INTRODUCTION

Even with rising labor force participation, women are less likely to be in the formal workforce when there are very young children in their household. How the gap in these participation rates between women with and without young children changes over two decades is the focus in this paper. Moreover, are the effects in labor force participation rates over time modified by education status? The purpose of this study is to examine U.S. census records from 1980-2000 and report labor force participation rates across child status by education level while controlling for other covariates. The following analysis provides empirical point-in-time estimates of female labor force participation between those with and without children including measures of associations across levels of education via interactions between education factors and presence of children. These results can offer empirical evidence regarding trends in participation rates between women with and without children addressing hypothesized retreats from the labor force over time when there are children in the household.

Proportionately more women leave the workforce to stay at home with young children in recent years as indicated from a study using the PSID (Panel Study of Income Dynamics) as a data source and covering the years 1968-1992 (Whittington, Averett and Anderson 2000). The sample represents women in 'professional, managerial or technical position in the year preceding a birth' and the response is probability of return to work after the birth of a child. Do increasing probabilities of withdrawal over time for those with more education, most likely to be in the positions in the aforementioned sample, reflect differences over the decades in the overall levels of labor force participation rates for those women with and without children in the U.S.?

Similarly, changes in paid labor force participation by married women over the life-cycle in the 1990s persist from prior time periods (Lehrer 1999): women are in the paid labor force less after the birth of a child than before. In this study of factors associated with a mother's participation in the work force, it uses longitudinal data from NSFH (National Survey of Families and Households) divided into cross sectional phases meant to represent life stages for a women before and after becoming a mother. The scope of time covers 1992-1994. Again, women may participate less in the paid labor force with presence of children in the household in this time, but is there a quantitative way to measure differences in the dropout with presence of children from the 1980s?

Women on average do participate less in the workforce after the birth of their child, but is this aspect changing over time? There has been evidence that women are less likely to participate in the workplace upon the birth of a child (Whittington et al. 2000) more in recent time, and associations between national level participation rates may supplement these prior findings. Specifically, if differences in labor participation rates for women with versus those without children increase over time, this offers evidence as to the strength of this aforementioned trend. Alternately, a decrease or non-change in the difference in participation rates of women with children under five and those without children under five could indicate that women are maintaining or ramping up their labor force participation over time. Furthermore, what is the situation across different education levels? Is this trend amplified for women with more education, particularly for women with a college or more education?

To answer the question regarding the association between education status, presence of young children in the household, and labor force participation for women over decades, I propose the use of a generalized log-link regression model not yet utilized with census data regarding this topic in the literature. The response in the model is the rate of labor force participation for married, non-hispanic white women in single-family households with a husband present. Covariates in the model will be education and age from the IPUMS (Integrated Public Use Microdata Series) (Ruggles et al. 2004) United States 5% census sample for three different times, 1980, 1990 and 2000. This model, offering a good model fit when examining counts in large populations, can offer a broad characterization of participation rate change by education status and presence of children in the household, the two primary covariates of interest. In turn, this information can be useful in substantiating any trends over time amongst women having children and their formal labor force behavior already found on a micro-level.

METHODS

The first model in the analysis represents each year separately, and it is a generalized log-link linear regression with the participation rate in the paid labor force as the response:

$$\log\left\{\frac{\mu(\mathbf{x})}{\mathbf{N}}\right\} = \mathbf{x}'\boldsymbol{\beta} \Rightarrow \log\{E(Y_i)\} = \beta_0 + x_{i1}\beta_1 + x_{i2}\beta_2 + x_{i3}\beta_3 + x_{i3}\beta_3 + x_{i4}\beta_4 + x_{i5}\beta_5 + x_{i1}x_{i2}\gamma_1 + \log\{N_i\} \quad (1)$$

where $\mu(\mathbf{x})$ = E($\mathbf{Y}$), the expected number of women in the labor force. $\mathbf{Y}$ is the vector of the number of women in the labor force, and it follows the negative binomial distribution. log($\mathbf{N}_i$) is the offset, and $\mathbf{N}_i$ is the vector representing the total number of person-weeks[1] thus creating a

[1] Note: With this model, the assumption is that the denominator serves as an estimate of person-weeks where each woman contributes one week since the labor force variable only applies to the current week.

response of an average employment rate, $\frac{\mu(\mathbf{x})}{\mathbf{N}}$. $\mathbf{x}'$ is the vector of covariates noted in Table 1 and $\boldsymbol{\beta}$ is the vector of model coefficients.

