503	0.226	-2.115	0.259
Number of opposite-sex partners in lifetime	-0.006	0.006	-0.011	0.011
Whether R belongs to a religion	-0.152	0.298	-0.126	0.431
How important is religion to R's daily life	0.338	0.279	0.257	0.424
R's score on conservative/liberal scale	0.007	0.011	0.004	0.016
Constant	2.880	0.703	2.950	1.281

** These coefficients are from an equation estimated for the complete samples of males and females

***These coefficients are from an equation estimated for samples of males and females under the age of 30

coefficient is not statistically significant in the third models, the logistic regressions of whether the respondent had a child in the last 12 months. The interpretation of these results on is really simple: for the first two models, both full and reduced, the difference between males and females with respect to the direct measure of fertility in question is significant; in the third model, there is no significant difference. Therefore, I will proceed with an evaluation of comparisons estimated on the male and female datasets for only the models 1st and 2nd models. Evaluation of these two sets of models will comprise the remaining pages of this chapter.

Model 1

The first model utilizes as its variable of interest the count of children ever born, for both men and for women. Since the completed pregnancies variable is a count variable, the assumptions for OLS regressions are not met. Thus, a count-specific regression model, like a Poisson or negative binomial, is instead appropriate.

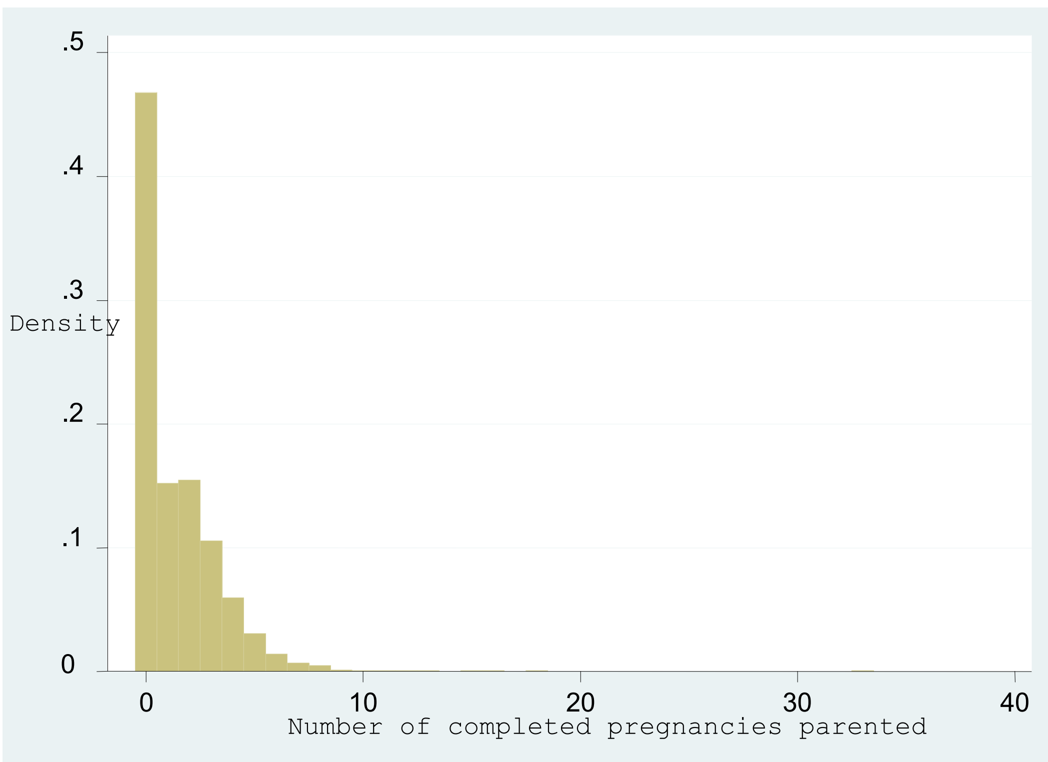
The descriptive statistics (reported in Chapter III) hint at significant overdispersion in the data. In cases where this overdispersion occurs, the commonly used Poisson estimates will be consistent but inefficient, often resulting in falsely large z-values. This will often result in overestimation of the significance of the independent variables. Statisticians therefore recommend that the dependent variable be estimated with negative binomial regression when there is overdispersion in the count data (Poston and McKibben 2003).

To determine which technique to use, that is, whether there is a significant amount of overdispersion, I first estimated a negative binomial regression using the count of ever-born children as the dependent variable and all other variables (age, education, the race variables, income, urban/rural status, age at first intercourse, whether the respondent ever married or cohabited, whether the respondent reports having a religion, the importance of the respondent’s religion in his daily life, and the score on the constructed conservative/liberal variable) as independent variables. Since the alpha value is not equal to zero, the model does not reduce to a Poisson model. The chi-squared value for the likelihood ratio test of alpha is highly significant (468.6); this is the formal test of whether there is a significant amount of overdispersion;

clearly the negative binomial regression model is the appropriate model for these data.

A second problem arises when reviewing the values of the count variable for the combined dataset graphically, as shown below in Figure 1.

Figure 1 – Histogram, completed pregnancies parented (combined dataset)



Almost half of the respondents report zero completed pregnancies. Accordingly, I next estimated a zero-inflated negative binomial regression with the count of completed pregnancies variable as the dependent variable and all the other variables as independent variables. The Vuong statistic, which compares the zero-inflated negative binomial model to a negative binomial model, indicates that the zero-inflated model was preferred (z =14.04, Pr>z = 0.0000). These results for males are shown in Table 4, and the results for females are shown in Table 5. Bolded coefficients are significant at at least the .05 level.

Table 4 – Zero-inflated negative binomial regression equation estimating the number of children ever born, males, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.033**	**0.004**	**3.342**
R's education (number of years of schooling)	0.013	0.011	1.289
Whether R is Black	**0.252**	**0.052**	**28.647**
whether R is Hispanic	0.061	0.055	6.338
whether R is other race	0.060	0.098	6.181
R's poverty level income	**-0.001**	**0.000**	**-0.142**
whether R is urban resident	0.044	0.064	4.517
R's age at first sex	**-0.027**	**0.008**	**-2.702**
Whether R ever married/cohabited	**-1.478**	**0.206**	**338.613**
Number of opposite-sex partners in lifetime	**0.005**	**0.002**	**0.526**
Whether R belongs to a religion	0.178	0.110	19.490
How important is religion to R's daily life	-0.079	0.099	-7.620
R's score on conservative/liberal scale	**0.018**	**0.004**	**1.800**

The coefficients from the zero-inflated negative binomial regression estimated for males (Table 4 above) may be interpreted in many ways. I have decided to exponentiate them, which converts them into incidence rate ratios (IRR); these are very similar to odds ratios. I next calculated for each of the independent variables the percent change in its incidence rate ratio, using this formula:

Percent change in IRR = (IRR – 1) * 100

This tells me about the_percent change in the expected count of ever-born children, holding other variables constant.

For example, the coefficient for the age variable in Table 4 is 0.033; when I exponentiate this value into an IRR, it becomes 1.033. I then calculate the percent change in the IRR as (1.033 -1) * 100 = 3.34%. This is interpreted as follows: for every additional year of age among males, holding all other variables constant, respondents on average have 3.34% more completed pregnancies fathered. Variables significant at the .05 level or less are boldfaced in Table 4 above.

Since the results reported in Table 1 indicate that there is a significant difference between males and females in the number of children ever born, this allows me to proceed to test the second hypothesis, that the difference between regression coefficients in the male data and the female data are significant. I first reviewed the results from the male model (Table 4), and found that several sociodemographic variables were statistically significant: age of respondent, whether the respondent is Black, income, age at first intercourse, whether the respondent ever married or cohabited, number of opposite-sex lifetime partners, and the constructed CONSERVATIVE variable. These significant variables and their coefficients are all highlighted in Table 4.

Here are their interpretations: For every additional year of age, holding all other variables constant, men on average have 3.34% more completed pregnancies fathered. Black male respondents had 28.65% more children than the reference category of White respondents. For every additional increase in unit of income (again, the units are percentage of poverty level – the higher the value, the more enhanced the economic position)), men have 0.14% fewer children fathered. Men who delay their first sexual activity by a year on average have 2.70% fewer completed pregnancies. Men who have ever-cohabited or ever-married reported on average 338.6% more offspring, while each unit increase in number of reported lifetime sexual partners added on average 0.53 children to the total count. Additionally, men had 1.80% more children for every point higher on the CONSERVATIVE scale.

I now turn attention to females; their results are reported in Table 5. Bolded coefficients are significant at least the .05 level. The results for females demonstrate that a number of sociodemographic variables from the male model (in Table 4) were also significant for females (age, income, age at first intercourse, marriage/cohabitation, number of lifetime partners and conservative) with the importance of religion variable also showing up as significant.

Table 5 - Zero-inflated negative binomial regression equation estimating the number of children ever born, females, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.054**	**0.003**	**5.553**
R's education (number of years of schooling)	-0.014	0.008	-1.387
Whether R is Black	0.046	0.049	4.757
whether R is Hispanic	0.072	0.046	7.507
whether R is other race	**0.179**	**0.050**	**19.573**
R's poverty level income	**-0.002**	**0.000**	**-0.186**
whether R is urban resident	0.055	0.044	5.602
R's age at first sex	**-0.056**	**0.006**	**-5.409**
Whether R ever married/cohabited	**1.257**	**0.090**	**251.529**
Number of opposite-sex partners in lifetime	**0.006**	**0.002**	**0.648**
Whether R belongs to a religion	-0.083	0.097	-7.971
How important is religion to R's daily life	**0.221**	**0.084**	**24.686**
R's score on conservative/liberal scale	**0.012**	**0.003**	**1.181**

For every additional year of age, holding all other variables constant, women on average have 5.55% more completed pregnancies. Respondents reporting an "other" race have on average 19.57% more children than the control category of White respondents. Women on average have 5.41% fewer completed pregnancies for every year that they delay their first sexual activity, and for every additional lifetime sexual partner they have on average 0.65% more pregnancies completed. For every additional percentage point above the poverty level, women have 0.19% fewer offspring. Additionally, women who have ever cohabited or been married have 251.53% more completed pregnancies on average than women who have not. Women scoring higher on the CONSERVATIVE scale also experience higher lifetime completed pregnancies, having 1.18% more for every score higher on the constructed scale. For every point higher on the religion importance scale, women on average have 24.69% more children.

After estimating the models for males and females (reported in Tables 4 and 5), the regression coefficients can be compared following the test for the equality of regression coefficients:

$$Z = \frac{b_1 - b_2}{\sqrt{\left(SEb_1^2 + SEb_{2_2}^{2}\right)}}$$

where b_1 and b_2 are the regression coefficients, and SEb_1 and SEb_2 are the standard errors for those coefficients (Paternoster 1998). The results are presented in tabular form below in Table 6. A t-value of 2.0 or higher indicates that the difference between the two coefficients is statistically significant.

Table 6 - Test for equality of regression coefficients – Model 1

Variable	t score	p(t)	p<.05
R's age at interview	**-4.356**	**0.00001**	*
R's education (number of years of schooling)	1.946	0.05165	
Whether R is Black	**2.868**	**0.00413**	*
whether R is Hispanic	-0.153	0.87840	
whether R is other race	-1.078	0.28103	
R's poverty level income	1.853	0.06388	
whether R is urban resident	-0.132	0.89498	
R's age at first sex	**2.773**	**0.00555**	*
Whether R ever married/cohabited	0.984	0.32512	
Number of opposite-sex partners in lifetime	-0.439	0.66066	
Whether R belongs to a religion	1.785	0.07426	
How important is religion to R's daily life	**-2.310**	**0.02089**	*
R's score on conservative/liberal scale	1.284	0.19914	

Four variables (age, whether the respondent is Black, age at first intercourse, importance of religion) showed statistically significant differences between the regression coefficients of the models estimated on the male and female data. Age has a slightly stronger effect on fertility for women than it does on men. The Black variable was significant only for men, while the religion importance variable was significant only for women. Age at first intercourse was also notably stronger for women than it was for men.

Model 1a

The subdivided dataset, including only those respondents under the age of 30, was used to estimate the next series of models (1a). Again, I estimated a zero-inflated negative binomial regression using completed pregnancies as the dependent variable and all other variables of interest as the independent variables for both the male and female datasets. A significant result with the male variable allowed me to proceed to test the hypothesis that the difference between regression coefficients in the male dataset and the female dataset are significant. The coefficients from the regression equations, again, will be interpreted in terms of percent change of expected count of completed pregnancies fathered/mothered, holding other variables constant. Variables significant in the male dataset at the .05 level are boldfaced in Table 7 below.

