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MENOPAUSE TRANSITION AND LABOR MARKET OUTCOMES

BY

MERCY MVUNDURA

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

GEORGIA STATE UNIVERSITY
2007

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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

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ABSTRACT

MENOPAUSE TRANSITION AND LABOR MARKET OUTCOMES

By

MERCY MVUNDURA

August 2007

Committee Chair: Dr. Paul G. Farnham

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Over the past 50 years, women have become important participants in the labor market. With the increase in the number of middle-aged women going through the menopause transition, the question arises as to the effect of this transition on the labor market. Previous studies have shown that reproductive cycles have a non-trivial negative effect on women's labor market outcomes. Thus, the cessation of these reproductive cycles (menopause) should bring relief for these women. However, another body of literature asserts that the menopause transition itself has a negative effect on women's mental and physical health and so may have a negative effect on labor market outcomes.

This study seeks to explore the effect of the menopause transition on labor market outcomes. The empirical analyses are done using data from the National Longitudinal Survey of Young Women, with the key explanatory variables being the menopause transition stages: premenopause, perimenopause, surgical menopause and natural postmenopause. The regressions include a control for whether the woman experienced early menopause and whether she had a hysterectomy.

The first part of the study examines the impact of the menopause transition on health using depression and the scores on the activities of daily living as the measures of health status. These analyses use cross sectional data drawn from the 1995 wave of the survey for activity limitations and the 2003 wave for the depression measure. The findings of these analyses indicate that the menopause transition increases the likelihood of depression and functional limitations.

The main part of the study explores the effect of the menopause transition on the following labor market outcomes: labor force participation, hours worked, full time employment, wages, and self-employment. Ordinary Least Squares, the fixed effects model, the random effects model, and the family fixed effects (siblings) model are used to examine these questions. The analysis also uses 2SLS to correct for endogeneity of the menopause variables and the Heckman two-step procedure to correct for sample selection bias.

The findings show that women in premenopause are less likely to be in the labor force than women in natural postmenopause, even after controlling for life-cycle variables. The results also indicate that there are certain benefits from using hormone replacement therapy (HRT), as women who had surgical menopause and are using hormones are more likely to be in the labor force than women with surgical menopause who are not using HRT.

Women in premenopause and women in perimenopause are less likely to work full-time compared to women who experienced natural postmenopause. The findings also show that there are no significant differences in hours worked by women in the different menopause stages. Women in premenopause typically earn more than women in natural

postmenopause. Furthermore, women in perimenopause and women with surgical menopause are more likely to be self employed.

The findings indicate that, among a generally healthy population, the menopause transition results in an increase in labor supply. However, a wage penalty is observed among women in postmenopause, when compared to women who are premenopause. The implications of the findings are that menopause should not be medicalized but should be viewed in a social and cultural context as the changes that occur during the transition may open up possibilities for positive individual development. Thus the cessation of menstrual cycles brings relief for women and results in an increase in labor supply, albeit one associated with a wage penalty.

CHAPTER 1: INTRODUCTION AND ORGANIZATION

Introduction

According to Goldin (2004), two revolutions involving women occurred during the post WWII period. The first was the noisy revolution of women's rights and feminism, and the second was a quiet revolution of contraceptive use that enabled women to delay marriage and childbearing. Women's education investment and hence their labor force participation increased because of these revolutions. As a result, women have become important participants in the labor market. In 1948, the labor force participation rate for civilian women was 30.7%. By 1997 the female labor force participation rate had doubled to 60%. Women are now significant participants in the labor market, and hence their health status has an impact on the labor market.

This study focuses on women's reproductive health and its effect on their labor market outcomes. Menarche heralds the start of menstrual cycles for every woman. The menstruation lasts for 2 to 7 days, and the cycle repeats every 28 days, on average. Because of the hormonal changes that result from the menstrual cycles, some women experience premenstrual syndrome (stress and physical symptoms prior to the onset of menstruation) a few weeks before the beginning of each menstrual cycle. Some other women also experience dysmenorrhea (cramps or painful menstruation). Both premenstrual syndrome and dysmenorrhea result in poor health for women who are still having menstrual cycles.

