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THE EFFECTS OF THE 1978 PREGNANCY DISCRIMINATION ACT ON FEMALE LABOR SUPPLY*

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This article analyzes the effects of the 1978 Pregnancy Discrimination Act (PDA) on the labor force participation rates of married women by estimating a dynamic model of labor force participation. Results show that the PDA increased the labor force participation rate of pregnant women by 8.2 percentage points, of women with a child less than one year old by 3.4 percentage points, and of women with older children by 1.5 percentage points. Counterfactual policy simulations show that the provision of unpaid leave will increase the labor force participation rate of women with older children by an additional 3.7 percentage points.

1. INTRODUCTION

Maternity leave policies vary widely throughout the world. In general, these policies are more generous in Europe than in the United States. These policies may have a substantial effect on the participation of women in the labor force (Klerman and Leibowitz, 1997; Waldfogel, 1998; Baker and Milligan, 2008). This article explores the effect of the 1978 Pregnancy Discrimination Act (PDA), a policy change that affected the ability of women to remain in the workforce during the period surrounding childbirth, by developing and structurally estimating a dynamic model of the participation of women in the labor force. Simulations based on the estimated model show that the PDA increased the labor force participation rate of pregnant women by 8.2 percentage points, of women with a child under the age of one by 3.4 percentage points, and of women with older children (between one and six years old) by 1.5 percentage points.

The labor force participation rate of married women increased substantially during the second half of the last century, with a particularly striking increase among women with very young children. As Table 1 shows, from 1960 to 2000, the labor force participation rates for married women increased from 30.5% to 61.6%, whereas the rate for married women with children under the age of six increased from 18.6% to 61.8%. The participation rate for women with a child under the age of one increased from approximately 31% in 1975 to approximately 55% by 2000.[2] Table 2 shows an even more dramatic increase in participation rates for women aged 16–44 during the period surrounding the first birth over the period from 1960 to 1995.[3] The first column shows the percentage of women who had ever worked six or more months continuously at any time prior to the first birth. During this period, the participation rate prior to the first birth increased by six percentage points. In contrast, the participation six months (one year) after the birth rose by 35 (37) percentage points, with most of the changes occurring between 1971–75 and 1981–85.

Many explanations have been proposed in the literature to account for the overall increase in the participation of married women. These explanations include increasing real wages for

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[2] U.S. Bureau of Labor Statistics, Bulletin 2307.

[3] Current Population Report, Smith et al. (2001).

TABLE 1
LABOR FORCE PARTICIPATION RATES OF WOMEN IN LAST FOUR DECADES

			Married With Child Less Than	
Year	Single Women	Married Women	Six Years Old	One Year Old
1960	44.1	30.5	18.6	–
1970	53	40.8	30.3	–
1975	57	44.4	36.7	31
1980	61.5	50.1	45.1	38
1985	65.2	54.2	53.4	48.8
1990	66.4	58.2	58.9	52.8
2000	68.1	61.6	61.8	55.2

SOURCE: U.S. Bureau of Labor Statistics, Bulletin 2307.

TABLE 2
PARTICIPATION RATES OF 25–44-YEAR-OLD WOMEN AROUND FIRST BIRTH

Year	No Children	Six Months After Childbirth	Six Years After Childbirth
1966–70	66.4	18.3	23.9
1971–75	68.9	21.9	27.9
1976–80	73.1	32.2	38.8
1981–85	73.4	48.3	56.3
1986–90	75.5	52.3	60.8
1991–95	73.8	52.9	60.1

SOURCE: Current Population Report, Smith et al. (2001).

women (Smith and Ward, 1985), increasing divorce rates (Johnson and Skinner, 1986), increasing returns to experience (Blau and Kahn, 1997), a decreasing gender wage gap (O'Neill and Polachek, 1993; Jones et al., 2003), delayed marriage and childbearing (Goldin and Katz, 2002), a shift in employment toward sectors that are skill and female intensive (Murphy and Welch, 1991), and the introduction of labor-saving devices in home production (Greenwood et al., 2002). Lee and Wolpin (2009) evaluate several explanations for the increased participation of women in the labor force. They report that both demand and supply side factors were important in accounting for the increase in participation of women in the labor force.

However, none of these papers account for the much larger increase in labor force participation among women with young children. Leibowitz and Klerman (1995) argue that changes in demographic characteristics and earnings can partially explain the increased participation of married women with children. Olivetti (2001) argues that there has been an increase in wage return to work experience for women, which makes withdrawal from the labor force in the period surrounding childbirth more costly. Attanasio et al. (2004) evaluate several other possible explanations, including a reduction in child care costs and increased uncertainty regarding the earnings of women's husbands.

This article argues that the literature has largely overlooked the effects of the PDA on the labor force participation rate of women, particularly those with young children. In 1978, Congress passed the PDA, which amended Title VII of the Civil Rights Act of 1964. The 1978 PDA reversed a number of Supreme Court decisions on the issue (such as Geduldig v. Aiello, 1974; GE Co v. Gilbert, 1976); in these decisions the Supreme Court had ruled that the exclusion of pregnancy from the list of compensable disabilities was constitutional. Although the PDA did not mandate any statutory leave, it required employers to treat a pregnancy as a temporary disability. Among other changes, employers were required to allow pregnant women to work as long as they were able to perform their tasks or to provide them with modified tasks. Employers were also required to hold the jobs open for the same length of time as they would for any other sick or disabled employee. The following quote from Edwards (1996) suggests that the PDA has been an effective piece of legislation: “Surprisingly, once the Gilbert decision was essentially reversed with the 1978 Pregnancy Discrimination Act, no more sick-leave cases appear in the record of appeals cases. This most likely suggests that employers were allowing employees to at least use the sick-leave already accrued rather than face the ‘perplexing legal questions’.”

Gruber (1994) provided the only other analysis of the PDA. He focused primarily on health insurance and sought to determine whether employers were passing on the increased costs of health insurance to the employees; but he also considered the effects of the PDA on employment. Taking all married women between the ages of 20 and 40 as the treatment group and using data two years before and after the PDA to estimate the effects, Gruber did not find any significant effect on employment in the probit estimation. Gruber’s result may have arisen because the PDA did not immediately affect all women; rather, it only affected pregnant women and women with very young children.

The behavioral model builds on previous dynamic models of labor force participation that incorporate human capital accumulation (Weiss, 1972; Heckman, 1976; Weiss and Gronau, 1981; Eckstein and Wolpin, 1989). The basic feature of these models is that current participation affects future wages through increased work experience and, thus, future participation. In the model, women are assumed to receive a new wage offer every period (calendar quarter). Upon receiving an offer, a woman decides whether to accept or to reject the wage offer. If she accepts the offer, she is employed at that wage. If she rejects the offer, she is not employed for that period. Women who did not work in period $t-1$ but choose to work in period t incur a reentry cost. The PDA is modeled as an unanticipated permanent change to the cost of supplying labor. Prior to the enactment of the PDA, a woman who did not work during the period surrounding childbirth had no guarantee of being rehired after childbirth. Given the relatively high utility cost of supplying labor during the period surrounding childbirth, working is a less attractive option. If a woman ceased working and was not rehired, she would have to incur the reentry costs associated with a new job. After the enactment of the PDA, the provision of performing modified tasks and the option of taking a leave (as long as her company’s policy allowed leave for other health conditions, her employer was required to hold her job open for the same length of time) and then returning to the previous job, in effect, lowered the cost of maintaining a job and enabled women to remain attached to their jobs during the period surrounding childbirth. In the model the effect of the PDA is captured by changes in the utility cost of supplying labor during the period surrounding childbirth. This approach is implemented because the PDA did not specify any statutory leave amount; hence the benefits available to a woman depended on the policy of her employer, and such data are not available.[4] When women remained attached to their jobs, they did not incur the reentry costs. It also resulted in higher levels of work experience and no depreciation of skills; thus, although the PDA lowered the cost of supplying labor only during the period surrounding childbirth, the law increased participation during the period surrounding childbirth and increased overall participation later.

