Mental Health, Teenage Motherhood, and Age at First Birth among British Women in the 1990s

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ABSTRACT AND NON-TECHNICAL SUMMARY

Teenage fertility has many consequences, one of which is its influence on the mental health of mothers. In this paper we compare the medium- to long-term mental health effects of four groups of women in Britain in the 1990s: teenage women who had first births, teenage nonmothers, and mothers of two older age groups. We study as well the effect of women's age at first birth on their psychological well-being and estimate the so-called pivotal age at first birth to determine at what age having a birth would change to from a bust to a boost to mental health. These aims are achieved by analyzing the first 10 waves the British Household Panel Survey (1991-2000). We find that teenage mothers tend to have a significantly higher level of depression in the medium term postpartum. More generally, within five years postpartum, no pivotal age at first birth is found, and estimated pivotal age at first birth begins to appear reasonable only from five to ten years postpartum. The results suggest that, while older mothers tend to have a smaller likelihood of depression than younger mothers, the effects are curvilinear, and that motherhood may not enhance a mother's well-being until the child is at least no longer a toddler.

Introduction

Britain has the second highest teenage birth rate in the developed world, with 32 mothers per 1,000 teenagers in 1998, a rate lower only to that of the U.S. (UNICEF Innocenti Research Centre 2001). Being a mother early in one's life has many social, behavioural and health consequences, including a greater likelihood than other teenagers to suffer depression (Clarke 1999; Simms and Smith 1986). In this paper we examine medium- to long-term mental health consequences of motherhood among British women in the 1990s. The definition of long term is relative to the event of concern—birth. A new mother may experience postnatal depression, a short-term effect of giving birth in the form of major depression occurring within six months postpartum and affect 10-15% of mothers (Boyce et al. 2000). Here we consider durations beyond the immediate postnatal period, i.e., durations of one to three years postpartum as medium term and those of three to five years and beyond postpartum as long-term.

This paper has a triple research foci: First, we aim to understand the mental health effects of a woman's having had a teenage birth in Britain up to five years since birth and the trajectory of such effects. Second, to assist our understanding we compare the psychological well-being trajectory of teenage mothers with those of teenage nonmothers as well as older mothers. Finally, we study the pivotal age at first birth among these women—the age that divides parenthood's likely emotional liability from its likely emotional benefit. The paper contains two analyses, the first of which deals with the first and the second foci, and the second features the third research focus.

The design of the analyses in this paper distinguishes itself from the prominent research in the literature including very recent ones (e.g., Mirowsky and Ross 2002). Past research typically relies on cross-sectional analyses of births that occurred in the past. In contrast, the current research employs a dynamic design that allows the researcher to follow

the women in the analyses from prenatal to postpartum years, thereby making possible a more accurate understanding of the relationship between motherhood and mental health. Panel data are used in this design because such data are necessary to tease out the effects of age at first birth and duration since birth, in a fashion not dissimilar to the research on disentangling the effects of poverty and early motherhood (Hobcraft and Kiernan 2001).

Following the introduction is a review of the literature focusing on potential confounding factors of the effect of teenage births, or more generally age at first birth, on mental health. After the literature review, we introduce the data used in the study, the British Household Panel Survey. The subsequent section discusses the methods and the measures. The findings and discussion section cover the two analyses of the three research foci before the final concluding section.

The Literature on Mental Health and Motherhood

There exist multiple reasons for the association between one's psychological well-being and motherhood. For example, people who are in unstable relationships or lack of resources may be overwhelmed by the experiences of motherhood. Furthermore, there may exist an association between age at first birth and emotional well-being as a spouse's emotional support, the economic conditions of the household, and affordable childcare can all affect the new mother's mental health (Glass and Fujimoto 1994; Lennon and Rosenfield 1994; Mirowsky and Ross 2002; Ross and Mirowsky 1988; Ross and Van Willigen 1996; Umberson and Williams 1999). Below we review six major aspects of the relevant literature.

Socioeconomic status: Socioeconomic factors are imperative to include in the current study, as it has been found that most of the adverse health consequences of teenage childrearing can be allocated to social and economic factors rather than young age (Makinson 1985).

However, mother's age at birth still matters and may work hand in hand with one's social and economic conditions. An early age at first birth may disrupt one's education or work. Unfavorable conditions such as interrupted employment and low level of education may increase depression (Mirowsky and Ross 1986; Ross and Huber 1985). The time one spends in pursuing education positively relates to the delay of childbirth. Put differently, teenage fertility and high school completion are inversely related, though there is a certain amount of endogeneity in the twin processes (Ribar 1994). On a broader scale, early births tend to delay interrupt the completion of high school, entry into university or completion of university (Anderson 1993; Hoffman, Foster, and Furstenberg 1993). Lower educational attainment and disrupted employment interfere with one's financial ability to provide for food and shelter, and such economic hardship, possibly compounded by lower educational attainment and interrupted employment, leads to depression (Ross and Huber 1985). Finally, because disrupted education may be a direct consequence of teenage birth (Menken 1972), having quit school early may interact with such birth to produce depression.

Health conditions: One's health status may explain the relation between early motherhood and depression. Some pregnancy complications are most common among young mothers (Mirowsky and Ross 2002). Being a mother and taking care of a baby is a demanding job, and can be an emotional drain on mothers. Precisely for the same reason, women who delay first birth too long may be ill-prepared physically for meeting the challenge as one's fitness declines with age. In addition, poor subjective health, chronic disease, disability, and low energy may be depressing themselves (Turner and Noh 1988).

Family formation: An early first birth typically does not bode well for one's family formation, often ending in single motherhood and broken family. Conditions such as premarital motherhood and early and unstable marriage may be difficult contexts that increase depression (Ross and Mirowsky 1999; Williams et al. 1997). Being a single

divorced mother may have further repercussions in disrupting education and work (McLanahan and Sandefur 1994; Williams et al. 1997). Growing up in a single-parent household increases the level of distress when children become young adults, and this is true even after economic factors are taken into account (Ermisch and Francesconi 2001). Similarly, being in a disrupted household may contribute to depression among mothers themselves, especially if they are young and lack of the kind of social capital that older mothers have.

Role and time conflict: For those new mothers who have a job or still go to school, the need for the care of the young may create strain because of the conflicting demand in time and energy due to the two sets of roles of being a mother and an employee (or student) (Goode 1960; Liao 1998). Contrary to the role strain theory, the role substitution hypothesis proposes that employment and marriage can substitute each other in their health benefits (Waldron, Weiss and Hughes 1997). Unlike work environment, which may create strain, a school environment may provide a haven from the harsh realities of the real world and an escape from stress as long as the school involved does not discriminate against young parents. Thus, being in school as a full-time student may actually boost one's emotional well-being.

