

## Motherhood: A Burden on a Woman's Career

*How childbearing affects wages across different education levels, races, and regions*

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### **Abstract**

This paper examines the role that having children, getting married, and educational attainment level play in affecting a women's earnings and therefore her career by using five different econometric regression models. Data from IPUMS-CPS of June of 1990 and 1995 was used, and the results show that a woman does suffer a wage penalty due to motherhood. Not accounting for other variables, a one-year motherhood delay among women with a college degree increases her weekly earnings by \$7.11. For women with no bachelor's degree, a one-year increase in motherhood delay will increase her weekly earnings by \$4.99. This leads us to conclude that college-educated mothers do not experience such a high wage penalty for having children than women who didn't pursue a college degree, hence a positive relationship exists between a woman's education level and her earnings. Similar to what Baxter et. al concluded in their study, this paper found little or no correlation between marriage delay and a women's earnings. A possible explanation to this is that marriage does not usually imply childbearing for many women who have less liberal views on gender roles (Blount et. al, 2007). More black respondents in this study were single than white ones, which could motivate black women to be in the labor force for longer periods of time and served as a possible explanation as to why black mothers experience a lower wage penalty after childbearing than white ones. Earnings are also influenced by region, since the presence and quality of educational institutions and job opportunities vary from region to region. This may affect the education levels that women pursue as well as the job and industry that they work at, which can therefore influence their childbearing decisions and the effect of these in her career (Blount et. al, 2007).

## I. Introduction

Previous studies and literature have concluded that delaying motherhood is associated with greater opportunities for career growth and higher earnings. One of the main drivers of this delay is a woman's educational attainment level, since an educated woman is aware of the opportunities for career growth that she has ahead of her. Therefore, she may decide to delay childbearing because the opportunity cost of having kids is higher for her than it is for a woman with a lower educational attainment and therefore limited opportunities and career goals. Educational attainment information in this study is represented through dummy variables that reflect whether or not the woman graduated college. Women with low educational attainment not only tend to have children at a younger age than their college-educated counterparts, but returns to age at first birth also appear to be lower for them than for women with a Bachelor's Degree or higher.

Region also plays a role in determining a woman's childbearing actions, since the demographics of each region can greatly influence the accessibility a woman has to good education and job opportunities, which in turn affect her childbearing decisions and therefore earnings.

The effects of having children also vary across different races. Similar to the findings of this paper, white women suffer greater wage penalties than black women (Blount et. al, 2007). A possible explanation to this is that more black women are single mothers (in this study, 16.2% more white women are married relative to black ones), which motivates them to continue in the work force and develop professionally rather than abandoning the work force and focusing on a more conservative and traditional role in the household – such as taking care of the children rather than working (Blount et. al, 2007). Another possible explanation for this is the fact that black women have a more liberal gender ideology than white women, so they are more motivated to stay in the workforce regardless of being mothers (Blount et. al, 2007).

So by how much does maternity affect a woman's weekly earnings depending on her educational attainment, race, and region? And how influential are such factors on a woman's childbearing decision? This study explores the differences in the correlation between motherhood and wages across different education levels (either the woman is a college graduate or she isn't), race (white women versus black women), and region (Northeast, Midwest, or South) in order to answer these questions. Marital status is also considered to try to explain why black women suffer lower wage penalties than white ones.

The question of how early motherhood correlates with lower earnings as well as how education, race, and region play a role in this issue is important because of the effect that this has on the survival of society, since increased fertility and therefore motherhood leave make it hard for firms and businesses to find temporary replacements as aging population and reduced economic growth continue to prevail (Ameudo and Kimmel 2003). A possible explanation as to why motherhood is negatively related to wages is the fact that it makes many women prioritize caring for their children over their jobs. According to Buchamann and McDaniel (2016), this makes them lose work experience, hence making it harder for them to re-enter the work force when they see fit and seeming less attractive for firms and businesses relative to their male counterparts who most likely have more experience. This penalty reduces women's earnings and therefore makes them cut back on spending. In the long run, this may affect their earnings and their children as well, since lower wages make it harder

for mothers to invest in their child's education.

Another possible explanation between why motherhood is negatively associated with earnings is marriage, since it can either demotivate women to continue in the workforce or make them more inclined to have children. In this study, marital status was an important factor in determining a woman's childbearing wage penalty. Single mothers, for instance, are the ones who carry this burden the most, since they are the only ones responsible for the financial sustainability of their household and don't have a spouse that can either take care of the family expenses or at least contribute with them to some extent. This may be a motivation for them to not leave the workforce and therefore have higher wage growth than their married counterparts in the long run. This paper uses econometric methods to determine which possible explanation of the relationship between motherhood and wages is more appropriate (Cawley, 2004).

Section II examines the results of similar studies and compares those findings to the ones in this paper. Section III contains the econometric models as well as a brief overview of the different analyses used that examine the effect of motherhood and on wages along with the influence that education level, race, and region have on these decisions and on earnings. Section IV contains the data and descriptive statistics of this paper. The explanation and details of the empirical results of the analyses of this paper are in Section V, and Section VI includes the conclusion (Cawley 2004).

## **II. Literature Review**

Several papers have studied the relationship between earnings and either motherhood or marriage age among women along with race, region, and educational attainment level. Cheng (2015), Buchamann and McDaniel (2016), Blount et. al (2007), and Baxter et. al (2002) examine the effects of motherhood and marriage delay on earnings as well as the role that race, human capital factors, and family characteristics play in determining a woman's career growth.

Siwei Cheng's study analyzed data from the National Longitudinal Survey of Youth of 1979. According to Cheng, past literature associated marriage with a small wage premium and even sometimes a wage penalty for women (Cheng, 2015). According to Cheng, past literature found that marriage had a negative effect on women's motivation to work for both black and white women. Literature also found that black women receive a smaller wage penalty for having a child than white women do when controlling for marital status (Cheng, 2015), which is similar to the conclusions of this paper. Cheng (2015) also concluded that childbearing brings career impediments for both white and black women.

Claudia Buchamann and Ane McDaniel's 2016 study used IPUMS and ACS data from 1980 and 2010 to examine the difference between earnings of women with children and women without children across different levels of education (Buchanan and McDaniel, 2016). Prior research showed that the negative effect of motherhood on wages varies through race and ethnicity (Buchanan and McDaniel, 2016). Other literature also suggested that a potential reason for the negative relationship between motherhood and wages can be the fact that childbearing usually makes women take maternity leave and reduce their work hours, which in turn causes the loss of work experience, a key determinant of higher wages, promotion, and career development (Buchamann and McDaniel, 2016). The study controlled for average hours worked per week, a dummy variable for education beyond a bachelor's degree, age, age squared, marital status, and race (Buchamann and McDaniel, 2016). Similar to the

findings of this paper, Buchanan and McDaniel found that “African American women have smaller negative wage differentials for motherhood than white women.”

The study made by Blount et. al used data from the National Longitudinal Survey of Youth (NLSY) from 1988 to 1998. Previous studies had found that women with children faced more wage barriers than their male counterparts and women without children (Blount et. al, 2007). According to some scholars, motherhood is the riskiest economic decision a woman can make, since childbearing in many cases not only makes a woman responsible for the care of her child but also for the economic maintenance of her home or family (Blount et. al, 2007). This literature examines whether the effects of childbearing are the same between white and black women, and regressed earnings on gender ideology ideals, education, race, and region. The study found that conservative gender ideology (opinions that support having a more traditional family) reduces earnings more for white women than for black ones, and that black women have less conservative gender ideologies than do white ones (Blount et. al, 2007). This can explain why black mothers have smaller wage penalties, since more liberal gender ideologies motivate them to remain more time in the labor force. Similar to what was found in this paper, Blount et. al state that previous literature has concluded that levels of educational attainment vary depending on the region in which an individual lives in. This is relevant and similar to what was found in this paper, since the quality of educational institutions as well as job opportunities vary from region to region (they are different in the South and Northeast regions) and therefore may change the educational and career opportunities that women can obtain (Blount et. al, 2007).

