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Establishment of Legal Paternity for Children of Unmarried American Women Trade-offs in Male Commitment to Paternal Investment

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Abstract

The establishment of a legal father for children of unmarried parents reflects both high paternity confidence and male willingness to commit to paternal investment. Whether an unmarried man voluntarily acknowledges paternity after a child is born has important consequences for both the mother and child. This paper brings to bear a life history perspective on paternity establishment, noting that men face trade-offs between mating and parental effort and that women will adjust their investment in children based on expected male investment. I predict that paternity establishment will be more likely when the mother has high socioeconomic status, when maternal health is good, and when the child is male, low parity, or a singleton (versus multiple) birth. I further predict that establishment of paternity will be associated with increased maternal investment in offspring, resulting in healthier babies with higher birthweights who are more likely to be breastfed. These predictions are tested using data on 5.4 million births in the United States from 2009 through 2013. Overall the results are consistent with the hypothesis that the trade-offs men face between reproductive and parental investment influence whether men voluntarily acknowledge paternity when a child is born.

Keywords

Paternity establishment; paternal investment; birth certificates; pregnancy outcomes; life history theory

Nonmarital births are widespread in the United States, with 40.6% of births in 2013 occurring to unmarried women (Martin et al. 2015). The establishment of paternity—that is, identifying a legal father for a child—has important implications for paternal involvement and child support compliance (Argys and Peters 2001; Huang and Han 2012; Miller and Garfinkel 1999) and is likely to impact children's long-term outcomes. A concerted policy focus has increased the establishment of paternity at birth to children of unmarried women, but a significant minority of children do not have a legal father identified on their birth certificate (Guzzo 2009; Mincy et al. 2005). In this paper, I draw on life history theory to examine the establishment of paternity in the context of trade-offs between parental

investment and reproduction. I argue that the voluntary establishment of paternity for unmarried couples is related to the man's assessment of paternity confidence—that is, whether or not a man thinks he is the father of a given child. On this assumption, I hypothesize that the establishment of legal paternity will be inversely correlated with variables that are likely to decrease paternity confidence and/or male investment (such as low socioeconomic status, poor maternal health, and high parity). Life history theory also predicts that the prospect of secure male investment (measured via paternity establishment) should impact the mother's investment choices in her offspring. I test the hypothesis that paternity establishment is inversely correlated with deleterious birth outcomes (such as preterm delivery, low birthweight, and low Apgar score) and positively correlated with maternal investment in offspring (measured via breastfeeding). I test these predictions using data from a population-based sample of births to unmarried American women from 2009 through 2013.

Establishing Paternity

In the United States, great emphasis is placed on establishing a legal father for a child at birth. For married couples, the husband of the child's mother is usually assumed to be the father, and he is typically given the status of legal father on the birth certificate. For unmarried women, a man must be formally named as the father in order to establish legal paternity, usually by the man signing an Acknowledgment of Paternity (AOP) form. This is most often done at the hospital, where most babies are born; a majority of unmarried women name a man as the father on the child's birth certificate, and 81% of established paternities occur in the hospital (Mincy et al. 2005; Osborne and Dillon 2014).

Note that legal paternity is conceptually distinct from biological paternity. A woman's husband might not be the biological father of her child (owing to extramarital sex, sperm donation, etc.), but married men rarely challenge paternity unless divorce occurs (Gray and Anderson 2010). States and government agencies have a strong incentive to establish legal paternity (for obtaining child support, in particular), and every U.S. state can require a man to take a paternity test if he disputes paternity (Miller and Garfinkel 1999), but states have no motivation to reveal nonpaternity among married couples. Unmarried men can voluntarily claim paternity before or after birth, and filing an AOP does not require a paternity test (Osborne and Dillon 2014). If a man is not named on the birth certificate, legal paternity can be established later, but paternity that is established after the infant leaves the hospital is more likely to be involuntary—in other words, at the insistence of the state (Mincy et al. 2005).

Changes in the relationship between marriage and fertility—specifically, the large increase in nonmarital births in recent decades—have led to a tremendous increase in the need for paternity establishment. A total of 1.6 million U.S. children were born to unmarried parents in 2013 and were thus eligible for paternity establishment (Martin et al. 2015). Overall rates of paternity establishment are difficult to determine. Numbers provided by the Office of Child Support Enforcement (2016: Table 72) suggest that paternity is established for 78.2% of nonmarital births in the United States. Mincy et al. (2005), using a national sample of

nonmarital births, found that paternity is established for 69% of them, although a different national sample suggests that paternity is established for 90% of births (Guzzo 2009).

Establishing legal paternity has been associated with many positive consequences for children. When paternity is established, nonresident fathers are more likely to pay child support and have greater involvement with their children, including higher visitation rates (Argys and Peters 2001; Huang and Han 2012; Mincy et al. 2005). In addition, having a father named on the birth certificate is associated with lower rates of infant mortality (Blabey and Gessner 2009, Gaudino et al. 1999; Ngui et al. 2014), suggesting that male involvement has a protective effect in terms of survival. Children for whom paternity is not established are also more likely to be low birthweight or born prematurely (Almond and Rossin-Slater 2013; Ngui et al. 2009; Puder et al. 2003).

Several demographic factors are known to correlate with paternity establishment. Paternity is more likely to be established if the couple is cohabiting or still in a relationship (versus no longer together), and cohabiting men are more likely to voluntarily establish paternity in the hospital rather than after the baby has been discharged (Child and Family Research Partnership 2014; Guzzo 2009, Mincy et al. 2005; Murray et al. 2012).

Socioeconomic status also correlates with paternity establishment. Paternity is less likely to be established if the father has a high school degree or less (Almond and Rossin-Slater 2013; Mincy et al. 2005; Puder et al. 2003; but see Child and Family Research Partnership 2014 for no difference in paternity establishment by education in Texas). It is also more likely to occur if the father was employed, and it is less likely if the mother was on Temporary Assistance for Needy Families (TANF) or food stamps (Child and Family Research Partnership 2014; Mincy et al. 2005). Paternity establishment is also less likely if the mother received no or late prenatal care, which is correlated with low socioeconomic status (Puder et al. 2003).

Race/ethnicity appears to play a factor in establishing paternity, though whether this is a proxy for socioeconomic status or for cultural differences, including attitudes or beliefs about fatherhood and paternal responsibility, is unclear. Paternity establishment is less likely among African Americans (Almond and Rossin-Slater 2013; Guzzo 2009; Murray et al. 2012; Puder et al. 2003) and Hispanics (Almond and Rossin-Slater 2013; Guzzo 2009) than among whites. However, among adolescent mothers, paternity establishment is more likely among Hispanics (Murray et al. 2012), and no difference is found between whites and Hispanics in Texas (Child and Family Research Partnership 2014). Paternity is less likely to be established if men or women have a history of multipartnered fertility (having children through multiple partners) (Child and Family Research Partnership 2014; Mincy et al. 2005; though see Guzzo 2009 for nonsignificant results). Younger mothers are less likely to have paternity established for their children (Almond and Rossin-Slater 2013), and paternity establishment is more likely for first-born than later-born children (Guzzo 2009) and for sons than daughters (Almond and Rossin-Slater 2013; though Guzzo 2009 reports no effect of child's sex).

Direct male involvement is correlated with paternity establishment: paternity is more likely to be established if the father contributed cash or in-kind support during the pregnancy, if he is more supportive, if it is anticipated he will help raise the infant, if the mother anticipates being dependent on his financial support, or if he is present at the child's birth (Mincy et al. 2005; Puder et al. 2003). Additionally, men who previously did not establish paternity for a nonmarital birth are also more likely not to establish paternity for subsequent births (Guzzo 2009).

Paternity in Evolutionary Perspective

As noted above, the question of biological paternity (whether a man is the genetic father of a child) is conceptually distinct from legal paternity (whether a man assumes legal responsibility as a child's father). Yet assessment of biological paternity has a strong bearing on legal paternity: men who think they are the fathers of the children ascribed to them should be more likely to assume legal and social responsibility for those children, compared with men who doubt they are the father of a particular child. However, the literatures on paternity confidence and legal paternity generally do not overlap, nor has the establishment of legal paternity been approached from the perspective of life history theory, the branch of evolutionary theory that focuses on how trade-offs influence life history traits such as the timing of reproduction (Roff 1992; Stearns 1992). In particular, life history theory focuses on the trade-offs individuals face between somatic effort (investment in the self, such as growth or the immune system) and reproductive effort (investment in reproduction). Reproductive effort can be further divided into trade-offs between parental effort (investment in existing offspring) and mating effort (investment in the acquisition of mates and the production of new offspring) (Low 1978; Trivers 1972). When faced with the birth of a prospective offspring, a man can choose to acknowledge paternity or not. If he accepts paternity and remains in a relationship with the child's mother, his future reproductive opportunities with other women are limited. Even if he does not remain with the child's mother, if he continues to invest highly in the child he may reduce his prospects of future relationships (and reproductive opportunities) with other women (Anderson 2011).