Table 7 – Zero-inflated Negative binomial regression equation estimating the number of children ever born, males, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.048**	**0.017**	**4.958**
R's education (number of years of schooling)	-0.009	0.034	-0.908
Whether R is Black	0.296	0.163	34.384
whether R is Hispanic	0.089	0.121	9.348
whether R is other race	**0.440**	**0.218**	**55.269**
R's poverty level income	**-0.001**	**0.000**	**-0.089**
whether R is urban resident	0.063	0.152	6.472
R's age at first sex	**-0.099**	**0.023**	**-9.449**
Whether R ever married/cohabited	**1.286**	**0.232**	**261.972**
Number of opposite-sex partners in lifetime	**0.013**	**0.006**	**1.310**
Whether R belongs to a religion	0.371	0.381	44.900
How important is religion to R's daily life	-0.366	0.370	-30.619
R's score on conservative/liberal scale	**0.028**	**0.009**	**2.890**

The model using the subdivided male dataset presents a few variables as significant: age of respondent, whether the respondent was of "other" race, income, age at first intercourse, whether the respondent married/cohabited, number of lifetime partners, and the artificial CONSERVATIVE variable. With every additional year of age, holding all other variables constant, men in the subdivided under-thirty dataset are on average expected to have 4.96%

more completed pregnancies fathered. Men of racial category “other” had on average 55.27% more offspring than respondents in the reference “white” category. For each increase in unit of income based on percentage of poverty level, men in the under-thirty subset have 0.09% fewer children fathered. Men delaying their first sexual activity on average have 9.45% fewer completed pregnancies for every year of delay. Men who married or cohabited reported on average 261.97% more offspring, while respondents report 1.31%% more children for every additional lifetime sexual partner. Finally, men in this subset of the data had 2.89% more children for every point they scored higher on the CONSERVATIVE scale. Coefficients significant at the .05 level are boldfaced in the table below.

Table 8 – Zero-inflated Negative binomial regression equation estimating the number of children ever born, females, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.130**	**0.011**	**13.892**
R's education (number of years of schooling)	**-0.117**	**0.017**	**-11.023**
Whether R is Black	**0.366**	**0.069**	**44.189**
whether R is Hispanic	0.136	0.093	14.580
whether R is other race	0.019	0.101	1.879
R's poverty level income	**-0.002**	**0.000**	**-0.204**
whether R is urban resident	-0.162	0.090	-14.995
R's age at first sex	**-0.128**	**0.015**	**-12.017**
Whether R ever married/cohabited	**1.029**	**0.087**	**179.747**
Number of opposite-sex partners in lifetime	0.004	0.003	0.410
Whether R belongs to a religion	-0.167	0.184	-15.351
How important is religion to R's daily life	**0.335**	**0.166**	**39.799**
R's score on conservative/liberal scale	0.009	0.006	0.898

Similar results were obtained with the under-thirty subset of the females, with a number of the same sociodemographic variables presenting significant results listed above in Table 8. As in the male subset, age of respondent, income, age at first intercourse, and the marriage and cohabitation variable were all significant. Additionally, the variables for education and Black ethnicity also showed significance.

The regression coefficients may now be compared following the test for the equality of regression coefficients (Paternoster 1998). The results are shown in Table 9 below, with the significant findings boldfaced.

Table 9 – Test for equality of regression coefficients – Model 1a

Variable	t score	p(t)	p<.05
R's age at interview	**-3.975**	**0.00007**	*
R's education (number of years of schooling)	**2.830**	**0.00465**	*
Whether R is Black	-0.399	0.68989	
whether R is Hispanic	-0.306	0.75960	
whether R is other race	1.752	0.07977	
R's poverty level income	**2.646**	**0.00814**	*
whether R is urban resident	1.272	0.20337	
R's age at first sex	1.030	0.30301	
Whether R ever married/cohabited	1.038	0.29927	
Number of opposite-sex partners in lifetime	1.433	0.15186	
Whether R belongs to a religion	1.269	0.20444	
How important is religion to R's daily life	-1.726	0.08435	
R's score on conservative/liberal scale	1.862	0.06260	

In the models developed using the under-thirty subset of the male and female respondents, we obtain a different result from that found using the full dataset. For the younger respondents, coefficients differing significantly for males and females are age and education, Once again, the effect of these variables is much greater in strength for women than for men. In the case of the education variable, this was largely the result of the variable being significant in the female model, but not in the male model.

Model 2

In the next set of models, I will use as the dependent variable another direct measure of fertility. However, instead of utilizing a count variable as in the previous section (the number of children ever born to the respondent), I now estimate a logistic regression model based on whether or not the respondent has ever had a child. Interestingly, 61% of females report having ever had children, while only 45% of males report having ever had children. The following table (Table 10) presents the results of the logistic regression model estimated on the male dataset. Variables significant at the .05 level are bolded below.

Table 10 – Logistic regression equation estimating whether the respondent ever had a liveborn child, males, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.141**	**0.012**	**15.087**
R's education (number of years of schooling)	**-0.070**	**0.024**	**-6.778**
Whether R is Black	0.332	0.233	39.359
whether R is Hispanic	0.311	0.191	36.434
whether R is other race	0.531*	0.317	70.073
R's poverty level income	**-0.002**	**0.001**	**-0.243**
whether R is urban resident	-0.101	0.178	-9.584
R's age at first sex	**-0.102**	**0.019**	**-9.661**
Whether R ever married/cohabited	**3.422**	**0.199**	**2,962.500**
Number of opposite-sex partners in lifetime	-0.004	0.005	-0.429
Whether R belongs to a religion	0.286	0.238	33.052
How important is religion to R's daily life	0.189	0.198	20.825
R's score on conservative/liberal scale	**0.044**	**0.012**	**4.454**

The coefficients from the logistic regression estimated for males will be interpreted in terms of percent change in the odds of having a child, holding other variables constant. Variables significant at the .05 level are boldfaced in Table 10 above.

A review of the estimated model for males reveals that a number of sociodemographic variables were significant: age of respondent, education level, income, age at first intercourse, whether the respondent ever married or cohabited, and the CONSERVATIVE variable. For every additional year of age, with other variables held constant, men are 15.09% more likely to have a child, and for every unit increase in years of education, men are 6.78% less likely to have fathered a child. Holding other variables constant, a unit increase in level of income indicates a 0.24% lower likelihood of fathering a child. Men delaying their first sexual activity have on average a 9.66% lower per year chance of fathering a child. Male respondents in this dataset were a whopping 2962.50% more likely to have had children if they had ever married or cohabited. Men also were 4.45% more likely to have children, holding other variables constant, for every point higher scored on the CONSERVATIVE scale. I turn next to a similar analysis for females. Coefficients significant at the .05 level are bolded below.

Table 11 – Logistic regression equation estimating whether the respondent ever had a liveborn child, females, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.183**	**0.011**	**20.026**
R's education (number of years of schooling)	**-0.091**	**0.037**	**-8.668**
Whether R is Black	**0.826**	**0.211**	**128.511**
whether R is Hispanic	**0.676**	**0.197**	**96.639**
whether R is other race	0.400	0.225	49.188
R's poverty level income	**-0.004**	**0.001**	**-0.409**
whether R is urban resident	-0.066	0.127	-6.364
R's age at first sex	**-0.171**	**0.024**	**-15.704**
Whether R ever married/cohabited	**2.238**	**0.164**	**837.471**
Number of opposite-sex partners in lifetime	**0.017**	**0.008**	**1.761**
Whether R belongs to a religion	-0.237	0.333	-21.084
How important is religion to R's daily life	**0.838**	**0.289**	**131.220**
R's score on conservative/liberal scale	**0.030**	**0.010**	**3.030**

The coefficients from the logistic regression estimated for females (Table 11 above) will also interpreted in terms of percent change in the odds of having a child, other variables held constant. Variables significant at the .05 level are boldfaced in Table 10 above.

A review of the model estimated for females shows reveals that a number of the same sociodemographic variables were significant as in the male model: age of respondent, education level, income, age at first intercourse, whether the respondent ever married or cohabited, and the CONSERVATIVE variable. Additionally, the variables representing Black and Hispanic race, as well as the religion importance variable, were significant.

Following the methodology used in the comparison of coefficients in the count models, the coefficients of the logistic regression models will now be examined. The results are shown in the table below, with significant findings presented in bold type. The comparison of the coefficients in the male and female logistic regression models provides a number of interesting results. Age of respondent, income, reported age at first intercourse, whether the respondent ever married or cohabited, and the number of lifetime partners were all statistically significant in both the male and female models, and the differences between their regression coefficients are significant.

Table 12 - Test for equality of regression coefficients – Model 2

Variable	t score	p(t)	p<.05
R's age at interview	-2.620	0.00879	*
R's education (number of years of schooling)	0.468	0.63978	
Whether R is Black	-1.574	0.11549	
whether R is Hispanic	-1.331	0.18319	
whether R is other race	0.336	0.73687	
R's poverty level income	2.157	0.03101	*
whether R is urban resident	-0.160	0.87288	
R's age at first sex	2.271	0.02315	*
Whether R ever married/cohabited	4.583	0.00000	*
Number of opposite-sex partners in lifetime	-2.286	0.02225	*
Whether R belongs to a religion	1.275	0.20231	
How important is religion to R's daily life	-1.852	0.06403	
R's score on conservative/liberal scale	0.902	0.36706	

Age of the respondent had a much stronger effect on women in the sample, as did the poverty and age at first intercourse variables. Only the marriage/cohabitation variable had a statistically stronger effect on the men than it did on the women.

Model 2a

The subdivided dataset, including only those respondents under the age of 30, was used to estimate the next set of models (2a). I again estimated a logistic regression model based on whether or not the respondent has ever had a child, using all the same variables as in model 2 previously. Results of the regression for the subset of the male dataset are presented in Table 13 below. Several of the same sociodemographic variables relevant in the previous model were also significant in the reduced model: age of respondent, education level, age at first intercourse, whether the respondent ever married or cohabited, and the constructed metric of conservatism. I turn next to the results for females.

Table 13 – Logistic regression equation estimating whether the respondent ever had a liveborn child, males under age 30, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.224**	**0.034**	**25.132**
R's education (number of years of schooling)	**-0.218**	**0.045**	**-19.611**
Whether R is Black	0.325	0.321	38.430
whether R is Hispanic	0.224	0.257	25.085
whether R is other race	0.271	0.698	31.133
R's poverty level income	-0.001	0.001	-0.122
whether R is urban resident	-0.199	0.303	-18.053
R's age at first sex	**-0.144**	**0.041**	**-13.402**
Whether R ever married/cohabited	**2.854**	**0.225**	**1,635.950**
Number of opposite-sex partners in lifetime	-0.002	0.011	-0.233
Whether R belongs to a religion	0.184	0.425	20.206
How important is religion to R's daily life	0.154	0.354	16.651
R's score on conservative/liberal scale	**0.035**	**0.017**	**3.607**

Table 14 – Logistic regression equation estimating whether the respondent ever had a liveborn child, females under age 30, U.S. 2006-08

	coef	se	%change
R's age at interview	**0.317**	**0.025**	**37.253**
R's education (number of years of schooling)	**-0.244**	**0.041**	**-21.664**
Whether R is Black	**1.127**	**0.215**	**208.492**
whether R is Hispanic	**0.605**	**0.264**	**83.187**
whether R is other race	0.199	0.217	22.065
R's poverty level income	**-0.004**	**0.001**	**-0.375**
whether R is urban resident	-0.132	0.172	-12.361
R's age at first sex	**-0.228**	**0.044**	**-20.385**
Whether R ever married/cohabited	**1.821**	**0.171**	**518.038**
Number of opposite-sex partners in lifetime	0.011	0.014	1.129
Whether R belongs to a religion	0.312	0.442	36.627
How important is religion to R's daily life	0.477	0.422	61.073
R's score on conservative/liberal scale	0.004	0.012	0.443

Once again, the regression coefficients from the subdivided male and female models (Tables 13 and 14 above) are interpreted in terms of percent change in the odds of having a child. Variables significant at the .05 level are indicated in bold type in Table 14 above.

A review of the estimated model on the subset of the female dataset reveals results similar to those from the subdivided male model: age of respondent, education level, age at first intercourse, and whether the respondent ever married or cohabited. The Black and Hispanic race variables, as well as the income variable, were also significant in the under-thirty population of women.

Comparison of the regression coefficients of the male and female subdivided datasets yielded the results presented in Table 15 below. After comparing the coefficients of the male and female models, it is evident that age, Black, income, and prior marriage/cohabitation each has a significantly different effect on this direct measure of fertility. As in the previous model, age, income, and age at first intercourse had significantly stronger effects for women than for men. The Black variable was significant only in the model for females. As in the full model, the marriage/cohabitation variable was again the only factor having a statistically stronger effect for men than for women.