A second model includes time as a covariate, and it is the same as the first model except it a) includes year as a covariate and b) includes year interacting with the covariate indicating presence of children:

$$\log\{E(Y_{ij})\} = \beta_0 + x_{i1}\beta_1 + x_{i2}\beta_2 + x_{i3}\beta_3 + x_{i3}\beta_3 + x_{i4}\beta_4 + x_{i5}\beta_5 + x_{i6}\beta_6 + x_{i1}x_{i2}\gamma_1 + x_{i1}x_{i6}\gamma_2 + \log\{N_{ij}\} \qquad (2)$$

In this model, the correlations between counts for each of the 3 years were modeled using GEE (generalized estimating equations) in SAS PROC GENMOD® (Johnston 1996) with an autoregressive correlation structure for observations over the three years. Y_{ij} represents the counts of women in the labor force for time j and N_{ij} represents the total number of women in year j for the i^{th} observation.

Counts of women in and out of the labor force were derived from the dichotomous LABFORCE variable from IPUMS, and these counts formed the participation rate in which either a person was a paid laborer in any form for that reference week or they were not, nor were they seeking any paid labor. The data set comprised one woman from each single family household in the sample. The reference group was selected to be those women ages 36-40, with some children under age 5 in the household, with some children ages 5-18 in the household, college educated, and with spouse's income greater than the median. All estimates in the following figures derive from either model (1) or (2).

Before selecting a negative binomial model, two other models, a logistic and Poisson regression, were evaluated and rejected as options since they displayed overdispersion and poor model fit. The logistic regression model is a generalized linear model except the link function was logit instead of log as in equation (1), and there is no offset.

$$\text{logit}(\theta_i) = \log\left\{\frac{\theta_i}{1-\theta_i}\right\} = \beta_0 + x_{i1}\beta_1 + x_{i2}\beta_2 + x_{i3}\beta_3 + x_{i3}\beta_3 + x_{i4}\beta_4 + x_{i5}\beta_5 + x_{i1}x_{i2}\gamma_1, \quad (3)$$

where θ_i = probability of employment

When this logistic regression model was fit for each year, it showed a Pearson chi-square goodness-of-fit statistic divided by its degrees of freedom greater than 400 for each of the years when this value should be as close to one as possible (Stokes, Davis and Koch 2000). In comparison, the value of the Pearson chi-square goodness-of-fit statistic for the negative binomial model divided by its degrees of freedom does not exceed (230/202=1.14) and is never statistically significant at an alpha level of 0.05. The negative binomial model as specified in (1) and (2) showed the best fit with its flexible distributional assumptions.

Table 1. Model specification

Variable	**Coefficient**	**Response**
KIDSLT5: Presence of children under 5 in household (hh).	β_1	1) None
		2) Yes, at least one (referent)
EDUC: Education	β_2	1) No high school education
		2) Has at least a high school diploma but no bachelor's degree.
		3) Has at least a bachelor's degree (referent)
AGE: Age (years)	β_3	1) 20-30
		2) 31-35
		3) 36-40 (referent)

Variable	Coefficient	Response
SP_TINCD: Spouse's income	β_4	1) >= median
		2) < median
KIDS5_18d: Presence of children between 5 and 18 in hh.	β_5	1) None
		2) Yes, at least one (referent)
YEAR: Year of census*	β_6	1) 2000
		2) 1990
		3) 1980 (referent)

* in model 2 only.