Social support: Factors related to social support may play an important role in one's psychological well-being. Even though the mechanism through which social support affects mental health or buffers stress is not very clear, research has found higher levels of social support associated with recovery from recurrent psychological difficulties (Brugha et al. 1997) and lower levels of social support related to higher levels of depression (Pevalin and Goldberg 2003). These findings make inclusion of social support a prerequisite for any analysis of mental health regardless of the objective of the research.

Biological and physiological factors: A woman's age at menarche is positively related to age at first birth (Manlove 1997; Udry 1979), and may represent underlying biological or genetic differences. In less developed societies, an early age at menarche may mean an early chance at marriage (Riley 1994), but in more developed societies an early age at menarche can lead to an early age at first intercourse, thus pregnancy (Udry 1979). While such factors may not have direct implications for one's mental health, it is possible that an early motherhood may create liability for one's psychological well-being by a young mother's relative lack of financial and emotional readiness, thus possibly operating through factors such as income. While emotional readiness can be difficult to measure, there are reasonable income measures available to researchers.

Intergenerational influences: Research has found that daughters of teenage mothers are more likely to have a birth in their teenage years themselves (Wellings 1999), and the reproduction of early motherhood over generations is carried out through factors such as age at menarche, and family and economic environments (Manlove 1997). Some of these environments include economically and educationally disadvantaged family backgrounds (Kiernan 1997). Similar to biological factors, intergenerational influences may have a direct impact on one's emotional and financial readiness, and they may condition some young women into mothers while others into nonmothers. However, their role in a mother's postpartum mental health is unclear.

In the analyses to follow, measures of these confounding factors discussed so far will be included as long as availability allows even though testing their effects are not the primary purpose here. Once the effects of the potential confounders are adjusted, any remaining difference in mental health can then be attributed to teenage motherhood or more generally, age at first birth.

The Data

The analyses use the first ten waves of the 1991 to 2000 British Household Panel Survey (BHPS), an annual survey of each adult aged 16 and over member of a nationally representative sample of more than 5,000 households (approximately 10,000 individual interviews). The same individuals are re-interviewed in successive waves and, if they split off from original households, all adult members of their new households will also be interviewed. Children are interviewed once they reach the age of 16 (at the time of the interview) though there is also a special survey of 11-15 year old household members from Wave 4. The main objective of the survey is to investigate social and economic change at the individual and household level in Britain, and to identify, model and forecast such changes, their causes and consequences in relation to a range of socio-economic variables.

The analyses in this paper are restricted to women of childbearing ages (15-50). In the first analysis, three groups of mothers—teenage mothers, mothers aged 20 and over until 30, and mothers aged 30 and over at the time of the first birth—and one group of teenage nonmothers are included. The second analysis includes mothers and nonmothers of all childbearing ages from the ten waves.

Because the BHPS does not specifically record events of births, the age at first birth variable is constructed using the following four sources of information represented by six variables: (1) whether the hospital (or clinic) stay in the past year was due to childbirth, (2) the year and month of birth of the respondent, (3) the year and month of the interview, and (4) the number of own children in household. A median value of childbirth date is assigned to the time period between the previous and the current interviews, and an age at first birth is calculated accordingly using the respodent's birth date information. While this approach is not perfect as home births are missed, the misses should not be too numerous since home

birth rates are as low as about 2% in Britain. Figure 1 presents the first 560 births in the first seven waves of the BHPS.

---Figure 1 about here---

Because our concern is to follow the mental health trajectory of mothers in their postpartum years, including births from all 10 waves would give some women no postpartum years to observe. Defining the observation period of births from wave 1 to 7 allows us to have enough length in observable postpartum years for the 525 mothers with nonmissing information on the variables in the first analysis (up to 10 observations per woman with the mean=6.169). To capture any potential selection effect of motherhood, especially teenage motherhood (i.e., mothers are by themselves different from nonmothers), the psychological well-being during the years leading to the first birth are also included as long as the information is available, in addition to the time-invariant, unit-variant term of u_i in equation (2), which typically captures unobserved individual characteristics in panel analysis. The definition of the observational period results in 4,322 observations for the 525 mothers, with observations as early as five years prior to the first birth to 10 years postpartum. The variable *years since birth* records the year a mother was in with regard to the first birth (i.e., with a maximum range from -5 to 10 and 0 indicating the birth year). These 525 mothers contribute 4,322 observations collectively with a mean number of 8.232 observations each (i.e., including on average a bit over 2 prenatal years), and they together with teenage nonmothers contribute a total of 8,623 observations in the first analysis, with a mean number of 6.538 observations per woman. The second analysis adds to the above sample nonmothers who were aged between 20 and 50.

Because nonmothers, teenage or older, have no birth as a reference point, a randomly chosen reference point was assigned to them by assuming a uniform distribution throughout the 10 years so that they became comparable to the mothers. The assumption is

valid as long as birth is random event in terms of time. That is, there is no reason to doubt that birth is independent of time. Similarly, the nonmothers' reference "birth" years are independent of time, thereby distributed evenly over the 10 waves. Using the assignment under the uniform distribution, the years since birth variable reflects the departure in number of years from this arbitrarily defined yet randomly chosen reference point for nonmothers.

The most often used instrument for measuring personal well-being and mental health in the UK is the General Health Questionnaire (GHQ), which has been widely and successfully tested and used. The full-length version of the GHQ includes several dozens of questions. The BHPS administers a shortest version (12 items) of the GHQ (GHQ-12), which has been found a consistent and reliable instrument when used in general population samples with relatively long intervals between applications as in the BHPS (e.g., Pevalin 2000). The questions ask the respondents how they have been feeling over the past few weeks concerning the 12 areas or items listed in Appendix A.

The four-point answers follow the pattern of "more (or less) than usual", "same as usual", "less (or more) than usual", and "much less (or more) than usual". To reduce the potential problem of regression toward the mean and to avoid the unreasonable equal spacing assumption when treating the four points as numerical values, a dummy variable was created for each of the twelve item with "feeling worse" coded "1" regardless of the degree of how much worse. The cronbach α reliability coefficients for the 12 recoded variables are 0.874 and 0.895 for the nonmissing cases in the two analyses, respectively. The 12 variables were then aggregated into a single variable with a value ranging from 0 to 12. The coding procedure renders the 12 items into a count variable.

Methods

Model

A variable created by summing over multiple items is often analyzed with a linear regression model. This approach assumes a normal distribution and a continuous or metric variable. An alternative approach uses a Probit model, which still assumes an underlying normal distribution though it relaxes the additional assumption of equally spaced categories by the linear regression. A histogram of the empirical distribution of the recoded GHQ-12 variable graphed against the normal, the Poisson, and the negative binomial distributional assumptions demonstrates that while the Poisson, a distribution often used for count data, is better than the normal, the negative binomial distribution provides the best fit to the data because it allows for overdispersion, a common characteristic of count data. The current data present a mean of about 2 and a variance over 8, indicating an extreme amount of overdispersion (which is confirmed by a chi-square test). Therefore, the negative binomial distribution is preferred.

