Additional appendices for

THE MOMMY EFFECT:
DO WOMEN ANTICIPATE THE EMPLOYMENT EFFECTS OF MOTHERHOOD?

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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, related, would be disproportionately female, as women 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) that 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 variables are defined as follows. Employed last week is equal to 1 if an individual did paid work last week (i.e. was physically present at work) and excludes 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. Other employment variables we use include job last week (which includes individuals who had a paid job but for whatever reason were away from it), in labor force currently (which includes individuals who are unemployed and looking for a job), and employed full/part time (which is defined as $\geq$ and $<$ 30 hours, respectively). Finally, we also examine whether an individual's *spouse* is employed in a given year. Note that these individuals are excluded from our sample, as they are not randomly chosen to be included.

We also examine a range of questions on an individuals' opinions on gender roles in the household. Appendix Table A.6 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.

Another set of questions we examine in the BHPS relate to expectations of future labor force. The question that we use about labor force expectations is worded as follows: "Do you think this actually will happen in the coming twelve months? Give up paid work." Note that this question is only asked of individuals who currently have a paid job. We examine this question, combining yes and "don't know," and compare to actual labor force outcomes, conditional on answering the question in the previous wave. These variables are always keyed on the year the expectation was made *about*, so that in event year zero, the expectation variable is made in the year before an individual had their first child. Finally, we construct a variable that asks whether your prediction was correct. This variable (expected to work this year but wrong) is equal to 1 if an individual predicted that she would work this year and was correct and is equal to 0 if she predicted that she would work this year and was wrong. Note that this variable is missing for individuals who expected *not* to work this year. In practice, this group is only 3% of total answers.

A final set of questions we examine in the BHPS relate to job satisfaction. Like the gender-roles questions, we examine each individually and construct an omnibus variable.

The individual questions are asked on a scale of 1 (not satisfied at all) to 7 (completely satisfied), and pertain to: (1) overall satisfaction, (2) total pay, (3) security, (4) the work itself, and (5) hours worked. Like the gender-roles questions, we standardize these variables so that they have a mean of zero and standard deviation of one and sum them all together to form an omnibus measure. Note that more questions were available, but they were not asked after wave 7, so for the sake of consistency in our omnibus measure, we selected only those questions that were asked in all waves.

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 people 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 and 2nd 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 to the nearest whole number.

B.2.7. Other Demographic Information

Education: Each year, the NLSW68 records the highest completed grade and highest college degree obtained by respondents. We assign the highest grade completed to be the respondent's maximum highest grade reported among all years. Similarly, we assign the highest college degree to be the respondent's maximum reported degree. 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 people 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"). For regressions on gender-role attitudes, we must observe the respondent's answers to each of the eight questions to be included in the sample.

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. Gender-role attitudes

NLSY79 asks respondents about their attitudes towards women working four times over the course of the survey – in 1979, 1982, 1987, and 2004. In particular, they ask if respondents personally agree or disagree with each of the following statements

a: A woman's place is in the home, not in the office or shop

b: A wife who carries out her full family responsibilities doesn't have time for outside employment

c: A working wife feels more useful than one who doesn't hold a job

d: The employment of wives leads to more juvenile delinquency

e: It's much better for everyone concerned if the man is the achiever outside the home and the woman takes care of the home and family

f: Men should share the work around the house with women, such as doing the dishes, cleaning, and so forth

g: Women are much happier if they stay at home and take care of their children

We recode each question so that a higher value indicates a more gender-liberal position. Non-interviews as well as responses of "do not know" and "refused" are coded as missing.

B.3.6. Date of Birth of 1st and 2nd Child

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

B.3.7. 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 to the nearest whole number.

B.3.8. 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 at age 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 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 people 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 and 2nd Child

To determine the date of birth of respondent's first and second 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 (second minimum) date of birth among all the respondent's births is taken to be the date of birth of the first (second) 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 ever report having completed 16 or more years of schooling.

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 it's 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.

B.5 Supplementary data sources asking expectations of future labor supply

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		

We also make use of the 1961 wave of a two year Purdue Opinion Panel of high school students grades 9-12. We restrict our sample to female high school seniors. 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=.`

Finally, we 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=.`

Appendix C. Full model with proofs

C.1 Overview

In our model, a young woman forms an estimate of how hard it will be to take care of children while working, which informs 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 the daughter inherits part of her mother?s costs, neither of these two error terms gets passed on to her.

C.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 a base wage for those with higher education $e = 0$ and $\beta > 0$ is the hourly return to higher education $e = 1$. Gaining 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. 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 and an idiosyncratic component. For example, her own mother's 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. Generational "good luck" could be, for example, giving birth in a moment with cheap, technological substitutes for child care. But the 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.[35]

Assume further that $\mu \sim U[0, 1]$ and $\delta = \{\lambda - \epsilon, \lambda + \epsilon\}$ 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

[35]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.

that $w - \mu - \delta$ is always greater than zero (so mothers' predicted effective wages are always positive).