Baxter et al. (2002) used data from a 1996-97 Australian data survey titled “Negotiating the Life Course Project” to investigate the impact of marriage on earnings. They analyzed marital status, family (whether the person had kids or not), age, education, experience, and job characteristics. They regressed the log of gross annual income before tax on the independent variable marital status, which consisted of dummy variables for never married, previously married, and currently marrying or cohabiting (Baxter et al. 2002). The study found that for women, “the relationship between marriage and mean earnings tends to be small and non-significant” (Baxter et al. 2002). Therefore, as time passes, the effect of marriage on earnings becomes smaller, maybe due to political and social factors such as more gender equality in the workforce (Baxter et. al, 2007).

### III. Econometric Model

This paper examines the effect of childbearing, marriage, education level, race, and region/location on a woman's earnings. It also studies how these factors can influence a woman's childbearing decision. Past studies have established that a woman's career *is* affected by motherhood and marriage, since caring for her children (in most cases) becomes a priority above career development. Studies have also shown that wage penalty due to motherhood varies across races and ethnicities (Blount et. al). This study found that white women have children and get married at an older age than black women, and they also attain on average a slight higher level of education, as seen in Table 3. This could explain the higher weekly earnings of white women when not taking into account other factors.

The following econometric model looks at the effect that age at first birth  $B$ , age at first marriage  $M$ , education level (college graduate or non-college graduate), race (either white or black) and region (Northeast, Midwest, or South) have on a woman's weekly earnings,  $W$  or *Wage*. As Table 3 shows, women with higher education levels (a Bachelor's Degree or higher) tend to marry and have children at an older age than woman who didn't graduate from college, hence the effect that having children will have on her earnings will be less than the effect on the earnings of her less educated counterpart.

An explanation to this is the fact that a more educated woman is likely to be more optimistic about her professional future, and may decide to invest on her career for more time than a woman who didn't graduate and who believes she has no opportunities for wage or career growth.

Something similar happens among white women. On average, they tend to have children at an older age than black women, leading them to have higher weekly earnings and greater career growth and opportunities when not taking into account other factors. However, as Table 3 of the appendix shows, the sample used in this study found that white women tend to marry at a younger age than black women when omitting other variables, but this did not have a negative effect on their earnings. Despite marrying younger, white women still earn more, which could mean that marriage does not necessarily have a negative effect on earnings. This agrees with what Baxter et. al (2002) found in their study, and can be explained by the fact that when getting married, in many cases, the earnings of women and their spouses are put together.

Women who live in the Northeast region of the US were the ones that on average showed higher education levels, and they were the ones who married and had children at older ages than women in the Midwest, West, and South regions of the US. Factors such as greater presence of educational institutions or job opportunities in each region could account for the fact that women in the Northeast region were more educated, got married, and had children at older ages than women in other regions. Also, middle to high-class families tend to live in the Northeast, and there is presence of academic institutions such as well-known colleges and universities. This can explain the higher earnings, education, marriage age, and motherhood age in this region when compared to the others. In general, there are more opportunities in this region for career growth and education than there are in others. Section IV of this paper goes into detail about the results found in the regression, and analyzes the effect of each region on a woman's earnings, which can also be found on Table 4.

The first econometric model assumes that weekly earnings  $W$  and age at first birth  $B$ , age at first marriage  $M$ , being a college graduate  $colgrad$ , race ( $white$ ), and region have the following relationship:

$$(1) W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 colgrad + \beta_5 white + \beta_6 northeast + \beta_7 midwest + \beta_8 south + e$$

In Equation 1,  $B$ ,  $M$ ,  $colgrad$ ,  $white$ , and regions are independent variables that affect a woman's weekly earnings,  $W$ . A dummy variable for the woman's education was created, and it is coded as  $colgrad = 1$  if a woman has a Bachelor's Degree or higher (received 16 or more years of education) and 0 if otherwise. Another dummy variable for race was created and it was coded as  $white$ , where  $white = 1$  if the woman is white and 0 if she is black. Dummy variables for each region (Northeast, Midwest, and South) were also created to compare the different weekly earnings, education level, and age at first birth and marriage for the women in each region. West region was used as a base and not considered.

The OLS estimates in this model are interpreted as the true effect of a woman's age at first birth on wages (since this is the main variable of interest) while also taking into account age at first marriage, education, race, and region. Table 1 in the Appendix has the labels and descriptions of all the variables used in this paper.

When looking at a histogram of our sample (shown in Graph 1 in the appendix) to see the distribution of weekly earnings, we see that the data is concentrated on the left and is right skewed. To make the distribution more normal, we take the log-linear model of the data, which has the same  $x$

variables as the first model but the dependent variable is in log form as seen in Table 4. This model shows the effect of each independent variable on log earnings in percentage terms.

When generating the histogram for earnings in this second model, the data appear more normally distributed than in the multiple regression model. The OLS estimates for Model 2 are discussed and analyzed in Section IV and can be found on Table 4.

The third model examined in this paper is the quadratic model, which introduced a quadratic term on education since returns to weekly earnings are not the same across all levels of education.

$$(2) W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{education}^2 + \beta_5 \text{white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south} + e$$

This model was useful to see the returns that an extra year of education brought to women depending on how educated they already were, that is, the marginal effect of education on weekly earnings. In the quadratic model, the dummy variable for college graduates was substituted for the squared variable of years of educational attainment. The OLS estimates of this model are further discussed in the next section and can also be found on Table 4. In short, the marginal effect of education on earnings shows that the higher the level of education of a woman, the greater returns (weekly earnings) she will receive for every additional year of education that she obtains.

To see how the effect of motherhood on earnings varies with education if a woman is a college graduate, an interaction term between age at first birth and college graduate was created. This multiplicative term is useful to understand how the effect of age at first birth on a woman's weekly earnings varies with her level of education – whether she is a college graduate or not. This model considers the same independent variables as models 1 and 2, and adds the new variable which is represented by  $B * \text{colgrad}$ . The coefficients and the results obtained from this sample to interpret this model can be found in Table 4 and are examined and analyzed in Section IV.

To see the differences in the wage penalty that motherhood brings among black and white women, an interaction term between age at first birth and race was created ( $B * \text{white}$ ). This interaction term, along with the one in Model 4, is included in Model 5 to examine how the marginal effect of age at first birth on earnings varies not only depending on a woman's educational attainment level but also on her race.<sup>1</sup> Results for white college educated and non-college educated women as well as black college educated and non-college educated women are studied in the Results section of this paper, and the OLS estimates of the model are in Table 4.

Hypothesis tests were also conducted to see the difference between the importance of the main variable of interest and other variables in the study. One test tested to see if education was at least 20 times more important than age at first birth in determining earnings.<sup>2</sup> A second test was made to see if race (being white) was five times more important than age at first birth in explaining earnings. The conclusions of these tests are in the Results section of this paper, and the null and alternative hypothesis are in Table 5. Another hypothesis test was made to see whether or not at least one of the variables used in this study brought returns to earnings through the F-test at a 95% confidence level.

