Continuation of NLS Discussion Paper 95-21
Part 2 of 2

This version of the paper was split for web delivery.

APPENDIX A: NLS-Y DATA ON WORK AROUND CHILDBIRTH

The NLS-Y includes five conceptually distinct batteries of questions on female labor force patterns. Each of the batteries has strengths and weaknesses. Some of the complexity of the estimation method is driven by an attempt to optimally combine these different batteries. This appendix carefully describes each of the batteries. It then presents some descriptive statistics on the responses to each battery. Finally, we discuss the joint availability of the different batteries.

Work History Data

The NLS-Y is officially part of the "National Longitudinal Surveys of Labor Market Experience." Befitting that name, a major effort of the NLS-Y has been to collect complete (event history) information on employment. These data are distributed on a "Work History Tape" which recasts the survey responses into a weekly record of employment.

The exact battery is as follows:

> *Now I'd like to ask a few questions about your employment with (EMPLOYER NAME, THIS SUPPLEMENT).*
>
> C. *Is this the same (EMPLOYER NAME) you were working for last year on (DATE OF LAST INTERVIEW)?*
>
> 3. *When did you first start working for (EMPLOYER)?*
>
> 5. *Between (DATE STARTED) and (DATE OF LAST INTERVIEW), were there any periods of one month or more during which you were not working for (EMPLOYER), not counting paid vacation or paid sick leave?*
>
> 7. *Are you currently working for (EMPLOYER)?*
>
> *INTERVIEWER NOTE IF: RESPONDENT HAS DIFFICULTY DECIDING WHETHER "CURRENTLY WORKING," USE THESE PROBES:*
>
> *IF ON MATERNITY LEAVE, PROBE: WILL RESPONDENT BE ON MATERNITY LEAVE FOR LESS THAN 90 DAYS, TOTAL? IF SO, CODE "YES," CURRENTLY WORKING, AT Q.7, ABOVE. IF NOT, CODE "NO", NOT CURRENTLY WORKING.*
>
> 1. *Does R Receive Wages From Employer For Time Not Working There?*
>   *Yes . . . . (CLASSIFY AS CURRENTLY WORKING)*
>   *No . . . . (GO TO 2)*

> 2. *Is There A Commitment On The Employer's And Respondent's Part To Return To Work In The Future?*
>   *Yes . . . .(GO TO 3)*
>   *No . . . .(CLASSIFY AS NOT CURRENTLY WORKING)*
>   *Don't Know . . . . . (GO TO 3)*
>
> 3. *Is The Respondent Currently On Layoff?*
>   *Yes . . . . (CLASSIFY AS NOT CURRENTLY WORKING)*
>   *No . . . . (CLASSIFY AS CURRENTLY WORKING)*

B.   *When did you last stop working for (EMPLOYER)?*

As the probes at Question 7 make clear, the NLS-Y concept explicitly includes paid vacation as time employed. From the perspective of this paper, this is a crucial omission. We are interested in time at work (see Klerman and Leibowitz, forthcoming, for an extended discussion of the importance of this distinction in understanding the labor market behavior of new mothers). Thus, we have a fundamental measurement problem. This problem is explicitly noted in the *NLS Handbook*:

> *Users should note that the NLS-Y main questionnaire defines respondents who are on vacation, on sick leave, on unpaid leave of less than one month, or on maternity leave of less than 90 days as still attached to an employer. Therefore a mother with this kind of status would be considered working, even though she was on leave around the time of the birth of a child. ...* Researchers cannot use these variables for the period close to the birth if their actual concern is real hours of employment immediately before or after the birth *(Emphasis in the original). However, this caveat applies principally to the last quarter before the birth and the first quarter after the birth. (NLS-Y Child Handbook, p. 34)*

Thus, for women who quit their jobs during pregnancy, we know the exact day of last work during pregnancy and the exact day of return to work after delivery (if the woman has returned to work by her last interview). However, for women who do not quit their jobs (nor take unpaid maternity leave, see below), we can not distinguish (using this work history data) between a woman who took maternity leave and a woman who worked until close of business on one day, delivered the baby that night, and returned to work the next day. This potential problem is in fact a major characteristic of the data.

Gaps in Employment

As Question 5 above makes clear, the NLS-Y's concept includes only periods of paid employment. The Employer Supplements include a careful battery to identify "gaps in employment." The battery proceeds as follows:

> 8.   *For one reason or another, people often do not work for a week, a month, or even longer. For example, strikes, layoffs, and extended illnesses can cause people to miss work for a week or longer.*

Between (DATE IN Q.6) and (DATE IN Q.7B/now), were there any periods of a full week or more during which you did not work for this employer, not counting paid vacations or paid sick leave?

> Yes . . . .(ASK A ON PAGE ES-8) 1
> No . . . ﹍﹍. . . .(GO TO Q.9, PAGE ES-10) 0

GAPS WITHIN JOBS

IF YES TO Q.8, ASK A:

A.   *Please tell me each period between (DATE IN Q.6) and (now/DATE IN Q.78) during which you didn't work for this employer for a full week or more. PROBE: What other period was there during which you didn't work for this employer for a full week or more? ENTER DATES IN "A", NEXT PAGE. IF MORE THAN THREE PERIODS GO TO NEW EMPLOYER SUPPLEMENT P.ES-9. THEN ENTER BELOW THE TOTAL NUMBER OF SEPARATE PERIODS DURING WHICH R DID NOT WORK FOR THIS EMPLOYER:*

C.   *What was the reason you were on unpaid vacation or unpaid leave? HAND CARD I.*
    FOR REASONS 6-13:   ENTER CODE IN B, THEN GO TO K.
    1)   On strike   . . . .(GO TO K) 01
    2)   On layoff   . . . .(GO TO K) 02
    3)   Quit job but returned to same employer. . . .(GO TO E) 3
    4)   Job ended for a period of time but began again. .(GO TO E) . 4
    5)   Some other reason for which you were on
              unpaid vacation or unpaid leave .(ASK C) 05
    6)   Going to school . . . .(GO TO K) 06
    7)   In the Armed Forces . . . .(GO TO K) 07
    8)   Pregnancy . . . .(GO TO K) 08
    9)   Pregnancy . . . .(GO TO K) 09
    10) Had problems with child care . . . .(GO TO K) 10
    11) Had other personal or family reason . . . .(GO TO K) 11
    12) FOR SCHOOL EMPLOYEES ONLY:
              School shut down . . . . (GO TO K) 12
    13) Did not want to work . . . . (GO TO K) 13
    14) Some other reason . . . .(ASK D). 14

10. *Between (DATE IN Q.6) and (DATE IN Q.7B/NOW), were there any periods of a full week or more during which you took any paid leave from work with this employer because of a pregnancy or the birth of a child?*

> Yes . . . .(AGO to Q.11) 1
> No . . . . (SKIP TO Q.12, ES-11) ..0

11. *Please tell me each period between (DATE IN Q.6) and (DATE IN Q.7B/NOW) during which you didn't work for this employer for a full week or more because of a pregnancy or the birth of a child and you received pay.*

   PROBE: What other period was there during which you didn't work for this employer for full week or more because of pregnancy or the birth of a

child and you received pay? ENTER DATES IN "A", BELOW. IF MORE THAN TWO PERIODS, GO TO A NEW EMPLOYER SUPPLEMENT PAGE ES-10. THEN ENTER BELOW THE TOTAL NUMBER OF SEPARATE PERIODS DURING WHICH R DID NOT WORK FOR THIS EMPLOYER AND RECEIVED PAY:

14.   *How many hours per week (do/did) you usually work at this job?*
        (PROBE: DURING WEEKS WHEN YOU ARE/WERE WORKING).
        ENTER NUMBER OF HOURS |___|___|___|

Thus, for women on *unpaid* maternity leave, we know the exact date of last work during pregnancy and the exact date of return to work after childbirth.

