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Research Article

Cultural Inheritance and Fertility Outcomes: An Analysis from Evolutionary and Interdisciplinary Perspectives

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Taking evolutionary and interdisciplinary perspectives, this study views the reproductive result as an evolutionary outcome that may be affected by parental characteristics through cultural inheritance. We hypothesize that inheriting more cultural traits from parents leads to a greater resemblance between fertility outcomes of the offspring and their parents. In societies that experience a demographic transition, a greater resemblance can be indicated by a higher level of fertility of the offspring and a sooner transition from union formation to childbearing. We operationalize inheriting cultural traits from parents as reporting a religious affiliation the same as those of their parents. Through analyzing data from the National Survey of Family Growth (NSFG) Cycle 6, our results show that inheriting the same religious traits from parents does have an effect on one's fertility. In particular, women who reported the same religious affiliations as those of their parents reported a greater number of children. They tend to have births inside, rather than outside, of marriage. Inside marriage, they are also more likely to give births sooner, rather than later. These findings support our hypotheses and help to build a theoretical framework that explains the changes in fertility outcomes from an interdisciplinary perspective.

1. Introduction

The demographer Watkins (1990) [1] has developed the diffusion theory which considers culture and cultural norms to understand the causes of fertility decline in European countries from 1870 to 1960. She suggested that geographic diffusion of the innovation of fertility limitation within marriage was the key to fertility reduction in Europe. This argument, initiated by Watkins, has been labeled as a "diffusion/cultural perspective" to explain fertility reduction. After Watkins, several other studies followed a similar vein and confirmed Watkins' findings on the effects of culture on fertility at the (*macro*) *societal* level [2–5]. These studies, along with Watkins' research, emphasize the importance of culture and cultural norms as they influence fertility. They also imply that cultural norms coming from outside the family could be factors that have accelerated fertility decline. Thus far, however, no theoretical statements have been made to explain the mechanism why cultural norms inherited from nonparental sources or from outside of the family system have accelerated fertility reduction.

In order to fill the voids of prior literature, this paper takes evolutionary and interdisciplinary approaches to investigate the mechanism why cultural norms from nonparental sources or from outside of the family system are likely to reduce fertility. We first provide a theoretical background which views the fertility result as an evolutionary outcome and discusses how fertility could be influenced by parental characteristics through cultural inheritance. We then put forth our hypotheses which argue that cultural inheritance is analogous to genetic inheritance, for those who inherited fewer cultural traits from parents but more cultural norms from outside of the family system are more likely to show a dissimilar fertility result as compared to their parents.

In societies that experience a demographic transition, such dissimilarity is shown as a lower fertility of the offspring and a slower transition from union formation to childbearing. We discuss the significance and contributions of the research in the end of the paper. Now we move to a discussion of the theoretical background of the research.

2. Theories and Hypotheses

2.1. 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* [6, 7]. Culture, as it affects human behavior, is considered an equal status with genes because culture produces its own evolutionary dynamics and outcomes that are not predicted by assumptions of natural selection working alone on genes [8, 9]. Here "culture" is defined as information that is socially transmitted between individuals [10–12]. This definition is in contrast to "culture" defined as individuals learning the environment on their own and cultural information being obtained genetically.

The process of socially transmitting culture, according to anthropologists, may go through two ways: (1) from parents to offspring in a manner analogous to genes—this is referred to as unbiased or vertical transmission; (2) from nonparental sources, such as teachers, peers, and the media, which is referred to as biased or horizontal transmission [13]. Richerson and Boyd [12] argued that cultural inheritance is analogous to genetic inheritance: individuals who obtain cultural traits from parents are more likely to show resemblance between themselves (the offspring) and their parents. 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. This argument makes intuitive sense when it comes to fertility because if individuals act nonparentally (produce few or no offspring), the cultural variants responsible for the reproductive restraint will be possibly removed from the population and inherited by no one.