Menopause signals the end of these menstrual cycles. Perimenopause describes the period immediately before menopause, that is, the time from when the hormonal and clinical symptoms of approaching menopause commence until the first year after

menopause (WHO, 1996). During this time a woman experiences a variable menstrual cycle length of greater than seven days' difference from her normal cycle and also two or more skipped cycles and periods of amenorrhea (absence of menses for six consecutive months). After perimenopause comes menopause. A woman is considered as being in natural menopause (also referred to as natural postmenopause) when she has not had a menstrual cycle for twelve consecutive months, and there is no obvious pathological cause of this cessation of menses. Studies have shown that the mean age for natural menopause is 51.4 years, but it can occur anywhere between the range of 40 and 58 years (NAMS, 2004). The median age for natural menopause is 47.5 years. A woman can also become menopausal through surgery when both ovaries are removed. Women who have surgical menopause usually have pre-existing health problems.

The North American Menopause Society (NAMS, 2004) noted that specific menopause statistics are not available. However, it estimated that in the year 2000 forty million U.S. women aged over 50 were postmenopause. Also 3 million women who were aged between 40 and 50 years were naturally postmenopause, while 2 million women were surgically postmenopause. Half a million women also had experienced premature natural menopause (reached menopause before the age of 40). Thus by the year 2000, there were 46 million postmenopausal women in the U.S.

NAMS (2004) gives three reasons that menopause, with its physical and psychological consequences, is a public health issue: (1) it affects every woman; (2) a large number of women are postmenopausal; and (3) more post menopausal women are living beyond the age of 65. Menopause is associated with poor health for some women. The World Health Organization (1996) reports that the most prevalent symptoms during

the menopause transition include hot flushes (or flashes), night sweats, menstrual irregularities, depression, nervous tension, palpitations, headaches, insomnia, lack of energy, difficulty concentrating, and dizzy spells. Avis et al. (2001) report that there is no universal menopause syndrome and that menopause symptoms differ by ethnic and racial groups.

Reproductive hormones change during perimenopause and also during menstruation, making women susceptible to poor health. When women are still menstruating, the hormone changes can lead to symptoms like abdominal pain, irritability, migraine headaches and anxiety disorders. Thus, both the reproductive cycle and its cessation can have negative effects on the health of some women.

Importance of the Study

Women are important participants in the labor market, as shown by their increased participation over time. Also, the official retirement age has increased to 67 years and as a result postmenopause women now remain in the labor force for a greater period of time. Previous researchers have argued that menstrual cycles have non-trivial, negative consequences on some women's health, lifestyles, and labor market behavior. Because illness-related work absenteeism is higher among premenopausal female workers than male workers, some studies claim that part of this absenteeism is attributable to reproductive cycles (Hardie, 1997; Ichino & Moretti, 2006; Johnson, 2004). The end of these reproductive cycles at menopause should bring relief for these women. However, another body of literature asserts that menopause is associated with poor health for some women and may have a negative effect on their labor market

outcomes. The importance of this study is that it will provide new evidence on the effect of the transition from premenopause to postmenopause on women's labor market behavior. Much of the menopause literature paints a gloomy picture about women's health at midlife and the effect of this poor health on their work performance at midlife. Yet no detailed study has been done to explore whether this is just a myth or reality.

With an increasing aging population, it is important to know how life events affect the population's physical and mental well-being as well as its effect on labor market outcomes. This study examines whether women continue to have worse outcomes in the labor market as a result of problems associated with reproductive cycles or if the cessation of reproductive cycles results in an improvement in labor market outcomes. No previous study has linked the menopause transition to labor market outcomes.

The results of this study will also be important for policy. As mentioned previously, some studies have shown that women have higher work absenteeism than men and part of this difference is explained by the negative effects of reproductive cycles. This paper will explore the effect of the cessation of reproductive cycles and whether it has any impact on labor market outcomes for women.

