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ABSTRACT

The birth of a first child is a major life transition, particularly for women, and recent work documents it still leads to large declines in female labor supply. We make three related arguments about women's ability to predict the effects of motherhood on their employment. First, we present a variety of evidence from the US and UK that modern cohorts of women underestimate these effects. This underestimate is largest for those with college degrees and who themselves had working mothers. We show that this optimism about post-baby working life is new; earlier cohorts of mothers underestimated their post-baby labor supply. Second, an important implication of this finding is that, at the time they are making decisions over post-secondary education, young women underestimate the probability they will be stay-at-home mothers. This underestimation thus provides a potential resolution to the puzzle of why, despite plateauing labor-force attachment since 1990, women in the US continue to increase human-capital investment. Third, we explain why women today underestimate maternal employment costs using a two-generation model alongside evidence that the costs have recently increased after decades of decline. In our model, women, especially those who saw their own mothers work, invest in human capital under the assumption that the employment costs of motherhood would continue to fall.We show that roughly in the 1980s, however, key costs begin to rise.

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1 Introduction

The birth of a first child is a major life transition. It is arguably more significant than retirement, marriage or any educational milestone, especially for women. Motherhood is at once incredibly common (even at low points throughout U.S. history, generally more than eighty percent of women eventually give birth to at least one child) and yet difficult to envision *ex ante* (the titles of a popular series of pregnancy and parenting books all begin with the words "What to expect…").

Maternal labor supply is likely to be a particularly difficult aspect of motherhood for young women to forecast. While the vast majority of women in the US and other rich countries work *before* motherhood (and have done so for decades), the labor supply of *mothers* has changed dramatically over time. In the US, it rose rapidly between 1960 and 1980. It has since plateaued and in fact slightly decreased since 1990 (we show these trends in Appendix Figure A.1, along with those from several other rich countries). Moreover, whether a mother works while her children are young remains a controversial subject.[1] While there is a rich literature in economics assessing whether individuals and households prepare sufficiently for retirement, there is little work examining whether they form correct expectations about parenthood or exploring the implications of mistaken expectations thereof.

In this paper, we make three related arguments about women's ability to anticipate *the employment costs of motherhood*, which we define as the time, effort or money required for mothers to raise their children in a manner they deem appropriate, while also working outside the home. Examples of these costs might include the emotional cost of being separated from the child while at work, the per-hour cost of a nanny or day-care service, guilt over (perceived or real) underperformance as an employee or mother, or diminished sleep or other aspects of wellbeing due to working while also performing childcare activities.[2]

First, we present a variety of evidence that women in modern cohorts (those born in the

[1] A few recent articles include, "I'm not 'just' a stay-at-home mother," *NYT*, 2019, `https://www.nytimes.com/2020/04/17/parenting/stay-at-home-mom.html`. "Regret being a stay-at-home mom? Would you ever admit it?" *Forbes*, 2020, `https://www.forbes.com/sites/terinaallen/2020/04/25/regret-being-a-stay-at-home-mom-would-you-ever-admit-it/?sh=11463bd123c9`. The topic played a role in the 2012 election when a surrogate for President Obama said that candidate Mitt Romney's wife had "never worked" (Ann Romney was a full-time mother and home-maker).

[2] See Bertrand (2013), who finds that among college-educated mothers, those with a career report being more unhappy, stressed, and tired than stay-at-home mothers. See Fortin (2005) for a longer discussion of feelings of guilt among working mothers.

late 1960s through the 1970s, who have only recently completed or are nearing completion of their child-bearing years) have *underestimated* the employment costs of motherhood. Second, an important implication of such underestimation is that, pre-motherhood, women make human capital decisions under the belief that being a working mother is easier than it turns out to be, and we show that *educated* women are indeed the ones who most underestimate the "mommy effect" on employment. Our evidence thus provides a potential resolution to the puzzle of why, despite plateauing labor-force attachment since 1990, women in the U.S. continue to increase human capital investment in the form of costly education (they are now substantially more educated than men, see Appendix Figure A.2) and job experience (in part by delaying motherhood, see Appendix Figure A.3). Third, we present evidence that helps explain *why* women underestimate the employment costs of motherhood: while these costs were falling for their mothers' generation, they have in fact plateaued or increased more recently.

We develop each of these arguments using data from the U.S. and the U.K. We begin by replicating in our data the main results from the recent "child penalty" literature (see, e.g., Kleven *et al.*, 2018 using Danish data; Angelov *et al.*, 2016 using Swedish data; and Byker, 2016, Chung *et al.*, 2017, and Goldin and Mitchell, 2017 using U.S. data).[3] Consistent with past work, we find large and significant employment declines (roughly thirty percentage points) in female employment probability after the first birth. Having a college degree and growing up with a working mother predict smaller declines, but even for these groups the declines are economically and statistically significant (thus echoing the results in Bertrand *et al.*, 2010 on female MBAs). As noted, these "child penalties" are by now well documented, but little if any work has studied whether women *anticipate* these large employment declines. And if not, why not?

We show a variety of evidence that, prior to motherhood, women *underestimate* how hard it is to work while being a mother. If the impact of motherhood on the ability to manage both work and family commitments is indeed unexpected in the short run, then women's *beliefs* about the appropriate balance between home and market work should change discontinuously

[3]Papers that have used other methods to examine the question of children and women's labor supply include, of course, Angrist and Evans (1998), who focus on developing credible instruments for the birth of a *third* child. More recently, Lundborg *et al.* (2017) argue that, conditional on undergoing *in vitro* fertility (IVF) treatment, its success is sufficiently random to serve as a valid instrument for fertility. While event-studies cannot formally address endogeneity of fertility, interestingly, Kleven *et al.* (2018) shows that the event-study estimate of the effect of a *third* birth lines up closely to the IV-based estimate using twins or sex composition as an IV for a third birth.

upon the birth of the first child, as this event allows them to update their beliefs with new information. Our U.K. data include a consistently worded set of questions on gender roles and work-family balance (e.g., degree of agreement with statements such as "a woman and her family would all be happier if she goes out to work" or "both husbands and wives should contribute financially") in repeated interviews across time, allowing us to use event-study methods to measure how attitudes change with the arrival of a first child. We show that, before motherhood, most women say that work does not inhibit women's ability to be good wives and mothers, but after the birth of their first child they become significantly more negative toward female employment, consistent with having underestimated the impact of motherhood on employment. The effect is significantly stronger for women who are more educated and whose own mothers worked while they were children. Thus, while these groups display smaller employment declines, they nonetheless appear to shift their beliefs the most upon the first birth.

We provide two additional pieces of evidence that women, and especially those with a college degree and who themselves had a working mother, underestimate the employment cost of motherhood. While not measured in the years immediately before and after the birth of the first child as in the event-study analysis, we perform a "long" difference-in-differences analysis using a U.S. survey of high-school students that then follows up on them in their thirties. One of the questions asked both in high school and in the later follow-up is the importance placed on career success (worded in the future tense in the tenth-grade survey and in the present tense in the follow-up survey). We show that relative to women without children, mothers in this sample downgrade the importance of career success relative to their tenth-grade expectations. This divergence in stated importance of career between parents and non-parents does not occur for men in the sample. Like the UK event-study results, the decline of mothers' career ambition relative to other women is largest for more educated women and those who grew up with working mothers.

As a final piece of evidence that women who are most likely to invest in education are also those who *ex-ante* underestimate the difficulty of motherhood, we use a retrospective question asking if raising children is harder than the respondent expected. Not only are women much more likely to agree with that sentiment than are men, college-educated women are in fact the most likely to agree (and there is no such education gradient for men).

All of the evidence described above on the underestimate of the employment costs of motherhood come from women born in the late 1960s or in the 1970s (whose first births

occur mostly in the 1990s and early 2000s). Did women always underestimate the employment effects of having a child, or is this lack of anticipation unique to these cohorts? We use a combination of true panel data and synthetic panel data to compare how young women in high school *forecast* their prime-age labor supply versus its actual realization twenty years later. We gathered a variety of data sources that allow us to perform this exercise for a six-decade period—beginning with high school students in the early 1960s and continuing through today.

Consistent with the results documented above, in recent decades, female high school seniors vastly underestimate the likelihood they will be at home full-time twenty years later. From roughly 1985 onward (so, birth cohorts from the late 1960s onward), no more than two percent say they will be home-makers or stay-at-home moms at age forty, but in reality roughly twenty percent of them will be. However, we show, consistent with Goldin (1990), this overestimate of future labor supply is a sharp reversal from a previous *under*estimate. In the 1960s, the large majority of high-school girls predicted they would be full-time home-makers in their thirties, significantly underestimating their future labor supply. Between 1968 and 1978, the share of high-school seniors expecting to be housewives plummets from two-thirds to one-tenth. Importantly, we show that young women from the 1970s onward desire and expect to be mothers (of two or more children), but not, apparently, stay-at-home mothers.

That recent cohorts of women seem to systematically underestimate the employment consequences of motherhood—and thus overestimate their future labor-market attachment—begs the question of how they could get such an important prediction so substantially wrong. After all, motherhood is a very common event and they could in principle learn from the experience of their own mothers and that of their peers. We close the paper with our preferred explanation: *that the employment costs of motherhood have risen relative to those experienced by their own mothers.* While we do not formally test and reject other explanations, we show that this explanation accommodates all the results described above and we provide a variety of evidence that supports this proposed increase in costs.

We start by presenting a simple model of a woman's education and employment choices when her future employment costs of motherhood are uncertain. When making human capital decisions, she forms predictions over the level of her own future employment costs by observing her own mother's employment costs, but she inherits the costs her mother faced with some noise (which may or may not have a mean of zero). We first show that the model

yields under very general conditions two of our most striking empirical results: that educated women exhibit smaller employment "mommy effects" than their less educated counterparts, but at the same time appear the most "surprised" by the high employment cost of motherhood (in terms of their greater updating of beliefs about work-family gender roles and their larger retrospective expressions of surprise at how hard motherhood is). Women in our model choose higher levels of education—which raises the return to market work *ex post* and thus results in higher labor supply post-motherhood—in part *because* they underestimate the cost of motherhood *ex ante*. We show that these results hold *regardless* of whether the average employment costs of motherhood have increased or decreased for the current generation relative to the previous one. That these results hold under relatively general conditions not only bolsters the credibility of the model, but also serves as a "proof of concept" for the empirical results. We then show that some of our other central results—that *unconditional on education* women in modern cohorts appear to underestimate the costs of motherhood—holds if and only if costs have, on average, *increased* for today's mothers relative to earlier cohorts.

To complement this theory-based argument that the cost of motherhood must have risen, we provide a collage of empirical evidence suggesting that, while the cost almost surely fell during much of the twentieth century, it appears to have recently risen along some important metrics, especially since the 1990s. Some of this evidence we take from past literature and some, to the best of our knowledge, we provide for the first time. For example, as we review in more detail in Section 5, past work has emphasized the *decline* in the cost of motherhood over the middle decades of the 20th century due to technological advances (e.g., household appliances and advances in infant formula) and links these falling costs to the large rise in female LFPR over the same period. We argue that those advances may have fully played out and in fact more recent developments (e.g., research advocating the benefits of breastmilk over formula) may have effectively increased the costs of motherhood. Indeed, in both the US and the UK, we show that breastfeeding rates have increased significantly over the past several decades, especially since the 1990s. Similarly, while the underlying cause is still debated, time-use data show that mothers invest more hours in child-rearing than their own mothers did.

Finally, consistent with our claim of a *u*-shape pattern over time in the costs of motherhood, we show that beginning in the late 1990s, large majorities of mothers tell survey takers that motherhood is harder today than for their own mothers and that they are more

involved in their children's lives than their mothers were in theirs. By contrast, mothers surveyed in the 1950s and 1960s report that motherhood is *easier* for them than that it was for their own mothers. In the conclusion, we briefly take up the question of *why* the costs of motherhood may have increased over recent decades, but otherwise leave that important question to future work.

Beyond the literature on employment "child penalties" we already discussed, we also contribute to an extensive economics literature on gender-role norms, and in particular how they change over time.[4] For example, Goldin (2006) suggests that innovations in contraception may have contributed to altering women's identity in the 1960s and 1970s. Fernández *et al.* (2004) argue that men growing up in families with working mothers appear to have developed more liberal gender-role attitudes.[5] Related, perhaps, to the slowdown in labor market convergence we noted earlier, Fortin (2005) shows that while birth cohorts have become more liberal regarding norms about women in the workplace, this trend has recently plateaued in OECD countries. We show that gender-role attitudes appear to exhibit life-cycle effects: women themselves adopt more traditional attitudes after they become mothers.

Of course, the idea that motherhood changes women's priorities is hardly original, and appears frequently in the popular press.[6] To the best of our knowledge, we are the first to examine how gender-role norms regarding employment change after parenthood in a formal event-study framework. We are aware of a small number of academic papers, mostly from sociology, that examine similar questions, all using panel data from high-income countries (Grinza *et al.*, 2017; Baxter *et al.*, 2015; Shafer and Malhotra, 2011; Jarrallah *et al.*, 2016; Vespa, 2009). But these panels tend to be short (in some cases, only two waves), and thus these analyses cannot perform event studies to determine if any estimated effect on attitudes is coincident with motherhood or instead driven by trends.

The remainder of the paper is organized as follows. Section 2 reports our results on

[4]Recent contributions to this literature have focused on norms in the marriage market or within couples. Bertrand *et al.* (2015) and Kleven *et al.* (2016) provide a variety of evidence that couples follow the norm that husbands should out-earn their wives. Bursztyn *et al.* (2017) show that traditional gender-role norms remain relevant even among career-oriented MBA students—anticipation of the marriage market appears to limit the public signaling of career ambitions of single female MBA students.

[5]On the other hand, Alesina *et al.* (2013) highlight the long-term persistence of gender norms, showing that ethnicities and countries whose ancestors practiced plough cultivation (which is more suited to male labor) have lower rates of female labor force participation even today.

[6]See, e.g., "What Happens to Women's Ambitions in the Years After College," in *The Atlantic*, December 2016. `https://www.theatlantic.com/business/archive/2016/12/ambition-interview/486479/`.

the effect of motherhood on labor supply. Section 3 provides a variety of evidence that women underestimate the employment effects of motherhood, including event-study analysis of how women's gender-role attitudes change in the years surrounding the first birth, how they answer retrospective questions about parenthood being harder than expected, and how they downgrade the importance of their own careers as a function of parenthood. Section 4 examines the accuracy with which female high school students forecast their future labor supply, showing that over a short period in the 1970s, high-school girls went from significantly under-estimating their future labor supply to significantly over-estimating it. Section 5 relies on both theoretical and empirical evidence to argue that the reason why modern cohorts of women have not anticipated the costs of motherhood is because these costs recently increased in an unpredictable manner. Section 6 concludes and poses some questions for future work.

2 How does motherhood affect employment?

As our motivating question is whether women anticipate the large post-baby declines in their employment, we begin by documenting the employment declines themselves. We provide only a brief summary of the data sources here and much greater detail in Appendix B.

2.1 Sampling restrictions and data sources

A substantial portion of the empirical work in this section and the next involves event-study analysis. We thus adopt sample restrictions with that exercise in mind. Our preferred sample will include only those individuals whom we observe at least once before and once after the "event" of the birth of a first child, so that all subjects help identify a standard difference-in-difference estimate of the effect of parenthood (though in robustness checks we will add back in subjects who remain childless or had children before entering the sample, to serve as controls). We also, whenever possible, require that we observe respondents over the full period of their most likely child-bearing years (between ages 20 and 40).[7] Thus, whenever possible, we restrict cohorts to those who, were they to have a child between ages twenty and forty, the birth would be observed in our sample period.

[7]The one exception is the British Household Panel Survey (BHPS). As the BHPS only spans 18 years (with a later additional booster sample spanning only about 10 years), imposing the 20-40 age restriction is impossible. Instead of imposing the 20-40 restriction, we require our main sample of women to be at least 16 years old at the start of our panel. For our control samples of childless women, we require that we observe them at some point at age 29, the median age at first birth among women in our treatment sample.

2.1.1 British Household Panel Survey

The British Household Panel Survey (BHPS) is a longitudinal survey that runs from 1991 through 2009. This dataset is unique in that it asks consistently worded questions about gender norms in repeated interviews, which we describe in more detail in the next section. Col. (1) of Table 1 shows summary statistics for women in our preferred sample in the BHPS. The sample restrictions described above leave us with a total of 681 women. On average, in our analysis sample, we observe individuals 4.1 times pre-birth and 6.6 times after. While we do not impose perfect balance for our event-time figures, it is reassuring to know that we observe parents several times before and after their first birth so that trends are unlikely to be explained by composition changes.

2.2 U.S. panel data sources

We make use of three commonly used sources of U.S. panel data: the "Young Women" component of the National Longitudinal Surveys of Young and Mature Women (hereafter NLSW), the National Longitudinal Survey of Youth (NLSY), and the Panel Study of Income Dynamics (PSID).

Women in the NLSW were 14-24 when first interviewed in 1968; the last interviews occurred in 2003. For the most part, we can only examine employment outcomes with these data, as there are no questions on gender-role attitudes that are asked consistently over time (the NLSY occasionally asks about gender norms, but these questions are scattered over many years and not sufficiently frequent to perform an event-study analysis). However, we will make use of a variable that asks women in 1968 about their employment and parenthood expectations when they are 35. Our sampling criteria include only women who were born between 1948 and 1954 (so they are roughly in their sixties today). Our preferred sampling criteria leave us with 1,413 women. Summary statistics are presented in col. (2) of Table 1.

The NLSY begins interviewing young men and women between the ages of 14 and 22 in 1979 and continues through 2014. Again, to ensure that we observe the full period of respondents' most likely child-bearing ages, we only include the 1959-1964 cohorts (so our sample is born roughly ten years after their NLSW counterparts). These sampling criteria leave us with 2,256 women. Summary statistics for this preferred NLSY sample appear in col. (3) of Table 1.

Our final U.S. panel data source is the PSID. While it begins in 1968 (and continues through today), our preferred analysis sample includes all individuals for whom we observe

the first birth *after 1979* (because the employment outcomes we most use are not coded consistently before this date). To meet our usual requirement that we observe individuals between the ages of twenty and forty, our preferred sample includes only the 1957-1975 cohorts, leaving us with 1,007 women. Col. (4) of Table 1 displays summary statistics for our PSID sample. On average, the women in our sample are born about five (fifteen) years after those in the NLSY79 (NLSW68).

Due to slightly different definitions, we cannot compare all variables across the BHPS and our U.S. datasets, but where we can, the differences are as expected. Note that even the PSID, our most recent U.S. panel dataset, samples women who are from slightly earlier cohorts than the BHPS. Consistent with having later cohorts in the BHPS and the general tendency of the British to delay childbirth relative to Americans (recall Appendix Figure A.3), individuals in all our U.S. samples have their first child at a younger age than do women in the BHPS and also have more children in the period in which we observe them.[8] Consistent with the evidence in Figure A.2, the summary statistics show that American women are more likely to have completed university education than their British counterparts, despite coming from earlier cohorts. American women in the PSID and NLSY79 samples are also significantly more likely to have obtained a college degree than their counterparts in the NLSW68, consistent with the rapid growth in female college graduation rates in the US between the 1950s and 1970s cohorts (Goldin *et al.*, 2006).

2.3 Event-study specifications

Much of our analysis examining the short- and medium-run changes associated with parenthood makes use of a basic event-study methodology, defining the first child's year of birth as the "event," following Kleven *et al.* (2018). Specifically, we model a given outcome y_{it} (e.g., current employment) for person i in year t as:

$$y_{it} = \sum_{\tau=-6,\neq-2}^{\tau=\tau^{max}} \beta_\tau \cdot \mathbb{1}[\tau = t - c^i] + \sum_a \gamma_a \cdot \mathbb{1}[a = \text{Age}_{it}] + \delta_t + \epsilon_{it}. \quad (1)$$

We index event time (time relative to birth of a child) by τ. The variable $\mathbb{1}[\tau = t - c^i]$ is defined as follows: c^i denotes the calendar year in which person i had their first child, so $\mathbb{1}[\tau = t - c^i]$ is an indicator for person i in year t having had their first child τ years ago.

[8] Our British panel is also shorter than our American panels, so the U.K. women are also less likely to have completed their fertility by the end of the panel.

Negative values of τ indicate having a first child $|\tau|$ years in the future. In the summation term, we omit the event-time indicating two years before the first birth. The $\tau = -6$ (or $\tau = \tau^{max}$) term in fact includes all years greater than or equal to six years before (or τ^{max} years after) the first birth, and these coefficients are *not* plotted in the event-study graphs. The value for τ^{max} depends on the length of the sample period in a given panel dataset, but we are typically able to look 5-10 years after the first birth. We control for a vector of calendar-year fixed effects (δ_t) and a vector of age-in-years fixed effects ($\sum_a \mathbb{1}[a = \text{Age}_{it}]$). The error term is ϵ_{it}. We cluster standard errors at the individual level.

This specification normalizes the event time $\tau = -2$ to zero, though in our figures we will often add to all coefficients the raw mean of the outcome variable at $\tau = -2$ to facilitate comparisons across different subgroups in both levels and changes. Note that we normalize $\tau = -2$ instead of the standard $\tau = -1$ because pregnancy may have an effect of interest as well.

We present our results by plotting the β_τ coefficients, to show the evolution of our outcome variables relative to the event of parenthood, conditional on year and age fixed effects. To summarize the effects more succinctly, we will typically present alongside the event-study graphs: (a) the average of all post-period coefficients (i.e., coefficients on event-time $\tau = 0$ through the final plotted coefficient in the figures); (b) the slope and significance of the pre-period coefficients, to gauge pre-trends; and (c) a pre-trend-adjusted average of post-period coefficients. This final statistic is based on the following specification:

$$y_{it} = \sum_{\tau=-1}^{\tau=\tau^{max}} \beta_\tau \cdot \mathbb{1}[\tau = t - c^i] + \lambda \cdot \tau_{it} + \sum_a \gamma_a \cdot \mathbb{1}[a = \text{Age}_{it}] + \delta_t + \epsilon_{it}, \tag{2}$$

where all notation is as in equation (1) and the $\lambda \cdot \tau_{it}$ term captures the *projected pre-trend*. As we allow all post-period coefficients (plus the year of pregnancy) to vary freely but restrict the pre-period (i.e., periods -5 to -2) to take a linear form, the post-period coefficients represent any post-period changes after netting out the projected (pre-pregnancy) pre-trend.

If the pre-trend coefficient λ is itself not significant, then we tend to prefer the equation (1) specification. We are fortunate that in almost all cases, netting out the projected pre-trend makes little difference to our conclusions.

2.4 Main results

We begin our analysis by examining the share of women who are currently employed, before and after the birth of a first child. Figure 1(a) shows the event-study coefficients from equation (1), estimated on our U.K. data, which defines currently employed as having a paid job. Two years before the birth of a child (so roughly one year before pregnancy), 91 percent of women are working (recall that the coefficient for $\tau = -2$ is merely the raw mean at $\tau = -2$), a rate nearly as high as that for men who will become fathers in two years (not shown). There is a very slight, insignificant, negative pre-trend. The year before the birth exhibits a very modest decline, likely due to pregnancy, and it is swamped by the large, thirty percentage-point decline in the year of the birth.

Above the event-study graph, we report the average of the six post-period coefficients and its level of significance. This average 33 percentage point decline is only slightly reduced to 29 percentage points when we project forward the (insignificant) pre-trend.

Figure 1(b) replicates this event-study figure for our U.S. data sources and finds very similar results. As we might expect, the employment decline is slightly smaller for the more modern cohorts in the PSID and NLSY than in the NLSW. To avoid clutter and because there is little visual evidence for concern, we do not adjust for pre-trends in these graphs.

It is worth emphasizing that Figure 1 and our other event-study figures plot event-study coefficients (how employment changes relative to $\tau = -2$, conditional on all the controls in equation 1) and thus except for $\tau = -2$ (which is, by construction, normalized to the raw mean in that year) raw means cannot be read off the figure. For example, for each of our four panel datasets, female employment is on a positive, secular trend, which we capture with the year fixed effects. So, in raw levels, women *do* increasingly return to work as time passes after the birth of their first child, but not any faster than the year fixed effects and other controls would predict. Appendix Figure A.4 demonstrates this same point in a slightly different manner, using childless women as the counterfactual instead of modeling the counterfactual with year and age fixed effects as we do in Figures 1(a) and 1(b) (following Kleven *et al.*, 2018). We use the NLSY and plot employment for childless women, generating a "placebo event" of childbirth (see the figure notes for more detail). We then compare this series to employment outcomes for women who become mothers (where both series are simply raw means in event-time). For the most part, the childless-women series is increasing slightly each year, as is the series for mothers, except for the large decrease in the year of childbirth.[9] In

[9]The same exercise for the other three panel datasets is available upon request.

the paper, for the sake of exposition, we will often refer to an outcome as rising or declining upon motherhood. However, such a statement rarely refers to raw levels, but instead to changes conditional on the controls in the event-study specification.

How do our results compare to existing work? Figure 1 very closely parallels the results in Kleven *et al.* (2018), which uses Danish register data drawing from the 1955-1973 birth cohorts. Like us, they find little evidence of pre-birth pre-trends, a large effect the year of the birth, and little if any long-run recovery. Our effect sizes, however, are much larger—Danish mothers are roughly twelve percentage points less likely to work than they were before motherhood, whereas the decline for for U.S. and British women of similar cohorts is two to three times as large. In general, Denmark has a much higher female labor force participation rate than the UK or US (and in fact, higher than essentially any other country), and comparing our results to those using Danish data suggests that a large part of the difference likely comes from women's different responses to motherhood.[10]

2.5 Heterogeneity and other results

Our goal in this subsection is to examine heterogeneity along dimensions related to our hypothesis, namely human-capital formation and expectations about future labor supply. Here we estimate the difference in employment responses by distinct and mutually exhaustive groups $X = 1$ and $X = 0$, where X is a dummy variable such as college completion. We begin by estimating the following equation:

$$\begin{aligned} y_{it} = &\sum_{\tau=-6,\neq-2}^{\tau=\tau^{max}} \beta_\tau \cdot \mathbb{1}[\tau = t - c^i] + \sum_a \gamma_a \cdot \mathbb{1}[a = \text{Age}_{it}] + \delta_t + \\ &\mathbb{1}[X = 1] \cdot \left[\sum_{\tau=-5}^{\tau=\tau^{max}} \beta_\tau^{X=1} \cdot \mathbb{1}[\tau = t - c^i] + \sum_a \gamma_a^{X=1} \cdot \mathbb{1}[a = \text{Age}_{it}] + \delta_t \right] + \epsilon_{it}. \end{aligned} \tag{3}$$

This equation is based on our main event-study equation (1), but it fully interacts the event-study coefficients, the age fixed effects, and the time fixed effects with the dummy variable $\mathbb{1}[X = 1]$. So, in the case of college completion, the event-time, age and year fixed effects are allowed to have unrestricted differences for those who did and did not finish college. As

[10]Smaller effect sizes in Denmark may be explained by the country's more generous parental-leave and child-care policy. In addition to covering 52 weeks of parental leave, the Danish government guarantees all children between the ages of six months and five years a spot in heavily subsidized child-care facilities. By contrast, U.K. and especially U.S. parental leave is much less generous, a point to which we briefly return in Section 5.

the post-baby declines in employment for each subgroup (as well as the differences in those declines), we report in Figure 2 the average of the post-period coefficients (and its confidence interval) for each subgroup. We then report the *difference* in the post-period average for each group and *its* level of significance.[11]

We choose X variables that relate to human capital investment and expectations. Specifically, whenever data permit, we split each of our samples by whether the respondent (a) completed college; (b) had a working mother herself; (c) had, pre-motherhood, positive views toward working mothers; and (d) planned, pre-motherhood, to work after having a baby, though we defer discussion of (d) until Section 4.