In order to test for multicollinearity, the correlation between the independent variables was

<sup>1</sup>  $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{colgrad} + \beta_5 \text{white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south} + \beta_9 B * \text{colgrad} + \beta_{10} B * \text{white} + \epsilon$

<sup>2</sup> 20 was chosen because the coefficient of education was much larger than the one of age at first birth

examined to see how related the variables were with each other. The correlations between the variables are shown in Table 7.

Model selection criterion was also studied to determine which of the four models in this study best fit the data. AIC, BIC, and the adjusted  $R^2$  across the models were compared. The SSE in the log-linear model was first made comparable to the dependent variable in the other models which were in linear terms, and can be found in Table 6.

To determine whether there is omitted variable bias present in each model, a RESET test was conducted to see if there were misspecification errors in the studies. The p-values of each model's RESET test are in Table 6, and they are useful to see whether the null hypothesis (there are no omitted variables) is rejected or not.

#### **IV. Data and Descriptive Statistics**

The data used in this study is from the IPUMS Current Population Survey (CPS) website, which takes into account US information. The sample only includes women who answered the questions of this survey in June of 1990 and in June of 1995. The sample size was initially of 289,854 observations, but after dropping missing observations and categories that were not useful for this study, the sample size ended up being 4,884.

The respondents of this study were asked to disclose their race. The different races were white, black, American indian/aleut/eskimo, Asian or Pacific Islander, Asian only, or other (single race). However, this study dropped all of the races that weren't white or black, so this paper only examined white and black women. There was missing data/observations for women who had two or more races, so this information was dropped and not taken into account.

Initially, there were nine different divisions that the sample considered: New England division, Middle Atlantic division, East North Central division, West North Central division, South Atlantic division, East South Central division, West South Central division, Mountain division, and Pacific division. In order to make the data easier to analyze, the different divisions were paired depending to the region that they belonged to. Northeast, West, South, and Midwest regions were created. The New England and Middle Atlantic division were included into the Northeast region, East North Central and West North Central divisions were included in the Midwest region, the South Atlantic, East South Central, and West South Central divisions were included into the South region, and the Mountain and Pacific divisions were included into the Western region. West was not included in the regression models because it was used as the "base" region.

The IPUMS CPS data had the age of women when having their first child in months rather than years. In order to be able to analyze the effect of a one-year increase of age at first birth on earnings, the variables were converted into years. This was done by pairing every 11.9 months with their respective age in years. For instance, women coded as having their first child at 300-311 months old in the original CPS data were then replaced to show that they were 30 years old. The sample had women who had their first child from ages 12 to 50 years. Missing observations (not in universe) coded as 999 were dropped and not considered.

The same happened with the age of women at the time of their first marriage. The CPS gave the ages in months rather than years. To fix this and make the data easier to understand, ages in months

were replaced with their respective ages in years. Women who got married for the first time from the age of 480 to 491 months were replaced to show that they were 40 years old. This was done for every single year of age from 12 years to 61 years. Unavailable or missing observations coded as 9999 were replaced with "." and dropped and not considered.

Codes for education level were also replaced and correctly coded. Observations coded as having "blank" education were dropped and not considered. The CPS coded education as the highest grade level that a woman attended. For example, "grade 7" represented women who attended school until grade 7, "bachelor's degree" represented women who graduated college, and so on. For the purposes of this study, educational attainment levels had to be in terms of years of education rather than in terms of grade level. To do this, "grade 7" was replaced with 7, which represented 7 years of education, "grade 5 or 6" was replaced with 6, which represented 6 years of education, "12<sup>th</sup> grade" was replaced by 12, which represented 12 years of education, "bachelor's degree" was replaced with 16, which represented 16 years of education and so on. Educational attainment levels of "none" or "preschool" were both replaced with having zero years of education, so that's why the new codes for educational attainment levels in terms of years represented their grade level equivalent.

The marital status variable included married women with a present spouse, married women with an absent spouse, and separated, divorced, and widowed women. Women who were married and had either a present or an absent spouse were considered as being married. Separated, divorced, and widowed women were coded as not married. Something that this study found was that white women earned less than black women did weekly, as seen on Table 3. A possible explanation to this is that more white women who have children are married than black women who have children, which makes black women be single mothers and therefore be the only source of income in their family. Since marriage usually demotivates women to work and continue with their careers, single black mothers must work and can't stop their careers in order to be able to sustain their children and themselves. The fact that black women are driven to work more allows them to develop more professionally in the long run and therefore have higher earnings. The marital status variable let us prove or disprove this theory. Table 3 shows that a greater percentage of white women is married than black women, which serves as a possible explanation as to why black women appeared to earn more than white ones.

## V. Results

The results suggest that delaying motherhood along with having a higher level of educational attainment is better for a woman's career and weekly earnings. Marriage delay, on the other hand, showed a small and almost insignificant effect on earnings, which is similar to what Baxter et. al found in their 2002 study using samples from the 1990s as well. A possible explanation for this is the fact that when married, a woman's and a man's earnings are "pooled" together, so when a woman gets married, the earnings of her husband can also be considered hers when not considering other factors.

Education plays a pivotal role in determining the age at first birth and marriage of a woman, therefore affecting her career growth and earnings. Table 3 in the Appendix shows the descriptive statistics of this sample by education level: either the woman is a college graduate or she isn't. Women with a college degree and women without a college degree, on average, tend to have children when they are 25.56 and 22.26 years old respectively. This is a three-year motherhood delay differential means higher earnings for women who are college graduates. The same is seen with marriage age: less educated women, on average, marry when they are 20.43 years old, compared to college educated women who tend to marry at an age of 22.18 years. Women with higher levels of education may be

more career-oriented and interested in their professional development, hence choosing to delay both motherhood and marriage in order to focus on their careers for a greater amount of time.

As Table 3 shows, white women tend to earn \$2.60 more per week than black women when not accounting for other variables. White women marry and have children at an average age of 20.49 and 22.68 years, whereas black women marry and have children at an average age of 21.43 and 21.31 respectively. The fact that black women marry at an older age yet still earn less than white women further supports what was previously mentioned about the fact that there is little or no significant effect of age at first marriage on earnings, which will be examined further in this paper.

Furthermore, region can have either a positive or negative effect on a woman's earnings. A woman in a region where people are more educated and therefore earn more is likely to have a greater level of education, marry later, and delay motherhood more than a woman who lives in a region where people tend to be less educated and there are less opportunities for career growth. The Northeast was the region where women were more educated and earned more, and where they married and had children at an older age. The South, on the other hand, was the region where women were less educated and had children and got married the youngest. However, despite these factors, women in the South were not the ones who earned less on average. The Midwest was the region where women earned less, earning \$339.68 compared to the average of \$361.71 of all other regions. Table 3 shows the results of the descriptive statistics according to each region. Table 2 shows the descriptive statistics of each variable.

#### *Model 1: Multiple Regression Model*

The results of the multiple regression model shown in Table 4 showed that a one-year increase in motherhood delay will increase a woman's weekly earnings by \$5.18 when regressing earnings on age at first birth, age at first marriage, education, race, and region.

The effect that each variable has on weekly earnings can be interpreted through semi-elasticity. At the mean level of \$356.34 (Table 2) and a  $b_2$  of \$5.18, a one-year delay in motherhood will increase weekly earnings by 1.4% at a 1% level of significance.<sup>3</sup> Therefore, a positive relationship does exist between motherhood delay and weekly earnings.