---Figure 2 about here---

By assuming the negative binomial distribution for the overdispersed panel count data, we use the random-effects negative binomial model, which is estimated in both analyses:

$$\Pr(Y = y_{it} \mid \mathbf{x}_{it}, \varepsilon_{it}) = \frac{e^{-\lambda_{it}\varepsilon_{it}} (\lambda_{it}\varepsilon_{it})^{y_{it}}}{y_{it}!}, \qquad \text{for } y=0, 1, \ldots$$

Integrating out ε_{it} we obtain

$$\Pr(Y = y_{it} \mid \mathbf{x}_{it}) = \frac{\Gamma(\theta + y_{it})}{\Gamma(y_{it}+1)\Gamma(\theta)} r_{it}^{y_{it}} (1-r_{it})^{\theta}, \qquad (1)$$

with the link function

$$\ln(\lambda_{it})(\varepsilon_{it}) = \mathbf{x}_{it}\boldsymbol{\beta} + u_i + \varepsilon_{it} \qquad (2)$$

where Y is a random variable, y_{it} are a realization of it, λ_{it} are its mean, u_i are unit-specific effects, ε_{it} are random errors (effects) across units and over time, $\mathbf{x}_{it}$ are a vector of explanatory variables, $r_{it}=\lambda_{it}/(\lambda_{it}+\theta)$, and $\boldsymbol{\beta}$ are a vector of regression coefficients. The distribution has conditional mean λ_{it} and conditional variance λ_{it} $[1+(1/\theta)\lambda_{it}]$. The θ parameter can be regarded as an indication of overdispersion for when $\theta=1$, the mean and the variance of the distribution are equal, and the Poisson distribution is then valid.

For the first analysis, (2) is applied to the data and three dummy variables representing teenage mothers, twenty-something mothers and thirty-and-over mothers and their interaction with the number of years since birth variable are included in the **x** matrix along with many essential potential confounding variables of mental health.

In the second analysis the focus is on age at first birth and its pivotal effect, analyzed in a model also in the form of (2). For the sake of simplicity we ignore the subscripts hereafter. To study the pattern of age at first birth and estimate the pivotal age at first birth, the basic internal modifier model (Mirowsky and Ross 2002) is used (subscripts from earlier equations are omitted for the sake of brevity):

$$\ln \lambda = a_0 + [a_1 + a_2(A_{FB} - k_{FB})]P + \ldots + u \qquad (3)$$

The derivative of logged count of depression with respect to motherhood or parenthood (P) in the simplest case is as follows:

$$\partial \ln \lambda / \partial P = a_1 + a_2(A_{FB} - k_{FB}) \qquad (4)$$

where A_{FB} represents age at first birth and k_{FB}, an arbitrarily chosen reference point of the same variable, and the as are regression coefficients. To estimate the pivotal age at first birth, we obtain the value of A_{FB} at which the derivative of $\ln \lambda$ with respect to motherhood is zero. That is, mothers who had the first birth before that age would be more depressed than nonmothers, and mothers who had the first birth after that age would be less depressed

than nonparents. For the simplest specification which is expressed in (4), the pivotal age is estimated as:

$$A_{FB\ pivotal} = k_{FB} - \frac{a_1}{a_2} \tag{5}$$

However, for the current panel analysis we have information on mothers for each panel so that we can find out the degree of depression for each year both prior to and after the first birth up to 10 years postpartum (though not for every mother). The basic model of (3) needs to be modified in three ways: to test a parabolic association over the span of age at first birth, to model the effect of the number of years since birth and its interaction with age at first birth, and to adjust for hypothetical confounders or mediators discussed in the literature section:

$$\ln\lambda = a_0 + a_1 P + a_2[(A_{FB} - k_{FB})P] + a_3[(A_{FB} - k_{FB})P]^2 + a_4[(A_{FB} - k_{FB})PZ] + a_5[(A_{FB} - k_{FB})PZ]^2 + \sum \beta_j X_j + u \tag{6}$$

where Z records the number of years since birth and X_j indicates the jth confounder or mediator variable. For these data k_{FB}=27 is used as it is the closest integer to the mean of age at first birth. In a procedure identical to that of moving from (3) to (5) by taking the partial derivative of ln λ with respect to motherhood for estimating pivotal age at first birth, we obtain:

$$A_{FBpivotal} = k_{FB} - \frac{a_1}{a_2 + 2a_3 + a_4 Z + 2a_5 Z} \tag{7}$$

From (7) we see clearly that the estimate of the pivotal age at first birth is a function of the number of years since birth. When cross-sectional data are used, parents of varying postpartum duration are included, creating an averaged estimation. Panel data, however, allow us to estimate a specific pivotal age for each antepartum and postpartum year.

Measurement

In the following analyses, depression is measured by the GHQ-12 variable, a consistent and reliable representation of one's psychological wellbeing (Pevalin 2000). The construction of the measure has been discussed in the data and model sections. To contrast the GHQ-12 levels of different age-at-first-birth groups, three dummy variables are used—one each for the teenage mothers, the twenty-something mothers, and the mothers aged 30 and over. The analysis adjusts potential confounding effects by using various control variables introduced below that are along the lines of the discussion in the literature review.

Four variables represent socioeconomic status. A dummy variable records a woman's attainment of higher education (1=university degree holder; 0=otherwise). For capturing one's disruption of education, an early school leaving dummy variable indicates one's break from formal education before the age of 16, compulsory in Britain since 1972 (1=leaving early; 0=otherwise). A household income scale adjusted for one's household size and housing cost is used to measure the economic resources of a household (Department of Social Security 1998). Holding a permanent job may give someone a sense of security, represented here by a dichotomous variable (1=having a permanent job; 0=otherwise).

To control for a woman's physical health status, we use three variables in the analyses, one's own assessment of health status, disability conditions, and health problems. Subjective poor health, being disabled, and having health problems are all coded 1 and 0 otherwise for the three variables.

There are two variables measuring family formation—whether a woman was divorced or separated and whether she had a partner living together. Having divorced or separated can be a source of stress, and having a partner may alleviate stress. Both of these are dummy variables, with 1 indicating divorced or separated for the first variable and having a partner living together for the second, 0 otherwise.

To take into account of the role strain theory and the role substitution hypothesis, a woman's number of work hours per week is included in the analysis as a continuous variable. The models also have a dichotomous variable to record one's status of being still in school (1=in school; 0=otherwise), as school may provide an escape from the real world.