CPS Job/Employment Status Recode

At each interview, the NLS-Y administers (a version of) the standard Current Population Survey (CPS) labor market battery with respect to the job held in the previous week. That batter is:

SECTION 5: ON CURRENT LABOR FORCE STATUS (CPS QUESTIONS)

1.   *Now I'd like some information on what you were doing last week. What were you doing most of last week -- working, keeping house, or something else? RECORD VERBATIM AND CODE ONE ONLY.*

_____

_____

Working............(SKIP TO Q.3).. 01
With A Job But Not At Work... 02
Looking For Work.. 03   56-57/
Keeping house... 04
Going To School 05
Unable To Work (SKIP TO Q.20. PAGE 5-41) 06
OTHER (SPECIFY) _____
_____ .07

2.   *Did you do any work at all last week, not counting work around the house?*
        (INTERVIEWER NOTE: DO NOT INCLUDE VOLUNTEER WORK OR WORK DONE IN PRISON. IF FARM OR BUSINESS OPERATOR IN HH, ASK R ABOUT UNPAID WORK.)
        Yes _____
        No _____ No
        (SKIP TO Q.8, PAGE 5-35)   0
        58-59/

3. *How many hours did you work last week at all jobs:*
    ENTER TOTAL # OF HOURS: *60-61/*

4. *INTERVIEWER: CODE FROM Q.3. RESPONDENT WORKED:*
    1 - 34 HOURS 1
    35 - 48 HOURS ....(SKIP TO Q.6, PAGE 5-32)2   2   *62-63/*
    49 OR MORE HOURS (SKIP TO Q.7, PAGE 5-34)   3

ASK Q.5 ONLY IF CODE 1 IN Q.4.

5.   *Do you usually work 35 hours or more a week at this job?*
    Yes .... (ASK A)...1   *64-65/*
    No......................(ASK B) 0

ASK Q.8 ONLY IF "NO" TO Q.2, PAGE 5-29.

8.   A. *INTERVIEWER: LOOK AT Q.1, PAGE 5-29. WAS CATEGORY 02*
    " W   I   T   H   A   J   O   B
    BUT NOT AT WORK" CODED?
    Yes .... (GO TO Q.9)..1
                                                                            29-30/
    No .... (ASK B) 0

    B. *IF NO: Did you have a job or business from which you were temporarily absent*
        or on layoff last week?
        Yes .... (GO TO Q.9).......................................1
                                                                            31-32/
        No ....(SKIP TO Q.13, PAGE 5-37) 0

---

9.   *Why were you absent from work last week?* RECORD VERBATIM AND CODE ONE
ONLY.

> *IF MORE THAN ONE REASON GIVEN, PROBE:* *What was the main reason why you were absent from work last week?*

_____

_____

_____

_____

OWN ILLNESS .....(SKIP TO Q.11, PAGE 5-36).........	*01*
ILLNESS OF OTHER FAMILY MEMBER	
(SKIP TO Q.11, PAGE 5-36)......................	*02*
ON VACATION .....(SKIP TO Q.11, PAGE 5-36)........	*03*
BAD WEATHER .....(SKIP TO Q.11, PAGE 5-36)....... .	*04* *33-34/*
LABOR DISPUTE ... (SKIP TO Q.11, PAGE 5-36)......	*05*
NEW JOB TO BEGIN ....(ASK A)	*06*
ON LAYOFF .... (GO TO Q.10, PAGE 5-36)	*07*
SCHOOL INTERFERED (SKIP TO Q.11, PAGE 5-36) 08	
OTHER (SPECIFY) (SKIP TO Q.11, PAGE 5-36)	
_____	*09*

A. *"IF NEW JOB TO BEGIN":* *Is your new job scheduled to begin within 30 days from today, or sometime after that?*
Within 30 days ... (SKIP TO Q.15, PAGE 5-38)...............   1
Sometime after that (SKIP TO Q.13B, PAGE 5-37)...........   2   *35-36/*

11.   *Are you getting wages or salary for any of the time off last week?*
Yes...   1
No   0   *45-46/*
(IF VOLUNTEERED): SELF-EMPLOYMENT   3

_____

_____

12. *Do you usually work 35 hours or more a week at this job?*
Yes..   1
No   0   *47-48/*

_____

_____

13. A. **_INTERVIEWER_**: SEE Q.1, PAGE 5-29. WAS CATEGORY 03, "LOOKING FOR

WORK" CODED?

Yes....................(GO TO Q.14)...	1	
No......................(ASK B)	0	49-50/

IF "NO" TO Q.13A, OR IF CODE "2" IN Q.9A PAGE 5-35, ASK B:

B.   Have you been looking for work during the past 4 weeks?

Yes..	1	
No................. (SKIP TO Q.20, PAGE 5-41)	0	51-52/

14.   What have you been doing in the last 4 weeks to find work?   RECORD VERBATIM
        AND CODE ALL THAT APPLY.

Nothing....(SKIP TO Q.20, PAGE 5-41)	01	53-54/
Checked With:		
Public Employment Agency	02	55-56/
Private Employment Agency	03	57-58/
Employer Directly	04	59-60/
Friends Or Relatives	05	61-62/
Placed Or Answered Ads	06	63-64/
Looked In The Newspaper	07	65-66/
School Employment Service	08	67-68/
Other (Specify) _____		
	09	69-70/

As Klerman and Leibowitz (forthcoming) have noted, this battery explicitly distinguishes "employed and at work" from "employed, but not at work." Thus, for a quarter of the sample we know the true work status during the crucial last trimester of pregnancy; and for a different quarter of the sample, we know the true work status during the crucial first three months after childbirth.

There is one crucial caveat. The hazard analysis in the body of the paper focuses on the last date worked during pregnancy and the first date worked after delivery. It is possible that a woman was not working during the week preceding the interview during her pregnancy, but was working at some later point in her pregnancy. Analogously, it is possible that a woman was not working during the week preceding the interview after childbirth, but had worked in some earlier week since childbirth.

To minimize the biases introduced by these possibilities, we only use this information for three months preceding and three months following the birth. Responses earlier or later than those dates are too likely to include both an exit and a subsequent entry (or an entry and a subsequent exit). Second, after childbirth, we require both that

Maternity Leave Supplement (1983)

In 1983, the NLS-Y included a special "Maternity Leave Supplement" which specifically probed for work (not employment) during pregnancy and following childbirth. The questions referred to the most recent child (throughout, we ignore any sample selection due to this limitation).

23. Did you work at any time while you were pregnant with (YOUNGEST CHILD)?
     Yes (ASK A & B) .... 1.. 74/
     No   .... (GO TO Q. 24) 0

A.   Did you work during the ....
         (CODE "YES" OR "NO" FOR EACH ITEM)

	YES	NO	
first 3 months of pregnancy?	1	0	75/
second 3 months of pregnancy, that is, the fourth through the sixth month?	1	0	76/
last 3 months of pregnancy, that is, the 7th through the 9th month?	1	0	77/

B.   Did you continue to perform the same day to day tasks in your job as you did before you were pregnant?
     Yes   1.. 78/
     No   0.. 0

42. INTERVIEWER: DID R WORK DURING HER PREGNANCY (IS Q. 23 CODED "YES")?
     YES (GO TO Q. 43)................ 1.. 38/
     NO   .... (SKIP TO Q. 45) 0

43. Did your place of employment offer maternity leave when you became pregnant with (YOUNGEST CHILD)?
     Yes   (ASK A)......................... 1.. ... 39/
     No   .... (GO TO 44) 0

A. IF YES, ASK: How many months along were you in the pregnancy when your maternity leave started?
                ENTER NUMBER OF MONTHS: |___|___| 40-41/
                STARTED AFTER BIRTH 95

44. Did you return to work after (YOUNGEST CHILD) was born?

Yes   (ASK A)........................... 1...   42/
No   .... (GO TO B) 0

A.   *How old was the baby when you returned to work?*
                    ENTER NUMBER OF WEEKS OLD: |___|___| *43-44/*
....*OR*
....*ENTER*
NUMBER OF MONTHS OLD:|___|___| *45-46/*

```
               GO TO Q. 45
```

B. *Do you intend to return to work?*
Yes   (ASK 1)............................ 1.. 47/
No   0

1. *How old will (CHILD) be when you would like to return to work*
ENTER AGE
MONTHS: |___|___| 48-49/
OR
YEARS : |___|___| 50-51/

Thus, for most children born before 1983, we can recover the length of paid employment. Note, however, that the information is only available in weeks or months, not days (as in the work history and gap data) and that the respondent chose the units. We ignore any sample selection due to the units chosen.