In reality, both types of cultural inheritance are observed. When biased transmission is considered, Richerson and Boyd [12, pages 153-154] offer the example of teachers who are in a position to transmit ideas to large numbers of children. Teachers are likely to hold views concerning reproduction that differ, on average, from parents. This is because teachers themselves often have to delay marriage and limit their own number of children to be successful teachers. Depending on how much influence teachers have on children, the teachers' biased views towards fertility and reproduction may be spread to their students. Teachers are just one of the many nonparental sources of cultural influence that expose children to nonparental ideas which lead to evolutionary outcomes other than those of their parents. Other sources of biased cultural traits include friends, priests, politicians, managers, entertainers, and the media [14]. Biased cultural traits thus increase the spread of the cultural variant at a cost to an individual's fertility and reproductive success.

The theories discussed above suggest the importance of culture in the evolutionary process and how culture may possibly impact the evolutionary results. Though anthropologists consider the process of cultural inheritance as separate from that of genetic inheritance, the process of cultural inheritance is analogous to the process by which children inherit traits genetically from their parents. In this sense, coevolutionary theorists, like Richerson and Boyd, argued that the greater the degree of cultural transmission from parents to offspring is, the more similar cultural inheritance will be to genetic adaptation. Consequently, there is a greater resemblance between parents and offspring regarding their evolutionary results. If we take cultural and coevolutionary perspectives and claim that fertility outcome may be considered as part of the evolutionary results, then our research hypotheses can be proposed as follows.

2.2. Hypotheses. Based on the preceding, we propose this central hypothesis regarding cultural traits and fertility outcome as the greater the extent that children have inherited cultural traits from their parents, the more similar the fertility results of parents and offspring are. It follows then that the offspring would maximizetheir individual reproductive success and slow down the fertility transition process during which fertility changes from a high to a low level. This central hypothesis further leads to three research hypotheses that may be tested, which examines three aspects of the fertility results.

The first hypothesis concerns the level of fertility. In recent decades, there has been a declining pattern of fertility in most industrialized countries. Using the US as an example, the total fertility rate (TFR) was 3.2 in the early 1950s. The rate then dropped to 2.9 in the mid-1960s and to 2.0 in the 1990s. The TFR in the US would have dropped even below the replacement level without immigration (U.S. Census Bureau 2002). The replacement level of fertility means a TFR level of 2.0. The reason a TFR level of 2.0 is considered as a "replacement level" of fertility is because for a couple to replace themselves, they need to have at least two children to do so. A declining pattern of fertility has also been 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 be able 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 as follows.

2.2.1. Hypothesis 1. Individuals who received cultural traits from parents should have a greater number of children than those who did not receive or received less cultural traits from their parents. This is especially true in societies with a declining pattern of fertility.

In addition to the level of fertility, we also consider the fertility outcome that is related to the process of union formation. Traditionally, marriage was the union that was

considered acceptable for childbearing, and it was where most births have occurred. A strong positive association between marriage and fertility has indeed been shown repeatedly in previous studies [15–17]. By the 1980s, researchers revealed that the majority of births still occurred in marital unions in the US and most European countries [18–22]. Since the early 1990s, the number of births to cohabitating women began to be nearer that of married women [22]. This change in number is believed to be due to the rising proportions of women who cohabitate and bear children in cohabitating households [23, 24]. We expect to find that those who are highly influenced by the cultural norms of older generations tend to give birth inside rather than outside of marriage. Thus, our second hypothesis is set as follows.

2.2.2. Hypothesis 2. Individuals who receive more cultural traits from parents have a higher likelihood of giving birth inside than outside of marriage, compared to individuals who received none or less cultural traits from their parents.

Our last hypothesis deals with the likelihood of giving birth to children after marriage. Previous research indicated that recent generations tend to marry later and give birth later, relative to the older generations [25, 26]. Some people nowadays even choose not to have children, which results in the emergence of lowest-low fertility in European regions and some Asian countries [27]. Kowalska and Wroblewska [28] further observed 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. These people are more likely to be enrolled at school in colleges or universities and participate in labor force. They are less likely to follow traditional norms. These findings seemed to suggest that individuals who are highly engaged in modern life tend to postpone their transition from marriage to childbearing. This phenomenon may be explained by the cultural inheritance perspective as well; that is, the reason that people who are highly exposed to modern cultural views tend to delay childbearing is because they have a greater likelihood of obtaining cultural traits from nonparental sources. Their inherited cultural traits become biased against parental sources. As a result, their fertility outcomes are more likely to be nonparental phenotypes than those of individuals who have obtained cultural traits from parents. Based on findings of prior research and our rationale proposed above, we 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, then our last research hypothesis may be set as follows.