The empirical analysis is based on data from young womens in their cohort of the National Longitudinal Survey who were between the ages of 14 and 24 in 1968. This data set is particularly useful for identifying the effects of the PDA because the working and reproductive lives of these women span the period before and after the legislation. The model is estimated using simulated maximum likelihood on data for married white women. The fit of the model is assessed using within-sample fit criteria and out-of-sample validation. The model captures the changing pattern of labor force participation within the sample. The women respondents to the National Longitudinal Survey, 1979 cohort (NLSY79) were used to conduct the out-of-sample validation of the model. The model is shown to accurately predict the labor force participation rates for the NLSY79 cohort of women.

[4] In the NLS data it is not possible to distinguish whether an individual was actually working or held a job while on temporary leave except during the survey week. So when estimating the model, all women with jobs (whether or not they are currently working) are regarded as employed.

The estimated model was used to assess the effects of the PDA on the labor force participation rate of women. By simulating decisions during the life cycle with and without the PDA, one can directly evaluate the cumulative effects of the PDA on pregnant women, women with very young children (less than one year old), and women with relatively older children (one to six years old). Simulations show that the PDA increased the labor force participation rate of pregnant women by 8.2 percentage points, women with a child under the age of one by 3.3 percentage points, and women with older children (between one and six years old) by 1.5 percentage points.

The estimated model was also used to evaluate the effects of alternative forms of maternity leave and benefit legislation found in other countries. The maternity benefits legislations in various countries differ immensely in terms of maternity leave and monetary benefits. Simulations based on the estimated model show that the provision of unpaid maternity leave[5] (up to a year after childbirth) with a guarantee that women can return to their jobs reduces participation immediately surrounding childbirth. This policy would reduce the labor force participation rate by about 18 percentage points in the quarter following a childbirth. This result is consistent with the results obtained by Baker and Milligan (2008), who report that relatively long maternity leave entitlements (i.e., more than a quarter) lead to mothers spending more time at home immediately after childbirth. However, this reduction in labor force participation rate is temporary. Model simulations also show that unpaid leave increases participation of women with children between one and six years old by an additional 3.7 percentage points. Thus, the provision of unpaid maternity leave increases long-term labor force participation rates of women with children.[6] Providing monetary benefit (in addition to unpaid leave) is shown to have an even larger negative impact on participation during the paid leave period. Again, this negative effect is temporary, as labor force participation rates return to higher levels once the leave period is exhausted.

2. THE LAW

Beginning in the early 1970s, a large number of pregnancy discrimination cases were brought before the judiciary. These cases can be divided into five major categories: forced leave, discharge, seniority/rehire, benefits, and hire/promotion (Edwards, 1996). In Geduldig v. Aiello (1974) and again in GE Co v. Gilbert (1976) the Supreme Court ruled that the exclusion of pregnancy from the list of compensable disabilities did not violate Title VII of the U.S. constitution.

The PDA of 1978 reversed the General Electric Co. v. Gilbert (1976) Supreme Court decision. Congress enacted the PDA as an amendment to the Civil Rights Act of 1964. Some of the primary features of this act, as described by Edwards (1996), are presented below. See Edwards (1996) for more details. An employer may not distinguish pregnancy-related conditions for special procedures to determine an employee's ability to work. If an employee is temporarily unable to perform her job due to pregnancy, the employer must treat her in the same way as any other temporarily disabled employee would be treated; for example, the employer must provide modified tasks, alternative assignments, disability leave, or leave without pay. Pregnant employees must be permitted to work as long as they are able to perform their jobs. If an employee has been absent from work as a result of a pregnancy-related condition and subsequently recovers from this condition, her employer must not require her to remain on leave until the baby's birth. An employer may not have a rule that prohibits an employee from returning to work for a predetermined length of time after childbirth. Employers must hold open a job for a pregnancy-related absence for the same length of time that a job is held open for employees on sick or disability leave.

[5] Note that this policy is different from the PDA because the PDA did not specify any statutory leave amount; hence the benefits available to a woman depended on the policy of her employer.

[6] Baker and Milligan (2008) do not analyze the longer term impact of maternity leave policies.

3. THE MODEL

This section presents a dynamic stochastic model of labor force participation for married women. Each woman has a decision horizon that begins at the age of marriage and ends at age 60. In each quarter, each woman chooses whether to work (W) or not work (NW). A birth may occur at any period during the fertile period, which is assumed to end at age 40. It is assumed that fertility follows a given exogenous process to be estimated from the data. At each age, the objective of a woman is to maximize the expected present value of remaining lifetime utility.

To allow for the possibility that unobservable factors may affect fertility and labor force participation rates, unobserved heterogeneity was incorporated in the form of discrete unobserved types (e.g., Heckman and Singer, 1984). The probability of a woman being assigned to a particular type depends on her education and the age of marriage. These variables constitute the initial conditions in the model. The current period's alternative-specific utility function $\left(U^i_{ak}\right)$ associated with a person of age a and type k is

$$(1)\quad \begin{aligned} U^W_{ak} &= (1+\alpha_1)C_a + (\alpha_2 K_{a-1} + \alpha_3 K^2_{a-1}) + \mu_k(1+\alpha_{6k}n_a + \alpha_{7k}n_a^2) \\ &\quad + \mu_k\left[\gamma^0_j 1\,(\mathrm{PDA}=0)\,1(S_a = j|1 \le j \le 7) + \gamma^1_j 1\,(\mathrm{PDA}=1)\,1(S_a = j|1 \le j \le 7)\right] \\ &\quad + \mu_k(\alpha_8\,(n_a+1) + \alpha_9(n_a+1)^2)\,(1-p_{a-1})] + (\alpha_4 a + \alpha_5 a^2)n_a \qquad k = 1, 2, 3 \end{aligned}$$

$$(2)\qquad U^{NW}_{ak} = C_a,$$

where C_a is the goods consumption at age a. α_1 captures the effect of work on the utility from consumption. If $\alpha_1 < 0$, then working reduces the utility from consumption. α_2 and α_3 capture the effect of work experience (K_a) on utility. Note that the utility is not separable across periods as long as either $\alpha_2 \neq 0$ or $\alpha_3 \neq 0$.

The parameter μ_k is the utility cost of supplying labor or the value of leisure for a woman who does not have any children and is not pregnant at age a. This parameter may vary according to unobserved types (denoted by the k subscript). n_a, the number of children in the household, can take integer values between zero and four (if more than four children are observed in the data, then they are recoded as four). The value of leisure depends on the number of children (α_{6k} and α_{7k} capture these changes). The model assumes that the change in the value of leisure due to the presence of children is proportional to the baseline value of leisure μ_k.

The presence of very young children (less than one year old) or being pregnant further affects the value of leisure. S_a represents the pregnancy trimester or the age of the youngest child in quarters. $S_a = 0$ represents women who do not have any children and are not pregnant. Thus based on Equation (1), the value of leisure when $S_a = 0$ is μ_k. $S_a = 1$ indicates the first trimester of pregnancy; $S_a = 2$ indicates the second trimester of pregnancy; $S_a = 3$ indicates the third trimester of pregnancy; $S_a = 4$ indicates the youngest child's birth quarter (i.e., the child's age is zero quarters); $S_a = 5$ represents a child's age is one quarter; $S_a = 6$ represents a child's age is two quarters; $S_a = 7$ represents a child's age is three quarters; and $S_a = 8$ represents a child over the age of one.[7] $1(\mathrm{PDA} = 0)$ is an indicator function that takes the value of one prior to the enactment of the PDA (before 1978). $\gamma^0_j\mu_k$ ($\gamma^1_j\mu_k$) is the additional disutility of supplying labor when $S_a = j$ before (after) the 1978 PDA was enacted. The effect of the PDA is captured by changes in the utility cost of supplying labor in the periods surrounding childbirth. This approach is implemented because the PDA did not specify any statutory leave amount; hence, the benefits available to a woman depended on the policy of her employer, and such data are not available. In fact, in the NLS data, it is not possible to distinguish whether a woman was actually working or was holding a job while on temporary leave, except during the survey week.

[7] The model already contains the quarterly age and quarterly experience of mothers in the state space. Incorporating the age of the children into the state space would be computationally very burdensome.