Table 15 - Test for equality of regression coefficients – Model 2a

Variable	t score	p(t)	p<.05
R's age at interview	-2.200209679	0.02779	*
R's education (number of years of schooling)	0.428856792	0.66803	
Whether R is Black	-2.074733807	0.03801	*
whether R is Hispanic	-1.034948219	0.30069	
whether R is other race	0.098092516	0.92186	
R's poverty level income	2.964643808	0.00303	*
whether R is urban resident	-0.19295761	0.84699	
R's age at first sex	1.406247558	0.15965	
Whether R ever married/cohabited	3.653420788	0.00026	*
Number of opposite-sex partners in lifetime	-0.781976823	0.43423	
Whether R belongs to a religion	-0.20878839	0.83461	
How important is religion to R's daily life	-0.585831858	0.55799	
R's score on conservative/liberal scale	1.480892717	0.13864	

Conclusion

Although the chapter began with three dependent variables of interest, after subjecting each of them to an initial regression analysis, in only two of them was there a statistically significant effect of sex of the respondent. I then estimated a series of count regression models using children ever born as the dependent variable for both the male and female datasets, and compared the regression coefficients between the two models for significance. Subsequently, I estimated similar logistic regression models using an indicator of whether the respondent ever had a child as the dependent variable and again compared the regression coefficients for significance.

Although the results from the count variable models were mixed, the results from the logistic regression model indicated that there is often a significant difference between the effects of a variety of variables between males and females. Several variables consistently appeared significant: age, income, and age at first intercourse had significantly stronger effects on women, while the marriage/cohabitation variable was the only one having a statistically stronger effect on the men than it did on the women. In the concluding chapter of this dissertation, I will discuss in more detail these differing effects.

In the next chapter, Chapter V, I will examine a series of three indirect metrics of fertility in a similar manner. These three indirect models examine behaviors as a measure of exposure to the risk of fertility. The first model will examine the determinants that influence age at first intercourse, and how they differ between men and women. The second model will focus on the determinants influencing the number of lifetime sexual partners, with attention to how and whether those determinants affect men and women differentially. Chapter V will conclude with an examination of the determinants of whether an individual had sexual activity within the last 12 months, and how those determinants differ between males and females.

CHAPTER V

ANALYSES OF MALE AND FEMALE FERTILITY USING INDIRECT MEASURES

Introduction

This chapter continues my substantive analysis of male and female fertility in an evaluation of yet another series of measures of fertility, namely, indirect measures. I follow the same methodology I used in the analyses direct measures set forth in the preceding chapter. Although the approach of counting offspring directly is a method of critical importance in demography, there are also measures that examine fertility in an indirect fashion. Instead of following an approach estimating models that count actual fertility, the analyses in this chapter will estimate models with dependent variables that measure the *risk of* or *exposure to* fertility. By examining this alternate dimension of fertility, I hope to uncover findings that might not be evident through a strict, counting-babies approach.

Specifically, in this chapter I will estimate a sequence of fertility models, utilizing three separate indirect measures of fertility as dependent variables: 1) a linear regression predicting age at first intercourse; 2) a count regression of the number of reported lifetime opposite-sex sex partners; and 3) a logistic regression model of whether the respondent had sex with an opposite-sex partner within the last 12 calendar months. Each of these analyses will be examined with a complete dataset, and subsequently with an age-graded subset of the sample population (under the age of thirty).

Combined Models

Again, the initial method presented in the previous chapter will be followed here to determine if there is anything to find: is the thesis, that there are fertility differences between men and women with respect to indirect measures of fertility, worth pursuing? This is accomplished by estimating models on a combined dataset consisting of both male and female data, with a dummy variable indicating whether the respondent is male (coded 1) or female (coded 0). If the variable is statistically significant in the computed models, I will then proceed to estimate the same models separately, on both the male and female datasets. I will then compare statistically the coefficients obtained in the male and female datasets to ascertain if their differences are significant. If there are significant differences between the coefficients produced in the male and female models, those differences become points of interest.

Table 16, Table 17, and Table 18 below show the results of the appropriate regressions estimated on the combined male and female datasets for the three dependent variables.

Evaluation

Coefficients for the sex variable, i.e., "whether the respondent is a male," are highlighted in the above tables. The results from the combined male and female models are mixed. For both the full dataset and the under-thirty dataset, the coefficient for the MALE variable is significant in both models represented in Table 17, measuring the count of lifetime sexual partners, and in the models represented in Table 18, the logistic regression model analyzing whether the respondent had intercourse with an opposite-sex partner within the last 12 months.

Table 16 – Ordinary least squares regression equation estimating the age at first intercourse, males and females, U.S. 2006-2008

	Coef**	se	Coef***	Se
Whether R is male	**-0.002**	**0.104**	**-0.109**	**0.093**
Whether R had any children	-1.079	0.120	-0.845	0.116
R's age at interview	0.107	0.009	0.179	0.018
R's education (number of years of schooling)	0.310	0.022	0.302	0.037
Whether R is Black	-0.599	0.124	-0.589	0.146
whether R is Hispanic	0.321	0.120	-0.124	0.155
whether R is other race	1.697	0.484	0.458	0.345
R's poverty level income	-0.001	0.000	-0.001**	0.000
whether R is urban resident	0.238	0.183	0.273*	0.141
Whether R ever married/cohabited	0.087	0.170	0.151	0.123
Number of opposite-sex partners in lifetime	-0.101	0.005	-0.093	0.008
Whether R belongs to a religion	0.106	0.185	0.102	0.199
How important is religion to R's daily life	0.262	0.186	0.196	0.196
R's score on conservative/liberal scale	0.073	0.011	0.052	0.018

** These coefficients are from an equation estimated for the complete samples of males and females

*** These coefficients are from an equation estimated for samples of males and females under the age of 30

Table 17 – Zero-inflated negative binomial regression equation estimating the number of lifetime sexual partners, males and females, U.S. 2006-2008

	Coef**	se	Coef***	Se
Whether R is male	**0.128**	**0.016**	**0.081**	**0.020**
R's age at interview	0.010	0.001	0.035	0.004
R's education (number of years of schooling)	0.017	0.004	0.023	0.006
Whether R is Black	0.089	0.020	0.061	0.029
whether R is Hispanic	-0.050	0.019	-0.046	0.031
whether R is other race	-0.039	0.053	-0.085	0.070
R's poverty level income	0.000	0.000	0.000	0.000
whether R is urban resident	-0.017	0.022	-0.026	0.025
R's age at first sex	-0.075	0.004	-0.099	0.007
Whether R ever married/cohabited	-0.044	0.028	0.028	0.031
Number of opposite-sex partners in lifetime	0.064	0.001	0.070	0.003
Whether R belongs to a religion	0.062	0.032	0.023	0.051
How important is religion to R's daily life	-0.076	0.034	-0.054	0.046
R's score on conservative/liberal scale	-0.009	0.002	-0.006	0.003

** These coefficients are from an equation estimated for the complete samples of males and females

*** These coefficients are from an equation estimated for samples of males and females under the age of 30

Table 18 - Logistic regression equation estimating whether the respondent had sex with an opposite-sex partner in the last 12 months, males and females, U.S. 2006-2008

	Coef**	se	Coef***	Se
Whether R is male	**1.701**	**0.115**	**1.343**	**0.148**
R's age at interview	-0.008	0.008	0.035	0.024
R's education (number of years of schooling)	0.027	0.024	0.035	0.035
Whether R is Black	0.285	0.144	0.148	0.196
whether R is Hispanic	-0.494	0.107	-0.516	0.136
whether R is other race	-0.268	0.186	-0.496	0.263
R's poverty level income	0.001	0.000	0.001	0.000
whether R is urban resident	-0.131	0.140	-0.076	0.168
R's age at first sex	-0.188	0.015	-0.237	0.022
Whether R ever married/cohabited	-0.476	0.132	0.181	0.186
Whether R belongs to a religion	-0.244	0.240	-0.664	0.299
How important is religion to R's daily life	0.252	0.211	0.531	0.267
R's score on conservative/liberal scale	-0.035	0.008	-0.037	0.009

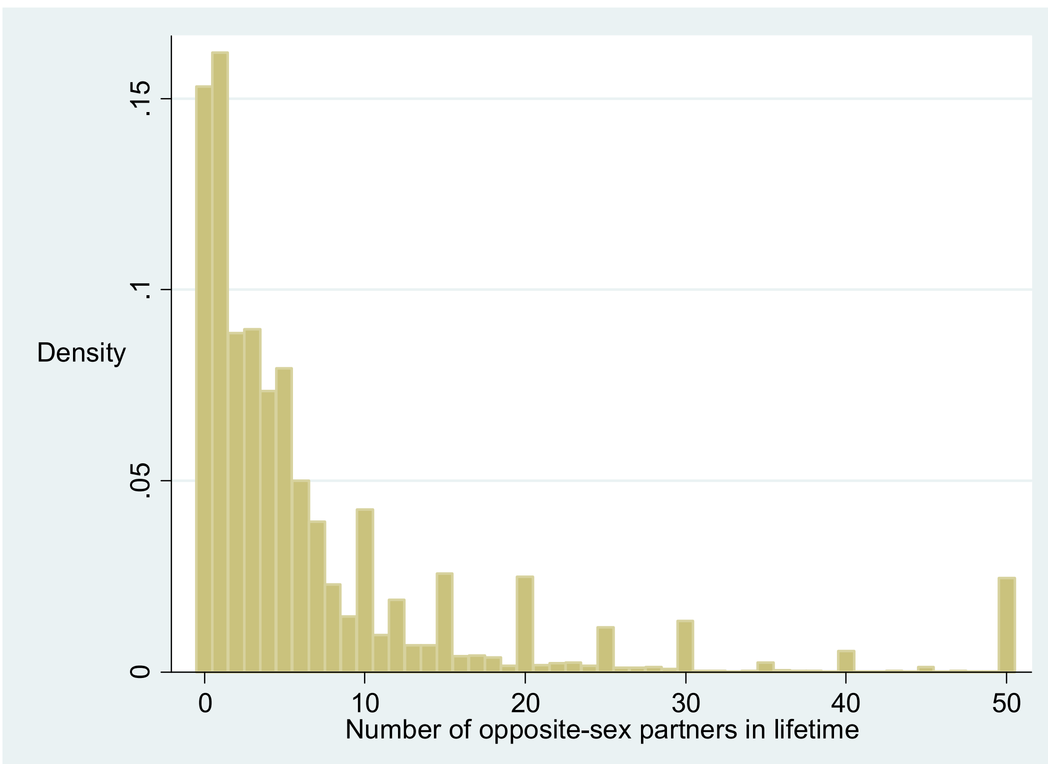
** These coefficients are from an equation estimated for the complete samples of males and females
*** These coefficients are from an equation estimated for samples of males and females under the age of 30

However, the coefficient for the sex variable is not statistically significant at the .05 level in the OLS regression using age at first intercourse as the dependent variable, whose results are displayed in Table 16. The interpretation of these results with respect to the data is straightforward: for the last two models (5 and 6), both full and reduced, the differences between males and females regarding the indirect measures of fertility in question are significant; in the first model (4) there is no significant difference evident. Accordingly, I will proceed with the evaluation of comparisons estimated with the male and female datasets only for the models evaluating the count of lifetime sexual partners, and whether the respondent had sex with an opposite-sex partner in the last 12 months. The remainder of this chapter will evaluate these two models and compare their regression coefficients for significance.

Model 5

Model 5 uses as its dependent variable the count of the number of lifetime sexual partners reported by the respondent for both women and men. As seen in the previous chapter with the variable measuring count of completed pregnancies in the first direct model, the number of lifetime sexual partners is a count variable requiring treatment with a count-specific regression method. Because of the potential for overdispersion in the data, I began by estimating a negative binomial model using the number of lifetime sexual partners as the dependent variable. The resulting alpha value was not zero, indicating a significant amount of overdispersion in the data; therefore the model did not reduce to a Poisson model. Use of a negative binomial model is thus appropriate for an analysis of these data. The distribution of values of the lifetime sexual partner count variable is presented in Figure 2 below.

Figure 2 – Histogram, number of opposite-sex partners in lifetime, males and females, U.S. 2006-2008



The coefficients from the negative binomial regression estimated on the models may again be interpreted by exponentiating them, transforming them into incidence rate ratios (IRRs). I then calculate the percentage change in incidence rate ratios for each of the independent variables, again following the formula:

Percent change in IRR = (IRR -1) * 100

This yields an efficiently interpretable result, namely, the percent change of expected count of number of lifetime opposite-sex sex partners, with other variables held constant. Results significant at the .05 level are boldfaced in the table below (Table 19).

I found that several of the sociodemographic variables were statistically significant: age of respondent, education, whether the respondent is Black, age at first intercourse, marriage/cohabitation, and the constructed variable measuring conservative or liberal attitudes.