Figure 2 shows these results. Subfigure (a) shows that for each of our four datasets, a college degree mutes the "mommy effect" on employment, in most cases in a statistically and economically significant manner. However, because the baseline employment decline is so large, even the smaller responses for these more educated women mean that they still have substantial and significant declines post-baby (as shown in the figure, the confidence intervals for these subgroups do not come close to including zero). To avoid clutter, we do not report in these figures the pre-trends from the underlying event-study graphs nor pre-trend-adjusted post-period averages, but we show all of the actual event-study graphs in Appendix Figure A.5 and differential pre-trends do not appear to be a concern (in fact, adjusting for pre-trends would make the difference in the "mommy effects" between subgroups reported in Figure 2 even larger).

A similar but more muted pattern appears in all of our datasets with respect to being raised by a working mother: such women have smaller employment declines in three of our four datasets (though none of the differences are statistically significant). A similar pattern appears for having "pro-working-mother" values pre-baby (see figure notes and Appendix B for more detail on how this variable is defined in our datasets).

In summary, this section provides a variety of evidence showing the large, negative employment effects of motherhood, replicating past work in other countries. While the effects for later cohorts in the US (PSID and NLSY) appear to be somewhat smaller than for older cohorts (NLSW), in both the US and UK they remain large: roughly thirty percentage points. To put this decline in perspective, in the most recent CPS, employment rates are 23 percent-

[11]So, for the $X = 0$ group, the average of the post-period coefficients is given by the post-period β_τ coefficients. For the $X = 1$ group, it is given by the *sum* of the post-period β_τ and $\beta_\tau^{X=1}$ coefficients. The difference in post-period effects between the two groups is given by the post-period $\beta_\tau^{X=1}$ coefficients.

age points lower for 65-69 year-olds than for 60-64 year-olds.[12] Thus, our estimated "mommy effect" is comparable to a retirement effect. We now turn to whether women anticipate this large change in their labor supply.

3 Do women anticipate the "mommy effect?"

There have been several dynamic labor supply models from the macro literature that attempt to jointly explain women's fertility, human capital and employment decisions (or some subset of these decisions). Most of these models (e.g., Attanasio *et al.*, 2008; Blundell *et al.*, 2016; Adda *et al.*, 2017) assume that agents have perfect foresight of how children will affect labor supply and thus plan accordingly.[13] This section provides several pieces of evidence that questions that assumption and suggests that women systematically underestimate the effect of motherhood on employment. This underestimate manifests in the short run (i.e., in the years right before the first birth) as well as earlier in their lives (i.e., when they are in high school and making post-secondary human capital decisions).

3.1 Effect of parenthood on views toward female employment

We begin by exploring whether women's beliefs about the proper balance between family responsibilities versus market work change upon having a child. If, as we argue, women underestimate the costs of motherhood, then the event of the first birth serves as an information shock and thus beliefs should be updated.

3.1.1 Data on attitudes toward female employment

To measure how beliefs change, we make use of six questions in the BHPS. These questions are in the form of statements about the proper role of women in the workplace versus the home, and respondents are asked to state their agreement with each statement on a 1–5 scale (e.g., "All in all, family life suffers when the woman has a full time job," "Both the husband and wife should contribute to the household income"). If needed, we reverse the order of the responses so that each question is increasing in the pro-female-employment direction. We then standardize each of these variables and sum them. Appendix Table A.1 provides summary statistics for this "omnibus" measure of summed standardized variables as well as each component (and the wording of each component statement). Note that, in contrast to

[12] See https://www.bls.gov/cps/cpsaat03.pdf.

[13] An important exception is Fernández (2013), which we return to in Section 5.

the employment question, which is asked every year, the BHPS asks these six gender-role questions every other year, so we expect point estimates to be noisier given the smaller sample.

We refer to this omnibus variable as our *index of gender-roles regarding work and family*, or simply *gender-roles index*, for expositional ease. To provide a sense of magnitudes, we show in Appendix Table A.1 that women are generally 0.77 units more in the pro-work (that is, agreeing that it is good for women to combine family and work) direction than are men.

This index has strengths and weaknesses. A strength is that all the questions refer to the desirability of wives and mothers working outside the home. One could imagine instead questions about gender stereotypes, but not about employment (e.g., "On average, women and men have equal innate intelligence"), which would be less germane to our hypothesis. Another strength is that the question is abstract and does not specifically ask about the respondent's *own* household, as such a question would not lend itself to event-study analysis. The BHPS statements are about households *in general* and thus respondents without children can still answer these questions.

A weakness is one that arises for any type of subjective response: it is impossible to know exactly what the respondent means when she answers. But because statements in the BHPS are not about one's own situation but about the appropriate responsibilities for men and women generally, in principle a woman who perfectly anticipates the costs of motherhood should give the same response before and after becoming a parent. By contrast, a woman who overestimated (underestimated) the employment costs of motherhood should change her answer in a pro- (anti-) work direction once she learns how easy (hard) motherhood actually is and thus how realistic or desirable it is for mothers to work while raising children. Our implicit assumption is that respondents are answering this question about households in general, but are using their own experiences to inform these answers.

3.1.2 Main results

Figure 3 shows the results of our event-study analysis of gender-role attitudes. The birth of the first child is associated with women moving 1.2 units in the *anti-work* direction on our omnibus gender-roles index. The effects of childbirth on our gender-roles index take about two years to be fully realized: attitudes become somewhat more anti-work the year of pregnancy and then move more in the anti-work direction over the subsequent two years. Beyond that point, they stabilize and show no evidence of recovery. Appendix Figure A.7

shows a smaller, but also significant, effect for fathers in the same direction (becoming more negative toward working women).

Figure 3 reports a negative, though slight and insignificant, pre-trend. Projecting this pre-trend forward over the next seven years reduces the post-period average to 0.64, but it remains highly significant. Even this smaller estimate is economically significant—it is nearly as large as the male-female difference in the gender-norms index reported in Appendix Table A.1.

As we did with the employment event-study results, we can use childless women to generate a counterfactual instead of modeling it with year and age fixed effects. Figure 4 performs this exercise. As we might expect, women who do not have children during our sample period give more pro-work answers than women who will have children, even before the latter group become mothers. We see the same sharp decline as in Figure 3 in pro-female-work sentiment among mothers in the year of the birth and the following year, after which their answers stabilize. The implied magnitude of the growth in the difference between mothers and the control group of women who do not have children in our data is very close to that in Figure 3 as well: approximately a one-point decline.

As noted, this omnibus index is composed of six underlying questions. In Appendix Figure A.8 we show how women's views evolve for each component of our omnibus measure, returning to our standard specification. Of the six components, five show statistically significant movement in the anti-work direction and one ("pre-school child suffers if mother works") shows an insignificant movement in the pro-work direction.[14]

3.1.3 Heterogeneous effects

As with the employment results, we focus in particular on heterogeneity by college completion and own mother's employment. As we have fewer results to display, we simply show each of the corresponding event-study graphs in Figure 5. Subfigures (*a*) and (*b*) show results for those without and with a college degree, respectively. The change in norms is more pronounced among *college-educated* women: while in the pre-period they have more positive attitudes toward female employment than their less educated counterparts, they move nearly 1.5 points (roughly twice the male-female difference) in the anti-work direction upon

[14]We have no intuition for why this question moves in the opposite direction of the others, but do note it is the only question that refers specifically to *pre-school* children, so is somewhat misaligned in terms of our event-study and difference-and-difference assumption that the event is the birth itself.

motherhood. The difference in responses between the two groups is even more pronounced if pre-trends are projected forward. The estimated effect for the college educated barely moves (as their pre-trends are flat), but the effect becomes insignificant for those without a college degree.

Splitting the sample by whether the subject reports that her own mother worked tells a similar story. For those who grew up with a stay-at-home mother, there is no significant decline in the gender-norms index upon the first birth, with or without the pre-trend adjustment. For those whose mothers did work, there is a large move in the anti-work direction, significant with or without the pre-trend adjustment.

It is worth emphasizing the different patterns revealed by the heterogeneity analysis for the gender-norms outcome than for the employment outcome. For the latter, we saw that education and having a working mother was somewhat *protective* against larger employment declines. The patterns here are reversed. Even though they have smaller employment effects, these women seem more "surprised" by motherhood in that the event of first birth made them update their beliefs to a greater extent.

One important implication of this pattern of results is that it is harder to dismiss the norms results as mere avoidance of cognitive dissonance (Festinger, 1957). One might worry that women voice more anti-work views merely because they themselves have stopped working, but if that dynamic were driving the results, we would expect to see a larger change in views among those who exhibit the largest changes in employment.

3.2 Evidence from retrospective questions

We interpret the results from the BHPS norms questions as demonstrating that, prior to motherhood, women on average underestimate the employment costs of motherhood (and this underestimation is concentrated among the more educated). We complement this analysis with retrospective questions from the PSID. In 1997, 2001, 2007, and 2013 the PSID asks subjects with children if parenthood is harder than they thought it would be (the average birth cohort among respondents to this question is 1968, similar to our BHPS event-study sample). Importantly, this question is posed to both primary child-care givers (primarily mothers) and secondary child-care givers (primarily fathers), though the response rate for the latter group is lower. We cannot investigate how this question evolves in event time, as it is not posed to individuals *until* they become parents. We can, however, determine whether educated women are more likely to agree with this statement than their less ed-

ucated counterparts, which would be consistent with our reading that educated mothers' larger change in responses to the gender-role questions in the previous subsection represents a greater pre-baby underestimate of the costs of motherhood.

Table 2 shows results from regressing an indicator variable for the subject reporting that parenting was "harder than I thought" on a college-degree indicator and a vector of standard covariates (which we vary to probe robustness). We perform this regression for women (cols. 1–4) and men (cols. 5–7) separately. Before discussing the regression coefficients, it is interesting to note the large differences in the mean of the dependent variable by gender: whereas 51 percent of mothers with children age six and under report having underestimated how hard parenting would be, only 40 percent of fathers with similarly aged children respond the same way.[15] Most striking, in col. (1) we see that those mothers with a college degree are 16 percentage points more likely to agree than their less educated counterparts, an effect robust to adding controls (col. 2). It remains significant (though smaller) when we include mothers of older children (col. 3). For men (cols. 5–6), education is not a significant predictor of agreement with this sentiment. For this outcome, having a working mother does not seem to be an important mediator, for either men or women.

3.3 Evolution of career ambition from high school to prime-age

To our knowledge, the BHPS is the only dataset that asks repeated, norms-related questions at a sufficiently high frequency to allow us to perform an event-study analysis of how norms change in the years surrounding the first birth. However, other datasets are useful for long-differences analysis. In particular, the Longitudinal Study of American Youth (LSAY) surveys a representative group of U.S. students (all from the early- to mid-1970s birth cohorts) in high school and then again in 2007. As we detail in Appendix B.5, the main objective of the LSAY is to examine high school students' interest in science, technology, engineering and math (STEM) and whether they pursue STEM careers later in life. For our purposes, however, we make use of questions the LSAY asks in tenth grade and in 2007, asking respondents to assess the importance of career success in their lives: (1) not important, (2) somewhat

[15]Respondents were asked to rank the truth of the statement "Being a parent is harder than I thought it would be" on a scale of (1) "not at all true" to (5) "completely true." Responses for our regression sample are as follows: 16 percent of women and 22 percent of men select (1) "not at all true;" 11 percent of women and 21 percent of men select (2); 22 percent of women and 21 percent of men select (3), 18 percent of women and 20 percent of men select (4), and 33 percent of women and 17 percent of men select (5) "completely true."

important, (3) very important.[16] While the question asked of students and the question asked of adults are not identical word-for-word , they are the closest we can find to a question that asks respondents to assess the personal importance of career over time. These questions of course differ from our BHPS index on feelings toward women working, as it does not ask about gender or motherhood or even attitudes more generally. Instead, it asks respondents to prioritize work-related success in their own lives.

We begin by modeling the 2007 level of self-reported career importance as a function of motherhood and the respondent's tenth-grade answer. Col. (1) of Table 3 replicates the main result from Figure 3: that motherhood is associated with women changing their views in an anti-work direction, in this case about the importance of career success in her own life. While it is difficult to compare this result to our BHPS event-study results, the point estimate in col. (1) is equal to about one-fifth of a standard deviation of the dependent variable, whereas the event-study analysis in Figure 3 suggests about one-third of a standard deviation change (though of course the outcome is different and the change in the outcome is measured over a much shorter time interval). Col. (2) shows that the result is robust to adding a standard set of controls (all measured at grade ten and thus not endogenous to the decision to have a child). In col. (3) we employ a more restrictive specification, modeling the *difference* in self-reported importance between 2007 and grade ten (in effect restricting the coefficient on *Importance in grade 10* to equal -1). The coefficient is unchanged, though less precise and loses significance.

We use the specification with the outcome in changes to simplify the heterogeneity analysis, which we examine in the remainder of the table. First, we show that the downgrading of career importance for mothers relative to non-mothers is significantly larger for college-educated women (col. 4). It is also significantly larger for respondents who report in high school that their own mother worked (col. 5). A nice feature of the LSAY is that it evaluates math and science aptitude of the high-school respondents, so we use the score on these tests (proxied as an indicator variable for scoring above the median) as a unique measure of investment in future career. We find the same pattern, that the downgrading of career

[16]The exact wording of the question posed in high school is as follows: "Now I would like to read you a list of goals you may or may not have for your life. For each goal—as I read it—I would like you to tell me if it is very important, somewhat important, or not important to you. First, being successful in your line of work." The exact wording of the question posed to the adults in 2007 is as follows: "Now, please think about your goals or things that are important to you in life. For each of the goals listed below, please indicate if this goal is very important to you, somewhat important, or not important...Having accomplished something important in my work."

importance post-baby is concentrated among women who in high school scored in the top half of the distribution on math (col. 6) and science (col. 7).

Appendix Table A.2 replicates Table 3, but for the men in the sample. None of the coefficients on parenthood (cols. 1–3) or interactions thereof with proxies for human capital investment (cols. 4–7) are significant. Individuals downgrading career importance after parenthood—driven by those who appeared in high school to be investing in human capital or seeing their own mothers work—is a phenomenon unique to women in our data.

4 Women's expectations versus realizations of labor supply over six decades

In the previous section, we presented a collage of evidence that women underestimate the employment costs of motherhood. Almost all of this evidence comes from the late 1960s and 1970s birth cohorts, who are for the most part having children in the 1990s and early 2000s. To the best of our knowledge, the data required to replicate the exact analysis in Section 3 for older cohorts do not exist. We can, however, compare—over a longer period of time—how young women in high school estimate their prime-age labor supply with the actual realizations. We perform this exercise for the 1940s birth cohorts onward, using a combination of actual panel data and synthetic panels.

4.1 Data and variable definitions

Some of the analysis in this section makes use of the NLSW68 and the NLSY79, and some relies on data we have yet to introduce. Summary statistics for these supplementary data sources can be found in Appendix Table A.3 and more details on the data can be found in Appendix B.6. We provide a brief overview below.

Monitoring the Future (MTF) is an ongoing study of the behaviors, attitudes, and values of a nationally representative sample of U.S. students. We examine twelfth-graders' responses to a question on the type of work they expect they will be doing at age thirty. Specifically, the question asks, *"What kind of work do you think you will be doing when you are 30 years old? Mark the one that comes closest to what you expect to be doing."* There are fifteen occupational categories from which students can choose, with "home-maker" as one option. See Appendix B.6 for a list of the occupations provided by the MTF for this question (as well as the list of occupations offered to respondents in the other data sources we describe

in this subsection).

The NLSY79 asks respondents what they plan to be doing at age 35. Unlike in the MTF, respondents can only choose among four options: "working at current job," "working at a different job," "married, raising a family," and "other." Respondents who indicate that they plan to be "married, raising a family" are *then asked a follow-up question* about whether they also plan to be working outside the home at age 35. We define expected home-maker in the NLSY79 to be those who indicate planning to be "married and/or raising a family" *and* not working outside the home at age 35.

For years prior to 1977, we can in principle rely on the NLSW68. However, we are concerned that the NLSW68 may *overstate* the share being categorized as "home-maker," since respondents are forced to choose between motherhood and work. Specifically, respondents are asked the *first* question from the NLSY79 but then those who choose "married, raising a family" are *not* asked the follow-up question on whether they also plan to work outside of the home. We thus supplement this earlier period with three additional, cross-sectional surveys: the 1961 and 1962 Purdue Opinion Panels of high school students grades 9–12 and a 1961 Gallup opinion poll of young high school, college, and non-students. The Purdue Opinion Panel asks "What kind of job do you expect to have 20 years from now?" and respondents can choose between twelve possible occupations, including "housewife." Respondents in the Gallup poll were instead asked the open-ended question "What do you expect to be doing when you are 40 years old?" Responses were organized into 18 categories. We use the "house wife," "home maker," "house work," and "raising children" category as our definition of expected homemaker. In both surveys, we restrict our data to female high school seniors, to match the MTF.[17]

How do we compare the expectations of teenagers to their actual behavior once they are in their thirties? For the longitudinal surveys, we simply compare the expectations and realizations of the same group of individuals (so, we look only at those individuals who *both* answer the expectations question in their teens *and* report their realized employment status in their mid-thirties).[18] For the cross-sectional surveys (i.e., the MTF, and the Purdue

[17]A potential concern is that the term "housewife" or "homemaker" is dated and has been replaced by the more modern "stay-at-home mom," and that this antiquated language potentially lowers the share of women who would see themselves in this role. Using Google Ngrams, we find that both "housewife" and "homemaker" are still used far more often than "stay-at-home mom" through 2008 (the last year NGrams provides data). Moreover, the term "stay-at-home mom" is almost never used until the late 1990s.

[18]The MTF does appear to include a longitudinal component, but the data are not shared and

and Gallup surveys), we compare respondents to their "synthetic selves" in the CPS 12-20 years later (this twelve-to-twenty-year range accounts for the fact that the MTF asks about expectations at age 30, twelve years after age 18; the NLSY79 at age 35, seventeen years after; the Purdue "twenty years later;" and the Gallup at age forty, twenty-two years later). That is, we compare answers regarding expectations at age 18 to realizations averaged over the ages 30 to 40.[19]

4.2 Results

Figure 6 depicts several series of *expectations* (displayed with hollow markers) and *realizations* (displayed with solid markers). We describe these results chronologically. The earliest expectation results we have are from the Gallup survey, from 1961, and the Purdue surveys, from 1961 and 1962. Reassuringly, results from these surveys agree with each other: fifty-five to sixty percent of women in all surveys predict that in their late thirties they will be home-makers. In general, these shares are quite similar to those based on eighteen-year-olds in the NLSW from later in the decade (though are somewhat lower, lending some credence to our concern that the NLSW might slightly overstate the share relative to the other surveys, due to the way the question is posed). Consistent with Goldin (1990) and Goldin (2006), we find that, in the NLSW, roughly two-thirds of young women in 1968 expect to be home-makers at age 35, with this share falling over the following two years.[20]

Comparing these expectations to the realized labor supply of women twelve to twenty years later, we see that eighteen-year-old women in the 1960s vastly underestimated their future labor supply (again consistent with Goldin's earlier work). Comparing their expectations to the behavior of their future, synthetic selves in the CPS, women in the Purdue and Gallup surveys overestimate the probability they would be housewives by about fifty percent. As the actual housewife share declines rapidly over the next ten years, the women in the NLSW in fact make more severe (by a factor of two) overestimates of their future housewife status. This result holds whether we compare the NLSW68 women to their future

in fact we can find few citations that make use of these data. Not even codebooks appear to be published.

[19]In previous versions, we matched each expectation to the exact future age to which it referred. Results are nearly identical, though far more cluttered visually.

[20]Our panel data sources, the NLSW68 and the NLSY79, ask expectations questions several times. The points plotted in Figure 6, however, use only the data from the year a respondent turns 18, to match the MTF. A small concern is that some of these 18 year-olds will have seen the question in previous waves of the survey. Readers concerned with this potential anchoring bias can simply ignore the points after 1968 and after 1979 for the NLSW68 and the NLSY79, respectively.

selves in later waves of the study or to their synthetic selves in the CPS—reassuringly, the two series are very close to each other.

Between the high school classes of 1968 and 1978, young women's tendency to underestimate their future labor supply disappears and in fact reverses. In 1968, over sixty percent predict they will be housewives, by 1974 that share falls to one-third and by 1978 to roughly ten percent. While up through the 1974 high school class, young women were *overestimating* the probability of being a housewife, from 1978 onward, every high school class in our data *underestimates* it. For the late 1970s high school classes (when we can compare the MTF and the NLSY79, as their samples overlap in terms of birth cohorts during this period) the magnitude of the underestimate is very similar whether we compare MTF respondents to their synthetic selves in the CPS or the NLSY79 respondents to their own future selves: around ten percent of respondents predict they will be housewives, but in reality nearly twenty percent will be. Since about 1990, less than two percent of our MTF sample predicts they will be housewives at age thirty, whereas the actual housewife share in the CPS has not declined appreciably since 1980 (it has bounced between 15 and 18 percent).[21]

One natural explanation for the results in Figure 6 is that more recent cohorts of young women are underestimating their *fertility*—perhaps they expect or want fewer children relative to previous cohorts or expect to have fewer children than they actually do. That is, instead of underestimating the employment costs of motherhood, they simply underestimate the probability of motherhood itself. In fact, Appendix Figure A.9 shows that, if anything, female high school seniors in the MTF report substantially higher desired fertility than their actual realizations. Moreover, young adult women between the ages of 17 and 20 in the National Survey of Family Growth (NSFG) overestimate their future fertility. As such, young women desire and expect to have children, but, at the same time, do not connect motherhood with home-making.

[21]This result that young women seem unconcerned or unaware about the future challenges of child-rearing echos recent work by Lordan and Pischke (2016). In a survey experiment, they ask 18-year-olds to make pairwise choices between possible careers and then to explain in an open-ended format why they made those choices. No students, male or female, mention the need for flexibility or childcare, but focus instead on the attributes of the job. The disregard for the future challenges of childcare suggested by their and our results is consistent with speculation in Bertrand (2018): "It is also possible that women today more than in the past believe (rationally or not) that they can 'have it all.' "

4.3 Related results and discussion

Taken together, these results indicate that there has been a sharp reversal in the accuracy of young women's predictions of their future labor supply. Throughout the 1960s and early 1970s, we find that young women are largely *overestimating* the probability that they will be home-makers. From 1978 through the early 21st century, we instead find that young women are *increasingly underestimating* this probability. As such, since the late 1970s, women who are on the cusp of making key human capital investment decisions appear to substantially overestimate their future attachment to the labor market.

Indeed, returning to subfigure (*d*) of Figure 2, we see that in more modern cohorts, whether you *plan* to work in your prime-age years has little, if any, predictive power over the size of the child penalty. In the NLSY79 cohorts, young women who say they plan to work exhibit essentially the same employment decline post-baby as do other women. However, in older cohorts, when the majority of young women did *not* say that they planned to be working in their thirties and forties, predicting that you would in fact work provided real informational content. The smaller employment declines for these women relative to others is economically and statistically significant.

Ethnographic evidence supports the idea that women in modern cohorts indeed plan to work full-time during motherhood and are thus surprised when they drop out of the labor force or shift to part-time work. Schank and Wallace (2018) extensively interview 43 of their Northwestern sorority sisters who graduated, like they did, in the early 1990s (so were born in the early 1970s).[22] This sample is obviously not representative of all U.S. women from these cohorts, but they are of interest to our inquiry as they reflect high-achieving women who have made sizable investments in education.[23] Whereas all these women anticipated high-powered careers while in college and most left college for graduate degrees or jobs with long hours, only eight of the thirty-four who became mothers maintained full-time jobs. Fifteen moved to flexible or part-time work and eleven fully dropped out of the labor force.

[22]The authors describe sororities at Northwestern being unlike typical sororities at other U.S. universities with "no hazing and a lot of studying." Women joined sororities at Northwestern to make friends and to gain a sense of belonging in a large school. As a result, according to the authors, the women in the sample were more economically diverse and academically accomplished than one might assume based on the typical sorority.

[23]As a reference, we compared the labor market outcomes of the Northwestern sorority sisters to women in our PSID sample, which, among our various U.S. datasets, most closely resembled the Northwestern graduates in age. Of the 34 sorority sisters who became mothers, 68% worked in some capacity post-baby. In our PSID sample, approximately 79% of comparable women (college graduate mothers in their early 40s) were working.

Almost all the women who moved to flexible work or dropped out express surprise at the outcome. "I wasn't planning on staying home with my son after he was born," one mother said, "but once he was born, I realized something had to give and I needed to figure out what." Said another: "I never wanted to stay home with my kids, ever," but six weeks after the birth of her first child, the woman decided not to return to work. As the authors write, *only two* of the eleven mothers who dropped out of the labor force planned to do so before the actual birth.

In summary, this section has shown a variety of evidence consistent with the claim that, during the years they make their key human capital decisions, women in modern cohorts do not fully anticipate the effects of motherhood on employment. Given how large this effect remains and how common an occurrence motherhood is, our results so far raise the question of *why* women today would fail to anticipate these effects. We now turn to this question.

5 Why do women today underestimate the effects of motherhood?

The results in Section 2 further contribute to the growing literature that motherhood is associated with large and lasting declines in employment, even for modern cohorts. The evidence from Section 3 suggests these women were surprised by the challenges of working motherhood. In heterogeneity analysis, we show that this "surprise" is especially pronounced among the college educated and women whose own mothers worked. Indeed, as we demonstrated in the previous section, as they approach the end of high school the vast majority of young women today (and over the past few decades) plan to become mothers but also to work outside the home nonetheless. The massive increases in human capital investment they made relative to older cohorts (and relative to men of their own generation) suggest they were indeed preparing for long-term employment. This overestimation of future labor supply is a new development: as late as the 1950 birth cohort (those graduating from high school in late 1960s), the vast majority of female high school students expected to be full-time home-makers in their thirties.

To explain this pattern of results, *we hypothesize that the employment costs of motherhood are higher for current mothers than they would have predicted by observing their own mothers or projecting from past trends.* Such an explanation has a number of attractive features. It explains why young women now (but not in earlier cohorts) overestimate the likelihood they will work in their thirties. It also explains why they have invested so much in education and have delayed childbirth despite, since roughly 1990, seeing no increase in labor force

attachment (because they were making investment decisions under the mistaken assumption of high, future labor force attachment, due to their underestimation of motherhood costs).

We begin this section with a simple model of women's educational investment decisions in the face of uncertain employment costs of motherhood. We first show that it yields, under quite general conditions, two of the more striking results from the paper: that, compared to their less educated counterparts, college-educated women exhibit smaller *employment* effects of motherhood (recall Section 2.5, where we show that this result holds across all four of our datasets), but at the same time they are also more "surprised" by how hard motherhood actually is (recall Section 3.1, where we show their attitudes change more in the anti-work direction on work-family balance questions in the BHPS and Section 3.2 where they are more likely to say in the PSID that parenthood is harder than they anticipated). *We show that this result holds whether or not the average cost of motherhood has increased or decreased relative to the previous generation.*

We then show that the model predicts some of our other key results—namely, that women *on average* update their attitudes in the anti-work direction upon motherhood and report that parenthood is harder than they expected—*only* when the costs of motherhood have increased on average across generations.

We complement this theory-based argument with a collage of empirical evidence that while the cost of motherhood fell during much of the twentieth century, by some important metrics, it has recently risen. Some of this evidence we take from existing literature and some, to the best of our knowledge, we provide here for the first time.

5.1 Modeling women's education and employment as a function of expected employment costs of motherhood

We present a simple, two-period model in which women predict the employment costs associated with their future children based on their observations of their own mother (though we explore implications of a three-generation model at the end). In particular, when they are making human capital decisions, they can over- or underestimate these future costs (which leads to under- and overestimates, respectively, of their future labor supply). In this sense, our model takes Fernández (2013) as inspiration. She explicitly models how women form beliefs over the effect of working on family life, using signals they inherit from their own mothers as well as common signals embodied in the current female labor force participation rate. While our paper focuses much more on empirical evidence and our model is simpler

and less micro-founded, we share her view that it is legitimately hard for women to predict the costs of working post-motherhood. As she writes: "It is not an exaggeration to state that, throughout the last century, the consequences of women's (market) work have been a subject of great contention and uncertainty."