Thus, when estimating the model, all women with jobs (whether currently working or not) are regarded as employed, and the effect of the PDA is captured by estimating the differences in the utility cost of supplying labor during the period surrounding childbirth.

Thus, based on Equation (1) the value of leisure for a woman of type k who is in the first trimester of her first pregnancy (i.e., she does not have any children yet) in the pre-PDA period is $\left(1+\gamma_1^0\right)\mu_k$. Similarly, the value of leisure for a woman who is in the first trimester of her third pregnancy (i.e., she already has two children) in the pre-PDA period is $\left(1+2\alpha_6+4\alpha_7+\gamma_1^0\right)\mu_k$. Changes in the value of leisure due to pregnancy and/or children are assumed to be proportional to the baseline value of leisure. This approach ensures that the number of parameters remains manageable without assuming that these costs are identical for all types.

It is assumed that women who were not employed during the previous period ($p_{a-1}=0$) but are working in the current period incurred a reentry cost. This cost is ex post because only the women who were not employed in period $t-1$ but were employed in period t incurred the cost. This cost is a quadratic function of the number of children. These costs are also proportional to the baseline disutility from work (μ_k). Thus, based on Equation (1) the reentry cost incurred by women who are type k and who do not have children is $(\alpha_8+\alpha_9)\mu_k$, and the cost for a woman with one child is $(2\alpha_8+4\alpha_9)\mu_k$. The disutility from work can also vary by age (α_4 and α_5 capture these changes).

The birth of a child is assumed to follow an exogenous stochastic process, which depends on the characteristics of each woman, such as age, age squared, and on the number of children she already has. In each period in which a woman is not pregnant, there is a probability that she will become pregnant during the subsequent period.[8] This process continues for the entire fertile period (up to quarterly age 160). The probability that a woman of type k will become pregnant at age a is as follows:

(3)
$$P_{ak}\left(S_{a+1}=1|S_a=0 \text{or} S_a\geq 4\right)=\frac{\exp(\pi_{1k}+\pi_2 a+\pi_3 a^2+\pi_4 n_a+\pi_5 n_a^2)}{1+\exp(\pi_{1k}+\pi_2 a+\pi_3 a^2+\pi_4 n_a+\pi_5 n_a^2)} \quad \text{for } k=1,2,3.$$

Pregnancy results in a childbirth in the following way:

$$P(S_{a+1}=j|S_a=j-1)=1 \qquad \text{for } j=2,3,4. \tag{4}$$

The household budget constraint is given by the following:

$$y_a^h+y_a^w p_a=C_a, \tag{5}$$

where y_a^h is the husband's earnings and y_a^w is the wife's earnings.

The wife's earnings are endogenous and stochastic. Education does not explicitly affect wages, but the effect of education will be captured by the constant in the wage equation; this constant varies across unobserved types. Because the model begins after the women have already completed their education (i.e., education is an initial condition that does not vary for any given individual), this approach is a parsimonious way of modeling the effect of education. Wages depend on experience, age, and lagged employment. Including lagged employment status in the wage equation captures skill depreciation that results from not working during the previous period. The wage function for an individual of type k is as follows:

$$\ln y_{ak}^w=\beta_{1k}+\beta_2 K_{a-1}+\beta_3 K_{a-1}^2+\beta_4 a+\beta_5 a^2+\beta_6 p_{a-1}+\varepsilon_a^w, \tag{6}$$

[8] We do not consider abortions or miscarriages because the data pertaining to such events are not available. Such events may not be very important in this context because we restrict our sample to married white women who are more than 18 years old. Moreover, most abortions and miscarriages occur during the first trimester.

where K_{a-1} is a woman's total work experience at age a and ε_a^w has a zero mean and finite variance and is serially uncorrelated. Work experience evolves according to the following:

$$K_a = K_{a-1} + p_a. \tag{7}$$

A woman's husband's income is stochastic and given by the following:

$$y_{ak}^h = \phi_{1k} + \phi_2 a + \phi_3 a^2 + \varepsilon_a^h. \tag{8}$$

The model assumes that a wife can forecast the deterministic portion of her husband's future earnings based on the observable characteristics of the wife. This assumption reflects the hypothesis that women tend to marry men with similar observable characteristics (Van der Klaauw, 1996). The addition of the characteristics of the husbands would increase the state space and render the model more computationally burdensome. The two wage shocks $(\varepsilon_a^w, \varepsilon_a^h)$ are assumed to be jointly normal, $N(0, \sum)$, and serially uncorrelated.

The maximized present discounted value of lifetime utility at age a, the value function, is given by

$$V(\Omega(a), a) = \max_{p_a \in \{0,1\}} E\left\{\sum_{\tau=a}^{A} \beta^{\tau-a} U_a^j | \Omega(a)\right\},$$

where U_a^j is the maximum among the alternatives available to an individual at age t. A is the terminal age of the model and is assumed to be age 60 (240 quarters). The expectation is taken over the distribution of wage shocks.

4. MODEL SOLUTION AND ESTIMATION

The value function can be written as the maximum among the alternative-specific value functions, $V^j(\Omega(a), a)$, for $j \in \{0, 1\}$ that satisfies the Bellman equation:

$$\begin{aligned} V(\Omega(a), a) &= \max_{j \in \{0,1\}} [V^j(\Omega(a), a)] \\ V^j(\Omega(a), a) &= U^j(a, \Omega(a)) + \beta E(V(\Omega(a+1), a+1 | p_a = j, \Omega(a)) \text{ for } a < A, \\ &= U^j(A, \Omega(A)) \quad \text{for } a = A. \end{aligned}$$

The optimization problem does not have an analytical solution; thus, the model is solved numerically. The solution consists of values of $E(V(\Omega(a+1), a+1 | p_a = j, \Omega(a))$ for all j and elements of $\Omega(a)$. The solution is obtained through the use of backward recursion beginning with the last period, A. Monte Carlo integration was used to calculate the expected value of the maximum of the alternative-specific value functions at each state point.[9]

In the solution to the model, it is assumed that the PDA was an unexpected and permanent shock. In the numerical solution, this assumption is implemented in the following way: For a woman who was married before 1978 (the year of the PDA enactment), her value functions for the period before 1978 were calculated as if the pre-law regime would endure indefinitely. However, for the period after 1978 her value functions were calculated with the changed set of parameters assuming that the new regime would endure indefinitely.

The choices the women have made, the associated state variables, and the accepted wages for the women who chose to work during a particular period are observed in the data. Given the data, the solution to the optimization problem serves as an input in calculating the likelihood function. It is assumed that each woman is solving the decision problem described above. The

[9] Fifty draws were used for the numerical integrations. Likelihood was calculated with 1,000 simulations.

probability that a woman would make a particular choice at a particular age is the probability that the value function associated with that choice is the maximum of the two choice-specific value functions for that period. Let O_{ia} represent the outcomes (work choices, observed wages) of individual i and age a. In addition, let I_i denote the set of initial conditions for this individual (age at marriage, education). The contribution to the likelihood of individual i is given by the following:

$$L_i(\Theta) = \sum_{k=1}^{K} \Pr\left(O_{iA_0}, O_{iA_0+1}, \ldots, O_{ia}; \xi_k = 1, I_i\right) \Pr\left(\xi_k = 1 | I_i\right), \tag{9}$$

where $\Pr(\xi_k = 1|I_i)$ denotes the type probability that depends on initial conditions. The unobserved type is assumed to be known to the individual but not to the econometrician; the outside summation integrates over the type probabilities. The likelihood can be written as the product of the age-specific choice probabilities:

$$L_i = \sum_{k=1}^{K} \Pi_{a=A_0}^{A} \Pr(O_{ia}|O_{ia-1}, \ldots, O_{ia_0}; \xi_k = 1, I_i) \Pr(\xi_k = 1|I_i). \tag{10}$$

To illustrate the calculation of the likelihood, suppose that the jth alternative chosen by individual i is to work; thus, the wage is observed at age a. The probability of observing this choice and wage outcome conditional on the state space (which includes $O_{ia-1}, \ldots, O_{ia_0}$, I, and *type*) is as follows:

$$\begin{aligned}
&\Pr(O_{ia}|O_{ia-1}, \ldots, O_{ia_0}; \xi_k = 1, I_i) = \Pr(p_a = 1, y_a^w, y_a^h|\Omega(a), \xi_k = 1, I_i) \\
&\quad = \Pr(p_a = 1|y_a^w, y_a^h, \Omega(a), I_i) f_w(y_a^w|\Omega(a), \xi_k = 1, I_i) f_h(y_a^h|\Omega(a), \xi_k = 1, I_i),
\end{aligned}$$

where $f_w(y_a^w|\Omega(a), \xi_k = 1, I_i)$ is the wife's wage density and $f_h(y_a^h|\Omega(a), \xi_k = 1, I_i)$ is husband's wage density.