Table 19 – Negative binomial regression equation estimating the count of lifetime opposite-sex sex partners, males, U.S. 2006-2008

	Coef	se	%change
R's age at interview	**0.034**	**0.003**	**3.478**
R's education (number of years of schooling)	**0.018**	**0.009**	**1.768**
Whether R is Black	**0.266**	**0.081**	**30.422**
Whether R is Hispanic	-0.065	0.069	-6.298
Whether R is other race	0.016	0.108	1.650
R's poverty level income	0.000	0.000	0.030
Whether R is urban resident	0.038	0.070	3.863
R's age at first sex	**-0.181**	**0.009**	**-16.530**
Whether R ever married/cohabited	**0.241**	**0.066**	**27.199**
Whether R belongs to a religion	-0.022	0.089	-2.130
How important is religion to R's daily life	0.009	0.078	0.941
R's score on conservative/liberal scale	**-0.018**	**0.005**	**-1.826**

For every additional year of age, holding all other variables constant, men tend to have an average of 3.48% more lifetime sex partners of the opposite sex. Additional years of education add on average 1.77% more opposite-sex sexual partners over the course of the respondent’s lifetime. Black men in the sample have on average 30.4 percent more partners over the course of their lifetimes than the reference category, white males. Men delaying their first sexual activity by a year on average have 16.53% fewer sex partners over their lifetimes, while men in the sample who married or cohabited reported on average 27.20% more lifetime partners. Additionally, men had 1.83% fewer lifetime sexual partners for every additional point scored on the scale of conservatism/liberalism.

Table 20 – Negative binomial regression equation estimating the count of lifetime opposite-sex sex partners, females, U.S. 2006-2008

	coef	se	%change
R's age at interview	**0.022**	**0.003**	**2.229**
R's education (number of years of schooling)	**0.021**	**0.011**	**2.126**
Whether R is Black	0.086	0.050	8.939
Whether R is Hispanic	**-0.428**	**0.054**	**-34.826**
Whether R is other race	-0.119	0.126	-11.228
R's poverty level income	**-0.000**	**0.000**	**-0.037**
Whether R is urban resident	0.088	0.077	9.174
R's age at first sex	**-0.161**	**0.008**	**-14.879**
Whether R ever married/cohabited	**0.128**	**0.058**	**13.659**
Whether R belongs to a religion	0.050	0.147	5.085
How important is religion to R's daily life	-0.255	0.134	-22.501
R's score on conservative/liberal scale	**-0.027**	**0.004**	**-2.640**

The model estimated for males (Table 4) is next estimated for females (see Table 5). The results are comparable. Years of age, education, age at first intercourse, and the constructed conservative/liberal variable were all significant, with Hispanic ethnicity and income also showing up as additional significant variables.

Holding other variables constant, women’s number of lifetime opposite-sex partners increased 2.23% for every additional year of age. With each increase in the income scale, women reported 0.04% fewer lifetime sex partners. More education is significantly associated with more partners, with every additional increase in years of education leading to 2.13% more lifetime partners. Women respondents delaying their first sexual activity by a year have 14.88% fewer opposite-sex sex partners on average. These same women report 2.64% fewer lifetime sexual partners for every additional point scored on the CONSERVATIVE scale. Hispanic ethnicity is related with significantly fewer sexual partners, with 34.83% fewer partners reported relative to white women (the reference standard).

I next evaluated the differences between the sets of regression coefficients using the equality of regression coefficients measure, discussed in Chapter IV. The results and interpretations are presented in Table 21 below.

Table 21 – Test for equality of regression coefficients in male and female fertility models predicting the number of lifetime sex partners, males and females, U.S. 2006-2008

Variable	t	p(t)	p<.05
R's age at interview	**2.81**	**0.00495**	*
R's education (number of years of schooling)	-0.256	0.79795	
Whether R is Black	1.895	0.05809	
Whether R is Hispanic	**4.122**	**0.00004**	*
Whether R is other race	0.817	0.41393	
R's poverty level income	**2.709**	**0.00675**	*
Whether R is urban resident	-0.479	0.63194	
R's age at first sex	-1.621	0.10502	
Whether R ever married/cohabited	-1.28	0.20055	
Whether R belongs to a religion	-0.415	0.67814	
How important is religion to R's daily life	1.711	0.08708	
R's score on conservative/liberal scale	1.415	0.15707	

Significant Results

Three variables present significant differences between the male and female models estimated with number of lifetime opposite-sex sexual partners as the dependent variable: age, Hispanic ethnicity, and income. Hispanic ethnicity and income were both significant only in the female model, while age was slightly stronger in its effects on males.

Model 5a

The next step is to evaluate the same male and female models but to restrict the respondents to those under the age of thirty. Again, the coefficients from the regression estimated on the models are interpreted as percent change in the expected count of number of lifetime opposite-sex sex partners, other variables held constant. The results demonstrating statistical significance at the .05 level are boldfaced in Table 22 below.

Results indicate several significant variables have an effect on the number of opposite-sex sex partners reported by men under the age of thirty: age of respondent, education, Black race, Hispanic ethnicity, urban residence, and age at first intercourse. Older men have more partners, with 11.27% more lifetime partners of the opposite sex reported for each additional year of age.

Table 22 - Negative binomial regression equation estimating the count of lifetime opposite-sex sex partners, males under the age of 30, U.S. 2006-2008

	Coef	se	%change
R's age at interview	**0.107**	**0.009**	**11.270**
R's education (number of years of schooling)	**0.041**	**0.015**	**4.158**
Whether R is Black	**0.242**	**0.113**	**27.422**
Whether R is Hispanic	**-0.117**	**0.059**	**-11.007**
Whether R is other race	-0.134	0.145	-12.557
R's poverty level income	0.000	0.000	0.022
Whether R is urban resident	**0.155**	**0.062**	**16.768**
R's age at first sex	**-0.263**	**0.014**	**-23.104**
Whether R ever married/cohabited	0.066	0.082	6.807
Whether R belongs to a religion	0.009	0.126	0.888
How important is religion to R's daily life	-0.044	0.127	-4.268
R's score on conservative/liberal scale	-0.006	0.006	-0.632

Adding years of education increases lifetime partner counts by adding on average 4.16% to the total number for every additional year of age. Male urban residents have 16.79% more partners on average than rural residents. Delaying the onset of sexual activity reduces the number of sex partners; males report on average 23.10% fewer sex partners for every year of abstinence. Black and Hispanic status effect the number of partners in opposite directions, with Black men reporting 27.42% more partners and Hispanic men reporting 11.01% fewer partners relative to the standard of comparison, white males.

Table 23 - Negative binomial regression equation estimating the count of lifetime opposite-sex sex partners, females under the age of 30, U.S. 2006-2008

	coef	se	%change
R's age at interview	**0.105**	**0.009**	**11.106**
R's education (number of years of schooling)	0.017	0.018	1.742
Whether R is Black	0.053	0.063	5.430
Whether R is Hispanic	**-0.324**	**0.086**	**-27.680**
Whether R is other race	-0.184	0.122	-16.795
R's poverty level income	-0.000	0.000	-0.040
Whether R is urban resident	-0.037	0.104	-3.611
R's age at first sex	**-0.205**	**0.011**	**-18.529**
Whether R ever married/cohabited	0.054	0.061	5.587
Whether R belongs to a religion	0.379	0.211	46.135
How important is religion to R's daily life	-0.343	0.210	-29.024
R's score on conservative/liberal scale	**-0.029**	**0.005**	**-2.891**

For women under thirty, there were fewer differences in the independent variables of importance compared to the model estimated for men: age, Hispanic ethnicity, age at first intercourse, and conservatism all showed significance in this model, while Black race and urban residence failed to register as significant. Older women have more partners, adding an average of 11.11% more lifetime sexual partners for every year of additional age. Abstaining from intercourse for a year gave respondents 18.53% fewer partners, while more conservative women under thirty report an average of 2.89% fewer partners for every point higher on the constructed scale.

Both sets of regression coefficients were then evaluated to determine they were statistically different from each other, using Paternoster's *et al.* test for equality of regression coefficients; the results presented in Table 24 below. Significant variables are signified with bold type.

Significant Results

When comparing these two models estimated using the number of lifetime opposite-sex sexual partners as the dependent variable, only three variables show significant differences: Hispanic ethnicity, age at first intercourse, and the score on the conservative scale.

Table 24 – Test for equality of regression coefficients in male and female fertility models predicting the number of lifetime sex partners, males and females under the age of 30, U.S. 2006-2008

Variable	t	p(t)	p<.05
R's age at interview	0.113	0.91003	
R's education (number of years of schooling)	0.974	0.33006	
Whether R is Black	1.467	0.14238	
Whether R is Hispanic	**1.983**	**0.04737**	*
Whether R is other race	0.262	0.79332	
R's poverty level income	1.826	0.06785	
Whether R is urban resident	1.586	0.11274	
R's age at first sex	**-3.184**	**0.00145**	*
Whether R ever married/cohabited	-1.173	0.24080	
Whether R belongs to a religion	-1.508	0.13155	
How important is religion to R's daily life	1.219	0.22284	
R's score on conservative/liberal scale	**2.958**	**0.00310**	*

Young women are more strongly affected by their Hispanic ethnicity than are young men. Age at first intercourse was slightly stronger in its effect on the number of sex partners for males than for females; and the conservatism scale was significant only for females. I now turn to sex-specific analyses of another indirect fertility.

Model 6

The next set of models to be evaluated is another series of indirect measures, or measures of exposure to fertility. Where the previous model explored number of lifetime sexual partners as the dependent variable, this set of models will analyze whether the respondent had sexual activity in the last year with an opposite-sex partner. Again, this is a measure of potential exposure to or risk of fertility, and is as such an indirect measure of fertility. The reason for selecting several alternative methods of measuring fertility, both indirectly and directly, is to find whether and how multiple dimensions of the same underlying concept can be affected differently by the same social, cultural, or demographic effects. In the Cycle 7 results of the NSFG (2006-2008), 64.45% of females in the dataset report having sex in the last calendar year, while 74.55% of males report opposite-sex sexual activity. The following table (Table 25) presents the findings of the logistic regression model analyzing the male dataset. The results are presented in terms of exponentiated regression coefficients (odds ratios) interpreted as percent change in the odds or likelihood of having sex in the last twelve months, holding each of the other variables in the regression model constant. Results significant at the .05 level are indicated in bold text.

Table 25 - Logistic regression equation estimating whether the respondent had opposite-sex sex in the past year, males, U.S. 2006-2008

	coef	se	%change
R's age at interview	**-0.089**	**0.012**	**-8.537**
R's education (number of years of schooling)	**0.119**	**0.042**	**12.678**
Whether R is Black	0.003	0.216	0.276
Whether R is Hispanic	-0.044	0.260	-4.283
Whether R is other race	0.059	0.346	6.059
R's poverty level income	0.000	0.001	0.002
Whether R is urban resident	-0.104	0.219	-9.908
R's age at first sex	-0.032	0.024	-3.187
Whether R ever married/cohabited	**2.161**	**0.212**	**767.809**
Whether R belongs to a religion	-0.316	0.313	-27.101
How important is religion to R's daily life	0.399	0.256	49.035
R's score on conservative/liberal scale	**0.040**	**0.014**	**4.127**

As in many of the previously analyzed models, a number of variables are significant in this model: age, education, whether or not the respondent ever married or cohabited, and the respondent's score on the constructed liberal/conservative metric. For every additional year of age, holding other variables constant, men are 8.54% less likely to have had opposite-sex sex in the last year. Adding an additional year of education increases the likelihood of having sex in the last year by 12.68%. As might be expected, those men who ever married or cohabited are much more likely – 767.81% - to have experienced sexual intercourse with a female partner in the last year. Conservative men in the sample are more likely to have had sex in the last year than men who identify as liberal - for every additional point they score higher on the constructed conservatism scale, their likelihood of intercourse in the last twelve months increases by 4.13%.

I continue my analysis by now estimating the same model, but this time for females (Table 26). Significant results are indicated in bold type.

Table 26 - Logistic regression equation estimating whether the respondent had opposite-sex sex in the past year, females, U.S. 2006-2008

	coef	se	%change
R's age at interview	**0.021**	**0.009**	**2.158**
R's education (number of years of schooling)	0.019	0.027	1.877
Whether R is Black	0.321	0.171	37.841
Whether R is Hispanic	**-0.567**	**0.136**	**-43.267**
Whether R is other race	**-0.488**	**0.228**	**-38.585**
R's poverty level income	**0.001**	**0.000**	**0.150**
Whether R is urban resident	-0.140	0.154	-13.106
R's age at first sex	**-0.331**	**0.026**	**-28.159**
Whether R ever married/cohabited	**0.718**	**0.204**	**105.016**
Whether R belongs to a religion	-0.092	0.269	-8.790
How important is religion to R's daily life	-0.101	0.285	-9.565
R's score on conservative/liberal scale	**-0.057**	**0.009**	**-5.541**

In the female dataset, a slightly different set of independent variables were shown to be statistically significant: age, marriage/cohabitation, and the conservativism variable were significant as in the male dataset, but Hispanic race, whether the respondent was a member of an “other” race, and age at first intercourse were also significant in the female model. For each additional year of age, women were 2.16% more likely to have had sex in the last year; I note that this coefficient is weaker than, and in the opposite direction from, that reported for males. Hispanic women and women of "other" races were less likely to have had sex in the past year relative to the reference category of white women by 43.27% and 38.59%, respectively. Higher income meant more likelihood of intercourse, with every unit increase in the income scale increasing the likelihood of having sex in the past year by 0.15%. Those women who delayed intercourse were less likely to have had sex with an opposite-sex partner in the last year, decreasing their likelihood by 28.16% for every year of delay. Women who ever experienced marriage or cohabited with a romantic partner are expected to be more likely to have had sex in the last twelve months. This result was supported by the model, with ever married or cohabiting women being 105.02% more likely to have had sex in the last 12 months. The results of the conservative/liberal scale were opposite those obtained in the male model, with women on average 5.54% less likely to have had sex in the last year for every point scored higher on the conservative scale; more conservative men in the sample were shown to be more likely to have had sex, while more liberal women are more likely to have had intercourse in the last 12 months.

