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November 2010

November 7, 2010

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I am grateful for helpful comments and suggestions from Marianne Bertrand, Marianne Bitler, Shin-Yi Chou, Damon Clark, Diane Coffey, Taryn Dinkelman, Henry Farber, Elizabeth Frankenberg, Michael Geruso, Jonathan Guryan, Devon Haskell, William Hubbard, Edward Laumann, David Lee, Steven Levitt, Ethan Lieber, Dean Lillard, Lee Lockwood, Terra McKinnish, Alicia Menendez, Emily Oster, Andrew Oswald, Zhuan Pei, Seth Sanders, Diane Whitmore Schanzenbach, Sam Schulhofer-Wohl, Dean Spears, Linda Waite, Ji Yan, and Andrew Zuppann. This research was supported by a National Institute on Aging training grant (T32AG000243) at the Center on Demography and Economics of Aging at NORC and the University of Chicago, a Eunice Kennedy Shriver National Institute of Child Health and Human Development training grant (T32HD007163) at the Office of Population Research at Princeton University, a research grant from the Becker Center on Chicago Price Theory at the University of Chicago, and a research grant from the Center for Health and Wellbeing at Princeton University.

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Genevieve Pham-Kanter

Although the effect of parents on their children has been the focus of much research on health and families, the influence of children on their parents has not been well studied. In this paper, I examine the effect of the sex composition of children on mothers' physical condition, as proxied by their weight. Using two independent datasets, I find that, many years after the birth of their children, women who have first-born daughters weigh, on average, 2-6 pounds less than women who have first-born sons. This weight gap emerges around the time that the first-born child is in his or her pre-teen years and is largest during the child's teen years. I present indirect evidence that this gender weight gap is associated with bargaining power shifts and with mothers' appearance-centered behaviors in the presence of daughters, but find no support for the hypothesis that mothers with sons weigh more because sons eat more than daughters and induce mothers to eat more. I also show that it is unlikely that underlying biological factors like a Trivers-Willard effect are significantly biasing these estimates. Although this weight gap may appear small, weight gains of this magnitude may contribute to increased risk of breast cancer. This study is the first to show that children can have real impacts on the physical condition of their parents and points to a novel channel through which policy makers may be able to influence health.

1 INTRODUCTION AND BACKGROUND

Most research on health and families has focused, and understandably so, on the effect of parents on their children. There has been far less research on the effect of children on their parents even though we know that family members are important influences on each other. But for the same reasons that family conditions matter for child health, they also matter for adult health: the family provides an important setting for exposure to health risks and for decisions and behaviors that affect health outcomes.[1] For example, children can introduce income and relational shocks that not only affect parental incentives and behaviors, but that also affect parental physical and mental well-being; in other words, children cost money and can introduce marriage and other emotional stresses, thereby affecting parental health.

In this paper, I carefully consider one aspect of how children affect their parents and ask the question: how does the sex composition of children affect the physical condition of mothers? I also briefly analyze the physical condition of fathers but, in this paper, primarily focus on mechanisms for mothers. For the measure of physical condition, I focus on body weight, a measure that is well-defined, comparable across different surveys, and sensitive to physical changes in healthy adults.

I report two findings on the weight-related effect of children on their mothers. I find that mothers who have daughters appear to be, on average, thinner than mothers of sons many years after the birth of their children. To identify the causal effect of daughters versus sons, I specifically look at how the sex of the first-born child–whether the eldest child is a boy or a girl–affects maternal weight. Because the sex of the eldest child is arguably as good as randomly assigned, I can isolate the causal effect of the sex of the eldest child on a mother's weight. I find that women who have first-born daughters weigh, on average, 2-6 lbs less than women who have first-born sons. This weight gap emerges when the first-born

[1] Of course, childhood exposure to health risks may have long-lasting effects reaching into adulthood (see, for example, Almond (2006), Barker (1997), Black, Devereux, and Salvanes (2007), Case, Fertig, and Paxson (2005), and Currie (2000)), whereas the reverse is not true (one's health as an adult cannot affect one's health as a child). There still remains, however, a great deal of variation in adult health that is not explained by childhood conditions.

child is in middle school (in his or her pre-teen years) and increases during the child's teen years. Although this weight difference may appear small, a 6 lb weight gap may contribute to as much as a 10% increased risk of breast cancer (Eliassen et al. 2006).

I present evidence suggesting that this weight difference is related to increased bargaining power associated with having a son (mothers who have sons have marriages that are less likely to dissolve and can afford to take less care with their physical appearance). I also find that mothers with daughters are more likely to engage in behaviors that are centered on their physical appearance. In addition, I evaluate the possibility that a biological mechanism such as a Trivers-Willard effect could be responsible for this weight difference, and the possibility that, since sons eat more than daughters, sons might induce mothers to eat more and gain more weight. I find less evidence in support of these last two hypotheses.

These findings about bargaining power and mothers' appearance-oriented behaviors are surprising in light of several studies reporting that having daughters makes parents more socially progressive. Washington (2008) reports that legislators who have daughters are more likely to vote in favor of liberal and pro-feminist causes, and Oswald and Powdthavee (2009) show that parents with daughters are more likely to align themselves with Britain's liberal political parties.[2] The results reported in this paper suggest that, along some dimensions of private behavior, having daughters may make mothers behave in sex-stereotypical ways that are arguably less progressive.

More generally, this paper contributes to the literature on the often unexpected consequences of the sex of one's children. There is accumulating evidence that having a girl rather than a boy can significantly affect parental behavior–for example, the probability of getting divorced (Morgan, Lye, and Condran 1988; Dahl and Moretti 2008), how much parents work (Lundberg and Rose 2002, Lundberg 2005a), and as noted above, how parents vote (Washington 2008, Oswald and Powdthavee 2009)–to mention just a few of the many social consequences (Lundberg 2005b, Raley and Bianchi 2006). This will be the first paper to

[2] Conley and Rausch (2010), however, briefly report some results to the contrary.

demonstrate that, in addition to these social consequences, there are physical consequences as well.

This paper also contributes to the literature on social determinants of weight gain and obesity. Much of this literature has focused on the effect of neighborhood characteristics (for reviews, see Pickett and Pearl 2001, and Diez-Roux 2001). More recently, there has been an emphasis on examining the role of intimate relationships like friendships and spousal relationships (see for example, Christakis and Fowler 2007). This study is the first to examine the effects of children on the weight of their parents. Because the sex assignment of children to parents appears to be random, this study will also avoid some of the endogeneity problems that have made the accurate estimation of the effect of social factors so difficult.

Overall, this study suggests that children can affect the physical condition of their parents. These results are consistent with those of Powdthavee, Wu, and Oswald (2009), who find that parents who have daughters are less likely to smoke. Although much more research is required to parse through the many ways in which children can affect parental health, and the study reported here looks only at the circumscribed question of sex composition, these results point more broadly to a novel channel that policy makers may be able to use to influence health and health behaviors. For example, programs aimed at improving children's health habits may well have spillover effects on parents' health behaviors. If this is the case, policy makers may want to seriously consider and leverage the broader consequences of child-directed health programs.

2 DATA AND METHODS

2.1 Data

I use two independent data sets to look at the relationship between maternal body weight and sex of first-born children. Using these data sets, I first establish the empirical relationship between child gender and mother's weight. I then use these data in conjunction with a third data set to look at social mechanisms that might be generating this weight pattern.

The first data set is the 2002, or Cycle 6, of the National Survey of Family Growth (NSFG). The NSFG is a nationally representative cross-sectional survey of American women who are 15-44 years old. The survey asks women about their contraceptive practices, fertility history, and fertility plans. In 2002, NSFG also asked respondents about their weight. The second data set is the 2006 and 2007 Eating and Health module of the American Time Use Survey (ATUS). The ATUS is a nationally representative survey conducted annually between 2003 and 2008 which reports the amount of time that individuals spend daily in their household, work, and leisure activities. In 2006 and 2007, ATUS included an Eating and Health module which asked questions about eating patterns, general health, and body weight.[3]

The summary statistics from the NSFG and ATUS samples are reported in Table 1. For all of the analyses, I restrict my sample to white women, ages 22-44.

When I turn to consider the social mechanisms that might be generating these weight differences, I use additional data from ATUS as well as data from the Coronary Artery Risk Development in Young Adults (CARDIA) study. CARDIA is a longitudinal study of cardiovascular risk factors that sampled from 4 urban areas, and followed racially and educationally balanced subgroups of men and women ages 18-30 from 1985 to 2001. From CARDIA, I use data from the subgroup of women for whom I can identify the sex of the first child. Since sex of children is only recorded for children born between waves 1 and 2, my analysis is restricted to those women who had their first child between these two waves. The resulting sample is small but still illustrative. The summary statistics of the CARDIA sample are reported in Table 1. For other analyses, I also use ATUS weight data from fathers answering the ATUS survey, as well as time use data from all ATUS survey years (not just

[3] Unlike NSFG, ATUS does not report a full fertility history, but does report the age and sex of each child under age 18 in the household. Because of the age restriction of my analytic sample (women ages 22-44), the oldest child in the household is, in most cases, the first-born child. Measurement error in the sex of the first-born child would bias the estimate of the ATUS effect towards zero, so the true weight gap is likely to be even larger than the weight gap reported in this paper.

the years that ask questions about weight).