Data:

The data source was from Integrated Public Use Microdata Series (IPUMS), specifically, 5% metro samples of census data for 1980, 1990, and 2000 for the entire United States. Within that population, the sample was of women not living in group quarters who were ages 20-40, married, white, non-Hispanic, in a family with their spouse present and only one family per household. IPUMS documentation (IPUMS 2003b) notes that selecting only one person per household is recommended to avoid clustering problems inherent in the data, and was accomplished by analyzing one woman per household. Because of oversampling (IPUMS 2003a), a sample weight for each individual, from the PERWT variable, was applied to each observation to obtain person-level counts representative of the general population.

RESULTS

The two-way interaction between number of children under the age of five at home and education level is of interest for all three models representing 1980, 1990 and 2000, and this interaction will indicate differences by education level between the differences in labor force participation between those with and without children under 5 in the household. The age

interaction was not of primary interest neither was it statistically significant in the model. However, the main effect of age was left in the model for adjustment purposes.

Table 2. 1980 Model Parameter Estimates.

Parameter	Category (1)	Category (2)	Estimate	
Intercept			-0.5723	**
age	20-30		-0.0324	
age	31-35		0.0041	
age	36-40		0	
educ	1 no hs		-0.5473	**
educ	2 hs or hs+		-0.2799	**
educ	3 4yrs college		0	
kidslt5	0 no		0.4428	**
kidslt5	1 yes		0	
educ*kidslt5	1 no hs	0 no	0.1065	*
educ*kidslt5	1 no hs	1 yes	0	
educ*kidslt5	2 hs or hs+	0 no	0.1155	*
educ*kidslt5	2 hs or hs+	1 yes	0	
educ*kidslt5	3 4yrs college	0 no	0	
educ*kidslt5	3 4yrs college o	1 yes	0	
sp_tincd	0 spouse inc gt		-0.2395	**
sp_tincd	1 other		0	
kids5_18d	0 no		0.1017	**
kids5_18d	1 yes		0	

* = level of significance at 0.05, ** = level of significance at 0.01.

Table 3. 1990 Model Parameter Estimates.

Parameter	Category (1)	Category (2)	Estimate	
Intercept			-0.3207	**
age	20-30		-0.0514	**
age	31-35		0.0082	
age	36-40		0	
educ	1 no hs		-0.5136	**
educ	2 hs or hs+		-0.1684	**
educ	3 4yrs college		0	
kidslt5	0 no		0.2299	**
kidslt5	1 yes		0	
educ*kidslt5	1 no hs	0 no	0.1558	**
educ*kidslt5	1 no hs	1 yes	0	
educ*kidslt5	2 hs or hs+	0 no	0.0588	
educ*kidslt5	2 hs or hs+	1 yes	0	
educ*kidslt5	3 4yrs college	0 no	0	
educ*kidslt5	3 4yrs college	1 yes	0	
sp_tincd	0 spouse inc gt		-0.1413	**
sp_tincd	1 other		0	
kids5_18d	0 no		0.0881	**
kids5_18d	1 yes		0	

Table 4. 2000 Model Parameter Estimates.

Parameter	Category (1)	Category (2)	Estimate	
Intercept			-0.3254	**
Age	20-30		-0.0556	**
age	31-35		-0.0148	
age	36-40		0	
educ	1 no hs		-0.5182	**
educ	2 hs or hs+		-0.1476	**
educ	3 4yrs college o		0	
kidslt5	0 no		0.213	**
kidslt5	1 yes		0	
educ*kidslt5	1 no hs	0 no	0.1658	**
educ*kidslt5	1 no hs	1 yes	0	
educ*kidslt5	2 hs or hs+	0 no	0.0348	
educ*kidslt5	2 hs or hs+	1 yes	0	
educ*kidslt5	3 4yrs college o	0 no	0	
educ*kidslt5	3 4yrs college o	1 yes	0	
sp_tincd	0 spouse inc gt		-0.1126	**
sp_tincd	1 other		0	
kids5_18d	0 no		0.071	**
kids5_18d	1 yes		0	

* = level of significance at 0.05, ** = level of significance at 0.01.