5.1.1 Assumptions and set-up

Let utility $u(c, h)$ be a quasi-linear function of consumption c and labor h (for hours worked, say). Specifically, assume that

$$u(c, h) = c - \frac{h^{\gamma+1}}{\gamma + 1},$$

where $\gamma > 0$.

Women's consumption will be equal to market wages net of employment costs of motherhood (both per hour) times labor supply (in hours). Market wages are $\tilde{w} = w + \beta \cdot e$, where w is the base wage for those without higher education ($e = 0$) and $\beta > 0$ is the hourly return to higher education ($e = 1$). Acquiring higher education $e = 1$ costs some "tuition" $\alpha > 0$, while $e = 0$ is free.

We view "employment costs of motherhood" very broadly, as any cost mothers endure during work. Recall, from the introduction, that these might include the per-hour cost of a nanny or day-care service, the emotional or psychic cost of being separated from the child while at work, the sense of guilt at underperforming as a mother or colleague, or simply lack of sleep due to working while also performing childcare activities.

Actual employment costs for a given woman i are μ_i, but she predicts this cost with some error δ_i. In particular, she observes her mother's employment costs, $\mu_i + \delta_i$, but she only inherits the μ component. The δ component was her mother's "luck" (good or bad) and is *not* passed down to the daughter. This luck is the sum of (i) a generational component λ and (ii) an idiosyncratic component ϵ. For example, generational "good luck" in terms of low employment costs could be raising children in an era when formula is viewed as no worse than breastmilk. Idiosyncratic good luck might include having had a very understanding supervisor at work or having parents or in-laws who live in close proximity and can provide free child care. But the young woman in our problem cannot distinguish between μ_i and δ_i and instead uses the sum as the best signal of her *own*, future employment costs of motherhood.[24]

[24]Note also that women in our model are *naive* in the sense that they do not take into account

Assume further that $\mu \sim U[0,1]$ and $\delta \in \{\lambda - \epsilon, \lambda + \epsilon\}$ with equal probability, where λ and $\epsilon > 0$ are both constants. Note that λ can take negative values (for much of the analysis below, λ will drop out, but allowing $\mathbb{E}(\delta) \neq 0$ will be useful later). We assume μ and δ are independent. For simplicity, we further assume no taxes and that w is sufficiently large such that $w - \mu - \delta$ is always greater than zero (so mothers' predicted effective wages are always positive). Note that this assumption as well as modeling motherhood costs as per-hour instead of having some fixed components means that variation in labor supply comes fully from the intensive margin, despite the importance of the extensive margin shown consistently in empirical research on female labor supply. We leave this important refinement to future work.

We abstract away from many possible dimensions of heterogeneity. There is no variation in fertility in our model: women become mothers with probability one and we ignore issues related to delaying or timing childbirth. Unlike many models of human capital, we ignore any variation in "ability" and thus the effective return to and cost of education do not vary along this dimension.

The implicit timing of the model is as follows (and depicted in Appendix Figure D.1): A woman i makes her education decision $e \in \{0,1\}$ assuming that her future employment costs of motherhood are $\mu_i + \delta_i$, but then will make her actual labor-supply decision after this uncertainty is resolved and her actual costs, μ_i, are revealed to her. While this timing is helpful to keep in mind, the problem can in fact be collapsed to a single decision: the woman's (only) problem is to optimally choose education $e_i \in \{0,1\}$. Once she chooses e_i and once her true costs μ_i are revealed to her, her labor supply is given by a simple optimization problem and thus can be viewed as deterministic. Note that, as we are assuming away many other dimensions of heterogeneity, variation in optimal e_i^* comes entirely from variation in expected employment costs, $\mu_i + \delta_i$.

Working backward, the woman calculates her predicted utility for each $e_i \in \{0,1\}$. This comparison requires calculating, for each $e_i \in \{0,1\}$, the optimal predicted labor supply $\hat{h}_i^*$ given her assumptions about employment costs $\mu_i + \delta_i$ and then determining the value of e_i that yields higher utility. We describe key characteristics of both the predicted labor supply $\hat{h}^*$ and actual labor supply h^* in the Appendix.

that δ is drawn from a distribution and instead just assume employment costs will be $\mu + \delta$ with probability one.

5.2 Predictions yielded by the model

Claim 1. *Women who choose $e = 1$ will on average work more (post-baby) than women who choose $e = 0$.*

Proof. See Appendix D. ∎

The intuition is relatively simple. Women who choose $e = 1$ have higher wages, and because the utility function is quasi-linear, there is no income effect of higher wages on labor supply. While *some* women with $e = 0$ will supply more labor than *some* women with $e = 1$ (because some women with $e = 1$ will have much higher employment costs of motherhood than they had expected because their own mothers had *very good* luck), *on average* those with $e = 1$ work more.

Note that to connect this result directly to the empirical work, we need to add slightly more detail to the timing of the model. We have effectively collapsed the model into a single period (i.e., women make their education decision based on expected costs of motherhood, and then instantaneously have a child and have their true costs revealed to them). If we instead assume that women all have a (perhaps brief) pre-baby period where everyone works some maximum "full-time" hours (which is roughly what we see in our data), then the claim maps not only into educated women having higher post-baby labor supply, but also exhibiting smaller employment "mommy effects."

The next result states that, even though more educated women have smaller mommy effects with respect to employment, they are nonetheless the most "surprised" by the demands of motherhood.

Claim 2. *The average forecast error for women with $e = 1$ is less than the average forecast error for women with $e = 0$. That is, $\mathbb{E}[\delta \mid e = 1] < \mathbb{E}[\delta \mid e = 0]$.*

Proof. See Appendix D. ∎

Note that we mean "smaller" as in either "less positive" *or* "more negative," so we refer here to both the sign and magnitude of the error, not just the magnitude, which is often the relevant statistic in other forecasting contexts.

A "less positive" or "more negative" δ means that actual employment costs μ will be *greater* than expected costs $\mu+\delta$, thus leading to "surprise" by the challenges of motherhood. Intuitively, women whose mothers draw a low δ will, all else equal, be more likely to invest

in $e = 1$, because they assume (based on their own mother's experience) low employment costs of motherhood for themselves and thus high future labor supply. Put differently, they choose $e = 1$ in part *because* they assume smaller employment costs of motherhood relative to women who choose $e = 0$.

As is made clearer in the proofs, Claims 1 and 2 hold for any value of "generational luck" λ. That is, they hold if the previous generation had on average lower, higher or equal employment costs of motherhood relative to the current generation. The model thus, under fairly general assumptions, yields our results on heterogeneity by college education in how much norms change (Figure 5, subfigures *a* and *b*), how parenthood is harder than predicted (Table 2) and downgrading of career importance post-baby (Table 3, col. 4). It also, by simple extension, yields the heterogeneity results by own mother worked in how much norms change (Figure 5, subfigures *c* and *d*) and the downgrading of career importance (Table 3, col. 5), as in the model, observing her mother having low employment costs of motherhood is the *reason* she chooses to attend college.

Next, we show that our *unconditional* results on belief-updating (i.e., that, *on average*, women's gender-role attitudes move in the anti-female-employment direction after baby and that they report parenthood being harder than they expected) hold *if and only if* the employment costs of motherhood have increased for the current generation relative to the previous.

Claim 3. $\mathbb{E}[\mu + \delta] < \mathbb{E}[\mu]$ *iff* $\lambda < 0$.

Proof. See Appendix D. ∎

To convey the key intuition of our model, we need only two generations. If daughters assume they will inherit their mothers' costs but then costs on average grow, then our model can explain the key results in our paper. Extending to a three-generation (i.e., grandmother, mother, and daughter) set-up of the model actually relaxes the conditions needed to generate "surprise" among daughters. In this set-up, the daughter considers not only the *level* of her mother's costs, but also the *trend* of these costs across generations, defined by the *change* between her grandmother and mother. If that trend suggests falling costs, then instead of needing an *increase* in costs to "surprise" the daughter, a mere *plateauing* or *slowing* of the rate of decline would suffice.

In the next subsection, we present a collage of evidence that motherhood costs *fell* from the 1920s until (depending on the measure) the 1970s or 1980s (where the year here refers not

to mother's birth cohort but the years she is having and raising children). Shortly thereafter, most costs (e.g., share breastfeeding, time spent with children) began to rise, and have continued to rise through today. Others (e.g., gender norms and division of household labor) moved significantly in the egalitarian direction until the 1980s, when they plateaued.

5.3 Empirical evidence on the evolution of the costs of motherhood across cohorts

5.3.1 Costs that follow a U-shaped pattern over time

Several macroeconomists have modeled the *rise* of working mothers over much of the twentieth century as a function of *declining* costs of motherhood. Greenwood *et al.* (2005) argues that electrification liberated women from household chores, chronicling the dramatic decline in time cost associated with tasks such as laundry and cooking. Albanesi and Olivetti (2016) focus more on the biological aspects of motherhood. They show that the health costs of pregnancy and delivery fell dramatically beginning in the 1920s, due to pharmaceutical innovations such as sulfa drugs and antibiotics as well as the modernization of obstetric practices, all of which dramatically reduced mortality and morbidity associated with childbirth. Moreover, the quality of infant formula improved substantially over this time, minimizing the need for mothers to breastfeed, a major time cost associated with infants. Until formula and piped water, the alternatives were either risky (cow's milk) or limited to the very affluent (wet nurses).

The data we collect on breastfeeding documents the dramatic decline in the practice from the 1920s through the 1970s, as can be seen in Figure 7. Over 85 percent of U.S. mothers report breastfeeding in 1925. That share declines steadily until an abrupt reversal around 1970. Indeed, by 1965, only twenty percent of U.S. mothers report ever having breastfed. Since then, nursing has regained all the ground it lost to the introduction of formula, and is now as common as it was in the 1920s. We do not have U.K. data going back as far as our U.S. data, but we show that nursing has become far more common in the U.K. as well, with the "ever breastfed share" rising from roughly 45 to 80 percent between 1975 and 2010. While we focus on "breastfeeding at all" because it is the measure we can best compare across time and countries, Appendix Figure A.10 shows that alternative measures follow the same U-shaped pattern over time.

The reversal is not surprising, as mothers today are encouraged to breastfeed exclusively for at least six months and formula is deemed a distant, second-best option. The U.K.

National Health Services (NHS) recommend: "Exclusive breastfeeding (breast milk only) is recommended for around the first six months of your baby's life." Moreover, the NHS lists as a "myth" the claim that formula provides comparable benefits to breastmilk. The American Academy of Pediatricians official policy statement on breastfeeding reads: "The American Academy of Pediatrics reaffirms its recommendation of exclusive breastfeeding for about six months, followed by continued breastfeeding as complementary foods are introduced, with continuation of breastfeeding for 1 year or longer as mutually desired by mother and infant."[25] Interestingly, while scientific and technological advances tend to save time, breastfeeding is an example where advances in understanding and evidence made the scientific and medical community modify recommendations in a manner that required more time from mothers (and exclusively mothers, as obviously breastfeeding cannot be out-sourced to the father).[26]

Ramey and Ramey (2010) have documented another time cost that has risen since the 1980s: time spent with children. Figure 7 presents trends similar to theirs based on time-use data.[27] Our time-use data only go back to 1965, but we do see a decline in time spent with children from 1965 to 1975, consistent with our other U-shaped series. In 1975, women spent only seven hours a week with their children on average. We see a gentle rise over the next ten years, and then between 1985 and today women double the weekly time spent with their children.

Finally, we note that the cost of one of the most common substitutes for maternal inputs into child-rearing—professional childcare services—has grown steadily in real terms since the early 1980s. Figure 7 documents a 65 percent increase since the 1980s.

Do women themselves perceive that the costs of motherhood have risen since they were themselves being parented? It is certainly possible that the increased costs we highlight above (i.e., time costs of child-rearing, prevalence of nursing, and monetary cost of childcare services) are offset by other factors we do not observe. We thus gather all surveys we can find that ask women if they think being a mother today is easier or harder than a generation ago (Appendix B.8 provides exact question wording and dates as well as other details; most of

[25]See `https://www.nhs.uk/conditions/pregnancy-and-baby/your-breastfeeding-questions/` and `http://pediatrics.aappublications.org/content/129/3/e827.full#content-block`, respectively.

[26]The debate on the benefits of breastfeeding versus formula is active and at times heated, but it is beyond the scope of our paper.

[27]The main results in Ramey and Ramey (2010) are split by education and regression-adjusted, whereas to match the rest of our series in Figure 7 we pool across education groups and plot the raw means. The overall rising trends appear very similar.

the data are from CBS and ABC opinion polls). As Figure 7 shows, from the 1990s onward, the vast majority of women (between sixty and eighty percent) agree that motherhood is harder for them than it was for their own mother's generation. Of course, mothers today are more likely to work than their own mothers were, and thus perhaps they feel they have it harder because they are being asked to both work and raise children. But on the specific question of the demands of child-rearing, 56 percent of current mothers say they are more involved in their child's life than their own mothers were in theirs, with only four percent saying they are less involved (not shown in figure).[28]

Importantly, mothers in the previous generation did *not* feel the same way. Indeed, mothers interviewed in the years around the trough of the u-shaped cost graph indeed perceived that things were easier for them. In 1955, less than forty percent reported that they felt raising children was harder for them than for their own mother, and in the 1960s the share was below twenty percent (though note that the 1960s question is slightly different than the others, asking whether "my job as a homemaker is harder than my mother's"). The 1955 survey went on to ask *why* women felt it was easier (or harder) and the most common response category referred to helpful technological advances and improved standard of living (echoing the themes in Albanesi and Olivetti, 2016 and Greenwood *et al.*, 2005).[29]

5.3.2 Costs that declined then plateaued

If the "daughters" in our model take into account the decline in costs that occurred between their grandmothers and mothers, then a mere plateauing of these costs would lead them to underestimate their own employment costs of motherhood. In Figure 8, we document a number of costs that display such a pattern. Interestingly, they each involve some notion of gender equity.

[28]The remainder say they are equally involved. ABC/Good Housekeeping poll of women, 2006. See `https://ropercenter.cornell.edu/ipoll/study/31086592/questions#0f05d2ac-a498-4799-96ca-7e439b94f587`.

[29]The increase in the costs of motherhood relative to past generations is echoed in ethnographic accounts as well. Schank and Wallace (2018) attribute the increased costs to growing societal anxiety around children being out of the care of their mothers, which was fueled by Hollywood and the media (e.g., stories about day care scandals and kidnapping) as the numbers of women in the workforce rose. Today parents spend more time shepherding children from place to place and supervising children as it is less socially acceptable to leave children unattended. "All the places where parenting has evolved into a hyper-strategized act—from what goes into a school lunchbox to which of the ridiculous number of extracurricular activities a kid is signed up for—require an increment of time that used to be devoted to something else being consumed by parenting."

The father taking on a greater role in child-rearing obviously helps working mothers by relaxing their time budget constraint. From 1966 to 1985, the share of total housework plus childcare that fathers performed grew dramatically: the mother-to-father ratio of hours spent on such work declined from 4.5 to 2.5 over that period. It declined more slowly over the next decade or so, and since then has remained stuck at around a two-to-one ratio. Since women are still doing (in total hours) much more of this type of work than men, the stalling cannot be due to a floor or ceiling effect. Thus, a mother in the early 2000s who had expected household division of labor to continue its decades-long trend toward equality would have been surprised at how little house- and child-care-work her spouse performed.

Ethnographic accounts refer to women being surprised at the traditional division of child-care labor. Schank and Wallace (2018) write that even respondents who felt they were in "egalitarian" marriages pre-baby found that "once children arrived, though, the second shift reared its head—and vaulted the balance toward women doing the lion's share of the parenting work."

Maternal employment remains a sensitive subject, suggesting that stigma costs play a role in mothers' decisions to work. Fernández *et al.* (2004) argue that World War II served as a negative shock to this stigma cost, as mothers were told it was their patriotic duty to work, and that this change in norms may have passed on to future generations. While we cannot find consistently worded questions on norms that date back to the 1940s, Figure 8 shows a dramatic increase between 1970 and 1990 in the acceptance of mothers working and having careers. Since then, however, these proxies remain almost totally flat, both for adults in their prime child-raising years (25 to 44) and high school seniors.

5.4 Discussion

We have so far provided evidence that the family component of work-family balance has become more difficult for mothers. But perhaps (instead or additionally) workplaces have become more hostile to mothers. In many ways, workplaces are, in principle at least, more family-friendly than in the past. In 1975, U.K. maternity leave policy entitled eligible women to twenty-nine weeks of leave, of which only six were paid (Gregg *et al.*, 2007). Since then, eligibility has expanded, as has the length of leave, currently at fifty-two weeks, of which twenty are paid (Glassdoor, 2016). Government provision and subsidization of daycare has also expanded since 1999 (Gregg *et al.*, 2007). The US has much less generous support of working mothers, though it, too, has increased over time. Today, about fourteen percent of

the civilian U.S. workforce has access to paid family leave (which includes maternity leave).[30]

Of course, in practice, there are important countervailing trends. Goldin (2014) and Bertrand (2018) document the rise in the returns paid to long hours. Since women remain the chief providers of child care and tend to work fewer hours in the labor market, they are especially penalized in occupations that are characterized by these high and growing rewards to working long hours, many of which are highly remunerated.[31]

While again only suggestive, ethnographic evidence supports the view that whether or not workplaces have become more or less accommodating to working mothers, the demands on the "life" side of work-life balance has certainly grown. After describing a long list of tasks associated with childcare, one of the working mothers interviewed by Schank and Wallace (2018) says: "Then I go to work, where I can rest."

6 Conclusion

This paper contributes evidence to a growing literature showing that, despite huge increases in women's human capital investment, there remains a large and lasting negative effect of motherhood on women's labor force attachment. We view our chief contribution, however, as demonstrating that women do not appear to accurately anticipate this "mommy effect" on employment. They now substantially overestimate the likelihood that they will be in the labor force during their chief child-rearing years, suggesting that they may be making education and other human-capital investment decisions under mistaken assumptions.

We rationalize this behavior with a simple model. One implication of the model is that the costs of motherhood have risen in a manner today's cohort of mothers was likely unable to predict. In the final part of the paper, we add further evidence to recent work suggesting that such an increase, likely starting in the 1980s, indeed took place.

[30] See http://www.pewresearch.org/fact-tank/2017/03/23/access-to-paid-family-leave-varies-widely-across-employers-industries/.

[31] Cha and Weeden (2014) argue that the rising returns to long hours, coupled with the gender gap in the propensity to work overtime, plays a role in accounting for the slow convergence of the gender wage gap from 1979 to 2009. Indeed, there is abundant empirical evidence that women, particularly those with young children, place a higher value on flexibility at work and shorter work hours relative to men (Flabbi and Moro, 2012, Mas and Pallais, 2017 and Wiswall and Zafar, 2017). Not surprisingly, women respond to the challenges of combining career and family by disproportionately sorting into family-friendly firms or public sector jobs after the birth of their first child (Hotz *et al.*, 2017 and Pertold-Gebicka *et al.*, 2016) and making occupational choices with these considerations in mind (Wasserman, 2018).

We offer three suggestions for future work. First, if current cohorts of women indeed overestimate their future labor supply (as we claim), are they in fact *over-investing* in education? Chen and Chevalier (2012) argue that female medical students systematically over-invest in education: given that female doctors work significantly fewer hours than male doctors, they argue that, from a purely pecuniary perspective, these students should have instead become physicians' assistants. Other papers have instead examined the *social* return of the rise of women's educational attainment. For example, Currie and Moretti (2003) show that exogenous increases in educational opportunities for adolescent women correlate with improved birth outcomes when these women become mothers. Yet other papers have emphasized the marriage market returns to women's education (Lefgren and McIntyre, 2006; Oreopoulos and Salvanes, 2011; Kaufmann *et al.*, 2015; Bruze, 2015), though it is important to note that these returns are private, not social, returns, as they are likely zero-sum. Related work argues women may invest in education as insurance against the risk of divorce, which had been rising during the second half of the twentieth century (Bronson, 2014; DiPrete and Buchmann, 2006). Our work suggests that, especially if employment declines post-motherhood remain large, non-labor market returns to female education are perhaps just as important to study as labor-market returns.

Second, throughout this paper we have taken as given that the employment costs of motherhood might change over time due to technological developments or changes in norms, but future work might focus on *why* they change.[32] On face, it is deeply puzzling that at a moment when women are more prepared than ever for long careers in the labor market, norms would change in a manner that encourages them to spend more time at home.

Finally, it will be interesting to revisit our analysis in the future as today's young women (the daughters and younger sisters of the women on which we focus in this paper) progress through adulthood and early middle-age. Younger women today are still writing their own stories as students, workers and (for most, but likely less than in past generations) mothers.[33] We look forward to future work documenting how employment costs of motherhood change and how well today's young women anticipate them.

[32] A small number of recent papers suggest that the rise in involved parenting (and increase in time spent on children), particularly among educated parents, could be due to factors such as the increase in competition for slots in top colleges (Ramey and Ramey, 2010) and increases in inequality (Doepke and Zilibotti, 2017).

[33] While there is still some debate whether the decline in U.S. fertility since the early 2000s is merely a *postponing* of fertility, there has been no catch-up since then and today the U.S. fertility rate is the lowest ever recorded. The pattern is similar in other rich countries.

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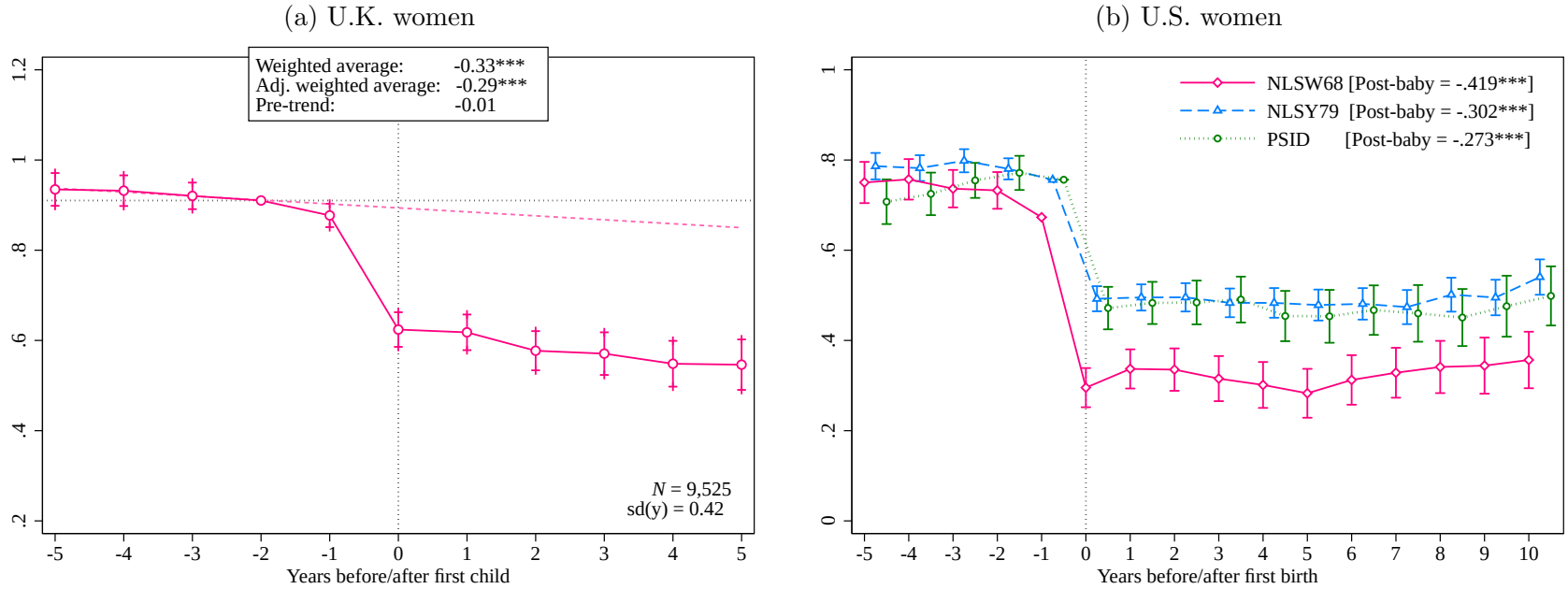
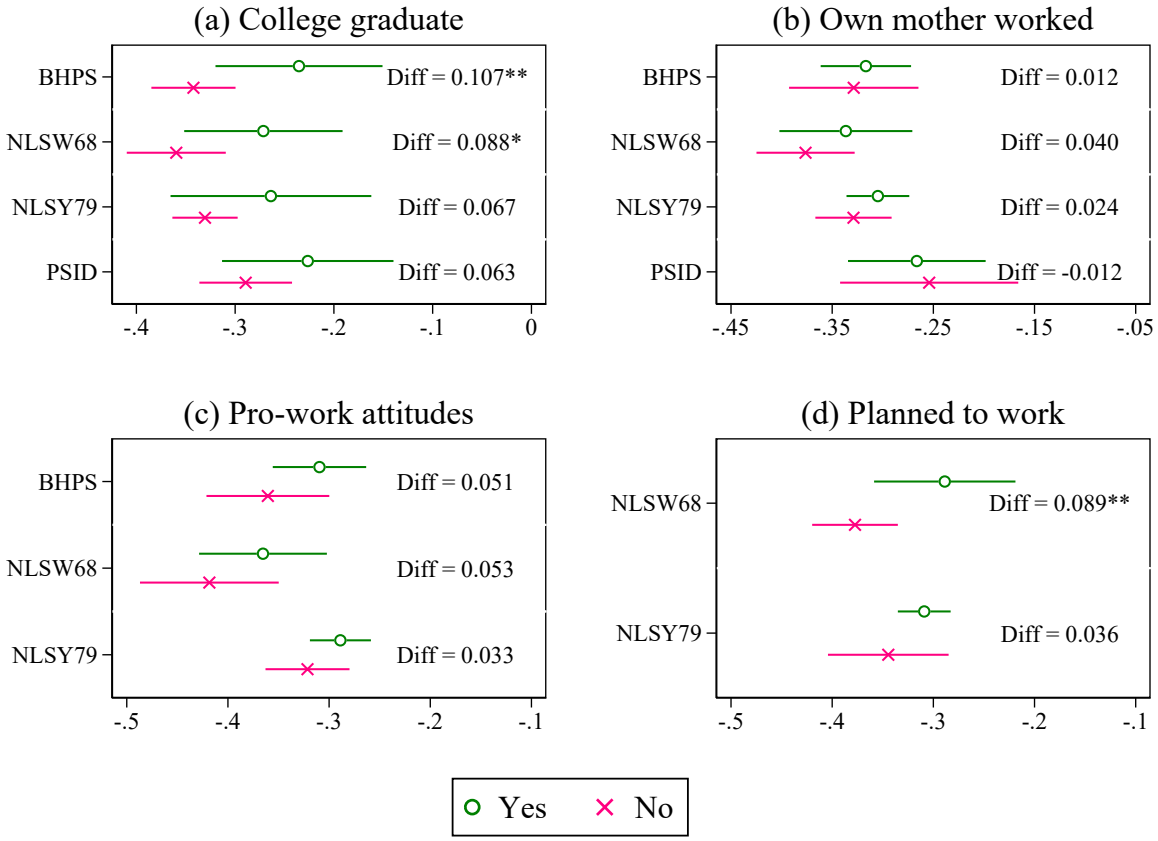
Figure 1: Event-study analysis of how probability of employment changes after motherhood, U.S. and U.K. women



Sources: British Household Panel Survey (BHPS), National Longitudinal Survey of Young Women (NLSW68), National Longitudinal Survey of Youth (NLSY79), and Panel Study of Income Dynamics (PSID). For more detail see Sections 2.1.1 and 2.2 as well as Appendices B.1-B.4.