2.2 Model Estimation

For the base cross-sectional regressions, I estimate a model of the form:

$$\begin{aligned} Weight_i &= \alpha + \beta \mathbf{1}\{\text{1st child is girl}_i\} + \gamma \mathbf{1}\{\text{1st child is only child}_i\} \\ &+ \delta \mathbf{1}\{\text{1st child is girl}_i\} \times \mathbf{1}\{\text{1st child is only child}_i\} + \varepsilon_i \end{aligned} \quad (1)$$

where $Weight_i$ is the weight of individual i, $\mathbf{1}\{\text{1st child is girl}_i\}$ is a dummy variable indicating whether the first child is a girl, and $\mathbf{1}\{\text{1st child is only child}_i\}$ is a dummy variable indicating that the first child is the sole child in the family.[2] The "only child" variables are included to account for different weight patterns among the small minority of families who chose to or could only have one child (results from analyses based solely on families with more than one child are not substantively different from those reported here and are available upon request).

If sex of the first-born child is random, i.e. does not differ by family or mother characteristics, the effect of the sex of the child should be evident in this simple specification. In addition to the simple model, I estimate the model in (1) and include family characteristics and mother characteristics. In these regressions with controls, I include a variable indicating whether there is a younger daughter in the family, a variable indicating whether there is a younger son, the number of children in the household (and its quadratic term), and the mother's age (and its quadratic term).[4]

Since both NSFG and ATUS bottom- and top-code the values of their weight variable (at 108 lbs and 240 lbs in the case of NSFG, and 98 lbs and 330 lbs in the case of ATUS), I estimate the model in three ways. I first estimate the model by OLS and include the

[2]For the ATUS regressions, I also include a dummy variable for survey year since the data are aggregated across two survey years.

[4]I also estimate additional models with a full complement of control variables, including employment and labor variables and health variables. The inclusion of these variables does not change the point estimates; results are available upon request.

censored observations. I then estimate a Tobit model that accounts for the left- and right-censoring through explicit distributional assumptions. I also estimate quantile regressions which do not impose distributional assumptions and which should be largely insensitive to censoring. I report results from the quantile regressions for the 10th, 33rd, 66th, and 90th weight quantiles.

3 RESULTS

3.1 Identifying Assumption

The identifying assumption required for my estimates to be interpreted as causal is that sex of the first-born child is "random." More precisely, I assume that whether an individual has a first-born boy or girl is uncorrelated with other factors that determine her body weight.

Although I cannot directly test whether this assumption holds, I can provide evidence showing that the assumption is plausible. Tables 2a and 2b report the demographic, family, and physical characteristics of the two types of mothers. Overall, I find few differences in the observable characteristics of mothers who have first-born boys and those who have first-born girls.

Both types of mothers have similar average levels of education, similar employment statuses, and were of similar ages when they first gave birth. They also look very much alike when we examine various measures of well-being such as average height and likelihood of reporting that they are in "excellent health." Notably, in these samples, the mothers of first-born girls have the same average number of children as the mothers of first-born boys, and also have similar probabilities of having a younger daughter and of having a younger son. That is, there is no difference between the two types of mothers in the number of children or in the sex composition of children subsequent to the birth of their first child.

This contrasts with other studies (Ben-Porath and Welch 1976, Teachman and Schollaert 1989, Angrist and Evans 1998) where parents exhibit preferences for mixed-sex families;

given this mixed-sex preference, we would have expected that women with first-born daughters would have a slightly greater probability of having a younger son than mothers with first-born sons (and similarly but in the opposite direction with having a younger daughter).[3]

Because the reported effect of mixed-sex preference on fertility has tended to be small, it would most likely only be detected in very large samples. In the samples here, we do not see any evidence of mixed-sex preference, so these preferences (as manifest through different probabilities of having a younger daughter or having a younger son) are unlikely to be important sources of bias for this study. Nevertheless, some specifications do include variables for the presence of a younger daughter and for the presence of a younger son; the inclusion of these variables does not significantly change the point estimates of the effect of the first-born child.

Overall, Table 2 suggests that women who have first-born daughters are not different in important observable ways from women who have first-born sons, so the identifying assumption appears reasonable.

3.2 Changes in the Weight Distribution

Looking first, broadly, at the distributions of body weight of mothers of first-born girls and mothers of first-born boys, we see that, when the first-born child is 1-3 years old, there is very little difference in the weight distributions between the two types of mothers (Figure 1a). In this sample, the distributions appear similar for most of the weight range, although there does appear to be more of the heaviest mothers who have sons.

The distributions for the two types of mothers when their children are older–in the 16-18 year old age range–are shown in Figure 1b. Here, we see a distinct difference between the two distributions. While there is clearly a shift in density towards higher body weight for both kinds of mothers, there is a much larger shift for mothers of first-born sons who are in the middle of the weight distribution. This suggests that mothers of first-born sons,

[3] This is because, if these women have a mixed-sex preference–i.e. they want at least one boy and at least one girl–women who have children who are all of the same sex would keep having children until they have a child of the opposite sex.

especially those in the middle and upper parts of the weight distribution, gain relatively more weight as they and their children age.

3.3 Regression Results

Turning to regressions for a more detailed analysis, we see in Tables 3a (NSFG sample) and 3b (ATUS sample) that there are significant differences in the mean weights of mothers of sons and mothers of daughters in both samples. Focusing on the Tobit estimates, we see that in the NSFG sample, mothers of first-born daughters weigh on average 5-6 lbs less than mothers of first-born sons. In the ATUS sample, the mean weight difference is smaller, around 2 lbs.

We notice two additional patterns. First, in both data sets, the mean weight differences appear to be strongest among mothers who have (at most) a high school education. The point estimates for college educated mothers are also consistently negative although they are not statistically significant. These point estimates, however, suggest that there is a first-born daughter weight effect among these more highly educated mothers as well.

Secondly, the estimates from the quantile regressions are somewhat consistent with the patterns we saw in the figures. The NSFG estimates suggest that most of the sex of child effect is localized in the middle to upper part of the weight distribution of mothers. The point estimates from ATUS tell a slightly different story. These estimates suggest that, for the subgroup of women who appear to be driving the weight difference (high school educated mothers), the weight effect is present across the full range of body weights.

Taken altogether, the NSFG and ATUS estimates suggest that mothers of first-born girls–especially those mothers in the upper part of the weight distribution–weigh less than mothers of first-born boys. Moreover, the largest effect appears among mothers with a high school education, although there is some effect observed among college educated mothers as well. That estimates from these two independently collected data sets point in the same direction, are similar in size, and are larger among the same subgroups of women (e.g. high school educated mothers) strongly points to an effect of sex of first-born child on maternal weight.

3.4 Weight Differences by Age of Child

We can also look at weight differences by the age of the eldest child. Table 4 reports estimates from the ATUS data by age group of the first-born child. At this level of disaggregation, we see that a weight difference emerges among high school graduates (but not college graduates) when the first-born is 9-12 years old. A further interesting development is that, when the first-born child reaches his or her teen years, we observe a large weight difference in both high school educated mothers and college educated mothers. For both sets of mothers, women who have teenage first-born girls weigh, on average, 5-7 lbs less than those who have teenage first-born boys.

3.5 Summary of Results

By and large, the estimates from the two cross-sectional data sets are consistent with each other. Analyses using these two independent data sets suggest a weight difference of, conservatively, 2-4 lbs between women who have first-born girls and women who have first-born boys. There is of course heterogeneity in this sex of child effect. The largest effects appear to be among women who are in the upper part of the weight distribution and among women who are high school graduates. Among these mothers, a weight difference emerges when the eldest child is in his or her pre-teens; among college graduates, the weight difference emerges when the eldest child is in his or her teen years.

4 SOCIAL MECHANISMS

What might be possible reasons for this weight difference? I consider a number of social and biological hypotheses that might explain this weight gap. In the social realm, I consider the possibility that the sex of one's first child can affect, in substantive long-term ways, (bargaining) power relations within a marriage, sex-stereotypical behaviors that focus on physical appearance, and differential exposure to social eating environments that influence food consumption. In particular, having a son as opposed to a daughter could: (1) shift the balance of bargaining power in a marriage towards the mother, leading her to expend less effort in maintaining her weight; (2) attenuate the degree to which a mother attends to her physical appearance and weight; and (3) lead to mothers eating more because sons eat more. In addition to these social dimensions, I also take seriously the possibility that there are observed and unobserved health factors that may determine the different weight trajectories.