Regarding age at first marriage, a one-year delay in marriage will have little or no effect on a woman's wages, and will cause a .05% decline in her weekly earnings. Since the p-value of age at first marriage is .854, this x variable, in this model, is not significant in explaining earnings. This minimal effect can be explained by the fact that women's role in society has become more prominent, and gender equality in the workplace has been increasing over the years. Marriage does not cause a substantial negative effect on earnings because women continue to work despite being married, which is not the case when a woman has a child. Therefore, there doesn't seem to be a significant relationship or effect between marriage age on earnings, as Baxter et al. (2002) found.

The relationship is strongest when looking at a woman's education level. A one-year increase in education will cause a 76.85% increase in her weekly earnings, and college graduates earn \$273.85 more per week than do women with no bachelor's degree. This is at a 1% significance level, which further proves that a woman's education attainment level (whether she is a college graduate or not) is significant in explaining her weekly earnings.

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<sup>3</sup>  $((\$5.18/\$356.34)*100)$

Table 3 shows that white women earn \$2.60 more per week than black women when excluding other variables. However, when not excluding other variables such as age at first birth, age at first marriage, education, and region, the results change and show that white women in this sample earn \$21.17 less than do black women, or white women earn 5.94% less per week than black women. This study found that 75.68% of white women were married and that 59.4% of black women are married, as seen in Table 3. This can explain why black mothers are inclined to grow more professionally and focus more on their careers than do white mothers. Therefore, since more black women are likely to be single mothers than white women, they are less inclined to stop working once they have children, hence they develop more than do white woman professionally, earning higher wages in the long run.

The OLS estimates of the multiple regression of the variables in Table 3 showed that women in the Northeast earn the most and that women in the South earn the least. The Midwest is in the middle of these two. Living in the Northeast region increases a women's weekly earnings by \$27.81 or 7.8%, whereas living in the South decreases them by \$2.81 or .78%. Therefore, the region a woman lives in does have an effect on her weekly earnings, since each region has different demographics and educational and job opportunities that in the long run affect factors such as the age at which a woman gets married, has children, the education level she pursues, and her earnings.

The OLS estimates in this multiple regression model therefore show that a woman who delays childbearing, marries young, is a college graduate, is black, and lives in the Northeast region will have the highest weekly earnings. Conversely, a woman who gets married late, has children very young, does not have a college degree, is white, and is from the South will have the lowest weekly earnings.

#### *Model 2: Log-linear model*

When making the data more normally distributed through the log-linear model, the OLS estimators for the log predicted model, shown in Table 4, allow us to analyze the effect of each variable on log earnings through semi-elasticity. A one-year increase in age at first birth, living in the Northeast, and being a college graduate will lead to a 1%, 3%, and 64% increase on a woman's log earnings respectively. A one-year marriage delay, being white, living in the south, or in the Midwest will decrease a woman's log weekly earnings by 3.9%, 2%, and 4.9% respectively.

This model makes the distribution of the data more normal, since the data based on Model 1 appeared to be right skewed, as shown in Graph 1. When looking at the histogram of log weekly earnings in the log-linear model shown in Graph 2 in the appendix, the distribution is much more normally distributed.

#### *Model 3: Quadratic model*

Introducing a quadratic term in education shows that returns to education on earnings are not the same across different levels of education. The coefficients of the Xs for such model are expressed in the equation below, where the dummy variable for college graduates was replaced with the variable of education.<sup>4</sup>

$$(2) \widehat{Wage} = \$76.73 + \$2.43 B - \$0.966 + \$1.68 \text{ education}^2 - \$15.90 \text{ white} + \$11.57 \text{ northeast} - \$21.06 \text{ midwest} - \$18.92 \text{ south}$$

<sup>4</sup> Since the dummy takes the value of 0 or 1, squaring it will say nothing about the marginal effect of education on earnings.

The quadratic term on education tells us that the slope of the function with respect to education is the following:

$$\frac{\partial \widehat{Wage}}{\partial education} = 2 * 1.68 \text{ education} \rightarrow 3.36 (\text{education})$$

This means that as education rises, returns to education regarding earnings also rise given the slope, which is not constant and depends on the level of education of a woman. For example, when comparing returns to education between women who graduated college (education = 16) and women who graduated High School (education = 12), the following results are obtained:

$$\left. \frac{\partial \widehat{Wage}}{\partial education} \right|_{\text{education} = 12} = 3.36 (12) = \$40.32$$

$$\left. \frac{\partial \widehat{Wage}}{\partial education} \right|_{\text{education} = 16} = 3.36 (16) = \$53.12$$

The results shown above demonstrate that more educated women in fact have higher earnings. A woman with a college degree earns \$12.80 more per week than does a woman who only obtained a High School diploma. This means that per year, a college educated woman earns \$640 more than a woman with no college education. The results also showed that a one-year increase in education will increase a woman's earnings by \$3.36 per week. In other words, returns to education for a woman who graduated college are greater than the returns to education for a woman who graduated High School.

#### *Model 4: Introducing an Interaction Term*

The introduction of an interaction term between age at first birth and the level of education paints a much clearer picture of the results discussed above, since it takes into account not only education level but also the main variable of interest, the age of a woman when she has her first child.<sup>5</sup> This allows us see how a variation or a change in the level of education affects the effects of childbearing on weekly earnings. The regression of the variables examined in this paper can be found in Table 4. The interaction term  $B * colgrad$  will now be used to interpret how the marginal effect of age at first birth on weekly earnings varies with education.

$$\frac{\partial \widehat{Wage}}{\partial age \text{ at first birth}} = \$4.96 + \$1.87 \text{ colgrad}$$

The equation above shows how the marginal effect of motherhood age on earnings depends on whether you're a college graduate or not. The marginal effect of age at first birth on earnings, if a woman is a college graduate, is of \$6.83. For a woman who did not receive a Bachelor's Degree, the marginal effect of age at first birth on earnings will be of \$4.96 dollars. Therefore, delaying age at first birth by one year will increase a college graduate's earnings by more than a non college graduates' weekly earnings. The results allow us to conclude that the more educated a woman is, the less of a burden she has on her earnings when having her first child.

<sup>5</sup>  $\widehat{Wage} = \$254.63 + \$4.96 B - \$0.15 M + \$226.57 \text{ colgrad} - \$21.02 \text{ white} + \$5.66 \text{ northeast} - \$21.81 \text{ midwest} - \$24.87 \text{ south} + \$1.87 B * \text{colgrad}$

This can explain why more educated women tend to have children at an older age than less educated women, since women with lower education can expect lower returns on earnings when delaying motherhood. This makes the opportunity cost of having children for them lower than the opportunity cost for a woman with a college degree who has more opportunities for a brighter future.

Something similar can be examined with how the marginal effect of education on earnings will depend on age at first birth. It is found by getting the expected value of weekly earnings when  $colgrad = 1$ , which is expressed in the equation below:

$$(3) E(wage|colgrad = 1) = \$254.63 + \$4.96 B - \$0.15 M + \$226.57 - \$21.02 \textit{white} + \$5.66 \textit{northeast} - \$21.81 \textit{midwest} - \$24.87 \textit{south} + \$1.87 B$$

The equation above shows how the effect of education on earnings can depend on how old a woman is when she has her first child ( $B$ ). The older, the better. The same can be found for a woman who is not a college graduate:

$$(4) E(wage|colgrad = 0) = \$254.63 + \$4.96 B - \$0.15 M - \$21.02 \textit{white} + \$5.66 \textit{northeast} - \$21.81 \textit{midwest} - \$24.87 \textit{south}$$

Subtracting Equation 4 from Equation 3 will give us the difference in the expected wage that college educated women and non college educated women earn when having children at a certain age.

$$E(wage|colgrad = 1) - E(wage|colgrad = 0) = \$254.63 + 1.87 B$$

Plugging in 25 in the equation to examine the difference in the earnings of a woman with a college degree and a woman with no college degree who both have a child at the age of 25, shows that a college-educated woman who has her first child at the age of 25 will earn \$301.38 more per week than a non-college educated woman who has her first child at the same age. The same can be examined if these women were to have their children at the age of 30. Plugging in 30 into the equation above, a college educated 30-year old mother is expected to earn \$310.73 more per week than her non-college educated counterpart. This means that returns to education on weekly earnings are greater for college educated women the older they have their child. Therefore, the older the age at which a college-educated woman has her first child, the less wage penalty she will suffer.