In a world of perfect information, men would always know who their children are, but the mechanics of internal fertilization and gestation in mammals means that although women are always sure which children are theirs, men must rely on indirect cues, such as female behavior around the time of conception as well as physical resemblance, to assess their likelihood of paternity (Anderson et al. 2006; DeBruine et al. 2016). Male assessment of paternity is fairly accurate, and women are generally accurate at identifying the fathers of their children: when a man has high paternity confidence, he is the biological father about 98% of the time, and when his assessed paternity confidence is low, he is the biological father about 70% of the time (Anderson 2006). When a man is informed by a woman that she is pregnant and he is the father, he faces two independent decisions with overlapping consequences. First, should he accept that the child is his? Second, should he invest in the child? Even men with high paternity confidence may nonetheless choose not to be involved with their children because of the trade-offs discussed above. We expect higher levels of paternal investment from men with high paternity confidence, however, and lower levels from men with low paternity confidence (Alexander 1974; Trivers 1972).

Humans, unlike most mammals, exhibit biparental care in essentially every society, with both parents frequently cooperating to raise children. However, male care is highly facultative, and whether a man invests in a given child depends on context, including the trade-offs he faces between paternal and mating effort, and between investing in that child versus other children. As a result, male care is highly variable both within and across societies (Gray and Anderson 2010; Hrdy 2009). Internal gestation gives men the opportunity to end a relationship with a woman before their child is born, and children can be considered a collective good: both parents receive fitness benefits from the birth of a child, even if only one invests in the offspring. Similarly, if only one parent raises the offspring, that parent cannot prevent the other parent's fitness from increasing as a result of that investment (Borgerhoff Mulder 1992; Chase 1980; Hawkes 1992).

An important problem associated with collective goods is that they attract “free-riders” who can enjoy the good without cost because someone else has paid to provide it. In the context of parental care, this has real meaning. In many human societies, biparental care significantly increases the child's fitness relative to single-parent care: children generally have greater survival and better outcomes, when raised by two parents (Gray and Anderson 2010; Sear and Mace 2008). From this perspective, a man should be expected to invest in his children. However, humans are also cooperative breeders, meaning that we exist in social systems “in which nonmaternal individuals help support offspring who are not their own” (Kramer 2010:418; see also Hrdy 2009, Sear 2016). If a woman (whether alone or with support from others, including family members and government welfare) can raise a child without an investing male, a man has the opportunity to defect on parental investment, letting others raise the child while still receiving the fitness benefits of fatherhood (Borgerhoff Mulder 1992; Maynard Smith 1977).

Women may in turn respond to male lack of commitment by aborting the pregnancy and thus avoid raising a child without male investment (Anderson et al. 2006; Hill and Low 1992; Hrdy 2000). If the pregnancy is carried to parturition, the relationship between the parents is more likely to end if the man has low confidence of paternity, and he will subsequently invest less in the child (Anderson et al. 2007). Women may offset reduced investment from a child's biological father by recruiting a stepfather who can invest in the child, albeit at reduced levels compared with a resident biological father; subsequent male partners may invest in her existing offspring in exchange for future reproductive opportunities as a form of mating effort (Anderson 2000; Anderson et al. 1999; Smuts and Gubernick 1992).

Predicting Paternity Establishment

The idea, drawn from life history theory, that men and women face different trade-offs over investing in current versus future offspring has important implications for the establishment of legal paternity. Drawing on life history theory, I now outline some predictions regarding the voluntary establishment of paternity for children of unmarried couples. I first examine paternity establishment as a dependent variable, predicted by maternal and child characteristics. I then use paternity establishment as an independent variable, predicting birth outcomes and maternal investment in the child.

A man's decision to invest in his offspring, and to claim paternity for them, will be influenced by the returns to his investment, compared with the benefits gained from allocating those resources to a competing activity (such as mating effort). Theory suggests that higher levels of socioeconomic status, including educational attainment for both parents, are associated with greater returns to investment in offspring (in terms of offspring income or status), leading to an inverse relationship between education and fertility (Kaplan 1996; Shenk et al. 2013; see Nettle 2008 for empirical support). Men in higher socioeconomic strata may thus gain more fitness benefits from investing in current children than from pursuing additional mating opportunities. Therefore, paternity establishment is expected to correlate with parental education (Almond and Rossin-Slater 2013; Mincy et al. 2005; Puder et al. 2003), as well as with other measures of socioeconomic status (such as income and private health insurance). This leads to *Prediction 1: Paternity establishment will be more likely when socioeconomic status is higher.*

A man's decision to acknowledge paternity and invest in a child depends in part on the future of his relationship with the child's mother. Remaining with the child's mother raises the possibility of future reproductive opportunities with her, but these may be reduced if her behavior or circumstances might reduce his confidence of paternity in subsequent pregnancies. Men who are not in a relationship with the mother are less likely to establish paternity (Murray et al. 2012), whereas unmarried couples who cohabit (and presumably have greater commitment than noncohabitating partners) are more likely to establish paternity (Child and Family Research Partnership 2014; Guzzo 2009; Mincy et al. 2005). Additionally, chronic maternal health issues may lead to increased maternal investment in somatic effort, at the expense of both parental effort and future reproductive opportunities, thereby decreasing a man's prospects of future reproduction and possibly lowering his likelihood of remaining with the mother. Obesity is associated with lower odds of conception and higher odds of pregnancy loss (Brewer and Balen 2010; Chin et al. 2014), in part through its association with polycystic ovary syndrome (PCOS), the most common endocrinological disorder among reproductive-aged women (Unger 2012). Type 2 diabetes is also associated with adverse birth outcomes, including pregnancy loss, congenital abnormalities, preterm delivery and low birthweight (Anderson et al. 2016; Kinsley 2007; Roland et al. 2005). Although gestational diabetes (GDM) manifests itself during pregnancy, after which glucose tolerance usually returns to normal, GDM is predictive of the mother subsequently developing Type 2 diabetes (Lee et al. 2007). GDM is also associated with birth complications such as low birth weight and preterm delivery, and children of mothers with GDM are more likely to develop Type 2 diabetes (Anderson et al. 2016; Bellamy et al. 2009; Metzger 2007). Similarly, hypertension, including gestational hypertension, is associated with long-term health risks, including increased likelihood of stroke (Wilson et al. 2003).

Additionally, the presence of sexually transmitted infections (STI) during pregnancy might indicate a history of multiple short-term sexual partners (by either partner). The Centers for Disease Control (CDC) recommend routine screening of all pregnant women for syphilis, HIV, and hepatitis B and C, and of all women under 25 for chlamydia and gonorrhea, with retesting for all of these infections (or initial testing for chlamydia and gonorrhea) if the mother exhibits certain risk factors, including new, multiple, or concurrent sex partners

(CDC 2015b). Thus, the presence of STI might reduce the man's assessment of paternity confidence if he believes she has been unfaithful or promiscuous. These health-related factors lead to *Prediction 2: Paternity establishment will be more likely when maternal health is better.*

Lastly, child-specific factors are also likely to play a role in paternity establishment. Among married couples in the United States, divorce following first birth is more likely if the child is a girl (Ananat and Michaels 2008; Bedard and Deschênes 2005), suggesting men might feel closer to sons than daughters. Almond and Rossin-Slater (2013) found that paternity establishment was more likely following the birth of a son (though Guzzo [2009] found no effect of child's gender).

Multipartnered fertility—having children through multiple partners—has also increased in recent years, and among unmarried parents it is associated with higher parity (Guzzo and Furstenberg 2007), suggesting that higher parity may indicate a history of less-stable long-term relationships. Multipartnered fertility may result in reduced willingness by men to acknowledge paternity for high-parity children if they feel they are only the latest in a number of partners who may be replaced by someone else. In addition to parity, the number of children per pregnancy will influence costs and trade-offs. Multiple births (twins, triplets, etc.) require greater investment than singleton births and also represent greater risk of reproductive failure because of greater risk of preterm delivery, stillbirth, and infant mortality (Hogue and Silver 2011, MacDorman 2011). Men therefore may be less likely to acknowledge paternity for multiple births than for singleton births. This leads to *Prediction 3: Paternity establishment will be associated with child-specific factors and will be more likely if the child is male, low parity, or a singleton birth.*