4.1 Bargaining Power in Marriage

Simply stated, bargaining power in marriage refers to a valued (yet unobserved) quantity that allows the spouse with relatively more of this quantity to be able to impose his or her preferences on the other spouse. In a popular economic model of bargaining within marriage, bargaining power is formally defined as the threat point or the utility that each spouse would derive from divorcing (Manser and Brown 1980; McElroy and Horney 1981). In social exchange theory, bargaining power is defined as the possession of material or non-material resources (Blood and Wolfe 1960; Heer 1963).

However bargaining power is defined, there appears to be empirical support for the claim that the birth of a son would shift bargaining power in favor of the wife. Morgan, Lye, and Condran (1988) find that marriages with sons are less likely to dissolve than marriages with daughters; they and others (Harris and Morgan 1991, Katzev, Warner, and Acock 1994) suggest that, among couples with sons, there is greater involvement of the father in family life and consequently greater marital stability. Dahl and Moretti (2008) report that men are more likely to marry women carrying their child if they know the fetus is a boy; if they divorce, men are more likely to have custody of their sons than their daughters. These authors claim that the weight of this and other evidence points to a bias among fathers in favor of sons.

These studies suggest that the presence of a son increases the father's commitment to and desire to be in a marriage. Viewed in relation to the definition of bargaining power mentioned above, the birth of a first-born son is an exogenous event that decreases the utility that a husband would derive from being divorced and hence decreases the bargaining power of the husband relative to the bargaining power of the wife (assuming she does not have a similar son preference).

How might this shift in bargaining power affect wives' weights? The bargaining power theories of marriage imply that the individual with greater bargaining power will be better able to impose his or her preferences. If we believe that maintaining one's weight is difficult or costly for women–either because restricting one's food consumption is arduous or because exercise takes time and effort–then women can use their increased bargaining power to expend less effort on maintaining their figure. In other words, if women prefer to not watch their weight, but men prefer their wives to stay slim, the shift in bargaining power in favor of the wife allows the wife's preferences to dominate so they can "let themselves go" and gain weight. I return to this bargaining power hypothesis in the next section when I discuss how we can indirectly evaluate this hypothesis.[5]

4.2 Sex-Stereotyped Behaviors

Another explanation for the weight gap is that women who have daughters may engage in more of what is known as sex-typed behaviors that are focused on their physical appearance. Sex-typing or sex-stereotyping are terms that refer to an individual's having stereotyped views of the abilities, roles, and interests of males and females. Thus, encouraging daughters to play with dolls and sons to play with trains is an example of a sex-typed behavior. In the psychology literature, expressing concern for and taking care of one's physical appearance and weight is considered sex-stereotypical behavior that is associated with a feminine orientation (Jackson et al. 1988). The sex-typing hypothesis, then, conjectures

[5] There are other models of bargaining within marriage–for example, Lundberg and Pollak (1993)–but they appear to be less applicable to the empirical question at hand.

that women who have daughters engage in more sex-stereotypical behavior which includes taking more care with their physical appearance and weight.

Notably, although mothers of daughters report more egalitarian attitudes towards gender roles than the mothers of sons (see for example, Downey, Jackson, and Powell 1994, and Warner 1991), there is evidence that, behaviorally, mothers engage in more sex-stereotypical behavior with their daughters than with their sons. Close observational studies of dyads (mother-daughter, father-son, mother-son, father-daughter) report that sex-typed behaviors among parents is much more prominent in same-sex dyads (mother-daughter and father-son) than in opposite-sex dyads (see for example, Juni and Grimm 1993, and Jacklin, DiPietro, and Maccoby 1984); women are more likely to engage in play activities that are less aggressive, more verbal, and more emotional when they are with their daughters, for example. In general, mothers appear to tone down their (female) sex-typed behavior when they are with their sons, but ratchet them up when they are with their daughters. This suggests that women may spend more time and expend greater effort on the sex-stereotypical behavior of maintaining their physical appearance and weight if they have daughters. This, in turn, could explain why mothers of first-born daughters weigh less than mothers of first-born sons.

4.3 Socially Influenced Eating

In addition to the bargaining power and sex-stereotyping hypotheses, a third possibility is that having boys influences how much and the kind of food that mothers eat. In the social eating hypothesis, eating with others who have different caloric needs influences one's own eating. Within the family, the caloric needs of children influence parental caloric intake, and reciprocally, parents' caloric needs influence children's eating. In the simplest model, individual eating is, in equilibrium, determined by the relative caloric needs of all family members, and individuals with the least caloric needs eat more than they would otherwise eat, while those with the greatest needs eat less than they would otherwise eat.

Since boys have higher caloric needs and greater caloric intake than girls (Berkey et al 2000), we expect that, *ceteris paribus*, women who have a first-born son will eat more food in general and eat more high-calorie foods in particular than women who have a first-born daughter. This difference is likely to be larger when the children reach their teen years, a period in which there is a greater gap in sex-specific caloric needs. In this way, socially influenced eating could generate the weight gap between women with first-born sons and those with first-born daughters.

5 EVALUATING SOCIAL HYPOTHESES

There is no obvious test that cleanly distinguishes among the three candidate hypotheses. Moreover, the three mechanisms need not be mutually exclusive, and all three could very well be operating concurrently. Although the data do not exist to directly examine whether these (sometimes psychological) mechanisms are indeed generating the weight gap, we can look at the predictions of the different hypotheses and see whether the empirical patterns we observe are consistent with, or contradict, these predictions. In this section, I derive qualitative predictions of the three hypotheses and look at whether the data are consistent with these predictions. I find that there is some empirical support for the bargaining power and sex-stereotyping mechanisms. I find little empirical evidence for the social eating hypothesis.

5.1 Bargaining Power in Marriage

Marital status

For the bargaining power mechanism to operate, there must be someone with whom the mother can bargain. Put differently, if bargaining power is generating the weight difference between the mothers of first-born sons and the mothers of first-born daughters, it can only do so if there exists a husband who cares about the sex of the first-born child. If there is no husband or partner, there is no bargaining power to be lost or gained. Thus, one implication of the bargaining power hypothesis is that we should observe a weight difference among married women, but not among never married or divorced mothers.

Table 5 reports the estimates from ATUS for these two separate subsamples: married and cohabiting mothers, and unmarried and divorced mothers. We see that, among married and cohabiting mothers, women who have first-born daughters are indeed thinner than women who have first-born sons. Among never married or divorced mothers, however, we see no such relationship, at least among high school educated mothers. Among college educated mothers who have never been married or are divorced, we see a rather puzzling larger weight difference, although the size of this subgroup is rather small and the standard errors are large. These patterns suggest that bargaining power may be an important mechanism for high school educated mothers, but that a different mechanism may be responsible for weight differences among college educated mothers.

5.2 Sex-Stereotyped Behaviors

5.2.1 Time use

If women with first-born girls engage in more sex-typed behavior related to their physical appearance, we should be able to see these differences in the time spent attending to their grooming and physical appearance. Table 6 reports the effect of having a first-born girl on the amount of time women spend grooming or using personal care services each day.

We see that having a girl appears to have little effect on weight when the child is young; indeed, if there is any effect at all at younger ages, having a girl seems to decrease the amount of time that mothers spend on grooming. When the first-born child reaches high school, however, we see that mothers with first-born daughters spend, on average, about 3 additional minutes grooming relative to mothers with first-born sons.

We see similar patterns when we look at time spent on personal care services. These services include grooming-like activities dispensed by service providers such as getting a haircut, receiving a manicure or a pedicure, or going to a tanning salon. When the first-born is a teenager, mothers with daughters spend on average 3 additional minutes engaging in personal care services. Extrapolating, these results suggest that women with first-born teenage daughters spend, in an average week, 40 more minutes in grooming and personal care activities than mothers with first-born teenage sons. Notably, we see an increase in time spent on these physical appearance-related activities among both college educated and high school educated women.

Adolescence is exactly the period in which we would expect that mothers' sex-typed behaviors, especially as these behaviors relate to physical appearance, might be particularly pronounced. It is during the teen years that body image concerns and the development of secondary sex characteristics–which serve to further differentiate females from males–become particularly salient for young women, and this may reinforce mothers' sex-typed behaviors related to physical appearance. (The psychological mechanisms that may be driving these behaviors are discussed in the next section.)

There remain a few puzzles in the time use results, however. We would expect to see, when the first-born children are in their pre-teen years, a daughter effect among high school educated mothers but not college educated mothers (if these time use patterns are to be consistent with the weight patterns observed). Instead, we see a daughter effect among college educated mothers and an effect of the opposite sign among high school educated mothers; that is, college educated mothers with daughters spend more time in grooming and personal care activities, while high school educated mothers with daughters spend less time when their daughters are pre-teens. Looking more closely at these high school educated mothers, we see that these mothers appear to be shifting their time from grooming and personal care to shopping. Shopping itself may well be associated with physical appearance concerns if these mothers are, say, shopping for clothes, but at this point, we would be veering into unsubstantiated speculation about the behaviors of these mothers.