Table 5. Parameter Estimates for Model 2 of Labor Force Participation Rates.

Parameter	category (1)	Category (2)	Estimate		SE
Intercept			-0.7836	**	0.038
age	20-30		-0.0533	**	0.019
age	31-35		-0.0022		0.018
age	36-40		0		
educ	1 no hs		-0.5216	**	0.027
educ	2 hs or hs+		-0.1823	**	0.030
educ	3 4yrs college		0		
kidslt5	0 no		0.4367	**	0.040
kidslt5	1 yes		0		
educ*kidslt5	1 no hs	0 no	0.1471	**	0.040
educ*kidslt5	1 no hs	1 yes	0		
educ*kidslt5	2 hs or hs+	0 no	0.0633		0.038
educ*kidslt5	2 hs or hs+	1 yes	0		
educ*kidslt5	3 4yrs college	0 no	0		
educ*kidslt5	3 4yrs college	1 yes	0		
year	1 2000		0.3299	**	0.018
year	2 1990		0.3328	**	0.016
year	3 1980		0		
year*kidslt5	1 2000	0 no	-0.228	**	0.024
year*kidslt5	1 2000	1 yes	0		
year*kidslt5	2 1990	0 no	-0.2088	**	0.020
year*kidslt5	2 1990	1 yes	0		
year*kidslt5	3 1980	0 no	0		
year*kidslt5	3 1980	1 yes	0		
sp_tincd	0		0.149	**	0.015
sp_tincd	1		0		
kids5_18d	0 no		0.081	**	0.016
kids5_18d	1 yes		0		

* = level of significance at 0.05, ** = level of significance at 0.01.

Exponentiating combinations of the interaction parameter estimates from tables 2-4 provide the ratios of labor force participation rate estimates given education level and child status of the sampled women and these estimates are in Figure 2. The labor force participation rates themselves, as shown in Figure 1, are the result of exponentiating linear combinations of the parameter terms representing each category while controlling for other variables in the model: AGE, KIDS5_18D, and SP_TINCD. Given the adequate model fit, these estimates are expected to represent the United States sub-population I have selected of married, white, non-Hispanic women in single family households.

Looking at average rates of participation in the labor force by time it is apparent that changes have been occurring. In 1980, no more than 52% of white married women with some children under five were in the labor force across all three categories of education level, while no less than 41% of women were in the labor force under the same conditions for 2000 (Figure 1). For those women with no children under age 5 in the household, they started off with a minimum of 52% non-participation and in 2000 the minimum was up to 60% for those with no high school education. Labor participation rates have been on the rise for women from 1980-1990, which is not a highly disputed fact (Brewster and Rindfuss 2000), and the increase is larger for years 1980-1990 than 1990-2000. In addition, women with children ages 5-18 work less after controlling for other variables. Women with a husband having an income above the median work less, although for the income covariate this effect is significantly less at an alpha level of 0.05 in the more recent decades than 1980 (analysis not shown).

What is interesting is examining the values for the interaction between presence of children less than five and education of the mother. The interactions with education show that the higher the education level, the smaller the difference in participations rates between those with and without children, controlling for age. In particular, in 1980 both those with no high school education or those with a high school education have ratios of labor participation rates of none versus some children that are 11% and 12% larger, respectively, than those with a college or more education (figure 2). For the next two time periods, 1990 and 2000, the differences between those with no high school education goes up to 17% and 18% larger respectively, while there is no statistical difference between those with a high school education and those with a college education. In

other words, there is a bigger percent difference in participation rates across child status occurring for those at the lower end of the education spectrum, and this effect gets bigger over time although the time effect was not tested due to model fit restrictions.