The overall likelihood for $i = 1 \ldots N$ individuals is the product of the individual likelihoods:

$$L = \Pi_{i=1}^{N} L_i.$$

The presence of wage outliers may influence the parameter estimates. To account for outliers, it is assumed that wages are measured with error. In particular, for an individual of type k,

$$\ln y_{ak}^w = \beta_{1k} + \beta_2 K_{a-1} + \beta_3 K_{a-1}^2 + \beta_4 a + \beta_5 a^2 + \beta_{6k} p_{a-1} + \varepsilon_a^w + u_a^w, \tag{11}$$

where $u_a^w \sim N(0, \sigma_u^2)$ is serially uncorrelated and uncorrelated with ε_a^w and ε_a^h for all a. The parameter σ_u^2 will be estimated in addition to the other structural parameters.

It is assumed that type depends on age at marriage and education (the initial conditions, denoted as I_i) in the following way:

$$P(type = k|I_i) = \frac{\exp(I_i'\tau)}{1 + \exp(I_i'\tau)}.$$

The choice of parameters that may vary across the unobserved types is fairly subjective. The trade-off here again is flexibility versus number of parameters. μ (the disutility of labor), β_1 (the constant in the wife's wage function), ϕ_1 (the constant in the husband's wage function), and π_1 (the constant in the probability of the child arrival process) are allowed to vary across the unobserved types. To achieve parsimony without sacrificing flexibility, other cost parameters associated with labor supply (e.g., the extra cost of labor during pregnancy) are measured as a fraction of μ (the disutility of labor). Hence they also (implicitly) vary across types.

The model parameters enter the likelihood function[10] through the choice probabilities that are computed from the solution of the dynamic programming problem. Subsets of parameters also enter through the wage offer function. The maximization of the likelihood function iterates between solving the dynamic program and calculating the likelihood.[11]

4.1. *Identification.* The wage parameters are identified based on the data pertaining to participation and wages. The identification of the parameters pertaining to the changes in the value of leisure surrounding the birth of a child results from the differences in the participation behavior of women in different phases of life (S_a). In the data women with different values of S_a are observed both before and after the 1978 PDA. For example, the difference in participation behavior between women with $S_a = 0$ (women who do not have children and are not yet pregnant) and $S_a = 1$ (women in the first quarter of pregnancy) before the 1978 PDA identifies γ_1^0. Note that the model assumes that the parameter γ_1^0 (as well as other γs) does not depend on the number of children. Thus, γ_1^0 can also be identified on the basis of the difference in participation behavior between women with $S_a = 8$ (women with a child over the age of one) and $S_a = 1$ before the 1978 PDA. Similarly, the difference in participation behavior between women with $S_a = 0$ and $S_a = 1$ after the 1978 PDA identifies γ_1^1. All other γs are identified by the same argument. One implicit assumption that is necessary to identify γs is the absence of an independent time effect. The model specification allows for a significant amount of flexibility; for example, it allows for age effects (which cannot be distinguished from calendar time effects since there is only one cohort) and unobserved types that depend on the initial state vector.

5. DATA AND DESCRIPTIVE STATISTICS

The data used in the estimation were obtained from the young women's cohort of the National Longitudinal Survey covering the period from 1968 to 1991. The original sample consists of 5,159 women who were between the ages of 14 and 24 in 1968, when the first survey was conducted. These women were interviewed 16 times between 1968 and 1991. The sample used in the estimation consists of white women whose spouses were always present during the sample period. The data pertaining to the women who later divorced their spouses were truncated three years before the reported divorce. For example, if a woman was married in 1973 and then reported being divorced in 1988, then her data for the period from 1973 to 1985 were used in the estimation. The sample is further restricted to include only women for whom at least two consecutive years (or eight consecutive quarters) of data are available.

NLS interviews were conducted in one- or two-year intervals and once after three years. In the model, a period is defined as one quarter. The model has been estimated using quarterly data for two primary reasons. First, there is considerable variation in the quarterly employment rates of women during the period surrounding childbirth, and one of the goals of this article is to capture this quarterly variation in employment rates. Second, the estimated model is used to evaluate the effect of more generous maternity benefit policies. Most of these policies provide women with one or two quarters of paid leave and up to six quarters of unpaid leave. Hence, to evaluate such policies, the model must be estimated on the basis of quarterly data.

A quarterly data set was constructed from the NLS data set for all of the relevant state variables. For all of the interviews, except for the interviews in 1975 and 1977, the women were asked to describe their work history since the time of their previous interview and to indicate the starting and termination dates of the various jobs they held during the intervening period.

[10] The kernel smoothed frequency simulator (McFadden, 1989) is used to estimate the probability $\Pr(O_{it}|O_{it-1},\ldots,O_{it_0};\mu_k = 1)$. The value of the smoothing parameter is set at five.

[11] Standard errors are computed using the outer product approximation to the Hessian with numerical first derivatives.

TABLE 3
SUMMARY STATISTICS

Variable	Mean/Percent
Age (in years)	31.3
Age at marriage (in years)	22.7
Experience (in quarters)	32.1
Wife's quarterly wage	3016.8
Husband's quarterly wage	5753.0
Percentage of women with less than high school	4.9
High school degree	43.7
Some college	21.8
College degree	29.6
Labor force participation rate	0.55
Number of births per woman	1.6
Person-quarter observations	49,327

Therefore, it is possible to construct a quarterly work history using the relevant questions. However, for the interview years of 1975 and 1977, some questions were asked only for a period of 12 months preceding the interview date (such as concerning the number of weeks worked), whereas other questions (such as regarding the starting and stopping dates of current or most recent job) refer back to the previous interview. By combining the information with some reasonable assumptions, it is possible to construct the employment history for the period. In the first interview in 1968, respondents were asked about their date of entry into the labor market and about any intermediate exits. This information was used to calculate the work experience of the women prior to the first interview.

A woman is assumed to be employed in a quarter if she worked in all three months of a particular quarter. This definition implies that women who worked only a few weeks within a quarter are classified as not employed. Part-time work is not explicitly modeled at the quarterly level because it is not possible to determine how many hours an individual worked in any particular quarter from the data.[12] However, although part-time work in terms of the hours worked per quarter is not explicitly modeled here, the model does allow for part-year work. Quarterly wages were constructed by dividing the annual earnings by the number of quarters worked. However, wage information is not available for all work periods. If the wage is not available for a particular period in which a woman was employed, then it is integrated out in the calculation of the likelihood.

Table 3 presents summary statistics of the variables used in the estimation process. The sample consists of 49,327 observations from 863 women. The average age during the sample period is approximately 31 years and average work experience is about eight years (32 quarters). The mean age of marriage for the women in the sample is slightly under 23. Among the women in the sample, 4.9% of the women do not have a high school degree, 43.7% are high school graduates, 21.8% have some college education, and 29.6% have a college degree. The overall labor force participation rate during the sample period is 55.0%. The average wage of women during the sample period was about \$3,017 per quarter[13] (in 1982 dollars) and the average wage of their husbands was \$5,793 per quarter. A total of 1,388 births are observed during the sample period, or approximately 1.6 births per woman.

[12] Even the determination of annual hours would require additional assumptions.

[13] Wage observations below \$500 per quarter, equivalent to approximately 150 hours of work per quarter at the 1982 minimum wage, were dropped (i.e., they were treated as missing observations).