The time use data thus tell a complicated story. We can say, however, at least in the teen years, mothers' time use is consistent with the sex-stereotyped behavior hypothesis:

mothers with first-born daughters spend an average of an additional 40 minutes per week in grooming and personal care activities relative to mothers with first-born sons. In the pre-teen years, however, time use does not fully explain weight patterns that we observe.

5.2.2 Body image ratings

The time use data showed us that women with first-born daughters who are teenagers spend more time taking care of their physical appearance. This suggests that having a daughter may have effects on mothers' body image and on mothers' incentives to take care of their appearance.

In the 4th wave of the CARDIA study, respondents were asked questions about their self-image and particularly their body image. In my analyses, I focus on two types of body image measures. One type measures what is conventionally called appearance evaluation and is derived from questions related to how attractive women think they are; the second type relates to what is known as appearance orientation and is derived from questions about how preoccupied women are with their physical appearance. For both types of measures, I report an example of a specific question that was asked and also a summary measure.

Table 7 reports the estimates of the relationship between sex of first child and these two types of body image measures. We can see that among low weight women, having a first-born girl has a significant negative effect on their evaluation of their appearance. That is, low weight women who have girls, on average, rate themselves as less physically attractive than low weight women who have boys. Moreover, the signs of the point estimates of the summary measure suggest that, across the full range of body weights, having a first-born girl negatively affects mothers' assessments of their physical attractiveness.

When we turn to look at measures of orientation towards physical appearance–i.e. attention to and concern about one's physical appearance–we see that having a first-born girl increases some mothers' orientation towards their physical appearance. Women at the tails of the weight distribution and who have first-born girls appear to be more concerned about their physical appearance than similar weight mothers who have first-born boys. Thus, having a first-born girl increases mothers' attention to their physical appearance and lowers mothers' assessments of their physical attractiveness.

Overall, the CARDIA and time use results point to mothers of daughters feeling worse about their physical appearance, being more concerned about their physical appearance, and when their daughters are in their teen years, spending more time in grooming and personal care. We cannot, however, distinguish among all possible psychological mechanisms that might be at work in generating the weight differences we observe. Possible mechanisms might be: mothers are simply more conscious of their physical appearance during their daughters' teen years because the daughters are more conscious of their own appearance; mothers feel competitive with their daughters; mothers want to act as gender role models and so exaggerate their sex-typed behaviors; daughters are more critical of the physical appearance of their mothers; mothers enjoy grooming and personal care activities more when they have daughters because it is more fun to do these activities with their daughters. Although we cannot distinguish among all of these mechanisms, the CARDIA and ATUS results do provide evidence for mothers of daughters engaging in more appearance-related sex-typed behaviors which might generate the lower average weights that we observe.

5.3 Socially Influenced Eating

5.3.1 Marital status

Whereas the bargaining power hypothesis implies that there will be a weight gap among married mothers but not among single mothers, the social eating hypothesis implies no such difference. That we observe a weight difference among married and cohabiting mothers but not among divorced and never married mothers is one piece of evidence against the social eating hypothesis.

5.3.2 Gender weight gap among fathers

If the greater exposure to high calorie environments associated with having a first-born son affects mothers, we would expect that they would affect fathers in a similar way. Since equilibrium eating is determined by the relative caloric needs of all of the family members, then *ceteris paribus*, the weight effect of a first-born son relative to a first-born daughter should be in the same direction for both fathers and mothers. We would thus also expect a gender weight gap among fathers. Table 8 reports ATUS estimates for fathers.

In contrast to the patterns with mothers' weights, we see that fathers of first-born daughters weigh, on average, more than fathers with first-born sons. Whether we are looking at differences in mean weights or differences in quantile weights, we see that fathers who have daughters tend to weigh several pounds more than fathers who have sons.

While we might interpret this as daughters conferring more bargaining power to fathers in the same way that sons confer more bargaining power to mothers, there are two difficulties with this interpretation. First, it requires that additional bargaining power be manifest physically in men in the same way that it does in women; however, we might think that, for men, there may be other dimensions along which men might adjust–for example, working fewer hours or making less money–because, according to conventional wisdom, physical appearance is not valued an attribute in men (husbands) as it is in women (wives). Second, if the weight difference in men reflects a shift in bargaining power, we would expect this weight gap to be more evident among fathers who are high school graduates because they would be more likely to be married to women who are high school graduates (and these women show the largest weight gap). That we observe a bigger weight gap for men who are college graduates suggests that bargaining power may not be a part of the story of the weight gap for men.

Exactly what is generating a weight gap in the opposite direction for fathers of daughters remains unclear. What this weight gap among fathers does tell us is that the social eating mechanism is not likely to be responsible for the weight difference that we observe in mothers.

Overall, then, we see that the data do not support the hypothesis that increased exposure to higher calorie environments associated with having a first-born son is responsible for the weight difference. There is some evidence consistent with the bargaining power mechanism, and there is support for the hypothesis that women themselves are more critical of and spend more time on their physical appearance when they have a first-born daughter.

6 BIOLOGICAL MECHANISMS

Finally, in addition to the social mechanisms that might explain this gender weight gap, there may very well be biological explanations. I consider two different mechanisms that might generate the observed weight gap. First, I consider the possibility of an omitted biological or health factor that affects both the likelihood of having a boy and the likelihood of subsequent weight gain. If, say, healthier women are more likely to give birth to a boy and are more robust or efficient in their weight gain, this might explain the difference in weights between mothers of boys and mothers of girls. In the biological literature, this possibility is formalized in the Trivers-Willard hypothesis (Trivers and Willard 1973). I present two ways in which I test whether a Trivers-Willard mechanism might be operating and find that this mechanism is unlikely to generate weight differences of the size that we observe.

Second, I consider whether there may be a direct effect of the sex of one's child on subsequent weight gain. If having a boy changes maternal physiology such that she is more likely to gain weight, this may also explain why mothers with first-born sons are heavier. I review the medical literature related to this hypothesis and present evidence that argues against this possibility.

6.1 Trivers-Willard mechanism

In the biomedical literature, very few things outside of sex-selective abortion have been found to be clear determinants of the sex of one's child. One subtle but real possibility, however, is that healthier women may be more likely to give birth to sons. Known as the Trivers-Willard hypothesis, healthier females of species where males have multiple partners (including, alas, humans) are thought to have a higher probability of giving birth to sons (Trivers and Willard 1973).

The Trivers-Willard hypothesis is relevant for this analysis because there may be some unobservable health condition that contributes to both higher weight and a higher probability of giving birth to a boy. More precisely, if better health is responsible for both greater weight retention after birth and for a greater likelihood of having a son, the estimates in Tables 3 and 4 could be biased.

There is some indirect support for the Trivers-Willard hypothesis when one estimates associations between socioeconomic status and the sex ratio, but the effect size is unclear. Almond and Edlund (2007) report that women who have some college education and are married are, on average, 0.80% more likely to give birth to a son than women who are unmarried and who have never finished high school. Cameron and Dalerum (2009), however, report that women who bore children with billionaires produced sons 65% of the time (relative to the 51% rate in the general population) although women who were billionaires in their own right through inheritance or their own earnings were not more likely to produce sons than the general population.

To deal with the Trivers-Willard possibility, I first identify an exogenous health shock that appears to have affected some women's likelihood of bearing a son, and look for documentation of weight change associated with that shock among these women. I also review the broader biomedical literature and look for factors thought to affect the sex ratio in humans. I identify several health conditions that are known to affect the probability of having a son and review the literature on these conditions to see if they are associated with body weight or with postpartum weight gain or loss. These two investigations should give us an estimate of the degree to which biological associations might account for the coefficients I report.

Turning to the first approach, I consider the effect of the health shock of the 1959-1961 China famine. Almond, Edlund, Li, and Zhang (2007) document some socioeconomic and health consequences for women (and men) who were prenatally exposed to the China famine.

They find that this cohort was adversely affected along a number of different dimensions, including having lower literacy rates, a greater likelihood of being unemployed, and a lower likelihood of being married. They also find that women who were in utero during the famine were more likely to bear daughters than cohorts who were in utero prior to or after the famine. Taken in toto, their study suggests that in utero exposure to the China famine resulted in adverse adult health consequences which are associated with about a 0.4 percentage point lower likelihood of giving birth to sons.

What are the consequences of prenatal exposure to the China famine for adult weight? I was able to find one study that reported on the weight consequences of the famine: Luo, Mu, and Zhang (2006); it estimates the likelihood that women prenatally exposed to the famine are overweight as adults. This study finds that women with the greatest in utero exposure to the famine are 0.086 percentage points more likely to be overweight. The result from the China famine literature suggests, then, that the health conditions that increased the likelihood of bearing girls also tended to increase the likelihood of these women being overweight rather than being underweight.