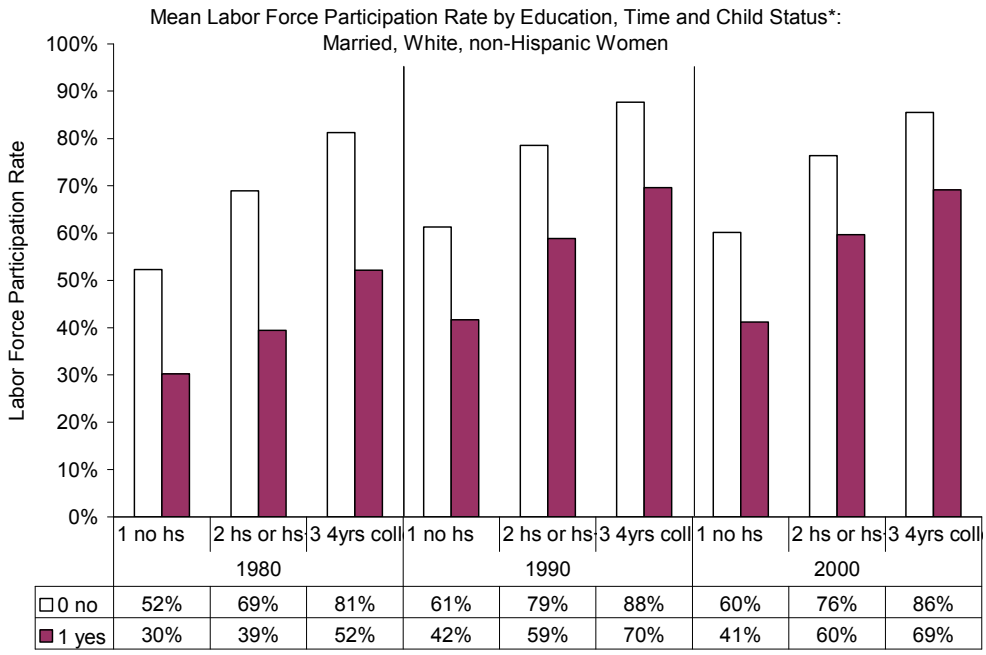
The participation rates for those with at least one child under five all rise from 1980 to 1990 by at least 11 percentage points and at most 19 percentage points, across specific education levels (figure 1). Interestingly, the participation rates also increase for women with no children less than five in the household by education level, but the largest percentage point difference is 10 (for those with a high school education), the minimum for those women with children under five. These point differences suggest a narrowing gap over time between participation rates for women with and without children, and evidence from model (2) in figure 3 suggests this narrowing gap over time is significant, controlling for education levels. A decrease in differences in labor force participation rates between women with and without children under 5 has significantly decreased from 1980 over two ten year periods as figure 4 demonstrates. In 1990 the difference between those with and without children under 5 decreases around 19% and levels off in year 2000, but certainly there is no reversal in the downward trend from 1980 (Table 5).

To this point, two findings from the data regarding women's participation rates are: 1) differences in rates across education and child status by year, and 2) differences across time and child status. Several trends are evident from these data, some obvious, others not:

- In general, women have higher participation rates in 2000 than the start point for analysis, 1980, across all education and child levels.