Recent articles in the popular press call for the need to study the effects of menopause in the workplace. In the past, discussion of these menopause issues was taboo because such talk implied that women were hormonal and less able to control themselves. Thus, there was always the possible threat of discrimination against women in the workplace. Now at least two factors seem to encourage discussion about menopause in the workplace: (1) the growing number of women in the workplace; and (2) the entrance of baby boomers into midlife. If the results of this study indicate that women in

menopause have better labor market outcomes, then it will imply that the effects of menopause do not negatively impact the labor market. Thus, menopause should not be viewed negatively by employers where the emphasis is on the effects on women's health and their work performance. Even though women may need to be accommodated when they face menopause symptoms in the workplace, the effects of menopause do not result in poor labor market outcomes. This result would agree with the sociology literature that argues against the medicalization of menopause.

However, if the results indicate that the menopause transition has a negative effect on labor market outcomes; this implies that menopause is a workplace issue. As a result employers may need to develop policies appropriate for dealing with menopausal issues pertaining to sick leave, absence, and accommodation.

This study also adds to the literature on the effect of health on labor market outcomes of midlife women. As the literature review shows, many studies tend to focus on men, with very few studies focusing on midlife women.

Objectives of the Study

This research uses data from the National Longitudinal Survey of Young Women (NLSYW), a survey of civilian, non-institutionalized women residing in the US who were aged between 14 and 24 years as of December 31, 1967. The empirical analyses for this study are done using five waves of the survey, with biennial data from 1995 to 2003. In 1995, 3,019 women were interviewed and these women were aged between 42 and 52 years at the time of the survey.

The first objective of this study is to explore the effect of the menopause transition on a woman's physical and mental health. This part of the paper adds to the existing medical literature on the effects of menopause on health. Most studies have examined the effect of menopause on depression, with few studies addressing its effect on physical health. This study adds to the existing literature by examining the effect of the menopause transition on both physical and mental health. Mental health is measured using an indicator of depression, derived from the Center for Epidemiological Studies Depression Scale (CES-D). Physical health is measured using individual scores of the ability to perform basic and intermediate activities of daily living. The menopause stages are premenopause, perimenopause, natural postmenopause and surgical menopause. The analysis also explore whether there are differences in outcomes for women who use hormones during the menopause transition.

The second and main goal of the study is to examine the effect of the menopause transition on labor market outcomes. This integrates the health research on menopause and the economics research on labor market outcomes and this is the main contribution of the dissertation, given that no previous authors have linked the two subjects. The labor market outcomes of interest are labor force participation, hours worked, fulltime employment, wages, and self-employment. The analyses also explore whether there are any differences in outcomes for women who use HRT during the menopause transition.

Limitations of the Study

The main limitations of this study arise through issues regarding data availability. The NLSYW does not have detailed information on women's symptoms reported during the menopause transition, which would have enabled a deeper exploration of the labor market decisions faced by women with differing severities of menopause symptoms.

Furthermore, the data were collected biennially. Given this long period of time between observations, it becomes difficult to capture short-term responses to health problems arising from the menopause transition. Also, only cross-sectional data on depression and physical functioning were available which limited my ability to explore the effects of menopause transition as women progressed into menopause.

However the NLSYW is the best data set currently available as it is the only longitudinal data set which includes both labor market variables and menopause transition variables. This makes it the most suitable data for my analyses.

Organization of the Research

This dissertation is organized as follows. Chapter 1 gives the introduction, importance of the study, and objectives of the research. Chapter 2 reviews previous literature on the effect of menopause on health and the effect of health on labor market outcomes. Chapter 3 presents the theoretical framework relating health and labor market outcomes. In this chapter, the standard labor-leisure choice model with health as the main variable is used, and the chapter also includes a discussion of the econometric and methodological issues arising from including health as an explanatory variable in labor supply models. Chapter 4 discusses the data set, its limitations, and the construction of the variables used in the

empirical model. The empirical findings are presented in Chapter 5. Chapter 6 summarizes the major findings of this research and presents the policy implications and conclusions of the research.

CHAPTER 2: LITERATURE REVIEW

Previous studies in the medical literature have focused on the effect of menstrual cycles on work performance but none have focused on the effect of the cessation of these menstrual cycles on labor market outcomes. Literature exists on the effect of the menopause transition on health, and another separate body of literature focuses on the effect of health on labor market outcomes. Yet no previous study has explored the effect of menopause on labor market outcomes.