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: A woman makes her education decisions assuming that her future employment costs of motherhood are $\mu + \delta$, but then will make her actual labor supply decisions after this uncertainty is resolved and her actual costs, μ, are revealed to her. While this timing is helpful to keep in mind, in fact the problem can be collapsed to a single decision: the woman's (only) problem is to optimally choose education $e \in \{0, 1\}$. Once she chooses e and once her true costs μ 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 comes entirely from variation in expected employment costs, $\mu_i + \delta_i$.

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 child-care costs* for each e and then seeing which realized utility is higher. For a given e and prediction of child-care cost $\mu_i + \delta_i$, the optimal predicted $\hat{h}$ is given by setting

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

which yields the following *predicted* labor-supply function:

$$\hat{h}^* = (w + \beta e - \mu - \delta)^{\frac{1}{\gamma}}. \tag{2}$$

Note that, as we would expect, predicted hours will increase in wages (and thus education, as education increases wages) and decreases in hourly child-care costs.[36]

The woman takes her optimal predicted $\hat{h}^*$ for each of the two possible levels of education $e \in \{0, 1\}$ and determines which yields higher utility. She thus compares the following two expressions:

$$u(\hat{h}^*(e=0)) = \underbrace{(w - \mu - \delta)}_{\substack{\text{effective wage} \\ \text{if } e=0}} \cdot \overbrace{(w - \mu - \delta)^{\frac{1}{\gamma}}}^{h^*(e=0)} - \frac{\left[(w - \mu - \delta)^{\frac{1}{\gamma}}\right]^{1+\gamma}}{1 + \gamma} \tag{3}$$

and

[36] 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.

$$u(\hat{h}^*(e=1)) = \overbrace{(w+\beta-\mu-\delta)}^{\text{effective wage if } e=1} \cdot \overbrace{(w+\beta-\mu-\delta)^{\frac{1}{\gamma}}}^{h^*(e=1)} - \alpha - \frac{\left[(w+\beta-\mu-\delta)^{\frac{1}{\gamma}}\right]^{1+\gamma}}{1+\gamma}. \quad (4)$$

After some algebra, it is easy to show that expression (4) will be greater than (3) (i.e., the woman will choose $e = 1$) iff:

$$(w+\beta-\mu-\delta)^{\frac{1+\gamma}{\gamma}} - (w-\mu-\delta)^{\frac{1+\gamma}{\gamma}} > \alpha\frac{1+\gamma}{\gamma}. \quad (5)$$

Intuitively, a higher tuition cost α will discourage choosing $e = 1$. 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 (also intuitive).

Less intuitive but important is that the LHS is decreasing in $\mu + \delta$. This claim follows from $\frac{1+\gamma}{\gamma} > 1$ and can be easily shown by taking the derivative of the expression with respect to $\mu + \delta$.

C.2 Predictions yielded by the model

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

Proof. We first prove the following useful lemma:

Lemma 1. *For a given set of parameter values $(w, \beta, \gamma, \alpha, \lambda, \epsilon)$ for which (the technical condition) $\beta^{\frac{1+\gamma}{\gamma}} < \alpha\frac{1+\gamma}{\gamma}$ and a given realization of the error term $\delta = \{\lambda - \epsilon, \lambda + \epsilon\}$, there exists some μ' such that a woman will choose $e = 1$ iff $\mu < \mu'$ when $\delta = \lambda - \epsilon$ and another such cut-off μ'' such that for all $\mu < \mu''$ she will always choose $e = 1$ when $\delta = \lambda + \epsilon$.*

Proof. First, fix $\delta = \lambda+\epsilon$. The LHS of equation (5), $(w+\beta-\mu-(\lambda+\epsilon))^{\frac{1+\gamma}{\gamma}} - (w-\mu-(\lambda+\epsilon))^{\frac{1+\gamma}{\gamma}}$, is continuous and strictly decreasing in μ. It also tends to infinity as μ tends to negative infinity. It reaches its minimum (real) value, $\beta^{\frac{1+\gamma}{\gamma}}$, as $\mu \to (w - (\lambda + \epsilon))$. As $\beta^{\frac{1+\gamma}{\gamma}} < \alpha\frac{1+\gamma}{\gamma}$ by assumption, the LHS tends to infinity as $\mu \to -\infty$, then by the intermediate value theorem we know there exists some μ'' such that the LHS and RHS of (5) are equal. Finally, as the LHS is strictly decreasing in μ and the RHS is constant, then this μ'' is unique and equation (5) holds iff $\mu < \mu''$.