Recall our original concern with the Trivers-Willard hypothesis. My analysis showed that mothers with first-born girls weighed less than mothers with first-born boys. We were concerned that some or all of this effect might be caused by some unobserved adverse health factor that increased women's likelihood of bearing girls and that is also associated with lower weight. The China famine data suggest that, at least for health risks related to the famine and more generally related to deficient prenatal nutrition (Barker 1997), an increased likelihood of having daughters is actually associated with higher weight not lower weight. This provides suggestive evidence that the effect I report is, firstly, not likely due to unobserved Trivers-Willard-type health risks that are caused by poor prenatal nutrition, and secondly, may be an underestimate of the true effect since these types of unobserved health factors tend to increase weight.

Reviewing the biomedical literature on sex ratios, I find that, although theories abound, there appear to be few documented health conditions which are known to consistently affect women's probability of having boys. According to a review by James (1987), four health conditions are known to be associated with the sex ratio: (1) non-Hodgkin's lymphoma, which increases the probability of having a girl; (2) preeclampsia (hypertension) in pregnancy, which increases the probability of having a boy; (3) multiple sclerosis, which increases the probability of having a boy; and (4) hepatitis B infection, which increases the probability of having a boy.

Of these conditions, multiple sclerosis is not systematically related to weight gain, weight loss, or weight levels. There is some evidence that obesity is associated with non-Hodgkin's lymphoma (Larsson and Wolk 2007) and the likelihood of preeclampsia (Redman and Sargent 2005). Of these two conditions, only the presence of preeclampsia could misleadingly inflate the estimates reported here (non-Hodgkin's lymphoma would generate a weight gap in the opposite direction). With hepatitis B, there is evidence that chronic hepatitis B (not acute or past infection) is associated with metabolic syndrome, which is linked to diabetes and obesity (Yen et al. 2008). Thus, among the 4 conditions, preeclampsia and chronic hepatitis B would be the health conditions most likely to bias the reported estimates.

To determine the degree of the potential bias, I compute the weight gain that must be associated with preeclampsia and chronic hepatitis B if they are responsible for the weight difference that I report. That is, if the true difference between the weights of mothers of sons and mothers of daughters is zero, then what must the weight gain associated with preeclampsia and chronic hepatitis B have to be to account for the estimates I report? The methodology used to compute these estimates is detailed in the appendix.

Because of the small changes in the sex ratios associated with and the relatively low prevalences of preeclampsia and hepatitis B, I find that the weight gain associated with either condition must be extremely large to generate the reported estimates. For example, given that the average weight difference I observe for first-born children is, conservatively, 1.7 lbs (Table 4), then the weight gain associated with preeclampsia would have to be a whopping

566 lbs, while the weight gain associated with chronic hepatitis B would have to be 68 lbs, to generate that 1.7 lb weight gap if there were no true weight difference between mothers of daughters and mothers of sons.

Clearly, this kind of weight gain is implausibly large. The reason for these absurd weight values, as I noted, is that changes in the sex ratio induced by preeclampsia, hepatitis B, and other conditions that affect the sex ratio is very small, and their prevalence rates are relatively low as well (3%-5%). The presence of preeclampsia or chronic hepatitis B would therefore be unlikely to seriously bias my estimates.

This kind of argument of generalizes. There may well be any number of health risks, yet unidentified, that affect both sex ratios and weight gain. The above calculations show, however, that the candidate condition would need to affect sex ratios to an even greater degree than the ones I identified above, and/or also have greater population prevalence, to plausibly generate even a 2 lb weight gap. It is unlikely that a condition that has such large specific biological effects still remains to be unidentified. Overall, these results, along with the China famine analysis, provide evidence that the weight gap between mothers of first-born sons and mothers of first-born daughters is unlikely to be wholly driven by a Trivers-Willard mechanism.

6.2 Direct effect of sex of child

Is it possible that there is a direct effect of the sex of one's first-born child on maternal weight? That is, does having a boy predispose mothers towards greater weight gain subsequent to birth? The available evidence argues against this biological hypothesis.

First, there is no evidence in the medical literature that fetal sex changes the physiology of women in general, or predisposes them towards weight gain in particular. Despite the abundance of research on gestational and postpartum weight gain, there are no studies suggesting that this kind of physiological change or a mechanism for this kind of change exists. Moreover, if such a mechanism did exist, we might expect this weight gain to appear within, say, several years after the birth of the baby; instead, we see the weight gap first emerging, at the earliest, a full 9 years after birth, making it unlikely that a physiological change engendered by fetal sex is primarily responsible for the observed weight gap.

A second possibility is that, even if there is no change in maternal physiology, perhaps mothers who carry boys gain more weight during pregnancy than those who carry girls. Since on average boys weigh more than girls at birth,[6] perhaps mothers with male fetuses gain more weight during pregnancy and have more difficulty losing the weight after pregnancy.

In the medical literature, however–where weights of expectant mothers are carefully measured and closely followed–there is no evidence that fetal sex affects maternal weight gain (see for example, Dawes and Grudzinskas 1991). That is, on average, mothers who carry male fetuses gain as much as weight as mothers who carry female fetuses (about 24 lbs). Indeed, given that males weigh more at birth than females, if there is any difference in the postpartum of weight of mothers, we would expect mothers of sons to weigh *less* than mothers of daughters after birth. Thus, this purely mechanical weight gain mechanism cannot explain the maternal weight differences reported in this paper.

In general, then, there does not appear to be any evidence that fetal sex physiologically or mechanically changes mothers' predisposition towards gaining weight. Thus, the biological hypothesis of a direct effect of fetal sex is unlikely to account for the 2-6 lb weight difference we observe.

7 CONCLUSION

In summary, this paper presents evidence that mothers of first-born sons weigh several pounds more than the mothers of first-born daughters many years after the birth of their children. This weight gap emerges around the time that the first-born child is in his or her pre-teen years and is largest during the child's teen years. Although nominally small, weight differences of this size are associated with increased risk of breast cancer.

[6] Boys, on average, weigh about 100 gm (0.2 lbs or 3.5 oz) more than girls at birth.

I find indirect evidence that some part of this gender weight gap is driven by mothers with daughters focusing more on their physical appearance, feeling worse about their appearance, and spending more time maintaining their appearance. I also report evidence consistent with the hypothesis that increased bargaining power associated with the birth of a son leads to mothers of sons weighing more, but find no support for the hypothesis that mothers with sons are heavier because they eat more in the presence of their sons. I also show that it is unlikely that underlying biological factors like a Trivers-Willard effect are significantly biasing these estimates.

One mechanism not explored in this paper is the role of labor supply. The empirical evidence for the effect of child gender on mothers' labor supply is complicated. Lundberg (2005a), using data from the 1979 National Longitudinal Survey of Youth, finds that high school educated mothers decrease their labor supply after they have a son, while college educated mothers increase their labor supply. In previous work with data from the Panel Study of Income Dynamics, however, Lundberg and Rose (2002) find no effect on mothers' labor supply. Lundberg (2005b) suggests that these differing results may be the result of the two data sets sampling from different birth cohorts.

In the cross-sectional data sets used for this paper, there does not appear to be any difference in mothers' labor supply by sex of first child (Table 2), and the inclusion of employment status as a control does not change the basic estimates. Nevertheless, in light of previous work, one might imagine that the labor supply of mothers (and fathers) might vary as a function of the age of the first boy or girl and of the age of subsequent children, and that this might have an effect on maternal weight and health. Study of this mechanism requires modeling and estimating the dynamics of labor supply, related behaviors, and body weight as children age. More broadly, a careful study of the dynamics of the effects reported here, using a variety of longitudinal data sets, would be a useful extension.

For now, these cross-sectional results do point to children having a real impact on the physical condition of their parents. They also hint at the possibility that health policies targeted at children could have positive spillover effects for parents. For example, programs that provide incentives for children and parents to participate in exercise activities together would certainly be good for children, but may also be good for parents as well. The exact mechanisms underlying specific spillover effects are likely to be nuanced and would need to be carefully studied. As an example, the section discussing the social eating mechanism showed that sons' higher caloric intake did not appear to affect mothers. This result suggests that healthy eating programs directed at children may not directly translate to healthier eating among parents, or perhaps that there are sex-specific effects in these spillovers (mothers may be more influenced by daughters than by sons). Although the results presented in this paper focus on the gender effects of children on parents, the fact that children appear to affect the physical condition of their parents does more generally suggest a novel channel through which health policy may be mediated.