The first section of the literature review provides an overview of the literature on the effect of menstrual cycles and menopause on women's health. The literature that is reviewed explores the effect of menstrual cycles on work performance and also the effect of the menopause transition on mental and physical health. Most of the studies reviewed here tend to focus on the effects of menopause on either mental health or physical health, with very few encompassing both issues.

The second set of literature review focuses on the effect of health on labor market outcomes. A review of the methodological literature focusing on the estimation issues that arise when health is used as an explanatory variable in labor supply models is done. Also a review of the literature that examines the effect of health on the labor market outcomes of women in midlife is presented. It is interesting to note that there are not many studies focusing on midlife women because most studies focus on older men.

Menstrual Cycles, Menopause and Health

Menstrual Cycles, Health and Work

Johnson (2004) provides a review of the literature on the epidemiology of Premenstrual Syndrome (PMS). The author notes that there are numerous emotional and physical symptoms for PMS, but women were more likely to seek treatment for the emotional symptoms. The emotional symptoms include depression, anxiety, sadness, anger and mood swings, while the physical symptoms include fatigue, insomnia, abdominal bloating, headaches and joint pain. The author notes that some studies have found that PMS is associated with significant impairment, some of which includes interference with work performance.

Borenstein et al. (2005) use a sample of 699 women aged between 18 and 45 years to assess the impact of Premenstrual Syndrome on work-related impairment. The women who were selected to participate in the survey had regular menstrual cycles and were required to complete a daily diary for 64 days. The diary included 28 items that measured PMS symptoms, activity impairments and work productivity. Productivity was measured using three items: (i) the number of hours of intended work that day; (ii) the number of intended work hours missed; and (iii) self assessed productivity at work that day. Using analysis of variance techniques, the authors find that PMS adversely affected workplace attendance. For women who still went to work with PMS, there was a significant reduction in productivity, when compared with women without PMS.

Robinson and Swindle (2000) use a national representative random sample of 1,022 women residing in the US who were aged between 18 and 49 years to explore the effect of PMS on social functioning and treatment-seeking behavior. The respondents

were interviewed using a mailed questionnaire which included questions on the type of PMS symptoms they experienced, the severity of the symptoms, and the level of PMS interference with work or school activities, household activities and social relationships. The questionnaire also collected data on other demographic and economic variables. The analysis was done using Pearson's correlation and chi-square tests. The authors find that 14.2% of the women reported that PMS had a severe level of interference with their lives. Also 20.3% of the women reported missing at least one workday during the year due to PMS.

Ichino and Moretti (2006) use data from a large Italian bank to explore whether there are biological gender differences to explain absenteeism. The authors report that women were more likely to be absent from work than men. Using graphical analysis, they find that there was a cyclical pattern in female absenteeism which recurred in a 28-day cycle. This cycle was observed among women who were aged less than 45, and it disappeared for women aged more than 45 years. Using hazard functions, they conclude that menstrual cycles increase absenteeism among female workers who are premenopausal. This cyclical absenteeism was still observed for managers and women who were due for promotion, thus ruling out the possibility that the absenteeism was due to shirking. The authors conclude that reproductive cycles may explain part of the differences in absenteeism between males and females.

In summary, there are several studies in the medical literature on the impact of menstrual cycles on work performance and absenteeism. These studies use either an analysis of variance or correlation methods for the empirical work and are based on personal reports of premenstrual symptoms, self-assessed measures of the effects of PMS

on work productivity, and self-reported absence from work. There is only one study in the economics literature on this topic, and it uses data collected by an employer on absenteeism. Even though the techniques differ across the reviewed studies, there is a consensus in the findings that menstrual cycles result in poor health that can negatively affect work performance and increase work absenteeism for women experiencing PMS.

Menopause and Mental Health

This section explores the literature on the effect of the menopause transition on health. I first review the literature on the effect of the menopause transition on mental health and then explore the literature on the menopause transition and physical health.

The higher prevalence of depression among women compared with men is one of the most documented findings in the psychiatry literature (Kessler, 2003). Women have a risk of depression that is twice that of men throughout their life from puberty until death. The cause of this higher prevalence of depression in women is unknown. Some researchers find no link between menopause and depression, while others find a higher prevalence of depression during the menopause transition. This study will contribute to this debate on the link between menopause and depression.