The BHPS asked the respondent about social support by using five questions administered in Waves 1, 3, 5, 7 and 9. The five items are designed to measure instrumental social support such as someone who will listen, someone to help in crisis, someone the respondent can relax with, anyone who really appreciate the respondent, and anyone to count on to offer comfort. Data from Wave 1 was imputed to Wave 2, Wave 3 to Wave 4, and so on (Pevalin and Goldberg 2003). A new variable is no social support at constructed by summing over the five recoded dummy variables, with a value of 5 denoting no social support at all and a value of zero indicating 5 channels of support. The resultant variable thus measures low social support.

Some other controls are also considered. Respondent's age is measured in years, and is included in both analyses. In the second analysis age is centered at its mean and quadratic function is estimated because all women of childbearing ages are in the analysis with age as a continuous variable whereas in the first analysis women are in age groups. Teenage mothers tend to live in local authority housing. Among the young mothers Allen and Dowling (1999) interviewed, one-third of them lived in such housing, and another third were on waiting list. Women in council housing might be less stressed as housing would be one thing less to worry about, but a test of the variable with the available data from the wave from which the data were available did not turn out to be significant, thus is not included in the final analyses. Factors measuring intergenerational effects are not included, primarily because many of these are only available on selected waves of the data. However, because disadvantaged background is often reproduced in women who were teenage mothers

(Kiernan 1997; Manlove 1997), women's current, time-varying socioeconomic factors in the current analyses should capture most of the differences in mental health. Because there exists ethnic heterogeneity in teenage births in Britain (i.e., Caribbean, Pakistani and Bangladeshi women were more likely to be teenage mothers while Indian women were less likely to have teenage births than the national average, see [Berthoud 2001]), the analyses are conducted on women who did not declare themselves as ethnic minorities. To control for possible period effects, the analyses include a dummy variable contrast the years of 1991-1996 when the Tories were in power versus the years of 1997-2000 under the New Labour government.

Finally, the basic internal modifier model of (3) is represented by two variables, a dummy variable indicating motherhood (P) and an interaction between age at first birth and motherhood [$P(A_{FB}-k_{FB})$]. The extension in (6) calls for three more variables, $[P(A_{FB}-k_{FB})]^2$, [$PZ(A_{FB}-k_{FB})$], and $[PZ(A_{FB}-k_{FB})]^2$. The fact that nonmothers would have no valid values for age at first birth is of little practical consequence because an assignment of any arbitrary value would cancel out when multiplied by the motherhood dummy (Mirowsky and Ross 2002).

Findings and Discussions

The model expressed in the form of (2) was estimated for all mothers in the sample together with teenage nonmothers as a reference category for comparison. This simple model (Model 1) of age-at-first-birth group comparison was extended to include a years since birth variable in Model 2, and the results are reported in Table 1.

---Table 1 about here---

According to either model, teenage mothers have a significantly higher (about exp(0.36)=1.4 times higher) level of depression than teenage nonmothers while the other

mothers do not exhibit significantly higher levels of depression. Overall, mental health declines (or depression worsens) with time elapsed since birth (or the reference point for nonmothers), as indicated by the variable representing the number of years since birth. However, the interpretation of the comparison between teenage mothers and nonmothers can only be tentative without having controlled the numerous potential confounding factors.

Models 3 and 4 in Table 2 present the analysis which adjusts the effects of the mediating variables suggested in the literature review and introduced in the measures subsection of the methods section. Model 3 includes, in addition to the group contrasts, these potential confounding factors. Because a woman might have the highest level of depression immediately after the first birth, and lower levels both before and after the birth, a quadratic function of years since birth is introduced. The results from Model 3 show that the function is concave, i.e., higher in the middle of the curve but lower at the tails. Age tends to dampen depression, but the interpretation of its effect must be made in conjunction with the age-at-first-birth group variables. Women under the Tory rule appear more depressed than when under the New Labour rule, other things being equal. Of the four socioeconomic variables related to education and employment, only adjusted income is associated with mental health. A higher level of income after adjusting for household size and housing cost is negatively related to depression. Two of the three physical health indicators are strongly related to mental health. Specifically, a woman's subjective evaluation of health and her health problems both have a significant impact on depression. Of the two factors measuring family composition, a woman who is divorced or separated has a poorer psychological well-being while having a partner present does not seem to matter. Note that these two variables are not carbon copies of each other: among those who were not divorced or separated, there were as many observations who had a partner present as not having a partner present. The estimate of hours worked per week suggests support for the

beneficial effect of having an additional role because of work, whether or not it replacing another role. Thus, there is no evidence for the role strain theory. Being in school provides only a rather weak escape, possibly due to the relatively small number of cases (3% of the sample in the first analysis) who were still in school. Finally, having low social support is highly significantly related to poor mental health, placing the variable only second to the two health variables in terms of strength. The low social support index is constructed from the questions that tap women's social networks. While their networks might vary in size and density, but there was no one-to-one correspondence between these network features and how supported they felt (Phoenix 1991). Instead, it is the actual amount of support that we must be concerned about when comparing mental health of teenage mothers and nonmothers.

---Table 2 about here---

Interestingly, the pattern of the group contrasts has not changed much with the inclusion of the control variables. The dummy variable contrasting teenage mothers and nonmothers still is highly significant and positive, indicating a higher level of depression among teenage mothers than nonmothers.

Model 4 introduces refinements over Model 3 by specifying a set of group-specific functions for the over-time change in the levels of depression among the women. Because it is not sensible to assume that the age-at-first-birth groups have an identical convex function of years since birth as is done in Model 3, we allow each group to have its own convex function of *years since birth*. This is particularly important for the nonmothers because their "birth" year was a randomly assigned point of comparison, suggesting that they really should have a flat line instead of a convex curve. The specification of group-specific functions is achieved by the inclusion in Model 4 a set of interaction terms between the dummy group contrasts and the years since birth variable and a set of squared terms of these interactions.

We have already included women's antepartum years to allow for individual variations, an indirect way to control for possible potential selection bias. In a further attempt to account for possible selection of women into teenage motherhood, we now introduce a dummy variable of father's occupation to represent social class in Model 4. Parental social class can be considered as a potential factor for selection bias. The BHPS included this question in wave 1 but not many other waves. To keep as many observations as possible, we use the dummy variable of whether father was from the professional or managerial class from wave 1, and tested Model 4 with the respondents from wave 1 and later waves as long as they did not drop out. The result is presented in Table 3.

---Table 3 about here---

In the table, all the other control variables are omitted even though they were included in the models. Model 4 is the same as that in Table 2, and Model 5 includes the additional paternal social class variable. Clearly, the estimation is not affected much at all, with an insignificant estimate for the paternal social class dummy variable, and all the key variables for testing mental health differentials unaffected by the addition of the social class factor. Overall, the estimates for the group differences are slightly less significant though still statistically significant ay any conventional level, compared with those from Model 4, because of the smaller sample size, but more sizable. With this evidence in mind, we return to Model 4 as the final model.