2.2.3. Hypothesis 3. The greater the degree of cultural traits being inherited from parents to offspring, the greater the likelihood of offspring making a transition from the first marriage to having first births.

3. Data, Variables, and Methods

3.1. 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 the 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 and 4,928 men aged 15 to 45 years in the United States in years 2002 and 2003 (National Center for Health Statistics 2004: 5). The dataset also has information on an individual's demographic characteristics, socioeconomic status, and religious participation. The richness of the data allows us to carry this study to examine the influence of cultural inheritance on fertility. We will restrict our analyses to female respondents only.

3.2. Dependent Variables. Since we are interested in testing three research hypotheses, we will undertake three separate analyses. The dependent variable for the first analysis 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 the 5,213 respondents who reported first births, 68.7% of them had their first births inside marriage. The rest of the respondents had first births in nonmarital unions.

In terms of the third analysis of the likelihood of having a first birth after the first marriage, we use two variables to measure the hazard of experiencing a first birth: one is a dummy variable indicating for each woman whether or not the event (the first birth) occurred during the observation period. The second measures 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" otherwise. The interval variable (*months*) reflects the number of months between the time the respondent first married and the time the first birth occurred to the respondent, or the number of months 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 the following events: the woman having a pregnancy which ends in a miscarriage, a stillbirth, or an abortion; the woman being infertile; or the woman having had her first birth before marriage and the date the NSFG surveys were conducted. The 4,126 respondents who reported a marital experience were at risk of having a first birth after first marriage. Among the respondents, 3,242 women had first 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 would have conceived before first marriages. Because our research interest is the likelihood of giving first birth after the first marriage, we decided to remove those

Table 1: Descriptive statistics for variables used in the analysis: US 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 was 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, Episcopalian, 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, Episcopalian, 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		

Table 1: Continued.

Variables	Mean (or %)	S.E.	*N*
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 subcategories may not add up to 100% due to rounding. R refers to the respondent. All cases are weighted.

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 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.

3.3. Key Independent Variable. When it comes to the main independent variables that are able to measure cultural inheritance, there are a variety of cultural traits inherited from parents that could be analyzed. Among them, some 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 some genetic heritability [29]. Such measures are therefore avoided in our analyses since the focus here is the influence of unbiased cultural traits on fertility.

In contrast to political attitudes, researchers found that some other cultural traits are less likely to be biased by genetics. One such trait is religious affiliation of the offspring; it has been found to be inherited from parents with little genetic transmission [30, 31]. These findings suggested that such group affiliations are likely to be culturally derived [32]. Though Bradshaw and Ellison's [33] research showed that religious involvement is a product of both genetic and environmental influences, their findings did not challenge the

findings of prior literature that religious affiliation of the offspring inherited from parents has little genetic transmission. Considering these matters and the availability of information in the NSFG dataset for the respondent's religious affiliation, we decided to use the religious affiliation variable to represent unbiased cultural traits inherited from parents to offspring. This variable is chosen also because previous research has shown a strong association between religion, religious affiliation, religious participation, and fertility [17, 34–38].

The religious affiliation variable in our research is based on two questions in the NSFG dataset. The first question asks the female respondent about her present religious affiliation. The second question asks the respondent what her religious affiliation was when she was growing up. We assume that the religion with which 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 Catholic when she was growing up. Thus, if the respondent reported her current religious affiliation to be the same as that when she was growing up, then we consider the respondent has inherited the same religious beliefs of her parents. In other words, she has inherited unbiased cultural traits from parents. Based on the two NSFG questions, we generate a variable, *same religion*. We code it as "1" if the respondent's current religious affiliation is the same as when she was growing up, and "0" otherwise. We treat those women who are coded as "0" as receiving biased cultural traits. We admit that more measures of cultural inheritance other than religious affiliation should be undertaken. However, due to the constraint of the data, we were not able to develop other measures. We initially wanted to use religiosity as the second measure to study the way in which inheriting similar levels of religiosity influences an individual's fertility outcomes. Since Bradshaw and Ellison's [33] research showed that personal religiosity is largely affected by genetic factors rather than cultural factors, we decided not to use this measure because we believe good measures of cultural inheritance are those that show little genetic influences.