Notes: Sample comprises all female original sample members for whom we observe the event of childbirth. Individuals must also be observed during their prime child-bearing years. In our U.S. datasets, individuals must be observed between ages 20–40. In the BHPS, we require that individuals must be over the age of 16 at the start of the panel (the BHPS is a shorter panel and we cannot impose the same requirement). Employment is defined as whether the respondent had a paying job last week (including if they were away from their job). Event years are measured with some rounding error, so that event-year $t = 0$ (the year of birth) corresponds to the 12 months post-birth. The year before pregnancy (two years before birth) is normalized to the mean of the outcome variable at event-year $t = -2$. We "cap" event years so that $t = -6$ ($t = 6$) include all person-year observations six or more years before (six or more years after) the first birth (these coefficients are not plotted). The event-study specification controls for age-in-years and calendar-year fixed effects. Standard errors are clustered at the person level. In subfigure (a), we report the weighted average of the post-period coefficients ("Weighted average") as well as a post-period weighted average controlling for a linear pre-trend ("Adj. weighted average"). "Pre-trend" is the slope of the pre-trend line. In subfigure (b), we report only the weighted average of the post-period coefficients. $^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

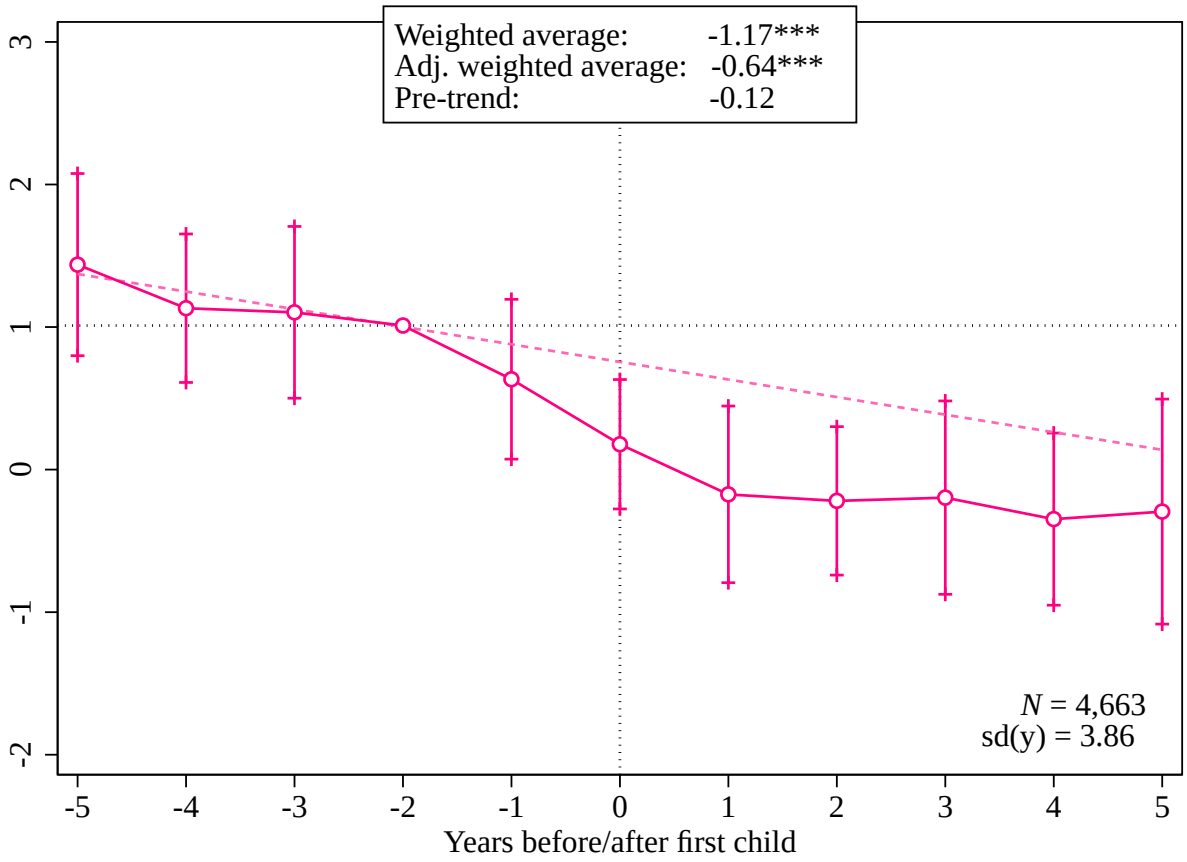
Figure 2: Heterogeneous effects of first birth on current employment, women



Sources: British Household Panel Survey (BHPS), National Longitudinal Survey of Young Women (NLSW68), National Longitudinal Survey of Youth (NLSY79), and Panel Study of Income Dynamics (PSID). For more detail see Section 2.2 and Appendix B.2-B.4.

Notes: Sample comprises all female original sample members for whom we observe the event of childbirth. Individuals must also be observed during prime child-bearing years. In our U.S. datasets, individuals must be observed between ages 20–40. In the BHPS, we require that individuals must be over the age of 16 at the start of the panel (the BHPS is a shorter panel and we cannot impose the same requirement). Estimates are from an interacted event study regression that is identical to our main event-study specification, except that we also include interactions of the event-year, calendar-year, and age-in-years fixed effects with our various heterogeneity variables (the underlying event-study figure for each subsample is displayed in Appendix Figure A.5). Estimates corresponding to "No" are from a t-test of the post-period weighted average of the non-interacted event-study coefficients (where the weights are the share of observations that identify each coefficient). The "Diff" values listed to the right of each series of estimates are the weighted averages of the interacted post-period event-study coefficients, and the estimates corresponding to "Yes" are the sum of "No" and "Diff." Regressions in the NLSW68, NLSY79, and PSID are weighted by the probability of selection. Standard errors are clustered at the person level.

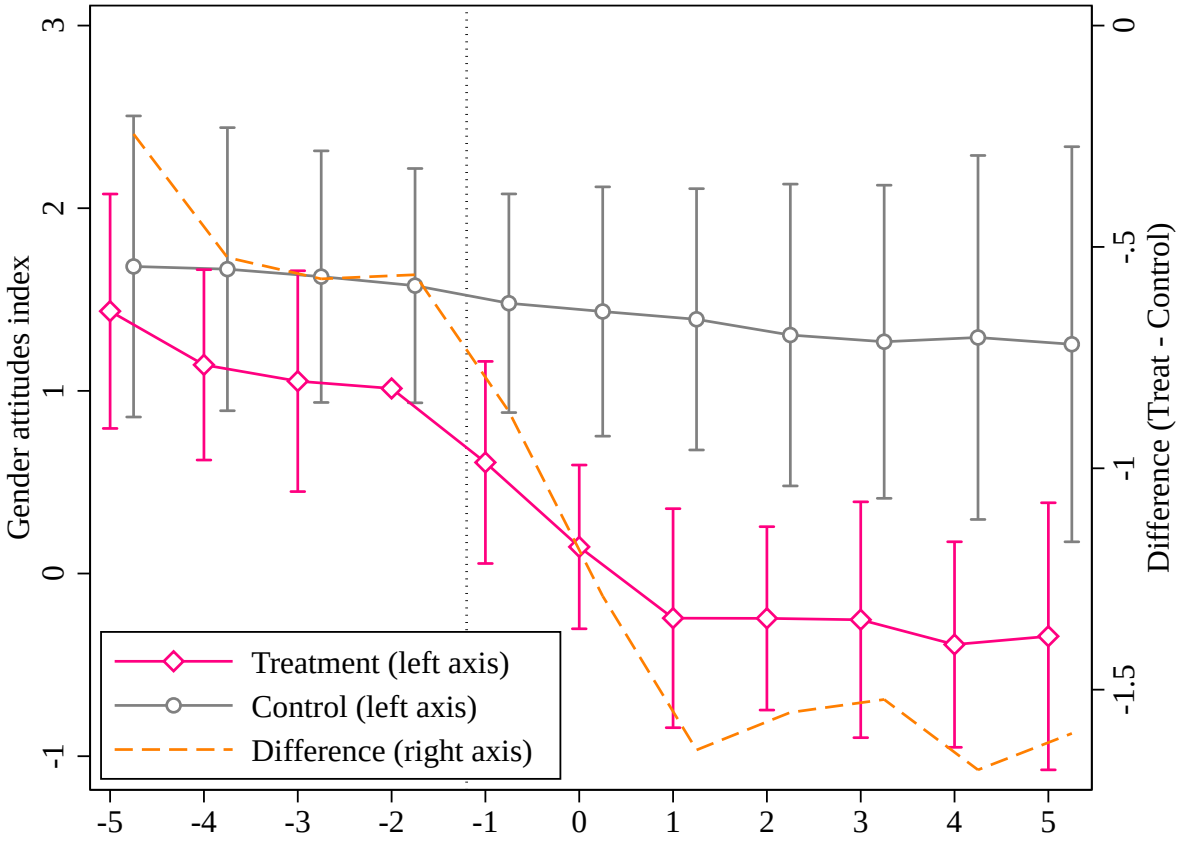
Figure 3: Event-study analysis of how gender-role attitudes change after motherhood (BHPS)



Source: British Household Panel Survey. For more detail see Section 2.1.1 and Appendix B.1.

Notes: The gender-role index variable is constructed as the (standardized) sum of six questions on the appropriate role of men and women with respect to household, child-care, and labor-market responsibilities. It is increasing in the "pro-working-mom" direction. A list of these questions can be found in Appendix Table A.1 and event studies for each component can be found in Appendix Figure A.8. The sample comprises all female original sample members for whom we observe the event of childbirth and who were over age 16 at the start of the panel. See notes to Figure 1 for details on the event study specification.
$^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

Figure 4: Gender-role attitudes index over event-time for women with and without children, assigning "placebo births" to women without children

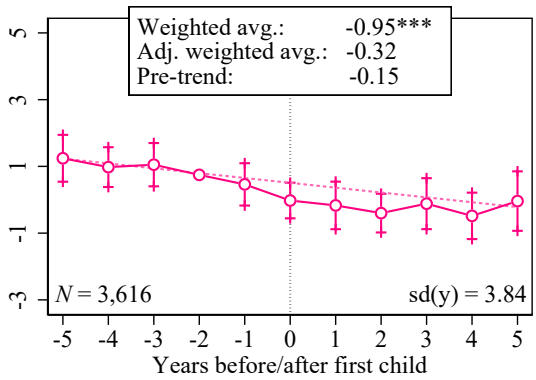


Source: British Household Panel Survey. For more detail see Section 2.1.1 and Appendix B.1.

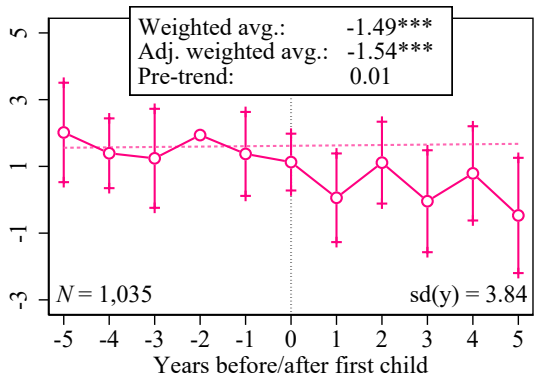
Notes: For both series, we plot estimates from event-study regressions that include calendar-year fixed effects and cluster standard errors at the individual level. Event-year $t = -2$ is normalized to be the mean of the gender attitudes index for event-year $t = -2$. For women with children (the treatment group), event time is defined relative to the birth of the first child, where year 0 is the 12 months following a woman's first birth. For women without children (the control group), we first identify a sample of women most likely to remain childless beyond the period we observe them in the data (broadly following Kleven *et al.* (2018)). We then assign this group random placebo first births as follows: We assume that women's age at first birth follows a log-normal distribution, where the mean and variance of this distribution are the observed mean and variance in age at first birth among the treatment group. We impose our standard sample restriction to this control group (observed at least once pre- and post-birth) and then simulate the random assignment of placebo births 1,000 times to generate bootstrapped standard errors. See Appendix C for further detail on the simulation procedure.

Figure 5: How gender-role attitudes change after motherhood, heterogeneous effects

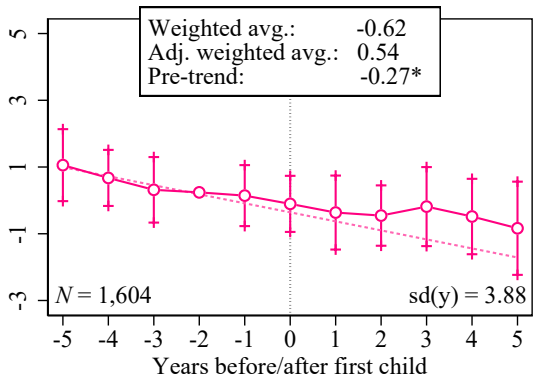
(a) Gender-role attitudes, non-college



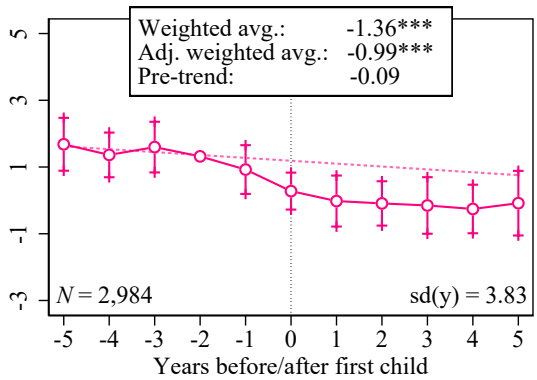
(b) Gender-role attitudes, college



(c) Gender-role attitudes, mom did not work



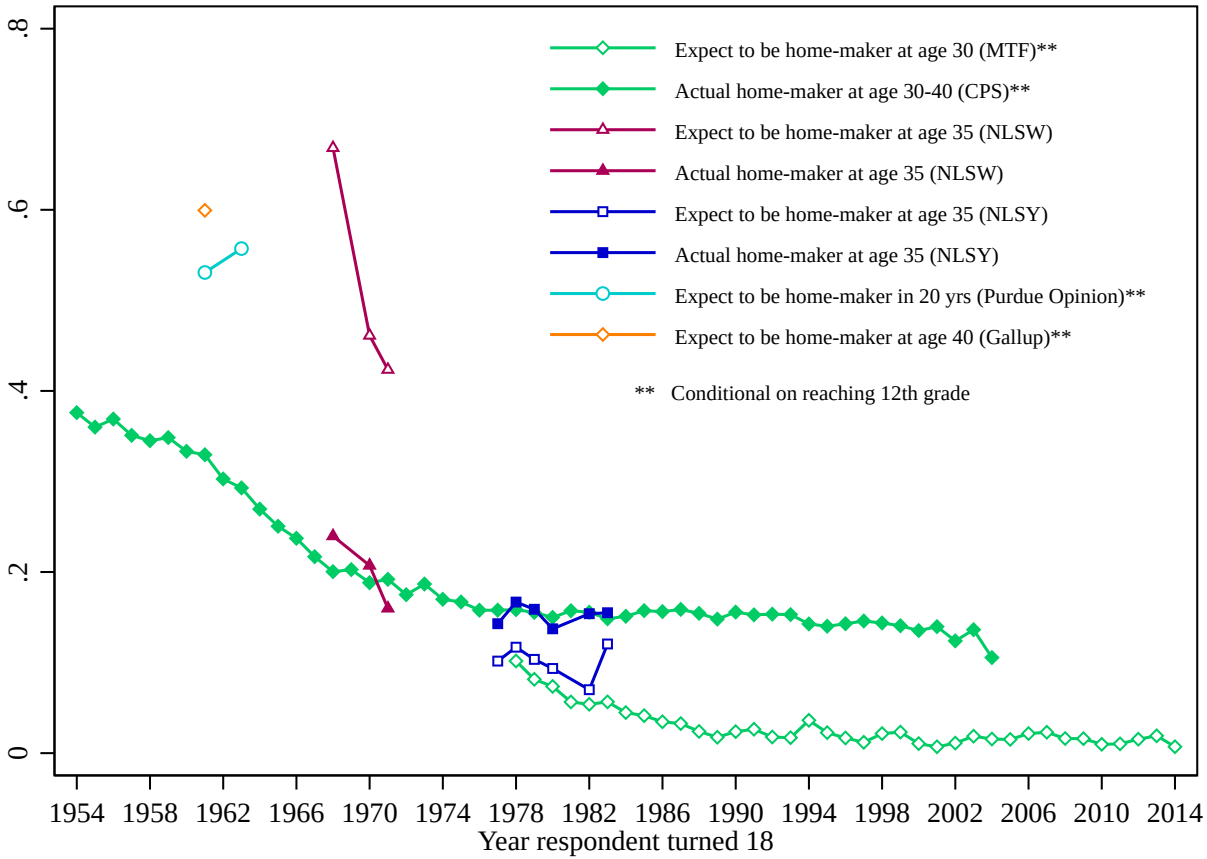
(d) Gender-role attitudes, mom worked



Source: British Household Panel Survey. For more detail see Section 2.1.1 and Appendix B.1.

Notes: See notes to Figure 3. The analysis is identical here except we split the sample by whether a respondent has obtained a college education by age 25 (Subfigures (a) and (b)), and by whether a respondent's mother worked when the respondent was 14 (Subfigures (c) and (d)).
$^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

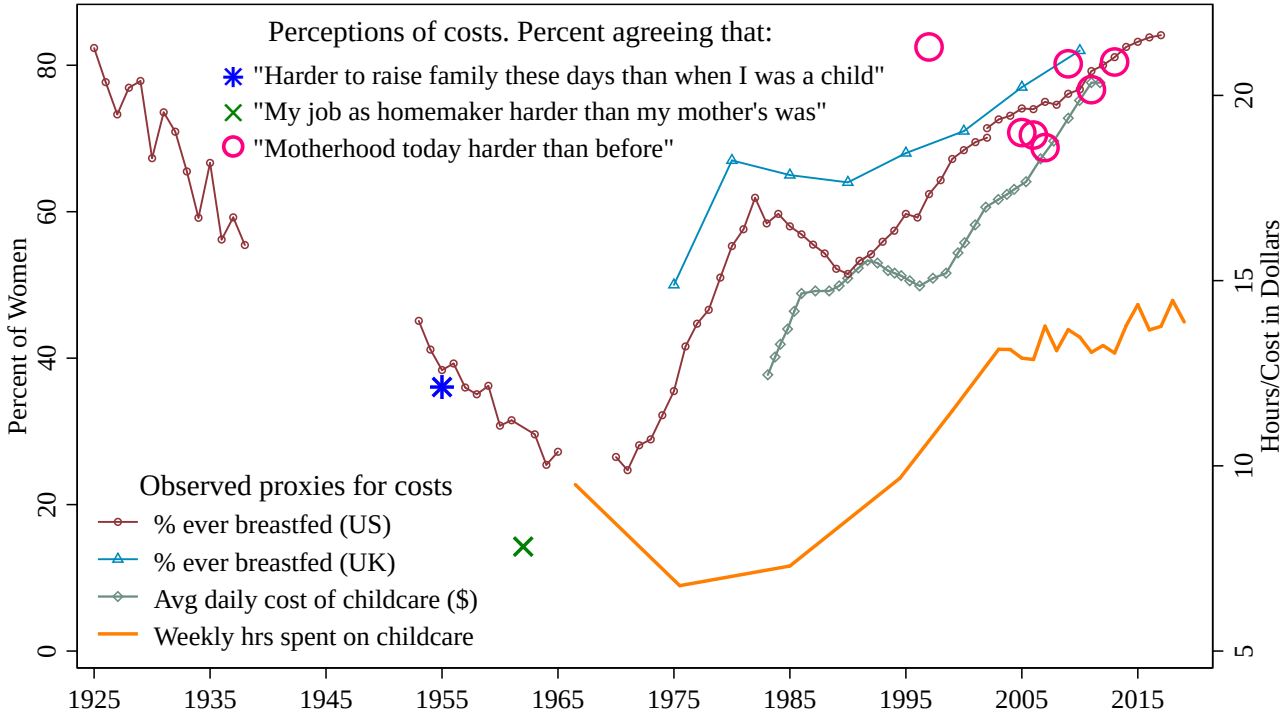
Figure 6: Expectations and realizations of future home-making among U.S. female high school seniors



Source: Monitoring the Future Survey (MTF), 1978 to 2014; CPS, 1972 to 2016; NLSW68, 1968 to 1973; NLSY79, 1979 to 1984; Purdue Opinion Panel, 1961 and 1962; Gallup Opinion Poll, 1961. See Appendix B.6 for more detail.

Notes: Home-maker is defined in the CPS, NLSW68, and NLSY79 as an individual who is out of the labor force and married to a wage earner. In the MTF, Purdue Opinion Panel, and Gallup Opinion Poll, expected home-maker is defined as someone who reports planning to be a housewife or homemaker at age 30, 20 years from now, and at age 40, respectively. In the NLSW68, expected home-maker is someone who reports planning to be married and raising a family at age 35. In the NLSY79, expected home-maker is someone who reports planning to be married and raising a family *and* not working outside the home at age 35. To match the MTF, the CPS sample is restricted to individuals who have completed at least 11th grade. We similarly restrict our Purdue and Gallup samples.

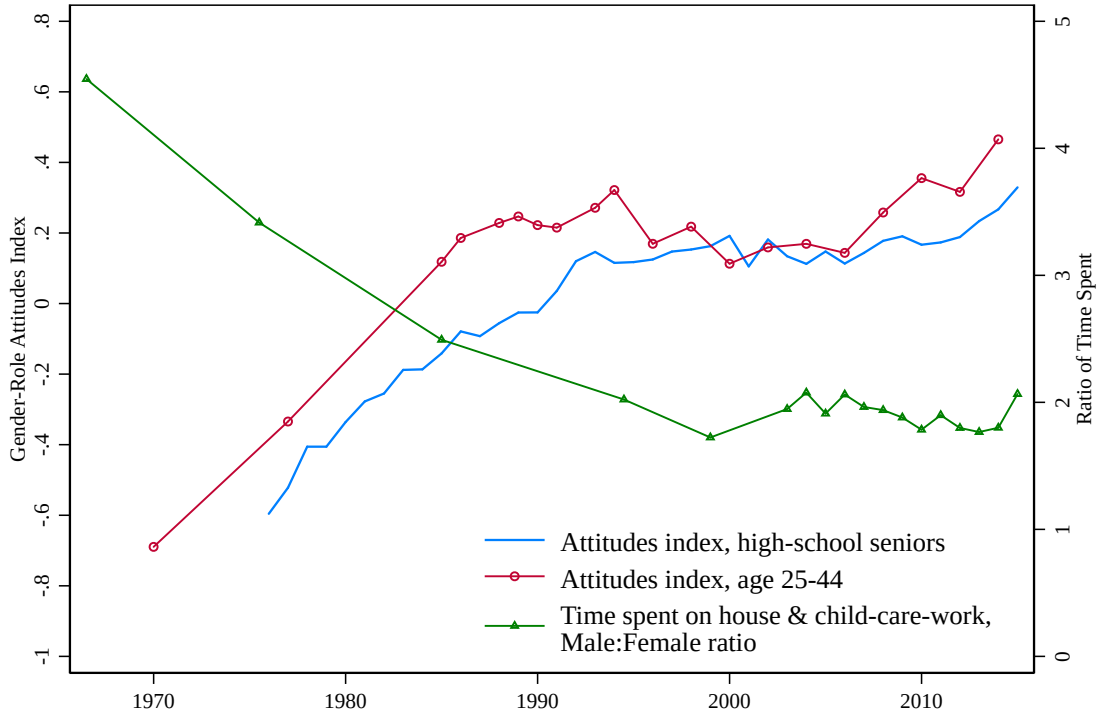
Figure 7: Proxies for employment costs of motherhood and perceived costs relative to past generations



Sources: Breastfeeding data for the U.S. come from three different sources: the Low-Fertility Cohorts Study, 1978; National Fertility Survey (1953-1965), the Ross Labs Mothers Survey (1970-2002), and the National Immunization Survey (2002-2017). Breastfeeding data for the UK come from the Infant Feeding Survey. Data for weekly hours spent on childcare by mothers are calculated from the American Heritage Time Use Study (1965 to 2012) and the American Time Use Survey (2013 to 2019). Data for average weekly childcare costs were extracted from Census Bureau Report CB13-62, available at https://www.census.gov/newsroom/press-releases/2013/cb13-62.html, using an online WebPlotDigitizer tool. Data on perceptions are from the Growth of American Families (1955), a *Saturday Evening Post* survey (1962), and various modern polls (1990s onward). See Appendices B.7 and B.8 for details.

Notes: Estimates of breastfeeding rates from the Low-Fertility Cohorts Study (LFCS), which was performed in 1978, are retrospective. Estimates of breastfeeding rates from the National Fertility Survey (NFS), which was performed in 1965, 1970, and 1975, pool all three surveys. Estimates from the LFCS, the NFS, and the National Immunization Survey are calculated based on the reported year of birth of the child, rather than the year each woman was surveyed. We only plot years in which we observe 100 or more children from the LFCS or 900 or more children from the pooled NFS. In the Ross Labs Mothers Survey and the Infant Feeding Survey, mothers are asked about their children who are currently infants, so we calculate based on survey year. Estimates for weekly hours spent on childcare are based on time-use reports by mothers, aged 25 to 44, with at least one own child below the age of 18 residing in the household in the respective survey years. Due to small sample sizes, we pool the following years of data from the AHTUS: 1965 and 1966; 1975 and 1976; 1992 and 1993; 1994 and 1995; 1998 to 2000. Cost of childcare measures the average weekly expenditures among people making childcare payments, in 2011 dollars.

Figure 8: Trends in gender-egalitarian norms and division of labor



Sources: The data on gender-role attitudes for high school seniors are from the Monitoring the Future Survey (MTF), 1976 to 2015. The data on on gender-role attitudes for adults are from the 1970 National Fertility Survey (NFS, *which covered only women*) and the 1977-2015 General Social Survey (GSS). The data for the female to male ratio on time spent on household work come from the AHTUS (1965 to 2012) and the ATUS (2013 to 2015).

Notes: The gender-role attitudes index is for each of the samples is constructed based on the degree of agreement to the following three statements (on a four-point scale): (1) *"It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family,"* (2) *"A preschool child is likely to suffer if his or her mother works,"* and (3) *"A working mother can establish just as warm and secure a relationship with her children as a mother who does not work."* The index is constructed as the standardized sum of these three questions for each sample in each survey year. With the exception of the 1970 NFS data (which covered only women), we pool men's and women's responses and apply the relevant sampling weights for each survey. The MTF sample includes 12th graders while the GSS and NFS sample is comprised of individuals between the ages of 25 and 44. Estimates for for the ratio of time spent on household work is based on time-use reports by mothers and fathers, between the ages of 25 to 44, with at least one own child below the age of 18 residing in the household in the respective survey years. Due to small sample sizes, we pool the following years of data from the AHTUS: 1965 and 1966; 1975 and 1976; 1992 and 1993; 1994 and 1995; 1998 to 2000.

Table 1: Summary statistics for women in our main data sources

	BHPS	NLSW	NLSY	PSID	CDS	LSAY
Currently employed	0.77	0.63	0.69	0.68	0.69	0.76
In labor foce	0.78	0.73	0.72	0.74	0.75	0.80
Hours worked	24.87	22.06	25.76	.	.	.
Year of birth	1968.75	1950.72	1961.67	1965.87	1968.08	1973.15
Age at first birth	28.7	22.9	24.8	25.4	24.3	25.6
Total children	1.76	2.30	2.28	2.27	2.76	1.49
Married before first birth	0.63	0.75	0.70	0.67	0.55	0.69
Black	.	0.10	0.14	0.13	0.17	0.08
Has college degree	0.22	0.27	0.13	0.27	0.37	0.31
Plans to work	.	0.25	0.79	.	.	1.00
Own mother worked	0.65	0.40	0.56	0.64	0.63	0.84
Number individuals	681	1,478	2,360	1,153	3,938	1,305
Observations	10,410	28,679	58,700	24,968	6,202	1,305

Sources: In order of the columns in the table, we use data from the British Household Panel Survey (BHPS), National Longitudinal Survey of Young Women (NLSW), National Longitudinal Survey of Youth 1979 (NLSY), Panel Survey of Income Dynamics (PSID), the Child-Development Supplement of the PSID (CDS) and the Longitudinal Study of American Youth (LSAY). For more detail see Sections 2.1.1, 2.2, 3.2 and 3.3 as well as Appendices B.1-B.5.