Maternity Leave Battery (1988 and following)

As is indicated by the earlier quote from the *NLS Handbook,* the work-employment distinction was recognized by those running the NLS-Y. Beginning with the 1988 interview (and thus, covering births in 1987), an additional battery of questions was added to the Employer Supplements. This Maternity Leave Battery explicitly probed for paid leave for pregnancy or immediately after child-birth. The exact battery is as follows:

10. *Between (DATE IN Q.6) and (DATE IN Q.7B/NOW), were there any periods of a full week or more during which you took any paid leave from work with this employer because of a pregnancy or the birth of a child?*

    Yes ....(AGO to Q.11) 1

    No .... (SKIP TO Q.12, ES-11) 0

11. *Please tell me each period between (DATE IN Q.6) and (DATE IN Q.7B/NOW) during which you didn't work for this employer for a full week or more because of a pregnancy or the birth of a child and you received pay.*

    PROBE: What other period was there during which you didn't work for this employer for full week or more because of pregnancy or the birth of a child and you received pay? ENTER DATES IN "A", BELOW. IF MORE THAN TWO PERIODS, GO TO A NEW EMPLOYER SUPPLEMENT PAGE ES-10. THEN ENTER BELOW THE TOTAL NUMBER OF SEPARATE PERIODS DURING WHICH R DID NOT WORK FOR THIS EMPLOYER AND RECEIVED PAY:

14.   *How many hours per week (do/did) you <u>usually</u> work at this job?*

       (PROBE: DURING WEEKS WHEN YOU ARE/WERE WORKING).

                            ENTER NUMBER OF HOURS

       |_____|_____|_____|

Thus, for all births after 1987 we have the exact dates of last work during pregnancy and first work after childbirth.

APPENDIX B: THE CUBIC SPLINE BASELINE HAZARD

Proportional Hazards with Arbitrary Baselines

Recall the basic hazard algebra (see for example Lancaster, 1991). The hazard, $h(t)$, is defined as:

$$h(t) = \lim_{dt \to 0} \frac{P\{t \leq T < t + dt | T \geq t\}}{dt} = \frac{f(t)}{1 - F(t)} = \frac{f(t)}{S(t)}$$

All of the computations in the likelihood refer to the survivor function. In terms of the hazard, the survivor function is:

$$S(t) = \exp\left\{ -\int_0^t h(s)ds \right\}$$

$$= \exp\left\{ -\int_0^t e^{X\beta} \lambda(s)ds \right\}$$

$$= \exp\left\{ -e^{X\beta} \int_0^t \lambda(s)ds \right\}$$

$$= \exp\left\{ -e^{X\beta} \Lambda(t) \right\}$$

The first equality is definitional. The second equality follows from the proportional hazard assumption (where $\lambda(s)$ is the baseline hazard) and the parameterization of the dependence on the covariates. The third equality follows the elementary properties of integrals. The final equality defines $\Lambda(t)$. Note that this implies that the integration can be done once for any values of the over all observations; i.e. it is not necessary to perform the numerical integration separately for each observation.

Cubic Spline Baseline Hazard

Now note that we specify the baseline hazard as an exponentiated cubic spline. The exponentiation is used to guarantee non-negativity of the hazard. Following de

Boor (1978; see also Press, et al. 1986), we use a B-Spline representation. Specifically, we consider the cubic spline approximation to an arbitrary function:

$$y = Ay_j + By_{j+1} + Cq_j + Dq_{j+1}$$

where A, B, C, D are defined as:

$$A = \frac{x_{j+1} - x}{x_{j+1} - x_j}$$

$$B = 1 - A = \frac{x - x_j}{x_j - x_{j+1}}$$

$$C = \frac{1}{6}(A^3 - A)(x_{j+1} - x_j)^2$$

$$D = \frac{1}{6}(B^3 - B)(x_{j+1} - x_j)^2$$

and the q's satisfy the N-2 equations in N unknowns:

$$\frac{x_j - x_{j-1}}{6} y''_{j-1} + \frac{x_{j+1} - x_{j-1}}{3} y''_j + \frac{x_{j+1} - x_j}{6} y''_{j+1} = \frac{y_{j+1} - y_j}{x_{j+1} - x_j} - \frac{y_j - y_{j-1}}{x_j - x_{j-1}}$$

where we use the natural cubic spline boundary conditions, which set $q_1 = 0$ and $q_N = 0$:

These relations can be expressed in matrix form as:

$$
\begin{bmatrix}
\frac{x_3 - x_1}{3} & \frac{x_3 - x_2}{6} & 0 & 0 & \cdots & 0 \\
\frac{x_3 - x_2}{6} & \frac{x_4 - x_2}{3} & \frac{x_4 - x_3}{6} & 0 & \cdots & 0 \\
0 & \frac{x_4 - x_3}{6} & \frac{x_5 - x_3}{3} & \frac{x_5 - x_4}{6} & \cdots & 0 \\
0 & 0 & \frac{x_5 - x_4}{6} & \frac{x_6 - x_4}{3} & \cdots & 0 \\
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
0 & 0 & 0 & 0 & \cdots & \frac{x_N - x_{N-2}}{3}
\end{bmatrix}
\begin{bmatrix}
q_2 \\
q_3 \\
q_4 \\
q_5 \\
\cdots \\
q_{N-1}
\end{bmatrix}
=
\begin{bmatrix}
\frac{y_3 - y_2}{x_3 - x_2} - \frac{y_2 - y_1}{x_2 - x_1} \\
\frac{y_4 - y_3}{x_4 - x_3} - \frac{y_3 - y_2}{x_3 - x_2} \\
\frac{y_5 - y_4}{x_5 - x_4} - \frac{y_4 - y_3}{x_4 - x_3} \\
\frac{y_6 - y_5}{x_6 - x_5} - \frac{y_5 - y_4}{x_5 - x_4} \\
\cdots \\
\frac{y_N - y_{N-1}}{x_N - x_{N-1}} - \frac{y_{N-1} - y_{N-2}}{x_{N-1} - x_{N-2}}
\end{bmatrix}
$$

or:

$$Mq = b(y)$$

Now consider the cubic spline approach from the perspective of estimation. Given the xs chosen ex ante, we treat the ys as parameters and maximize the likelihood with respect to them. To do so, we need the derivatives of the approximation with respect to the ys. Note that the approximation:

$$y = Ay_j + By_{j+1} + Cq_j + Dq_{j+1}$$

is only a function of the ys through the bs. Solving the matrix system, we have:

$$q = M^{-1}b(y)$$

Taking derivatives using standard matrix differentiation formulae, we have:

$$\frac{\partial q_i}{\partial y_j} = \left[M^{-1}\right]_{i,j} \frac{\partial b(y)}{\partial y_j}$$

Integrating the Baseline Hazard

Putting these two pieces together, it is possible to numerically integrate the baseline hazard. Specifically, we want to compute the integral $\lambda(s)$ in the survivor function expression at each integer day t:

$$
\begin{aligned}
\Lambda(t) &= \int_0^t \lambda[s]ds \\
&= \int_0^t e^{y[s]}ds \\
&= \left\{ \sum_{i=1}^{j-1} \left[\int_{x_i}^{x_{i+1}} e^{y[s]}ds \right] \right\} + \int_{x_j}^t e^{y[s]}ds \\
&= \sum_{d=1}^t \left[\int_{d-1}^d e^{y[s]}ds \right] \\
&\approx \sum_{d=1}^t \left[\tfrac{1}{2} \left\{ e^{y[d-1]} + e^{y[d]} \right\} \right]
\end{aligned}
$$

where t is a point between spline knots j and $j=1$. The first equality is definitional. The second equality writes the hazard in terms of the underlying cubic spline function, y, which is itself a function of the parameters, the y_k (the values of y at the knots). The third equality partitions the integral into regions over which the function is exactly cubic

(not a useful representation for this approach; but note that if we did not exponentiate, we could compute the integrals exactly using standard rules for integrating polynomials).