#### *Model 5: Adding $B*colgrad$ and $B*white$ into the regression*

The fifth model, which has the interaction term between age at first birth and the  $colgrad$  dummy as well as age at first birth and  $white$  dummy, can tell us how returns to earnings vary among white and black women across different levels of education. The OLS estimates for this model can be found in Table 4. Returns to age at first birth depending on a woman's race and educational attainment level were examined. The expected value of the earnings of white college graduates, white non-college graduates, black college graduates, and black non-college graduates are shown below:

$$(3) E(wage|colgrad = 1, white = 1) = b_1 + b_2 B - b_3 M + b_4 - b_5 + b_6 \textit{Northeast} - b_7 \textit{Midwest} - b_8 \textit{South} + b_9 B - b_{10} B$$

$$(4) E(wage|colgrad = 0, white = 1) = b_1 + b_2 B - b_3 M - b_5 + b_6 \textit{Northeast} - b_7 \textit{Midwest} - b_8 \textit{South} - b_{10} B$$

$$(5) E(\text{wage} | \text{colgrad} = 1, \text{white} = 0) = b_1 + b_2 B - b_3 M + b_4 + b_6 \text{Northeast} - b_7 \text{Midwest} - b_8 \text{South} + b_9 B$$

$$(6) E(\text{wage} | \text{colgrad} = 0, \text{white} = 0) = b_1 + b_2 B - b_3 M + b_6 \text{Northeast} - b_7 \text{Midwest} - b_8 \text{South}$$

To see how earnings change depending on age at first birth between a white college graduate and a black college graduate who has a child at the age of 25, the difference between Equation 3 and 5 above is taken.

$$E(\text{wage} | \text{colgrad} = 1, \text{white} = 1) - E(\text{wage} | \text{colgrad} = 1, \text{white} = 0) = \$56.65 - \$3.61 B$$

Plugging in 25 in the above equation, a white college graduate who has her first child at 25 years old earns \$33.6 dollars less per week than her black counterpart. A possible explanation for this is that the white woman, who is likely to have a more conservative gender role view (Blount et. al, 2007), will likely leave the work force entirely upon having her child, whereas childbearing for the black woman does not motivate her to stop working and therefore she is able to grow more professionally than her white counterpart. The same is examined for women who have their first child at the age of 30. A white college educated woman who has her first child at the age of 30 will earn \$51.65 less per week than her black counterpart. In short, the older the age at first birth of a white college educated woman, the more her weekly earnings will suffer relative to a black college educated woman who has her child at that same age. Therefore, weekly earnings do incur in a penalty depending on race. The wages of white women suffer more from childbearing than the wages of black women. The wage penalty due to motherhood is therefore lower for black college-educated women the older they have a child relative to white women (Blount et. al, 2007).

The difference between the effect that childbearing has on the earnings of non-college educated white women and non-college educated black women has the same effect as above.<sup>6</sup> Therefore, race is a determinant of the differences between the effect of childbearing on earnings, which is similar to what Blount et. al (2007) found in their study.

### *Hypothesis Testing*

To see *how* important education is in determining a woman's weekly earnings in this study, we substitute the dummy variable colgrad with level of education to see the importance of education in general in determining earnings.<sup>7</sup> We compare education's effect to the effect that the main variable of interest, age at first birth, has on earnings. How much more than age at first birth does education affect a woman's weekly earnings?

To get an answer to this question, we test if education is more than 20 times as important as age at first birth in explaining a woman's weekly earnings, as shown in Table 5.<sup>8</sup> The results of this test will tell us if the effect of education ( $\beta_4$ ) is more than twenty times as big as the effect of age at first birth ( $\beta_2$ ) on weekly earnings. Since this is a right-tailed test, we must work with the T-stat, which in this case is equal to -.90. The critical value is 1.645, and we conclude at a 95% level of significance that the effect of education on a woman's weekly earnings is not more than 20 times than that of age at

<sup>6</sup>  $E(\text{wage} | \text{colgrad} = 0, \text{white} = 1) - E(\text{wage} | \text{colgrad} = 0, \text{white} = 0) = \$56.65 - \$3.61 B$

<sup>7</sup>  $\widehat{Wage} = -\$173.55 + 2.86 B - \$0.70 + \$40.70 \text{education} - \$16.21 \text{white} + 10.72 \text{northeast} - 23.62 \text{midwest} - 18.96 \text{south}$

<sup>8</sup> Twenty was selected because of the large differences between the coefficients of age at first birth and education, which are 2.86 and 40.70 respectively

first birth. Even though the effect of education on weekly earnings is greater than the effect of age at first birth on weekly earnings, its importance is not as big as we initially hypothesized.

The importance of the main variable of interest, age at first birth, in determining a woman's weekly earnings, was also compared to that of race. The multiple regression model showed that being white had a greater effect on weekly earnings than did delaying motherhood by one year. A hypothesis test was conducted to see if being white ( $\beta_5$ ) was five times more important than the age at which she had her first child  $\beta_2$  in determining earnings, as Table 5 shows. The T-stat for this test was -.43 and the critical value  $t_c$  was given by  $t_{.05,4882} = 1.645$ . Since the T-stat is less than the critical value, we do not reject the null and conclude with 95% certainty that being white is less than five times more important than age at first birth when determining weekly earnings.

### *The F-test*

To test the relevance of the variables that are being used to explain the variation in a woman's weekly earnings, an F-test is conducted. The F-test helps us see the overall significance of Model 1. It is useful for finding out whether all explanatory variables are not zero, that is, whether all of them bring returns to earnings or if at least one of them doesn't. The null and alternative hypothesis are therefore explained in the following expression:

$$H_0: \beta_2 = 0 \ \& \ \beta_3 = 0 \ \& \ \beta_3 = 0 \ \& \ \beta_4 = 0 \ \& \ \beta_5 = 0 \ \& \ \beta_6 = 0 \ \& \ \beta_7 = 0$$

$$H_1: \beta_2 \neq 0, \beta_3 \neq 0, \beta_3 \neq 0, \beta_4 \neq 0, \beta_5 \neq 0, \beta_6 \neq 0, \beta_7 \neq 0 \text{ or at least one of them is not zero}$$

This imposes  $K - 7$  restrictions, hence, the F stat is expressed as  $F_{K-7, 4876-7}$ . F-stat for the overall significance of Model 1 shown in the regression output is 105.40. The critical value of the F-stat is  $F_{c} = F_{7, 4876} = 2.01$ .<sup>9</sup> Since  $F_c < F\text{-stat}$ , we reject the null hypothesis at a 5% confidence level and conclude with 95% certainty that at least one of the explanatory variables used in this study is nonzero, that is, one or more of the Xs taken into consideration in this paper affect a woman's earnings.