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Table 1. Summary statistics

	Weighted Mean or Proportion		
	2002	2006 & 2007	1985-2001
Variable	NSFG	ATUS	CARDIA
Mean age	33.5	34.2	31.9[a]
Mean age at first birth	25.4	25.3	27.2
% High school diploma	63.2	55.8	45.8[b]
% College graduate	26.8	32.7	54.2[b]
Annual family income			
% $\geq \$15,000$ and $< \$30,000$	18.5	12.7	26.7[c]
% $\geq \$30,000$ and $< \$50,000$	22.1	19.4	30.2[c]
% $\geq \$50,000$ and $< \$75,000$	21.1	19.9	22.1[c]
% $\geq \$75,000$	25.9	30.2	20.9[c]
% Employed part-time	18.6	10.6	59.2[d]
% Employed full-time	42.0	33.4	33.3[d]
Marital status			
% Married	78.9	81.8	81.8[e]
% Divorced	7.4	6.7	9.1[e]
% Never married	7.2	8.3	0.0[e]
% with first-born daughters	50.0	48.6	41.7
Mean age of oldest child	8.1	8.5	6.3[d]
Mean parity (no. of children)	1.0	2.0	2.1[e]
Mean weight (lb)	155[f]	155[f]	133[a]
Median weight (lb)	146	145	133[a]
Sample size	1789	3143	24

[a]Averaged over all survey years.

[b]In 1987/1988, i.e. in the survey year immediately after first birth.

[c]Averaged over survey years for which this measure is available (1990-2001). Categories do not exactly correspond to those of ATUS and NSFG, and are: % $\geq \$16,000$ and $<\$34,999$; %$\geq \$35,000$ and $<\$49,999$;%$\geq \$50,000$ and $<\$74,999$; %$\geq \$75,000$.

[d]Averaged over all years beginning with the survey year immediately after first birth (1987-2001).

[e]In 2000/2001, i.e. last survey year available.

[f]This mean value includes all observations. For NSFG and ATUS, this includes censored values where NSFG observations are left-censored at 108 lbs and right-censored at 240 lbs, and ATUS observations are left-censored at 98 lbs and right-censored at 330 lbs.

Table 2a. Mother characteristics by sex of eldest child, NSFG and ATUS samples

	2002 NSFG			2006-2007 ATUS		
Variable	FB boy	FB girl	t-stat of diff	FB boy	FB girl	t-stat of diff
Age	33.5	33.5	0.19	34.2	34.2	0.46
Age at first birth	25.4	25.5	0.14	25.6	25.8	1.78
% High school diploma	63.9	62.4	0.63	54.8	56.8	2.06
% College graduate	26.3	27.4	0.48	33.0	32.4	0.55
% Employed part-time	18.0	19.2	0.55	11.4	9.8	2.96
% Employed full-time	40.3	43.7	1.34	32.7	34.1	1.32
Mean height (in)	64.7[a]	64.7[a]	0.26	64.4[a]	64.6[b]	2.79
Median height (in)	65.0	65.0	0.23[b]	64.0	65.0	0.12[b]
% Ever had miscarriage	24.8	28.0	1.21	..	..	..
% Reporting excellent health	32.2	33.3	0.32	21.7	22.0	0.29
Mean parity (no. of children)	1.9	1.9	0.57	2.0	2.0	0.00
Mean age of oldest child	8.1	8.1	0.07	8.62	8.48	1.11
Another daughter in the family	40.5	42.2	0.55	41.1	39.4	1.55
Another son in the family	38.3	37.0	0.36	41.7	41.4	0.30
Sample size	914	875		1617	1526	

[a]These mean values include all observations. For NSFG, this includes censored values (left-censored at 60 in, right-censored at 70 in).

[b]χ^2 statistic for difference of medians test (p=0.630 for NSFG and p=0.279 for ATUS).

Table 2b. Mother characteristics by sex of eldest child, CARDIA sample

Variable	2002 NSFG FB boy	FB girl	t-stat of diff
Age	32.3	31.5	0.73
Age at first birth	27.4	27.0	0.25
% High school diploma	57.1	30.0	1.32
% College graduate	42.9	70.0	1.32
% Employed part-time prior to first birth	42.9	40.0	0.13
% Employed full-time prior to first birth	57.1	60.0	0.13
% Employed part-time after first birth	58.6	60.0	0.16
% Employed full-time after first birth	34.3	32.0	0.26
Mean height (in)	64.5	64.5	0.03
Median height (in)	64.2	64.2	0.00[a]
Mean weight prior to first birth (lb)	124.7	123.4	0.19
% Ever had marriage	28.6	10.0	2.94
Mean parity (no. of children)	2.1	2.1	0.09
Mean age of oldest child	6.3	6.3	0.09
Sample size	14	10	

[a] χ^2 statistic for difference of medians test (p<0.001 for NSFG).

Table 3a. Mother's weight and whether first-born is girl, NSFG sample

Dependent variable: Mother's weight (lb)	G-B diff OLS (1)	G-B diff Tobit (2)	G-B diff at selected quantiles 10^{th} (3)	33^{rd} (4)	66^{th} (5)	90^{th} (6)
I. Base regression (no controls)						
A. All mothers						
First-born is girl	-5.391*	-5.705*	0.000	-3.000*	-9.000*	-14.000**
	(2.955)	(-3.281)	(2.527)	(1.623)	(4.671)	(6.300)
B. HS educated mothers						
First-born is girl	-7.438**	-7.665*	2.000	0.000	-14.000***	-20.000**
	(3.520)	(4.010)	(4.252)	(0.788)	(4.827)	(9.920)
C. College educated mothers						
First-born is girl	-3.291	-3.988	-1.000	0.000	-4.000	-18.000
	(5.788)	(6.289)	(3.218)	(4.196)	(7.645)	(15.531)
II. With controls						
A. All mothers						
First-born is girl	-5.134*	-5.406*	1.296	-2.194	-7.461**	-15.182**
	(2.868)	(3.193)	(1.479)	(2.418)	(3.290)	(7.641)
B. HS educated mothers						
First-born is girl	-7.962**	-8.295**	1.938	-0.826	-15.000***	-24.000***
	(3.290)	(3.775)	(1.556)	(1.178)	(5.238)	(5.423)
C. College educated mothers						
First-born is girl	-2.254	-2.923	0.504	0.000	2.397	-11.654
	(5.295)	(5.754)	(2.000)	(2.398)	(6.696)	(14.508)
Mean weight (all)[a]	156	156	115	134	165	214
Mean weight (HS only)[a]	159	159	115	135	170	220
Mean weight (college)[a]	149	149	115	128	154	208

*p=0.10 **p=0.05 ***p=0.01 Sample: 2002 NSFG (n=1789 for all mothers, of whom 1113 are high school graduates and 450 are college graduates). The base regression includes whether first-born child is a girl, an indicator whether the first-born is an only child, and an interaction between sex of the first-born and the only child indicator. The regression with controls includes the variables in the base regression as well as a variable indicating the presence of a younger daughter, a variable indicating the presence of a younger son, parity (number of children) and its quadratic, and mother's age and its quadratic.

[a]Constant term from base regressions.

Table 3b. Mother's weight and whether first-born is a girl, ATUS sample

Dependent variable: Mother's weight (lb)	G-B diff OLS (1)	G-B diff Tobit (2)	G-B diff at selected quantiles 10^{th} (3)	33^{rd} (4)	66^{th} (5)	90^{th} (6)
I. Base regression (no controls)						
A. All mothers						
First-born is girl	-1.762**	-1.811**	-1.000	0.000	-1.000	0.000
	(0.045)	(0.883)	(1.285)	(0.686)	(2.808)	(4.804)
B. HS educated mothers						
First-born is girl	-3.126**	-3.286**	-2.000	-5.000***	-5.000	-5.000
	(1.268)	(1.291)	(2.192)	(1.457)	(3.627)	(7.071)
C. College educated mothers						
First-born is girl	-1.700	-1.703	-3.000	0.000	-2.000	5.000
	(1.335)	(1.335)	(2.040)	(3.378)	(3.525)	(6.276)
II. With controls						
A. All mothers						
First-born is girl	-1.707*	-1.752**	-1.142	-1.169	-3.205	-1.636
	(0.876)	(0.888)	(1.346)	(1.360)	(2.885)	(5.829)
B. HS educated mothers						
First-born is girl	-2.770**	-2.923**	-0.525	-3.234	-2.836	-1.054
	(1.293)	(1.317)	(2.803)	(2.298)	(4.005)	(4.664)
C. College educated mothers						
First-born is girl	-1.736	-1.723	-4.308**	-1.149	-3.000	2.746
	(1.336)	(1.338)	(2.048)	(2.030)	(3.889)	(6.156)
Mean weight (all)[a]	153	153	119	135	160	195
Mean weight (HS only)[a]	157	157	117	139	165	205
Mean weight (college)[a]	149	149	118	132	155	175

*p=0.10 **p=0.05 ***p=0.01 Sample: 2006-2007 ATUS (n=3143 for all mothers, of whom 1744 are high school graduates and 1188 are college graduates). The base regression includes whether first-born child is a girl, an indicator whether the first-born is an only child, an interaction between sex of the first-born and the only child indicator, and a dummy variable for survey year. The regression with controls includes the variables in the base regression as well as a variable indicating the presence of a younger daughter, a variable indicating the presence of a younger son, parity (number of children) and its quadratic, and mother's age and its quadratic.