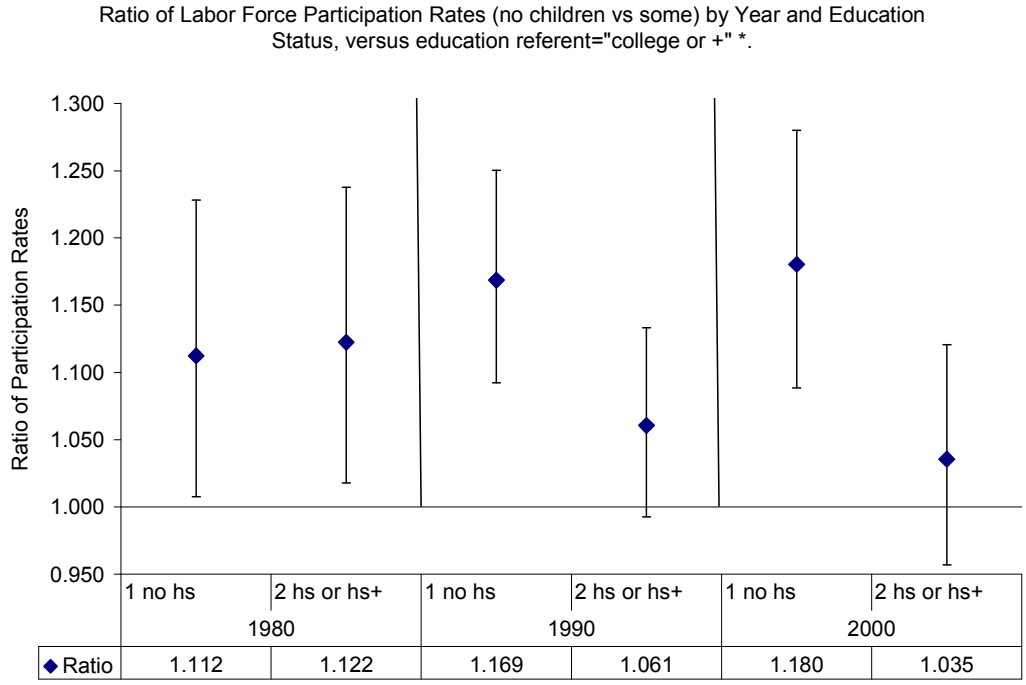
- While participation rates are higher, those with more education have smaller differences in labor force participation across child status compared to women with less education.
    - Over time, those with no high school education show a trend of larger gaps in participation between those with and without children compared to those with higher education levels.
- Percent differences in participation rates by child status for 1990 and 2000, averaged over the three education levels and controlling for other variables, are significantly smaller than 1980.
    - The difference in participation rates across child status from 1990 to 2000 is small, reflecting achievement of a plateau.

Figure 1.



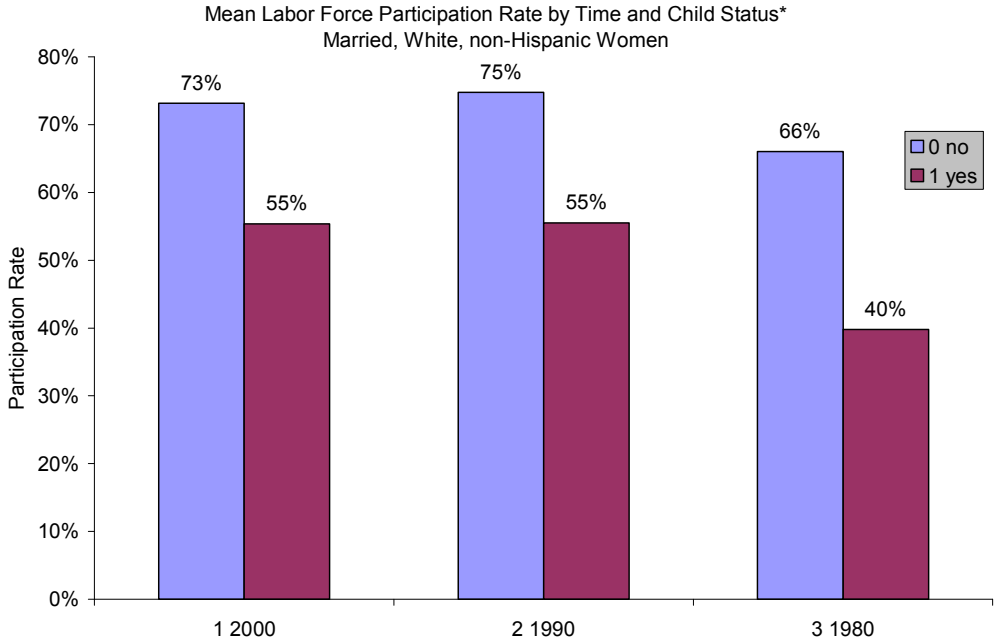
* controlling for age, number of children 5-18 and spouse's income. All are sig greater than 0, p-value<.01. Estimates from model 1.