In the NSFG surveys, there are eight religious denominations that could be chosen by the respondent: (1) no religion; (2) Catholic; (3) Baptist/Southern Baptist; (4) Methodist, Lutheran, Presbyterian, Episcopalian; (5) Fundamental Protestant; (6) other Protestant denomination; (7) Protestant-no specific denomination; and (8) other non-Christian religion. The percentages of respondents who reported being currently affiliated with Catholic religion or being raised as Catholics are the highest of all the subcategories (35.1% and 28.7%) (see Table 1). In Table 2, we also show the percentage distributions of the respondent's religious affiliation raised and her current religious affiliation. An obvious pattern we can draw from Table 2 is that the majority of the respondents reported their current religious affiliation and their religious affiliation raised as the same (see Table 2, e.g., 77.9% of Catholics and 74.8% of Baptists claimed their current religion and the religion raised as the same).

3.4. Control Variables. In our analyses, we also include four types of control variables: demographic composition, socioeconomic status, family background characteristics, and proximate determinants. Demographic and socioeconomic factors are controlled because extensive research exists on the relationships between demographic and socioeconomic factors and fertility outcome [39–42]. Age, gender, race and ethnicity, nativity, metropolitan residence, and number of times the respondent has married are controlled. Education and 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 the variables: mother's education, father's education, and whether the respondent has lived in an intact family until the age of 18. These variables are controlled because previous research has shown that women from families with lower social economic status, as reflected by a parent's relatively lower educational attainment and income, are more likely to enter motherhood sooner and to have nonmarital births than those from families with higher social economic status [43]. The experience of parental separation is also found to be related to an increased likelihood of cohabitating and giving birth at earlier ages [44, 45]. The proximate determinant measures are contraceptive use and sterilization. These measures represent whether the respondent had used a contraceptive method or whether she had a sterilization operation. Descriptive information for all variables is presented in Table 1. We have tested for multicollinearity and made sure including these independent variables in the models does not violate the assumptions of regression.

3.5. Statistical Methods. In terms of methods, for our first analysis, the effect of *same religion* on CEB, we estimate a Poisson regression model. 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" [47, page 349]. All cases in this and the other models are weighted based on the final weights 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 having a first birth inside rather than outside of marriage. The logistic regression model is used because the dependent variable of whether giving a first birth inside of marriage (*marital birth*) is a dichotomous variable.

When conducting our third analysis of whether *same religion* enhances a married woman's transition to have a first birth after the first marriage, Cox's partial-likelihood method is used to estimate a continuous time proportional hazards model of the transition from marriage to having first births.

4. Results

The three columns of data in Table 3 present 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 marital first

Table 2: Percentage distributions of respondents' religious affiliation raised and current religious affiliation (%): US females, 2002-2003.

Religion raised	Current religion								
	(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 [46]. All cases are weighted.

Table 3: Results for Poisson regression (PR) model, Logit regression (LR) model, and Cox hazard model: US females, 2002-2003.