In this final model, the effects of the control variables remained largely unchanged from Model 3, and the group-specific functions of time since birth yield two significant quadratic effects. However, their interpretation is not as straightforward to interpret as a single convex function because of the multiplicative effects. To assist interpretation, predicted levels of depression measured by GHQ-12 for the four groups were computed and are presented in Figure 3. The computation used all parameter estimates including those of

the control variables (thus with their effects adjusted out) and the sample means were used for all variables except time since birth and age. Conditional mean ages were used for the four groups, and the prediction was calculated for the range of values from 2 years antepartum to 5 years postpartum.

---Figure 3 about here---

According to Model 4, the predicted levels of depression do not seem to vary much among the three groups of teenage nonmothers, 20-something mothers, and mothers aged 30 and over. While the nonmothers show a slight increase over time in their GHQ-12 scores along a straight line, the mothers all have a convex curve to a greater or lesser degree. The teenage mothers notably have a much more elevated level of depression that peaks about 1-2 years postpartum while the oldest group of mothers have a peak about 0-1 years postpartum. But the teenage mothers clearly follow a different trajectory in their mental health status from all the other women. It appears that their levels of depression at two years prior to the first birth and at five years postpartum, though still a little higher than, are much closer to, the levels of the other women. However, are the gaps ignorable? That is, are teenage mothers a rather different lot whose characteristics are not captured by the included confounding factors? To answer these questions, 95 percent confidence intervals for the predictions were calculated and plotted in Figure 4.

---Figure 4 about here---

To avoid clustering with too many lines, we focus on the two groups of teenage mothers and nonmothers and their confidence intervals only. Obviously, at two years prior to the first birth and five years postpartum, the predicted levels of mental health of the two groups are indistinguishable, but there exists a significant separation between the two sets of confidence intervals of the two groups between 0 year to a bit over 3 years postpartum. An earlier study of teenage mothers in England and Wales found that over two-fifths of the

women suffered from depression in the period of between three and 15 months after the birth of their "survey" baby (Simms and Smith 1986). The BHPS data allow us to go beyond the 15 months' limit of the earlier research. The findings here strongly indicate a more prolonged effect, or rather, a medium to long range effect of first birth on teenage mothers' mental health.

It may be puzzling to many as to why teenage mothers show a much elevated level of depression since most important potential confounding factors have been taken into account in the analysis. It is possible that certain teenagers self-selected into motherhood. Some of the factors for the selection may include, for example, young mothers who are more likely to have come from economically and educationally disadvantaged background (Kiernan 1997), and they tend to have mothers who were themselves young mothers (Kiernan 1997; Manlove 1997). Yet these young mothers would themselves be lower in their socioeconomic status, which was taken into account in the current analysis. The additional analysis in Table 3 also suggests that father's occupation does not matter. Thus, one can conclude from Figure 4 that teenage mothers' mental health status might not necessarily be worse than their counterpart two years before and it converges to the level of their counterpart five years after the birth. The explanation of the higher level of depression among teenage mothers may be birthweight and care related since studies showed that teen mothers in the U.S. at least were less likely to receive timely prenatal care and that their babies tended to have lower birthweight (Ventura and Curtin 1999). Lower birthweight and poorer infant health may have further, indirect impact on mothers' mental health.

Another viable explanation may be the possibility of an effect due to the shock factor. In their sample of women, Allen and Dowling (1999) found that, although 40% of them were pleased or delighted to find that they were pregnant, a quarter of the women were shocked and surprised, and a further quarter of them were scared or horrified. Some

women were devastated when they found they were pregnant: “I was gutted. I didn’t want to be pregnant,” but continued with the pregnancy after considering an abortion. However, continuing with the pregnancy was often not so much a decision as an acceptance of what had happened (Allen and Dowling 1999). It is not difficult to see that since half of their teenage mothers were shocked and unprepared to be a mother, it would be more likely for them to be depressed for longer when a baby was around.

In the second analysis we analyzed the issue of pivotal age at first birth in the BHPS sample. As suggested by the results from the first analysis and specified in the model of (6), we must include the interaction between the new age at first birth variable and the years since birth variable as well as the squared terms of the new age at birth variable and the interaction. Two such models including these in addition to all the control variables are presented in Table 4.

---Table 4 about here---

The first model in the table was estimated using all cases while the second, to focus on the postpartum years, was fitted using the cases of one to eight years after birth. While there are some changes in the effects of the control variables from the first analysis, for example, significant effects of having a university degree and permanent job but nonsignificant effect due to adjusted level of household income, we focus our attention on the interpretation of the effects that assist the estimation of pivotal age at first birth. It appears that the motherhood variable in the second model and the variable representing the internal modifier model and its interaction with time since birth in both models are important predictors of depression.

By applying (7), one may easily compute estimated pivotal age at first birth, namely, the age prior to which being a mother would have a higher level of depression than a nonmother and after which being a mother would have a lower level. Using k_{FB}=27, sample

mean of age at first birth, and the estimates from Table 4, we arrive at two sets of pivotal age at first birth estimates for various postpartum years. However, the estimates may not be sensible (i.e., too much outside the usual childbearing age limits) until at least five years postpartum according to the first model or four years postpartum according to the second model. The estimates of the pivotal age at first birth for five to 10 years since birth are as follows:

Postpartum	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Model 1	51.28	40.68	36.52	34.31	32.92	31.98
Model 2	42.50	39.33	37.27	35.76	34.65	33.79

Model 1 produces estimates that are a faster decreasing function of time since birth than Model 2, which relies on the data of the postpartum with the most cases (i.e., 1-8 years). Realistically, because the majority of women give births before age 30, there does not exist a pivotal age for them until when they get much older, namely, many more years after 10 years postpartum.

In comparison, when a cross-sectional design is used, the picture can be drastically different. For example, analyzing a cross-sectional sample of 2,592 US adults aged 18 to 95, Mirowsky and Ross (2002) found a pivotal age at first birth around the age of 23. Whereas such an early pivotal age would be much more interesting and useful because that is close to the sample mean age at first birth in their study, we should not forget that such estimate must be a mixture of many estimates of pivotal age at first birth. Put differently, the youngest women in the sample (i.e., the 18-year-olds) would be no more than three or so years postpartum, but births for the oldest women (i.e., the 95-year-olds) would be at least half a century ago, assuming that they gave birth at a late age of 45. In that sense estimates

of pivotal age at first birth take on a different meaning because of the mixing effects, bearing the combined imprints of time since birth as well as age (and cohort). A typical cross-sectional design relies on women on average beyond the first five to 10 years postpartum, and often they are much older when the average age of a sample is in the forties, a typical age for a national cross-sectional sample. This makes it impossible to tease out the effect of time since birth. In contrast, the panel design in this paper distinguishes such effect from other effects such as age of mother and time elapsed since the event because the event is always defined within the most immediate wave of the survey. Consequently, we may infer from the results that there is really no emotional benefit from having a birth because benefits after five to 10 years after the birth can not really be viewed as resulting from the birth, but rather, it can only be viewed as benefits of motherhood that become apparent when the child is older.

