Cultural Inheritance and Fertility Transition

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ABSTRACT

In this article, we examine the role of unbiased cultural traits inherited from parents in influencing fertility transition. We hypothesize that the unbiased cultural traits that are inherited from parents rather than from non-parental sources lead to a greater resemblance between fertility outcomes of the parents and the offspring. Thus, unbiased cultural traits are likely to prevent the fertility transition. Specifically, we expect that compared to those who inherited cultural traits from non-parental sources, the offspring who inherited cultural traits from parents should have a higher fertility level; they tend to have first births inside of marriage; after marriage, they are more likely to choose giving birth rather than being childlessness. Results based on examining data from the National Survey of Family Growth (NSFG) Cycle 6 provide empirical support to our hypotheses. We find that the U.S. women who reported the same religious affiliations as those of their parents also reported a greater number of children; their first births are less likely to be outside of marriage and their likelihood of making transition from first marriage to giving first birth is higher than those who reported different religious affiliations as those of their parents.

Key words: fertility transition, cultural traits, evolution

INTRODUCTION

Princeton demographer Susan Watkins (1991) initiated the diffusion theory of culture and cultural norms to elucidate the causes of the demographic transition in European countries from 1870 to 1960. She suggests that geographic diffusion of the innovation of fertility limitation within marriage was the key that caused fertility reduction in Europe. Watkins proposes that social pressures reflected by the timing and extent of each province's integration into the French nation became the factor that shaped people's marriage and childbearing patterns. She finds that the proportion of residents spoke French is the best indicator of whether individuals were part of a national network, which pushed individuals to be responsive to national patterns of expectations about marriage and childbearing. Watkins' diffusion/cultural perspective makes a significant contribution to fertility theories by emphasizing the importance of culture and cultural norms in influencing fertility. It suggests that cultural factors could affect fertility even in the absence of major structural changes at the societal level. After Watkins, a number of other fertility studies follow a similar vein by demonstrating fertility changes caused by culture at the *macro* level (Boling 2008; Cornell 1996; Murphy 2003; Thomas 1993). Until now, little research has been conducted examining the manner in which culture shapes fertility outcome at the *micro* level. Another aspect of the diffusion/cultural perspective that has eluded researchers is the "preventive" effect of cultural norms coming from inside of the family system on fertility transition. Watkins' cultural innovation/diffusion perspective seems to imply that cultural norms coming from outside of the family and village systems were factors that accelerated the process of fertility decline, at least in the European Continent. This implication, however, has rarely been

empirically tested. There is hardly empirical evidence certifying cultural norms that are inherited from parents or inside of the family system tend to prevent fertility reduction.

Recently, a book by environmental scientist Peter Richerson and anthropologist Robert Boyd, namely, *Not by Genes Alone: How Culture Transformed Evolution,* addresses the link between cultural inheritance and evolutionary results. From an evolutionary perspective, Richerson and Boyd argue that cultural inheritance is analogous to genetic inheritance; individuals that obtain cultural traits from parents are more likely to show resemblance between the offspring and the parents. If Richerson and Boyd's argument is sound and if the fertility transition process is considered as an evolutionary process, one would expect that cultural traits inherited from parents should result in similar fertility outcomes between the offspring and the parents. This rationale echoes the implication drawn from Watkins' findings. Following this rationale, in societies with a declining pattern of fertility, such as in the U.S., cultural traits inherited from parents should have a preventing effect on fertility transition.

In order to address the issues of diffusion/cultural approach that have eluded researchers and to test the applicability of Richerson and Boyd's argument in terms of fertility and reproduction, we investigate the effect of cultural traits, particularly those inherited from parents, on fertility transition from a multi-disciplinary perspective. We start the article by reviewing culture and evolution theories to build a theoretical link between culture and fertility. We then proceed by proposing our research hypotheses, introducing data, and presenting variables and methods. Findings are concluded and discussed at the end of the article.

THEORIES AND HYPOTHESES

Theoretical Background

The importance of culture has long been emphasized by anthropologists when studying the evolutionary process. According to evolutionary theories, humans evolve via two interdependent, inheritance systems: *genetic* and *cultural* (Durham 1991; Lumsden and Wilson 1981). Among these two systems, culture is considered as an ultimate cause of human behavior on equal status with genes because culture produces its own evolutionary dynamics and outcomes that are not predicted by assumptions of natural selection working on genes alone (Rogers 1988; Tinbergen 1951). Here we define "culture" as information that is socially transmitted between individuals (Cronk 1995; Flinn 1997; Richerson and Boyd 2005), which contrasts it with individuals learning the environment on their own and cultural information obtained genetically.

According to anthropologists, there are two ways that cultural traits can be transmitted from parents to offspring: 1) from parents to offspring in a manner analogous to genes; this is referred to as unbiased or vertical transmission; and 2) from nonparental sources, such as teachers, peers and the media; this is referred to as biased or horizontal transmission (Cavalli-Sforza and Feldman 1981). Richerson and Boyd (2005) argue that if children consistently adopt the traits of their parents, in the absence of other forces, the composition of cultural traits within a population will not change over time. Otherwise, the cultural traits between the parents and the offspring would differ. When it comes to fertility and reproduction, this argument makes intuitive sense if one considers that to the extent that individuals act nonparentally (produce few or no offspring), the cultural variants responsible for the reproductive restraint will be removed from the population of parents and inherited by no one.