TABLE 4
PARAMETER ESTIMATES

Parameter	Value (s.e.)	Parameter	Value (s.e.)
Utility Parameters		Wife's Wage Parameters	
μ_1(type=1)	−375.8 (23.2)	β_1(type=1)	6.2788 (0.026)
μ_1(type=2)	−1629.1 (37.9)	β_1(type=2)	7.4537 (0.079)
μ_1(type=3)	−2755.7 (134.8)	β_1(type=3)	7.8837 (0.023)
α_1	−0.0621 (0.0029)	β_2	0.005267 (0.00033)
α_2	−1.1583 (0.2983)	β_3	0.0000578 (4.78E-06)
α_3	0.01001 (0.0045)	β_4	0.001328 (0.00016)
α_4	1.048 (0.6655)	β_5	−0.00000329 (2.65E-06)
α_5	0.00547 (0.00786)	β_6(type=1)	−0.788 (0.484)
α_6(type=1)	0.0096 (0.098)	β_6(type=2)	−0.107 (0.062)
α_6(type=2)	0.1103 (0.0137)	β_6(type=3)	−0.671 (0.339)
α_6(type=3)	0.0814 (0.0087)	Husband's wage parameters	
α_7(type=1)	−0.0055 (0.0315)	φ_1(type=1)	8.003 (0.101)
α_7(type=2)	−0.0241 (0.0032)	φ_1(type=2)	7.871 (0.160)
α_7(type=3)	0.0173 (0.0030)	φ_1(type=3)	8.285 (0.357)
α_8	1.331 (0.065)	φ_2	0.01281 (0.00085)
α_9	−0.212 (0.026)	φ_3	−0.0000452 (0.000011)
Extra cost of labor supply parameters			
(Before the PDA)		(After the PDA)	
γ_1^0	0.079 (0.096)	γ_1^1	−0.017 (1.279)
γ_2^0	0.168 (1.599)	γ_2^1	0.056 (1.641)
γ_3^0	0.192 (1.488)	γ_3^1	0.019 (1.892)
γ_4^0	0.069 (1.305)	γ_4^1	0.135 (1.633)
γ_5^0	0.142 (0.998)	γ_5^1	0.239 (1.161)
γ_6^0	0.003 (1.069)	γ_6^1	0.009 (0.948)
γ_7^0	0.005 (1.053)	γ_7^1	0.004 (0.684)
Children arrival process		Variance parameters	
π_1(type=1)	−3.360 (2.097)	σ_ε^w	0.5772 (0.0339)
π_1(type=2)	−3.545 (1.740)	σ_ε^h	0.4510 (0.0651)
π_1(type=3)	−3.405 (1.094)	Cov(σ_ε^w,σ_ε^h)	−0.0001 (0.1502)
π_2	0.0449 (0.0103)	σ_u^w	0.4430 (0.3315)
π_3	−0.000784 (0.00051)		
π_4	0.0174 (2.030)		
π_5	−0.111 (0.676)		
Type probability parameters		Type probability parameters	
τ_{11}	−0.208 (11.13)	τ_{21}	−0.218 (14.42)
τ_{12}	0.755 (13.31)	τ_{22}	0.0093 (15.57)
τ_{13}	−0.137 (13.25)	τ_{23}	0.079 (4.41)
τ_{14}	0.003 (1.04)	τ_{24}	0.0096 (1.24)
	ln L=−21492.3		

NOTE: Numbers in parenthesis are standard errors.

6. RESULTS

The model described in Section 3 was estimated using the mechanism described in Section 4. The values of the parameters and their standard errors are presented in Table 4. The estimates imply that participation decreases utility ($\mu_1 < 0$). However, there is substantial heterogeneity across the various types. Type 3 values leisure the most and type 1 values leisure the least. This disutility is higher when children are present at home.

The estimates also show that there is an additional disutility of participation surrounding the time of birth of a child ($\gamma_j^0, \gamma_j^1 < 0; j = 1, 7$), except for γ_1^1, and show that the PDA made it easier for women to work during ($\gamma_j^0 < \gamma_j^1; j = 1, 3$) pregnancy. For example, before the enactment of the PDA, a woman working during the third trimester of her pregnancy incurred a 19% higher utility cost of participation compared to a woman who was not pregnant. After the enactment of the PDA, a woman in her third trimester of pregnancy incurs only a 2% higher utility cost.

TABLE 5
PREDICTED SELECTED CHARACTERISTICS BY UNOBSERVED TYPE

	Type 1	Type 2	Type 3
Labor force participation rate			
No children yet and not pregnant	44.3	86.8	84.4
During pregnancy	20.6	58.2	20.5
With child less than one year old	16	52.1	16.9
With one- and six-year-old child	21.1	78.2	21
Number of births per woman	1.82	1.61	1.77
Proportion	25.5	45.6	28.9

The size of the decline in the first two quarters of pregnancy is smaller but still substantial. However, there was no reduction in the utility cost during the post-childbirth period. The estimates indicate that the reentry cost for women who do not have any children is equivalent to the disutility of working for 1.3 months, whereas the reentry cost for women with two children is equivalent to the disutility of working for 2.1 months. Thus, it is more costly for women to return to the labor market following a childbirth. The discount factor is set at 0.95. There is considerable heterogeneity in the behavior across the various types. Table 5 shows that in our sample 25.5% of the women in the sample are classified as type 1, 45.6% are type 2, and 28.9% are type 3. Type 2 women have the highest overall labor force participation rate (86.9% for women without children) and type 1 has the lowest rate (44.3% for women without children). Type 1 women have the highest number of children (1.8 on average) and type 2 women have the smallest number of children (1.6 on average).

6.1. *Within-Sample Fit.* This section presents the evidence of the within-sample fit of the model.[14] Figure 1 compares the predicted employment rates to the actual employment rates according to the age of the women. As shown in Figure 1, in the actual life-cycle profile, the participation of married women in the labor force first increases with age, then flattens, and finally begins to increase again. The simulated data from the model replicate this pattern. Table A1 (in the Appendix) presents the results of the goodness-of-fit test. We cannot reject the model at conventional significance levels in 97 out of 108 quarters.

The simulated model accurately replicates the persistency observed in the data. The probability of a woman being employed in period $t+1$, if she is employed in period t, is 94.7% (96.2%) in the actual data (simulation). The probability of a woman not being employed in period $t+1$, if she is not employed in period t, is 97.7% (96.7%) in the actual data (simulation).

The model is also able to replicate the large difference in participation between the pre-PDA and post-PDA periods that we observe in the actual data during the period surrounding childbirth. Table 6 presents the actual and the simulated participation rates for the pre-PDA and post-PDA periods. Similar to the actual data, the pre- and post-PDA differences in the labor force participation rates during the period surrounding childbirth are greater than the differences in the participation rates of women without any children. The simulations under-predict the labor force participation rate for women who do not have any children and are not pregnant. The average participation rate for women who do not have any children and are not yet pregnant increased from 74.1% in the pre-PDA period to 82.9% in the post-PDA period (70.0% to 80.2% in the simulations). The participation rate for women in the first trimester of pregnancy increased from 34.4% to 49.5% (40.3% to 49.9% in the simulations), increased from 28.8% to 48.1% (31.2% to 46.4% in the simulations) in the second trimester of pregnancy, and increased from 26.2% to 43.3% (26.2% to 44.1% in the simulations) in the third trimester of pregnancy. The model also replicates the labor force participation rate after the birth of a

[14] Two hundred draws were used for numerical integrations, and the life-cycle profile of each woman was simulated 4,000 times. The results presented here are the averages from these simulations.