Table 27 - Test for equality of regression coefficients in male and female fertility models predicting whether the respondent had sexual intercourse in the past year, males and females, U.S. 2006-2008

Variable	t	p(t)	p<.05
R's age at interview	**-7.213**	**0.00000**	*****
R's education (number of years of schooling)	**2.013**	**0.04411**	*****
Whether R is Black	-1.156	0.24768	
whether R is Hispanic	1.782	0.07475	
whether R is other race	1.318	0.18750	
R's poverty level income	**-2.294**	**0.02179**	*****
whether R is urban resident	0.135	0.89261	
R's age at first sex	**8.378**	**0.00000**	*****
Whether R ever married/cohabited	**-9.781**	**0.00000**	*****
Whether R belongs to a religion	-0.543	0.58713	
How important is religion to R's daily life	1.305	0.19189	
R's score on conservative/liberal scale	**5.771**	**0.00000**	*****

Significant Results

The comparison of regression coefficients between the male and female datasets for Model 6 is presented in Table 27 above. A number of interesting results were obtained, with some variables not only showing significance in both the male and female models, but also working in opposite directions. Age is significant, and works in opposite directions. Generally, women are more likely to have sex in the last 12 month when they get older, while men are less likely. Level of education is only significant in the male model. Age at first sex and marriage/cohabitation both have a stronger effect among females, while conservativism works in opposite directions.

Model 6a

I next re-estimate the above models predicting whether the respondent had sex in the last year, but I now restrict the analyses to persons under age 30. I used the same independent variables as those used in Model 6 above. The results of the regression for younger males are presented in below. Some of the same variables are significant at the .05 level in the subdivided model, namely, age and marriage/cohabitation.

Table 28 - Logistic regression equation estimating whether the respondent had opposite-sex sex in the past year, males under the age of 30, U.S. 2006-2008

	coef	se	%change
R's age at interview	**-0.147**	**0.037**	**-13.663**
R's education (number of years of schooling)	0.128	0.070	13.642
Whether R is Black	-0.319	0.344	-27.316
Whether R is Hispanic	0.205	0.346	22.710
Whether R is other race	-0.322	0.468	-27.543
R's poverty level income	-0.000	0.001	-0.049
Whether R is urban resident	-0.153	0.316	-14.151
R's age at first sex	0.082	0.045	8.567
Whether R ever married/cohabited	**1.603**	**0.317**	**396.584**
Whether R belongs to a religion	**-1.054**	**0.370**	**-65.130**
How important is religion to R's daily life	**0.772**	**0.360**	**116.483**
R's score on conservative/liberal scale	0.025	0.018	2.557

Additionally, the two religion variables were also significant for the first time in the indirect models. With each additional year of age, men under thirty were 13.66% less likely to have had sex in the last year. Those men who ever married or cohabited were 396.58% more likely to have had sex in the last year. Respondents who indicated they had a current religion were 65.13% less likely to have had sex in the last year, but interestingly, those same respondents were 116.48% more likely to have had sex in the last year if they indicated that religion was important in their daily life.

The results of the same model estimated on the under-thirty subset of females are reported in Table 14.

Table 29 - Logistic regression equation estimating whether the respondent had opposite-sex sex in the past year, females under the age of 30, U.S. 2006-2008

	coef	se	%change
R's age at interview	**0.091**	**0.027**	**9.475**
R's education (number of years of schooling)	0.024	0.044	2.475
Whether R is Black	0.481	0.247	61.720
Whether R is Hispanic	**-0.695**	**0.184**	**-50.110**
Whether R is other race	**-0.614**	**0.312**	**-45.886**
R's poverty level income	**0.002**	**0.000**	**0.184**
Whether R is urban resident	-0.174	0.206	-15.966
R's age at first sex	**-0.443**	**0.049**	**-35.775**
Whether R ever married/cohabited	**1.297**	**0.255**	**265.845**
Whether R belongs to a religion	-0.211	0.421	-19.058
How important is religion to R's daily life	0.038	0.400	3.828
R's score on conservative/liberal scale	**-0.058**	**0.013**	**-5.590**

For the younger women in the subdivided sample, age, and whether the respondent ever experienced marriage/cohabitation were significant as in the male model. Additionally, Hispanic or “other” status, as well as age at first intercourse and score on the variable representing liberal/conservative leanings of the respondent were also significant. Older women were more likely to have had sex in the last year, increasing the likelihood by 9.48% for every additional year of age. Again, this works in a direction opposite to that found among males. Women of Hispanic ethnicity and “other” race demonstrated a diminished likelihood of having sex in the past year relative to the control group of white women. Hispanic women were 50% less likely, and women in the racial category of “other” showed a 45.89% lower chance of an opposite-sex sexual event in the past 12 months. Higher income women showed a significantly increased likelihood for sex in the last year, with a 0.18% higher chance for every unit higher of income. Delaying age at first sex was shown to decrease the likelihood of sex in the last year by 35.78% for each year of delay. Those women under 30 who married or cohabited were a whopping 265.85% more likely to have had sex in the last year, as might be expected: involvement in prior or current romantic relationships should certainly increase the likelihood of sexual activity. Conservativism decreases the likelihood by 5.59%

for every point higher scored on the scale, but was not significant in the model estimated for women under age 30.

The results of the comparison of regression coefficients between the two subdivided models are presented in Table 30 below. Results significant at the .05

Table 30 - Test for equality of regression coefficients in male and female fertility models predicting whether the respondent had sex in the past year, males and females under the age of 30, U.S. 2006-2008

Variable	t	p(t)	p<.05
R's age at interview	**-5.122**	**0.00000**	*****
R's education (number of years of schooling)	1.253	0.21021	
Whether R is Black	-1.889	0.05889	
whether R is Hispanic	**2.294**	**0.02179**	*****
whether R is other race	0.519	0.60376	
R's poverty level income	**-2.95**	**0.00318**	*****
whether R is urban resident	0.057	0.95455	
R's age at first sex	**7.859**	**0.00000**	*****
Whether R ever married/cohabited	**-7.138**	**0.00000**	*****
Whether R belongs to a religion	-1.503	0.13284	
How important is religion to R's daily life	1.365	0.17225	
R's score on conservative/liberal scale	**3.701**	**0.00021**	*****

level are indicated with bold type. Age, Hispanic ethnicity, income, age at first intercourse, marriage/cohabitation, and conservatism are all significantly different among males and females under-thirty datasets. The effect of age is significantly different between men and women, and works in opposite directions. Hispanic ethnicity, conservatism, income, and age at first intercourse are important only in the female model, having no significant effect in the male model. While the marriage/cohabitation variable works in the same direction among males and females, its effect is much stronger in the female models.

Conclusion

This chapter began with an analysis of three separate indirect measures of fertility as dependent variables in a combined male and female dataset. The initial analysis indicated that in only two of the three analyses was the coefficient for sex of the respondent statistically significant. Accordingly, I next estimated a series of count regressions on both the male and female datasets using number of lifetime opposite sex partners as the dependent variable, and then compared the regression coefficients between the models for significance. I followed the same procedure for estimating a series of logistic regression models on the other dependent variable of interest, whether the respondent reported having sex with an opposite-sex partner within the last twelve months. A number of variables, including age and age at first intercourse, proved to be significant. In several models, the differences between males and females with respect to certain other variables were significant, were in the opposite direction, or both.

The next and final chapter, Chapter VI, will pull together and interpret the overall findings from the previous two substantive chapters on direct and indirect modeling of fertility. In addition to the summary of results, I will discuss shortcomings of the research as well as important future directions that this avenue of inquiry will follow.

CHAPTER VI

IMPLICATIONS AND CONCLUSIONS

Introduction

The purposes of this dissertation were three: 1) situating the study of male fertility in the existing demographic literature; 2) modeling and comparing male and female fertility using a variety of direct and indirect metrics; and 3) extending our understanding of how male fertility should be studied, in addition to and alongside female fertility. To these ends, in this final chapter of my dissertation I begin with a discussion of my dependent variables and the models in which they were incorporated. Next, I will proceed to a treatment of my main independent variables and their differential effects on the fertility of men and women in several different models. In the final section of the chapter, I will frame several of the most important independent variables (age, income, age at first intercourse, and marriage/cohabitation) in the context of developed (and developing) theory. I will then describe the overall contributions of this research with respect to the similar and different ways that social, demographic, and cultural variables affect male and female fertility.

Dependent Variables

I begin this section with an overview of the direct and indirect fertility dependent variables utilized in this analysis. See the summary in Table 31 below.

Table 31 - Summary of Dependent Variables

Model	Dependent variable
1/1a	Count of children ever born
2/2a	Did the respondent ever have any children?
3/3a	Did the respondent have any children in the last 12 months? (Not significant)
4/4a	Age at first intercourse (Not significant)
5/5a	Count of lifetime sex partners
6/6a	Did the respondent have sex in the last 12 months?

Chapter IV presented the results of models examining a series of direct measures of fertility. The first set of direct models estimated with all the males and females in the dataset, utilizing the number of children ever born as the dependent variable, showed difference between men and women respondents with respect to four of the social, demographic, and cultural variables under examination: age, Black race, age at first intercourse, and the importance of religion in daily life. The same model estimated on the subset of the respondents under the age of thirty yielded three significant results, two of which were different from the results obtained in the full model. In retrospect, the inconsistencies of these findings are not surprising, and may be part of the reason that male fertility has been ignored as a concept of demographic importance: since fertility is most often measured through counts of offspring, the somewhat erratic and inconsistent differences uncovered in these models could be ignored as trivial, or as artifacts of the data, and therefore probably have been up until now. If the results are ignored as aberrations, as they likely have been in the past, it is unsurprising that male fertility has been given short shrift by demographers.

Further exploration of other potential measures of fertility, however, gives slightly more interesting and consistent results. In the second set of direct models (2 and 2a), there were significant differences between those estimated for males and those for females. Using an alternative (binary) measure of fertility, whether the respondent reported ever having any live-born children within his/her lifetime, resulted in models where up to 5 of the independent variables (age, income, age at first intercourse, whether the respondent ever married or cohabited, and number of lifetime partners) showed significant differences. Between the two full and reduced models, 3 independent variables were consistent in both places - age, income, and whether the respondent ever married or cohabited. The consistency here is key: by using an alternative but broader and equally valid measure of fertility and finding consistent results, the idea that the determinants of male fertility are an important avenue of research, both in conjunction with and independent of female fertility, was clearly supported.

By the same token, indirect measures of fertility provide another dimension to this research. Instead of only examining counts of offspring, indirect measures have the added benefit of being able to examine both the exposure to and the risk of fertility. Again, these alternative fertility metrics provide the interesting results presented in Chapter VI. In Models 5/5a, the dependent variable under examination was again a count; this time, however, it was a count of the number of opposite-sex sexual partners the male and female respondent reported in his/her lifetime. Only a few independent variables emerged as having statistically significant effects in these models, and only one (Hispanic ethnicity) was significant in both the full and reduced datasets.

In the other model measuring risk of or exposure to fertility, namely whether the respondent has sexual intercourse in the past twelve months, Models 6/6a, a number of factors (6 in each model) showed significant differences when comparing the regression coefficients between the male and female models. Age, income, age at first intercourse, marriage/cohabitation, and conservatism/liberalism were consistent between models. Through the use of a dependent variable measuring whether or not the respondent reported having intercourse in the last 12 months, another set of differences between the determinants of male and female fertility were discovered. This dependent variable and this general approach is important for a variety of reasons. First, using a dependent variable that measures fertility indirectly provides another lens through which we can examine fertility, and as in this case, it gives us a perspective that does not readily appear in standard direct measures of fertility. Also, by utilizing a variable with a short, discrete time frame, it is possible to capture some of the variability in the population without the complications that arise (like the aforementioned simultaneity problem) in measurements over a large time scale. Some measures like counts of offspring are the results of events that take place over the entire course of a respondent's reproductive life. Respondents are subject to the effects of independent variables that change over the course of life. In my case, for example, my first child was born when I was a graduate assistant making only $1200 per month. My third child will be born when I make over $50,000 per year. By asking me about events in the last twelve months, I could paint a more accurate picture of my fertility given my current circumstances, a picture that would not be evident if I were only asked about events that happened earlier in my life.