Paternity establishment has multiple benefits, not just for the child but for the mother as well. Because of the collective-action nature of parental care, increased involvement by the father will allow the mother to adjust her investment accordingly. Even though an AOP might not be signed until the child is born, the father presumably makes his willingness to invest in the mother and the child clear during the pregnancy (and paternity establishment is associated with male involvement during the pregnancy [Mincy et al. 2005; Puder et al. 2003]). The prospect of long-term male assistance with raising the child may enable the mother to invest more in the child prenatally, increasing the duration of the pregnancy as well as the baby's birthweight, and reducing the likelihood of serious birth complications. Low birthweight is a heterogeneous outcome, arising from preterm delivery as well as restricted growth in utero for full-term births (Goldenberg and Culhane 2007). Preterm delivery and low birthweight are both associated with many long-term health problems, including cerebral palsy, blindness and deafness, Type 2 diabetes, and infant mortality (Fujimoto et al. 2013; Goldenberg and Culhane 2007; Whincup et al. 2008). Marital status has been shown to impact birthweight, with married women producing larger babies (Feldman et al. 2000). Feldman et al. (2000) suggest this is due to social support having positive impacts on fetal growth rather than on the timing of delivery. Babies whose fathers have been and will continue to be involved with them, and who receive more maternal investment prenatally, should be less likely to have low Apgar scores, a widely used measure of child well-being immediately after delivery that is predictive of infant mortality

(Iliodromiti et al. 2014). Babies that receive greater parental investment should also be less likely to have birth complications that result in the baby being sent to the neonatal intensive care unit (NICU). The logic that increased male commitment will increase the mother's ability to invest in her offspring leads to *Prediction 4: The establishment of paternity will be associated with increased maternal gestational investment in offspring, resulting in babies that are more likely to be full term, have higher birthweight and higher Apgar scores, and are less likely to need medical intervention.*

Breastfeeding provides many health benefits to babies, and the American Academy of Pediatrics recommends exclusive breastfeeding for six months, with continued breastfeeding after solid foods are introduced until one year or longer (Section on Breastfeeding 2012). In the United States, 80.0% of babies born in 2012 were ever-breastfed, and 51.4% were still breastfeeding at six months (CDC 2015a). However, only 21.9% are exclusively breastfed at six months (CDC 2015a). Financial and emotional support from the child's father may facilitate breastfeeding, which might not otherwise be possible if the mother has to return to work soon after the birth or pursue a job which is less compatible with nursing or expressing milk, as women's employment, especially full-time employment, is associated with lower rates of breastfeeding (Labbock 2013, Neifert and Bunik 2013). This leads to *Prediction 5: Paternity establishment will be associated with higher rates of breastfeeding.*

Methods

Data

The data come from the U.S. Centers for Disease Control and Prevention's National Center for Health Statistics natality files, which include all live births registered in the 50 states, the District of Columbia, and New York City (which is an independent reporting area from New York state). Births to U.S. citizens outside the United States are not included. More than 99% of births in the United States are registered—that is, issued a birth certificate (National Center for Health Statistics 2010). Thus, the U.S. natality files reflect virtually all births in the United States for a particular year.

The analytical sample includes births to unmarried women in the United States for the years 2009 through 2013. These years were chosen because several key variables (including paternity establishment, maternal prepregnancy body-mass index, and maternal morbidity) were unavailable in the electronic files for earlier years. Two different versions of the birth certificate are currently in use in the United States: the 1989 revision of the U.S. Standard Certificate of Live Birth and the 2003 revision of the U.S. Standard Certificate of Live Birth, which provides many health-related variables that are not included in the 1989 version. This paper is restricted to states that used the 2003 version of the birth certificate, covering 80.28% of U.S. births during the period 2009 through 2013 (see Appendix 1 for a full listing of states included in the sample).

The 2003 birth certificate collects data from two different sources: the mother's worksheet and the facility worksheet (National Center for Health Statistics 2012). The mother's worksheet collects data directly from the mother, and includes age, race, Hispanic origin, educational attainment, receipt of WIC (the supplemental nutrition program for Women,

Infants, and Children), prepregnancy weight and height, marital status, and establishment of paternity. (Additional information on the father is collected for unmarried women only if the Acknowledgment of Paternity has been completed.) The facility worksheet obtains data directly from the medical records of the mother and infant and includes gestational age, birthweight, plurality, parity, source of payment for the delivery, infections present and/or treated during this pregnancy, admission to the neonatal intensive care unit (NICU), timing and frequency of prenatal care, five minute Apgar score, and breastfeeding.

The analysis focuses on births to unmarried women. Births were dropped from the analytical sample if the parents were married, if the 1989 birth certificate was used, or if data were missing on whether paternity was established. Births were also dropped if the pregnancy had resulted from infertility treatments (including artificial insemination, as well as fertility-enhancing drugs and other treatments) because paternity is unlikely to be established for sperm donors. Births were also dropped because of missing data on other variables. Since 2005, the publically released data file has not included any geographic data, including state or county of birth (National Center for Health Statistics 2010). It is thus not possible to distinguish between missing data that is due to unreported variables at the state or county level (which is unlikely to bias the remaining sample) versus individual nonresponse (which could bias the results if individuals who did not answer differed from those who did). Appendix 2 details the number of observations dropped for various exclusion criteria. The final sample used for analysis consists of 5,427,689 births to unmarried women. The analytical sample used for breastfeeding is smaller, consisting of 4,494,009 births to unmarried women, because breastfeeding was not reported by California in 2009, and by California and Delaware from 2010 through 2013 (National Center for Health Statistics 2010, 2011, 2012, 2013, and 2014).

Variables

Unless indicated, all variables used in the analysis are dichotomous, measured as either yes or no, or present or absent. The independent variable for predictions 1 through 3, was paternity established, comes from a question on the mother's worksheet: "If not married, has a paternity acknowledgment been completed for this child? (That is, have you and the father signed a form in which the father accepted legal responsibility for the child?)" This measure includes only paternities established prior to the mother being discharged from the hospital; paternities established at a later date are not recorded in the natality files. This variable thus measures voluntary paternity establishment.

Birth outcomes include preterm delivery (births before 37 completed weeks of gestation), which is based on gestational age. Gestational age is calculated from the mother's reported date of last menstrual period (LMP), obtained from medical records. If LMP was unavailable, gestational age was based on the clinical or obstetric estimate of gestation. This occurred for 6.1% of births in 2009, declining to 5.5% of births in 2013 (National Center for Health Statistics 2010, 2014). Birthweight is measured in grams, and low birthweight denotes that the baby weighed less than 2,500 g (5.5 pounds). The child's Apgar score is a summary measure of the infant's condition based on heart rate, respiratory effort, muscle tone, reflex irritability, and color, and is scored on a scale of 0 to 10 (National Center for

Health Statistics 2012). A 5-min Apgar score of 7 or more indicates the infant is in good to excellent condition (National Center for Health Statistics 2014); thus the Apgar score was recoded for this analysis as “low Apgar score” if the 5-min Apgar was less than 7. Breastfeeding was measured on the birth certificate by the question “Is the infant being breastfed at discharge?” (National Center for Health Statistics 2014). Women who intended to breastfeed, but who had not initiated breastfeeding by the time of hospital discharge, were coded as responding “no” to this question. Admission to the NICU was obtained from medical records.

Maternal variables include race and Hispanic origin, which are separate questions on the birth certificate. These were recoded into a series of dummy variables: white non-Hispanic, black non-Hispanic, American Indian/Alaska Native non-Hispanic, Asian non-Hispanic, and Hispanic. Father's race and Hispanic origin are not used because paternal variables are missing when paternity is not established. Maternal prepregnancy body-mass index (BMI), a crude measure of body fat, was pre-coded in the data files as underweight (BMI < 18.5), normal weight (BMI of 18.5 – 25.0), overweight (BMI of 25.0–30.0), or obese (BMI ≥ 30.0). The 2003 birth certificate distinguishes between prepregnancy diabetes mellitus (diagnosed before the current pregnancy) and gestational diabetes (diagnosed during the current pregnancy) but does not distinguish between prepregnancy Type 1 and Type 2 diabetes. It also distinguishes between prepregnancy (chronic) hypertension and gestational hypertension (including both pregnancy-induced hypertension and preeclampsia). The 2003 birth certificate collects data on several infections for which women are commonly screened during the pregnancy. Syphilis was coded as present or absent. For the current analysis, hepatitis B and hepatitis C were collapsed into a single variable indicating infection with hepatitis. Other STI were not used because they were not reported for every year.

Several measures of maternal socioeconomic status are available in the birth certificate files. Maternal education is coded into five dummy variables: less than high school, high school only, some college, college degree, and postgraduate degree. WIC, run by the U.S. Department of Agriculture, provides supplemental food, nutrition education, breastfeeding support, and referrals to health care and other social services for pregnant and postpartum women, as well as to children through age five (Johnson et al. 2013). WIC is used primarily by low-income women. The source of primary payment for the delivery is coded into four dummy variables: private insurance, Medicaid (a government program supporting health care for families and individuals with low income), self-pay, or other (including the Indian Health Service and the Department of Defense Champus/Tricare). Private insurance is typically indicative of higher socioeconomic status, relative to other forms of insurance or no insurance.