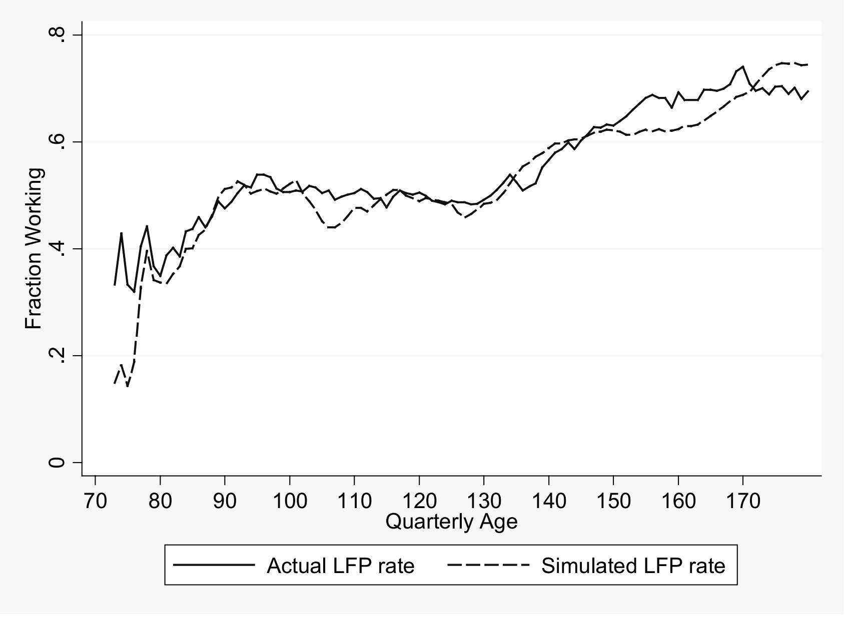

FIGURE 1

ACTUAL AND SIMULATED LABOR FORCE PARTICIPATION RATE

TABLE 6

MODEL FIT FOR PRE- AND POST-LAW PARTICIPATION RATES BEFORE, AROUND, AND AFTER CHILDBIRTH

	Data			Simulation		
	Before 1978	After 1978	Difference	Before 1978	After 1978	Difference
No children	74.1	82.9	12.5	70.1*	80.2*	12.1
Quarters before birth						
3	34.4	49.9	15.4	40.3*	49.9	14.1
2	28.8	48.1	18.7	31.2	46.4	17.5
1	26.2	43.3	16.6	28.9	44.1	14.8
Quarters after birth						
1	24.5	36.7	12	26.4	39.4	13.8
2	25.3	34.6	9.1	25	37.3	12.2
3	26.2	37.7	11.5	26.2	38.5	11.7
4	27.5	38.5	10.8	27.2	39.8	11.5
5–24	33.3	48.1	14.8	33.9	48.2	13.8

NOTES: *Actual mean is statistically different from simulated mean at 5%.
$\chi^2(0.05, 1) = 3.84$.

child. For example, the participation rate four quarters after a childbirth increased from 27.5% (27.2%) to 38.5% (39.8%) in the data (simulation). The higher participation precipitated by the reduction in the utility cost of supplying labor in the period surrounding childbirth leads to higher participation in women with older children. The last row of Table 6 shows that model accurately replicates the differences in the participation rates for women with children between one and six years old. For women in this group participation rates increased from 33.3% (33.9%) to 48.1% (48.2%) in the data (simulation). A goodness-of-fit test cannot reject the model at the 5% level of significance except for women who do not have any children and are not yet pregnant and for women in the first quarter of pregnancy in the pre-PDA period.

TABLE 7
ACTUAL AND SIMULATED (LOG) EARNINGS

Age	Data	Simulation
20–24	7.74	7.81
25–29	7.88	7.87
30–34	7.86	7.88
35–39	7.87	7.87
40–44	7.92	7.89

TABLE 8
OUT-OF-SAMPLE MODEL FIT FOR PRE- AND POST-LAW PARTICIPATION RATES BEFORE, AROUND, AND AFTER CHILDBIRTH FOR 1979 NLSY COHORT

	Actual Data	Simulation
No children and not pregnant	77.2	77
Quarters before birth		
3	60.1	53.8
2	58.9	49.7
1	56	46.4
Quarters after birth		
1	52	40.1
2	48.4	36.9
3	42.4	38.1
4	36.9	39.1
5–24	50.4	47.4

Table 7 presents the fit of the model with the earnings of women according to age groups. The log of quarterly earnings is relatively flat in the data, and the simulations replicate that pattern. In the simulations, age and experience effects cause earnings to increase with age, but the skill depreciation resulting from breaks in employment ensures that the earnings profile remains flat.

6.2. *Out-of-Sample Validation.* The female respondents to the National Longitudinal Survey, 1979, cohort (NLSY79) were used for the out-of-sample validation. These women were 14–22 years old in 1979 and were interviewed annually through 1994 and subsequently on a biennial basis. Our sample is limited to white, married women of this cohort. The NLSY79 data contain information regarding their education, age at marriage, and their work experience at the time of marriage. The life-cycle profiles of these women were simulated using these initial conditions. Because these women got married and had children only in the post-PDA period (the PDA was passed in 1978), their profiles are simulated with the post-PDA parameters. The data for the period ending in 1993 were used for this cohort to ensure that the ages of the respondents in this sample are comparable to the ages of the 1968 cohort during the pre-PDA period. Again, the life-cycle profile of each woman is simulated 4,000 times, and the results we report below are the averages from those simulations. Table 8 compares their actual participation rates to the simulated participation rates. The estimated model replicates the labor supply behavior of the 1979 cohort women even though their information was not used in the estimation process. The average participation rate for women who do not have a child is 77.2% (77.0%) in the data (simulation). However, compared to the data, the model predicts a lower participation rate for women during pregnancy and immediately after childbirth. The average participation rate for women in the first quarter of their pregnancy is 60.1% (53.8%) in the data (simulation) and labor force participation rate for women with a one-quarter-old child is 52.0% (40.1%) in the actual data (simulation). However, the simulated model is close to the data three quarters after childbirth (38.1% as compared to 42.4% in the actual data). For women who

TABLE 9
IMPACT OF THE 1978 PDA ON PARTICIPATION RATES

	Simulated Labor for Participation Rates (after 1978)	
	Without PDA	With PDA
No children and not pregnant	79.5	80.2
Quarters before birth		
3	43.4	49.9
2	37.1	46.4
1	35.2	44.1
Quarters after birth		
1	34.2	39.4
2	34.1	37.3
3	35.7	38.5
4	37.0	39.8
5–24	46.7	48.2

have children between the ages of one and six, the model predicts a participation rate of 47.4% as opposed to 50.4% in the data.

6.3. *The Effect of the 1978 PDA.* To determine the effect of the PDA, the estimated model was simulated under the assumption that PDA was never enacted (i.e., using the pre-PDA parameters). Table 9 shows the results. The first column shows the simulated average participation rates of the 1968 cohort only for the post-1978 period; these rates are based on the assumption that the PDA was not enacted. The second column shows the simulated average participation rates of the 1968 cohort (again only for the post-1978 period), but these are based on the assumption that the PDA was enacted.

Because the only difference is the change in the law, this change in the participation rate is solely the effect of the PDA. The PDA generates large differences in participation during the period surrounding birth and in the participation of women with children between the ages of one and six years. The effect of the PDA is relatively small for women who do not have any children. For this group, the PDA increased the participation rate by 0.7 percentage points (from 79.5% to 80.2%), whereas the effect on pregnant women is large (from 6.5 percentage points in the first trimester of pregnancy to 8.9 percentage points in the third trimester of pregnancy). The relatively small effect of the PDA on women without children and not pregnant is not surprising. The PDA affected these women only indirectly by changing their expectations of the cost of continuing to work during childbirth. However, the PDA directly reduced the cost of supplying labor for pregnant women and thus had a larger effect on this group. The effect of the PDA on women with very young children is also substantial. This effect ranges from 5.2 percentage points for women with one-quarter-old children to 1.8 percentage points for women with one-year-old children. For women with children between the ages of one and six years, participation increased by 1.5 percentage points as a result of the PDA.

The size of the effect of the PDA depends on the birth order. Birth order is important because the proportional decline in utility (as a proportion of the total utility cost) is highest for the women with least number of children. As Table 10 shows, the PDA increased the labor force participation rate during first pregnancy by 10.6%, but the law increased the labor force participation rate during pregnancy by 7.1% for women who already had at least one child. We find a similar pattern in the year following a childbirth. The rate increased by 4.1% following the birth of the first child and 3.0% following the birth of subsequent children.