The fourth equality rewrites the integral as the sum of a large number of terms. In our application, each term represents a day (thus the d notation). The final line approximates the integral using the trapezoidal rule. If the intervals are small enough and the function is smooth enough (as should be true of the exponentiated cubic spline) this simple integration formula should be sufficient.

To do the estimation, we need the derivatives of this approximation to the integral with respect to the parameters. In this case, the parameters are the values of y at the spline's knot points. We proceed by directly differentiating the approximation.

$$
\begin{aligned}
\frac{\partial \Lambda(t)}{\partial \theta} &= \frac{\partial}{\partial \theta} \int_0^t \lambda[s]\,ds \\
&\approx \frac{\partial}{\partial \theta} \sum_{d=1}^{t} \left[\tfrac{1}{2}\left\{ e^{y[d-1]} + e^{y[d]} \right\} \right] \\
&= \sum_{d=1}^{t} \left[\tfrac{1}{2}\left\{ e^{y[d-1]} \frac{\partial y[d-1]}{\partial \theta} + e^{y[d]} \frac{\partial y[d]}{\partial \theta} \right\} \right]
\end{aligned}
$$

where the second equality follows from the trapezoidal approximation to the integral.

APPENDIX C: CONSTRUCTION OF THE LIKELIHOOD

The likelihood is built up from primitives: Probit functions and (sub-)hazards. We begin by setting notation and describing the primitives. We then show how to use these primitives to construct the likelihood for the 18 cases.

There are three probit functions. The first probit function models the probability that a woman works during pregnancy is—*(wp=1)*: that she does not work during pregnancy—*P(wp=0)*. The second probit function describes whether a woman who works until delivery, quits her job—*P(pc=0)*, or that she goes on leave—*P(pc=1)* . The third probit function describes whether a woman who works until delivery goes on paid leave *P(pl=1)* or that she goes on unpaid leave—*P(pl=0)*.

The likelihoods are constructed in terms of the survivor functions. As is standard in competing risk models, there are three failure times t_{pq}, t_{pu}, t_{pp}. The first subscript, p, refers to pregnancy. The second subscript $q/u/p$ refers to quitting the job/unpaid leave/paid leave. Again as is standard in competing risk models, these failure times are assumed to be independent (conditional on the observed covariates and the random effects) and at most one of the failure times (the minimum of the three) is observed. Corresponding to each of these failure times is a Survivor function, $S_{pq}(t)$, $S_{pu}(t)$, $S_{pp}(t)$, representing the fraction of spells which would still be ongoing at time t, if this risk was the only risk. Finally, denote the censoring time (i.e. the age of the child at the last interview) as c.

There are eighteen cases in all. The only non-trivial cases are the last four, corresponding to the cases with an unknown date on which paid leave began during pregnancy (the fundamental data problem discussed in the text).

Case 1–No work during pregnancy, no work after childbirth:

$$L_1 = P(wp = 0)S_{cq}(c)$$

Case 2–No work during pregnancy, work after childbirth:

$$L_2 = P(wp = 0)\left\{S_{cq}(t_{cqe}) - S_{cq}(t_{cql})\right\}$$

Case 3–Work during pregnancy, quit job, no work after childbirth

$$L_3 = P(wp = 1)\left\{S_{pq}(t_{pqe}) - S_{pq}(t_{pql})\right\}S_{pu}(t_{pqe})S_{pp}(t_{pqe})S_{cq}(c)$$

Case 4–Work during pregnancy, quit job, work after childbirth

$$L_4 = P(wp = 1)\left\{S_{pq}(t_{pqe}) - S_{pq}(t_{pql})\right\}S_{pu}(t_{pqe})S_{pp}(t_{pqe})\left\{S_{cq}(t_{cqe}) - S_{cq}(t_{cql})\right\}$$

Case 5–Work during pregnancy, unpaid leave during pregnancy, no work after childbirth

$$L_5 = P(wp = 1)\left\{S_{pu}(t_{pue}) - S_{pu}(t_{pul})\right\}S_{pq}(t_{pue})S_{pp}(t_{pue})S_{cu}(c)$$

Case 6–Work during pregnancy, unpaid leave during pregnancy, work after childbirth

$$L_6 = P(wp = 1)\left\{S_{pu}(t_{pue}) - S_{pu}(t_{pul})\right\}S_{pq}(t_{pue})S_{pp}(t_{pue})\left\{S_{cu}(t_{cue}) - S_{cu}(t_{cul})\right\}$$

Case 7–Work during pregnancy, paid leave during pregnancy, no work after childbirth

$$L_3 = P(wp = 1)\left\{S_{pp}(t_{ppe}) - S_{pp}(t_{ppl})\right\}S_{pq}(t_{ppe})S_{pu}(t_{ppe})S_{cp}(c)$$

Case 8–Work during pregnancy, paid leave during pregnancy, work after childbirth

$$L_8 = P(wp = 1)\left\{S_{pp}(t_{ppe}) - S_{pp}(t_{ppl})\right\}S_{pq}(t_{ppe})S_{pu}(t_{ppe})\left\{S_{cp}(t_{cpe}) - S_{cp}(t_{cpl})\right\}$$

Case 9–Work during pregnancy until delivery, quit job at delivery, no work after childbirth

$$L_9 = P(wp = 1)S_{pq}(39*7)S_{pu}(39*7)S_{pp}(39*7)P(pc = 0)S_{cu}(c)$$

Case 10–Work during pregnancy until delivery, quit job at delivery, and then work after childbirth

$$L_{10} = P(wp = 1)S_{pq}(39*7)S_{pu}(39*7)S_{pp}(39*7)P(pc = 0)\left\{S_{cu}(t_{cue}) - S_{cu}(t_{cul})\right\}$$

Case 11–Work during pregnancy until delivery, unpaid leave after delivery, no work after childbirth

$$L_{11} = P(wp = 1)S_{pq}(39 * 7)S_{pu}(39 * 7)S_{pp}(39 * 7)P(pc = 1)P(pl = 0)S_{cu}(c)$$

Case 12–Work during pregnancy until delivery, unpaid leave after delivery, and then work after childbirth

$$L_{12} = P(wp = 1)S_{pq}(39 * 7)S_{pu}(39 * 7)S_{pp}(39 * 7)P(pc = 1)P(pl = 0)\left\{S_{cu}(t_{cue}) - S_{cu}(t_{cul}))\right\}$$

Case 13–Work during pregnancy until delivery, paid leave after delivery, no work after childbirth

$$L_{13} = P(wp = 1)S_{pq}(39 * 7)S_{pu}(39 * 7)S_{pp}(39 * 7)P(pc = 1)P(pl = 1)S_{cp}(c)$$

Case 14–Work during pregnancy until delivery, paid leave after delivery, and then work after childbirth

$$L_{14} = P(wp = 1)S_{pq}(39 * 7)S_{pu}(39 * 7)S_{pp}(39 * 7)P(pc = 1)P(pl = 1)\left\{S_{cp}(t_{cpe}) - S_{cp}(t_{cpl}))\right\}$$

Case 15–Work during pregnancy, unknown date on which paid leave began (but certainly before delivery, paid leave after delivery, no work after childbirth. The second line gives the approximation used in the actual computations. We do not know when the woman stopped working during pregnancy, but we know that it was before she quit her job and before she began unpaid leave. She may have worked until delivery and then began paid leave. Currently the integration (summation in the approximation for computation) is over all 39 weeks of pregnancy (in one day increments). In a quarter of the cases, we will have CPS question information which will change the limits of integration (summation).