The birth certificate also provides the first and last date of prenatal medical care and the total number of prenatal visits for this pregnancy. These variables, along with gestation length, allow the calculation of the Kotelchuck prenatal care index (Kotelchuck 1994), a widely used index for assessing the adequacy of prenatal care. The Kotelchuck prenatal care index evaluates prenatal care as either inadequate, intermediate, adequate, or adequate plus, coded for this analysis as a set of four dummy variables. Inadequate or intermediate prenatal care is generally indicative of lower socioeconomic status.

The birth certificate distinguishes between single, twin, triplet, quadruplet, and quintuplet or higher order births. Each infant born receives its own birth certificate. For the present analysis these categories were collapsed into singleton versus multiple births. Calendar year is coded as separate dummies for each year. Maternal age at the time of birth is available as five-year age classes: under 15, 15–19, 20–24, etc., with 45 and older being the highest category. The baby's gender is coded as male = 1 or female = 0, and birth order is coded as a set of dummy variables from firstborn through seventh born and higher. (Birth order reflects maternal parity only.)

Analysis

Disparities and inequalities across race/ethnic groups occur in many pregnancy and birth outcomes, including gestational diabetes, preterm delivery, low birthweight, and infant mortality (Anderson et al. 2016; Bryant et al. 2010; MacDorman 2011). The reasons for these disparities are complex, pervasive, and poorly understood and likely include socioeconomic inequalities, differential access to health care, engagement in risk behaviors, and racial and ethnic discrimination, as well as different cultural traditions (Bryant et al. 2010; Lu and Halfon 2003). Paternity establishment varies by race/ethnicity as well (Almond and Rossin-Slater 2013; Guzzo 2009; Murray et al. 2012; Puder et al. 2003). The extent to which race/ethnicity is merely a proxy for socioeconomic and structural variables influencing the establishment of paternity, or reflect underlying cultural differences in beliefs about paternal responsibility, is unclear. Because race/ethnicity is associated with both paternity establishment and health outcomes, most analyses here are run separately by race/ethnic group.

Descriptive statistics are presented by race/ethnicity as well as by whether or not paternity was established. Statistical significance across these groups is evaluated using analysis of variance (for continuous or dichotomous variables) or chi-square tests for groups of qualitative or ordinal variables (such as education dummies), with $\alpha = 0.05$. Multivariate regression is used to control for background variables. Dichotomous outcomes (including paternity establishment, most birth outcomes, and breastfeeding) are modeled using logistic regression, producing adjusted odds ratios. Birthweight, a continuous variable, is modeled using ordinary least squares regression. Although the data are likely to be clustered at the hospital, county, and state level, the lack of geographic identifiers in the public-release data means that we cannot use random or mixed effects models to control for this. The raw data are available from <http://www.cdc.gov/nchs/births.htm>, though this study uses the formatted Stata versions provided by the National Bureau of Economic Research (<http://www.nber.org/data/vital-statistics-nativity-data.html>). All analyses are performed using Stata/SE 14.1 for Windows (StataCorp 2015).

Results

Table 1 presents descriptive statistics for the analytical sample by race/ethnicity. Every variable under consideration varies significantly by race/ethnicity at $p < 0.0001$. In this sample of births to unmarried women, paternity establishment is lowest among African Americans and then American Indians and Alaska Natives (AI/AN). Preterm delivery is also

highest in those two groups. Birthweights are lowest among African Americans and highest among AI/AN, with African Americans the most likely to have low birthweight babies. Low Apgar scores are relatively uncommon across all groups, though they occur more frequently among African Americans and AI/AN. Admission to neonatal intensive care is highest among African Americans, and breastfeeding rates are lowest among African Americans and highest among Hispanics.

Among the independent and control variables, WIC usage is highest among Hispanics and lowest among Asians. Private insurance is most widely used by Asians and whites; Medicaid is more commonly used by blacks, American Indians and Alaska Natives, and Hispanics; and other forms of payment (which includes the Indian Health Service) are most common among AI/AN. In terms of prenatal care, AI/AN are the most likely to have inadequate prenatal care and the least likely to have the highest (adequate plus) level of care. Asian mothers are more likely than other groups to be underweight and are the only group in which a majority of mothers had normal prepregnancy weight. The majority of black, AI/AN, and Hispanic mothers are obese. Prepregnancy diabetes is equally uncommon in all groups, whereas gestational diabetes is more common among Asians and AI/AN. Hypertension (both prepregnancy and gestational) occurs most frequently among African Americans. Syphilis is rare in all groups, though its prevalence is highest among African Americans. Hepatitis, in contrast, is most common among Asians. American Indian/Alaska Natives are more likely to have higher parity babies (with 18% being fourth-born or higher), and African Americans were the least likely to have singleton births.

Table 2 presents descriptive statistics by whether or not paternity was established. All variables differ significantly by paternity establishment at $p < 0.0001$. Preterm delivery, low birthweight, low Apgar score, and admission to neonatal intensive care all occur more frequently when paternity is not established, whereas birthweight is higher and breastfeeding is more common when paternity is established. Mothers for whom their child's paternity is not established are more likely to have less than high school education, less likely to use private insurance and more likely to use Medicaid, more likely to have inadequate prenatal care, and more likely to be obese. Differences in other independent variables, although statistically significant, are generally small, on the order of 1% or less.

Establishing Paternity

Table 3 presents the results of multivariate logistic regression models of paternity establishment by race/ethnicity. For all groups, paternity establishment is lower among teenage mothers than mothers in their early twenties. For whites, Asians, and Hispanics, paternity establishment increases and then decreases with age. For African Americans, in contrast, paternity establishment is lower in the teenage years, then steady from age 20 and up, with a small decrease for ages 40–44 only. Paternity establishment is lowest if mothers have less than high school education than for women with some college, for all groups. For blacks and American Indians/Alaska Natives, paternity establishment is much higher than baseline at higher levels of education, whereas for whites and Asians it is lower among women with postgraduate degrees, relative to women with some college. Among whites, using WIC is associated with reduced odds of paternity establishment, whereas for other

groups it is associated with higher odds of paternity establishment (except for Asians, for whom WIC usage is nonsignificant). For all groups, paternity establishment is highest among those paying for the birth with private insurance, and lower among those paying for the birth with Medicaid, by themselves, or by other means. Increased utilization of prenatal care is also associated with greater odds of paternity establishment, compared with having inadequate prenatal care.

As predicted, paternity establishment is more likely when maternal health is good. Underweight white, Asian, and Hispanic women are less likely than normal-weight women to establish paternity, as are overweight white and American Indian/Alaska Native mothers. Overweight blacks, in contrast to the prediction, are slightly more likely to establish paternity than normal-weight blacks. Obesity is associated with reduced odds of paternity establishment among all groups except Asians. Prepregnancy diabetes is associated with reduced odds of paternity establishment for whites, blacks, and Hispanics, whereas gestational diabetes is associated with increased paternity establishment for those same groups. Hypertension, whether prepregnancy or gestational, is associated with reduced odds of paternity establishment among whites, blacks, and Hispanics only prepregnancy hypertension appears to reduce the odds of paternity establishment among Asians. Syphilis is associated with reduced odds of paternity among whites, blacks, and Hispanics, whereas hepatitis lowers paternity odds for all groups (with particularly large effect sizes observed for whites and Hispanics).

Male babies are associated with increased likelihood of paternity establishment among all groups, with one notable exception: despite a preference for sons among Asian Americans, as demonstrated by male-biased sex ratios at birth (Almond and Edlund 2008), the baby's gender has no relationship with paternity establishment in this group. Among African Americans, paternity establishment declines with parity. For whites, American Indians/Alaska Natives, and Hispanics, paternity establishment initially increases with parity and then declines by the third (whites), fourth (Hispanics), or fifth (AI/AN) child. Only among Asians is paternity establishment more likely among all later-borns compared with first-borns. Lastly, for all groups, paternity establishment is more likely among singleton births, compared with multiples.

Birth Outcomes

Table 4 presents adjusted odds ratios from logistic regression for paternity establishment as a predictor of various birth outcomes, except for birthweight which reflects the results of a multivariate least squares regression. This table summarizes 30 separate multivariate regression models (six outcomes by five race/ethnic groups); only the coefficient associated with paternity establishment is shown in the table. Although the Acknowledgment of Paternity is usually signed after the baby is born, men who establish paternity voluntarily in the hospital presumably are involved with the mother prior to the birth. Paternity establishment is associated with decreased odds of preterm delivery for all racial/ethnic groups, with the effect being weakest for American Indians/Alaska Natives. Paternity establishment is associated with higher birthweight (with the largest increase seen for whites, and the smallest increase seen for Asians), and reduced odds of low birthweight

(largest effects seen for whites and Hispanics). Paternity establishment is associated with reduced odds of a low Apgar score, apart from American Indians/Alaska Natives, for whom it is nonsignificant, and babies for whom paternity is established are less likely to enter the neonatal intensive care unit among all groups. Lastly, paternity establishment is associated with higher odds of breastfeeding for all groups, with the largest effect sizes seen among Hispanics and the smallest among Asians.