[a]Constant term from base regressions.

Table 4. Mother's weight and sex of first-born child, by age of first-born child

Dependent variable:	Age of first-born child			
Mother's weight (lb)	0-4	5-8	9-12	13-17
A. All mothers				
First-born is girl	-2.558	-1.860	-0.113	-3.675**
	(2.155)	(1.745)	(1.814)	(1.833)
N	640	575	811	825
B. HS educated mothers				
First-born is girl	-3.446	0.419	-4.433*	-5.314**
	(3.173)	(3.125)	(2.492)	(2.593)
N	322	296	490	508
C. College educated mothers				
First-born is girl	2.296	-0.313	2.925	-7.485***
	(2.440)	(2.465)	(2.678)	(2.715)
N	282	235	246	216

*p=0.10 **p=0.05 ***p=0.01 Sample: 2006-2007 ATUS. Coefficients from Tobit regressions reported. All regressions include whether first-born child is a girl, an indicator of whether the first-born is an only child, an interaction between sex of the first-born and the only child indicator, and a dummy variable for survey year.

Table 5. Mother's weight and sex of first-born child, by marital/cohabitation status

Dependent variable: Mother's weight in lbs	Married or cohabiting	Never married or divorced
A. All mothers		
First-born is girl	-1.823*	-0.311
	(0.990)	(2.258)
N	2,493	524
B. HS educated mothers		
First-born is girl	-3.883***	-0.177
	(1.464)	(2.967)
N	1,308	356
C. College educated mothers		
First-born is girl	-1.062	-3.120
	(1.351)	(5.822)
N	989	101

*p=0.10 **p=0.05 ***p=0.01 Sample: 2006-2007 ATUS. Coefficients from Tobit regression results reported. All regressions include whether first-born child is a girl, an indicator of whether the first-born is an only child, an interaction term between sex of the first-born and the only child indicator, and a dummy variable for survey year.

Table 6. Mother's time use and sex of first-born child

Dependent variable: Mother's weight (lb)	Age of first-born child 0-4	5-8	9-12	13-17
A. All mothers				
First-born is girl				
Grooming	-1.536	0.659	-2.131*	3.019**
Personal care services	-0.868	0.446	-2.434*	3.232**
Shopping (excl. food)	-2.955	1.770	4.977*	0.443
N	2,387	2,403	2,657	2,593
B. HS educated mothers				
First-born is girl				
Grooming	-1.114	-1.133	-3.357*	4.077**
Personal care services	-1.384	-1.037	-4.521**	4.075**
Shopping (excl. food)	0.054	0.088	8.276**	0.513
N	1,144	1,278	1,624	1,692
C. College educated mothers				
First-born is girl				
Grooming	-4.989*	-1.302	4.877*	5.832***
Personal care services	-3.220	-2.074	6.000**	6.007***
Shopping (excl. food)	-3.443	2.113	3.920	4.724
N	1,100	919	773	621

*p=0.10 **p=0.05 ***p=0.01 Sample: 2006-2007 ATUS. Coefficients from OLS regressions reported and are interpreted as the effect of first-born girl on the daily time spent in a given activity. All regressions include whether first-born child is a girl, an indicator of whether the first-born is an only child, an interaction between sex of the first-born and the only child indicator, and dummy variables for survey year.

Table 7. Body image measures and sex of first-born child

	Weight quantile		
Dependent variable	1^{st}-25^{th}	25^{th}-75^{th}	75^{th}-99^{th}
A. Appearance evaluation measures			
1. Agreement with the statement			
"Most people would consider me good-looking."			
1=Definitely disagree, 5=Definitely agree			
First-born is a girl	-1.000***	0.314	0.000
	(0.000)	(0.300)	(0.530)
2. Summary evaluation measure			
7=Definitely disagree with all 7 statements,			
35=Definitely agree with all 7 statements			
First-born is a girl	-3.667*	-1.886	-1.000
	(1.563)	(2.390)	(4.583)
B. Appearance orientation measures			
1. Agreement with the statement			
"I check my appearance in the mirror whenever I can."			
1=Definitely disagree, 5=Definitely agree			
First-born is a girl	0.667	-0.886	2.250**
	(0.882)	(0.477)	(0.718)
2. Summary orientation measure			
12=Definitely disagree with all 12 statements,			
60=Definitely agree with all 12 statements			
First-born is a girl	3.667	-6.171	6.000*
	(5.375)	(4.710)	(2.352)

*p=0.10 **p=0.05 ***p=0.01 for t-statistic in test of means. Sample: CARDIA (n=18). Difference in the mean level of agreement for individuals between the 1st and 25th, 25th and 75th, and 75th and 99th percentiles reported. The summary measures aggregate responses to questions about self-rated attractiveness (appearance evaluation) and concern about physical appearance (appearance orientation).

Table 8. Father's weight and whether first-born is a girl, ATUS sample

Dependent variable: Mother's weight (lb)	G-B diff OLS	G-B diff Tobit	G-B diff at selected quantiles 10^{th}	33^{rd}	66^{th}	90^{th}
	(1)	(2)	(3)	(4)	(5)	(6)
I. Base regression (no controls)						
A. All fathers						
First-born is girl	2.671**	2.648**	5.000**	5.000	2.000	5.000
	(1.180)	(1.184)	(2.396)	(0.721)	(4.215)	(4.404)
B. HS educated fathers						
First-born is girl	2.454	2.445	4.000	0.000	2.000	0.000
	(1.775)	(1.782)	(4.289)	(2.960)	(6.556)	(8.831)
C. College educated fathers						
First-born is girl	3.565*	3.538*	7.000**	2.000	-1.000	5.000
	(1.828)	(1.845)	(3.438)	(2.719)	(6.207)	(11.994)
II. With controls						
A. All fathers						
First-born is girl	2.732**	2.709**	4.132*	4.720**	1.690	3.402
	(1.178)	(1.183)	(2.350)	(2.333)	(2.978)	(5.828)
B. HS educated fathers						
First-born is girl	1.871	1.856	2.288	3.000	4.291	1.296
	(1.743)	(1.751)	(5.090)	(2.804)	(5.582)	(8.872)
C. College educated fathers						
First-born is girl	3.954**	3.924**	6.538*	2.699	-3.000	8.049
	(1.758)	(1.772)	(3.705)	(2.663)	(3.522)	(8.547)
Mean weight (all)[a]	195	196	150	175	203	245
Mean weight (HS only)[a]	198	198	150	180	210	250
Mean weight (college)[a]	197	197	155	180	205	250

*p=0.10 **p=0.05 ***p=0.01 Sample: 2006-2007 ATUS (n=2229 for all fathers, of whom 1185 are high school graduates and 824 are college graduates). The base regression includes whether first-born child is a girl, an indicator whether the first-born is an only child, an interaction between sex of the first-born and the only child indicator, and a dummy variable for survey year. The regression with controls includes the variables in the base regression as well as a variable indicating the presence of a younger daughter, a variable indicating the presence of a younger son, number of children and its quadratic, and father's age and its quadratic.

[a]Constant term from base regressions.