Both ways of cultural inheritance are observed in reality. When biased transmission is considered, Richerson and Boyd (2005: 153-154) offer the example of teachers, who are in a

position to transmit ideas to large numbers of children. Teachers are also likely to hold views concerning reproduction that differ, on average, from parents. This is because teachers themselves often have to delay marriage and reduce their own reproduction to be successful teachers. Depending on how much influence teachers have on children, fitness-reducing ideas can spread. Teachers are just one of the many nonparental sources of cultural influence that can inculcate children with nonparental ideas and lead to maladaptive outcomes. These sources also include friends, priests, politicians, managers, and entertainers, all of whom transmit all sorts of ideas via a variety of media such as the printed page, radio, television, movies, and the internet (Harris 1998). In this way, biased cultural traits will increase the spread of the cultural variant at a cost to the individual's reproductive success.

In sum, the above theories suggest the importance of culture in the evolutionary process. Anthropologists consider that process of cultural inheritance as separate from the natural selection working on genes alone. However, to a certain extent, the process of cultural inheritance is also analogous to the process that children genetically inherit traits from their parents. In this sense, coevolutionary theorists, such as Richerson and Boyd argue that the greater the degree of cultural transmission from parents to offspring, the more similar cultural inheritance to genetic adaptation; therefore, the greater the resemblance between parents and offspring regarding to their evolutionary results.

Hypotheses

Under this theoretical guidance provided by previous literature, we propose our central hypothesis regarding cultural traits and fertility transition as follows: the greater the extent children inherited cultural traits from their parents, the more similar the fertility results of parents and offspring. Thus, the more likely the offspring would maximize his/her individual

reproductive success and slow down the fertility transition process. This central hypothesis further leads to three research hypotheses for testing, which focuses on examining three aspects of the fertility transition. We have done so because the fertility transition not only refers to transition of fertility level, but also transitions of unions where childbearing behavior occurs and the timing of childbearing. So our first hypothesis concerns the level of fertility. In recent decades, there has been a declining pattern of fertility in most industrialized countries. Taking the U.S. as an example, the total fertility rate (TFR) was 3.2 in the early 1950s, it then dropped to 2.9 in the mid-1960s, and 2.0 in the 1990s. The TFR in the U.S. would have dropped even below the replacement level if there were no immigration (U.S. Census Bureau 2002). Similarly, a declining pattern of fertility is also observed in European and other developed countries in recent decades. Considering this overall declining pattern of fertility in most industrialized countries and our central hypothesis about the positive association between unbiased cultural traits and the resemblance between parents and offspring, we expect unbiased cultural traits to maintain similarities in parents' and offspring's fertility. In other words, we anticipate a higher fertility level of offspring due to the influence of unbiased cultural traits. Thus, our first hypothesis is proposed as follows:

Hypothesis 1: Individuals who received more cultural traits from parents should have a greater number of children than those who received less cultural traits from their parents. This is especially true in societies with a declining pattern of fertility.

In addition to level of fertility, we also consider the fertility transition that is related to union formation. Traditionally, marriage was the union that is more acceptable for childbearing and it was where most births occurred. The strong positive association between marriage and fertility has indeed been shown repeatedly in previous studies (Bongaarts 1982; Hervitz 1985;

Mosher, Johnson, and Horn 1986). By the 1980s, researchers reveal that the majority of births still occurred in marital unions in the U.S. and most European countries (Bachrach 1987; Blanc 1984; Carlson 1986; 1990). Since the early 1990s, the number of births to cohabitating women began to be nearer that of married women (Raley 2001), which is believed to be due to the rising proportions of women who cohabitate and bear children in cohabitating households (Bumpass and Sweet 1989; Cherlin 1992). Given this rising pattern of non-martial births, in our research, we expect that for those who are highly influenced by cultural norms of older generations are more likely to give birth inside rather than outside of marriage. Thus, our next hypothesis is set forth as follows:

Hypothesis 2: Compared to individuals who obtain less cultural traits from parents, individuals who receive more cultural traits from parents are more likely to give birth inside of marriage as how it was in traditional societies.

So far, we have proposed hypotheses that are related to level of fertility and fertility behavior occurring in different unions. Our last hypothesis deals with the likelihood of giving birth to children. Previous research indicates that recent generations tend to marry later and give birth in older ages relative to the older generations (Berrington 2001; Chang, Freedman, and Sun 1987). Pfeiffer and Nowak (2001) find that in Austria and other European countries, the transition processes, including entering into first marriage and giving first birth after marriage, are being postponed among the younger cohorts as compared to the older cohorts. Some people nowadays even choose not to have children, which results in the emergence of lowest-low fertility in European and some Asian countries (Kohler, Billari, and Ortega 2002). Kowalska and Wroblewska (2001) further observe that in Western societies, changing patterns in the transition processes to marriage and childbearing in the 1990s were first shown among people in large

cities who are more engaged in modern segments. Those people are more likely to be enrolled at school and work, and are less likely to be religious and to keep traditional norms. These findings seem to suggest that individuals who are highly engaged in modern segments tend to postpone their transition from marriage to childbearing. If we explain this correlation from the perspective of cultural inheritance, we could argue that the reason people who are highly exposed to modern settings tend to delay childbearing is because they are under a higher risk of obtaining cultural traits from nonparental sources. Their inherited cultural traits become biased away from parental sources. As a result, their fertility outcome is more likely to be nonparental phenotypes than that of individuals who obtained cultural traits from parents. Based on findings of previous literature and our rationale proposed above, we thus hypothesize that unbiased cultural traits should have a positive effect on people's transition to parenthood. If we restrict our analysis mainly to the transition process from first marriage to first childbearing, our last research hypothesis is set forth as follows:

Hypothesis 3: The greater the degree of cultural traits being inherited from parents to offspring, the greater the hazards of offspring making a transition from first marriage to having first birth.

DATA, VARIABLES AND METHODS

Data

In order to test the above hypotheses, we use data from the 2002 wave of the National Survey of Family Growth (NSFG) Cycle 6 to conduct analyses. This nationally representative dataset contains detailed information on "fertility, marriage, cohabitation, contraception, and related issues" of 7,643 women aged 15 to 44 years old and 4,928 men aged 15 to 45 years old in the United States in years 2002 and 2003 (National Center for Health Statistics 2004: 5). In this study, we restrict our analyses to female respondents only.

Dependent Variables

Since we are interested in testing three research hypotheses, three separate analyses were undertaken. The dependent variable for the first analysis of the offspring's fertility level, is measured by the number of children ever born (CEB) to a female respondent. We obtain the CEB information based on the NSFG survey question asking the female respondents "how many live births have you ever had?" As Table 1 shows, the average CEB reported by female respondents is 1.3 with a standard deviation of 0.03. For the second analysis of whether the respondent who inherited cultural traits from parents is more likely to give birth (or first birth) in a marital union, we use a dummy variable (*first child*) as our dependent variable. It is coded as "1" if the respondent had her first birth inside of marriage and "0" if otherwise. Among 5,213 respondents who reported first births, 68.7% of them had their first births after marriage. The rest of the 31.3% of respondents had first births in non-marital unions. In terms of the third analysis of the likelihood of giving first birth after first marriage, we apply two [dependent] variables: one is a dummy variable indicating for each woman whether or not the event (the first birth) occurred during the observation period; the second is a variable measuring the number of months that have elapsed since first marriage and the first birth occurred or the censoring event. The dummy variable (*child 1*) is coded as "1" if the woman had the first birth and "0" if otherwise. The second survival-time variable for the third analysis is an interval variable (*months*) which reflects the number of months between the time the respondent first married and the time the first birth occurred to the respondent, or between the time of first marriage and the time of the censoring event. Since all women in the dataset are aged 15 to 44, the censoring event includes such events as the woman having a pregnancy which ends in a miscarriage or in a stillbirth or in an abortion; the woman being infertile; the woman had her first birth before marriage and the date the NSFG

surveys were conducted. Those 4,126 respondents who reported a marital experience were at the risk of having a first birth after her first marriage. Among them, 3,242 women had firth births after first marriages, which accounts for 78.6% of all married women. Since it normally takes 9 months from conception to give birth, we assume those women who reported less than 9 months between the month of first marriage and the month of first birth should have had the conception before first marriages. Because our research interest is the likelihood of giving first birth after the first marriage, we thus decided to remove those respondents (548 cases) who had the conception before their first marriages from the dataset. Consequently, 65.3% (2,694 women) of all respondents with a marital experience reported having had first births after their first marriages. They had a mean duration time of risk of having a first birth for a total of 150,750 months. On average, each woman had a duration of 55.9 months.

Independent Variable

When it comes to the independent variable, there are a variety of cultural traits that could represent cultural traits inherited from parents. However, some of them may not be good measures of unbiased cultural traits although they show a strong parent-offspring correlation. This is because these cultural traits can be explained partially by genetics. For instance, political attitudes of the parents and the offspring are found to be related to each other. However, political attitudes may not be considered as unbiased cultural traits since they show genetic heritability (Alford, Funk, and Hibbing 2005). These measures are therefore avoided in our analyses considering the focus of our research is the influence of unbiased cultural traits on fertility. In contrast to political attitudes, researchers find that some other cultural traits are less likely to be biased by genetics. These traits are such as political affiliation which tends to be inherited from parents to offspring with very little genetic transmission involved (Alford, Funk, and Hibbing

2005; Cavalli-Sforza and Feldman 1973; Niemi and Jennings 1991). Similarly, religious affiliation of the offspring is also found to be inherited from parents with little genetic transmission (Bouchard, McGue, Lykken, and Tellegen 1999; Eaves, Martin, and Heath 1990). These findings suggest that group affiliations are likely to be environmental in origin and is nearly wholly culturally derived (Alvard 2003). Considering these matters and the availability of information for the respondent's religious affiliation in the NSFG dataset, we decided to use the religious affiliation variable to represent unbiased cultural traits inherited from parents to offspring. The religious affiliation variable is chosen in this research also because previous research has shown a strong association between religion and fertility (Bloom and Trussell 1984; Jurecki-Tiller 2004; McLanahan and Bumpass 1988; Mosher, Johnson, and Horn 1986; Rindfuss, Morgan, and Swicegood 1988; Zhang 2008).