Discussion

The results show that voluntary paternity establishment among unmarried American women is associated with maternal socioeconomic status, maternal health, and the child's characteristics, in ways that vary by race/ethnicity. The investigation draws on life history theory, noting that in the context of biparental care, each parent's decision to invest in an offspring will be influenced by the other parent's willingness to invest. The establishment of legal paternity is correlated with variables that are associated with increased paternity confidence and/or male investment. Similarly, the results are consistent with the hypothesis that paternity establishment and the prospect of secure male investment will impact the mother's investment choices in her offspring.

The present study used a national sample of U.S. nonmarital births and found that 69.5% of children had paternity established before they left the hospital. In contrast, the FY 2013 annual report by the Office of Child Support Enforcement (2016) claims that 96% of states establish paternity, and that for Title IV-D cases (in which child support is managed through the office), paternity establishment is 100%. However, the raw data provided in Table 72 of the appendix of that report do not support those numbers. In 2012, 1,562,169 children were born out of wedlock, of whom 1,221,095 (78.2%) had paternity established during that fiscal year (FY 2013). Two studies using different nationally representative samples estimate that paternity is established for 69–90% of births (Guzzo 2009; Mincy et al. 2005). These two studies also estimate that 61–85% of paternity acknowledgments occur in the hospital. This would imply that of the 78.2% of paternities established nationally in 2012, 48–63.3% occurred in the hospital. This figure is slightly below the 69.5% of hospital paternity acknowledgments reported by the current study. The discrepancy between these two figures could be due to the wider range of years in the current study (2009–2013), the inclusion of all U.S. states in the OCSE report (the current study includes only the subset of states using the 2003 birth certificate; see Appendix 1), or secular trends in the proportion of paternities established in the hospital (note that paternity establishment is more likely in 2013 than 2009 for all groups except American Indians and Alaska Natives [Table 3]).

Prediction 1, which stated that paternity establishment will increase with socioeconomic status, was generally supported. Compared with women who had some college education, women with high school degrees or less are less likely to have the paternity of their child established. Compared with women who paid with private insurance, women with Medicaid, self-pay, or other forms of payment are less likely to have their child's paternity established. Lastly, women with inadequate prenatal care (which is indicative of low socioeconomic status as well as other factors, such as rural location that might impose barriers to healthcare) were the least likely to have paternity established. All of these results are

consistent with the prediction that men are less likely to claim responsibility for offspring when the mother's socioeconomic status is low.

Two notable exceptions to this prediction are apparent. Although paternity establishment generally increases with maternal education, it is higher at the upper level of education—postgraduate degrees—than among women with some college for African American and American Indian/Alaska Native women only. For whites and Asians, women with postgraduate degrees are significantly less likely than women with some college to have their child's paternity established. Two possible explanations for this pattern come to mind. The first is that women with professional degrees may be economically independent to the point that they do not require male assistance. They may not plan to seek child support or involve the biological father in their child's life. They may be “single mothers by choice,” but we cannot examine this without relationship status, which is lacking in the natality files.

Second, it is likely that women who use sperm donors to become pregnant will be more concentrated among women with professional degrees. Individuals who responded that they used infertility treatments to get pregnant, including fertility enhancing drugs, artificial insemination, and assisted reproductive technology (ART, which includes in vitro fertilization), were excluded from the sample. However, this variable was available for only 18 to 29 states per year across the years sampled, and the number of births resulting from infertility treatments is likely underreported. A recent study (Luke et al. 2015) validating the birth certificate estimates of infertility treatments in eight states found that only 36.5% of ART children were correctly identified as such on the birth certificate. No such study has validated the identification of children conceived through donor insemination, but it seems likely that many pregnancies resulting from this method were retained in the analytical sample. Scheib et al. (2000) found that women who used donor insemination were highly educated: 88% had at least a college degree, with 49% having a postgraduate degree. Another study of women using donor insemination found that 72% had at least a four-year college degree, and their modal occupation was “professional” (Wendland et al. 1996). Unmarried women who use donor insemination are likely to be single mothers by choice, or in same-sex relationships, but we do not have the data to discern this. These associations might explain the reduced odds of paternity establishment among the most educated white and Asian women.

The second exception to the prediction that paternity establishment will increase with socioeconomic status occurs among women who make use of WIC. These women are less likely to have paternity established (as predicted) only among whites. Among Asians, WIC utilization is nonsignificant, while among African American, American Indian and Alaska Native, and Hispanic women, using WIC is associated with *increased* likelihood of paternity establishment. One possible explanation for this finding could be that cohabiting couples might be more likely to use WIC than noncohabiting couples, making WIC a proxy for cohabitation (which is unavailable in the birth certificate data). As noted above, men who cohabit are more likely to establish paternity than unmarried noncohabiting men (Guzzo 2009; Mincy et al. 2005). However, none of the reports detailing the characteristics of women using WIC (e.g., Johnson et al. 2013) offer any measures of marital or cohabitational status. The positive association between WIC usage and paternity establishment among

African American, American Indian/Alaska Native, and Hispanic women remains unexplained.

Prediction 2, which stated that paternity establishment will increase with maternal health, was largely supported by the data. Underweight women were less likely to have their child's paternity established for all groups except blacks and American Indians/Alaska Natives, and obese women were less likely to establish paternity among all groups except Asians. Prepregnancy diabetes and gestational hypertension were associated with reduced odds of paternity establishment for whites, blacks, and Hispanics, and prepregnancy hypertension was associated with reduced paternity establishment for all groups but AI/AN. Despite its low prevalence, syphilis was associated with reduced paternity establishment for whites, blacks, and Hispanics, and hepatitis correlated with lower paternity establishment for all groups. The one result that was contrary to the prediction was the finding that gestational diabetes (GDM) was associated with increased paternity establishment for whites, blacks, and Hispanics. Perhaps GDM, as a health complication that manifests during pregnancy, draws couples together and increases male involvement with his partner and with the pregnancy. Also, GDM may be perceived by men as a temporary health condition since most women's glucose tolerance returns to normal following parturition. However, this does not account for the fact that gestational hypertension, another pregnancy-specific medical condition, is associated with reduced odds of paternity establishment for those same groups.

The data also supported Prediction 3, which stated that paternity establishment is associated with child-specific characteristics. Paternity establishment was found to be more likely for sons than daughters (for all groups except Asians), and for singleton births over multiple births. Paternity establishment also decreased with parity: compared with firstborns, second-born children were more likely to have paternity established (except for blacks, who were less likely), but later-born children were all less likely to have paternity established. This effect held for all groups except Asians, for whom paternity establishment increased with parity. Whereas the odds ratios for paternity establishment for a non-Asian seventh-born child are only 0.65 to 0.76 relative to a firstborn, the odds ratio for a seventh-born Asian child is 1.33. High parity among unmarried women might reflect a history of multipartnered fertility and reduce men's willingness to invest in offspring, but the natality files have no data on relationship history. Perhaps high fertility among Asians is more likely to occur in a cohabitational context (which increases paternity confidence and paternity establishment) than among other groups.

The final two predictions addressed the relationship between paternity establishment and pregnancy and investment outcomes. Caution must be used in interpreting causal relationships from these results because the AOP may be signed immediately before or after these birth outcomes. Presumably most men signal their intention to acknowledge paternity earlier in the pregnancy, allowing the mother to adjust her investment in the pregnancy based on expected male involvement.

Prediction 4 stated that establishing paternity will increase maternal investment in offspring, resulting in babies that are more likely to be full term, to have higher birthweight, to have higher Apgar scores, and to be less likely to need medical intervention. These were all

supported by the data. Paternity establishment was associated with reduced odds of preterm delivery and low birthweight, as well as higher average birthweight, for all race/ethnic groups. Paternity establishment also predicted reduced odds of low Apgar scores for all groups except American Indians/Alaska Natives, and reduced odds of the baby being admitted to the NICU for all groups.

Lastly, Prediction 5, which stated that paternity establishment will be associated with higher rates of breastfeeding, was supported for all groups. Other studies have found ambiguous relationships between paternal support and breastfeeding. In the United Kingdom, father presence is positively associated with breastfeeding initiation, but father's parental involvement among the father-present subsample is associated with earlier breastfeeding termination (Emmott and Mace 2015). In a sample of mothers committed to breastfeeding, Cisco (2017) found that although spouses provided extensive emotional support, that support was not related to timing of weaning. The current study measures breastfeeding in the hospital only; no information is available on the frequency of breastfeeding after discharge, and in particular after the mother returns to work.

The results show that voluntary establishment of legal paternity, a proxy for both paternity confidence and male commitment to investment in offspring, is more likely when socioeconomic status (and hence returns to investment) is high, and when maternal health (and hence the prospect of future reproductive opportunities) is good. And paternity establishment is associated with higher maternal investment in offspring. Taken together, the results underscore the facultative nature of human parental care. Whether a man chooses to invest in his offspring is dependent on the context in which that investment occurs, and that decision will take into account both the costs and benefits of the investment. Life history theory notes that men have competing demands on their time and resources, and they may resist acknowledging paternity of a child if this might restrict their ability to invest in other offspring or pursue other mating opportunities.