Glazer et al. (2002) use data from the Ohio Midlife Women's study to analyze the relationship between menopause and depression in Caucasian and African American women. The Ohio Midlife Women's Study sampled women between 40 and 60 years of age who were not pregnant and who had not sought health care for menopause symptoms or radiation/chemotherapy at the time of the first survey. The women were recruited through newspaper advertisements, word of mouth, church and synagogue groups, social

organizations, women's organizations, and also through solicitation at shopping centers/malls and employee contact at one large company. The first wave of the survey included 208 women. Follow-up was conducted at nine-month intervals. At the end of the third follow-up 160 women remained, and it is these 160 women that are the subject of this paper by Glazer et al. Ninety-three women were Caucasian, and 73 were African American. The mean age of final sample was 47.7 years. In the 12 months prior to the survey 38% of the women had regular periods, 17% had irregular periods, 14% had no periods, and 33% had hysterectomies. Eighty-nine percent of the women were employed.

Depression is measured using the Center for Epidemiological Studies of Depression (CES-D) Scale, a 20-item self-report scale that measures current or immediately previous states of depression. The respondents rank each symptom or emotional experience within the previous week on a scale of 0 - 3, with zero representing "rarely or none of the time" and three representing "most or all the time." Thus, the possible range of scores is 0 - 60. A score of 16 or greater is indicative of depression. The CES-D scale includes questions on whether the respondent was bothered by things that usually did not bother her; did not feel like eating; could not shake off the blues even with help of the family; felt she was just as good as other people; had trouble keeping her mind on what she was doing; felt depressed; felt everything she did was an effort; felt hopeful about the future; thought that her life had been a failure; felt fearful; had restless sleep; was happy; talked less than usual; felt lonely; felt people were unfriendly; enjoyed life; had crying spells; felt sad; felt that people disliked her and could not get going.

The survey data were collected every nine months over an 18-month period. The authors explore the impact of menopause symptoms, attitude towards menopause,

menopause status, resources (measured using the Hobfoll Conservation of Resources model[1]), coping strategies for midlife stress, and other socio-economics characteristics on three dependent variables: depression, anxiety and health promoting activities.

Glazer et al. (2002) find that 22% to 30% of the women in the sample were depressed over the three interview periods, while 34-42% were anxious. At two time segments of the survey, women with irregular or infrequent periods and hysterectomies had the highest anxiety levels. However, for all the survey periods, the authors find no significant relationship between menopausal status and anxiety or depression. They find that loss of resources (which results in stress) is the best predictor of depression and anxiety. The authors also find that marital status, race, socio-economic status, and age were all insignificant predictors of depression and anxiety. This finding is contrary to findings in other studies, and the authors thus presented the results with caution.

Kaufert et al. (1992) use data from the Manitoba Project on Women and their Health in the Middle Years to explore the relationship between menopause and depression. The women in the sample were between 40 and 59 years of age and were living in the Manitoba Province in Canada at time of the survey. The first wave of the survey included 2,500 women. In the second and subsequent waves of the survey, a subsample of the women was interviewed. The subsample included 469 women who were at least 45 years old and who had menstruated within the three months prior to completing their questionnaires or had previously had a hysterectomy. These women

[1] The Hobfoll Conservation of Resources model analyzes the relative benefit of different resources and how the resources interact to affect health outcomes. The model defines resources as objects (e.g., physical goods like cars and services), personal characteristics, conditions (e.g., a good marriage) and energies that are valued by a person. Also energies that assist in attaining the valued objects, personal characteristics and conditions are considered as resources. The model assumes that people try to obtain, protect and maintain the resources they value. The loss in resources results in stress while the gain in resources results in well being. The model contains factors that economists would measure differently. (Glazer et al., 2002)

were followed for 3 years and interviewed at 6-month intervals using telephone interviews. The last interview wave erroneously skipped measuring depression for 7% of the respondents, so the authors exclude the data for the sixth wave in their analysis.