$$L_{15} = P(wp = 1)\left\{\int_{t_e}^{t_l} f_{pp}(t)S_{pq}(t)S_{pu}(t)dt\right\}S_{cp}(c)$$

$$\approx P(wp = 1)\left\{\sum_{i=t_e}^{t_l}\left\{\left\{S_{pp}(i-1) - S_{pp}(i)\right\}S_{pq}(i)S_{pu}(i)\right\}\right\}S_{cp}(c)$$

Case 16–Work during pregnancy, unknown date on which paid leave began (but certainly before delivery), paid leave after delivery, and then work after childbirth. See the notes for Case 13 which apply to Case 14 as well.

$$L_{16} = P(wp = 1)\left\{\int_{t_e}^{t_l} f_{pp}(t)S_{pq}(t)S_{pu}(t)dt\right\}\left\{S_{cp}(t_{cpe}) - S_{cp}(t_{cpl}))\right\}$$

$$\approx P(wp = 1)\left\{\sum_{i=t_e}^{t_l}\left\{\{S_{pp}(i-1) - S_{pp}(i)\}S_{pq}(i)S_{pu}(i)\right\}\right\}\left\{S_{cp}(t_{cpe}) - S_{cp}(t_{cpl}))\right\}$$

Case 17–Work during pregnancy, unknown date on which paid leave began (perhaps at delivery), paid leave after delivery, no work after childbirth. The second line gives the approximation used in the actual computations. We do not know when the woman stopped working during pregnancy, but we know that it was before she quit her job and before she began unpaid leave. She may have worked until delivery and then began paid leave. Currently the integration (summation in the approximation for computation) is over all 39 weeks of pregnancy (in one day increments). In a quarter of the cases, we will have CPS question information which will change the limits of integration (summation).

$$L_{17} = P(wp = 1)\left\{\begin{array}{l}\left\{\int_{t_e}^{39*7} f_{pp}(t)S_{pq}(t)S_{pu}(t)dt\right\}\\ + \left\{S_{pq}(39*7)S_{pu}(39*7)S_{pp}(39*7)P(pc = 1)P(pl = 1)\right\}\end{array}\right\}S_{cp}(c)$$

$$\approx P(wp = 1)\left\{\begin{array}{l}\left\{\sum_{i=t_e}^{39*7}\left\{\{S_{pp}(i-1) - S_{pp}(i)\}S_{pq}(i)S_{pu}(i)\right\}\right\}\\ + \left\{S_{pq}(39*7)S_{pu}(39*7)S_{pp}(39*7)P(pc = 1)P(pl = 1)\right\}\end{array}\right\}S_{cp}(c)$$

Case 18–Work during pregnancy, unknown date on which paid leave began (perhaps at delivery), paid leave after delivery, and then work after childbirth. See the notes for Case 13 which apply to Case 14 as well.

$$L_{18} = P(wp=1)\left\{\left[\left\{\int_{t_e}^{39*7} f_{pp}(t)S_{pq}(t)S_{pu}(t)dt\right\} + \left\{\begin{aligned} &S_{pq}(39*7)S_{pu}(39*7)S_{pp}(39*7)\\ &P(pc=1)P(pl=1) \end{aligned}\right\}\right]\right\}\left\{S_{cp}(t_{cpe})-S_{cp}(t_{cpl}))\right\}$$

$$\approx P(wp=1)\left\{\left[\left\{\sum_{i=t_e}^{39*7}\left\{\left\{S_{pp}(i-1)-S_{pp}(i)\right\}S_{pq}(i)S_{pu}(i)\right\}\right\} + \left\{\begin{aligned} &S_{pq}(39*7)S_{pu}(39*7)S_{pp}(39*7)\\ &P(pc=1)P(pl=1) \end{aligned}\right\}\right]\right\}\left\{S_{cp}(t_{cpe})-S_{cp}(t_{cpl}))\right\}$$

Table C.1 summarizes the number and distribution of new mothers according to the 16 "Cases" discussed in this Appendix.

Table C.1

Distribution of Cases

Case	Pregnancy	At Birth	After Childbirth	%	N	Not in 83 Suppl.	83 Suppl	Between ML Qs	Post 88 ML Qs
1	Never	—	Censored	23.1%	1506	146	393	589	378
2	Never	—	Not Censored	14.9%	966	90	324	372	180
3	Quit	—	Censored	9.9%	644	43	170	239	192
4	Quit	—	Not Censored	21.3%	1392	101	402	574	315
5	Unpaid	—	Censored	0.0%	0	0	0	0	0
6	Unpaid	—	Not Censored	8.7%	570	26	122	236	186
7	Paid	—	Censored	0.0%	0	0	0	0	0
8	Paid	—	Not Censored	4.9%	318	0	100	0	218
9	Worked	Quit	Censored	0.2%	13	1	1	4	7
10	Worked	Quit	Not Censored	2.6%	169	3	6	21	139
11	Worked	Unpaid	Censored	0.0%	0	0	0	0	0
12	Worked	Unpaid	Not Censored	3.8%	247	6	42	92	107
13	Worked	Paid	Censored	0.0%	0	0	0	0	0
14	Worked	Paid	Not Censored	3.3%	213	0	67	0	146
15	Can't Tell	Paid Leave	Censored	5.4%	273	4	0	23	0
16	Can't Tell	Paid Leave	Not Censored	6.6%	443	47	0	396	0
17	Can't Tell	Can't Tell	Censored	0.0%	1	0	0	1	0
18	Can't Tell	Can't Tell	Not Censored	0.2%	15	1	0	14	0
	Total:			100%	6524	468	1627	2561	1868

NOTE: Censored - No return to work as of two years after birth (or last interview)

Not Censored - Returned to work as of two years after birth (or last interview)

ML Qs - Maternity Leave Questions

APPENDIX D: NOTES ON DIFFERENTIATING THE LIKELIHOOD

Overall the likelihood can be written:

$$
\begin{aligned}
L(\theta) &= \prod_{i=1}^{I} P_i(\theta) \\
&= \prod_{i=1}^{I} \sum_{k=1}^{K} \left\{ \pi(k) P_{ik}(\theta) \right\} \\
&= \prod_{i=1}^{I} \sum_{k=1}^{K} \left\{ \pi(k) \prod_{j=1}^{J_i} P_{ijk}(\theta) \right\}
\end{aligned}
$$

where L is the likelihood over the whole sample, P_i is the sub-likelihood value of the ith individual (birth), P_{ik} is the value of the sub-likelihood for the ith individual for the kth value of the random effect (or the quadrature points), $\pi(k)$ is the probability of the kth value of the likelihood; and P_{ikj} is the value of the jth decision for the ith individual under the kth value of the random effect; where a decision is a probit or a censored hazard or an uncensored hazard. Differentiating we have:

$$
\begin{aligned}
\frac{\partial \ln P_i(\theta)}{\partial \theta} &= \frac{\partial \ln \left[\sum_{k=1}^{K} \left\{ \pi(k) \prod_{j=1}^{J_i} P_{ijk}(\theta) \right\} \right]}{\partial \theta} \\
&= \sum_{k=1}^{K} \sum_{j=1}^{J_i} \left[\frac{\pi(k) P_{ik}(\theta)}{P_i(\theta)} \frac{\partial P_{ikj}(\theta)}{\partial \theta} \right] \\
&= \sum_{k=1}^{K} \sum_{j=1}^{J_i} \left[\alpha_{ik} \frac{\partial P_{ikj}(\theta)}{\partial \theta} \right] \text{ where } \alpha_{ik} = \frac{\pi(k) P_{ik}(\theta)}{P_i(\theta)}
\end{aligned}
$$

where a_{ik} serves as a computational simplification (it is done once in the inner loop).