Notes: Cols. (1) through (4) are used in event-study analyses. Cols. (5) and (6) are used in cross-sectional analysis. In cols. (1) through (4), sample comprises all original sample members for whom we observe the event of childbirth. Individuals must also be observed during prime child-bearing years. See Section 2.3 for more detail on the event-study sampling rules. Col. (5) includes only individual who were parents at the time of the interview. Col. (6) is the only one that includes non-parents. Statistics in the NLSW68, NLSY79, PSID and LSAY are weighted by the provided sample weights. Age at first birth and age at marriage are coded as missing for those who, at the time of the survey, never had children or never married, respectively.

Table 2: Determinants of reporting that being a parent is harder than expected

	Dependent variable: Parenthood harder than expected						
	Women				Men		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
College graduate	0.160***	0.133***	0.0518*		0.0731	0.0332	
	[0.0418]	[0.0486]	[0.0292]		[0.0726]	[0.0382]	
Mom worked				0.0122			-0.0598
				[0.0442]			[0.0838]
Mean, dep. var.	0.512	0.512	0.532	0.521	0.403	0.423	0.406
Observations	1,364	1,364	6,067	1,191	437	1,893	342
Controls?	No	Yes	Yes	Yes	Yes	Yes	Yes
Age of children at home	0-5	0-5	0-17	0-5	0-5	0-17	0-5

Source: Childhood Development Supplement to the Panel Study of Income Dynamics. For more detail see Appendix B.4.

Notes: Sample comprises all primary and secondary caregivers in the Childhood Development Supplement to the Panel Study of Income Dynamics. There are fewer men in the sample because men are mostly secondary caregivers and the response rate is lower for secondary caregivers. Columns (2)-(5) control for birth decile, survey year, race, child age, and number of children fixed effects, marital status fixed effects and log of household income. Columns (1), (2), (4), (5), and (7) restrict to parents with children under 6 whereas columns (3) and (6) restrict to parents with children under 18. "Mom worked" is defined as the respondent's mother worked at some point when the respondent was between ages 8 and 16. The provided sample weights are used. Standard errors, clustered by respondent to account for the fact that some parents answer at more than one point in time, are reported in brackets.
$^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

Table 3: Change in women's self-reported importance of career, as function of motherhood and human capital investment

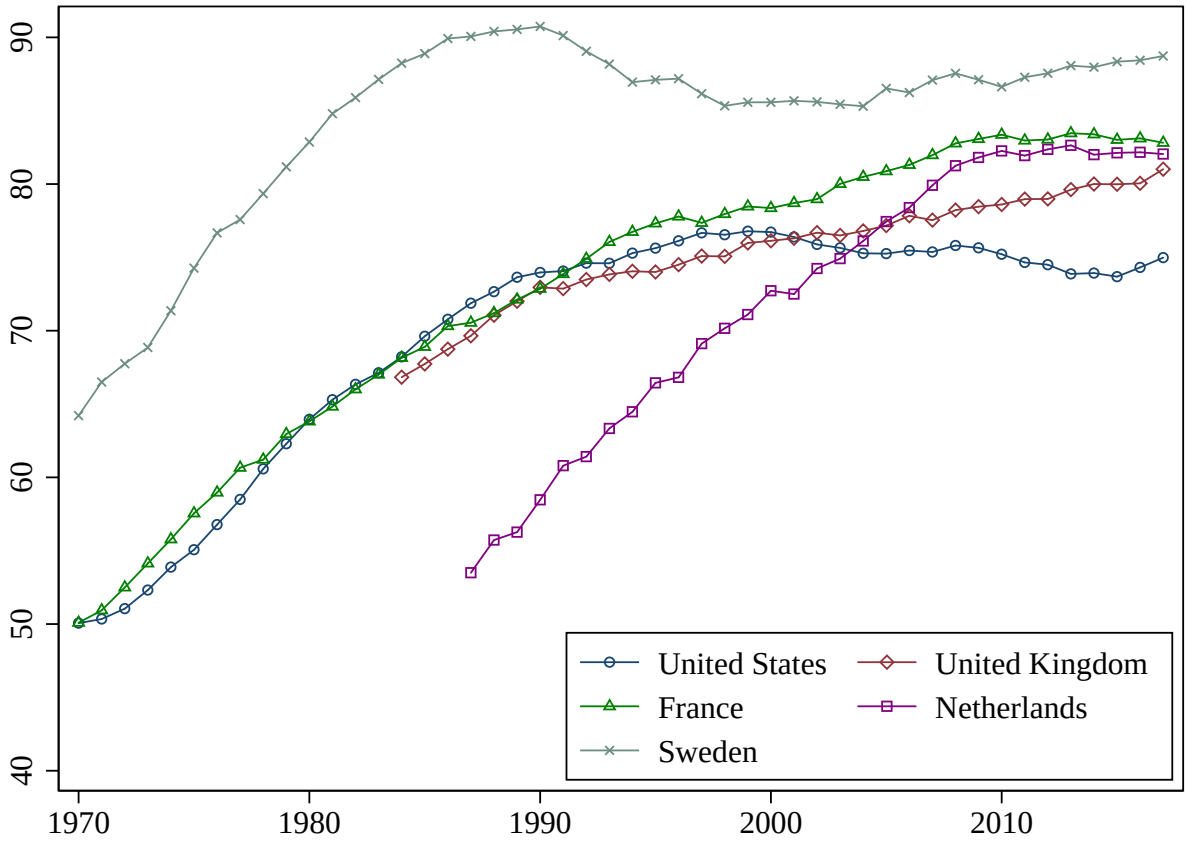
	Importance (2007)		Change in importance (2007 v. grade 10)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Has children	-0.0763**	-0.0839**	-0.0700	0.0809	0.211*	0.0550	0.0276
	[0.0354]	[0.0378]	[0.0434]	[0.0772]	[0.118]	[0.0802]	[0.0765]
Importance in grade 10	0.168***	0.162***					
	[0.0552]	[0.0579]					
Investment proxy				0.244***	0.175*	0.0902	0.0210
				[0.0832]	[0.105]	[0.0857]	[0.0845]
Proxy x Has children				-0.206**	-0.333***	-0.189*	-0.186**
				[0.0925]	[0.125]	[0.0966]	[0.0946]
Dept. var. mean	2.628	2.634	-0.251	-0.251	-0.251	-0.254	-0.255
Controls?	No	Yes	Yes	Yes	Yes	Yes	Yes
Investment proxy				College grad.	Mom worked	Math score	Science score
Observations	1439	1305	1305	1305	1305	1216	1211

Source: Longitudinal Survey of American Youth. See Appendix B.5 for more detail.

Notes: Cols. (1) and (2) control for self-reported importance of success in tenth grade, whereas the remaining columns model the *change* between 2007 and tenth grade. The question posed in high school is: "Now I would like to read you a list of goals you may or may not have for your life. For each goal—as I read it—I would like you to tell me if it is very important, somewhat important, or not important to you. First, being successful in your line of work." The exact wording of the question posed to the adults in 2007 is as follows: "Now, please think about your goals or things that are important to you in life. For each of the goals listed below, please indicate if this goal is very important to you, somewhat important, or not important.... Having accomplished something important in my work." We follow the survey and code as 1–3, increasing in importance. "Controls" (all observed in tenth grade, to avoid endogeneity to later outcomes) include fixed-effects for mom's highest degree, for dad's highest degree, race, ethnicity, and year of birth. Cols. (4) through (7) interact having had a child with various proxies for investment in human capital: having a college degree by the 2007 interview (col. 4); having grown up with a working mother (col. 5); scoring in the top half of the math and science exams administered by the LSAY in tenth grade (cols. 6 and 7, respectively). We use the provided survey weights to address attrition. Robust standard errors in brackets. $^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

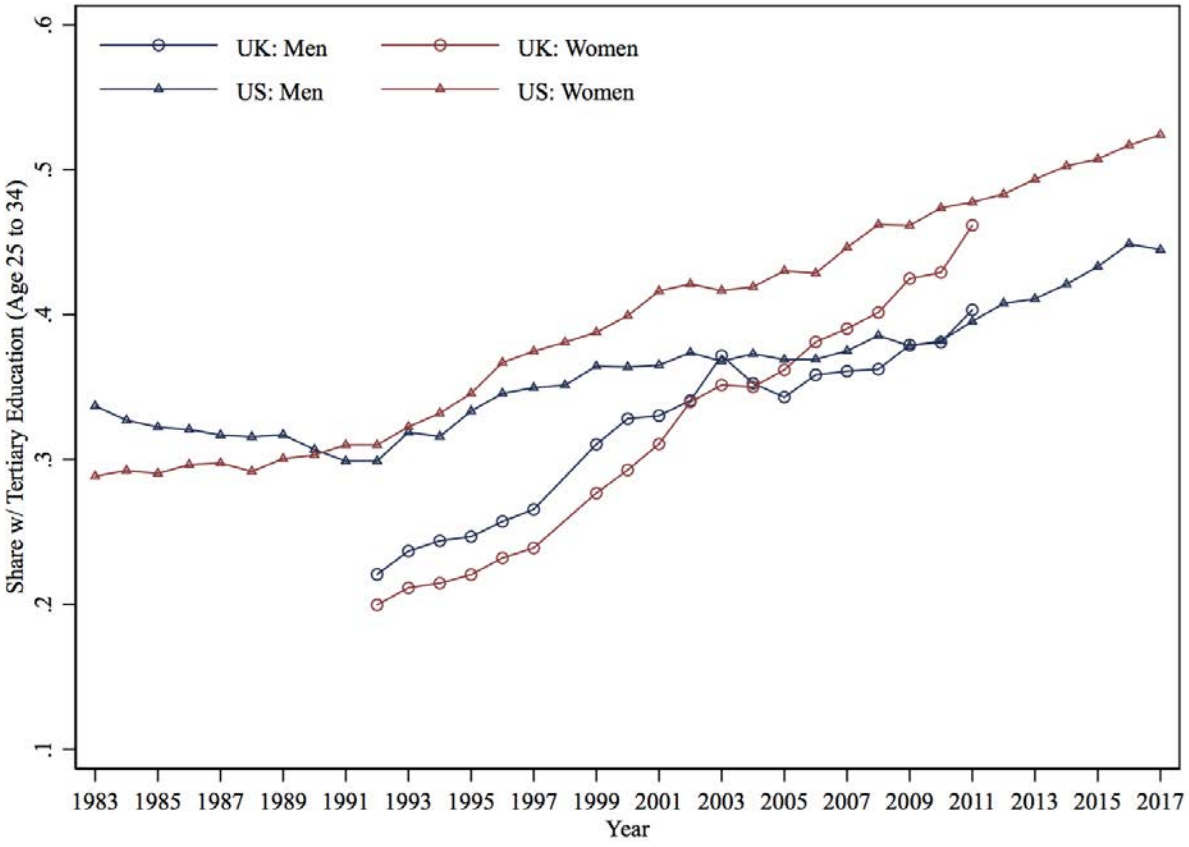
Appendix A. Appendix figures and tables

Appendix Figure A.1: Female labor force participation rates in select countries (ages 25-54)



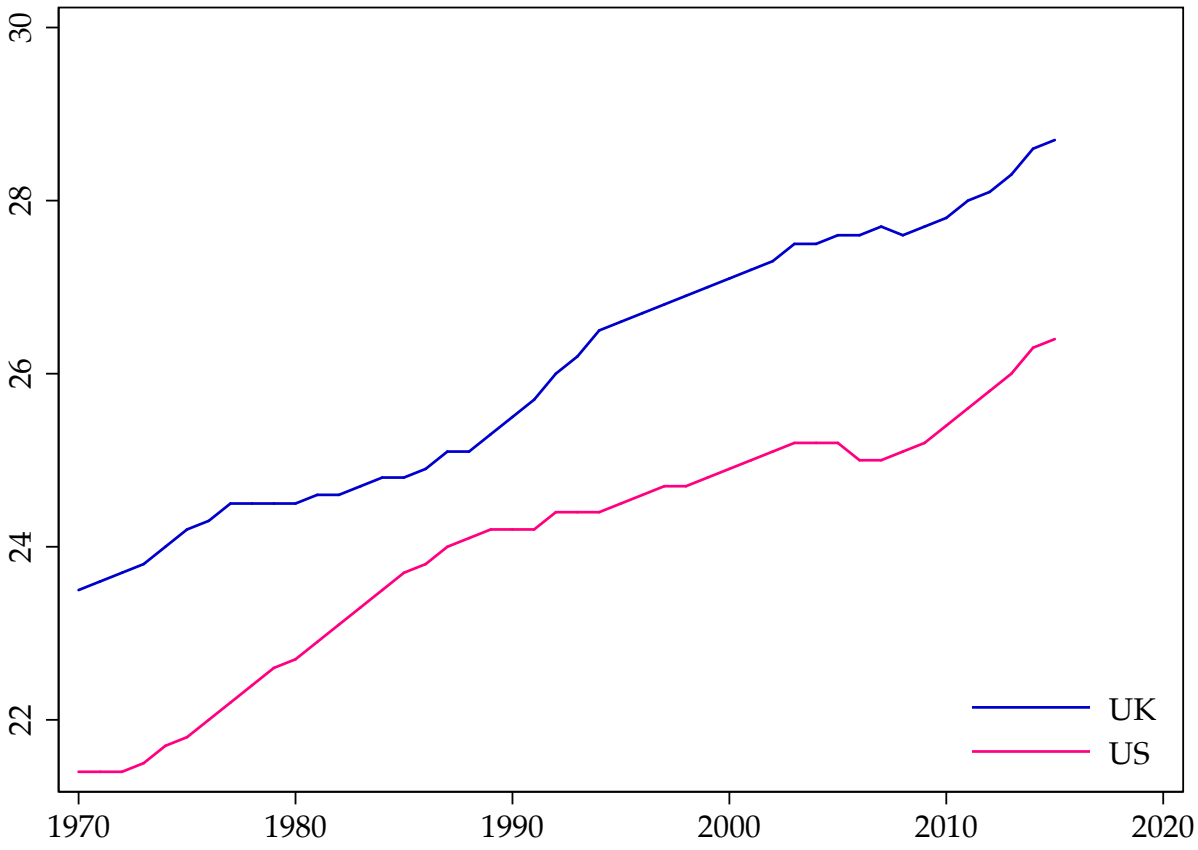
Source: OECD (`https://stats.oecd.org/Index.aspx?DataSetCode=LFS_SEXAGE_I_R#`). Data downloaded March 20th, 2018.

Appendix Figure A.2: Share of young adults with tertiary education, by gender



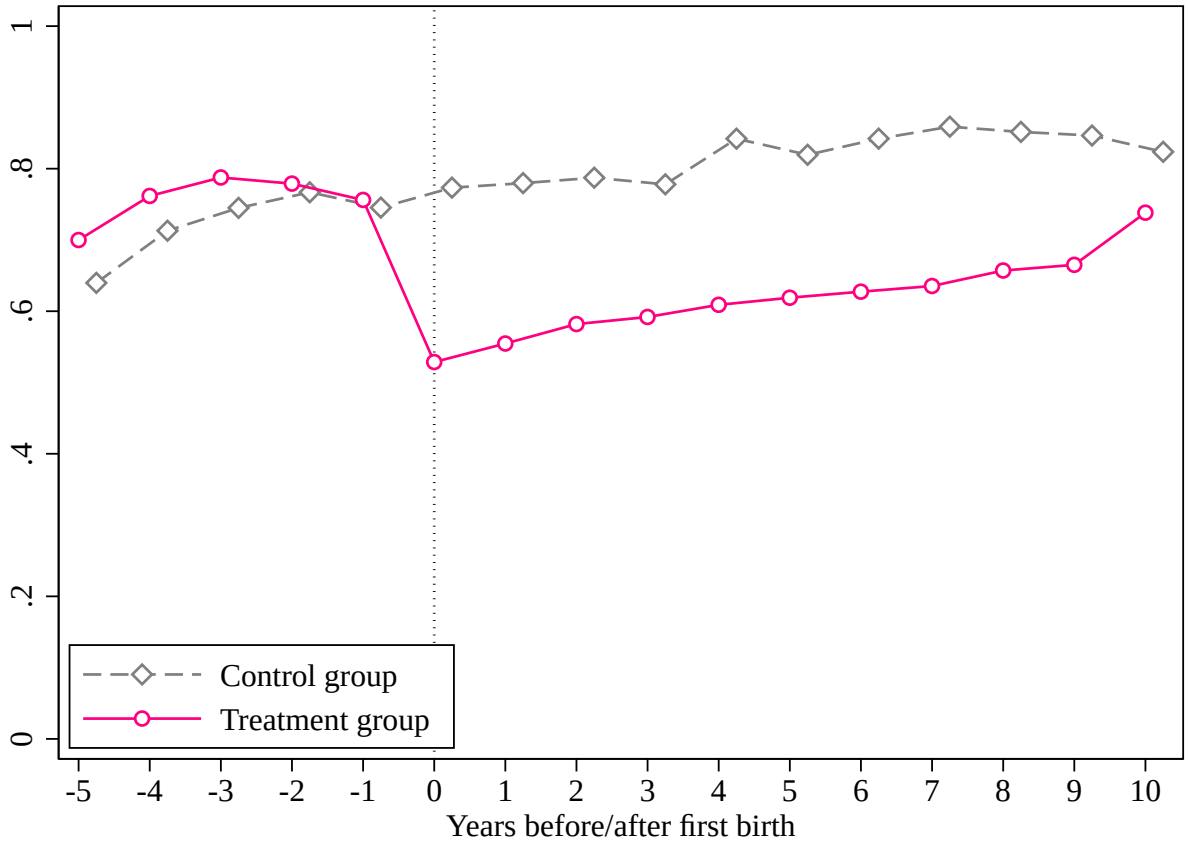
Source: CPS and EU-LFS.
Notes: The sample is restricted to individuals age 25 to 34. In the EU-LFS, tertiary education is defined as having completed ISCED levels 5 or 6. In the CPS, tertiary-education is defined as an associate's degree or more. In 1992, the CPS changed its coding of education. To account for this change, we set the share of people with tertiary education in 1991 to be the same as the share in 1992. For years prior to 1991, we set the share of people with tertiary education to be the share in 1992 times the percent change between that year and 1991.

Appendix Figure A.3: Average age at first birth (U.S. and U.K. women)



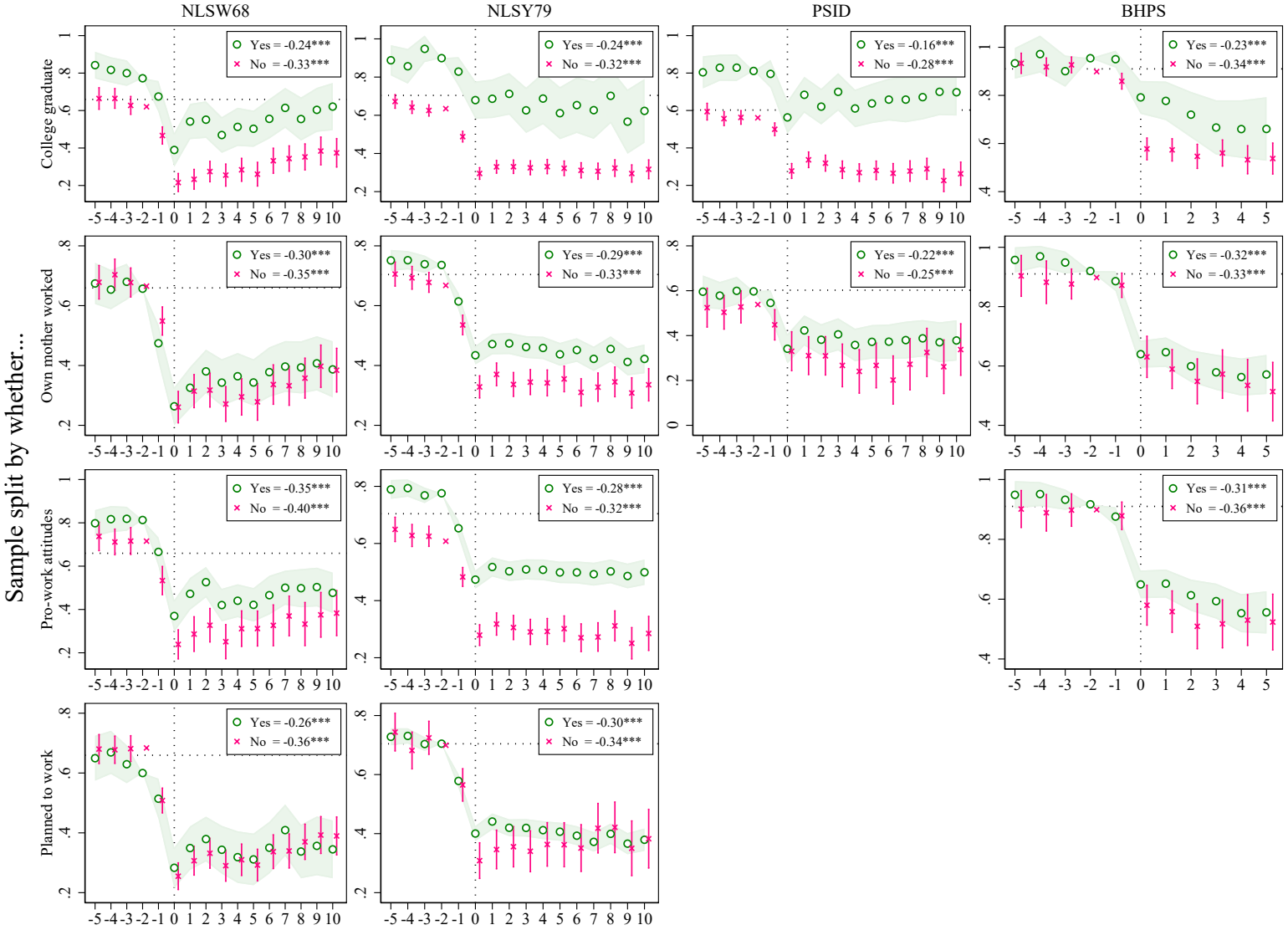
Source: Center for Disease Control (US) and Office for National Statistics (UK).

Appendix Figure A.4: Employment over event-time for women with and without children (NLSY), assigning "placebo births" to women without children



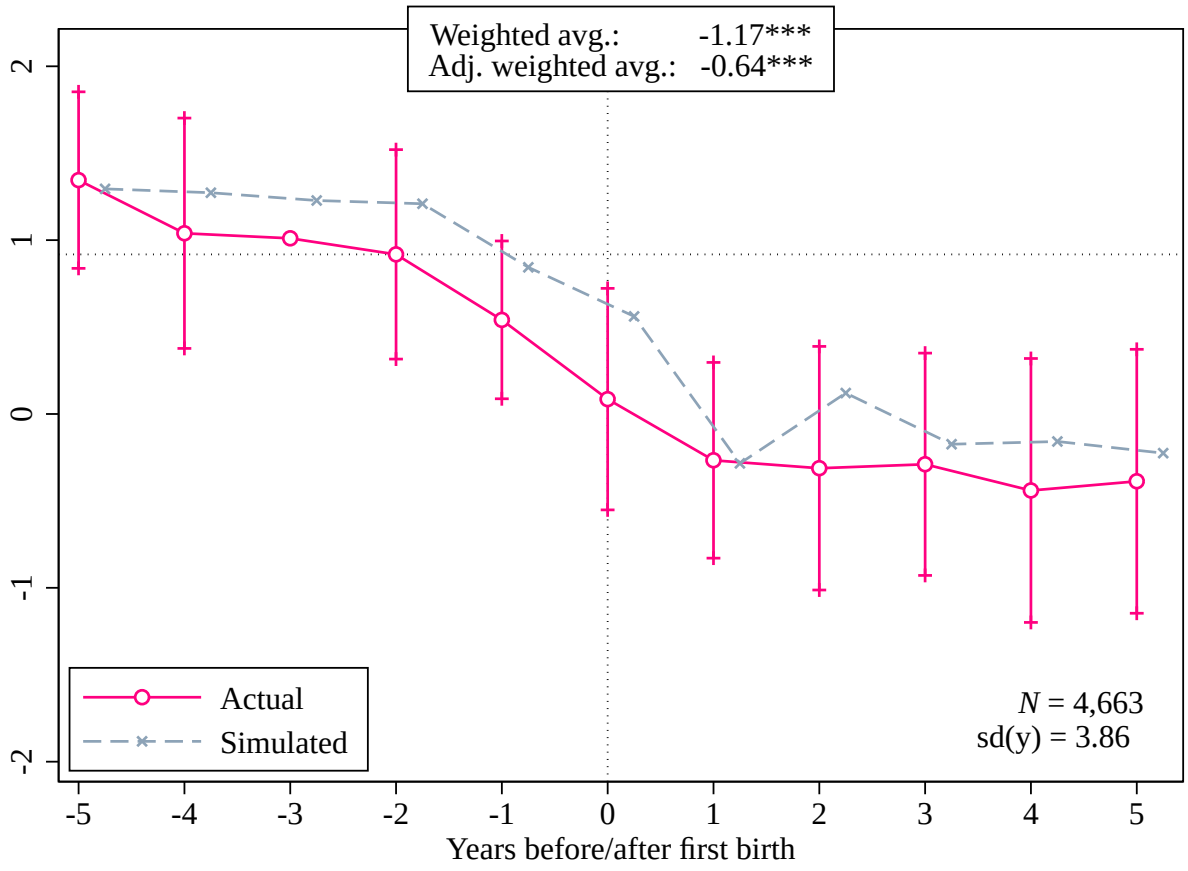
Source: NLSY.
Notes: For both series, raw means of the share currently employed are plotted. For women with children, event-time is defined relative to the birth of the first child. For women without children, we take the sample of (childless) women for whom we observed completed fertility (ages 20 to 40) and randomly assign placebo dates of first birth based on what we observe in our sample of mothers in the NLSY. We impose our standard sample restrictions to this control group (observed at least once pre- and post-birth, observed over ages 20–40, etc.) and then plot raw means with respect to "placebo event time." See Appendix C for more detail.

Appendix Figure A.5: Heterogeneous evolution of employment probability over event-time for new mothers in the U.S. and U.K.