Depression is measured using the CES-D scale. The authors pool the data for the five survey periods for their analysis. This method assumes that transition probabilities from one menopause stage to another were constant over time and also that probabilities of having depression are constant over time. The authors' methodology of pooling the five survey periods amounts to treating all changes in depression as if dealing with a single period of six months, separated by two time points. Over the two time points, there is time 1 and time 2. If at time 1, a woman was not depressed, she could either become depressed or stay not depressed in time 2. Similarly, if at time 1 a woman was depressed, she can become either depressed or become not depressed in time 2.

Women were defined as being premenopause if they had regular menses and postmenopause if they had not menstruated for at least 12 months. Women who were neither premenopause nor postmenopause according to the above definitions were classified as perimenopause unless they had a hysterectomy.

The authors use chi-square tests to explore the relative odds of depression. In the first analysis they compare women who were premenopause and then became perimenopause at any time during the follow-up surveys to women who were premenopause throughout the five surveys. The authors find no significant relationship between depression and changing or not changing menopausal status. In the second analysis, they compare women who were perimenopause at some time in the surveys and then became postmenopause to women who remained perimenopause over all survey

periods. They again find no significant relationship between this menopausal status change and depression. These bivariate analyses exclude women who had a hysterectomy because their menopause status did not change. The authors then compare the likelihood of depression between women with hysterectomies and all other women without hysterectomies, and they find that women with hysterectomies have a higher probability of depression.

Multiple logistic regressions are also performed for the transitions in depression from time 1 to time 2. The authors control for menopause status using dummy variables. They find that health is the key variable to a women being depressed while menopause status does not affect depression.

In the logistic regressions that include controls for midlife stressors, the authors find that women who report poor health are more likely to be depressed. The authors caution readers that the results of their study may not be generalized as representative of all women in the population because the original cross-sectional sample was not random.

Maartens et al. (2002) use longitudinal data from the Einhoven Perimenopausal Osteoporosis Study to explore the causal relationship between menopause and depression. The study focuses on Caucasian women born between 1941 and 1947 who resided in the Netherlands. The first wave of the survey was conducted between September 1994 and September 1995. The follow up survey was conducted in 1998, with the time range between the surveys varying from 2.8 to 4.7 years with a mean time of 3.5 years. The sample of 2,103 excluded women using Hormone Replacement Therapy (HRT) or women who had a hysterectomy (removal of the uterus) and/or ovariectomy (removal of one or both ovaries) because they are especially at risk for depression.

Depression is measured using the Edinburgh Depression Scale (EDS). The EDS asks respondents about how they felt in the past seven days on issues ranging from being able to laugh, being able to enjoy things, feeling anxious, feeling panicky, feeling unhappy, feeling sad, and thinking about harming oneself. The response options are yes-most of the time, yes-quite often, hardly ever, and never. These responses are scored with the total scores ranging from 0 to 30. Respondents with scores above 12 are considered having symptoms of depression.

Women were classified into three groups based on menopausal status: premenopause, perimenopause and postmenopause. Women were classified as perimenopause in this paper if they had an irregular menstrual pattern with at least one menstrual period in the 12 months prior to the survey. Over the two time periods for which the data were collected, women either remained in the same menopause group (premenopause, perimenopause or postmenopause) or their menopause status changed and as a result they were in transition from premenopause to perimenopause, premenopause to post menopause or perimenopause to post menopause. The authors then use indicator variables to capture these six possible menopause statuses as the main independent variables in logit regression analyses.

The authors find that the mean EDS scores were lowest in premenopausal women, higher in perimenopausal women and highest in postmenopausal women during both waves of the survey. They also find that there was an increase in the mean EDS scores for all transition groups. Women moving from perimenopause to postmenopause had the highest EDS scores. The dependent variable in the regression model was defined as 1 if the person had a large increase in EDS scores defined as an increase of more than 1

standard deviation above the mean change of 0.7. Using multiple logistic regressions (enter method) that control for demographic factors, and major life events (financial problems, relational problems, death of parent, partner or child, prior depression), the authors find that the transition from perimenopause to postmenopause was significantly related to a large increase in the EDS score. Using the stepwise logit method the authors find that the transitions from perimenopause to postmenopause and from premenopause to post menopause were significantly related to a large increase in the EDS score. The key finding was that the transition from one menopausal stage to another leads to an increase in depression.