### *Correlation*

The correlation between the variables in this study was examined to see if there was multicollinearity and to analyze how the explanatory variables were linearly related with each other. As seen in Table 7, the correlations between the variables showed to be the highest between age at first birth and age at first marriage, with a relationship of .6317. A reason for this high correlation can be that at the time in which the samples were taken, (1990 and 1995) the majority of the women, who were white, had more conservative and traditional ideas of family, hence associating marriage with starting a family (Blount et. al 2007). Therefore, in many cases, marriage could have implied motherhood due to the conservative ideology of gender roles of the majority of the women in this study.

### *Model Selection Criterion: Specification Tests and $R^2$*

Comparing the adjusted  $R^2$  across the models is useful in determining which model is the most adequate one, since it is a goodness of fit measure. The higher the adjusted  $R^2$ , the lower the SSEs of the model, hence the better it fits the data and a higher percentage of the variation in  $y$  is explained by  $x$ . The adjusted  $R^2$  for the multiple regression, quadratic, and interaction term models (both 4 and 5) are .1302, .1867, .1301, and .1304 respectively. For the log-linear model,  $\ln\text{Wage}$  had to be converted

<sup>9</sup> Found in the 95<sup>th</sup> percentile for the F-distribution table

into linear terms in order for the models to be comparable and get the SSE to get the adjusted  $R^2$ .<sup>10</sup> After doing that, the  $R^2$  of the log-linear model was .1297, and then an adjusted  $R^2$  of .1298 was found. This means that the quadratic model is the one that best fits the data, since it is the one with the highest  $R^2$ . In Model 3, 18.67% of the variation in weekly earnings is explained by the x variables. The remaining 81.33% of the variation is explained by other factors that were not considered in the study.

Model specification tests such as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) are also useful in helping us determine the best model. Table 6 shows the AIC and BICs of each model in this paper.<sup>11</sup> When comparing the values taken by hand shown in parenthesis in Table 6, the quadratic model shows the lowest AIC and BIC, which takes us to the same conclusion as above: It is the model that best fits the data.

#### *RESET Test and Omitted Variable Bias*

Conducting RESET tests for each model is useful to see if there is omitted variable bias. Table 6 shows the p-values of the RESET test of each model. At a 5% level of significance, the RESET test p-values of Models 1, 2, 4, and 5 lead us to conclude with 95% certainty that there are no omitted variables in the study and that therefore there is no misspecification error in such models. However, the p-value of the quadratic model lead us to a different conclusion. In this case, we are 95% certain that there are omitted variables in the model. Since there are additional functional forms going on, the RESET test for the quadratic model showed that there could be omitted variables at the 4<sup>th</sup> power.

## **VI. Conclusion**

The sample used in this study for June of 1990 and 1995 showed that motherhood has a negative effect on earnings, and that such effect varies among races, educational attainment levels, and regions. The objective of this paper was to analyze the wage penalty caused by motherhood across different education levels, races, and regions. Analyzing marriage as well as the important role that it plays in a woman's childbearing and career decisions was helpful in explaining why black mothers experience a smaller wage penalty than white ones. The study by Blount et. al (2007) was useful in determining this because it provided information about gender ideology roles among married white and black women, which could explain the difference in the wage penalties across both races. Buchamann and McDaniel (2016) also found that black women's earnings suffered less than white women's, and also concluded that childbearing's negative effect on earnings can be due to the fact that once women leave the workforce to care for their children, even if its temporarily, they will be less attractive to employers in the future due to their loss of experience. The smallest effect on black women's wages can also be explained by marriage. Marriage can reduce a woman's desire to work, and the fact that more black mothers are single relative to white ones therefore can explain their higher earnings (Cheng, 2015).

This paper found that the marginal effect of education on earnings increases as level of education increases. Women with college degrees earn more than women with no college degrees. Therefore, our results also led us to conclude that the higher level of education a woman attained, the

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<sup>10</sup> The exponent of the predicted values from the log-linear model was taken. Then the correlation between the exponent of the predicted values of the log linear model and weekly earnings was taken, and then the scalar command was used to get the comparable  $R^2$  of this model. This was then plugged into the equation  $\bar{R}^2 = 1 - (1 - R^2) \left[ \frac{N-1}{N-K} \right]$

<sup>11</sup> When calculating the AIC and BIC of the log-linear model using the comparable SSE, the result was a number nowhere near the AIC and BIC of the other models. Therefore, the AIC and BIC of the other models was also taken by hand and these are the ones that were compared. These values are in parenthesis in Table 6

smaller burden she has on her earnings when having her first child. The older at which a woman with a college degree has her first child, the less wage penalty she will suffer.

Apart from educational attainment level, this study concluded that race is also a determinant of the differences between the effect of childbearing among white and black mothers. Looking at the differences between the expected value of wages among black and white college graduates, white woman's wages suffer more than black woman's wages after motherhood. Marital status and gender role opinions may be the reason behind this (Buchamann and McDaniel, 2016).

A drawback to this study was the fact that a lot of influential factors in determining a woman's childbearing and marriage decisions and therefore her career growth were not accounted for. Other studies included variables that this paper did not include and could explain the effects of a woman's wage penalty upon motherhood. Blount et. al (2007) looked at factors such as a woman's occupational status, number of hours worked, and opinions regarding gender roles, which all could give information about a woman's working conditions before childbearing and therefore give us an idea of the opportunities she has if she decides to return to the workforce. For example, Buchamann and McDaniel (2016) studied the professions of women, which is a helpful indicator of the opportunities and options a woman has if she goes back to work after having children. For instance, women in STEM positions and in the financial sector earn more than women in female-dominated and public sector positions, and the hours between these different professions may vary (Buchamann and McDaniel, 2016). In this paper, hours worked per week were not considered, while the previously mentioned study did take them into account. These factors can determine the employment opportunities a woman faces upon re-entry to the workforce; a mother who used to work in the financial sector is likely to land a job in the same industry, therefore earn more than a mother who used to work in the public sector. Sample size was also a limitation since the IPUMS CPS data included a lot of missing observations which ended up making the sample size small.

Since gender roles and woman's role in society have greatly changed in the past decades, if this study used samples from 2016, the results would vary since there is now more gender equality in the workplace and liberal and non-traditional views of women roles have increased.

*Appendix***Table 1: Descriptive Variables**

Below are the labels for all the variables used in this study.

Variable	Description
educ_rev	This variable indicates the educational attainment of the person in the sample. E.g: education = 12, the woman received an education up to 12 <sup>th</sup> grade. If education = 16, the woman received a bachelor's degree; 18 = master's degree and so on.
Frage1_rev	This variable indicates a woman's age in years at first birth
mhagemar1_rev	This variable indicates a woman's age in years at first marriage
colgrad	This is a dummy variable that separates woman who have a college degree or higher from those who don't. If a woman received a bachelor's degree (educ_rev = 16) or a higher level of education, colgrad = 1. If otherwise, colgrad = 0
Earnweek	This variable indicates weekly earnings
white	Dummy variable that is equal to 1 if the woman is white and 0 if the woman is black
midwest	This is a dummy variable that separates woman who live in the midwest (Midwest = 1) and women who don't (Midwest = 0)
northeast	This is a dummy variable that separates woman who live in the northeast (northeast = 1) and women who don't (northeast = 0)
South	This is a dummy variable that separates woman who live in the South (South = 1) and women who don't (South = 0)
West	This is a dummy variable that separates woman who live in the West (West = 1) and women who don't (West = 0)
marst	This variable represents the marital status of each woman. It is a dummy variable which is marst = 1 if the woman is married and marst = 0 if she is not married
B*colgrad	Interaction term between age at first birth and being a college graduate
B*white	Interaction term between age at first birth and being white

**Table 2: Descriptive Statistics**

The average weekly earnings for the women in this study (both college graduates and non college graduates) was of \$356.34. The average age at which a woman had her first child was 22.55 years, and the average marriage age was 20.59 years. The average level of educational attainment was 12.38 years, which is approximately a High School diploma. 8% of the females in this sample were college graduates and 92% were not college graduates, receiving less than 16 years of education. 89% of the women in this sample were white and 11% of them were black. Regarding region, 24% were from the Midwest, 22% from the northeast, 33% from the south, and 20% from the west. 74% of the women in the sample are married.