Source: NLSW68, NLSY79, PSID, BHPS. For more detail see Sections 2.1.1-2.2 and Appendices B.1-B.4.
Notes: Event-study analysis is identical to analysis in Figure 1, except we split the sample by our various heterogeneity variables. "College graduate" is whether a woman completed a college degree by age 25. "Own mother worked" is whether a respondent's mother worked when the respondent was 14. "Pro-work attitudes" refers to whether the respondent's pre-baby gender attitudes index was more "pro-work" than average. Finally, "planned to work" is whether respondents as teenagers/young adults thought that they would be working at age 35. $^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

Appendix Figure A.6: Event study analysis of how gender-role attitudes change over time for actual vs. simulated women, assuming women gradually change attitudes from third trimester to first year post-birth

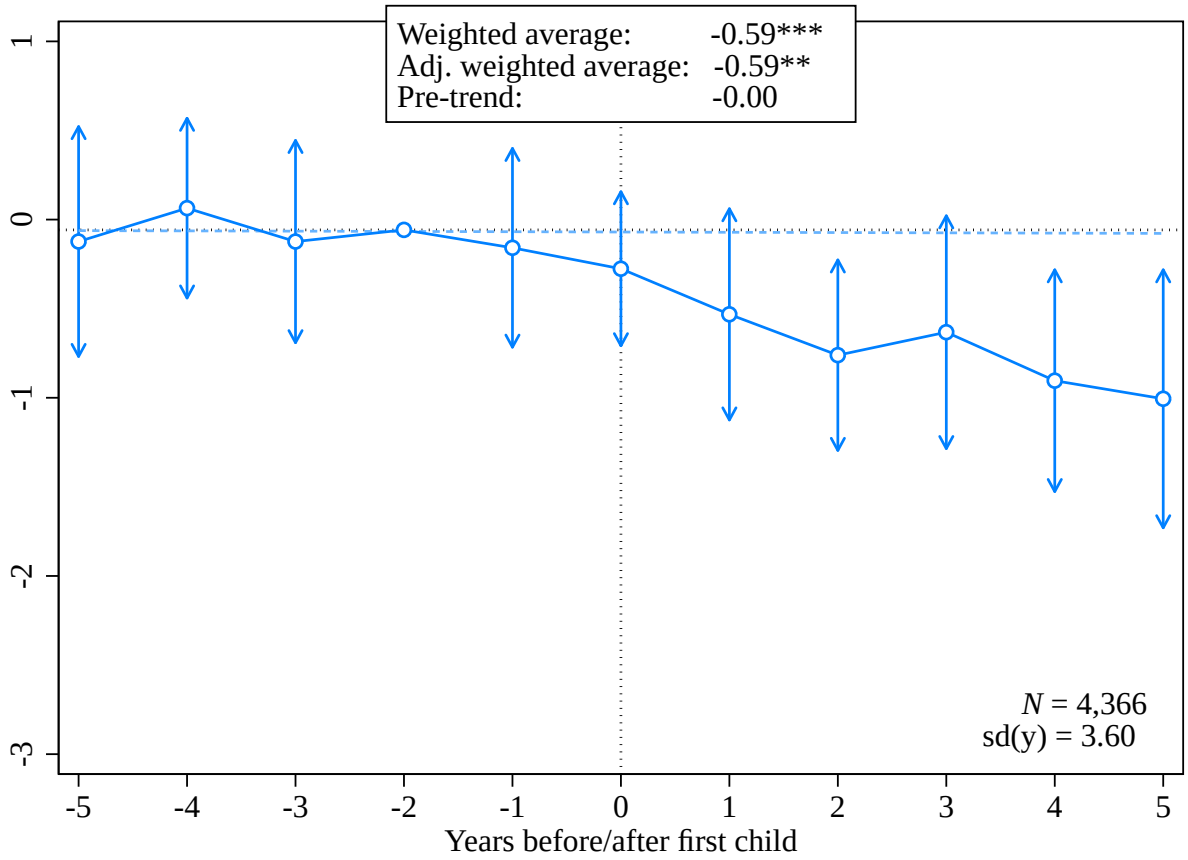


Source: BHPS, authors' calculations

Notes: The "actual" series replicates our main event study of the omnibus gender attitudes index (Figure 3). We construct a simulated gender attitudes index as follows: First, each woman starts with their (individual) pre-period average of their gender attitudes index. Then, each woman gradually changes their gender attitudes in their third trimester (where a quarter of the effect kicks in) and then the remainder of the effect (three quarters) kicks in linearly in the 12 months post-birth. See notes for Figure 3 for details on the event study specification.

$^{***}p < 0.01$;$^{**}p < 0.05$;$^{*}p < 0.1$

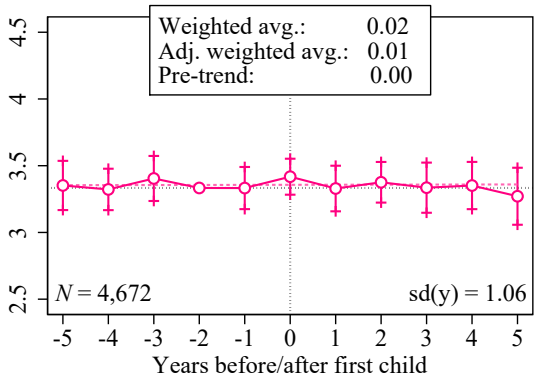
Appendix Figure A.7: Event-study analysis of how gender-role attitudes change after fatherhood (men in the BHPS)



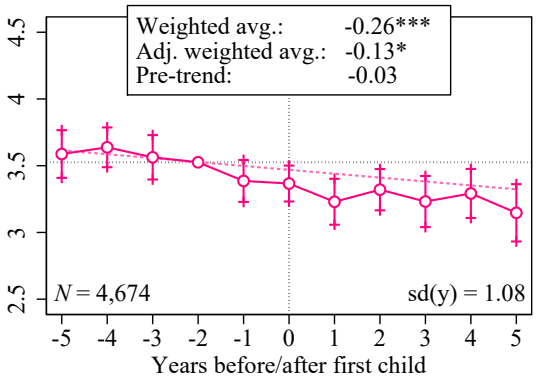
Source: British Household Panel Survey. For more detail see Section 2.1.1 and Appendix B.1.
Notes: See notes to Figure 3. Sample comprises all original sample men in the BHPS who were over 16 when they entered the sample and for whom we observe their first birth.
$^{***}p < 0.01;^{**}p < 0.05;^{*}p < 0.1$

Appendix Figure A.8: Event-study analysis of how gender-role attitudes change after motherhood

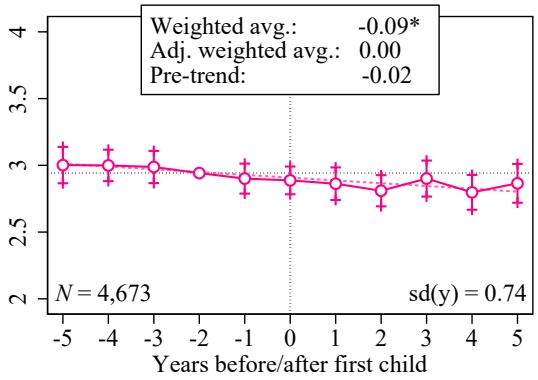
(a) Pre-school child suffers if mom works



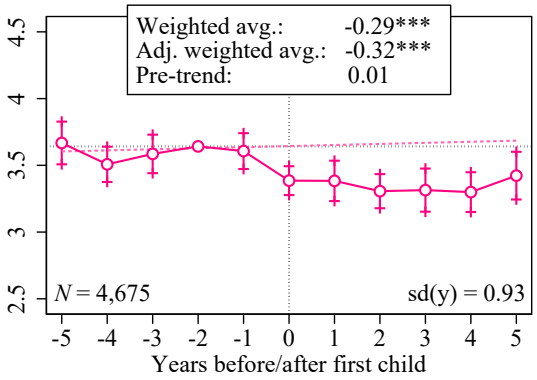
(b) Family suffers if mother works full-time



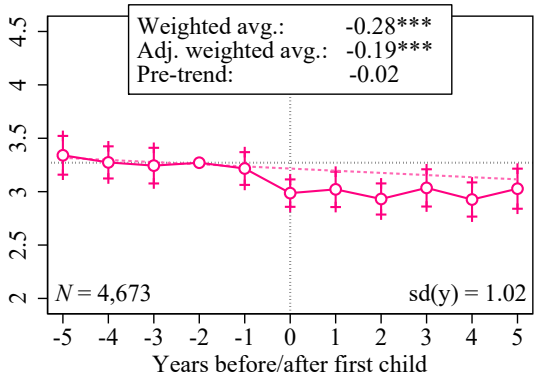
(c) Woman and family happier if she works



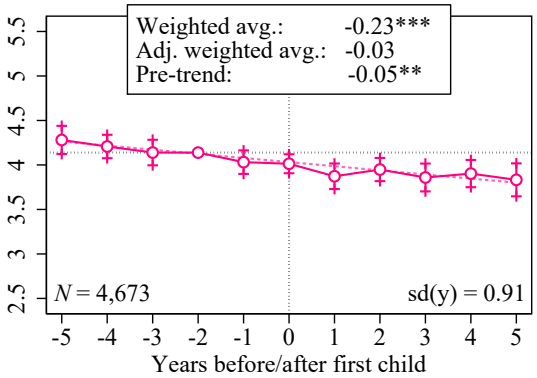
(d) Husband and wife should both contribute



(e) Full time job makes woman independent

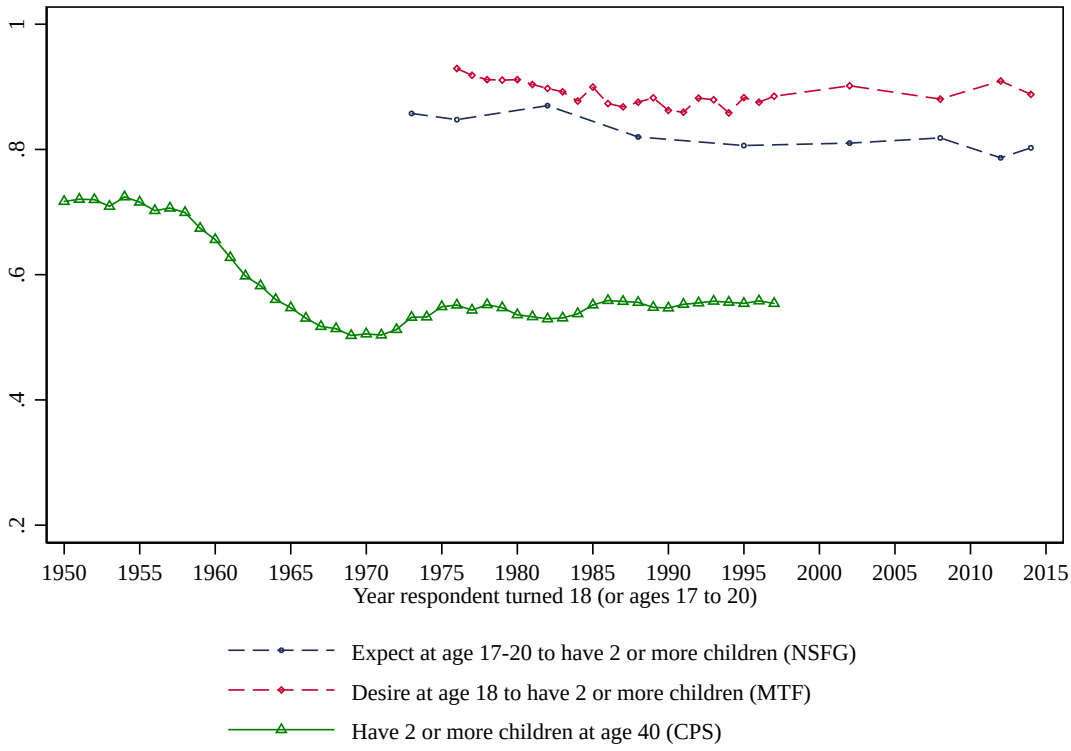


(f) Husband should earn, wife stay at home



Source: British Household Panel Survey. For more detail see Section 2.1.1 and Appendix B.1. *Notes*: See notes to Figure 3. The analysis is identical here except instead of the standardized index of gender-role attitudes, we use as outcomes each component of the index. Unlike the omnibus measure, here we do not standardize the components to have mean zero and variance one. *All answers are ordered (or re-ordered, if necessary) to be increasing in the pro-work direction.*

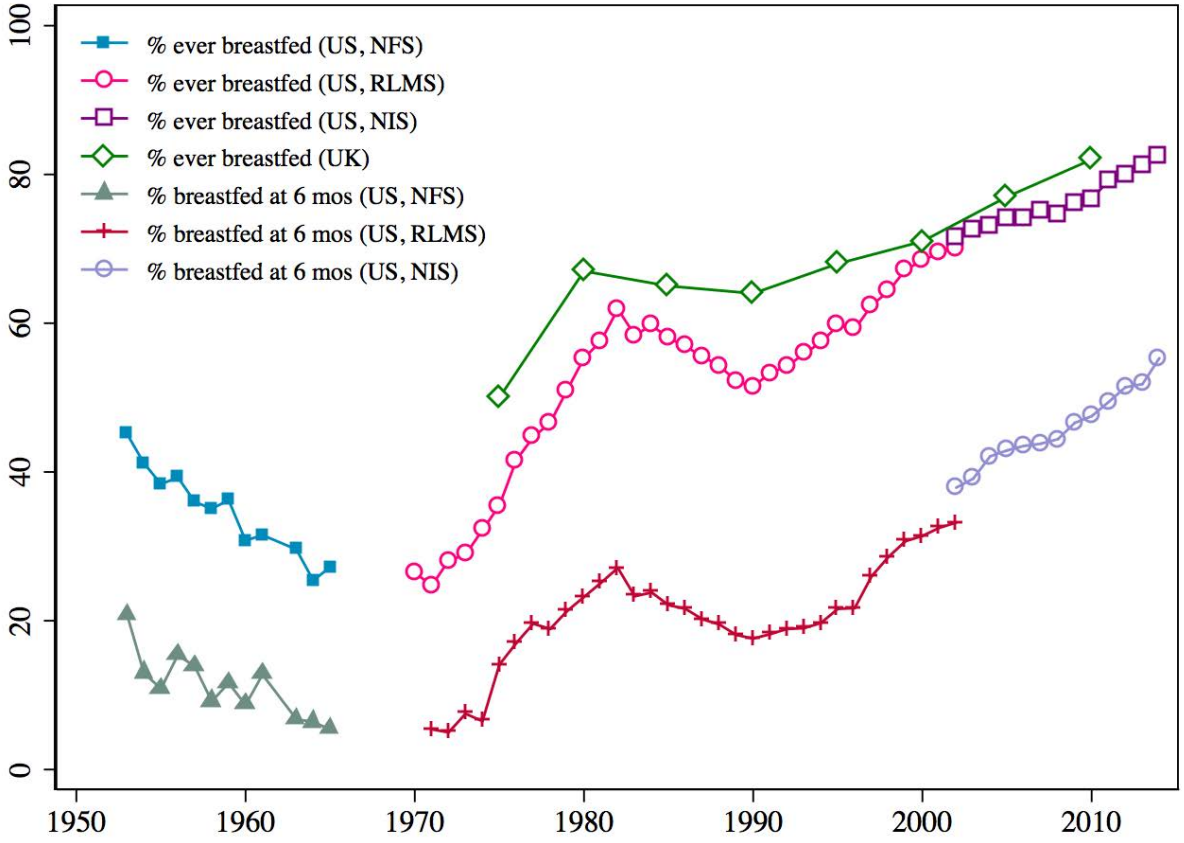
Appendix Figure A.9: Expectations and realizations of fertility at age 40 among young women/high school seniors



Source: National Survey of Family Growth (NSFG), 1973 to 2015; Monitoring the Future Survey (MTF), 1976 to 2014; CPS, 1970 to 2017.

Notes: This figure plots the share of young adult women (between the ages of 17 and 20 in the NSFG and high school seniors in the MTF) who expect/desire to have two or more children by the year the respondent turned 17 to 20 (or turned 18, as a high school senior) and the actual share of each cohort of 17 to 20 year olds who have two or more children by age 40 in the CPS. The fertility expectations variable from the National Survey of Family Growth (NSFG) is based on the sum of number of live pregnancies that the respondent had when the survey is administered and the mean number of additional babies the respondent expects to have (the survey question elicits the largest and smallest number of additional babies that the respondent expects to have). The fertility expectations for 1973 and 1976 are for women who were ever-married (since only ever-married women aged 15-44 were included in both of these waves). Starting in 1982, the sample includes women regardless of marital experience. The NSFG sample is restricted to those between the ages of 17 and 20 who have attended at least 12th grade. The desired fertility variable in the MTF is coded from responses to the following question: "All things considered, if you could have exactly the number of children you want, what number would you choose to have?" The responses in the NSFG and MTF are compared to the realized fertility of a similar cohort of young adults (who were aged 17 to 20 as in the NSFG survey) when they are age 40 in the CPS. To match the MTF and NSFG samples, the CPS sample is restricted to individuals who have completed at least 11th grade. The variable used to infer completed fertility in the CPS includes biological children, step-children, and adopted children. The observations are weighted using the appropriate sample weights from each survey.

Appendix Figure A.10: Evolution of various measures of breastfeeding prevalence



Source: Data sources for the US: Ross Labs Mothers Survey (RLMS), the National Immunization Survey (NIS), and the National Fertility Survey (NFS). Data source for the UK: Infant Feeding Survey (IFS).

Notes: Estimates of breastfeeding rates from the National Fertility Survey, which was performed in 1965, 1970, and 1975, pool all three surveys. Estimates from both the NFS and the NIS are calculated based on the reported year of birth of the child. For the NFS, we only plot years in which estimates come from 900 or more observations. In the RLMS and IFS, mothers are asked about their children who are currently infants. In these surveys, the survey year, rather than the year of birth of the child, is used.

Appendix Table A.1: Summary statistics, gender-role attitudes (BHPS)

	Men	Women
–Gender Norms (Higher = More pro-work, Scale: 1-5)		
A pre-school child is likely to suffer if his or her mother works (Rev.)	3.07	3.39
All in all, family life suffers when the woman has a full time job (Rev.)	3.27	3.39
A woman and her family would all be happier if she goes out to work	2.85	2.88
Both the husband and wife should contribute to the household income	3.33	3.41
Having a full-time job is the best way for a woman to be an independent person	3.11	3.03
Husband's job is to earn money; wife's job is to look after home/family (Rev.)	3.78	4.06
Omnibus gender norms (higher = more liberal)	-0.48	0.29
–Average # of Pre-/Post- Observations per Person		
Number of omnibus gender observations, pre-baby	2.48	2.22
Number of omnibus gender observations, post-baby	2.80	3.01
Number of respondents	628	681

Source: British Household Panel Survey. For more detail see Section 2.1.1 and Appendix B.1.

Notes: Sample comprises all original sample members for whom we observe the event of childbirth. Individuals must also be observed during prime child-bearing years. Individual component attitudes are on a scale of 1 to 5 (1 = strongly agree; 5 = strongly disagree) and reversed so that higher values imply more liberal, less traditional attitudes toward gender roles. The omnibus gender-role index takes each component question, standardizes it to have mean zero and standard deviation one, and sums across all questions.

Appendix Table A.2: Change in men's self-reported importance of career, as function of fatherhood and human capital investment

	Importance (2007)		Change in importance (2007 v. grade 10)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Has children	0.00463	0.0317	0.0354	0.0674	-0.0342	0.0612	-0.0208
	[0.0380]	[0.0416]	[0.0497]	[0.0728]	[0.147]	[0.0861]	[0.0916]
Importance in grade 10	0.0552	-0.00162					
	[0.0538]	[0.0548]					
Investment proxy				-0.0537	-0.0156	-0.179**	-0.157*
				[0.0769]	[0.116]	[0.0778]	[0.0895]
Proxy x Has children				-0.0741	0.0821	-0.0314	0.0961
				[0.0956]	[0.153]	[0.107]	[0.110]
Dept. var. mean	2.577	2.564	-0.299	-0.299	-0.299	-0.318	-0.324
Controls?	No	Yes	Yes	Yes	Yes	Yes	Yes
Investment proxy				College grad.	Mom worked	Math score	Science score
Observations	1291	1122	1122	1122	1122	1038	1022

Source: Longitudinal Survey of American Youth. See Appendix B.5 for more detail.

Notes: This table is identical to Table 3, except that male respondents instead of female respondents are analyzed. Cols. (1) and (2) control for self-reported importance of success in tenth grade, whereas the remaining columns model the *change* between 2007 and tenth grade. The question posed in high school is: "Now I would like to read you a list of goals you may or may not have for your life. For each goal—as I read it—I would like you to tell me if it is very important, somewhat important, or not important to you. First, being successful in your line of work." The exact wording of the question posed to the adults in 2007 is as follows: "Now, please think about your goals or things that are important to you in life. For each of the goals listed below, please indicate if this goal is very important to you, somewhat important, or not important.... Having accomplished something important in my work." We follow the survey and code as 1–3, increasing in importance. "Controls" (all observed in tenth grade, to avoid endogeneity to later outcomes) include fixed-effects for mom's highest degree, for dad's highest degree, race, ethnicity, and year of birth. Cols. (4) through (7) interact having had a child with various proxies for investment in human capital: having a college degree by the 2007 interview (col. 4); having grown up with a working mother (col. 5); scoring in the top half of the math and science exams administered by the LSAY in tenth grade (cols. 6 and 7, respectively). We use the provided survey weights to address attrition. Robust standard errors in brackets. $^{***}p < 0.01$;$^{**}p < 0.05$;$^{*}p < 0.1$

Appendix Table A.3: Summary statistics for supplementary data sources asking about expectations of future labor supply

	MTF	Gallup	Purdue
White	0.69	0.93	.
Black	0.13	0.07	.
Married	0.10	0.01	.
Expect to be homemaker at 30	0.03	0.60	0.54
Professional w/ PhD or equiv. at 30	0.21	.	.
Professional w/out PhD at 30	0.38	.	.
Def. will get college degree	0.53	0.54	0.21
Choose to have 2 or more kids	0.89	0.97	.
Choose to have 3 or more kids	0.42	0.79	.

Notes: MTF data are from the 12th grade sample of the 1978-2014 Monitoring the Future Surveys. Current marital status and fertility expectations are obtained from Form 3 of the MTF. Education expectations, employment expectations and race are from Form 4 of the MTF. Gallup data is from a 1961 Gallup opinion survey of high school and college students. We retain only respondents in 12th grade. Purdue data is from the 1961 and 1962 Purdue Opinion Panels of high school students. Again, we retain only students in 12th grade.

Appendix B. Data Appendix

B.1 BHPS

The BHPS started in 1991 with 5,500 households (10,300 individuals), known as the "original sample." Since then, the sample has grown in various ways. First, the main survey is only administered to adults, so children in original sample households "age in" to the survey upon turning 16. These "agers-in" and all other original sample members are continuously tracked as they form new households, and the individuals in these new households are also interviewed so long as they live with an original sample member. (If these new-comers move out of the household, they are no longer tracked.) One notable exception is that some will "marry in" to the sample and be tracked permanently if they have a child with an original sample member. Children born to original sample members are automatically counted as original sample members.

The BHPS has also grown via the addition of new booster samples. Between 1997 and 2001, the BHPS roughly doubled in size with the addition of 5,000 households (8,600 individuals) out of concerns that the original sample under-represented Scotland, Wales, and Northern Ireland. In 2009, the BHPS became subsumed under the "Understanding Society" dataset, which, including BHPS households, tracked roughly 40,000 households (50,000 individuals) in the UK. While Understanding Society maintained most questions from the BHPS, it notably dropped several of the gender-roles questions we are most interested in, so our main results focus on the BHPS through 2008, for the sake of consistency across our main outcome variables. Results that include data from Understanding Society are not much different from results using BHPS through 2008 only and are available upon request.

Our preferred analysis sample imposes the restriction that we observe each person at least once before becoming a parent and at least once after, so that all observations help identify the main effect of parenthood. Our sample comprises only those who were original sample members, *i.e.* those who were interviewed in the first wave and *not* those who marry into the sample later on. Because our panel is relatively short (18 waves) compared to our U.S. panel data sources, we exclude children who age into the sample because, in order to meet our restriction that we see the event of the birth of their first child, these individuals would disproportionately have children early (and, relatedly, would be disproportionately female, as women tend to have children at a younger age than men).

The BHPS conducts fertility history interviews for all respondents at the second wave after entry into the sample, and from this set of questions, we can identify parents who have had children before the BHPS starts. Unfortunately, this fertility history is not asked again after the second wave, so we look to the household grid, which lists all individuals who live in a household together as well as some basic demographic information, such as date of birth. Importantly for our purposes, this grid also includes relationships between household members, so we can link children to their parents and construct a full fertility history for each parent in our sample. This is largely the same method suggested by the BHPS. Unfortunately, because a parent must be living with their child in order to identify birth dates, we undercount fathers, as (we hypothesize) they on average are less likely to be living with their children than are mothers. Relative to a BHPS quality profile conducted at wave 13, we slightly over-count mothers (692 versus 673) and undercount fathers (567 versus

653).

Our main employment outcome variable is defined as equal to 1 if an individual had a paying job last week and includes people who, for example, were on maternity leave. Hours worked is the *typical* hours that an individual works within a given year, and is coded as zero if the individual is not working (including not looking for work). Thus, an individual may be on maternity leave in the week prior to a survey, but their usual hours worked might be greater than zero, since a respondent can interpret the question to be about when their hours prior to maternity leave.

We also examine a range of questions on an individuals' opinions on gender roles in the household. Appendix Table A.1 summarizes these questions. While 9 questions are available in total, we only choose a subset of 6 that pertain to the impacts of a woman working. These statements, asked on a scale of 1 (strongly agree) to 5 (strongly disagree) are: (1) A pre school child is likely to suffer if his or her mother works, (2) All in all, family life suffers when the woman has a full time job, (3) A woman and her family would all be happier if she goes out to work, (4) Both the husband and wife should contribute to the household income, (5) Having a full-time job is the best way for a woman to be an independent person, and (6) A husband's jobs is to earn money; a wife's job is to look after the home and family.

We take the individual gender-roles questions and construct an omnibus measure as follows. First, since some questions are phrased in a gender "liberal" manner (i.e. men and women should take on equal roles in the household) and others are phrased in a gender "conservative" manner (i.e. men and women should take on distinct roles in the household), we reverse some questions as necessary so that all are increasing in the gender liberal direction. We then standardize each variable so that they have a mean of zero and standard deviation of one, and sum them up.

B.2 NLSW 1968

B.2.1. Survey Design and Sample

We make use only of the "young women" component of the NLSW68. (While the National Longitudinal Surveys of Young and Mature Women include an older "mature women" sample, they have for the most part had their first child before entering the sample.) The "young women" component of the NLSW68 is a sample of 5,159 women born between 1941 and 1954. The women were aged 14-24 when first interviewed in 1968 and aged 49-62 when last interviewed in 2003. During the last wave of the survey 55.4% of the original sample was interviewed.

The sample is represented by a multi-stage probability sample drawn by the Census Bureau from 1,900 primary sampling units. In order to provide reliable statistics for black respondents, the NLSW68 oversampled the black population at about twice the expected rate of the total population. Black respondents make up approximately 28 percent of the sample, compared to 11 percent of the population at the time. Probability-of-selection weights created by the NLSW68 correct for this bias.

B.2.2. Sample Selection

Our sample comprises all respondents in the National Longitudinal Survey of Women who meet the following criteria: (1) We observe them at least once before and after the birth of their first child, (2) We observe them for the first time by age 20 and for the last time after age 40. We include people who drop out at some point in the sample.

In a given year, it is possible to observe a respondent's employment status, but not the number of hours they worked last week, or vise versa. Thus, for a respondent to be included in our sample, we must observe each of the three outcomes variables ("working now", "in labor force now", "hours worked last week").

B.2.3. Employment Status

Employment status is obtained from combining two NLSW68-created variables: employment status recode (ESR), available every 1-3 years from 1968 to 1993, and monthly labor recode (MLR), available every other year from 1995 to 2003. Although not exactly the same, the two variables are very similar. Employment status recode specifies whether the respondent was working, with a job but not at work, laid off and looking for work, unemployed, going to school, keeping house, unable to work, or retired. Monthly labor recode specifies whether the respondent was employed and at work, employed but absent, unemployed and laid off, unemployed and looking for work, retired, or disabled.

We code respondents as "working now" if they report working (employed and at work) and as "not working" if they report any other activity in the ESR (MLR). Negative values of each variable, which are assigned when respondents refuse to answer, do not know the answer, or are not interviewed, are coded as missing.

We code respondents as "in labor force" if they report working, having a job but not working, looking for work, or being laid off (employed and at work, employed but absent, unemployed and laid off, unemployed and looking for work) and as "not in labor force" if they report any other type of activity in the ESR (MLR). Negative values of each variable, which are assigned when respondents refuse to answer, do not know the answer, or are not interviewed, are coded as missing.

B.2.4. Hours Worked

Between 1968 and 1993, the NLSW68 asks respondents the number of hours they worked in the previous week. We assign this variable to be "hours worked." Respondents deemed to be not working ("working now" = 0) are assumed to have worked zero hours last week.

After 1993, the NLSW68 asks respondents the number of hours worked at their main job and at their other job. We assign our "hours worked" variable to be the sum of these two variables. Again, respondents deemed to be not working ("working now" = 0) are assumed to have worked zero hours last week.

B.2.5. Date of Birth of 1st Child

The NLSW68 does not consistently ask respondents for the date of birth of their children. Thus, to determine the date of birth of respondents' first and second children, we combine

several categories of variables pertaining to children's date of birth and take the minimum and second minimum value among these.

Between 1968 and 1993, the NLSW68 asks respondents directly about the date of birth of their children. In 1973, the NLSW68 records the date of birth of each child a respondent has had in their lifetime. In 1978, 1983, 1985, 1987, 1988, 1991, and 1993 the NLSW68 records the date of birth of each child the respondent has had since their last interview.