The religious affiliation variable in our research is generated based on two questions in the NSFG surveys. The first question asks the female respondent about her present religious affiliation and the second question asks religious affiliation when she was growing up. We assume that the religion the respondent was raised should be the same as the religion of the respondent's parents. For example, if the respondent reported that she was raised as a Catholic, then we assume her parents were affiliated with Catholic religion when she was growing up. Thus, if the respondent reported her current religious affiliation being the same as the one she was growing up, we consider the respondent as inheriting the same religious beliefs from parents. In other words, she has inherited unbiased cultural traits from parents. Based on the two NSFG questions, we generate a variable, namely, "*same religion*." We code it as "1" if the respondent's current religious denomination and the one when she was growing up are the same

and “0” if otherwise. We consider those women who are coded as “0” as receiving biased cultural traits.

In the NSFG surveys, there are eight religious denominations that could be chosen by the respondent, which are (1) no religion; (2) Catholic; (3) Baptist/Southern Baptist; (4) Methodist, Lutheran, Presbyterian, Episcopal Arian; (5) Fundamental Protestant; (6) other Protestant denomination; (7) Protestant-no specific denomination; and (8) other non-Christian religion. As it can be seen, the percentages of respondents who reported being currently affiliated with Catholic religion or being raised as Catholics are highest among all sub-categories (35.1% and 28.7%), followed by Baptist/Southern Baptist and Methodist, Lutheran, Presbyterian, Episcopal categories (see Table 1). We also observe that the percentage of respondents who were raised with no religion is only 7.8%; such a percentage increases to 14.1% when the respondents’ present religious denominations are considered. It indicates that some people became nonreligious when they grew up. Overall, 72.9% of 7,643 respondents reported their current religious affiliations being the same as the ones when they were raised. The rest of them reported their current religious affiliations being different from the ones that they used to be affiliated with. Among all respondents, there are higher percentages of Catholics (77.9%), Baptists/Southern Baptists (74.8%), and people belong to other Protestant denominations (76.8%) who reported the same religions as they were raised as compared to other religious groups. In addition, Catholics, Baptists/Southern Baptists and people who were raised as other non-Christian religions are less likely to be non-religious after they grew up. It is also interesting to see that for those who changed their religious affiliations after they grew up are more likely to be presently non-religious rather than being converted to other religions (see Appendix).

Control Variables

In our analyses, we also include four types of control variables: demographic composition, socioeconomic status, family background characteristics, and the proximate determinants. Demographic and socioeconomic factors are controlled because extensive research exists on the relationships between demographic and socioeconomic factors and fertility outcome (Ballard 2004; Ellison, Echevarria, and Smith 2005; Freedman, Whelpton, and Smith 1961; Singley and Landale 1998). Age, gender, race and ethnicity, nativity, metropolitan residence, and number of times the respondent has married are controlled as demographic covariates. Education, total combined family income, and whether the respondent has ever worked full time for more than six months are used as measures of socioeconomic status.

Family-background characteristics are measured by variables *mother's education*, *father's education*, and *whether the respondent has lived in an intact family till age 18*. These variables are controlled because previous research shows that women from families with lower social economic status as reflected by parent's relatively lower educational attainments and income are more likely to enter motherhood sooner and to have non-marital births than those from families with higher social economic status (Manning 1995). The experience of parental separation is also found to be related to an increased likelihood of cohabitating and giving birth at earlier ages (Althaus 1997; Berrington and Diamond 1999).

The proximate determinant measures are *contraceptive use* and *sterilization*, which represent whether the respondent had used a contraceptive method and whether she had a sterilization operation, respectively. Descriptive information for all variables discussed is presented in Table 1.

[Table 1 abut here]

Statistical Methods

In terms of methods, for our first analysis, the effect of *same religion* on CEB, we apply the Poisson regression as the statistical procedure to conduct the analysis. This is because CEB is a count variable which is heavily skewed with a long right tail, especially in the cases of low fertility populations. Applying the linear regression model to count outcomes could result in "inefficient, inconsistent, and biased estimates" (Long and Freese 2006: 349).

The Poisson regression model can be written as:

$$\mu_i = \exp(a + X_{1i} b_1 + X_{2i} b_2 + ... + X_{ki} b_k)$$

Where μ_i is the mean of the distribution, which is estimated from observed characteristics of the independent variables; a is the constant; b_i represents deviation from the mean of the omitted category, which is the reference group. The X variables are related to μ nonlinearly. In this case, μ_i is the expected number of children born to a respondent based on if the respondent reported the same religion (unbiased cultural traits), the respondent's socioeconomic status and so forth. All cases in regression models are weighted based on the final weights of each sample given by the NSFG.