Figure 2.



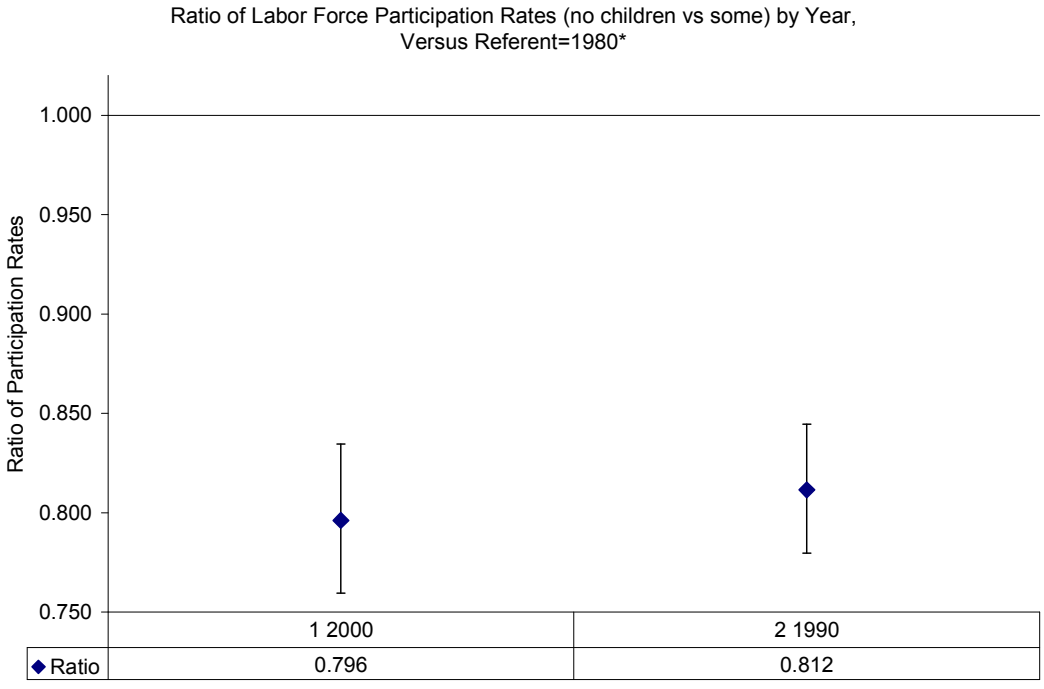
* controlling for age, number of children 5-18 and spouse's income. Error Bars represent 95% confidence intervals. Estimates from model 1.

Figure 3.



* controlling for age, number of children 5-18, education and spouse's income. Estimates from Model 2.

Figure 4.



* controlling for age, number of children 5-18 and spouse's income. Estimates from Model 2. Error Bars represent 95% confidence intervals.

DISCUSSION

On a basic level, women who do not have children less than five in the household are in the paid labor in some form at higher rates, regardless of education level. Another consistent trend for this population of women is the more education, the higher the labor force participation rates regardless of time and either with or without children under five as evidenced in figures 1. Both of these results are well documented and not too surprising, but differences by education are more subtle and emerge in the interaction analysis.

Women with more education tend to have less of a difference in participation rates between women with children and without children compared to those with less education. An alternate way of looking at situation is that the groups of women with children and without children are more similar in their labor force participation behavior if they are college educated than if they have no high school education. The interaction term representing presence of children under five in the home and education support this claim. Of course, whether or not these differences by education level are of a meaningful magnitude is open to interpretation, but these differences across time are constant: 12%-18% higher percent difference in the case for no high school versus college education.