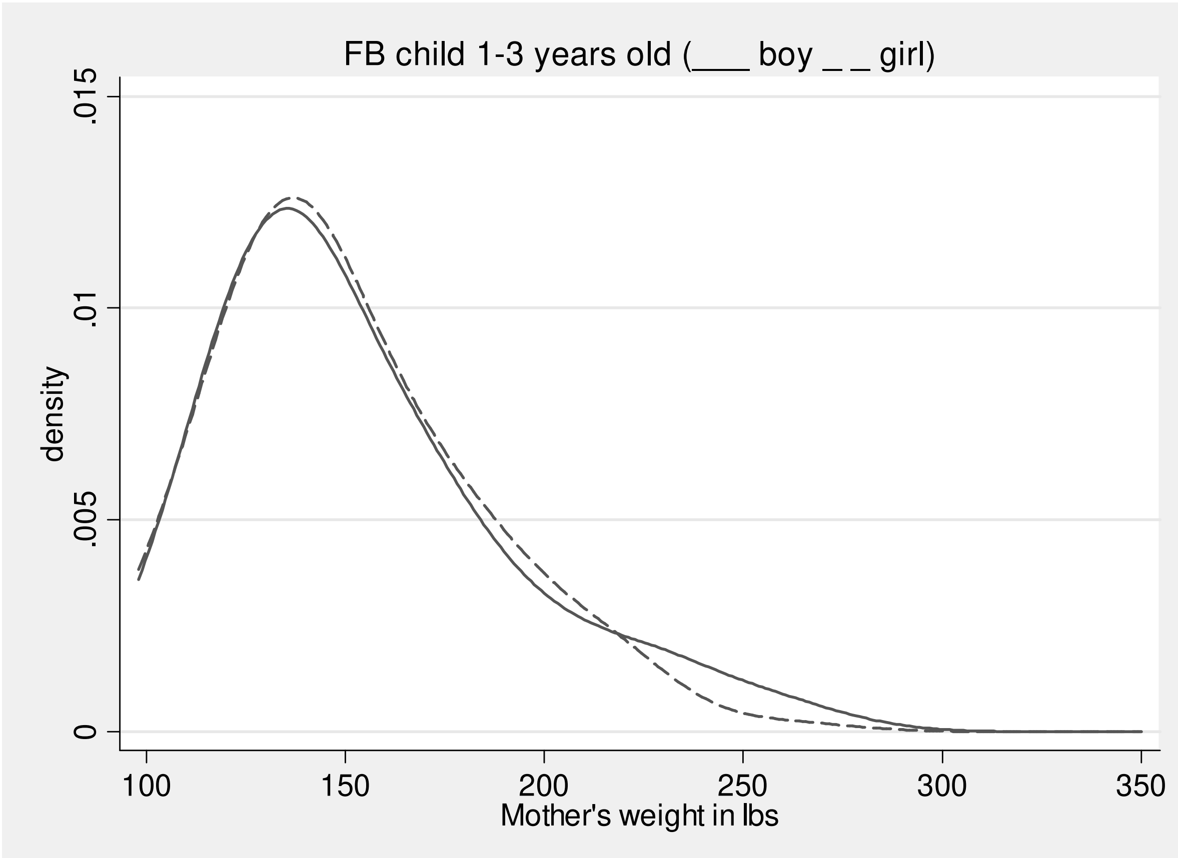

Figure 1a. Kernel density of mother's weight (ATUS), first-born child age 0-3.

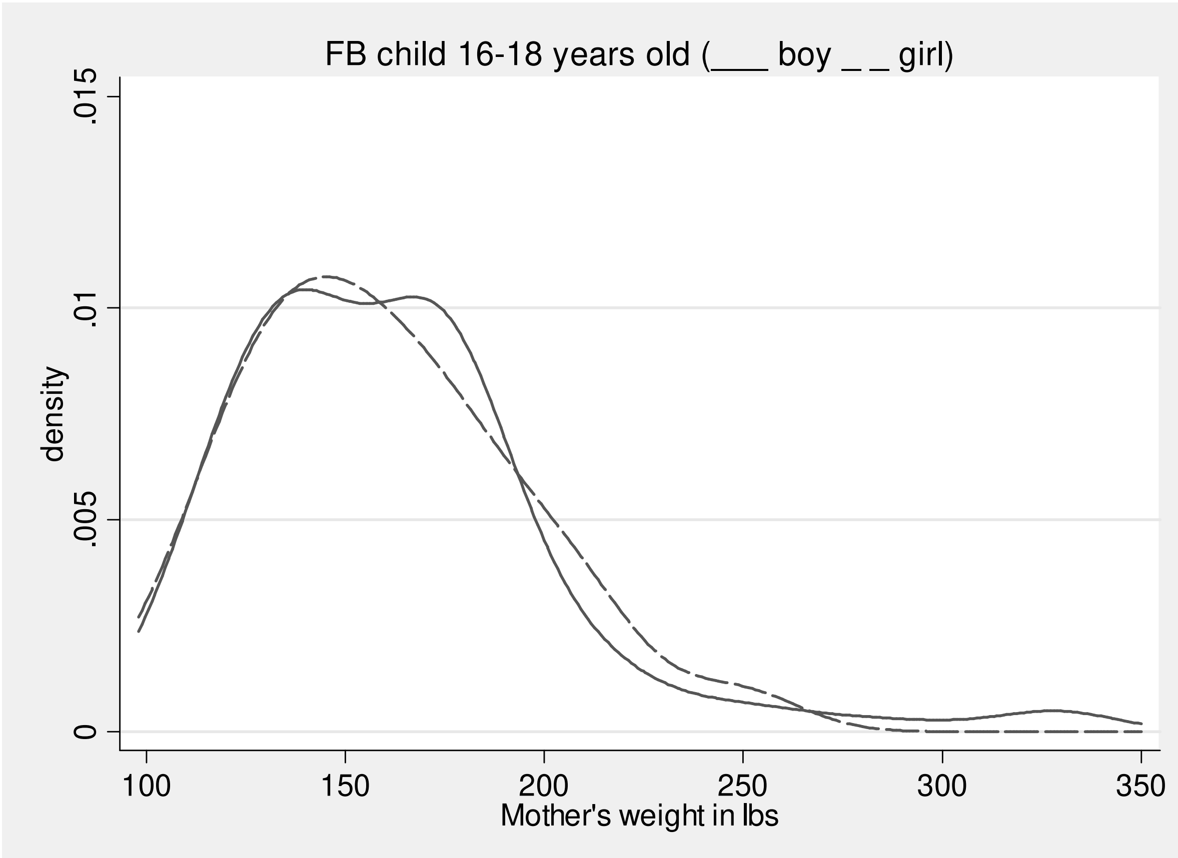

Figure 1b. Kernel density of mother's weight (ATUS), first-born child age 16-18.

APPENDIX

CALCULATION OF WEIGHT GAIN ATTRIBUTABLE TO HEALTH CONDITIONS

There may be bias from the presence of health conditions that increase the probability of having a boy and that are also associated with weight gain. Two conditions that would be most likely to cause bias are preeclampsia and chronic hepatitis B infection. Here, I show the computations that I use to calculate the weight gain that these conditions would need to induce in order to significantly bias the reported estimates.

If one of these health conditions is present, then the mean weight difference Δ that I estimate is:

$$\begin{aligned} \Delta &= Weight\,(G) - Weight\,(B) \\ &= P_{Z|G}\Delta_Z + \left(1 - P_{Z|G}\right)\Delta_G^* - \left[P_{Z|B}\Delta_Z + \left(1 - P_{Z|B}\right)\Delta_B^*\right] \end{aligned} \quad (2)$$

where $P_{Z|G}$ is the probability of health condition Z given that the first-born is a girl, Δ_Z is the weight gain associated with condition Z, Δ_G^* is the true weight gain of mothers of girls, $P_{Z|B}$ is the probability of health condition Z given that the first-born is a boy, and Δ_B^* is the true weight gain of mothers of sons. We see, then, that my estimate of the weight difference is a weighted average of the weight gain caused by the condition and the true weight gain. The estimate is biased because there are different probabilities of a mother's having the condition, given that she has a son versus a daughter.

Suppose there is no difference in the true weight gain of the mothers of girls and the mothers of boys, i.e. $\Delta_G^* = \Delta_B^* = \Delta^*$. Then we can use (2) to compute what the gain associated with the health condition must be in order to generate the estimates that I observe. Substituting and rearranging the above terms, we get:

$$\Delta_Z = \frac{\Delta}{P_{Z|G} - P_{Z|B}} - \Delta^* \tag{3}$$

We see that the estimated weight difference between the two mothers must be adjusted by the difference in the probability of the mother of a first-born girl versus the mother of a first-born boy having the condition. We can compute $P_{Z|G}$ and $P_{Z|B}$ from the reported changes in the sex ratio caused by the health conditions. From these sex ratio changes, I derive the following conditional probabilities:

	$P_{G\|Z}$	$P_{B\|Z}$	$P_{Z\|G}$	$P_{Z\|B}$
Preeclampsia	0.462	0.538	0.029	0.031
Hepatitis B	0.394	0.606	0.041	0.059

where $P_{G|Z}$ and $P_{B|Z}$ for preeclampsia and hepatitis B are derived from the sex ratios reported by, respectively, James (1987) and Oster (2005); P_G and P_B are from James (1987); the probability of having the condition P_Z (3% for preeclampsia and 5%[7] for hepatitis B) are from Redman and Sargent (2005) and McQuillan et al. (1999) respectively; and $P_{Z|G}$ and $P_{Z|B}$ are computed using Bayes' Rule. For the reported calculations, I assume Δ^*=24 lbs (average pregnancy weight gain) but since $\frac{\Delta}{P_{Z|G}-P_{Z|B}} >> \Delta^*$, we have $\Delta_Z \approx \frac{\Delta}{P_{Z|G}-P_{Z|B}}$. We see that because the changes in the sex ratio induced by these conditions are small, the difference in the likelihood of the mothers of girls versus the mothers of boys having these conditions $P_{Z|G} - P_{Z|B}$ is also very small. From equation (3), we see that if $P_{Z|G} - P_{Z|B}$ is small, the weight gain that would have to be induced by these health conditions would have to be very large in order for the conditions to account for the estimates that I report.

[7] The overall of prevalence of hepatitis B overstates the prevalence of chronic hepatitis B and thus gives us an upper bound on the effect of chronic hepatitis B.