Logistic regression is undertaken in the second analysis to examine whether keeping the same religious denomination increases the likelihood of women giving a first birth inside of marriage. The logistic regression models are applied because the dependent variable whether giving a first birth inside of marriage (*marital birth*) is a dichotomous variable. The OLS regression is inappropriate in this case for several reasons: first, it is possible that the variance of the errors will not be constant, which results in the OLS model being heteroscedastic; second, it can be shown that the errors in models will not be normally distributed, which violates the assumptions of the OLS regressions (Long and Freese 2006); third, since the OLS model may predict values of the dependent variable that are negative or that are greater than 1, the OLS

regression model could result in nonsensical predictions. The logistic function shown below is a transformed function which solves the above problems:

$$\mathbf{L = a + b_1X_1 + b_2X_2 + \ldots + bnXn + e}$$

where the logit is on the left-hand side, which is the dependent variable. It has been replaced by the logarithm of the odds of success, i.e., the logit. Instead of assuming that the relationship between p and Xi is linear, we now assume instead that the relationship between the logarithm of the odds of success, i.e., ln[p/(1-p)], and Xi is linear. Thus, the dependent variable is still a linear function of the independent variables, such as *same religion, socioeconomic status* and so forth.

When conducting our third part analysis of whether *same religion* enhances married women's transition to have a first birth after the first marriage, Cox's partial-likelihood method is used to estimate continuous time proportional hazards models of the transition from marriage to having first births. The Cox model may be represented as follows:

$$\mathbf{\log h(t) = a(t) + b_1X_1 + b_2X_2}$$

where $h0(t)$ is an unspecified function of time t, $x1$ to xk are covariates, and $b1$ to bk are parameters to be estimated. In our analysis, the main covariate of interest is a dummy variable indicating whether the respondent kept the same religious denomination. One feature of the Cox model that makes it so attractive is that the function of time does not have to be specified. The dependent variable, $\log h(t)$, is the hazard rate, which is an unobserved value gauging the instantaneous probability that a woman will have a first birth during the interval since she was married (Allison 1984; Yamaguchi 1991).

RESULTS

Table 2 presents the results of the Poisson regression predicting the effect of *same religion* on CEB, the logistic regression examining the influence of *same religion* on whether the respondent had a non-marital first birth, and the Cox proportional hazard estimates of the effect of *same religion* on the hazard of having a first birth after the first marriage. The most important result in Table 2 is the significantly positive regression/hazard coefficients for the *same religion* variable. Among all female respondents aged 15 to 44 in the sample, the *same religion* variable has a Poisson regression coefficient of 0.10, which means that inheriting the same religious beliefs from parents increases the respondent's CEB by 11% ($e^{(0.10)}$). Such a positive and significant effect is net the effects of other control variables. This finding corroborates our hypothesis 1, meaning receiving unbiased cultural traits increase an individual's level of fertility.

The logistic regression coefficient of 0.22 shown in model 2 can be interpreted as follows: other things being equal, women who reported the same religious affiliations as those when they were raised are 1.24 times ($e^{0.22}$) more likely to have a first birth inside of marriage than those who changed their religious affiliations. This finding suggests that unbiased cultural traits (receiving religious beliefs from parents) are likely to prevent an individual having a non-marital birth, which supports our second hypothesis. Regarding the hazard of having a first birth after the first marriage, our third hypothesis is supported by empirical evidence as well. The Cox hazard coefficient of 0.19 for the *same religion* variable shown in model 3 suggests that women who reported their current religious affiliations the same as the ones when they were growing up have a significantly higher probability of having a first birth after the first marriage as compared to those who reported different religious affiliations. If we exponentiate the value of the hazard coefficient, we would receive the hazard ratio for the *same religion* variable of 1.21 ($e^{0.19}$). This value means that among women who had a marital experience, inheriting religious beliefs from

parents increases the hazard of having a first birth after the first marriage by 21 %, everything else being equal. All these results strengthen our central hypothesis about the effect of unbiased cultural traits on fertility transition.

[Table 2 about here]

The positive effect of variable *same religion* on the hazards of women having a first birth is further depicted by the Kaplan-Meier (K-M) survivor function (Kaplan and Meier 1958) shown in Figure 1. In this figure, we break the respondents into two groups: respondents who reported their current religious affiliations being the same as the ones when they were raised (represented by the solid line) and respondents who reported different current and previous religious affiliations (represented by the dash line). As The K–M survivor curve indicates, for both groups, the curves step down rapidly from a probability of near 1.0 of surviving the hazard of having a first birth just a few months after the first marriage. However, the curve representing the group reported the same religious affiliations steps down faster than that for the other group. It means that the probabilities of surviving the hazard of having a first birth for respondents who reported the same religious affiliations are lower relative to respondents who reported different religion affiliations for each analysis time (each month). We observe that by about the 100^{th} month, the surviving probability for the group reported the same religious affiliations drops to about 0.15 as compared to 0.22 for the group that changed religious affiliations. The curve for women who reported the same religious affiliations levels off to a probability of surviving having a first birth around 0.04 by the 200^{th} month as compared to a probability of about 0.06 for their counterparts who reported different religions. These results again suggest that inheriting unbiased cultural traits (the same religious beliefs) from parents increases the probability of having first births.