The findings from the analysis of pivotal age at first birth, taken together with the findings from the analysis comparing the mental health teenage mothers with other women, suggest three major patterns in the relation between mental health and age of first-time motherhood. First, motherhood can influence a woman's psychological well-being negatively. While teenage mothers may be "shocked" by the birth of a child because the majority of teenage pregnancies are unplanned (Allen and Dowling 1999), women who are older and thus better prepared or planned for the birth still will be subject to possible negative mental health effects. Second, the negative mental health effects are fairly long lasting. That is, there is no reasonable pivotal age at first birth to speak of within five years postpartum, suggesting a poorer mental health status for all mothers; for the first three years teenage mothers' psychological well-being can be significantly worse than their counterparts. This finding can have important ramifications because teenage mothers were found no more likely than older mothers to rely on income support (Noble, Smith, and Cheung 1998),

thereby pointing to a need for a special support mechanism. Finally, the possible existence of a pivotal age at first birth for thirty-something mothers suggest that, even though they, as well as younger mothers, may not experience a psychological boost in the short to medium term of a birth, motherhood may give them a boost when their children are school-aged, at least five years postpartum.

Conclusions

From the analyses three substantive conclusions can be reached, vis-à-vis the three research foci. First, the teenage mothers in the BHPS data appeared to have a significant lower level of mental health than the other mothers or teenage nonmothers. This difference can at least in part be explained by the research on teenage mothers that gave evidence to the surprise arrival of a new life resulted from a pregnancy that is not prepared (Allen and Dowling 1999). Second, while there is some evidence for long-term convergence in the level of mental health between the teenage mothers and the others, the mental health trajectory of teenage mothers appears to be different from that of the other women. Teenage mothers tend to have an elevated medium-term depression whereas the curves for the older mothers tend to be flatter. From the point of view of policy making, more focused efforts should be given to helping teenage mothers, especially during the first three years postpartum.

Third, the pivotal age at first birth can only be meaningfully interpreted conditional on time since first birth. What do the findings tell us about the pivotal age at first birth in Britain? The 10 years of the BHPS strongly suggest three points. First, for most women having a first baby would dampen their mental health because the pivotal age does not come below age 35 until eight years after birth. It suggests that the impact of birth on mental health is long term. Second, the negative impact on a mother's mental health decreases with

age at first birth. The finding was consistently generated by the two different models. Finally, pivotal age at first birth is highly conditional on time since birth. For the short as well as the medium term, there is no meaningful pivotal age because the mental health curves of mothers and of nonmothers do not cross each other. Practically, the analysis has some important policy implications. Any support program should focus on the first five years, since only beyond that period some meaningful pivotal age at first birth can be estimated. This may be explained by the operation of the British education system, which offers compulsory primary education to children from five to 11 years. While many schools in England and Wales may also admit children under five into reception classes, the practice varies from area to area. It is possible that the beginning of formal education provides mental relief to a mother, but more research in needed to further explore along these lines.

There is also a methodological lesson from the current research. The results from the current analyses suggest that panel data enable the researcher to tease out the distinction between age effect and time since birth effect, and make it possible for the analyst to estimate age at birth effect on mental health conditional on time since first birth, whether focusing on the teenage years or more generally. This ability, not shared by analyses of cross-sectional data, will in turn assist our substantive understanding of the trajectory of women's mental health with respect to birth, or more generally, the long-term effect of a social event of interest in any sociological analysis.

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Appendix A: The 12-Item General Health Questionnaire (GHQ-12)

A: Able to concentrate

B: Loss of sleep

C: Playing useful role

D: Capable of making decisions

E: Constantly under strain

F: Able to overcome difficulties

G: Able to enjoy day-to-day activities

H: Able to face up to problems

I: Feeling unhappy or depressed

J: Losing confidence

K: Thinking self worthless

L: Feeling reasonably happy

Table 1: Random-Effects Negative Binomial Models of GHQ12 on Birth Groups

	Model 1		Model 2	
X Variable	Estimate	*Z*	Estimate	*Z*
Teen mother	.366	4.20	.364	4.16
Mother 20-29.9	.032	0.67	.034	0.72
Mother 30+	-.030	-0.48	-.029	-0.46
Years since (birth)			.018	2.43
			-.005	-4.34
Constant	-.162	-4.15	-.121	-2.94
Model χ^2	18.88 (p=0.000)		40.08 (p=0.000)	
LR test of dispersion	757.43 (p=0.000)		766.56 (p=0.000)	
N (persons)	8,684 (1,320)		8,684 (1,320)	

Table 2: Random-Effects Negative Binomial Models of GHQ-12 on Birth Groups and Confounding Factors

	Model 3		Model 4	
X Variable	Estimate	*Z*	Estimate	*Z*
Teen mother?	.185	2.17	.339	3.37
Mother 20-29.9?	.059	0.80	.064	0.84
Mother 30+?	.146	1.18	.240	1.89
Age	-.017	-2.40	-.012	-1.53
Tory years?	.142	3.48	.149	3.64
University degree?	.045	0.75	.015	0.25
Left school<16?	-.086	-0.71	-.109	-0.90
Adjust. income scale	-.112	-3.21	-.094	-2.61
Permanent job?	-.038	-0.93	.042	-1.01
Poor health?	.479	10.04	.486	10.19
Disabilities?	-.0004	-0.00	.003	0.02
Health problems?	.318	9.91	.317	9.89
Divorced/separated?	.426	4.39	.427	4.39
Partner together?	.047	1.04	.033	0.72
Job hours/week	-.003	-2.44	-.004	-2.77
Still in school?	-.128	-1.58	-.101	-1.23
Low social support	.186	7.34	.198	7.80
Years since (birth)	.033	3.45	.022	2.47
[Years since (birth)]^2	-.004	-3.68		
Teen mom×years			.030	0.80

20-29.9 mom×years			.003	0.20
30+ mom×years			-.008	-0.44
(Teen mom×years)^2			-.014	-2.74
(20-29.9 mom×years)^2			-.002	-1.09
(30+ mom×years)^2			-.003	-2.81
Constant	.125	0.80	-.041	-0.24
Model χ^2	410.99 (p=0.000)		432.78 (p=0.000)	
LR test of dispersion	547.81 (p=0.000)		550.82 (p=0.000)	
N	8,623 (1,319)		8,623 (1,319)	