A parallel argument establishes a unique value for μ'.

Finally, note that the LHS of equation (5) is everywhere higher when $\delta = \lambda - \epsilon$ than when $\delta = \lambda + \epsilon$, so it will equal $\alpha\frac{1+\gamma}{\gamma}$ for a strictly larger value of μ and thus $\mu'' > \mu'$.

While we have now proved the claim 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 gets educated. Figure C.1 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, labor supply is simply:

$$h^* = (w + \beta e - \mu)^{\frac{1}{\gamma}}. \tag{6}$$

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 6 and Lemma 1) as:

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

The last step follows because as $\frac{1}{\gamma} > 0$, $(w-\mu)^{\frac{1}{\gamma}}$ is decreasing in μ and thus both terms in the large parentheses 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 max "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. *Women with $e = 1$ underestimate the costs of motherhood more than women with $e = 0$. That is, $\mathbb{E}[\delta \mid e = 1] < \mathbb{E}[\delta \mid e = 0]$.*

Proof. : From the Lemma, we know that $e = 1$ iff event a *or* event b occurs, where event a is $(\delta = \lambda + \epsilon) \cap (\mu < \mu'')$ and event b is $(\delta = \lambda - \epsilon) \cap (\mu < \mu')$. Recall that μ and δ are independent.

We can thus write:

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

Note that the expression multiplying ϵ is negative, as $\mu'' < \mu'$.

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

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

Note that the expression multiplying ϵ is positive, as $\mu'' < \mu'$ and $\mu' + \mu'' < 2$ as $\mu', \mu'' \in (0, 1)$ by assumption.

It thus follows that $\mathbb{E}[\delta \mid e = 1] - \mathbb{E}[\delta \mid e = 0] < 0$. As λ drops out, note that 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

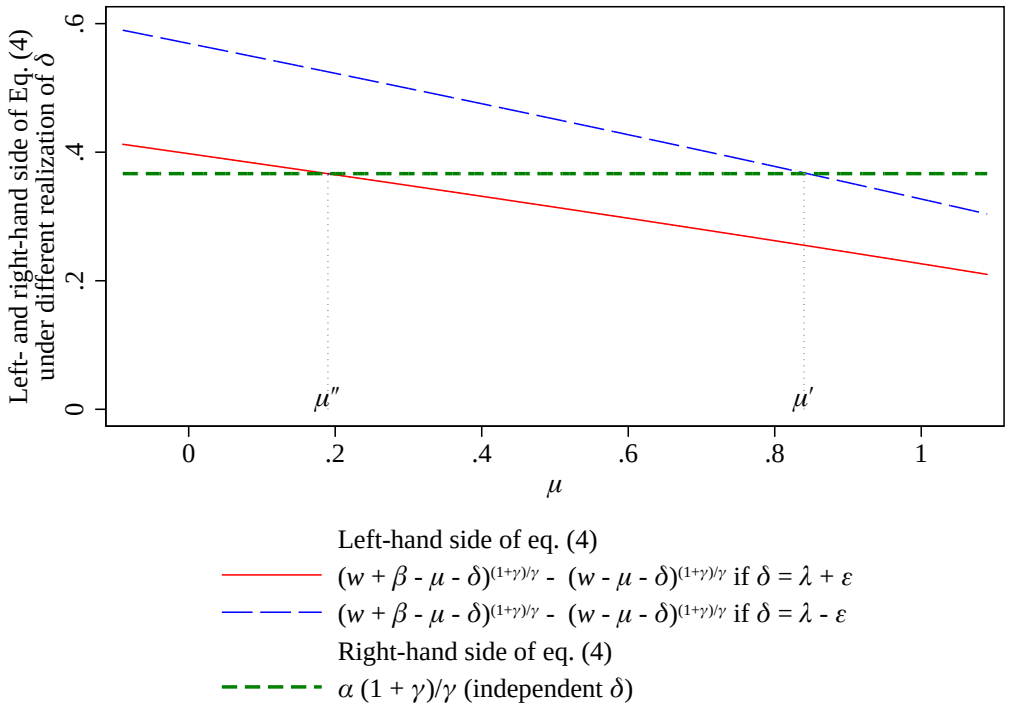
and that they report parenthood being harder than they expected) hold *if and only if* the employment costs of motherhood have increased for the current generation relative to the previous.

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

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

$$\mathbb{E}[\mu + \delta] = \mu + \lambda + {}^{1}\!/_{2}\epsilon - {}^{1}\!/_{2}\epsilon = \mu + \lambda < \mu \text{ iff } \lambda < 0. \quad \blacksquare$$

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



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