Variable	Obs	Mean	Std. Dev.	Min	Max
earnweek	4,884	356.3439	240.162	0	1923
frage1_rev	4,884	22.55057	4.633231	14	43
mhagemar1_~v	4,884	20.59173	3.889733	12	61
colgrad	4,884	.0876331	.2827895	0	1
nocolgrad	4,884	.9123669	.2827895	0	1
white	4,884	.8976249	.303172	0	1
black	4,884	.1023751	.303172	0	1
northeast	4,884	.222154	.4157367	0	1
midwest	4,884	.2438575	.4294517	0	1
west	4,884	.2029075	.4022053	0	1
south	4,884	.3310811	.4706504	0	1
married	4,884	.740172	.438585	0	1

**Table 3: i) Descriptive Statistics according to each dummy variable**

\*\*\*: 1% level of significance

\*\*: 5% level of significance

\*: 10% level of significance

	College Graduate	Non College Graduate	Difference
frage1_rev : age at first birth	25.561 years	22.261 years	3.30 years***
mhagemar1_rev : age at first marriage	22.18 years	20.43 years	1.75 years***
educ_rev : years of education	16.94 years	11.94 years	4.99 years***
earnweek : weekly earnings	\$622.76	\$330.75	\$292.01***
Marst: marital status	77.8% married	73.65% married	4.15%*

	White	Black	Difference
frage1_rev : age at first birth	22.68 years	21.31 years	1.37 years***
mhagemar1_rev : age at first marriage	20.49 years	21.43 years	-.933 years***
educ_rev : years of education	12.40 years	12.12 years	.282 years**
earnweek : weekly earnings	\$356.6	\$354	\$2.60
Marst : married women	75.6% married	59.4% married	16.2% ***

	Northeast	All other regions	Difference
frage1_rev : age at first birth	23.62 years	22.24 years	1.38 years***
mhagemar1_rev : age at first marriage	21.567 years	20.31years	1.255 years***
educ_rev : years of education	12.55 years	12.33years	.228 years***
earnweek : weekly earnings	\$386.228	\$347.79	\$38.49***
Marst: married women	76.11% are married	73.4% married	2.71%*

	South	All other regions	Difference
frage1_rev : age at first birth	22.096 years	22.77 years	-.678 years***
mhagemar1_rev : age at first marriage	20.09 years	20.83 years	-.7496 years***
educ_rev : years of education	12.2243 years	12.45 years	-.2257 years***
earnweek : weekly earnings	\$341.126	\$363.87	-\$22.74***
Marst: married women	72.79% are married	74.62% are married	- 1.83%

	Midwest	All other regions	Difference
frage1_rev : age at first birth	22.39 years	22.59 years	-.196 years
mhagemar1_rev : age at first marriage	20.50 years	20.61 years	-.1085 years
educ_rev : years of education	12.335 years	12.39 years	-.055 years
earnweek : weekly earnings	\$339.68	\$361.71	-\$22.025***
Marst: married women	10.8% married	7.31% married	3.49%**

	West	All other regions	Difference
frage1_rev : age at first birth	22.28 years	22.61 years	-.328 years**
mhagemar1_rev : age at first marriage	20.43 years	20.63 years	-.191 years
educ_rev : years of education	12.477 years	12.35 years	.1275 years
earnweek : weekly earnings	\$368.87	\$353.27	\$15.122 *
Marst: married women	70.54% are married	74.9% are married	- 4.36%***

**Table 4: Regression Estimates**

The following are the  $b_2$ ,  $b_3$ , and  $b_4$ ,  $b_5$ ,  $b_6$ ,  $b_7$ , and  $b_8$ ,  $b_9$ , and  $b_{10}$  for the five models examined in this study.

Variable	Model 1: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 colgrad + \beta_5 R\ white + \beta_6 northeast + \beta_7 midwest + \beta_8 south$	Model 2: $ln W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 colgrad + \beta_5 R\ white + \beta_6 northeast + \beta_7 midwest + \beta_8 south$	Model 3: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 education^2 + \beta_5 R\ white + \beta_6 northeast + \beta_7 midwest + \beta_8 south$	Model 4: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 colgrad + \beta_5 white + \beta_6 northeast + \beta_7 midwest + \beta_8 south + \beta_9 B*colgrad$	Model 5: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 colgrad + \beta_5 white + \beta_6 northeast + \beta_7 midwest + \beta_8 south + \beta_9 B*colgrad + \beta_{10} B*white + \epsilon$
fragel_rev : age at first birth	5.18 SE: .918***	.01 SE = .0028***	2.43 SE: .899***	4.96 SE: .975***	8.13 SE: 2.189***
mhagemar1_rev : age at first marriage	-.198 SE: 1.08	-.00039 SE = .003	-.96 SE: 1.04	-.154 SE: 1.08	-.1086 SE: 1.08
Colgrad if colgrad = 1	273.85 SE: 11.58***	.646 SE = .035***	N/A	226.57 SE: 59.35***	5=220.99 SE: 59.44***
Educ_rev_2: education squared	N/A	N/A	1.68 SE: .055***	N/A	N/A
Race if white = 1	-21.17 SE: 10.97** (.054)	-.088 SE: .033***	-15.90 SE: 10.60	-21.02 SE: 10.97* .055	56.65 SE:49.56
Northeast if northeast = 1, 0 otherwise	5.08 SE: 9.921	.034 SE: .030	11.57 SE: 9.59	5.66 SE: 9.92	5.99 SE: 9.92
Midwest if Midwest = 1, 0 otherwise	-22.00 SE: 9.64** .023	-.049 SE: .029* .096	-21.06 SE: 9.32** .024	-21.81 SE: 9.64**	-21.84 SE: 9.64**
South if south = 1, 0 otherwise	-24.82 SE: 9.17***	-.023 SE: .028	-18.92 SE: 8.88** .033	-24.87 SE: 9.18*** .007	-24.48 SE: 9.18***
Fragel_educ: interaction term between age at first birth and colgrad	N/A	N/A	N/A	1.87 SE: 2.30	2.12 SE: 2.31
Fragel_white: interaction term between age at first birth and race (white dummy)	N/A	N/A	N/A	N/A	-3.61 SE:2.24 P: .108
R <sup>2</sup>	.1314	.079	.187	.1315	.1320
N	4,884	4,879	4,884	4,884	4,884

**Table 5: Hypothesis Tests at a .05 level of significance**

Hypothesis	P-value
H <sub>0</sub> : colgrad ≤ 20 age at first birth H <sub>1</sub> : colgrad >20 age at first birth	.368
H <sub>0</sub> : β <sub>2</sub> = 0 & β <sub>3</sub> = 0 & β <sub>3</sub> = 0 & β <sub>4</sub> = 0 & β <sub>5</sub> = 0 & β <sub>6</sub> = 0 & β <sub>7</sub> = 0 H <sub>1</sub> : β <sub>2</sub> ≠ 0, β <sub>3</sub> ≠ 0, β <sub>3</sub> ≠ 0, β <sub>4</sub> ≠ 0, β <sub>5</sub> ≠ 0, β <sub>6</sub> ≠ 0, β <sub>7</sub> ≠ 0 or at least one of them is not zero	0
H <sub>0</sub> : white ≤ 5 age at first birth H <sub>1</sub> : white >5 age at first birth	.669