Then all we need is the $\dfrac{\partial P_{ikj}(\theta)}{\partial \theta}$. For the probit, these terms are well understood. For the duration's, these terms are either the survivor function or the difference of survivor functions. With proportional hazards, the survivor function is:

$$S(t) = \exp\left\{-\int_0^t h(s)ds\right\}$$

$$= \exp\left\{-\int_0^t e^{X\beta}\lambda(s)ds\right\}$$

$$= \exp\left\{-e^{X\beta}\int_0^t \lambda(s)ds\right\}$$

$$= \exp\left\{-e^{X\beta}\Lambda(t)\right\}$$

so:

$$\frac{\partial S(t;\beta,\theta)}{\partial\theta} = -e^{X\beta}S(t;\theta)\frac{\partial\Lambda(t;\theta)}{\partial\theta}$$

$$\frac{\partial S(t;\beta,\theta)}{\partial\beta} = -e^{X\beta}\Lambda(t;\theta)S(t;\theta)X = S(t;\theta)\ln[S(t;\theta)]X$$

APPENDIX E: USING THE ESTIMATED MODEL TO IMPUTE IMPRECISE EVENT DATES

As we noted in the Introduction, this paper is partially motivated by a major missing data problem induced by the "employment" (rather than "at work") concept used in the NLS-Y Employer Supplements (prior to 1988). For analyses of the effect of maternal work (not employment) on child development (e.g. Blau and Grossbard, 1992; Baydar and Brooks-Gunn, 1992)), we would like to impute the probability of an event (e.g. the mother did not return to work until after the child was two months old).

The imputations can be computed from the parameter estimates using Bayes Rule: Specifically:

$$P(E|y,X,\theta) = \frac{P(E\,\&\,y|X,\theta)}{P(y|X,\theta)}$$

where E is the event whose probability we want to impute (e.g. The mother did not return to work until after the child was two months old), y is the NLS-Y data on work (see below), X are the covariates, and θ are the estimated parameters of the model.

For post-1987 births, the 1988 Maternity Leave Battery should provide exact dates. The interesting cases, are the "can't tells" and the 1983 Maternity Leave Supplement (where responses are in weeks or months; so we know if paid leave was taken, but not the exact dates). Then the denominator of the Bayes Rule expression is the probability of the recorded response (a "can't tell" or a wide interval in the 1983 Maternity Leave Supplement). The numerator of the Bayes Rule expression is the joint probability of the event of interest and the recorded data.

Given the factor structure of the econometric model, work during pregnancy and return to work after childbirth are independent conditional on the (for the purposes of computation) discrete valued random effect. Thus computation can proceed as follows. For each value of the random effect, compute the probability of the data (or the joint probability of the data and the event) as the product of the probability of the data in pregnancy and the data after childbirth. Then the total probability is the weighted sum

over each of the values of the random effect (where the weights are the probabilities of each value of the random effect). These probabilities are simply the sum of the probability of beginning paid leave on each of the possible days (since the computations are done in days) and (in most cases) the probability of beginning leave at childbirth.

APPENDIX F: COMPLETE PARAMETER ESTIMATES
FOR 1-DIMENSIONAL RANDOM EFFECT

Table F.1

Probit Coefficients

		WP				SL				PL	
Constant		1.5131	***			1.0546	***			-0.2961	
	(	0.0728	)		(	0.1751	)		(	0.2951	)
Age		0.058	***			-0.0392				0.1015	**
	(	0.0144	)		(	0.0318	)		(	0.0379	)
Age Sq.		-0.0042	*			-0.0016				-0.0012	
	(	0.0020	)		(	0.0047	)		(	0.0053	)
Black		-0.1254				-0.0039				-0.1264	
	(	0.0714	)		(	0.1540	)		(	0.1773	)
Hispanic		-0.1564	*			0.2091				0.1607	
	(	0.0764	)		(	0.1433	)		(	0.1698	)
Year		0.0332	*			-0.1406	***			-0.108	***
	(	0.0139	)		(	0.0305	)		(	0.0317	)
Year Sq.		-0.0028				-0.0154	*			-0.0027	
	(	0.0025	)		(	0.0069	)		(	0.0073	)
H.S. Drop-out		-0.6641	***			-0.6169	***			0.2297	
	(	0.0658	)		(	0.1790	)		(	0.2144	)
Some College		0.1588	*			0.0016				0.3309	*
	(	0.0797	)		(	0.1358	)		(	0.1613	)
College Grad.		0.1901				0.1632				-0.2368	
	(	0.1153	)		(	0.1589	)		(	0.1923	)
2nd Child		-0.8242	***			0.2664	*			0.2144	
	(	0.0539	)		(	0.1217	)		(	0.1292	)
3+ Child		-1.283	***			0.4344	*			0.3547	
	(	0.0751	)		(	0.1712	)		(	0.2104	)
Never Married		-0.1821	**			0.1316				0.3427	
	(	0.0632	)		(	0.1632	)		(	0.1763	)
Divorced/ Widowed		-0.0744				0.2251				-0.0234	
	(	0.0838	)		(	0.2253	)		(	0.2339	)
R.E. Factor Loading		0.8832***				-0.0182				0.3257	
	(	0.0309	)		(	0.1336	)		(	0.2929	)

NOTE: *:p<.05, **: p<.01, ***: p<.001

WP - Worked during pregnancy (=1 if worked; = 0 if never worked)
SL - Took leave, (=1 if took leave = 0; if quit)
PL- Took paid leave (= 1 if paid leave; = 0 if unpaid leave)

Table F.2

Competing Risks (For Leaving Work During Pregnancy) Regression Coefficients

		PQ				PU				PP	
Age		-0.1024	***			0.0307				0.0074	
	(	0.0159	)		(	0.0269	)		(	0.0302	)
Age Sq.		0.0067	**			-0.0115	**			-0.0081	
	(	0.0023	)		(	0.0043	)		(	0.0045	)
Black		0.0352				0.2823	*			0.5696	***
	(	0.0794	)		(	0.1230	)		(	0.1447	)
Hispanic		-0.0924				-0.0268				0.1541	
	(	0.0807	)		(	0.1282	)		(	0.1487	)
Year		-0.033	*			-0.0772	**			-0.0438	
	(	0.015	)		(	0.0240	)		(	0.0267	)
Year Sq.		-0.0048				0.0016				-0.0127	
	(	0.0029	)		(	0.0052	)		(	0.0069	)
H.S. Drop-out		0.5860	***			0.1439				0.3089	
	(	0.0768	)		(	0.1491	)		(	0.1741	)
Some College		-0.1012				-0.1341				-0.3748	**
	(	0.0783	)		(	0.1121	)		(	0.1433	)
College Grad.		-0.4529	***			-0.353	*			-0.0488	
	(	0.1141	)		(	0.1584	)		(	0.1792	)
2nd Child		0.2681	***			0.0096				-0.1292	
	(	0.0611	)		(	0.1007	)		(	0.1233	)
3+ Child		0.5842	***			0.1519				-0.0441	
	(	0.0920	)		(	0.1509	)		(	0.1894	)
Never Married		0.1762	*			0.1298				-0.0784	
	(	0.0710	)		(	0.1185	)		(	0.1534	)
Divorced/ Widowed		0.2932	**			0.0072				-0.0420	
	(	0.1086	)		(	0.1834	)		(	0.2265	)
R.E. Factor Loading		-0.6948	***			-0.1470				-0.7068	***
	(	0.0488	)		(	0.1781	)		(	0.1322	)

NOTE: *:p<.05, **: p<.01, ***: p<.001

> PQ - Competing risk of quitting job during pregnancy
>
> PU - Competing risk of taking unpaid leave during pregnancy
>
> PP - Competing risk of taking paid leave during pregnancy
>
> n.b - Competing risks have no constant (it is implicit in the baseline hazard)

Table F.3

Spline Parameters Competing Risks (For Leaving Work During Pregnancy)

	PQ			PU			PP	
Spline 1	-6.9589	***		-10.9472	***		-9.4828	***
	(0.1119	)	(	0.6638	)	(	0.5533	)
Spline 2	-6.5536	***		-9.1576	***		-11.0121	***
	(0.084	)	(	0.2878	)	(	0.5995	)
Spline 3	-6.5314	***		-9.0044	***		-10.2244	***
	(0.0847	)	(	0.2129	)	(	0.3481	)
Spline 4	-5.9293	***		-6.8656	***		-6.438	***
	(0.0889	)	(	0.1503	)	(	0.2226	)
Spline 5	-5.1453	***		-5.7049	***		-5.1763	***
	(0.0945	)	(	0.1509	)	(	0.2023	)
Spline 6	-4.7758	***		-4.828	***		-4.5682	***
	(0.1087	)	(	0.1565	)	(	0.1941	)
Spline 7	-4.2401	***		-4.4298	***		-3.8698	***
	(0.1196	)	(	0.1656	)	(	0.178	)
Spline 8	-3.8103	***		-3.4173	***		-2.635	***
	(0.2018	)	(	0.2192	)	(	0.2521	)