[Figure 1 about here]

In addition to the clear effects of *same religion* on three indicators of the fertility transition process, we find most of the covariates being influential as well. In terms of the demographic factors, from the age range of 15 to 44, the level of expected CEB increases by around 5% ($e^{0.05}$). With age increasing, the likelihood of giving birth inside of marriage also increases. However, the probability of having a first birth after 1st marriage decreases with an increasing age. This negative association occurs probably because the average fertility peak of the U.S. women is in their mid- to late twenties. Thus, the hazard of having births decreases with an increasing age. Race and ethnicity also differentiate women's fertility. Compared to whites, minority women reported a significantly higher level of fertility; they are more likely to give birth inside of marriage and their probability of having a first birth after first marriages is also significantly higher. In terms of the marriage effect, women who married multiple times tend to have a greater number of children; they are more likely to have non-marital births and are less likely to entering into motherhood after their first marriages. The socioeconomic factors, such as education and income, show negative effects on fertility. As far as the influence of family background on fertility, we observe that living in an intact family increases the likelihood of having non-martial births. Unexpectedly, our results reveal that the proximate determinants, namely, *contraceptive use* and *sterilization operation*, show positive effects on level of fertility and the probabilities of having births after marriage. Explaining such positive effects requires caution since it may relate to the issue of endogeneity. This is because although the proximate determinants regulate fertility, it is also probable that an individual who shows a higher level of fertility and a higher probability of having a first birth may have already reached a *desired* number of births. Thus, the woman is more likely to use contraception and undergo a

sterilization operation than her counterpart who has not done so. Consequently, *contraceptive use* and *sterilization operation* show positive effects on fertility. Future research using the NSFG dataset needs to conduct more analysis to explore reasons that have caused this discrepancy.

DISCUSSION AND CONCLUSION

In this article, we have studied the effect of unbiased cultural traits on fertility by analyzing the U.S. samples. We have demonstrated strong associations between unbiased cultural traits and the fertility transition. Specifically, we show that women who have inherited the same religious beliefs from their parents tend to have a greater number of children. They are more likely to have first births inside of marriage and their probabilities of having first births after first marriages are higher than women who reported different religious beliefs as those of their parents.

We consider the findings of our research make contributions to existing fertility theories in the following aspects: first, our findings point out one of the possible underpinning mechanisms that could have caused the fertility transition. To explain the causes of fertility reduction, the demographic transition theory focuses on emphasizing the role of industrialization and modernization in providing an aggregate setting that influences fertility (Blake 1973). Mason (1997: 444) argues that social factors such as female labor force participation, increased education of women, secularization of society which "are presumed to be caused by industrialization and urbanization" are possible mechanisms that have resulted in the fertility transition. Our research shows that the declining pattern of the extent to which cultural traits being inherited from parents, which is associated with industrialization and urbanization can indeed be another mechanism that regulates fertility change. As the society becomes more urbanized and modernized, offspring receive more and more cultural information from

nonparental sources. This in turn results in decreased fitness--one aspect of which is lowered fertility. Such a mechanism has not been taken into account by the demographic transition theory or any other fertility theories. Another contribution our findings make to current fertility theories is that findings of our research extend the applicability of diffusion/cultural perspective explaining fertility change down to the individual level. In the existing literature, most empirical evidence supporting the diffusion/ cultural approach comes from aggregate level analyses. Through examining the individual level data, our research indicates that the diffusion effect of culture on fertility not only makes intuitive sense at the macro level but also at the micro level. Once cultural traits from other sources are diffused to individuals, decreased fitness occurs, which in turn leads to the fertility transition which is featured by a lowered fertility, a prevalence of non-marital births and delayed childbearing.

Besides contributions made to demographic theories, findings of our research also have a potential impact on multi-disciplinary studies of fertility. Our study raises a number of questions that could be pursued in future demographic and interdisciplinary studies. For example, we ask how the role of culture can be reconciled with evolutionary theory to explain the decision-making processes of childbearing. The coevolutionary theory argues for a central place for culture alongside genes. The research findings here provide empirical support to this central tenet of coevolutionary theory. This means that future research needs to pay more attention to cultural transmission, which can be considered as a force producing outcomes potentially different from, rather than simply reinforcing, those predicted by standard genetic evolutionary models in both evolutionary and demographic studies of fertility. Additionally, our research may be able to address some deficiencies in the evolutionary social sciences elucidating fertility change. Demographers have observed a negative association between wealth and fertility, meaning

wealthy people tend to have a fewer number of children (Borg 1989; Butz and Ward 1979; Muller and Cohn 1977; Poston 2000; Thornto 1978). This finding, nonetheless, contradicts the prediction of evolutionary theory, which contends that populations with the greatest wealth should have a greater number of offspring. Some social scientists tried to use the quality-quantity tradeoff hypothesis to resolve this discrepancy (Lack 1968). This hypothesis, however, is not supported by empirical evidence which shows that wealthy individuals can in fact easily increase fertility and poor individuals do not suffer reduced long-term fitness because of the greater number of presumably poorer quality offspring (Kaplan H, Lancaster, Tucker, and Anderson 2002). Instead of taking the quality-quantity approach, we offer an explanation from a cultural perspective. We contend that biased cultural traits could lead to a lowered fertility. For those wealthy individuals in a higher socioeconomic status, they may receive higher educational attainments and engage in work outside the home. Consequently, their contacts with nonparental sources are greater, their fitness shown as fertility is therefore decreased. The increased exposure to nonparental cultural information could thus be the key to resolve the inconsistency between evolutionary theory and demographic results.