Policy Implications

The findings of this study have potential implications for policy. If cases where the father may be less likely to sign the Acknowledgment of Paternity in the hospital can be identified in advance, interventions may be designed to increase the likelihood of the father being involved in the pregnancy. For example, factors associated with low paternity confidence, such as short relationship duration, unexpected pregnancy, and noncohabitation, are likely to predict male reluctance to establish paternity. In addition, women who have low socioeconomic status, have chronic health conditions or sexually transmitted infections, have experienced multipartner fertility, or are carrying multiple babies might benefit from extra effort on the part of caseworkers or support staff in engaging male involvement. From a policy perspective, it might be prudent to line up additional social and medical support for women and infants when the father is unlikely to voluntarily acknowledge paternity to help prevent deleterious birth outcomes, or to prepare additional resources in anticipation of the need for involuntary establishment of paternity. Furthermore, roughly half of first pregnancies in the United States are unwanted or unexpected, which is associated with greater likelihood of pregnancy loss, delayed prenatal care, and low birthweight, and with

lower likelihood of being breastfed (Bronte-Tinkew et al. 2009b; Korenman et al. 2002. Shah et al. 2014). Helping to prevent unwanted or unexpected pregnancies, especially in the context of unmarried noncohabiting couples, might increase voluntary establishment of paternity as well as improve birth outcomes and children's subsequent well-being.

Although governments have a strong incentive to establish paternity of children of unmarried parents (Argys and Peters 2001; Miller and Garfinkel 1999), it is important to consider that, under some circumstances, one or both of the parents may resist. Some men, for example, may have interests that conflict with those of women and of policy makers. For several decades, federal legislation has attempted to facilitate higher rates of paternity establishment at birth (Argys and Peter 2001; Miller and Garfinkel 1999), and paternity establishment is generally required for child support awards or legal visitation orders (Osborne and Dillon 2014). Despite increased legislative power to collect child support, compliance has remained remarkably stable over the past several decades, with around 25% of custodial single parents receiving no child support payments from 1992 through 2011 (Grall 2013; Huang and Han 2012). This suggests that men resist being coerced into investing in children when they have competing interests. Perceived fairness of the child support award is an important factor in determining whether men comply with the award (Lin 2000). If men perceive establishment of paternity to be against their interests—because of the trade-offs outlined above—they may be equally reluctant to cooperate. Understanding lack of male investment does not mean condoning it, but acknowledging the trade-offs involved in establishing paternity and investing in children may prove beneficial for changing these behaviors.

Furthermore, it is worth asking why some women do not nominate a man for paternity at the birth of their child. Some women may not know who the father is, or he may be married to or involved with someone else and will not acknowledge the child (Ngui et al. 2014). Some women may be estranged from the father, may not know where he is, or may prefer sole custody (Ngui et al. 2014). Women who have been abandoned by their boyfriends during pregnancy may be reluctant to reward these men following what they perceive as irresponsible behavior (Edin and Kefalas 2005), especially if the man was violent or abusive during the pregnancy or has been barred from the hospital due to concerns of violence (Child and Family Research Partnership 2014, Osborne and Dillon 2014). Women who utilize anonymous donor insemination and who are unpartnered with a man (i.e., single mothers by choice or women in same-sex relationships) may view paternity as meaningless since sperm donors are not legal fathers; they furthermore may not know the identity of the genetic father, and do not plan to seek child support. These women may have little motivation to cooperate in efforts to establish paternity.

Thus, although increasing the incidence of paternity establishment may improve investment in children and children's well-being, it is important to realize that men, and women too, have competing interests that may make achieving this goal difficult.

Limitations

The dataset contains limitations which should be discussed. Paternity establishment, as measured by the birth certificate, is a censored variable in that legal paternity can be

established months (or in some states, years) after discharge from the hospital. Guzzo (2009) reports that 17.7% of first births, and 44.0% of higher parity births, have paternity established outside of the hospital. Paternity establishment outside the hospital is likely to be involuntary, following the result of a court-ordered paternity test; thus the paternity variable used in this paper is best considered a measure of voluntary paternity establishment.

The birth certificate files are cross-sectional, leading one to exercise caution when inferring causality between variables of interest. This is especially true for pregnancy complications and birth outcomes, which usually occur before the Acknowledgment of Paternity is signed in the hospital. Thus the dataset measures associations, not consequences.

The dataset contains no variables on the father (such as age, education, or race/ethnicity) because those are only included when paternity is established. The natality files contain no geographical data, including rural/urban location, although healthcare practices vary regionally across the United States, as well as across hospitals and counties within states. There is also no tribal identification for American Indians or Alaska Natives, which is unfortunate because AI/AN are not culturally homogeneous. Socioeconomic status, which is correlated with poor maternal and child health outcomes, may not be fully controlled for in the models; thus the observed relationships may reflect residual confounding with SES. Breastfeeding is only measured at the hospital; it is not known how many women initiate breastfeeding in the hospital but discontinue it immediately upon leaving, so this measure likely overestimates women's commitment to breastfeeding.

The files lack information on cohabitation status among unmarried women, which is an important omission as cohabitation is likely to be associated with men's willingness to invest in children. Following a birth to an unmarried couple, cohabiting couples are much more likely to marry or remain together than noncohabiting couples (Fragile Families Research Brief 2007). Among non-residential fathers, ever-cohabiting men paid more child support than never-cohabiting men (Nepomnyaschy and Garfinkel 2010), and cohabiting parents are also more likely to voluntarily establish paternity in the hospital, as opposed to after discharge from the hospital (Child and Family Research Partnership 2014; Mincy et al. 2005). Pregnancies are more likely to be unexpected or unwanted among noncohabiting couples than unmarried cohabiting couples (Finer and Zolna 2014). Since men are most likely to have low paternity confidence if the couple was not married at the time of the conception or if the pregnancy was unplanned (Anderson et al. 2006), this suggests that noncohabiting men may have lower confidence of paternity than cohabiting fathers, which may explain their lower rate of voluntary paternity establishment.

The natality files also lack information on relationship history and thus on multipartnered fertility. Multipartnered fertility is more likely to occur if an individual's first birth is nonmarital (Guzzo and Furstenberg 2007), and it is associated with lower father involvement and poorer behavioral and health outcomes for children (Bronte-Tinkew et al. 2009a). Multipartnered fertility may be associated with greater conflicts of interest between men and women because men who experience multipartnered fertility may be expected to spread investment across children from several mothers. Subsequent male fertility with a new partner is associated with decreased visitation with, and child support paid to, children from

earlier unions as men shift investment from their previous children into their next relationship (Anderson 2011; Anderson et al. 1999; Manning and Smock 1999; Manning et al. 2003; Seltzer 1991).

There are substantial amounts of missing data in the natality files (Appendix 2). This may result in bias, especially if individuals who choose not to respond to certain questions differ from those who do. However, much of the missing data is at the state level, rather than the individual. For example, not every state uses the 2003 birth certificate (Appendix 1), and some states chose not to report specific variables for certain years. Since the natality files do not report geographic location, we cannot identify whether missing data occurs at the individual level, the state level, or some intermediate level (such as hospital or county). We also cannot perform random or mixed effects models to control for hierarchical clustering in the data.

Lastly, some of the natality data are self-reported by mothers, whereas others are matched by birth registrars from hospital records. A recent study comparing birth certificate data with medical chart records for samples drawn from two states found that many items had substantial or high sensitivity (i.e., exact agreement), indicating that the birth certificate data accurately reflected the medical records, though a few item had low or extremely low sensitivity (Martin et al. 2013). The study also found great variance across hospitals in the accuracy of reporting data. Items with high or substantial sensitivity included birthweight, gestational age, parity, payment method, and breastfeeding. Items with low sensitivity included number of prenatal care visits, gestational diabetes, and gestational hypertension. A separate study comparing birth certificates with hospital files found that hospital discharge data were marginally better at identifying gestational diabetes, and substantially better at identifying prepregnancy diabetes (Devlin et al. 2009). The natality data, while generally good, may underreport some health and medical variables, rendering some of the statistical tests presented here conservative.

Conclusion

This paper has argued that the voluntary establishment of legal paternity for children of unmarried parents is a proxy for both high male paternity confidence and men's willingness to invest in offspring. Drawing from life history theory and focusing on trade-offs between mating and parental effort, this paper offered three predictions regarding the factors predicting paternity establishment, and two regarding the relationship between paternity establishment and birth outcomes. Using data from 5.4 million births to unmarried American women, I found that paternity establishment was more likely when women had higher socioeconomic status; when women lacked chronic, gestational, or sexually transmitted diseases; and when children were male, low parity, or singleton births. I also found that paternity establishment predicted lower odds of preterm delivery, low birthweight, low Apgar scores, and being admitted to the neonatal intensive care unit, and also predicted higher birthweight and greater odds of being breastfed. Although some results varied across race/ethnic groups, most were consistent across these subpopulations. All of these results are consistent with a model of children as a collective good, with each parent's investment in children being influenced by the expected investment from the other parent. Important data

limitations included lack of information on cohabiting status, multipartnered fertility, and geographical location, and information on paternity establishment or breastfeeding following hospital discharge.