Which of the variables showed the most robust results? Models 2/2a, examining whether the respondent had children, and Models 6/6a, using whether the respondent had sex in the last year as the dependent variable, showed the largest number of significant differences between the male and female models. It is important to note that both of these were logistic regression models, built around binary variables. Furthermore, they utilized non-traditional measures of fertility: instead of the "counting babies" approach, alternate measures of indirect and direct fertility provide a new lens through which we might view the complex interrelations between male and female fertility modeling.

Independent Variables

Although the purpose of this dissertation was to compare males and females and their fertility, I present here as an overview and summary a section comparing each of the 12 models and submodels (including the models that were not significant) with respect to the magnitude and direction of each coefficient. This summary is presented in Table 32 below. This tabulation conveys three pieces of information in each cell, at the intersection of the model and independent variable.

First, a "+" or "-" indicates the direction of the coefficient, positive or negative, for the particular independent variable for the given model estimated on the male dataset. A "0" indicates that the coefficient was not significant in the particular model estimated on the male dataset. The second piece of information, either a "!" or a "=", indicates whether the Paternoster et al. test for equality of regression coefficients demonstrated a significant result between the models estimated on the male and female data. An "!" indicates that there was a significant difference, and "=" indicates no significant difference. An "x" in the middle position indicates that the initial examination of the model on a combined male and female dataset yielded no significant differences between males and females with respect to the outcome variable measuring fertility. The third and final piece of information, a "+" or "-", indicates the direction of the coefficient, positive or negative, for the particular independent variable for the model estimated on the female dataset. A "0" again indicates that the coefficient was not significant in the particular model estimated on the female dataset. Blacked out fields indicate an intersection where the model did not include the given variable.

For example, the intersection of "Model 1" and "R's age at interview" results in "+!+". This indicates that the direction of coefficients for males and females on this variable in the first model was positive, and that the test indicated a significant difference between the coefficients in the male and female datasets. The next row with a “0=0” demonstrates that in neither the model estimated on the male dataset nor the model estimated on the female dataset was the education variable significant. The next row with a “+!0” indicates that the Black race variable was significant in the model estimated on the male dataset, not significant in the female model, and the comparison indicated a significant difference between the models on the coefficient.

Table 32 - Summary of significant variables across models

Independent variable	Model 1	Model 1a	Model 2	Model 2a	Model 3	Model 3a	Model 4	Model 4a	Model 5	Model 5a	Model 6	Model 6a
R's age at interview	+!+	+!+	+!+	+!+	-x-	0x0	+x+	+x+	+!+	+=+	-!+	-!+
R's education (number of years of schooling)	0=0	0!-	-=-	-=-	0x0	0x-	+x+	+x+	+=+	+=0	+!0	0=0
Whether R is Black	+!0	0=+	0=+	0!+	0x0	0x+	-x-	-x-	+=0	+=0	0=0	0=0
Whether R is Hispanic	0=0	0=0	0=+	0=+	0x0	0x0	0x+	-x0	0!-	-!-	0=-	0!-
Whether R is other race	0=+	+=0	0=0	0=0	0x0	0x-	+x+	0x0	0=0	0=0	0=-	0=-
R's poverty level income	-=-	-!-	-!-	0!-	0x-	0x-	-x0	0x-	0!-	0=0	0!+	0!+
Whether R is urban resident	0=0	0=0	0=0	0=0	0x0	0x-	0x0	+x0	0=0	+=0	0=0	0=0
R's age at first sex	-!-	-=-	-!-	-=-	0x0	0x0			-=-	-!-	0!-	0!-
Whether R ever married/cohabited	-=+	+=+	+!+	+!+	-x-	-x-	0x+	0x+	+=+	0=0	+!+	+!+
R's number of lifetime partners	+=+	+=0	0!+	0=0	0x0	0x-	-x-	-x-	XXX	XXX	XXX	XXX
Whether R belongs to a religion	0=0	0=0	0=0	0=0	0x0	0x0	0x0	0x0	0=0	0=0	0=0	-=0
How important is religion to R's daily life	0!+	0=+	0=+	0=0	0x0	0x0	0x0	0x0	0=0	0=0	0=0	+=0
R's score on conservative/liberal scale	+=+	+=0	+=+	+=0	0x0	0x0	+x+	0x+	-=-	0!-	+!-	0!-

The independent variable measuring age of the respondent was significant in seven of the eight estimated models. Age was much stronger in its effects on the women in the sample, and in the model measuring likelihood of having sex in the last 12 months, age worked in opposite directions for men and women. The differential effects of age on male and female fertility, particularly with respect to exposure to and risk of fertility, may be an important focus for subsequent research. In the final section of this chapter, I will discuss the age variable and its differential effects in men and women, and how it might be incorporated into the larger body of fertility theory.

Years of education proved to be a significant variable in a number of the individual models, but were significant in only two instances when comparing regression coefficients between the male and female datasets. The long-demonstrated effect of education and its effect on women, where higher levels of education tend to lead to lower completed fertility, holds true for men as well. Whether interpreted as leading to higher income, greater workforce participation, or some other outcome, higher levels of education tends to have the same effect on fertility for men as it does for women. This hints that education may not prove to be a critical point of departure between men and women with respect to their fertility; it seems to work the same way in both strength and direction for both sexes.

The variable indicating Black race was significant in two of the direct models for one important reason: it was significant in models estimated on the female dataset, but not significant for models estimated on the male dataset. The status of being a Black man bore no significantly different effect on any measure of fertility, whether direct or indirect, than the reference category against which it was compared, that of white males. This suggests that identity as a Black woman has a much stronger effect on women with respect to their fertility, and that incorporating race into traditional demographic fertility models may be of less importance for measuring male fertility. It is as yet unclear what the source of this difference is. Some possible avenues of future research are differential rates of interracial marriage and childbirth between Black men and Black women, or incompleteness of men's marital birth reporting (Rendall et al. 1999);

overrepresentation of Black female heads of households in survey data; instability of Black male employment relative to Black women and subsequent instability in marital and family formation patterns (Hogan and Kitagawa 1985); or the decreased degree of family co-residence for some Black respondents (Goldscheider, Webster, and Kaufman 2000). Whether it is an artifact of the data, or an actual difference between men and women, future research along these lines may provide some illumination.

In my review of indirect measures of exposure to, or risk of fertility, Hispanic ethnicity proved to be significant in three of the four models. However, it never showed significance when comparing the direct models. This may be a result of the fact that the indirect models are really measures of sexual activity and exposure to fertility. There may be discrepancies in respondents' counts, and that "men and women may differ in what they consider a sex partner". Men might consider a brief encounter when enumerating lifetime experiences, while women may not (Laumann, Gagnon, Michael, and Michaels 1994). Some research on Hispanics indicates that the degree to which the individual is acculturated may have a differential effect between men and women on sexual attitudes (Marin, Tschann, Gomez, and Kegeles 1993). Research on the Cycle 6 NSFG also indicates a tendency toward Hispanic women reporting fewer lifetime sexual partners than non-Hispanic white or Black women (Mosher, Chandra, and Jones 2005). Following these findings, there may be differences in social desirability with respect to claiming larger number of sexual partners. This may account for the discrepancies in significance on the indirect dependent variables between Hispanic men and women.

Income was significant in six of the eight models, both in the models estimated on datasets subdivided to include only respondents under the age of thirty as well as in the models estimated on complete datasets. It tended to have a stronger effect on males than it did on women in the respective datasets. These results suggest that income is an important determinant of both male and female fertility, and that it is a result that may be an important direction for future research. I will discuss income in more detail in the final section of this chapter.

Age at first intercourse was another variable whose effects were consistently different for men and women. It showed a significant result in five of the eight models. In one case, (Model 1), this factor had over twice the effect on women than it did on men. This variable, and the theoretical implications of the differential effects on men and women, will be discussed in more detail at the end of this chapter.

A variable showing significant differences between men and women in four of the eight models was the variable indicating whether the respondent ever married or cohabited. In all four of the models where it proved significant, this variable had a stronger effect on men than it did on women. These results indicate another important point of future research as demographers develop a body of literature incorporating male fertility into the larger field of fertility theory. This will be discussed in more detail in the final section of this chapter.

The variable measuring the count of lifetime sexual partners was significant as an independent variable in only one model, Model 2. It proved to be barely significant in only the regression model estimated on the female dataset.

The importance of religion in daily life was significant in a number of male and female models, but in only a single case was it significantly different between men and women. This indicates that religiosity is an important determinant of the fertility process, but that it works in a similar fashion in both men and women. There is often a positive correlation between religiosity and fertility, where women claiming that religion plays an important role in daily life often have higher fertility, both real and intended, than those who report that religion has no such importance (Hayford and Morgan 2008). Research on this specific issue, using the 2002 NSFG Cycle 6 data, presents findings on religiosity consistent with the results of this dissertation. The author finds that the effects of religiosity and religion on fertility are significant, but do not significantly differ between men and women (Zhang 2008).

The variable measuring conservatism was also significantly different in its effects on men and women in three of the four indirect models, but it was never significantly different in the direct models. This indicates that while it is an important factor for both men and women in many of the models, it works differently for men and women with respect to their exposure to fertility. As with the previous indirect models, there may be issues of data quality, or there may be issues with respect to the fact that it is an indirect measure of exposure to fertility. Since the indirect measures are all measures of sex, it may be the case that there are attitudinal differences between liberal/conservative responses with respect to sex, but less so with respect to actual fertility. The issue then becomes one of attitudes toward sexuality and sex, and less of one toward fertility. It has been hypothesized that women may have more generally conservative attitudes toward sex and sexuality than men "because men have traditionally had more power in the social structure and have used their greater power… to make sure that potential mates are socialized to have more conservative scripts… without themselves adhering to such scripts" (Sprecher 1989). Men may claim conservative attitudes, but women may actually hold more true to those conservative ideals about sexuality. The differential effects of conservative or liberal attitudes on family planning and decision-making between men and women are another potential future avenue of research that this dissertation suggests. The instrument measuring conservative or liberal attitudes in this dissertation is, by necessity, a blunt instrument: it is an attempt at using the data already available in the sample survey to construct a new, one-dimensional variable. In the future, more nuanced approaches to measures of conservatism or liberalism, perhaps on multiple dimensions measuring political, social, and/or sexual attitudes, will be key to understanding their effects on fertility in men and women. A summary of the independent variables, and the number of times they demonstrated significance between the male and female models, is presented in Table 33 below.

Male and Female Fertility: The Beginnings of a Theory

The next task, starting in this dissertation and continuing after its completion, is to begin to incorporate the preceding findings into a cohesive body of theory. For the sake of this dissertation, I focus on several specific findings.

Table 33 – Review of independent variables across models and their frequency of significance

Independent variable	Number of times variable presented as significant
R’s age at interview	7
R’s poverty level income	6
R’s age at first sex	5
Whether R ever married/cohabited	4
Whether R is Hispanic	3
R’s score on conservative/liberal scale	3
R’s education (number of years of schooling)	2
Whether R is Black	2
R’s number of lifetime partners	1
How important is religion to R’s daily life	1
Whether R is other race	0
Whether R is urban resident	0
Whether R belongs to a religion	0

First, how can we explain the way that age affects male and female fertility differentially? In seven of the eight models, the differences were significant between men and women. In direct measures of fertility, age consistently worked in the same direction, but had a stronger effect on women than it did on men: older women seem more likely to have more children, or to have children at all, than men of comparable age. This can be seen as consistent with the evolutionarily-informed body of behavioral-ecological theory. As Darwin, Bateman, Trivers, and others discovered, females may be seen as the "limited resource" in the economic game of reproduction. Those females who wish to have children are quite often able to obtain mates and proceed with reproduction, while a number of males may not experience that opportunity. If data were available on the elephant seals mentioned in Chapter I, models estimated on those data would likely have similar results.

Incorporating men into the larger fertility literature through the use of indirect variables requires a more nuanced explanation. For the models evaluating fertility indirectly using number of lifetime partners, age was significant in each model, but the differences were not significant between the male and female models. Increasing age also increased the count of sex partners, but not at a notably different rate between men and women. One interpretation of this finding is that men and women are moving in parallel: while men and women in the United states are marrying at later ages than they did in the past, the age at first marriage for both men and women have increased at similar rates (around four years later for men, and around five years for women) (Waite 2005). Similarly, age at first intercourse for men and women in the NSFG Cycle 7 dataset was 17.4 and 17.6, respectively, indicating that sexual debut happens largely in parallel between men and women. The final set of logistic regression models is more interesting, as the age variable shows significance in all four cases. However, men appear to be less likely to have sex with an opposite-sex partner as they age, while women appear to be more likely to do so. Again, I borrow from the tradition of Darwin, Bateman, and others to argue that women tend to act as the "limited resource" in reproduction, and may well be consistently able to obtain mates (and therefore able to reproduce) if they so desire. In the NSFG data, the women range up to 45 years of age, and tend to still enjoy the ability to reproduce. Males, however, may not be able to obtain mates (and subsequently reproduce) because of limited social capital, socioeconomic resources, or access to marriageable women – the results of the indirect models indicate that, similar to the example of the elephant seals, there are a number of older males without "access" to females.