Table 3: Random-Effects Negative Binomial Models of GHQ-12 on Birth Groups and Confounding Factors, Controlling for Father's Social Class

	Model 4		Model 5	
X Variable	Estimate	*Z*	Estimate	*Z*
Teen mother?	339	3.37	.444	2.31
Mother 20-29.9?	.064	0.84	.057	0.61
Mother 30+?	.240	1.89	.119	0.75
Years since (birth)	.022	2.47	.003	0.23
Teen mom×years	.030	0.80	.060	0.80
20-29.9 mom×years	.003	0.20	.011	0.62
30+ mom×years	-.008	-0.44	-.001	-0.07
(Teen mom×years)^2	-.014	-2.74	-.018	-2.01
(20-29.9 mom×years)^2	-.002	-1.09	-.001	-0.69
(30+ mom×years)^2	-.003	-2.81	-.007	-2.61
Father professional?			.017	0.30
… …				
Constant	-.041	-0.24	-.414	-1.66
Model χ^2	432.78 (p=0.000)		325.76 (p=0.000)	
LR test of dispersion	550.82 (p=0.000)		334.35 (p=0.000)	
N (persons)	8,623 (1,319)		5,144 (630)	

Table 4: Random-Effects Negative Binomial Models of GHQ-12 Testing Pivotal Age

	1: All Years		2: Years Since Birth: 1-8	
X Variable	Estimate	*Z*	Estimate	*Z*
Tory years?	.085	3.72	.090	3.47
University degree?	.099	3.29	.129	3.15
Left school<16?	.042	1.12	.100	1.53
Adjust. income scale	-.021	-1.09	-.013	-0.46
Permanent job?	-.124	-5.54	-.115	-3.53
Poor health?	.638	28.42	.684	20.42
Disabilities?	.114	2.12	.061	0.79
Health problems?	.352	20.64	.358	14.73
Divorced/separated?	.217	5.84	.220	4.15
Partner together?	-.038	-1.51	-.056	-1.55
Job hours/week	-.003	-4.28	-.001	-0.68
Still in school?	-.106	-1.84	.027	0.32
Low social support	.152	14.08	.178	11.03
Motherhood	.044	1.13	.116	2.31
(Age-μ_{age})	-.008	-5.66	-.006	-3.02
(Age-μ_{age})^2	-.00001	-0.12	-.0002	-1.17
Years since (birth)	.005	1.42	-.002	-0.21
(A_{FB}-27)Parent	.001	0.22	-.004	-0.33
[(A_{FB}-27)Parent]^2	.002	2.43	.003	2.69
Year(A_{FB}-27)Parent	-.001	-1.10	-.001	-0.43
[Year(A_{FB}-27)Parent]^2	-.00007	-3.67	-.0002	-3.71

Constant	-.418	-8.52	-.403	-5.43
Model χ^2	2,327.01 (p=0.000)		1,211.07 (p=0.000)	
LR test of dispersion	1,640.77 (p=0.000)		458.40 (p=0.000)	
N (persons)	31,839 (7,205)		15,319 (4,839)	

Figure 1: Distribution of Births in Britain, 1991-1997 BHPS (N=560)

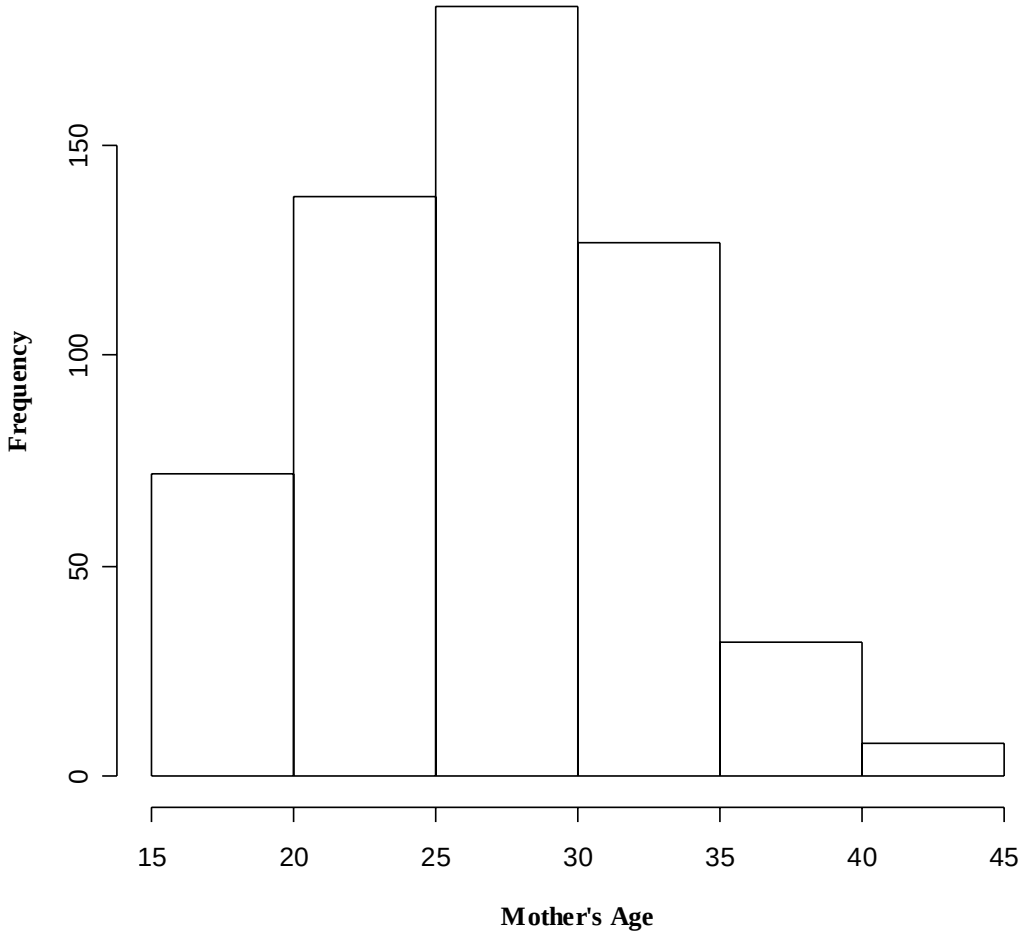

Figure 2: Distributions of GHQ-12, 1991-2000 BHPS (N=8,623)