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Appendix 1

States using the 2003 revision of the US Standard Certificate of Live Birth

	2009	2010	2011	2012	2013
Alabama					
Alaska					x
Arizona					
Arkansas					
California	x	x	x	x	x
Colorado	x	x	x	x	x
Connecticut					
Delaware	x	x	x	x	x
District of Columbia	*				
Florida	x	x	x	x	x
Georgia	x	x	x	x	x
Hawaii					
Idaho	x	x	x	x	x
Illinois		x	x	x	x
Indiana	x	x	x	x	x
Iowa	x	x	x	x	x
Kansas	x	x	x	x	x
Kentucky	x	x	x	x	x
Louisiana		*	x	x	x
Maine					*
Maryland		x	x	x	x
Massachusetts			*	x	x
Michigan	x	x	x	x	x
Minnesota			*	x	x
Mississippi					x
Missouri		x	x	x	x
Montana	x	x	x	x	x
Nebraska	x	x	x	x	x
Nevada	*	x	x	x	x
New Hampshire	x	x	x	x	x

	2009	2010	2011	2012	2013
New Jersey					
New Mexico	x	x	x	x	x
New York (including New York City)	x	x	x	x	x
North Carolina		*	x	x	x
North Dakota	x	x	x	x	x
Ohio	x	x	x	x	x
Oklahoma	*	x	x	x	x
Oregon	x	x	x	x	x
Pennsylvania	x	x	x	x	x
Rhode Island					
South Carolina	x	x	x	x	x
South Dakota	x	x	x	x	x
Tennessee	x	x	x	x	x
Texas	x	x	x	x	x
Utah	x	x	x	x	x
Vermont	x	x	x	x	x
Virginia				*	x
Washington	x	x	x	x	x
West Virginia					
Wisconsin			x	x	x
Wyoming	x	x	x	x	x
Percentage of US births	66%	76%	83%	86%	90%

x = used the 2003 birth certificate for the entire calendar year

* began using the 2003 birth certificate during this calendar year

Sources: National Center for Health Statistics 2010, 2011, 2012, 2013, and 2014

Appendix 2

Restrictions in the analytical sample

	Number dropped	Number remaining
All births, 2009 - 2013		20,007,721
Married women	11,856,861	8,150,860
Used 1989 birth certificate	1,486,322	6,664,538
Missing paternity data	162,747	6,501,791
Used infertility treatments	15,611	6,486,180
Missing other data	1,058,491	5,427,689
Final analytical sample		5,427,689

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Biography

Kermyt G. Anderson is an assistant professor in the Department of Anthropology at the University of Oklahoma. He received his PhD in human evolutionary ecology from the University of New Mexico, followed by a postdoctoral fellowship in demography at the University of Michigan. His research focuses on paternity confidence, fatherhood, life history theory, trade-offs between mating and parental investment, educational attainment, HIV/AIDS risk behaviors, obesity and diabetes, and birth outcomes.

Table 1
Descriptive statistics (mean; SD provided for birthweight only) for analytical sample, by race/ethnicity

	White	African American	American Indian/Alaska Native	Asian	Hispanic
Paternity established	0.73	0.54	0.65	0.76	0.77
Premature delivery	0.12	0.17	0.14	0.12	0.12
Birthweight (g)	3250.96 (580.14)	3053.95 (624.17)	3310.75 (597.13)	3170.50 (548.98)	3251.88 (556.95)
Low birthweight	0.08	0.14	0.07	0.09	0.07
Low Apgar	0.02	0.03	0.03	0.01	0.01
Admitted to NICU	0.08	0.10	0.07	0.08	0.07
Breastfed in hospital	0.64	0.56	0.64	0.72	0.80
Year					
2009	0.16	0.14	0.17	0.16	0.18
2010	0.18	0.18	0.18	0.17	0.19
2011	0.22	0.22	0.21	0.21	0.21
2012	0.22	0.23	0.22	0.23	0.21
2013	0.23	0.24	0.23	0.23	0.21
Maternal age					
under 15	0.00	0.00	0.00	0.00	0.00
15-19	0.18	0.18	0.20	0.09	0.20
20-24	0.39	0.39	0.39	0.27	0.33
25-29	0.24	0.24	0.23	0.30	0.24
30-34	0.12	0.13	0.12	0.20	0.14
35-39	0.05	0.05	0.05	0.11	0.07
40-44	0.01	0.01	0.01	0.03	0.02
45+	0.00	0.00	0.00	0.00	0.00
Maternal education					
Less than high school	0.21	0.24	0.31	0.18	0.45
High school	0.38	0.37	0.37	0.31	0.32
Some college	0.34	0.32	0.28	0.34	0.19
College graduate	0.06	0.05	0.02	0.13	0.03
Postgraduate degree	0.02	0.01	0.01	0.03	0.01
WIC	0.66	0.75	0.73	0.63	0.81

	White	African American	American Indian/Alaska Native	Asian	Hispanic
Payment type					
private insurance	0.27	0.17	0.11	0.30	0.13
Medicaid	0.68	0.77	0.75	0.62	0.73
self-pay	0.02	0.02	0.02	0.04	0.08
other	0.04	0.04	0.11	0.05	0.06
Kotelchuck prenatal care index					
inadequate	0.21	0.28	0.34	0.24	0.25
intermediate	0.10	0.11	0.13	0.11	0.11
adequate	0.33	0.28	0.29	0.33	0.33
adequate plus	0.36	0.33	0.25	0.32	0.31
Prepregnancy BMI					
underweight	0.06	0.04	0.03	0.09	0.04
normal weight	0.47	0.38	0.37	0.58	0.44
overweight	0.23	0.26	0.27	0.20	0.28
obese	0.24	0.32	0.33	0.13	0.24
Diabetes					
Prepregnancy diabetes	0.01	0.01	0.01	0.01	0.01
Gestational diabetes	0.04	0.03	0.05	0.07	0.04
Hypertension					
Prepregnancy hypertension	0.01	0.03	0.02	0.01	0.01
Gest hypertension	0.05	0.06	0.05	0.03	0.03
Syphilis	0.0005	0.0026	0.0006	0.0009	0.0006
Hepatitis	0.02	0.02	0.02	0.03	0.01
Baby is male	0.51	0.51	0.51	0.51	0.51
Child's birth order					
Firstborn	0.53	0.43	0.40	0.51	0.42
Second born	0.26	0.27	0.25	0.27	0.28
Third born	0.13	0.16	0.17	0.12	0.17
Fourth born	0.05	0.08	0.09	0.05	0.08
Fifth born	0.02	0.03	0.05	0.02	0.03
Sixth born	0.01	0.02	0.02	0.01	0.01

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	White	African American	American Indian/Alaska Native	Asian	Hispanic
Seventh born or later	0.00	0.01	0.02	0.01	0.01
Singleton birth	0.98	0.96	0.98	0.98	0.98
<i>N</i>	2,129,053	1,315,271	77,360	120,248	1,785,757
<i>N</i> (breastfeeding)	1,944,800	1,199,653	69,830	73,636	1,206,090

all $p < 0.0001$

Table 2
Descriptive statistics (mean; SD provided for birthweight only) by establishment of paternity

	Established	Not Established
Premature delivery	0.12	0.15
Birthweight (g)	3228.67 (580.06)	3143.29 (606.25)
Low birthweight	0.08	0.11
Low Apgar	0.02	0.03
Admitted to NICU	0.08	0.09
Breastfed in hospital	0.70	0.58
Race/ethnicity		
White	0.41	0.35
African American	0.19	0.36
American Indian/Alaska Native	0.01	0.02
Asian	0.02	0.02
Hispanic	0.36	0.25
Year		
2009	0.16	0.16
2010	0.18	0.19
2011	0.21	0.22
2012	0.22	0.22
2013	0.23	0.22
Maternal age		
under 15	0.00	0.01
15–19	0.17	0.22
20–24	0.37	0.37
25–29	0.25	0.22
30–34	0.14	0.12
35–39	0.06	0.05
40–44	0.01	0.01
45+	0.00	0.00
Maternal education		
Less than high school	0.28	0.35
High school	0.36	0.36
Some college	0.30	0.26
College graduate	0.05	0.03
Postgraduate degree	0.01	0.01
WIC	0.73	0.74
Payment type		
private insurance	0.22	0.15
Medicaid	0.70	0.76
self-pay	0.04	0.05