NOTE: *:p<.05, **: p<.01, ***: p<.001

PQ - Competing risk of quitting job during pregnancy

PU - Competing risk of taking unpaid leave during pregnancy

PP - Competing risk of taking paid leave during pregnancy

Table F4

Hazard (For Returning to Work After Childbirth) Regression Coefficients

	CQ		CU		CP	
Age	-0.0416 (0.0168)	*	-0.0703 (0.0195)	***	-0.0323 (0.0388)	
Age Sq.	0.0045 (0.0022)	*	-0.0021 (0.0036)		0.0003 (0.0072)	
Black	0.1543 (0.0814)		-0.1628 (0.1016)		-0.1934 (0.1292)	
Hispanic	-0.1656 (0.0869)		-0.1353 (0.1121)		-0.1146 (0.1443)	
Year	0.0569 (0.0168)	***	0.0615 (0.0231)	**	0.0950 (0.0296)	**
Year Sq.	0.0009 (0.0028)		0.0022 (0.0041)		-0.0012 (0.0059)	**
H.S. Drop-out	-0.5849 (0.0766)	***	0.0119 (0.1513)		-0.4033 (0.1509)	
Some College	0.2351 (0.0885)	**	-0.0349 (0.1204)		-0.2196 (0.1448)	
College Grad.	0.0921 (0.1372)		-0.0881 (0.1486)		0.2241 (0.1772)	
2nd Child	-0.2368 (0.0560)	***	-0.0653 (0.0862)		0.1513 (0.1180)	
3+ Child	-0.5010 (0.0803)	***	0.2571 (0.1472)		0.2310 (0.1848)	*
Never Married	-0.3156 (0.0697)	***	0.0853 (0.1091)		0.2964 (0.1413)	
Divorced/ Widowed	0.0025 (0.0941)		0.4121 (0.1798)	*	0.3327 (0.1795)	
R.E. Factor Loading	1.0064 (0.0390)	***	0.1670 (0.3607)		0.7855 (0.1762)	

NOTE: *:$p<.05$, **: $p<.01$, ***: $p<.001$

LQ - Hazard of Starting new job (having not worked during pregnancy or quit pregnancy job)

CU - Hazard of returning to work from unpaid leave

CP - Hazard of returning to work from paid leave

n.b - Hazards have no constant - (it is implicit in the baseline hazard).

Table F5

Hazard (For Returning to Work After Childbirth) Spline Parameters

		CQ			CU			CP	***
									)
Spline 1	(	-8.7937 1.0203	***)	(	-6.8780 0.9258	***)	(	-8.0486 4.6312	***)
Spline 2	(	-7.9347 0.3679	***)	(	-6.2836 0.4380	***)	(	-2.7758 0.3004	***)
Spline 3	(	-7.9951 0.3338	***)	(	-5.6531 0.3436	***)	(	-5.1171 0.5394	***)
Spline 4	(	-6.7442 0.1937	***)	(	-4.5273 0.2891	***)	(	-5.9867 0.4073	***)
Spline 5	(	-6.7445 0.2019	***)	(	-5.1013 0.3095	***)	(	-5.5337 0.3643	***)
Spline 6	(	-6.2882 0.1771	***)	(	-4.4228 0.2746	***)	(	-5.9754 0.4392	***)
Spline 7	(	-6.7308 0.1813	***)	(	-4.1778 0.2727	***)	(	-4.8209 0.2832	***)
Spline 8	(	-5.8716 0.1516	***)	(	-3.4794 0.2400	***)	(	-5.6959 0.3015	***)
Spline 9	(	-6.1136 0.1656	***)	(	-3.4672 0.2281	***)	(	-3.2149 0.1902	***)
Spline 10	(	-5.8555 0.1538	***)	(	-3.6549 0.2264	***)	(	-3.2137 0.2115	***)
Spline 11	(	-5.8896 0.1482	***)	(	-3.5044 0.2073	***)	(	-3.4083 0.230	***)
Spline 12	(	-5.8328 0.1216	***)	(	-3.6356 0.1966	***)	(	-2.8762 0.2423	***)
Spline 13	(	-5.9501 0.1332	***)	(	-3.5933 0.1830	***)	(	-3.4198 0.2467	***)
Spline 14	(	-6.0383 0.1156	***)	(	-3.5386 0.2067	***)	(	-3.574 0.3393	***)
Spline 15	(	-6.1755 0.1030	***)	(	-4.0944 0.2028	***)	(	-3.3402 0.3684	***)
Spline 16	(	-6.0592 0.0945	***)	(	-3.8989 0.1663	***)	(	-4.0663 0.4143	***)
Spline 17	(	-6.1838 0.1020	***)	(	-3.9411 0.1628	***)	(	-3.9896 0.3349	)
Spline 18	(	-6.0704 0.1018	***)	(	0.3444 1.5825	)	(	-4.3667 0.3570	
Spline 19	(	-6.1047 0.1067	***)				(	15.0844 8.5326	)
Spline 20		-6.1366	***						

	(	0.1137	)
Spline 21		-6.1463	***
	(	0.1249	)
Spline 22		-6.4601	***
	(	0.2011	)

NOTE: *:p<.05, **: p<.01, ***: p<.001

> LQ - Hazard of Starting new job (having not worked during pregnancy or quit pregnancy job)
>
> CU - Hazard of returning to work from unpaid leave
>
> CP - Hazard of returning to work from paid leave

APPENDIX G SUPPORTING FIGURES AND TABLES

This appendix collects additional results alluded to in the body of the paper. In some cases it presents full plots of some results. In other cases it presents, in tabular form, the numbers underlying the figures in the body of the paper.

Table G.1 cross-classifies these results by whether or not the woman worked until within three-days of delivery (labeled "At", for left work at delivery, as opposed to "Before" delivery). It shows that almost all short-leaves were paid. These leaves are equally divided between leaves beginning before delivery and at delivery; but since we know that most paid leaves begin before delivery, we can infer that most of the short leaves are a result of our coding those women who report continuous employment as short-leaves. When considering these results it is worth noting again that the length of "paid leaves" includes any unpaid leave occurring immediately after a paid (e.g., when accumulated vacation is exhausted).

Table G.1
Characterization of Leave by When the Leave Began

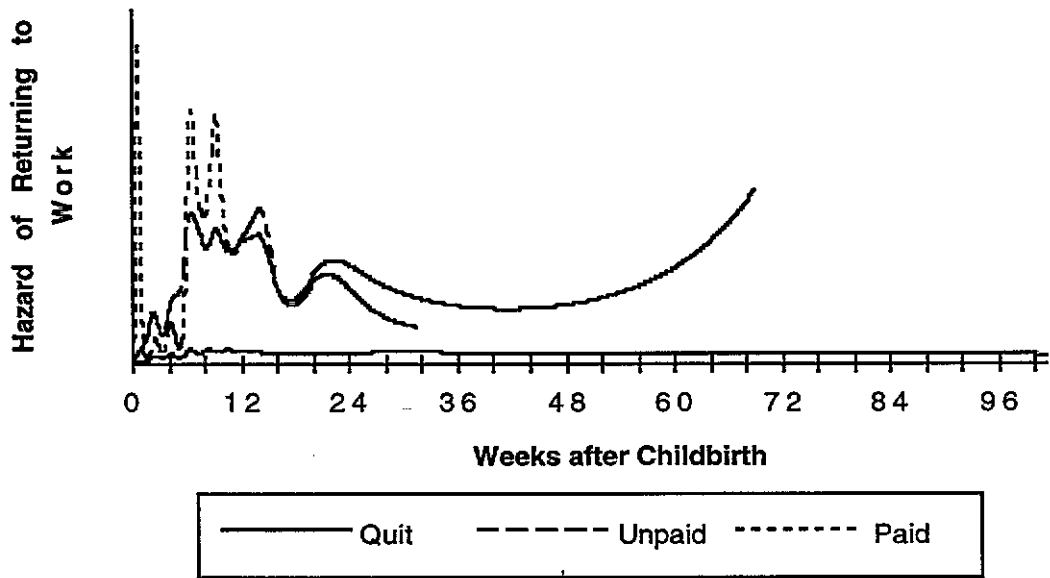| Type of Leave When Began	Never	Quit Before	Quit At	Unpaid Before	Unpaid At	Paid Before	Paid At	Total Before	Total At
Short Leave	0%	0%	0%	0%	0%	4%	4%	4%	4%
Long Leave	17%	26%	1%	8%	6%	8%	4%	42%	10%
No Return	16%	7%	0%	0%	0%	0%	0%	7%	0%
Total	33%	33%	1%	8%	6%	11%	7%	52%	14%