6.4. *Comparison to Difference-in-Difference Analysis.* An alternative method of estimating the effect of the 1978 PDA is difference-in-difference analysis. Women who do not have

TABLE 10
IMPACT OF THE 1978 PDA ON PARTICIPATION RATES: BY BIRTH ORDER

	Simulated Labor for Participation Rates (after 1978)	
	Without PDA	With PDA
During pregnancy		
First pregnancy	57.2	67.8
Subsequent pregnancies	29.8	36.9
All pregnancies	38.4	46.6
After childbirth		
Year following the birth of first child	50.4	54.5
Year following the birth of subsequent child	27.7	30.7
Year following the birth of a child	35.3	38.7

children and are not pregnant can serve as a control group for pregnant women and for women with children. The underlying assumption is that pregnant women and women with children would be affected by the PDA, whereas women who do not have children and are not pregnant would not be affected by the law. Table 6 shows that the participation rate for the control group increased by 8.8%, whereas the participation rate of women in the third quarter of a pregnancy increased by 16.1%; this finding implies that the PDA increased the participation of women in the third quarter of their pregnancies by 7.3%. The increase in participation rate three quarters after a childbirth is 11.5%, which implies that the PDA increased the participation of women three quarters after childbirth by 2.7%. Difference-in-difference estimates also suggest that the PDA led to a 5.9% increase in participation for women whose youngest children are between one and six years old.

However, these aggregate comparisons ignore the fact that 58% of pre-PDA births are first births, but only 27% of the births in the post-PDA period are first births. It is important because the labor force participation rates are lower for women who already have children. To control for the number of children and differences in education, age, and experience, a difference-in-difference regression equation was estimated. In the regression we further control for year effects and allow for individual fixed effects.

If women who do not have children and are not pregnant (in the post-PDA period) increase their labor force participation because of the PDA,[15] then they do not represent a valid control group. In this case the difference-in-difference analysis would be biased. Furthermore, the difference-in-difference analysis assumes that experience is exogenous, but it is endogenous in the structural model. Nonetheless, the difference-in-difference regression estimates are presented in Table A2 (in the Appendix) for comparison purposes. The estimated effects of the PDA during the period surrounding a childbirth from the difference-in-difference regression do not differ substantially from the estimates implied by the structural model, but these effects are somewhat smaller than the effects implied by the structural model.

7. POLICY ANALYSIS

There is a significant amount of variation in maternity (parental) leave and monetary maternity benefit policies around the world. This section seeks to determine the effect on the labor force participation rates of women with young children if any of these policies were adopted in the United States.

[15] The behavioral model allows women who do not have children and are not pregnant to increase participation as a result of the PDA. In fact, as shown in Table 9, the PDA does increase the labor force participation rate for this group, although the size of the increase is rather modest.

TABLE 11
SIMULATED PARTICIPATION RATES FOR ALTERNATIVE MATERNITY LEAVE POLICIES

	Baseline (PDA)	PDA Plus Unpaid Leave	PDA Plus Unpaid Leave & No Skill Depreciation	PDA Plus Unpaid Leave & One Quarter Paid Leave	PDA plus Unpaid Leave & Two Quarters Paid Leave
No Children	80.2	80.2	80.2	80.2	80.2
Quarters before birth					
3	49.9	50.7	50.7	50.7	50.7
2	46.3	29.3	22.7	22.7	22.7
1	44	27.2	25.2	25.2	25.2
Quarters after birth					
1	39.3	21.4	21.2	3.3	5.0
2	37.2	20.4	19.9	19.9	5.1
3	38.5	28.8	25.7	25.7	25.7
4	39.7	50.6	51.9	51.9	51.9
5–24	48.2	51.9	52.2	52.2	52.1

7.1. *Unpaid Leave.* Column 2 of Table 11 shows the effects of unpaid maternity leave in addition to the PDA on employment. This policy grants a woman who was working in the quarter in which she became pregnant to take a leave period of up to four quarters after childbirth.[16] Having the option of taking leave and returning to work without incurring the reentry costs decreases participation surrounding childbirth. When a woman is on leave, that is considered as nonparticipation. The labor force participation rate in the third quarter of pregnancy decreases from 44.0% to 27.2% and the labor force participation rate two quarters after childbirth decreases from about 37.2% to 20.4% as new mothers take advantage of the leave availability. Thus the return-to-work guarantee causes the labor force participation rates surrounding childbirth to be even lower than what they would have been without the 1978 PDA. However, the labor force participation rate four quarters after childbirth increases from 39.7% to 50.6%. This sudden increase in participation after four quarters is due to the reentry cost that women incur when they return to work beyond this time. The option of returning to a previous job increases long-term participation. For example, the employment rate for women who have a child between one and six years old increases by an additional 3.7 percentage points (from 48.2% to 51.9%) beyond the post-PDA employment rate. Thus, the long-term effect of a return to work guarantee is substantially greater than the effect of the PDA (3.7 percentage points versus 1.5 percentage points).

Even when unpaid leave is granted, women experience lower wages due to skill depreciation ($\beta_6 < 0$), and lost experience (in addition to the forgone wages during the quarters in which they do not work). Some countries mandate that women are given their pre-pregnancy wage when they return to work following childbirth. In the model, previous earnings are not in the state space. This policy is implemented by assuming that the nonrandom component (which is a function of state variables) remains unchanged. Thus, the simulation assumes that women who take leave during the period surrounding a childbirth do not face a reduction in their wages due to skill depreciation (in addition to the unpaid leave policy outlined above). The results are presented in Column 3 of Table 11. This additional benefit further reduces the labor force participation rate during pregnancy, but the higher wage (compared with the PDA or a simple unpaid leave policy) at the end the of leave period increases the labor force participation rates of women with children between one and six years old. The size of the increase is rather modest (0.3 percentage points).

[16] This statutory leave policy differs from the PDA. The PDA mandated that pregnant women should be treated as a temporarily disabled person but the law did not mandate any maternity leave.

7.2. *Paid Leave.* Many countries provide paid maternity leave, although the rate of payment and the amount of time for which women are eligible for paid maternity leave vary. Different countries have different eligibility criteria to determine who is eligible for paid leave and who is not. For example, in Canada, women who have worked at least 600 hours during the previous 52 weeks are eligible for up to 30 weeks of payment at the rate of 55%, whereas in France, women are eligible to receive full payment for 16 weeks if they have worked for at least 200 hours in the last three months. In the model, this leave policy is simulated by assuming that women who were employed during the quarter in which they became pregnant are eligible for the monetary benefits. Furthermore, since the model does not include previous earnings in the state space, this policy is implemented by assuming that women are paid according to the earnings function. This paid leave is in addition to the unpaid leave, and, as above, no skill depreciation. This policy further reduces participation compared with the participation rates observed under the unpaid leave policy. Since women receive compensation even when they are on leave and do not have to incur the reentry costs of finding a new job, the only cost that they incur is that of lost work experience. In simulations, the benefits from paid leave dominate the costs and further reduce participation rates during the benefit period. Column 4 of Table 11 presents the simulation results for the situation in which women receive compensation at the rate of 100% of their earnings (in addition to the simple unpaid leave) for the quarter immediately following the childbirth. The labor force participation rate decreases from 21.2% to 3.3% during the benefit period. In the second quarter, the labor force participation increases to 19.9% (because the compensation is no longer available). There is no long-term effect on employment, as characterized by the participation rate of women who have a child between the ages of one and six years. Column 5 of Table 11 presents the simulation results for the situation in which women receive compensation at the rate of 55% of earnings function (in addition to the simple unpaid leave) for two quarters immediately following the childbirth. The labor force participation rate decreases from 21.2% to 5.0% during the first quarter and from 19.9% to 5.1% during the second quarter. In the third quarter, the labor force participation increases to 25.7% (because the paid benefits are no longer available). Again, the long-term effect on employment, as characterized by the participation rate of women who have a child between the ages of one and six years, is very small (52.1% versus 52.0% without paid benefits). Thus, this policy analysis shows that the most effective way of increasing labor force participation is the provision of unpaid leave with the job-back guarantee.