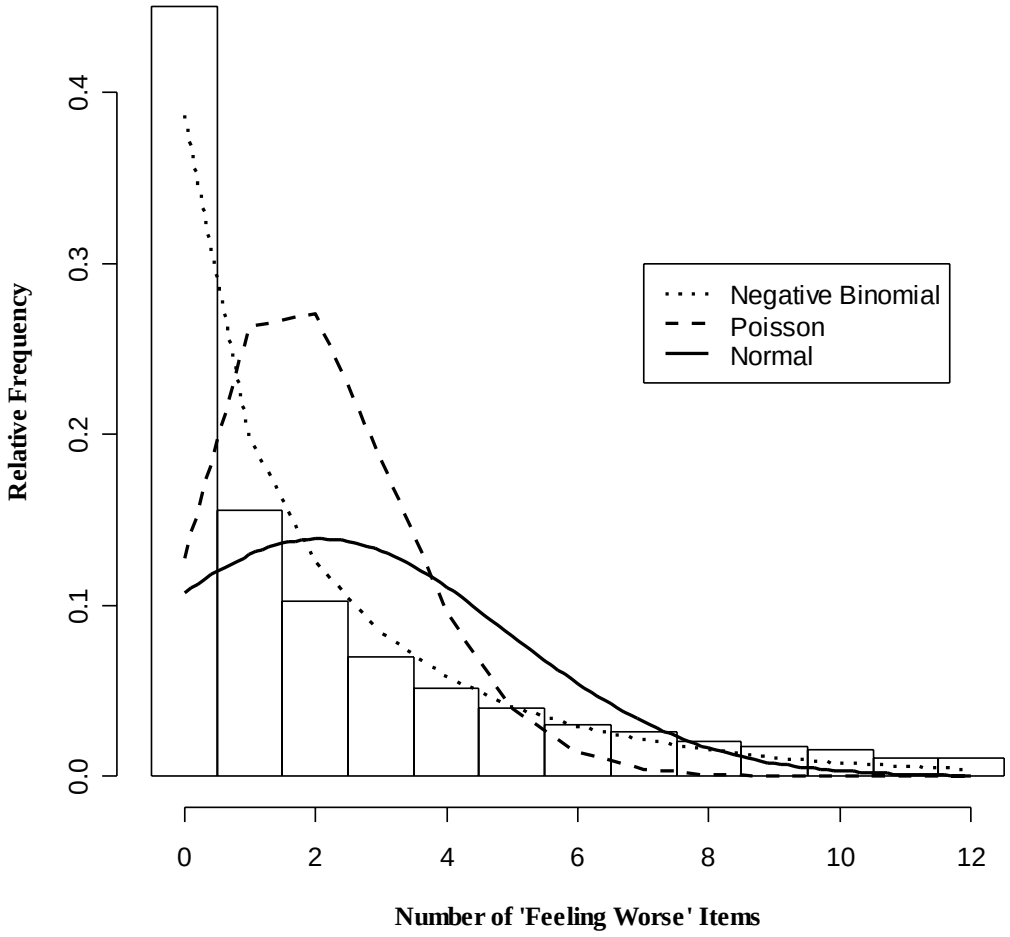

Figure 3: Predicted Depression according to the Random-Effects Negative Binomial Model

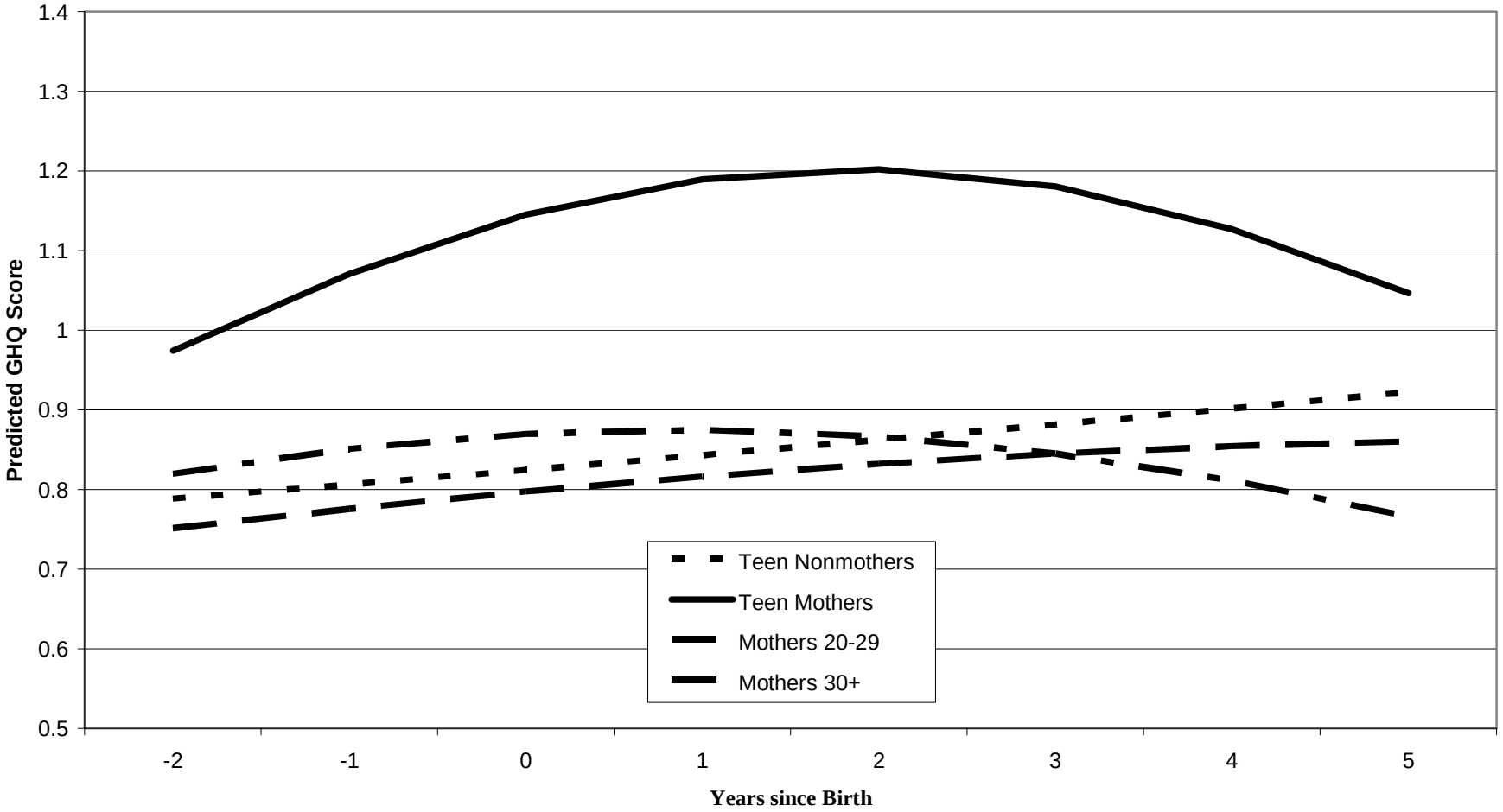

Figure 4: Predicted Depression with 95% CIs according to the Random-Effects Negative Binomial Model