Post 1993, the NLSW68 does not explicitly ask for dates of birth of children, but instead asks for a demographic information, including date of birth, for each member of the household. We include these variables in our calculation of minimum date of birth only if the household member is a child of the respondent (relationship to respondent equal to child, son, or daughter).

To determine the first (second) child's date of birth, we take the minimum (second minimum) date of birth among all date of birth variables described above. Children with missing months of birth but non-missing years of birth are assumed to have been born in September (the most common birth month).

B.2.6. Event Time

The event time variable is calculated by determining the number of months between the date of birth of the respondent's first child and the current interview, dividing by 12, and rounding down.

B.2.7. Other Demographic Information

Education: Each year, the NLSW68 records the highest completed grade and highest college degree obtained by respondents. We define having a college degree as whether a respondent had a college degree at age 25. Respondents who report completing less than 16 years of school are coded as having no college degree.

Age: Age is calculated by determining the number of months between the respondent's date of birth and the current interview, dividing this number by 12, and rounding down. Unknown interview months are assumed to be March.

Mom Worked: In 1968, respondents were asked whether their mother worked when they were 14. Responses of yes are coded as 1, responses of no are coded as 0, and all other values are coded as missing.

Planned to Work at Age 35: In 1968, respondents were asked what they plan to be doing at age 35. Responses of working at a different job and working at the same job are coded as 1. Responses of married, keeping house, other, or do not know are coded as 0. All other values are coded as missing.

B.3 NLSY 1979

B.3.1. Survey Design and Sample

The NLSY79 is a sample of 12,686 men and women born between 1957 and 1964. They were aged 14-22 when first interviewed in 1979 and aged 50-57 when last interviewed in 2014.

The NLSY79 purposefully over samples economically disadvantaged, Hispanic, and black youth. Approximately 25 percent of the sample is black and 16 percent of the sample is Hispanic, compared to their share of population which was around twelve and six percent, respectively, at the time. The inclusion of probability-of-selection weights corrects for this over sampling.

B.3.2. Sample Selection

Our sample comprises all respondents in the National Longitudinal Survey of Youth who meet the following criteria: (1) We observe them at least once before and after the birth of their first child, (2) We observe them for the first time by age 20 and for the last time after age 40. We include people who drop out at some point in the sample.

In a given year, it is possible to observe a respondent's employment status, but not the number of hours they worked last week, or vise versa. Thus, for a respondent to be included in our sample, we must observe each of the three outcomes variables ("working now", "in labor force now", "hours worked last week").

B.3.3. Employment Status

The NLSY79 records respondents' employment status for each week between 1978 and the date of their last interview. To determine a respondent's current employment status, we use the employment status variable corresponding to week the respondent was interviewed.

We code respondents as "working now" if their employment status is a job number (values of 100 through 3000) as as "not working" if they report not working, being unemployed, being out of the labor force, or being in active military service. All other values are coded as missing.

We code respondents as "in labor force" if their employment status is a job number or they report being unemployed and as "not in labor force" if they report being out of the labor force or in active military service. All other values are coded as missing.

B.3.4. Hours worked

As with employment status, the NLSY79 records the number of hours respondents worked for each week between 1978 and the date of their last interview. We assign this variable, in the week-year corresponding to each interview, to be "hours worked." Respondents deemed to be not working ("working now" = 0) are assumed to have worked zero hours in the previous week.

B.3.5. Date of Birth of 1st Child

The NLSY79 provides the date of birth for each of the respondent's children. We take the minimum date of birth among all children as the birthday of the first (second) child.

B.3.6. Event Time

NLSY79 provides the date of interview for each wave. The event time variable was calculated by determining the number of months between the birth of the respondent's first child and the current interview, dividing by 12, and rounding down to the nearest whole number.

B.3.7. Other Demographic Information

Education: Each year, the NLSY79 records the highest completed grade. We assign the highest grade completed to be the respondent's maximum highest grade reported among all years. A respondent is assumed to have a college degree if they have completed 16 or more years of schooling.

Age: Age is calculated by determining the number of days between the respondent's date of birth and the current interview, dividing this number by 365, and rounding down. Unknown interview months are assumed to be March and unknown interview days are assumed to be the 15th.

Mom Worked: In 1979, respondents were asked whether their mother worked when they (the respondents) were 14 years old. Responses of yes are coded as 1, responses of no are coded as 0, and all other values are coded as missing.

Planned to Work at Age 35: In 1979-1984 respondents were asked what they plan to be doing at age 35. Responses of working at a different job and working at the same job are coded as 1. Responses of married, keeping house, other, or do not know are coded as 0. All other values are coded as missing.

B.4 PSID

B.4.1. Survey Design and Sample

The PSID started in 1968 with a national sample of about 4,800 U.S. households. This initial sample was made up of two sub-samples. The first was a cross-sectional national sample conducted by the Survey Research Center (SRC) that produced about 2,900 interviews. The second was a sample of low-income families conducted by the Survey of Economic Opportunity (SEO) that produced about 1,900 interviews. The low income sample had unequal selection probabilities as it was limited to SMSAs and non-SMSAs in the southern region. By construction, the PSID oversamples low-income households.

In 1997 and 1999 the PSID added an immigrant booster sample of about 500 households. Those eligible for this sample must have immigrated to the US after 1968 or have been born 1969 or later to people not in the US in 1968.

The PSID includes probability-of-selection weights that are designed to adjust for the oversampling of low-income households and for differential attrition. They are especially

important given the combination of SEO and SRC samples that made up the original PSID sample. Weights are also adjusted every five years (1969, 1974, etc) for cumulative panel attrition.

PSID follows sample members no matter their living arrangements: if they split off and form a new household, then that household is added to the sample and each of its members are interviewed; if they have children, then each of their children are interviewed.

B.4.2. Sample Selection

Our sample comprises all respondents in the Panel Study of Income Dynamics who meet the following criteria: (1) We observe them at least once before and after the birth of their first child, (2) We observe them for the first time by age 20 and for the last time after age 40, and (3) They either begin in or are born into a household in the "core sample" – that is, a household randomly selected to be included in the sample. We include those who are added later on in "booster" samples that increase representation among immigrant and Latino populations and include people who drop out at some point in the sample.

In a given year, it is possible to observe a respondent's employment status, but not the number of hours they worked last week, or vise versa. Thus, for a respondent to be included in our employment sample, we must observe each of the two outcomes variables ("working now" and "in labor force now").

B.4.3. Employment Status

Employment status in the PSID is obtained from the individual employment status variables, available from 1979 to 2015. The variable specifies whether the respondent is working now, temporarily laid off, unemployed and looking for work, retired, permanently disabled, keeping house, or a student.

We code respondents as "working now" if they report working now and coded as "not working" if they report being temporarily laid off, unemployed and looking for work, retired, permanently disabled, keeping house, or a student. All other values are coded as missing.

We code respondents as "in labor force" if they report working now, being temporarily laid off, unemployed and looking for work. They are coded as "not in labor force" if they report retired, permanently disabled, keeping house, or a student. All other values are coded as missing.

B.4.4. Date of Birth of 1st Child

To determine the date of birth of respondent's first child, we use the childhood and adoption history file. We limit the data to birth records (as opposed to adoption records), so the date of birth of first and second children correspond only to birth children.

If the child's month of birth is missing, we assume they were born in September. If the child is listed as having been born in winter, spring, summer, or fall we assume they were born in January, April, July, and October, respectively. If the child's birth year is missing, we code the date of birth as missing. The minimum date of birth among all the respondent's births is taken to be the date of birth of the first child.

B.4.5. Event Time

The event time variable is calculated by determining the number of months between the date of birth of the respondent's first child and the current interview, dividing by 12, and rounding to the nearest whole number.

B.4.6. Other Demographic Information

Education: In each survey wave, the PSID records the number of years of education a respondent has received. A respondent is coded as having a college degree if they report having completed 16 or more years of schooling by age 25.

Age: To determine age, we rely on the PSID variable which asks respondent's for their age at the time of the interview. We then calculated an imputed age – equal to the number of months between the respondent's date of birth and current interview, divided by 12, and rounded down. If the reported age is more than two years from the imputed age or if the current age is lower than a previously reported age, we replace the age variable with our imputed age variable.

B.4.7. Childhood Development Supplement (CDS)

In 1997 PSID began to supplement its main data collection with a survey targeting 0-12 year old children and their parents. Original CDS respondents were interviewed an additional two times, in 2002 and 2007. In 2014, the CDS continued with a new cohort of 0-17 year old children and their parents.

CDS asks children's primary and second caregivers a variety of questions relating to parenthood. Primary caregivers are defined, in order of precedence, as the biological, step, foster, or adoptive mother of the child, the "wife" of a a PSID head who is father to the child, the biological, step, foster, or adoptive father of the child, the legal guardian of the child, and the adult in the household unit who takes primary responsibility for the child. Thus, primary caregivers are almost always women. Secondary caregivers (known as other caregivers after 1997), are defined, in order of precedence, as the biological, step, foster, or adoptive father of the child, the grandmother of the child, the boyfriend or girlfriend of the primary caregiver, another adult relative of the child, and another adult non-relative of the child.

Our analysis uses the "parenting is hard" question in the CDS. The question asks caregivers to rank on a 5 point scale how much they agree or disagree with the statement "being a parent is harder than I thought it would be." A value of 1 corresponds to "strongly disagree" whereas a value of 5 corresponds to "strongly agree." The "parenting is hard" question is asked to both primary and secondary caregivers in 1997, 2002, and 2007 but only to primary caregivers in 2014.

Having a college degree is defined as having a college degree by age 25. "Mom worked" is defined as whether a respondent's mother worked when the respondent was between ages 8-16.

B.5 Longitudinal Study of American Youth

The Longitudinal Study of American Youth (LSAY) was commissioned by the National Science Foundation (NSF). The objective of the LSAY was to study the tendency and determinants of U.S. adolescents to pursue a career in science, technology, engineering and math (STEM).

"Cohort one" of the LSAY sampled over 2,800 tenth-graders in 1987. These students were thus born in the early 1970s. "Cohort two" were in seventh grade at this time (in middle schools that served as feeder schools to the high schools sampled in Cohort one). These students were thus born in the mid-1970s.

While the students were initially followed only for a few years after high school, in 2006 the NSF provided additional funding to make a major effort to recontact all the original LSAY participants. The large majority of participants were identified and interviewed in 2007. Interviews occurred as well in the following years, though because of attrition with smaller sample size.

To maximize sample size, we pool cohorts one and two. We gather data from tenth grade for both cohorts (so, the first year of interviews for cohort one and the fourth year of interviews for cohort two). Choosing tenth grade as the first year in a long-differences analysis maximizes our sample. We use 2007 as the final year for both cohorts (so, Cohort one is roughly 36 and cohort two 32), again because later follow-up years after 2007 suffer from attrition and thus reduce sample size.

Given the two-cohort structure of the data collection, we control for year-of-birth fixed effects in the regression analysis.

Our main outcome variable comes from the 2007 survey, which asks all respondents (including those not working) about the importance of career success. The question (var R325C in the ICPSR version of the data that we use) reads as follows: "Now, please think about your goals or things that are important to you in life. For each of the goals listed below, please indicate if this goal is very important to you, somewhat important, or not important.... Having accomplished something important in my work." We follow the survey and code as 1–3, increasing in importance.

We compare the answer to this question with a similar question posed in tenth grade (var GA6A): "Now I would like to read you a list of goals you may or may not have for your life. For each goal—as I read it—I would like you to tell me if it is very important, somewhat important, or not important to you. First, being successful in your line of work."

We use as independent variables questions about fertility and investment in human capital. In particular, whether you have a child born by 2007 (var R13A3); whether you had a college degree by 2007 (R25G); whether your own mother worked (MOTHOCC); your score an math and science tests administered by the survey in tenth grade (GMTHIRT and GSCIIRT, respectively).

We downloaded the data from the LSAY homepage on ICPSR: `https://www.icpsr.umich.edu/web/ICPSR/studies/30263`.

B.6 Data sources asking expectations of future labor supply and fertility

B.6.1. Monitoring the Future

The Monitoring the Future (MTF) survey is an annual cross-sectional survey of American youth. It was first conducted in 1975 and includes about 16,000 high school seniors from approximately 133 public and private high schools in the contiguous United States. Beginning in 1991, the MTF added nationally representative samples of 8th and 10th graders, although we do not make use of them in this paper.

The MTF uses a multi-stage random sampling procedure to create a nationally representative sample of students from each grade. In the first two stages, researchers select particular geographic areas and (with probability proportionate to size) one or more schools in each area. The last stage involves selecting students within each school. In a given school, up to 350 students can be selected. Typically, in schools with fewer than 350 students, all students are included. In larger schools, entire classrooms are randomly sampled.

Our analysis makes use of a question that asks respondents the type of work they expect they will be doing at age thirty. Specifically, the question asks, *"What kind of work do you think you will be doing when you are 30 years old? Mark the one that comes closest to what you expect to be doing."* There are fifteen possible occupational categories that students can choose from, with "home-maker" as one possible option. Other possible choices include laborer; service worker; operative or semi-skilled worker; sales clerk in a retail store; clerical or office worker; craftsman or skilled worker, sales representative; protective service; manager or administrator; professional without doctoral degree; professional with doctoral degree or equivalent; owner of small business; farm owner/manager; and military service. Below is a list of example occupations provided in the MTF questionnaire for each occupational category.

Job Group	MTF 1976	MTF2016
Laborer	car washer	custodian
	sanitary worker	material mover
	farm laborer	maid
		landscape worker
		farm worker
Service worker		food preparer or food service
	cook	worker including fast food
	waiter	waiter/waitress
	barber	call center worker
	janitor	stock clerk
	gas station attendant	order filler
	practical nurse	nursing aide/orderly
	beautician	teacher assistant
		childcare worker
Operative or semi-skilled worker	garage worker	bus or truck driver
	taxicab	maintenance or repair worker
	bus or truck driver	assembly line worker
	assembly line worker	
	welder	
Sales clerk in a retail store	shoe salesperson	cashier
	department store clerk	supervisor of retail workers
	drugstore clerk	
Clerical or office worker		
	bank teller	secretary
	bookkeeper	receptionist
	secretary	bookkeeper
	typist	supervisor of office workers
	postal clerk or carrier	bank teller
	ticket agent	postal clerk or carrier
Craftsman or skilled worker		
	carpenter	carpenter
	electrician	mechanic
	bric layer	machinist
	mechanic	welder
	machinist	
	tool and die maker	
	telephone installer	

Job Group	MTF 1976	MTF2016
Sales representative	insurance agent real estate broker bond salesman	insurance agent real estate
Protective service	police officer fireman detective	police firefighter paramedic
Manager or administrator	office manager sales manager school administrator government official	office manager government official sales manager
Professional without doctoral degree	registered nurse librarian engineer architect social worker technician accountant actor artist musician	registered nurse school teacher accountant architect artist information technology worker
Professional with doctoral degree or equivalent	lawyer physician dentist scientist college professor	lawyer physician dentist scientist college professor
Owner of small business	restaurant owner shop owner	
Farm owner, farm manager		
Military service		
Full-time homemaker or housewife		

For desired fertility, we make use of the question: "All things considered, if you could have exactly the number of children you want, what number would you choose to have?" Raw data and documentation for this survey can be found at `https://www.icpsr.umich.edu/web/ICPSR/series/35`.

B.6.2. Purdue Opinion Panels

We also make use of the 1961 and 1962 Purdue Opinion Panels of high school students grades 9-12. Students selected for the sample participate in three to four surveys in a school year. The same panel of students takes part in all surveys within a school year; however, the panel changes every school year. The 1961 survey was conducted in March of that year while the 1962 survey was conducted in September; hence, the group of students polled differs between these surveys. We restrict our sample to female high school seniors in each survey. The panel asks "What kind of job do you expect to have 20 years from now?" and respondents can choose between twelve possible occupations, including "housewife." Other possible occupations include salesman; owner of factory or small business; professional-teacher, doctor, musician, musician, scientist; office worker; clerk in a store; farm or ranch owner; farm or construction laborer; factory worker or mechanic; big business management; deliveryman, truck driver; and carpenter, plumber, electrician. Raw data and documentation for this survey can be found at `https://ropercenter.cornell.edu/CFIDE/cf/action/catalog/abstract.cfm?type=&start=&id=&archno=USPOP1961-063&abstract=`.

B.6.3. Gallup

We also use a 1961 Gallup Opinion Poll of young high school, college, and non students. We again restrict our sample to female high school seniors. The Gallup poll asks respondents the open-ended question "What do you expect to be doing when you are 40 years old?" Responses were organized into 18 categories. We use the "house wife," "home maker," "house work," and "raising children" as our definition of expected homemaker. Other categories include teacher, sports coach, professor; scientist, physicist, biologist, chemist, medical research,

psychologist, research; business executive, own business, industry, management, business administration; minister, missionary, social worker; engineering, research engineer, managing engineer; entertainment, actor, broadcasting; medicine, dentist, psychiatry; lawyer; farmer, rancher, agriculture; armed services; government work; sales, clerical: secretary, sales clerk, office worker; nurse; mechanic, machinist, tool and dye maker; skilled trade: electrician, plumber, carpenter, mason, electronics; contracting, building construction, excavating; and artist, cartoonist, designer, draftsman, decorator. Raw data and documentation for this survey can be found at `https://ropercenter.cornell.edu/CFIDE/cf/action/catalog/abstract.cfm?type=&start=&id=&archno=USAIPOSPPOS1961-544&abstract=`.

B.6.4. National Survey of Family Growth

The National Survey of Family Growth (NSFG) began in 1973 and is designed to be nationally representative of ever-married women 15 to 44 years of age in the civilian, non-institutionalized population of the U.S. Starting in 1982, the sample was extended to include women aged 15 to 44 regardless of marital status. For the 1973, 1976, 1982 waves of the NSFG, the fertility expectations variable is based on the total number of births that the respondent expected. This variable is constructed by the NSFG based on the sum of the number of existing births reported by the respondent and the central number of additional babies expected (obtained from taking the mean of the smallest and largest number of additional babies expected). For the 1988, 1995, 2002, 2006-2010, 2011-2013, and 2013-2015 waves of the NSFG, we compute fertility expectations based on the sum of number of live pregnancies that the respondent had when the survey is administered and the central number of additional babies the respondent expects to have. To ensure that the sample size is sufficiently large to estimate fertility expectations of young adult women, we restrict the sample to women between the ages of 17 to 20. To match the MTF sample, we further restrict the sample to those who have attended at least 12th grade. Raw data and documentation fro this survey can be found at `https://www.cdc.gov/nchs/nsfg/about_nsfg.htm`.

B.7 Data sources used to proxy "employment costs of motherhood"

B.7.1. Low-Fertility Cohorts Study

We use breastfeeding data from the 1978 Low-Fertility Cohorts Study (ICPSR 4698). The sample consists of 1049 white, ever-married women born in the United States between July 1, 1900 and June 30, 1910. The study asks respondents about the birthyears of their first 16 live births and whether each was ever breastfed. We define the breastfeeding rate as the percentage of children born in each reported birthyear who were ever breastfed and only plot rates for birthyears with 100 or more observations (i.e. the 14 years between 1925 and 1939). The average number of observations per year is 130.7. Raw data and documentation for this survey can be found at `https://www.icpsr.umich.edu/web/ICPSR/studies/4698`.

B.7.2. National Fertility Survey

We also use breastfeeding data from the 1965, 1970, and 1975 waves of the National Fertility Survey (ICPSR 20002, 20003, and 4334 respectively) of currently married women living in the

United States. The NFS is the successor of the 1955 and 1960 Growth of American Families surveys. The 1965 NFS survey asks respondents about the birthyears of their first 18 live births and whether each was ever breastfed; the 1970 survey asks only about the first birth and the 1975 survey asks about the first 12. We pool responses from all three surveys and define the breastfeeding rate as the percentage of children born in each reported birthyear who were ever breastfed. We only plot rates for birthyears with 900 or more observations (i.e. the 13 years between 1953 and 1965). The average number of observations per year is 1199.8. Raw data and documentation for all three surveys can be found at `https://www.icpsr.umich.edu/web/ICPSR/series/220/studies`.

B.7.3. Ross Labs Mothers Survey

We also use the Ross Labs Mothers Survey to estimate breastfeeding rates in the US between 1970 and 2002. Surveys were sent to a nationally representative sample of new mothers by mail. Prior to January 1997, mothers received surveys when their babies turned 6 months old; in later years, surveys also were sent to mothers of babies that were 1 to 12 months old. The survey asks what type of milk their babies received in the hospital, at one week, in the last 30 days, and most often in the last week; possible choices include breast milk, commercially available infant formulas, and cow's milk. The data are then weighted by geography, race, and mother's age and education. We plot estimates of the percentage of infants in each survey year between 1970 and 2002 that were ever breastfed. Data and documentation for this survey can be found at `http://web.archive.org/web/20070101180255/http://www.ross.com:80/images/library/BF_Trends_2002.pdf`.

B.7.4. National Immunization Survey

Finally, we estimate US breastfeeding rates for children born between 2002 and 2017 using data from the National Immunization Survey. The survey is conducted annually by telephone using random-digit dialing; the sample includes households with children and teens in the 50 states and the District of Columbia. Since January 2003, all respondents with children 19 to 35 months old are asked questions about breastfeeding. Breastfeeding rates are calculated by child's birthyear rather than survey year; thus, each birthyear can consist of responses from up to three survey years. The NIS releases breastfeeding rates for children in a birthyear when approximately two-thirds of children born that year have been surveyed. Prior to 2009, the rates were replaced the following year with final rates based on all the children surveyed in the birthyear; however, starting from 2009, the CDC reports one final rate based on two survey years only. We plot estimates of the percentage of babies born in each year between 2002 and 2017 that were ever breastfed, as defined by the question "Was [child] ever breastfed or fed breast milk?" Data and documentation for this survey can be found at `https://www.cdc.gov/breastfeeding/data/nis_data/index.htm`.

B.7.5. Infant Feeding Survey

For our estimates of breastfeeding rates from the UK, we use data from the Infant Feeding Survey, started in 1975 and administered in five year intervals until 2010. The 1975

survey was conducted only in England and Wales; surveys from 1980 onward include Scotland, and surveys from 1990 onward also include Northern Ireland. Each survey consists of questionnaires sent to mothers in three stages: the first when their babies are approximately six weeks old, the second when their babies are around four to six months old, and the third when their babies are around eight to ten months old. The data are then weighted to be representative of all mothers who gave birth in the sampling period in each country by mother's age and socioeconomic status. For consistency, we plot estimates of initial breastfeeding rates among Stage 1 mothers (those with babies around six weeks old) for England and Wales only for all survey years between 1975 and 2010. Data and documentation for this survey can be found at `https://digital.nhs.uk/data-and-information/publications/statistical/infant-feeding-survey`.

B.7.6. American Heritage Time Use Survey and American Time Use Survey

We use the American Heritage Time Use Survey (AHTUS, 1965 to 2012) and American Time Use Survey (ATUS, 2013 to 2019) to measure average time spent on childcare (in minutes per day). The AHTUS and ATUS are national time-diary based samples and provide nationally representative estimates of how, where, and with whom Americans spent their time. The sample includes mothers aged 25 to 44, with no reported disability, and with at least one own child below the age of 18 residing in the household in the respective survey years. Due to small sample sizes, we pool the following years of data from the AHTUS: 1965 and 1966; 1975 and 1976; 1992 and 1993; 1994 and 1995; and 1998 to 2000. The total time spent on household work is the sum of reported time spent on housework (*act_undom*) and childcare (*act_chcare*). Raw data and documentation for these surveys can be found at `https://www.ahtusdata.org/ahtus/about.shtml` for the AHTUS and `https://www.bls.gov/tus/data.htm` for the ATUS.

B.7.7. General Social Survey and National Fertility Survey

Trends in gender-role attitudes among prime-age individuals are estimated based on data from the 1977 to 2015 General Social Survey (GSS) and the 1970 National Fertility Survey (NFS). The GSS is a nationally representative survey of adults in the U.S. conducted since 1972. Our analysis makes use of responses to the following three questions that were asked consistently from 1977 to 2015 (on a four-point scale):

1. *FEFAM*: It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family.

2. *FECHLD*: A working mother can establish just as warm and secure a relationship with her children as a mother who does not work.

3. *FEPRESCH*: A preschool child is likely to suffer if his or her mother works.

The sample is restricted to men and women between the ages of 25 and 44. To construct the index of gender-role attitudes, we first standardize the responses to each of the three questions to have a mean of zero and standard deviation of one in each survey year. We compute the aggregate individual-level sexism index by taking the average of the normalized

responses in each survey year for each individual. The relevant sampling weights are applied for each survey. Data and documentation for this survey can be found at https://www.icpsr.umich.edu/icpsrweb/ICPSR/series/00028.

To obtain an earlier measure of gender-role attitudes, we use data from the 1970 National Fertility Survey (also described in Section B.7.2). The 1970 NFS examines marital fertility and family planning in the U.S. and contains similar questions on gender-role attitudes as the GSS. The survey includes ever-married women who were born after July 1, 1925. The questions used to construct the gender-role attitude index for 1970 are very similar to in the GSS and were also measured on using a four point scale. Respondents who indicated that they were "Uncertain or don't know" to any of the three questions are coded as missing. We follow the same procedure as that outlined for the GSS to construct the attitude index for the NFS. The relevant sampling weights are applied. Data and documentation for this survey can be found at https://www.icpsr.umich.edu/web/ICPSR/studies/20003/summary.

B.7.8. Weekly childcare costs

Data for average weekly childcare costs were extracted from Census Bureau Report CB13-62, available at https://www.census.gov/newsroom/press-releases/2013/cb13-62.html, using an online WebPlotDigitizer tool. Cost of childcare measures the average weekly expenditures among people making childcare payments, in 2011 dollars.

B.8 Data sources used to measure mothers' perceived costs relative to previous generations

B.8.1. Growth of American Families

We use the 1955 wave of the Growth of American Families survey (ICPSR 20000). The sample consists of 2713 married women aged 18-39 living in the United states. We restrict the sample to women with at least one birth. The 1955 GAF survey asks respondents "Do you feel that it is easier or harder to raise a family these days than when you were a child?"; we code a woman as agreeing with the statement "It is harder to raise a family these days than when I was a child" if she answered "harder" or "harder, qualified." Other possible answers include easier; easier, qualified; pro-con; and don't know, depends. Raw data and documentation for this survey can be found at https://www.icpsr.umich.edu/web/ICPSR/studies/20000.

B.8.2. Attitudes of American Women

We also use the 1962 Attitudes of American Women survey sponsored by the *Saturday Evening Post*. The sample consists of married women (including divorced, widowed, and separated) aged 60 or younger and never-married women aged 25 to 60 from 227 non-rural interviewing areas in all parts of the United States; we restrict the sample to women with at least one child under the age of 18. The survey asks "Is your job as a homemaker harder or easier than your mother's was?"; possible answers include harder, easier, and the same. We code a woman as agreeing with the statement "My job as a homemaker is harder than my mother's was" if she answered "harder." Raw data and documentation for this survey can be found at https://ropercenter.cornell.edu/ipoll/study/31089519.

B.8.3. Modern (post-1990) polls

Finally, we use several modern surveys that ask about the perceived costs of motherhood. Specifically, we pool data on women aged 25-45, with at least one child below the age of 18, from following surveys:

- the Pew State of the Union Mother's Day Poll from 1997 (`https://www.pewresearch.org/politics/dataset/state-of-the-union-mothers-day-poll`);
- the *Washington Post* DC-Region Moms Poll from 2005 (ICPSR 4324, `https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/4324`)
- the ABC News Mother's Day Poll from 2006 (ICPSR 4655, `https://www.icpsr.umich.edu/web/ICPSR/studies/4655`);
- the Pew Marriage/Parenthood survey from 2007 (`https://www.pewsocialtrends.org/dataset/marriageparenthood/`); and
- the CBS Monthly National Polls from April 2009 (ICPSR 26947, `https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/26947`), April 2011 (ICPSR 33962, `https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/33962`), May 2011 (ICPSR 33963, `https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/33963`) and April 2013 (ICPSR 34997, `https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/34997`).