8. CONCLUSION

This article analyzes the effect of the PDA of 1978 on the participation of married women in the labor force by developing and structurally estimating a dynamic model of women's labor force participation. The estimated model was used to evaluate how the PDA has affected the labor supply of married white women. Simulating the labor supply choices over the life cycle with pre- and post-PDA estimated model parameters permits a direct assessment of the effects of the PDA. The effects of the PDA on single women or women of other races were not analyzed, and the results obtained in this article may not be easily generalized to those groups (Francesconi, 2002).

The parameter estimates suggest that the utility cost of supplying labor during pregnancy declined substantially in the post-PDA period. The simulation results indicate that the PDA had a substantial effect on the participation rates of pregnant women and women with young children. In particular, the PDA increased the labor force participation rate of pregnant women by 8.2 percentage points, increased the participation rate for women with children under the age of one by 3.4 percentage points, and increased the participation rate for women with older children (between one and six years old) by 1.5 percentage points.

The estimated model was used to evaluate alternative forms of maternity leave and benefit policies. The model simulations show that the provision of unpaid maternity leave with a guarantee that women can return to their former jobs reduces participation immediately surrounding childbirth. This policy would reduce the labor force participation rate by approximately 18 percentage points during the quarter following a childbirth but increase the participation of women with children between one and six years old by almost 3.7 percentage points. Thus, the provision of unpaid maternity leave increases the long-term labor force participation rates of women with children. Paid leave has an even larger negative effect on participation during the paid leave periods. Again, these negative effects are temporary because the labor force participation rates increase once the leave periods are exhausted.

APPENDIX

Solution Method. The solution to the optimization problem is a set of decision rules that relate the optimal choice at any age a, from among the feasible set of alternatives, to elements of the state space. Recasting the problem in a dynamic programming framework, the value function can be written as the maximum over alternative-specific value functions, $V^j(\Omega(a), a)$,

TABLE A1
ACTUAL AND SIMULATED LABOR FORCE PARTICIPATION RATE: BY QUARTERLY AGE

Age	Simulation	Actual	Age	Simulation	Actual	Age	Simulation	Actual
73	0.149	0.333	109	0.461*	0.502	145	0.606	0.603
74	0.182	0.429	110	0.477	0.504	146	0.612	0.614
75	0.143	0.333	111	0.477	0.512	147	0.618	0.628
76	0.188	0.320	112	0.470	0.506	148	0.619	0.627
77	0.326	0.405	113	0.481	0.494	149	0.623	0.633
78	0.396	0.442	114	0.493	0.495	150	0.622	0.631
79	0.342	0.367	115	0.502	0.478	151	0.619	0.639
80	0.337	0.349	116	0.510	0.498	152	0.614*	0.648
81	0.335	0.388	117	0.510	0.509	153	0.614*	0.661
82	0.353	0.402	118	0.500	0.504	154	0.619*	0.672
83	0.367	0.386	119	0.495	0.502	155	0.623*	0.683
84	0.400	0.433	120	0.489	0.505	156	0.620*	0.688
85	0.401	0.437	121	0.495	0.500	157	0.624*	0.683
86	0.426	0.459	122	0.493	0.490	158	0.620*	0.683
87	0.436	0.440	123	0.490	0.487	159	0.621	0.664
88	0.463	0.460	124	0.487	0.483	160	0.624*	0.693
89	0.498	0.489	125	0.484	0.490	161	0.630	0.679
90	0.512	0.476	126	0.468	0.487	162	0.630	0.679
91	0.515	0.488	127	0.458	0.487	163	0.633	0.679
92	0.526	0.504	128	0.465	0.483	164	0.640	0.698
93	0.520	0.519	129	0.474	0.484	165	0.649	0.698
94	0.503	0.515	130	0.484	0.492	166	0.657	0.696
95	0.508	0.539	131	0.486	0.500	167	0.666	0.700
96	0.513	0.539	132	0.491	0.510	168	0.676	0.708
97	0.507	0.534	133	0.504	0.524	169	0.684	0.732
98	0.503	0.513	134	0.523	0.539	170	0.688	0.741
99	0.513	0.506	135	0.539	0.525	171	0.694	0.709
100	0.522	0.506	136	0.554*	0.509	172	0.708	0.696
101	0.528	0.509	137	0.561*	0.517	173	0.723	0.701
102	0.504	0.507	138	0.572*	0.523	174	0.736	0.689
103	0.489	0.518	139	0.579	0.552	175	0.744	0.704
104	0.473*	0.515	140	0.589	0.567	176	0.748	0.705
105	0.452*	0.504	141	0.597	0.580	177	0.747	0.690
106	0.440*	0.509	142	0.597	0.587	178	0.748	0.702
107	0.440*	0.492	143	0.603	0.599	179	0.744	0.681
108	0.449*	0.498	144	0.605	0.587	180	0.745	0.695

NOTES: *Actual mean is statistically different from simulated mean at 5%.
$\chi^2(0.05, 1) = 3.84$.

TABLE A2
DIFFERENCE-IN-DIFFERENCE REGRESSION ESTIMATES

	Without Individual Fixed Effects		With Individual Fixed Effects	
	Estimate	(s.e.)	Estimate	(s.e.)
Quarters before birth				
3	0.075	(0.016)	0.077	(0.018)
2	0.059	(0.015)	0.064	(0.017)
1	0.006	(0.018)	0.018	(0.020)
Quarters after birth				
1	−0.011	(0.015)	−0.011	(0.017)
2	−0.008	(0.013)	−0.010	(0.015)
3	0.035	(0.011)	0.028	(0.014)
4	0.012	(0.013)	0.005	(0.016)
5–24	0.029	(0.006)	0.024	(0.011)

NOTES: Regressions include control for age, age squared, experience, experience squared, year dummies, number of children, education, age at marriage, and lagged employment status.
Figures in parentheses are standard errors.

i.e., the expected discounted value of alternative $j \in \{0, 1\}$ that satisfies the Bellman equation

$$\begin{aligned} V(\Omega(a), a) &= \max_{j\in\{0,1\}}[V^j(\Omega(a), a)] \\ V^j(\Omega(a), a) &= U^j(\Omega(a), a) + \beta E(V(\Omega(a+1), a+1|p_a = j, \Omega(a)) \text{ for } a < A, \\ &= U^j(\Omega(A), A) \quad \text{for } a = A. \end{aligned}$$

The expectation is taken with respect to $\varepsilon^w_{t+1}, \varepsilon^h_{t+1}$; thus it is a two dimensional integral. At any age $a < A$, the problem is to find alternative j that maximizes $V(\Omega(a), a)$. To solve that problem we need to know the continuation value at all possible state vectors. The solution consists of values of $E(V(\Omega(a+1), a+1|p_a, \Omega(a))$ for all j and elements of $\Omega(a)$. We refer to this function as the Emax. The solution is obtained by backward recursion, beginning with the last period, A:

$$EMAX(\Omega(a+1)) = \int_{\varepsilon^w_{a+1}} \int_{\varepsilon^h_{a+1}} V\big(\Omega(a+1), \varepsilon^w_{a+1}, \varepsilon^h_{a+1}\big) dF\big(\varepsilon^w_{a+1}, \varepsilon^h_{a+1}\big).$$

The multivariate integrations necessary to calculate the expected value of the maximum of the alternative-specific value functions at each state point are performed by Monte Carlo integration over the shocks. We evaluate the value of the Emax function at every possible state point. In the numerical implementation we draw N of shocks from the joint distribution of shocks $(\varepsilon^w_{a+1,n}, \varepsilon^h_{a+1,n})^N_{n=1}$, calculate the value function at each of these shocks, and then take the arithmetic mean over the N draws:

$$EMAX(\Omega(a+1)) \approx \frac{1}{N} V^n\big(\Omega(a+1), \varepsilon^w_{a+1}, \varepsilon^h_{a+1}\big).$$

$EMAX(.)$ is unbiased and is consistent as N becomes large (by the Law of Large Numbers).

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