The second challenge I address is centered on the relationship between income and fertility. The income variable proved to be significantly different in its effects for men and women in six of the eight models. In the direct models, income was negatively associated with the measures of fertility: more money meant fewer children, or a decreased likelihood of children. Where differences between men and women occurred, higher income women tended to have fewer children than their male counterparts with similar incomes. General sociobiological/economic approaches fail here, as one might expect that higher income (thus higher-status) males should enjoy greater reproductive success. Instead, a simpler explanation taking into account American social structure might prevail in this case: women with higher incomes may participate more fully in the labor force, and with that increased participation in the labor force might follow decisions to delay, postpone, or altogether forego the fertility process. As women are often the primary caregivers, men may well tend to suffer these effects more weakly than women. The relationships between indirect measures of fertility (like age at first intercourse or sexual activity in the last year) and income may well have less to inform fertility theory, particularly as effective birth control and abortion are part of the landscape of modern American life with little differential access based on socioeconomic status.

A third point of interest uncovered in this dissertation is the differential effect of age at first intercourse for males and females. In both direct models estimated with the full datasets of men and women, the coefficients for age at first intercourse worked in the same direction in the male and female models, but the effects were stronger for women. The earlier someone began his/her sexual career, the more children they had, but women had more children on average than men who started their sexual careers at the same age. Again, this fits within a behavioral-ecological approach to fertility, where women control access to reproduction and males may not achieve as high levels of reproductive success.

Marriage and cohabitation is the fourth point of interest unearthed in this dissertation. Although the consistent effects of these independent variables on fertility would seem to be somewhat commonsensical (people living together in romantic relationships are more likely to have children than those who do not), the strength of the effects is drastically different for men than for women. In all the models, men who cohabited are on average more likely to have children than women who cohabited. This departure is interesting, and deserves further exploration in order to frame it within the growing body of male/female fertility theory. First, this may be an artifact of the data, since "ever married" and "ever cohabited" are lumped into one monolithic category in the NSFG Cycle 7 data. The literature suggests that although they are both romantic co-residential unions, there are certainly differences between them with respect to their characteristics, as well as the reasons individuals enter into those institutions. Couples who cohabit share a residence, but may not share anything else – they are less likely to share bank accounts, to be monogamous, and to have children than individuals in a marriage (Waite 2005). If there are more women in the survey sample who fall into the "cohabited" category and more men who fall into the "married" category (or vice versa), the results discovered in this dissertation regarding the relationship between marriage or cohabitation and fertility may be spurious.

Furthermore, women and men man enter into monogamous unions, whether cohabiting or married, for different reasons (Goldscheider and Waite 1986) There is a significant literature that studies the causes for both men and women to enter into marital unions, including parental attitudes, presence or absence of children, or work force participation (Axinn and Thornton 1993; Axinn and Thornton 1996; Lloyd and South 1996; South and Lloyd 1992; Tsuya and Bumpass 2004). It may be the case that most men who enter into cohabiting or married relationships desire to have children, while the same is not true for women. A detailed study teasing apart cohabitation and marriage, as well as delving deeper into motivations for making the transitions to those states, will be necessary to further flesh out this body of knowledge.

Conclusions

This dissertation provides several important contributions to the study of fertility, as well as to demography as a discipline. First, my research provides substantive evidence that male fertility often differs in its determinants from female fertility; this by itself is an important avenue of research. The findings presented here provide several avenues for future research, and give us clues as to how we might approach “bringing men in” to the demographic analysis of fertility. Whether informed by theory out of anthropology, economics, demography, or sociology, it is clear that theory *can* be constructed that attempts to explain the differences unearthed in this dissertation. I have endeavored to present some of these preliminary underpinnings in the above paragraphs.

This dissertation also provides an important methodological contribution. By examining multiple dimensions of fertility and utilizing both indirect and direct measures, I was able to tease out some results that might have been invisible or gone ignored otherwise. The best evidence of this is found by comparing the limited results of some models, with the other subsequent models measuring fertility and fertility exposure in different ways. Some independent variables overlapped in their significant results across models, while some demonstrated significance in unexpected ways. Additionally, the simple but powerful logic of estimating identical models on male and female datasets, using consistent and somewhat simple independent variables, and then comparing their regression coefficients, is an easily replicable technique that could be “bottled” and used on any number of the emerging high-quality datasets incorporating survey information on both men and women.

In the future, I plan to extend this research in several ways. First, I hope to replicate these results in analyses of other datasets, both from the U.S. and abroad. By examining the results of this dissertation in comparison to earlier American datasets (like the National Survey of Family Growth Cycle 6, the National Longitudinal Survey of Adolescent Health, or the General Social Survey) and to some international datasets (like the Chinese Health and Family Life Survey or the rich variety of European datasets available through the European Union’s EuroStat, including those from the Scandinavian countries that record excellent vital data on men as well as women), I hope to put the results in a richer, more robust explanatory framework. Additionally, I plan to examine the variables that showed significant differences between the male and females, either in direction or magnitude, in more detail. Finally, I will look toward making methodological contributions to problems brought to light through the analysis of these data, particularly the evaluation of data quality on sensitive self-reported survey responses.

This contribution to the subject of male fertility, particularly in comparison to female fertility, is an attempt to fill a void in the literature; male fertility is still a neglected but very important avenue of research that is ready to be explored in greater detail. The ready availability of high-quality data, as well as burgeoning interest in the subject in both academic and popular circles, continue to make this avenue of inquiry a critical one. By measuring fertility in a variety of dimensions, and through direct and indirect methods, our understanding of the subject will continue to grow.

REFERENCES

Alemnji, G. A., K. D. Thomas, A. O. Oyelese, and T. O. Ojedije. 2002. "The Semen of Fertile Black Males: Analysis of 100 Consecutive Cases." *Annals of Saudi Medicine* 22:94-97.

Alfred, J. 2002. "Flagging Non-paternity." *Nature Reviews Genetics* 3:161.

Anderson, K. G. 2006. "How Well Does Paternity Confidence Match Actual Paternity? Evidence From Worldwide Nonpaternity Rates." *Current Anthropology* 47:513-520.

Anderson, K. G., H. Kaplan, and J. B. Lancaster. 2006. "Demographic Correlates of Paternity Confidence and Pregnancy Outcomes Among Albuquerque Men." *American Journal of Physical Anthropology* 131:560-571.

Anderson, K. G., H. Kaplan, and J. B. Lancaster. 2007. "Confidence of Paternity, Divorce, and Investment in Children by Albuquerque Men." *Evolution and Human Behavior* 28:1-10.

Axinn, W. G. and A. Thornton. 1993. "Mothers, Children, and Cohabitation - the Intergenerational Effects of Attitudes and Behavior." *American Sociological Review* 58:233-246.

Axinn, W. G. and A. Thornton. 1996. "The Influence of Parents' Marital Dissolutions on Children's Attitudes Toward Family Formation." *Demography* 33:66-81.

Bachu, A. 1996. "Fertility of American Men." in *Working Paper # 14*, edited by P. D. U.S. Census Bureau. Washington, D.C.

Barden-O'Fallon, J. 2005. "Associates of Self-reported Fertility Status and Infertility Treatment-seeking in a Rural District of Malawi." *Human Reproduction* 20:2229-2236.

Bateman, A.J. 1948. "Intra-sexual Selection in Drosophila." *Heredity* 2:349-368.

Becker, S. 1996. "Couples and Reproductive Health: a Review of Couple Studies." *Studies in Family Planning* 27:291-306.

Belfield, T. 2005. ""It Takes Two": Men and Contraception." *Journal of Family Planning and Reproductive Health Care* 31:3-5.

Betzig, L. 1986. *Despotism and Differential Reproduction: a Darwinian View of History*. New York: Aldine.

Bledsoe, C.H., S. Lerner, and J.I. Guyer. 2000. *Fertility and the Male Life-Cycle in the Era of Fertility Decline*. Oxford: Oxford University Press.

Carbone, J. 2007. "Is Fertility the Unspoken Issue in the Debate Between Liberal and Conservative Family Values?" *Law and Social Inquiry* 32:809-839.

Chacko, M. R. and J. C. Lovchik. 1984. "*Chlamydia trachomatis* Infection in Sexually Active Adolescents: Prevalence and Risk Factors." *Pediatrics* 73:836-40.

Chagnon, N.A. 1983. *Yanomamö : the Fierce People*. New York: Holt, Rinehart and Winston.

Chapple, A., M. Salinas, S. Ziebland, A. McPherson, and A. Macfarlane. 2007. "Fertility Issues: the Perceptions and Experiences of Young Men Recently Diagnosed and Treated for Cancer." *Journal of Adolescent Health* 40:69-75.

Cherlin, A., J. Griffith, and J. McCarthy. 1983. "A Note on Maritally-Disrupted Men's Reports of Child Support in the June 1980 Current Population Survey." *Demography* 20:385-389.

Cherpes, T. L., L. A. Meyn, M. A. Krohn, and S. L. Hillier. 2003. "Risk Factors for Infection with *Herpes simplex* Virus Type 2: Role of Smoking, Douching, Uncircumcised Males, and Vaginal Flora." *Sexually Transmitted Diseases* 30:405-410.

Coale, A. 1971. "Age Patterns of Marriage." *Population Studies* 25:193-214.

Coleman, D.A. 2000. "Male Fertility Trends in Industrial Countries: Theories in Search of Some Evidence." Pp. 29-60 in *Fertility and the Male Life-cycle in the Era of Fertility Decline*, edited by J. I. Guyer, C. H. Bledsoe, and S. Lerner. New York: Oxford University Press.

Colvard, D., U.F. Habenicht, and M.J. Harper. 2008. "Male Fertility Control--Where Are We? Preface. Editorial." *Contraception* 78:S1-2.

Darroch, J. E. 2008. "Male Fertility Control -- Where Are the Men?" *Contraception* 78:S7-S17.

Darwin, C. 1871. *The Descent of Man, and Selection in Relation to Sex*. London,: J. Murray.

Deneux-Tharaux, C., E. Kahn, H. Nazerali, and D. C. Sokal. 2004. "Pregnancy Rates after Vasectomy: a Survey of US Urologists." *Contraception* 69:401-406.

Dodoo, F. N. A. and Frost, A.E. 2008. "Gender in African Population Research: the Fertility/Reproductive Health Example." *Annual Review of Sociology* 34:431-452.

Einon, D. 1994. "Are Men More Promiscuous Than Women." *Ethology and Sociobiology* 15:131-143.

Einon, D. 1998. "How Many Children Can One Man Have?" *Evolution and Human Behavior* 19:413-426.

Fikree, F., R. Gray, and F. Shah. 1993. "Can Men Be Trusted? A Comparison of Pregnancy Histories Reported by Husbands and Wives." *American Journal of Epidemiology* 138:237-242.

Fuchs, E. F. and N. J. Alexander. 1983. "Immunologic Considerations Before and After Vasovasostomy." *Fertility and Sterility* 40:497-9.

Fuchs, E. F. and R. A. Burt. 2002. "Vasectomy Reversal Performed 15 Years or More After Vasectomy:

Correlation of Pregnancy Outcome with Partner Age and with Pregnancy Results of *in vitro* Fertilization with Intracytoplasmic Sperm Injection." *Fertility and Sterility* 77:516-519.

Fuchs Ebaugh, H.R. and C.A. Haney. 1978. "Church Attendance and Attitudes Toward Abortion: Differentials in Liberal and Conservative Churches." *Journal for the Scientific Study of Religion* 17:407-413.

Furstenberg, F. F., Jr., J. A. Levine, and J. Brooks-Gunn. 1990. "The Children of Teenage Mothers: Patterns of Early Childbearing in Two Generations." *Family Planning Perspectives* 22:54-61.

Gennart, J. P., J. P. Buchet, H. Roels, P. Ghyselen, E. Ceulemans, and R. Lauwerys. 1992. "Fertility of Male Workers Exposed to Cadmium, Lead, or Manganese." *American Journal of Epidemiology* 135:1208-19.

Goldberger, A.S. and O.D. Duncan. 1973. *Structural Equation Models in the Social Sciences*. New York,: Seminar Press.

Goldscheider, C. and P. Uhlenberg. 1969. "Minority Group Status and Fertility." *American Journal of Sociology* 74:361-372.

Goldscheider, F.K. and L.J. Waite. 1986. "Sex Differences in the Entry Into Marriage." *American Journal of Sociology* 92:91-109.

Goldscheider, F.K., P. Webster, and G. Kaufman. 2000. "Men, Parenthood, and Divorce in the Era of the Second Demographic Transition." Pp. 331-342 in *Fertility and the Male Life-cycle in the Era of Fertility Decline*, edited by C. H. Bledsoe, S. Lerner, and J. I. Guyer. Oxford: Oxford University Press.

Gray, P.B. and K.G. Anderson. 2010. *Fatherhood: Evolution and Human Paternal Behavior*. Cambridge, MA: Harvard University Press.