The 1997 and 2007 Pew surveys ask respondents "In general, do you think it's easier to be a mother today than it was 20 or 30 years ago, more difficult, or about the same?"; possible answers include easier, more difficult, and about the same.

The 2005 Washington Post survey asks respondents "Do you think motherhood today is more demanding than it was for the previous generation, less demanding, or about the same?"; possible answers include more, less, and about the same.

The 2006 ABC News survey asks respondents "Compared to when you were a child, in general, do you think being a mother today is harder, easier, or about the same?"; possible answers include easier, harder, and about the same.

The CBS surveys ask respondents "Compared to when you were a child, in general, do you think being a mother today is harder, easier, or about the same?"; possible answers include easier, harder, and about the same.

We code a woman as agreeing with the statement "Motherhood today is harder than before" if she answered "more difficult" to the Pew surveys, "more demanding" to the Washington Post survey, or "harder" to the ABC or CBS surveys.

Appendix C. Placebo births analysis

We describe our procedure for our placebo births analysis in this section, as seen in Figure 4 and Appendix Figure A.4. For women without children (the control group), we identify a sample of women most likely to remain childless beyond the period we observe them in the data and assign placebo births in the following manner (broadly following Kleven *et al.* (2018)): We generate predictions of childlessness by estimating a linear probability model of childlessness on a sample of women who have completed their fertility (*i.e.*, are over age 40 at the end of our panel in 2009) and use estimates from this model to predict lifetime childlessness for women who have not yet completed their fertility (*i.e.*, are under age 40 in 2009). In particular, we regress childlessness on whether the respondent's mother worked when the respondent was 14, education-category fixed effects, income-quartile fixed effects, and birth-cohort fixed effects. We then select the top $X\%$ of women with respect to predicted childlessness and code them as being childless. We set X to equal the share of women in our data who are age forty and over and are childless (about 25 percent in our sample). We then assign this group random placebo first births as follows: We assume that women's age at first birth follows a log-normal distribution, where the mean and variance of this distribution are the observed mean and variance in age at first birth among the treatment group. We impose our standard sample restrictions to this control group (observed at least once pre- and post-birth, do not age into the sample, etc.).

Appendix D. Full model with proofs

D.1 Overview

In our model, a young woman forms an estimate of her *employment cost of motherhood*, which determines her educational decisions. She forms this estimate by observing her own mother, but this estimate is subject to two types of forecasting errors. First, her mother's *generation* might have higher or lower mean costs of motherhood than her generation. Second, relative to the rest of her cohort, her own mother may have had idiosyncratic (mean-zero) higher or lower costs of motherhood. While a mother's employments costs are informative of her daughter's employment costs, neither of these two error terms gets passed on to her.

D.1.1. Assumptions and set-up

Let utility $u(c, h)$ be a quasi-linear function of consumption c and labor h (for hours worked, say). Specifically, assume that

$$u(c, h) = c - \frac{h^{\gamma+1}}{\gamma + 1},$$

where $\gamma > 0$.

Women's consumption will be equal to market wages net of employment costs of motherhood (both per hour) times labor supply (in hours). Market wages are $\tilde{w} = w + \beta \cdot e$, where w is the wage for those without higher education (i.e., $e = 0$) and $\beta > 0$ is the hourly return to higher education (i.e., $e = 1$). Acquiring higher education $e = 1$ costs some "tuition" $\alpha > 0$, while obtaining $e = 0$ is free.

We view "employment costs of motherhood" very broadly, as any cost mothers endure during work. These might include, for example, the per-hour cost of a nanny or day-care service or the emotional or psychic cost of being separated from the child while at work. Actual employment costs for a given woman i are μ_i, but she predicts this cost with some error δ_i. In particular, she observes her mother's employment costs, $\mu_i + \delta_i$, but she only inherits the μ component. The δ component was her mother's "luck" (good or bad) and is *not* passed down to the daughter. This luck is the sum of a generational component, which we call λ and an idiosyncratic component, which we call ϵ. For example, generational "good luck" would include giving birth at a time when experts deemed formula preferable to breastmilk, which lowers the employment cost of motherhood. Idiosyncratic good luck would include having a very flexible supervisor at work or parents or in-laws who live in close proximity and can provide free child care. But the young woman in our problem cannot distinguish between μ_i and δ_i and instead uses the sum as the best signal of her *own*, future employment costs of motherhood.[34]

Assume further that $\mu \sim U[0, 1]$ and $\delta \in \{\lambda - \epsilon, \lambda + \epsilon\}$ with equal probability, where λ and $\epsilon > 0$ are both constants. Note that λ can take negative values (for much of the analysis below, λ will drop out, but allowing $\mathbb{E}(\delta) \neq 0$ will be useful in some predictions), if, for

[34]Note also that women in our model are *naive* in the sense that they do not take into account that δ is drawn from a distribution and instead just assume employment costs will be $\mu + \delta$ with probability one.

example, the previous generation had on average lower employment costs of motherhood than the index generation. We assume μ and δ are independent. For simplicity, we further assume no taxes and that w is sufficiently large such that $w - \mu - \delta$ is always greater than zero (so mothers' predicted effective wages are always positive). Ruling out corner solutions makes the intuition clearer, though this simplification undoubtedly loses some connection to the real world where the participation margin is a key element of female labor supply.

We abstract away from many possible dimensions of heterogeneity. There is no variation in fertility in our model: women become mothers with probability one and we ignore issues related to delaying or timing childbirth. Unlike many models of human capital, we ignore any variation in "ability" and thus the effective return to and cost of education do not vary along this dimension.

The implicit timing of the model is as follows (and depicted in Figure D.1): A woman i makes her education decision assuming that her future employment costs of motherhood are the same as her mother's, i.e., $\mu_i + \delta_i$. But she will then make her actual labor supply decision h_i^* *after* this uncertainty is resolved and her actual costs, μ_i, are revealed to her.

While this timing is helpful to keep in mind, the problem in fact can be collapsed to a single decision: the woman's (only) problem is to optimally choose whether to obtain higher education $e = 1$ or instead remain at $e = 0$. Once she chooses $e_i \in \{0, 1\}$ and once her true costs μ_i are revealed to her, her labor supply is given by a simple optimization problem and thus can be viewed as deterministic. Note that, as we are assuming away many other dimensions of heterogeneity, variation in optimal e_i^* comes entirely from variation in expected employment costs, $\mu_i + \delta_i$. Since all that matters in our two-generation set-up is the *difference* between mothers' and daughters' employment costs of motherhood, we have normalized the daughter's generational and idiosyncratic luck to zero. At the end of this appendix section, we consider a three-generation problem.

Working backward, the woman calculates her predicted utility for each $e \in \{0, 1\}$. This comparison requires calculating the optimal predicted h^* *given her assumptions about employment costs of motherhood* for each $e \in \{0, 1\}$ and then choosing the one for which realized utility is higher. For a given e and prediction of employment costs $\mu + \delta$, the optimal predicted $\hat{h}^*$ is given by (dropping subscripts for notational convenience):

$$\frac{\partial}{\partial h}\left[(w + \beta e - \mu - \delta)h - \alpha e - \frac{h^{\gamma+1}}{\gamma + 1}\right] = 0.$$

This first-order condition yields the following *predicted* labor-supply function:

$$\hat{h}^* = (w + \beta e - \mu - \delta)^{\frac{1}{\gamma}}. \tag{4}$$

Note that, as we would expect, predicted hours will increase in wages (and thus education, as education increases wages) and decreases in hourly employment costs.[35]

The woman takes her optimal predicted $\hat{h}^*$ for each of the two possible levels of education

[35] As utility is quasi-linear, there is no income effect and thus the substitution effect dominates and labor supply is always a positive function of wages, consistent with a long line of empirical work suggesting that women (relative to men) increase labor supply more in response to increases in effective wages.

$e \in \{0, 1\}$ and determines which yields higher utility. She thus compares the following two expressions:

$$u(\hat{h}^*(e=0)) = \underbrace{(w-\mu-\delta)}_{\substack{\text{effective wage} \\ \text{if } e=0}} \cdot \overbrace{(w-\mu-\delta)^{\frac{1}{\gamma}}}^{h^*(e=0)} - \frac{\left[(w-\mu-\delta)^{\frac{1}{\gamma}}\right]^{1+\gamma}}{1+\gamma} \tag{5}$$

and

$$u(\hat{h}^*(e=1)) = \overbrace{(w+\beta-\mu-\delta)}^{\text{effective wage if } e=1} \cdot \overbrace{(w+\beta-\mu-\delta)^{\frac{1}{\gamma}}}^{h^*(e=1)} - \alpha - \frac{\left[(w+\beta-\mu-\delta)^{\frac{1}{\gamma}}\right]^{1+\gamma}}{1+\gamma}. \tag{6}$$

After some algebra, it is easy to show that expression (6) will be greater than (5) (i.e., the woman will choose $e = 1$) iff:

$$(w+\beta-\mu-\delta)^{\frac{1+\gamma}{\gamma}} - (w-\mu-\delta)^{\frac{1+\gamma}{\gamma}} > \alpha\frac{1+\gamma}{\gamma}. \tag{7}$$

Note that we will assume that $\beta^{\frac{1+\gamma}{\gamma}} < \alpha\frac{1+\gamma}{\gamma}$, or else all women would choose to obtain higher education $e = 1$.[36]

The inequality in equation (7) yields the standard results that a higher tuition cost α deters college-going. Similarly, as $\frac{1+\gamma}{\gamma} > 0$ (in fact, it is greater than 1) by assumption, the LHS of the equation is increasing in β so more women will choose $e = 1$ as the return to education rises. Similarly, all else equal, a lower μ increases the likelihood of choosing $e = 1$.

More novel to our model is the effect of *misestimation* of employment costs of motherhood on the college-going decision. The LHS of equation (7) is decreasing in $\mu+\delta$.[37] So, for a given μ, women who *under-estimate* child-care costs ($\delta < 0$) will obtain *more* education than the same women who over-estimates them. Recall that this under-estimation arises because she naively assumes she will inherit her mother's "good luck" in terms of lower employment costs, whereas in reality she inherits only the permanent term, μ.

D.2 Predictions yielded by the model

Claim 1. *Women who choose $e = 1$ will on average work more (post-baby) than those who choose $e = 0$.*

[36] To see this claim, note that the LHS of equation (7) is increasing in $w-\mu-\delta$, which we assume is greater than zero by assumption. Thus, the LHS is always greater than $\beta^{\frac{1+\gamma}{\gamma}}$, the value of the expression when $w - \mu - \delta = 0$. Thus, unless $\beta^{\frac{1+\gamma}{\gamma}} < \alpha\frac{1+\gamma}{\gamma}$, all women regardless of their μ and δ values would choose $e = 1$.

[37] This claim follows from $\frac{1+\gamma}{\gamma} > 1$ and can be easily shown by taking the derivative of the expression with respect to $\mu + \delta$.

Proof. We first prove the following useful lemma:

Lemma 1. *For a given set of parameter values* $\{w, \beta, \gamma, \alpha, \lambda, \epsilon\}$ *s.t.* $\beta^{\frac{1+\gamma}{\gamma}} < \alpha\frac{1+\gamma}{\gamma}$ *(to avoid corner solutions) the following three statements hold:*

(*a*) *If the error term* $\delta = \lambda - \epsilon$*, then there exists some unique cutoff value* $\mu' \in \mathbb{R}$ *such that the woman will choose* $e = 1$ *iff* $\mu < \mu'$*.*

(*b*) *If the error term* $\delta = \lambda + \epsilon$*, then there exists some unique cutoff value* $\mu'' \in \mathbb{R}$ *such that the woman will choose* $e = 1$ *iff* $\mu < \mu''$*.*

(*c*) *These cutoff values are such that* $\mu' > \mu''$*.*

Proof. (*a*) We assume the error term is $\delta = \lambda - \epsilon$. Consider the following function $f(\mu)$ defined by the LHS of equation (7):

$$f(\mu) := (w + \beta - \mu - \delta)^{\frac{1+\gamma}{\gamma}} - (w - \mu - \delta)^{\frac{1+\gamma}{\gamma}}.$$

Note that $f(\mu)$ is continuous and strictly decreasing. It is also unbounded, as $f(\mu) \to \infty$ as $\mu \to -\infty$.

Let $\mu_1 := w - (\lambda - \epsilon)$, then $f(\mu_1) = \beta^{\frac{1+\gamma}{\gamma}}$, as we are assuming in (*a*) that the error term is $\delta = \lambda - \epsilon$. Since f is continuous, strictly decreasing and unbounded, we can find $\mu_2 < \mu_1$ such that $f(\mu_2) > \alpha\frac{1+\gamma}{\gamma} > \beta^{\frac{1+\gamma}{\gamma}} = f(\mu_1)$. Note that $\alpha\frac{1+\gamma}{\gamma} > \beta^{\frac{1+\gamma}{\gamma}}$ follows from our technical assumption to avoid corner solutions.

We thus have that f is continuous on a closed, bounded interval $[\mu_2, \mu_1] \subset \mathbb{R}$, so by the intermediate value theorem, there exists some $\mu' \in (\mu_2, \mu_1)$ such that $f(\mu') = \alpha\frac{1+\gamma}{\gamma}$ (i.e., that the RHS and LHS of equation 7) are equal. Further, as f is strictly decreasing, we know this μ' is unique.

Thus, for any $\mu < \mu'$, we have $f(\mu) > f(\mu')$. That is, for any $\mu < \mu'$, we have

$$(w + \beta - \mu - \delta)^{\frac{1+\gamma}{\gamma}} - (w - \mu - \delta)^{\frac{1+\gamma}{\gamma}} > \alpha\frac{1+\gamma}{\gamma},$$

so the woman will choose $e = 1$ iff $\mu < \mu'$, when she observes error term $\delta = \lambda - \epsilon$.

(*b*) A parallel argument establishes a unique μ'' such that she will choose $e = 1$ iff $\mu < \mu''$, when she observes error term $\delta = \lambda + \epsilon$.

(*c*) Note that $f(\mu)$ is everywhere greater when $\delta = \lambda - \epsilon$ than when $\delta = \lambda + \epsilon$. Thus, f (which recall is simply the LHS of equation 7) will equal $\alpha\frac{1+\gamma}{\gamma}$ (the RHS of equation 7) for a strictly larger value of μ (because f is strictly decreasing) when $\delta = \lambda - \epsilon$ than when $\delta = \lambda + \epsilon$. Thus, $\mu' > \mu''$.

While we have now proved the Lemma as it is stated, note that we have only shown the existence of some unique $\mu', \mu'' \in \mathbb{R}$, not necessarily $\mu', \mu'' \in [0, 1]$. We will heretofore always assume values for $\{w, \beta, \alpha, \gamma, \lambda, \epsilon\}$ such that $0 < \mu'' < \mu' < 1$ to rule out situations where everyone or no one receives higher education. Figure D.2 provides a set of such parameter values and shows a graphical derivation of μ', μ''. ∎

We now return to the proof of Claim 1. Note that the actual labor supply is made *after* the education decision is made and after true employment costs of motherhood μ are revealed. It follows that, holding e and μ fixed, actual labor supply is simply:

$$h^* = (w + \beta e - \mu)^{\frac{1}{\gamma}}. \tag{8}$$

The claim requires us to show that $\mathbb{E}(h \,|\, e = 1) - \mathbb{E}(h \,|\, e = 0) > 0$, which can now be written (using equation 8 and Lemma 1) as:

$$\begin{aligned}
&\mathbb{E}(h \,|\, e = 1) - \mathbb{E}(h \,|\, e = 0) = \\
&\mathbb{E}\Big[(w + \beta - \mu)^{\frac{1}{\gamma}} \mid (\delta = \lambda - \epsilon, \mu < \mu') \vee (\delta = \lambda + \epsilon, \mu < \mu'')\Big] - \\
&\mathbb{E}\Big[(w - \mu)^{\frac{1}{\gamma}} \mid (\delta = \lambda - \epsilon, \mu > \mu') \vee (\delta = \lambda + \epsilon, \mu > \mu'')\Big] = \\
&\frac{1}{2}\mathbb{E}\Big[(w + \beta - \mu)^{\frac{1}{\gamma}} \mid \mu < \mu'\Big] + \frac{1}{2}\mathbb{E}\Big[(w + \beta - \mu)^{\frac{1}{\gamma}} \mid \mu < \mu''\Big] - \\
&\left(\frac{1}{2}\mathbb{E}\Big[(w - \mu)^{\frac{1}{\gamma}} \mid \mu > \mu'\Big] + \frac{1}{2}\mathbb{E}\Big[(w - \mu)^{\frac{1}{\gamma}} \mid \mu > \mu''\Big]\right) = \\
&\frac{1}{2}\left[\left(\mathbb{E}\Big[(w + \beta - \mu)^{\frac{1}{\gamma}} \mid \mu < \mu'\Big] - \mathbb{E}\Big[(w - \mu)^{\frac{1}{\gamma}} \mid \mu > \mu'\Big]\right) + \right. \\
&\left.\left(\mathbb{E}\Big[(w + \beta - \mu)^{\frac{1}{\gamma}} \mid \mu < \mu''\Big] - \mathbb{E}\Big[(w - \mu)^{\frac{1}{\gamma}} \mid \mu > \mu''\Big]\right)\right] > 0.
\end{aligned}$$

The last step follows because as $\frac{1}{\gamma} > 0$, $(w - \mu)^{\frac{1}{\gamma}}$ and $(w + \beta - \mu)^{\frac{1}{\gamma}}$ are both decreasing in μ. Thus both terms in the large parentheses of the final expression are positive. ∎

Note that to connect this result directly to the empirical work, we need to add slightly more detail to the timing of the model. We have effectively collapsed the model into a single period (women make their education decision based on expected costs of motherhood, and then instantaneously have a child and have their costs revealed to them). If we instead assume that women all have a (perhaps brief) pre-baby period where everyone works some maximum "full-time" hours (which is roughly what we see in our data), then the claim maps not only into educated women having higher post-baby labor supply, but also exhibiting smaller employment "mommy effects."

The next result states that, even though more educated women have smaller mommy effects with respect to employment, they are nonetheless the most "surprised" by the demands of motherhood.

Claim 2. *The average forecast error for women with $e = 1$ is less than the average forecast error for women with $e = 0$. That is, $\mathbb{E}[\delta \mid e = 1] < \mathbb{E}[\delta \mid e = 0]$.*

Proof. Note that we mean "smaller" as in either "less positive" *or* "more negative," so we refer here to both the sign and magnitude of the error, not just the magnitude, which is

often what is relevant in other forecasting contexts. From the Lemma, we know that $e = 1$ iff event a *or* event b occurs, where event a corresponds to $(\delta = \lambda + \epsilon) \wedge (\mu < \mu'')$ and event b corresponds to $(\delta = \lambda - \epsilon) \wedge (\mu < \mu')$. Recall that μ and δ are independent.

We can thus write:

$$\mathbb{E}[\delta \mid e = 1] = \mathbb{E}[\delta \mid a]\frac{P(a)}{P(a) + P(b)} + \mathbb{E}[\delta \mid b]\frac{P(b)}{P(a) + P(b)} =$$
$$(\lambda + \epsilon)\frac{P(\delta = \lambda + \epsilon) \cdot P(\mu < \mu'')}{P(\delta = \lambda + \epsilon) \cdot P(\mu < \mu'') + P(\delta = \lambda - \epsilon) \cdot P(\mu < \mu')} +$$
$$(\lambda - \epsilon)\frac{P(\delta = \lambda - \epsilon) \cdot P(\mu < \mu')}{P(\delta = \lambda + \epsilon) \cdot P(\mu < \mu'') + P(\delta = \lambda - \epsilon) \cdot P(\mu < \mu')} =$$
$$(\lambda + \epsilon)\frac{\frac{1}{2}\mu''}{\frac{1}{2}\mu'' + \frac{1}{2}\mu'} + (\lambda - \epsilon)\frac{\frac{1}{2}\mu'}{\frac{1}{2}\mu'' + \frac{1}{2}\mu'} =$$
$$\lambda\left(\frac{\mu'' + \mu'}{\mu'' + \mu'}\right) + \epsilon\left(\frac{\mu'' - \mu'}{\mu'' + \mu'}\right) = \lambda + \epsilon\left(\frac{\mu'' - \mu'}{\mu'' + \mu'}\right).$$

We follow a parallel argument to derive $\mathbb{E}[\delta \mid e = 0]$. Now, $e = 0$ if either event a' or b' occur, where a' is $(\delta = \lambda + \epsilon) \wedge (\mu > \mu'')$ and b' is $(\delta = \lambda - \epsilon) \wedge (\mu > \mu')$.

$$\mathbb{E}[\delta \mid e = 0] = \mathbb{E}[\delta \mid a']\frac{P(a')}{P(a') + P(b')} + \mathbb{E}[\delta \mid b']\frac{P(b')}{P(a') + P(b')} =$$
$$(\lambda + \epsilon)\frac{P(\delta = \lambda + \epsilon) \cdot P(\mu > \mu'')}{P(\delta = \lambda + \epsilon) \cdot P(\mu > \mu'') + P(\delta = \lambda - \epsilon) \cdot P(\mu > \mu')} +$$
$$(\lambda - \epsilon)\frac{P(\delta = \lambda - \epsilon) \cdot P(\mu > \mu')}{P(\delta = \lambda + \epsilon) \cdot P(\mu > \mu'') + P(\delta = \lambda - \epsilon) \cdot P(\mu > \mu')} =$$
$$(\lambda + \epsilon)\frac{\frac{1}{2}(1 - \mu'')}{\frac{1}{2}(1 - \mu'') + \frac{1}{2}(1 - \mu')} + (\lambda - \epsilon)\frac{\frac{1}{2}(1 - \mu')}{\frac{1}{2}(1 - \mu'') + \frac{1}{2}(1 - \mu')} =$$
$$\lambda + \epsilon\left(\frac{\mu' - \mu''}{2 - \mu' - \mu''}\right).$$

We thus have:

$$\mathbb{E}[\delta \mid e = 1] - \mathbb{E}[\delta \mid e = 0] =$$
$$\left[\lambda + \epsilon\left(\frac{\mu'' - \mu'}{\mu'' + \mu'}\right)\right] - \left[\lambda + \epsilon\left(\frac{\mu' - \mu''}{2 - \mu' - \mu''}\right)\right] =$$
$$\epsilon\left(\frac{\mu'' - \mu'}{\mu'' + \mu'}\right) - \epsilon\left(\frac{\mu' - \mu''}{2 - \mu' - \mu''}\right) < 0,$$

as $\mu'' < \mu'$ from Lemma 1 and the denominators of both terms in the final line are positive

as $\mu', \mu'' \in (0,1)$ by assumption. Note that as λ drops out, the claim holds for any value of λ. ■

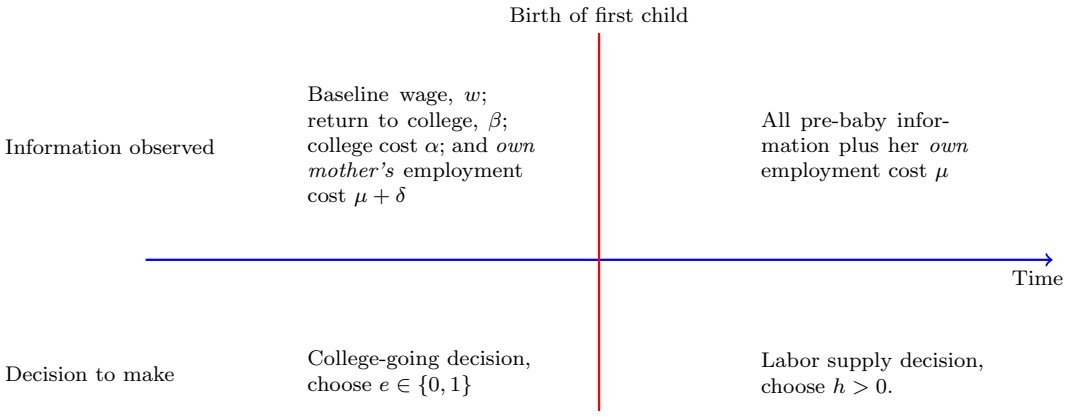
Now, we show that our *unconditional* results on belief-updating (i.e., that, *on average*, women's gender-role attitudes move in the anti-female-employment direction after baby and that they report parenthood being harder than they expected) hold *if and only if* the employment costs of motherhood have increased for the current generation relative to the previous.

Claim 3. $\mathbb{E}[\mu + \delta] < \mathbb{E}[\mu]$ *iff* $\lambda < 0$.

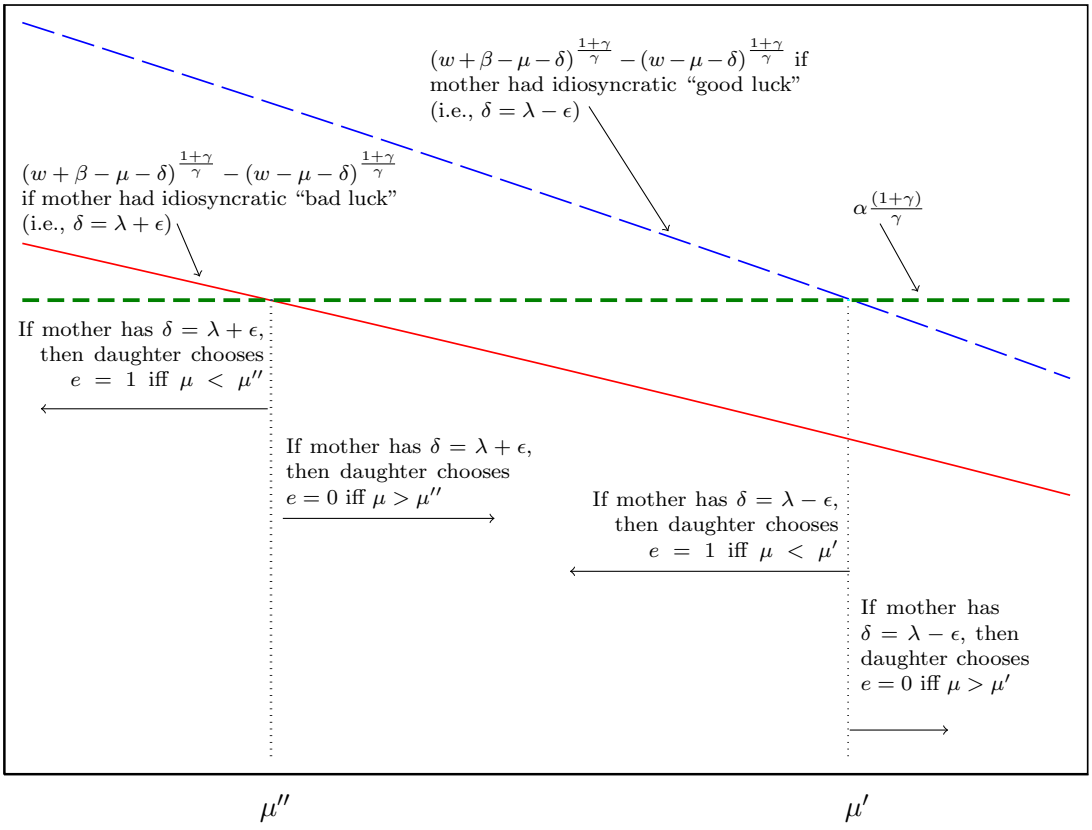
Proof. As $\delta \in \{\lambda + \epsilon, \lambda - \epsilon\}$ with equal probability, the claim follows trivially:

$\mathbb{E}[\mu + \delta] = \mu + \lambda + {}^1\!/_2\epsilon - {}^1\!/_2\epsilon = \mu + \lambda < \mu$ iff $\lambda < 0$. ■

Appendix Figure D.1: Timing of the model



Appendix Figure D.2: Graphical derivation of the μ', μ'' cut-off values in Lemma 1



Notes: To generate this graph, we use the following parameter values: $w = 2, \gamma = 1.2, \lambda = 0, \epsilon = 0.025, \beta = 0.12, \alpha = 0.2$.