Freeman et al. (2004) use data from the Penn Ovarian Aging Study to determine the relationship between depressed mood, menopausal status, and reproductive hormones. The Penn Ovarian Aging Study used random digit telephone dialing to recruit study participants who resided in Philadelphia County of Pennsylvania. The study included women between 35 and 47 years of age who had menstrual cycles in the range of 22 to 35 days in the three months prior to the survey and had at least one ovary and a uterus. Women who were using hormonal contraception or HRT, who were pregnant or breastfeeding, had serious problems that comprised ovarian functioning, or who were substance abusers were excluded from the survey. The data were collected at 8-month intervals for six assessment periods.

During the first wave of the survey, 436 women between 35 and 47 years of age were included in the study. Half of them were African American, and half were Caucasian. After the sixth wave 353 respondents remained in the survey, but only 332 were used in the study. At the sixth interview, the women were between 38 years and 52

years of age with the mean age being 44.6 years. One hundred sixty-five women were African American, and 167 were Caucasian.

The dependent variable, depression, is measured using the CES-D scale. Women were classified as: premenopause if they had regular menstrual bleeding (in the 22-35 day range); in early transition if they had a change in cycle length greater than seven days compared to their baseline menstrual cycles; in late transition if they had no menstrual bleeding for three to eleven months; and postmenopause if they had no menstrual bleeding for 12 months or more.

Analyses are done using multivariate logistic regressions. The authors also use fixed effects logistic regression to analyze the causes of new cases of depression which were defined as women who previously had CES-D scores of less than 16, but who later had scores above 16.

The authors find that women in menopause transition phases had higher CES-D scores compared to women not in menopause transition phases. The regression results show that women in early transition were 55% more likely to report high CES-D scores (scores greater than 16) and women in late transition were three times more likely to report high CES-D scores than premenopausal women, with both coefficients being statistically significant. There are also racial differences in probabilities of having depression, with African American women being twice more likely to report depression than Caucasian women. The authors find that new depression cases were nearly twice as likely to occur in women in the early transition phase of menopause compared to women in premenopause.

Lennon (1982) uses the Health and Nutrition Examination Survey (HANES[2]) to explore the link between the timing of menopause and depression. She argues that if expected life events (like menopause) occur on time, they should not be stressful because they are anticipated. However, when the life event occurs off schedule (either too early or too late), they cause stress. Menopause timing was captured through categorizing the respondents as younger women (aged 25 to 43 years), midlife women (who were between 44 and 54 years) and older women (aged 55 to 74 years). A woman was considered as having menopause on time if it occurred during midlife, early if it occurred when a woman was aged 25-43 years and late if it occurred after age 55. Timing of menopause was captured by interacting menopause status and the three categories of age. Depression, the dependent variable, is measured using the CES-D scale and the General Well Being (GWB) scale. The study excludes women who had surgical menopause.

The study results show that when women experienced menopause on time, menopause had no impact on their GWB score and the CES-D score. Early menopause resulted in greater psychological difficulties for young women. The author notes that some may question the direction of causality between early menopause and depression because depression may cause early menopause. Lennon argues that although the data did not permit the testing of the direction of causality between early menopause and depression, it was plausible to argue that early cessation of menstruation may be stressful in that it was deviant from the cultural norm expected of young women. Depression levels did not differ significantly for older women whose menopause was delayed, when compared to similarly aged women whose menopause was on schedule. However, higher depression levels were observed in older women who were in perimenopause. Lennon

[2] More recent surveys are now called National Health and Nutrition Examination Surveys (NHANES).

suggests that this finding may indicate that the change associated with menopause may be related to psychological distress.

Summary of the Findings

All but one of these studies measure depression using the CES-D scale. Some studies find no link between the menopause transition and depression (Glazer et al., 2002; Kaufert et al., 1992), while others find a significant relationship (Freeman et al., 2004; Lennon, 1982; Maartens et al., 2002). The studies that find a significant relationship show that women going through the transition stages tend to have a greater probability of depression compared to women not in transition. The studies also imply that women using hormone replacement therapy, women having surgical menopause, and women who had a hysterectomy were more prone to depression.

Timing of the menopause transition also seems to be important, although few studies explore this issue. Timing seems to be more important in young women than in older women.