Variables	PR model		LR model		Cox hazard model	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Cultural inheritance variable						
Same religion	0.10^{**} (1.11)	0.03	0.22^{*} (1.25)	0.13	0.19^{***} (1.21)	0.05
Demographic factors						
Age	0.05^{***} (1.05)	0.00	0.03^{**} (1.03)	0.01	-0.07^{***} (0.93)	0.00
Race (ref. = white)						
Hispanic	0.24^{***} (1.27)	0.03	-0.43^{***} (0.65)	0.14	0.28^{***} (1.32)	0.06
Non-Hispanic black	0.22^{***} (1.25)	0.05	-1.57^{***} (0.21)	0.17	0.11^{***} (1.11)	0.07
Non-Hispanic other	0.15^{*} (1.16)	0.07	-0.85^{***} (0.43)	0.30	-0.03^{*} (0.97)	0.09
Number of times R married	0.19^{***} (1.21)	0.02	2.26^{***} (9.58)	0.18	-0.26^{***} (0.77)	0.04
Socioeconomic factors						
Highest degree R ever earned	-0.06^{***} (0.94)	0.01	0.15^{***} (1.16)	0.03	-0.03^{**} (0.97)	0.01
Total combined family income	-0.01^{**} (0.99)	0.01	0.10^{***} (1.11)	0.01	0.01 (1.01)	0.01
If R ever worked full time for 6+ months	−0.02 (0.98)	0.02	0.08^{*} (1.08)	0.04	0.06^{***} (1.06)	0.02
Family background characteristics						
Father's education	−0.02 (0.98)	0.02	0.06 (1.06)	0.05	0.04^{*} (1.04)	0.02
If R lived in an intact family from birth to the age of 18	−0.01 (0.99)	0.03	0.36^{**} (1.43)	0.13	−0.03 (0.97)	0.04
Proximate determinants						
If ever used birth control methods	0.31^{**} (1.36)	0.12	−0.22 (0.80)	0.33	0.59^{***} (1.80)	0.14
If R ever had sterilization operation	0.33^{***} (1.39)	0.04	−1.05 (0.35)	0.15	0.34^{***} (1.40)	0.05
Constant	-0.77^{***}	0.21	-7.54^{***}	0.58	—	—
N	6,020		4,661		2,528	
LR chi^2	—		—		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 [46]. Variables foreign born, metropolitan residence, and mother's education are dropped from models due to nonsignificant regression coefficients. *Significant at $P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$, one-tailed test. Numbers in parentheses are the exponentiated forms of the coefficients.

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 3 is the significant and 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. This result means that inheriting the same religious beliefs from parents increases the respondent's CEB by 11% ($e^{(0.10)}$). This positive and significant effect is net of the effects of many other control variables. This finding supports our first hypothesis which says that receiving unbiased cultural traits increases an individual's level of fertility.

The significant logistic regression coefficient of 0.22 shown in model 2 (2nd column of data) 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, versus outside of marriage, compared to those who changed their religious affiliations. This finding suggests that unbiased cultural traits (receiving same religious beliefs from parents) work against an individual having a nonmarital birth. This finding 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 (see data in the 3rd column). The Cox hazard coefficient of 0.19 for the *same religion* variable shown in model 3 suggests that women who reported their current religious affiliation to be the same as the one 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 having a different religious affiliation. If we do an exponentiation of the value of the hazard coefficient, we receive the hazard ratio for the *same religion* variable of 1.21 ($e^{0.19}$). This value means that among first-married women, inheriting religious beliefs from parents increases the hazard of having a first birth after the first marriage by 21%, with all other factors held constant. All these results strengthen our central hypothesis about the effect of unbiased cultural traits on one's fertility outcome.

5. Discussion and Conclusions

In this paper, we have studied the link between inheriting unbiased cultural traits and fertility. With data on the US women, we show strong associations between unbiased cultural traits and one's fertility outcome. Specifically, we show that women who have the same religious beliefs as their parents tend to have a greater number of children. They are more likely to have first births inside rather than outside of marriage and their probabilities of having first births after first marriages are higher than women who reported a different religious affiliation from those of their parents.