Figure G.1 —Hazard for Returning to Work after Childbirth,
by Type of Leave (first two years, 104 weeks)

Table G.2

Leave Status in Selected Weeks of Pregnancy

Weeks	Never	Quit	Unpaid	Paid	Total
1	33%	0%	0%	0%	34%
13	33%	7%	0%	0%	40%
20	33%	10%	0%	0%	44%
26	33%	14%	1%	0%	47%
30	33%	16%	1%	1%	50%
32	33%	17%	2%	2%	52%
34	33%	19%	2%	3%	55%
35	33%	20%	3%	4%	56%
36	33%	21%	4%	5%	58%
37	33%	23%	5%	7%	61%
38	33%	24%	7%	9%	64%
39	33%	25%	8%	11%	66%

NOTE: Complement (i.e. 100%-Total) is women who are still working.
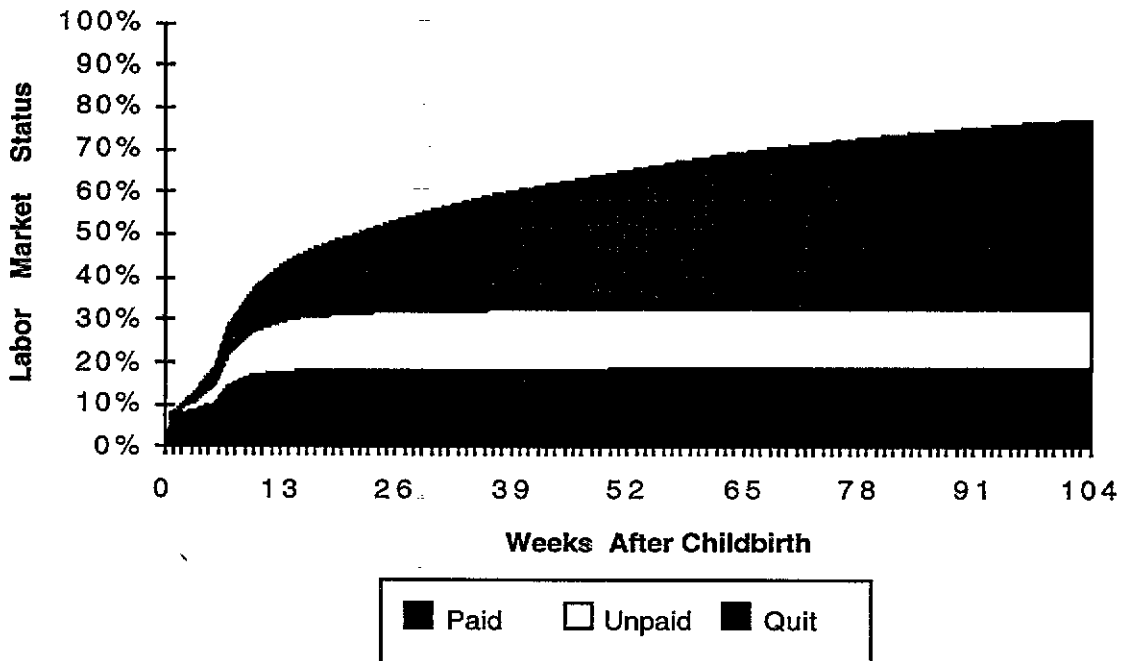
Figure G.2—Probability of Not Working by Weeks After Childbirth, stratified by Labor Market Status. Complement is women who have returned to work, Quit—quit pregnancy job, Unpaid-on unpaid leave, Paid-on

Table G.3

Leave Status After Childbirth, by Weeks After Childbirth

Weeks	Quit	Unpaid	Paid	Total
1	0%	0%	7%	7%
2	1%	1%	8%	9%
3	1%	2%	9%	11%
4	2%	3%	9%	13%
6	4%	5%	11%	19%
8	7%	9%	15%	30%
10	9%	10%	17%	36%
12	12%	11%	17%	40%
14	14%	12%	18%	43%
16	15%	13%	18%	46%
18	16%	13%	18%	47%
20	18%	13%	18%	49%
26	21%	14%	18%	53%
39	28%	14%	19%	60%
52	32%	14%	19%	65%
65	37%	14%	19%	69%
78	40%	14%	19%	73%
91	42%	14%	19%	75%
104	44%	14%	19%	77%

For a given leave type, Table G.4 reports the percentage of women who are at work by selected weeks after delivery. Note that here, quit includes women who never worked during pregnancy.

Table G.4

Percentage of Women who Have Returned to Work, by Leave Status

Weeks	Overall	All Women			Excluding Very Short Leaves		
		Quit	Unpaid	Paid	Quit	Unpaid	Paid
1	8%	0%	2%	41%			
2	10%	1%	7%	43%	1%	5%	3%
3	12%	2%	14%	45%	2%	12%	8%
4	14%	3%	19%	48%	3%	18%	13%
6	21%	6%	39%	58%	6%	38%	30%
8	31%	10%	61%	81%	10%	61%	68%
10	37%	14%	74%	91%	14%	73%	84%
12	41%	18%	81%	93%	17%	81%	89%
14	44%	20%	87%	95%	20%	86%	92%
16	46%	23%	90%	96%	22%	90%	94%
18	48%	25%	91%	97%	24%	91%	95%
20	49%	26%	93%	97%	26%	93%	95%
26	53%	31%	96%	98%	31%	96%	97%
39	60%	41%	98%	99%	41%	98%	98%
52	65%	48%	99%	99%	48%	99%	99%
65	69%	54%	100%	100%	54%	100%	100%
78	72%	59%	100%	100%	59%	100%	100%
91	75%	63%	100%	100%	63%	100%	100%
104	77%	66%	100%	100%	66%	100%	100%

NOTE: Very Short Leaves are less than a week (the first row of the middle panel).
Quit includes women who never worked during childbirth.

Table G.5
Share of Leave Types in Selected Weeks of Pregnancy

Weeks	Quit	Unpaid	Paid
1	94%	1%	4%
13	95%	4%	1%
20	94%	5%	1%
26	78%	12%	11%
30	56%	17%	27%
32	50%	18%	32%
34	45%	20%	35%
35	39%	25%	36%
36	34%	30%	36%
37	33%	28%	39%
38	28%	28%	45%
39	22%	30%	48%

Table G.6
Share of Leave Types in Selected Weeks after Childbirth

Weeks	Quit	Unpaid	Paid
1	4%	6%	90%
2	29%	54%	17%
3	42%	38%	21%
4	38%	34%	28%
6	25%	36%	39%
8	38%	32%	30%
10	51%	29%	21%
12	60%	27%	13%
14	62%	25%	13%
16	77%	16%	7%
18	82%	14%	5%
20	80%	15%	5%
26	90%	7%	2%
39	95%	3%	2%
52	94%	2%	4%
65	98%	3%	0%
78	100%	0%	0%
91	100%	0%	0%
104	100%	0%	0%

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