Since we rely on the measure of inheriting religious affiliation from parents to examine the effect of unbiased cultural traits on fertility, one may argue that the preventive effect of unbiased cultural traits on fertility shown here could in fact be the secularizing effect on fertility as revealed by previous studies (Adsera 2006; Mosher, Williams, and Johnson 1992). In our data, we do observe roughly 10% of respondents who grew up with religious affiliations reported themselves being presently non-religious. In this sense, we agree that secularization may have played a role in terms of the fertility transition. However, we also hold the opinion that our results cannot be fully explained by the secularization effect. For one, besides those 10% who

became currently non-religious, there are still another 16% of respondents who reported their current religious affiliations being different from the ones they were raised. The secularizing effect on fertility would not be applicable to this group of respondents. For another, we argue that instead of being explained by the secularizing effect, the deterrent effect of unbiased cultural traits on fertility actually explicates why the secularization effect on fertility transition occurs. This is because people who are secularized are also likely to be those who inherited cultural traits from other sources. Thus, it could be biased cultural traits rather than secularization itself accelerated their fertility transition process.

Finally, we would like to address a couple limitations of our research. We limit our study to the U.S. samples, which restricts the capability of our results being generalized to other subpopulations. Future research could extend the analysis to other social contexts to verify the association between cultural traits and the fertility transition shown here. Moreover, we only apply religious affiliation as our measure of unbiased cultural traits. We held the assumptions that both parents of the respondent should be affiliated with the same religious denomination and the fact that the respondent changed religious affiliation after she grew up is not resulted from the religious affiliation change of her parents. These two assumptions may not be met in reality for some cases. Therefore, future research could apply measures other than religious affiliation or religion measures drawn from different datasets to operationalize unbiased cultural traits. Research that aims to understand the role that cultural factors play in the demographic transition will make critical contributions to the existing demographic literature.

[Appendix about here]

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Please refer to the article to see the locations of tables, figure and appendix.

Table 1. Descriptive Statistics for Variables Used in the Analysis : U.S. Females, 2002-2003

Variables	Mean (or %)	S.E.	N
Dependent variables			
CEB	1.3	0.03	7,642
If R had 1st birth before marriage			5,213
Yes	68.7		
No	31.3		
Duration from marriage to 1st birth	58.0	1.55	4,126
If event censored			2,694
Yes	34.7		
No	65.3		
Independent variables			
Same religion			7,643
Yes	72.9		
No	27.1		
Number of children born to female parent	3.5	0.03	7,634
If R's parents married when R were born			7,580
Yes	87.4		
No	12.6		
Other variables			
Demographic factors			
Age (mean)	30.0	0.17	7,643
Race			7,643
Hispanic	14.8		
Non-Hispanic white	64.7		
Non-Hispanic black	14.0		
Non-Hispanic other	5.6		
R's religious denomination when R was raised up			7,619
No religion	7.8		
Catholic	35.1		
Baptist/Southern Baptist	19.1		
Methodist, Lutheran, Presbyterian, Episcopal Arian	18.4		
Fundamental Protestant	5.9		
Other Protestant denomination	5.6		
Protestant-no specific denomination	2.8		
Other non-Christian religion	5.4		
R's present religious denomination			7,620

No religion	14.1	
Catholic	28.7	
Baptist/Southern Baptist	16.9	
Methodist, Lutheran, Presbyterian, Episcopal Arian	15.4	
Fundamental Protestant	6.1	
Other Protestant denomination	7.4	
Protestant-no specific denomination	5.5	
Other non-Christian religion	5.9	
Nativity-if foreign born		7,643
Native born	85.7	
Foreign born	14.3	
Metropolitan residence		
Yes	82.3	7,643
No	17.7	
Family background characteristics		
Education		7,643
Less than high school	21.2	
High school graduate	28.3	
Some college/college	30.4	
University and above	20.1	
If R ever worked full time for 6+ months		7,636
Yes	74.1	
No	25.9	
Combined family income		7,643
$24,999 and under	33.1	
$25,000-$49,999	30.3	
$50,000-$74,999	18.9	
$75,000 and above	17.7	
Socialization factors		
Mother's education		7,593
Less than high school	24.1	
High school graduate	36.1	
Some college/college	21.7	
University and above	18.1	
Father's education		6,896
Less than high school	23.7	
High school graduate	31.5	
Some college/college	19.0	
University and above	25.8	
Lived in intact family till 18		7,643
Yes	65.3	
No	34.7	
Proximate determinants		
If ever used birth control methods		7,643
Yes	88.3	
No	11.7	
If R ever had sterilization operation		7,643
Yes	18.2	
No	81.8	