	Established	Not Established
other	0.04	0.05
Kotelchuck prenatal care index		
inadequate	0.21	0.32
intermediate	0.11	0.11
adequate	0.34	0.27
adequate plus	0.35	0.30
Prepregnancy BMI		
underweight	0.05	0.05
normal weight	0.45	0.43
overweight	0.26	0.25
obese	0.25	0.28
Diabetes		
Pregpregnancy diabetes	0.01	0.01
Gestational diabetes	0.04	0.04
Hypertension		
Pregpregnancy hypertension	0.01	0.02
Gestational hypertension	0.05	0.05
Syphilis	0.00	0.00
Hepatitis	0.01	0.02
Baby is male	0.51	0.51
Child's birth order		
Firstborn	0.47	0.47
Second born	0.28	0.25
Third born	0.15	0.15
Fourth born	0.06	0.07
Fifth born	0.02	0.03
Sixth born	0.01	0.02
Seventh born or later	0.01	0.01
Singleton birth	0.98	0.97
N	3,772,148	1,659,334
N(breastfeeding)	3,041,243	1,452,766

All differences by paternity establishment significant at $p < 0.0001$

Table 3
Multivariate logistic regression of paternity establishment, by race/ethnicity

Year	White			African American			American Indian/Alaska Native			Asian			Hispanic		
	OR	SE		OR	SE		OR	SE		OR	SE		OR	SE	
2009 (baseline)	1.00			1.00			1.00			1.00			1.00		
2010	0.96	0.01	***	0.97	0.01	***	0.90	0.02		1.04	0.02	+	0.99	0.01	*
2011	0.95	0.00	***	1.00	0.01		0.79	0.02		1.09	0.02	***	0.97	0.01	***
2012	1.00	0.01		1.06	0.01	***	0.84	0.02		1.16	0.03	***	1.00	0.01	
2013	1.05	0.01	***	1.08	0.01	***	0.85	0.02		1.15	0.03	***	1.03	0.01	***
Maternal age															
<15	0.25	0.01	***	0.25	0.01	***	0.27	0.04		0.32	0.06	***	0.26	0.01	***
15–19	0.80	0.00	***	0.87	0.00	***	0.88	0.02		0.88	0.02	***	0.79	0.00	***
20–24 (baseline)	1.00			1.00			1.00			1.00			1.00		
25–29	1.08	0.00	***	1.10	0.01	***	1.00	0.02		0.91	0.02	***	1.18	0.01	***
30–34	1.03	0.01	***	1.11	0.01	***	0.96	0.03		0.75	0.02	***	1.23	0.01	***
35–39	0.95	0.01	***	1.10	0.01	***	0.92	0.04	*	0.58	0.02	***	1.16	0.01	***
40–44	0.80	0.01	***	1.09	0.02	***	0.85	0.07	+	0.47	0.02	***	1.03	0.02	*
45+	0.52	0.03	***	1.13	0.08	+	0.88	0.34		0.36	0.05	***	0.87	0.05	*
Maternal education															
Less than high school	0.66	0.00	***	0.59	0.00	***	0.66	0.01		0.60	0.01	***	0.88	0.00	***
High school	0.89	0.00	***	0.84	0.00	***	0.85	0.02		0.84	0.01	***	0.99	0.01	
Some college (baseline)	1.00			1.00			1.00			1.00			1.00		
College graduate	1.23	0.01	***	1.45	0.01	***	1.33	0.08		1.09	0.03	**	1.16	0.02	***
Postgraduate degree	0.94	0.01	***	1.41	0.02	***	1.59	0.19		0.91	0.04	*	0.96	0.02	+
WIC	0.94	0.00	***	1.07	0.00	***	1.13	0.02		1.02	0.02		1.24	0.01	***
Payment type															
private insurance (baseline)	1.00			1.00			1.00			1.00			1.00		
Medicaid	0.76	0.00	***	0.74	0.00	***	0.69	0.02		0.56	0.01	***	0.72	0.00	***
self-pay	0.64	0.01	***	0.64	0.01	***	0.56	0.03		0.38	0.01	***	0.62	0.01	***
other	0.65	0.01	***	0.69	0.01	***	0.62	0.02		0.56	0.02	***	0.64	0.01	***

	White		African American		American Indian/Alaska Native		Asian		Hispanic		
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	
Kotelchuck prenatal care index											
inadequate (baseline)	1.00		1.00		1.00		1.00		1.00		
intermediate	1.43	0.01	***	1.30	0.01	***	1.25	0.03	***	1.48	0.04
adequate	1.64	0.01	***	1.48	0.01	***	1.47	0.03	***	1.73	0.03
adequate plus	1.57	0.01	***	1.47	0.01	***	1.49	0.03	***	1.73	0.03
Pregnancy BMI											
underweight	0.97	0.01	***	1.00	0.01		1.01	0.04	***	0.92	0.01
normal weight (baseline)	1.00			1.00			1.00			1.00	
overweight	0.95	0.00	***	1.01	0.00	**	0.94	0.02		1.02	0.02
obese	0.83	0.00	***	0.93	0.00	***	0.89	0.02	***	0.97	0.02
Diabetes											
Prepregnancy diabetes	0.92	0.02	***	0.89	0.02	***	0.92	0.06		0.93	0.08
Gestational diabetes	1.10	0.01	***	1.04	0.01	***	1.03	0.04		0.96	0.03
Hypertension											
Prepreg hypertension	0.92	0.01	***	0.87	0.01	***	0.96	0.06		0.80	0.06
Gest hypertension	0.97	0.01	***	0.92	0.01	***	1.05	0.04		0.94	0.04
Syphilis	0.52	0.03	***	0.75	0.03	***	0.92	0.28		0.94	0.20
Hepatitis	0.59	0.01	***	0.80	0.01	***	0.80	0.04	***	0.90	0.03
Baby is male	1.01	0.00	***	1.03	0.00	***	1.04	0.02	**	1.01	0.01
Child's birth order											
First born (baseline)	1.00		1.00		1.00		1.00			1.00	
Second born	1.06	0.00	***	0.96	0.00	***	1.05	0.02	*	1.24	0.02
Third born	0.93	0.00	***	0.88	0.01	***	1.03	0.03		1.34	0.03
Fourth born	0.84	0.01	***	0.81	0.01	***	0.96	0.03		1.27	0.04
Fifth born	0.75	0.01	***	0.76	0.01	***	0.84	0.03	***	1.45	0.07
Sixth born	0.69	0.01	***	0.72	0.01	***	0.84	0.05	**	1.37	0.10
Seventh born or later	0.65	0.01	***	0.69	0.01	***	0.76	0.05	***	1.33	0.10
Singleton birth	1.14	0.01	***	1.11	0.01	***	1.12	0.06	*	1.23	0.06
Intercept	2.69	0.03	***	1.27	0.02	***	2.61	0.17	***	3.25	0.19
N	2,129,053		1,315,271		77,360		120,248		1,785,757		

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	White		African American		American Indian/Alaska Native		Asian		Hispanic	
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
LR χ^2_{39}	69544.73		56251.96		2279.89		5221.76		55966.66	
p	0.0000		0.0000		0.0000		0.0000		0.0000	

$p < 0.10$,
*
 $p < 0.05$,
**
 $p < 0.01$,

 $p < 0.001$

Table 4
Adjusted odds ratios of paternity establishment on birth outcomes, by race/ethnicity

	White		African American		American Indian/Alaska Native		Asian		Hispani c						
	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE					
Premature delivery	0.84	0.00	***	0.88	0.00	***	0.91	0.02	***	0.85	0.00	***			
Birthweight (g) ^a	44.50	0.85	***	29.37	1.04	***	33.88	4.30	***	13.49	3.60	***	36.75	0.94	***
Low birthweight	0.82	0.00	***	0.90	0.00	***	0.89	0.03	***	0.92	0.02	***	0.84	0.01	***
Low Apgar	0.85	0.01	***	0.86	0.01	***	1.02	0.05		0.88	0.05	*	0.82	0.01	***
Admitted to NICU	0.83	0.00	***	0.94	0.01	***	0.90	0.03	***	0.92	0.02	**	0.89	0.01	***
Breastfed in hospital	1.35	0.00	***	1.36	0.01	***	1.23	0.02	***	1.13	0.02	***	1.42	0.01	***
<hr/>															
N	2,129,053			1,315,271			77,360			120,248			1,785,757		
N(breastfeeding)	1,944,800			1,199,653			69,830			73,636			1,206,090		

^aOLS coefficient presented for birthweight only

Each cell of the table represents a separate multivariate regression, with only the odds ratio (or OLS coefficient) for paternity establishment shown. Models control for year, maternal age and education, WIC usage, payment type, adequacy of prenatal care, prepregnancy BMI, diabetes, hypertension, syphilis, hepatitis, baby's gender and birth order, and singleton vs multiple birth. All models significant at $p < 0.0001$

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$