One reason contributing to this difference across education levels may lie with the type of employer these women have. Perhaps women in the labor force with no high school education have employers less likely to accommodate a work schedule flexible enough for a woman with a young child in the household. The service industry is a likely employer for those without a high school degree and their management practices may not be mother-friendly either. On a similar

note, the gap between women with a high school education and a college education is closing perhaps indicating that workplace policies are catching up to the ones in place for women with advanced degrees. Either way, women with less education are diverging from counterparts with more education in terms of work patterns with and without children under five. Whether or not this trend follows for those without a high school education and shows a reversal is an open question.

These data offer evidence that the gap in labor force participation between women with and without children under five is narrowing since 1980. The percent by which it narrows also depends on the education level. After 1990, this trend in difference reduction appears to have leveled off. Although these data do not represent the past four years, it covers the past 30 years for the U.S. indicating current trends of women. In that respect, these data show that for the nation as a whole, and on average while controlling for age, the differences in labor force participation between women with and without children under five are decreasing or stabilizing since 1980. Although children certainly influence a woman's participation in the paid workforce, this effect is not reducing their participation rates more recently according to these census data.

What the response does not reveal are the types of employment occurring in the labor force, and if there are shifts between full-time and part-time employment across child status. Including a variable indicating the type of employment would be useful. With the data in its present form, there is no evidence that women are participating less than their counterparts without children over time. However, if it appeared that while the participation rates change little from 1990 to 2000, but part-time employment occupies a larger proportion in the mixture of employment type

in 2000 for women with children compared to those without then that would suggest a form of retreat from the paid labor force.

No racial effects were examined in the analysis either, and this is another covariate of import, expecting even less of a difference between participation rates by child status for black women compared to white women (Cheng 1996). Use of this variable would represent a larger portion of the population as would treatment of single and married women. However, given the use of the 5% sample, the model fit was inadequate and the sample would have to be greater than 5% for an accurate representation for minorities. Furthermore, other variables useful in future analyses to control for differences would be presence of a blended family. Single women did not comprise the population under examination and any shift in their population over time relative to covariates in this model could explain differences as well. For example, if women with no high school education are less likely to divorce if they do not work than those with more education then their presence in later times could explain the gap that is occurring from 1980 to 2000.

Finally, the analysis is not simplistic but the outcome is. While this type of analysis has its advantages in terms of model fit, it also has drawbacks. Among them are the broad categories within the covariate such as income of spouse. Of course, estimates of income from census data may not be all that accurate and analysis according to status relative to the median may be just what is needed given these limitations. Age is also broadly related in 5 to 10 year age groups. The number of children is also dichotomized and a finer gradation on this covariate would be beneficial. However, negotiation between the nature of this data set offering unique information

and large size as well as the search for a model suitable for the outcome of interest leads to the broad categories, but accurate estimates.

CONCLUSION

This paper started by questioning what differences in levels of labor force participation exist from 1980 to 2000 for married, white, non-Hispanic women with and without children under five, and if those differences varied by level of education. The analysis shows not risks of employment for married women by child status, but differences in population rates of labor force participation at a point in time and any association with presence of children and education level, among several variables. Evidence from this analysis shows a 20% decline in the difference of labor force participation between those with and without children from 1980 to 2000 and a 19% decline in those differences from 1980 to 1990. In turn, those two percentages suggest little meaningful change from 1990 to 2000. In other words, differences between women with and without children are certainly not increasing in terms of participating in the paid workforce for this particular sample.

Examination of the interactions between education and presence of children contributes additional information regarding labor force participation. The effect of children in the household modifies participation in the workforce differently depending on the level of a woman's education. There exists a differential across education that may be rooted in privilege, environment or another yet unnamed variable. The main effects indicate women with higher education work more, and participation rates for women with more education are becoming more

similar or stabilizing across child status, not increasing over time, as the popular media has been suggesting recently.

Although there is a differential by education status, the interesting part is that it is shrinking over time for those with a high school education compared to those with a college education. If this indeed shows a catch-up in workplace conditions for those working with less education then it is a promising development, but why would it not extend to those without a high school education? Furthermore, will the plateau in differences between women with and without children from 1990 to 2000 extend to the end of this decade or will it change, and will this denote a threshold of participation for women with children?

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