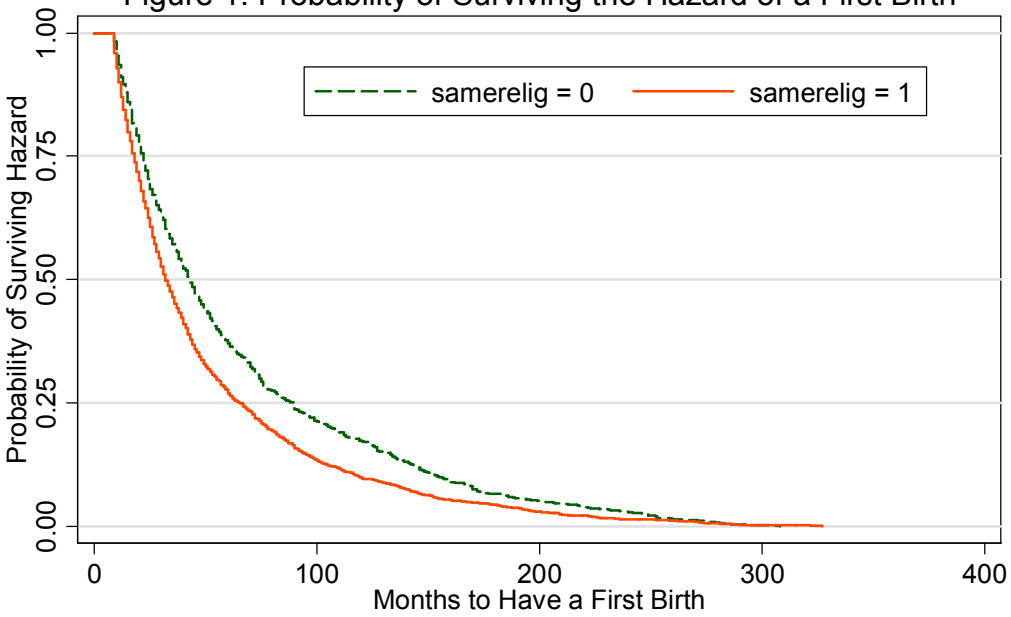
Note: some sub-categories may not add up to 100% due to rounding. R refers to the respondent. All cases are weighted.

Table 2. Results for Poisson Regression (PR) Model, Logit Regression (LR) Model and Cox Hazard Model: U.S. Females, 2002 - 2003

	PR Model		LR Model		Cox Hazard Model	
Variables	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Cultural inheritance variable						
Same religion	0.10**	0.03	0.22*	0.13	0.19***	0.05
Demographic factors						
Age	0.05***	0.00	0.03**	0.01	-0.07***	0.00
Race (ref. = white)						
Hispanic	0.24***	0.03	-0.43***	0.14	0.28***	0.06
Non-Hispanic black	0.22***	0.05	-1.57***	0.17	0.11***	0.07
Non-Hispanic other	0.15*	0.07	-0.85***	0.30	-0.03*	0.09
Number of times R married	0.19***	0.02	2.26***	0.18	-0.26***	0.04
Socioeconomic factors						
Highest degree R ever earned	-0.06***	0.01	0.15***	0.03	-0.03**	0.01
Total combined family income	-0.01**	0.01	0.10***	0.01	0.01	0.01
If R ever worked full time for 6+ months	-0.02	0.02	0.08*	0.04	0.06***	0.02
Family background characteristics						
Father's education	-0.02	0.02	0.06	0.05	0.04*	0.02
If R lived in an intact family from birth to age 18	-0.01	0.03	0.36**	0.13	-0.03	0.04
Proximate determinants						
If ever used birth control methods	0.31**	0.12	-0.22	0.33	0.59***	0.14
If R ever had sterilization operation	0.33***	0.04	-1.05	0.15	0.34***	0.05
Constant	-0.77***	0.21	-7.54***	0.58	-	-
N	6,020		4,661		2,528	
LR chi2	-		-		584.01	
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Sources: derived from NSFG Cycle 6 female dataset, 2002-2003. Variables foreign born, metropolitan residence and mother's education are dropped from models due to non-significant regression coefficients.
*Significant at $p<0.05$, **$p<0.01$, ***$p<0.001$, one-tailed test.

Figure 1. Probability of Surviving the Hazard of a First Birth



Appendix. Percentage Distributions of Respondent's Religious Affiliation Raised and Current Religious Affiliation (%): U.S. Females, 2002 - 2003

	Current Religion								
Religion Raised	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	N
1) No religion	66	4.5	4.9	9.7	3.2	3.2	3.0	4.8	630
2) Catholic	8.8	77.9	2.1	2.9	2.2	1.3	2.7	1.9	2,796
3) Baptist/Southern Baptist	7.6	0.8	74.8	4.2	3.7	2.7	4.3	1.7	1,594
4) Methodist, Lutheran, Presbyterian, Episcopal Arian	11.3	2.5	4.4	67.2	1.7	3.9	6.0	3.0	1,179
5) Fundamental Protestant	12.7	0.8	6.6	1.2	68.6	4.1	4.4	1.5	471
6) Other Protestant denomination	13.5	7.5	1.5	3.5	0	76.8	3.1	0.7	356
7) Protestant-no specific denomination	15.3	7.6	2.2	1.5	2.6	0	69.0	1.8	195
8) Other non-Christian religion	7.9	0.6	2.3	2.5	0.5	15.7	0.9	69.7	398
N	1,107	2,250	1,396	1,001	493	501	424	448	7,619

Sources: derived from NSFG Cycle 6 female dataset, 2002-2003. All cases are weighted.