These findings contribute to existing fertility theories, as follows: first, our findings point out one of the possible underpinning mechanisms explaining fertility decline at the individual level. To account for a fertility reduction, the demographic transition theory focuses on emphasizing the role of industrialization and modernization in providing an aggregate setting that influences fertility [48]. Mason [49, page 444] argued that social factors such as female labor force participation, increased education of women, and the 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 decline of the extent to which cultural traits can be inherited from parents, a pattern associated with industrialization and urbanization, can indeed be another mechanism that regulates fertility change. As a society becomes more urbanized and modernized, offspring tend to receive more cultural traits from nonparental sources. This in turn leads to a decreased fitness as an evolutionary result, one aspect of which is lowered fertility. Such a mechanism, showed in this analysis, has not been taken into account by the demographic transition theory or any other fertility theories. Our findings enrich the existing fertility theories in this sense. In terms of the type of societies in which our hypotheses can be supported, we argue that our hypotheses may be valid in all societies, particularly in those that have gone through a demographic transition. This is because societies that have experienced a demographic transition can clearly show the changing patterns of fertility due to a societal transition, for instance, a transition of traditional culture and norms being dominating to a stage that the traditional norms are gradually challenged or replaced by new ideas and new culture. In our study, we have analyzed the US society and shown that after the society has gone through a demographic transition, the group of women that has inherited more cultural norms from their parents tends to have more children and give birth sooner than others who have been influenced more by the nonparental sources.

The second contribution of our research is that our findings extend the applicability of diffusion/cultural perspective by explaining fertility change to the individual level. In the existing literature, most empirical evidence supporting the diffusion/cultural approach comes from aggregate level analyses. Our research examines individual level data and indicates that the diffusion effect of culture on fertility makes sense not only at the macrolevel but also at the microlevel. Once cultural traits from other sources are diffused to individuals, a decreased fitness occurs. This decreases results in the fertility transition which is featured by a lowered fertility, a prevalence of nonmarital births, and delayed childbearing after marriage.

An additional merit of the research is that it is able to resolve some discrepancies in theories that explain fertility change.Demographers have observed a negative association between wealth and fertility: wealthy people tend to have fewer children [50–54]. This observation seems to contradict the prediction of the evolutionary theory which contends that populations with the greatest wealth should have a greater number of offspring. Some scholars have used the quality-quantity tradeoff hypothesis to resolve the discrepancy between demographic observations and the evolutionary theory [55]. They argued that wealthy people tend to have high-quality offspring to offset a fewer number of children they have; poor individuals, in contrast, bear a greater number of children, and the quality of their children is low. This quality-quantity tradeoff hypothesis, nevertheless, is not supported by the empirical evidence. The empirical findings show that wealthy individuals can, in fact, easily increase fertility and poor individuals do not suffer a reduced long-term fitness because of the greater number of presumably poorer quality offspring [56]. In our analysis, instead of taking the quality-quantity approach, we have offered an explanation from a cultural perspective to resolve the contradiction between demographic observation and the prediction of the evolutionary theory. We contend that biased cultural traits are the key to account for a lowered fertility. For those individuals with high socioeconomic status, they may achieve higher educational attainments and engage in work outside home. Consequently, their contacts with nonparental sources are greater and their fitness, shown here as fertility, is decreased. The increased exposure to nonparental cultural information could therefore be the solution to resolve the

inconsistency between the argument of evolutionary theory and demographic results.

Beyond the theoretical contributions of the research discussed above, our findings also have a potential impact on multidisciplinary studies of fertility, which provides directions for future research. For instance, the coevolutionary theory argues for a central place for culture alongside genes. The research results reported here offer support for this central tenet of the coevolutionary theory. However, how the role of culture can be reconciled with evolutionary theories to explain the decision-making processes of childbearing has not been addressed in this research. Thus, it may be a topic that future research could possibly pursue.

Finally, we need to address the limitations of our research. We constrain our study to the US samples. This 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 individual fertility outcomes as shown here. Moreover, we only use religious affiliation as our measure of unbiased cultural traits. Future analysis needs to use measures other than religious affiliation to capture unbiased cultural traits if data become readily available. We understand that fertility outcomes could vary by religious denomination, race, and ethnicity as well as other independent and control variables under the context that fertility changes are attributable to unbiased cultural traits. Put differently, we have not considered the interaction effects between cultural inheritance and other covariates when influencing fertility. This limitation calls the future research attention in the field. Future research may go beyond this current research by evaluating how the effects of cultural inheritance on fertility outcomes vary by a variety of factors. In all, research that aims to understand the role that cultural factors play in shaping fertility outcomes will make critical contributions to the existing demographic literature.

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