**Table 6: Model Specification Tests**

\* The values in parenthesis were taken by hand in order to get the comparable AIC and BIC of each model

	Model 1: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{colgrad} + \beta_5 R \text{ white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south}$	Model 2: $\ln W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{colgrad} + \beta_5 R \text{ white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south}$	Model 3: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{education}^2 + \beta_5 R \text{ white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south}$	Model 4: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{colgrad} + \beta_5 \text{white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south} + \beta_9 B * \text{colgrad}$	Model 5: $W = \beta_1 + \beta_2 B + \beta_3 M + \beta_4 \text{colgrad} + \beta_5 \text{white} + \beta_6 \text{northeast} + \beta_7 \text{midwest} + \beta_8 \text{south} + \beta_9 B * \text{colgrad} + \beta_{10} B * \text{white} + \epsilon$
AIC	66728.47 (10.823)	(10.904)	66400.52 (10.75)	66729.81 (10.82)	66729.22 (10.824)
BIC	66780.42 (10.833)	(10.91)	66452.47 (10.76)	66788.25 (10.83)	66794.16 (10.83)
R <sup>2</sup>	.1314	.1297	.1878	.1315	.1320
$\bar{R}^2$	.1302	.1298	.1867	.1301	.1304
RESET	.2933	.6381	.0001	.2839	.7020

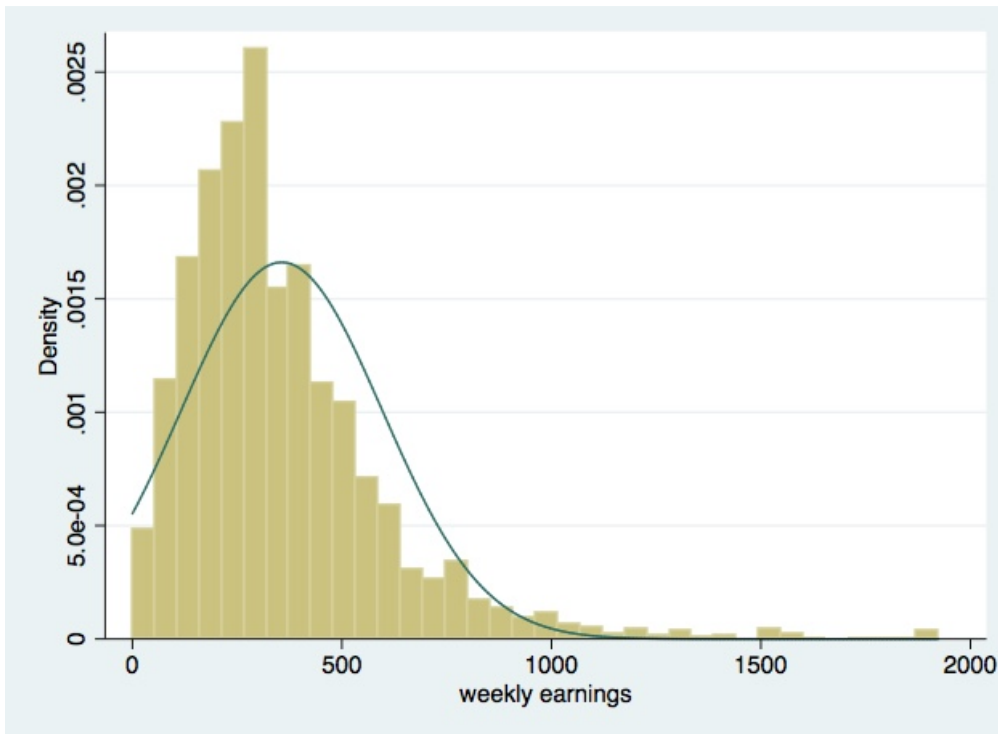
**Table 7: Correlation between the variables**

The variables in this study weren't too highly correlated. The highest correlation was between age at first birth and marriage (.6317), even though multicollinearity did not occur.

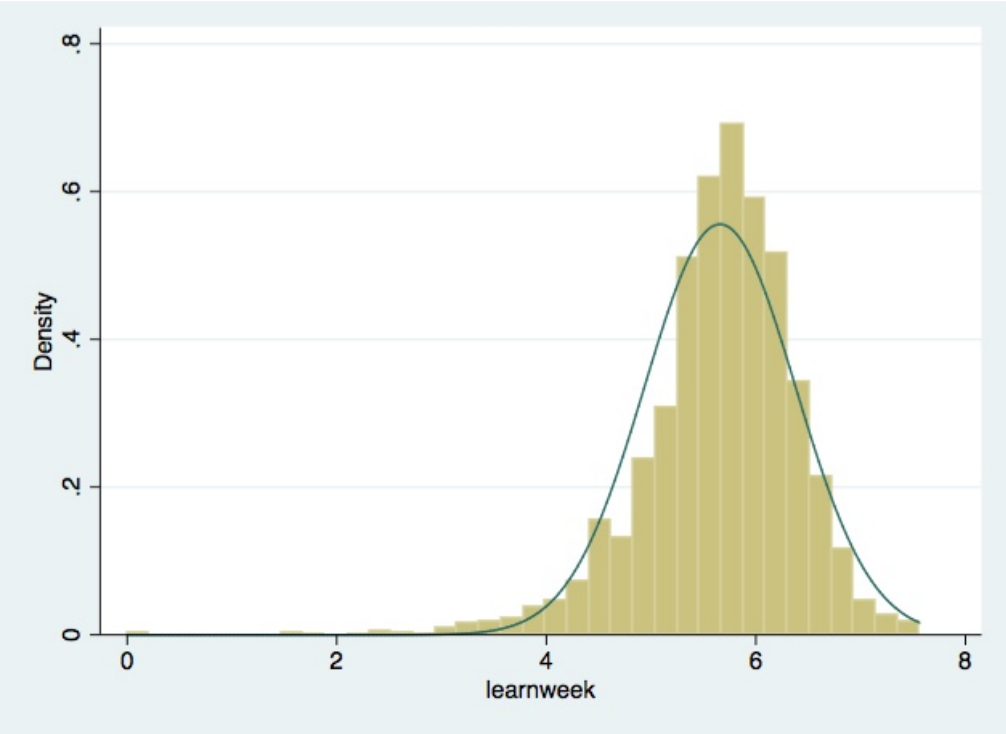
(obs=4,884)

	frage1~v	mhagem~v	colgrad	white	northe~t	midwest	south	earnweek	married
frage1_rev	1.0000								
mhagemar1~v	0.6317	1.0000							
colgrad	0.2017	0.1279	1.0000						
white	0.0900	-0.0728	0.0473	1.0000					
northeast	0.1245	0.1342	0.0451	0.0082	1.0000				
midwest	-0.0182	-0.0120	-0.0394	0.0722	-0.3035	1.0000			
south	-0.0690	-0.0907	-0.0180	-0.1700	-0.3760	-0.3995	1.0000		
earnweek	0.1660	0.1094	0.3438	0.0033	0.0666	-0.0394	-0.0446	1.0000	
married	0.1106	0.0481	0.0268	0.1126	0.0257	0.0342	-0.0197	-0.0334	1.0000

**Graph 1: Histogram of weekly earnings: Multiple linear regression model**



**Graph 2: Histogram of log weekly earnings: log-linear model**



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