Greene, M. E. and A. E. Biddlecom. 2000. "Absent and Problematic Men: Demographic Accounts of Male

Reproductive Roles." *Population and Development Review* 26:81-+.

Guest, P. 2003. "Reproductive Health Including Family Planning." *Asia-Pacific Population Journal* 18:55-79.

Guvenc, H., A. D. Aygun, H. Yenioglu, and S. Akarsu. 2005. "Nipple Diameter in Eastern Turkish Pubertal Boys." *Journal of Tropical Pediatrics* 51:260.

Guyer, J.I. 2000. "Traditions of Studying Paternity in Social Anthropology." Pp. 61-92 in *Fertility and the Male Life-Cycle in the Era of Fertility Decline*, edited by C. H. Bledsoe, S. Lerner, and J. I. Guyer. Oxford: Oxford University Press.

Hakim, C. 2003. "A New Approach to Explaining Fertility Patterns: Preference Theory." *Population and Development Review* 29:349-374.

Hayford, S.R. and S. P. Morgan. 2008. "Religiosity and Fertility in the United States: the Role of Fertility Intentions." *Social Forces* 86:1163-1188.

Heath, K.M. and C. Hadley. 1998. "Male Reproductive Strategies in a Polygynous Human Society: Mating vs. Parental Effort." *Current Anthropology* 39:369-374.

Hewlett, B.S. 1992. *Father-Child Relations : Cultural and Biosocial Contexts*. New York: Aldine De Gruyter.

Hogan, D.P. and E.MM Kitagawa. 1985. "The Impact of Social Status, Family Structure, and Neighborhood on the Fertility of Black Adolescents." *American Journal of Sociology* 90:825-855.

Hudson, V.M. and A. M. den Boer. 2004. *Bare Branches : the Security Implications of Asia's Surplus Male Population*. Cambridge, Mass.: MIT Press.

Isidori, A., M. Latini, and F. Romanelli. 2005. "Treatment of Male Infertility." *Contraception* 72:314-318.

Jamieson, D. J., C. Costello, J. Trussell, S. D. Hillis, and P. A. Marchbanks. 2004. "The Risk of Pregnancy

After Vasectomy." *Obstetrics and Gynecology* 103:848-850.

Jewkes, R., K. Dunkle, M. Nduna, J. Levin, and N. Jama. 2006. "Factors Associated with HIV Sero-positivity in Young, Rural South African Men." *International Journal of Epidemiology* 35:1455-1460.

Kaplan, H. 1996. "A Theory of Fertility and Parental Investment in Traditional and Modern Human Societies." Pp. 91-135 in *Yearbook Of Physical Anthropology, Yearbook Series Vol 39*, vol. 39, *Yearbook Of Physical Anthropology*.

Kaplan, H., J. B. Lancaster, W. T. Tucker, and K. G. Anderson. 2002. "Evolutionary Approach to Below Replacement Fertility." *American Journal of Human Biology* 14:233-256.

Kennedy, R.E. 1973. "Minority Group Status and Fertility: the Irish." *American Sociological Review* 38:85-96.

Keyfitz, N. 1977. *Applied Mathematical Demography*. New York: John Wiley & Sons.

Klebanoff, M. A., P. H. Shiono, and G. G. Rhoads. 1991. "Spontaneous and Induced Abortion among Resident Physicians." *Jama* 265:2821-5.

Laumann, E.O., J.H. Gagnon, R.T. Michael, and S. Michaels. 1994. *The Social Organization of Sexuality: Sexual Practices in the United States*. Chicago: University of Chicago Press.

Lerner-Geva, L., Y. Frenkel, A. Lusky, A. Farhi, and J. Rabinovici. 2008. "An Assessment of the Validity of Reporting by Proxy to Women's Health Questionnaire - a Pilot Study." *European Journal of Obstetrics & Gynecology and Reproductive Biology* 138:80-82.

Lloyd, K. M. and S. J. South. 1996. "Contextual Influences on Young Men's Transition to First Marriage." *Social Forces* 74:1097-1119.

Long, J.S. and J. Freese. 2006. *Regression Models for Categorical Dependent Variables Using Stata*. College Station TX: Stata Press.

Mantovani, A. and F. Maranghi. 2005. "Risk Assessment of Chemicals Potentially Affecting Male Fertility." *Contraception* 72:308-313.

Marciano, T.D. 1979. "Male Influences on Fertility: Needs for Research." *The Family Coordinator* 28:561-568.

Marin, B.V., J.M. Tschann, C.A. Gomez, and S.M. Kegeles. 1993. "Acculturation and Gender Differences in Sexual Attitudes and Behaviors: Hispanic vs Non-Hispanic White Unmarried Adults." *American Journal of Public Health* 83:1759-1761.

Marsiglio, W. 1993. "Adolescent Males' Orientation Toward Paternity and Contraception." *Family Planning Perspectives* 25:22-31.

Martin, T. C. 1995. "Women's Education and Fertility: Results from 26 Demographic and Health Surveys." *Studies in Family Planning* 26:187-202.

McVicar, C. M., D. A. O'Neill, N. McClure, B. Clements, and S. McCullough. 2005. "Effects of Vasectomy on Spermatogenesis and Fertility Outcome After Testicular Sperm Extraction Combined with ICSI." *Human Reproduction* 20:2795-2800.

McWhirter, R. 1998. "The Guinness Book of Records." Stamford, Conn.: Guinness Media.

Mesfin, G. 2002. "The Role of Men in Fertility and Family Planning Program in Tigray Region." *Ethiopian Journal of Health Development* 16:247-255.

Morgan, L.H. 1907. *Ancient Society: or, Researches in the Lines of Human Progress from Savagery Through Barbarism to Civilization*. New York,: H. Holt and Company.

Mosher, W.D., A. Chandra, and J. Jones. 2005. "Sexual Behavior and Selected Health Measures: Men and Women

15-44 Years of Age, United States, 2002." in *Advance Data From Vital and Health Statistics*, edited by C. D. o. V. Statistics.

Mosher, W.D., L.B. Williams, and D.P. Johnson. 1992. "Religion and Fertility in the United States: New Patterns." *Demography* 29:199-214.

Nelson, T.J. 2004. "Low Income Fathers." *Annual Review of Sociology* 30:427-451.

Padawer, R. 2009. "Who Knew I Was Not the Father?" *New York Times*, 17 November 2009.

Paternoster, R., R. Brame, P. Mazerole, and A. Piquero. 1998. "Using the Correct Statistical Test for the Equality of Regression Coefficients." *Criminology* 36:859-866.

Pearson, S. 2003. "Promoting Sexual Health Services to Young Men: Findings from Focus Group Discussions." *Journal of Family Planning and Reproductive Health Care* 29:194-198.

Poston, D. and S. McKibben. 2003. "Using Zero-inflated Count Regression Models to Estimate the Fertility of U.S. Women." *Journal of Modern Applied Statistical Methods* 2:371-379.

Poston, D., A. Baumle; M. Micklin. 2005. "Epilogue: Needed Research in Demography." Pp. 853-881 in *Handbook of Population*, edited by D. Poston, and M. Micklin. New York: Kluwer Academic/Plenum Publishing.

Poston, D. and E.Conde. 2010. "China's Extra Bachelors: What Are Their Numbers and Implications?"

Potter, J. and A. Mundigo. 2002. "Fertility Planning." Pp. 733-759 in *Handbook of Population*, edited by D. Poston and M. Micklin. New York: Kluwer Academic/Plenum.

Pradhan, M., A. Dalal, F. Khan, and S. Agrawal. 2006. "Fertility in Men with Down Syndrome: a Case Report." *Fertility and Sterility* 86:1765.e1-1765.e3.

Qiu, Y., D. T. Yang, and S. M. Wang. 2004. "Restoration of Fertility in Vasectomized Men Using Percutaneous Vasal or Epididymal Sperm Aspiration." *Contraception* 69:497-500.

Radcliffe-Brown, A. R. and C.D. Forde. 1950. *African Systems of Kinship and Marriage*. London, New York,: Published for the International African Institute by the Oxford University Press.

Ratcliffe, A., A. Hill, D. Harrington, and G. Walraven. 2002. "Reporting of Fertility Events by Men and Women in Rural Gambia." *Demography* 39:573-586.

Rendall, M.S., L. Clarke, H.E. Peters, N. Ranjit, and G. Verropoulou. 1999. "Incomplete Reporting of Men's Fertility in the United States and Britain: a Research Note." *Demography* 36:135-144.

Requeda, E., J. Charron, K. D. Roberts, A. Chapdelaine, and G. Bleau. 1983. "Fertilizing Capacity and Sperm Antibodies in Vasovasostomized Men." *Fertility and Sterility* 39:197-203.

Rindfuss, R. and L. L. Bumpass. 1978. "Education and Fertility: Implications for the Roles Women Occupy." in *American Sociological Association*. San Francisco.

Rindfuss, R. R., S. P. Morgan, and K. Offutt. 1996. "Education and the Changing Age Pattern of American Fertility: 1963-1989." *Demography* 33:277-290.

Rodgers, J.L, H. Kohler., K.O. Kyvik, K. Christensen. 2001. "Behavior Genetic Modeling of Human Fertility: Findings From a Contemporary Danish Twin Study." *Demography* 38:29-42.

Rutenberg, N., C. E. Kaufman, K. Macintyre, L. Brown, and A. Karim. 2003. "Pregnant or Positive: Adolescent Childbearing and HIV Risk in KwaZulu Natal, South Africa." *Reproductive Health Matters* 11:122-133.

Ruz, M.H. 2000. "The Seeds of Man: Ethnological Notes on Male Sexuality and Fecundity Among the Maya." Pp. 93-118 in *Fertility and the Male Life-Cycle in the Era of*

Fertility Decline, edited by C. H. Bledsoe, J. I. Guyer, and S. Lerner. Oxford: Oxford University Press.

Saenz, R. and M.C. Morales. 2005. "Demography of Race and Ethnicity." Pp 169-206 in *Handbook of Population*, edited by D. Poston and M. Micklin. New York: Kluwer Academic/Plenum.

Singh, B. K. and J. S. Williams. 1983. "Attitudes and Behavioral Intentions About Abortion." *Population and Environment* 6:84-95.

Smith, T. W. 1991. "Adult Sexual-Behavior in 1989 - Number of Partners, Frequency of Intercourse and Risk of Aids." *Family Planning Perspectives* 23:102-107.

South, S. J. and K. M. Lloyd. 1992. "Marriage Markets and Nonmarital Fertility in the United States." *Demography* 29:247-64.

Sprecher, S. 1989. "Premarital Sexual Standards for Different Categories of Individuals." *Journal of Sex Research* 26:232-248.

Stewart, A.D. 1989. "Screening for Cystic Fibrosis." *Nature Genetics* 341:696.

Toulemon, L. and E. Lapierre-Adamcyk. 2000. "Demographic Patterns of Motherhood and Fatherhood in France." Pp. 293-330 in *Fertility and the Male Life-Cycle in the Era of Fertility Decline*, edited by C. H. Bledsoe, S. Lerner, and J. I. Guyer. Oxford: Oxford University Press.

Trivers, R. 1972. "Parental Investment and Sexual Selection." Pp. 136-179 in *Sexual Selection and the Descent of Man*, edited by B. Campbell. Chicago: Aldine.

Tsuya, N.and L. L. Bumpass. 2004. *Marriage, Work, and Family Life in Comparative Perspective: Japan, South Korea, and the United States*: University of Hawai'i Press.

Underwood, J.H. 1998. "They Also Serve: Chamorro Male Fertility in the Pre-World War II Period." *American Journal of Human Biology* 10:23-35.

Vittinghoff, E., D.V. Glidden, S.Shiboski, and C.Mcculloough. 2005. *Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models*. New York: Springer.

Voas, D. 2004. "Conflicting Preferences: a Reason Fertility Trends Tend to be High or Too Low." *Population and Development Review* 29:627-646.

Waite, L.J. 2005. "Marriage and Family." Pp. 87-108 in *Handbook of Population*, edited by D. Poston and M. Micklin. New York: Kluwer Academic.

Walsh, A. 1993. "Love Styles, Masculinity Femininity, Physical Attractivene ss, and Sexual-Behavior - a Test of Evolutionary-Theory." *Ethology and Sociobiology* 14:25-38.

Wilson, E.O. 1975. *Sociobiology: the New Synthesis*. Cambridge, Mass.: Belknap Press of Harvard University Press.

Yaukey, D., B. Roberts, and W.Griffith. 1965. "Husbands' vs. Wives' Responses to a Fertility Survey." *Population Studies* 19:29-43.

Zarate, A. 1967. "A Note on the Accuracy of Male Responses to Questions on Fertility." *Demography* 4:846-849.

Zhang, L. 2008. "Religious Affiliation, Religiosity, and Male and Female Fertility." *Demographic Research* 18:233-256.

Zhang, X. G., Y. Xu, and S. Z. Qian. 1987. "Injection of Copper Powder Into Epididymides Via Vas Deferens on Male Fertility." *Advances in Contraceptive Delivery Systems* 3:167-71.

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