Methodological differences may explain the differences in these findings. The study by Glazer et al. (2002) uses the Hobfoll Conservation model where correlations between the variables in this model and menopause variables may result in insignificant results. The authors also find that race, marital status, age, and socio-economic status were all insignificant predictors of depression and anxiety. Yet most other studies find that these are significant predictors.

The study by Kaufert et al. (1992) uses a pooled data set with the underlying assumption that transition probabilities from one menopause stage to another are constant

over time. This methodology also assumes that the probability of having depression is constant over time. The authors do not test for this strong assumption. If these underlying assumptions are not valid, then the study results are also questionable.

The studies by Maartens et al. (2002) and Freeman et al. (2004) have no strong underlying assumptions. They use logit regressions,[3] a methodology familiar to economists. Using this methodology, they find a significant relationship between menopause and depression.

Menopause and Physical Health

Women have higher rates of chronic illness, severe disabilities and multiple disabling conditions than men (Santiago & Muschkin, 1996). The National Health Interview Survey finds that 15% of women between the ages of 45 and 64 report severe functional limitations and also that 50% of the women report that the onset of the limitations became evident between the ages of 40 and 55 years (Sowers et al., 2001). However, few studies explore the link between menopause and the onset of physical functioning limitations.

Sowers et al. (2001) use data from the Study of Women's Health Across the Nation (SWAN) to explore the association between menopause and physical functioning in women aged 40 to 55 years. The sample includes 14,427 women whose physical functioning was evaluated using the Medical Outcomes Study- Short Form 36 (MOS-SF-36). The MOS-SF-36 was only administered to the women who provided a positive response to the screener question on whether they felt they were limited in any activities because of impairments or health problems. Women were categorized by menopausal

status as premenopause, perimenopause, naturally postmenopause, and postmenopause because of surgery. Women who used hormones were categorized in their own group.

The dependent variable is an indicator of the absence or the severity of physical limitations. The authors used three categories of physical limitations. Women were classified as having no limitations (80.8% of the sample - those who responded negatively to the screener question and so the MOS-SF-36 was not administered to them), having some limitations (10.0%) and having substantial limitations (9.2%). Logit regression models were used to compare women with some limitation to women with no limitation and women with substantial limitation to women with no limitation. The authors find that women using hormones or women who had surgical menopause were more likely to have physical limitations.

Mishra et al. (2003) use data from the Australian Longitudinal Study on Women's Health to measure the changes in mental and physical health for women as they transition through menopause. The Australian Longitudinal Study on Women's Health randomly selected women who were permanent residents of Australia from the national Medicare health insurance database. The survey focuses on three age cohorts: 18-23 year olds, 45-50 year olds and 70-75 year olds. The authors use data on the mid-age cohort of individuals who were interviewed at baseline in 1996 and in a follow up interview in 1998.

The menopause categories included were premenopause, perimenopause and postmenopause. The authors compare the women's reported health at baseline and after 2-year follow-up and investigated differences in the health status of women in various

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[3] Kaufert et al. (1992) also use logit regressions but make strong underlying assumptions on the model.

stages of menopause. They use the MOS-SF-36 to capture physical, mental, and social measures of well being.

The authors find that the MOS-SF-36 scores are decreasing across the menopause categories, with women in premenopause having better health than those in perimenopause or postmenopause. The authors also conduct separate analyses for women on HRT and find that these women had the lowest scores. They also find that women who remained in perimenopause between the baseline survey and the 2-year follow up showed greater declines in all physical health measures compared to the women who were premenopause at baseline and were still premenopause at the 2-year follow up. The implication of this finding is that a long transitory passage to post menopause has a negative impact on a woman's health.

The authors also find that women on HRT had significant declines in health status and had worse health compared to all other women not on HRT. They note that this finding may be due to the fact that the women on HRT had poorer health initially and so had a predisposition to poorer health than other women not on HRT.

Summary of the Findings

The studies reviewed measured physical well-being using the MOS-SF-36 scale. The authors consistently find that women who use hormones are more likely to report physical limitations, although the authors caution that this result may be indicative of the fact that these women had poorer health initially. Also women who had surgical menopause were more likely to report physical limitations. Perimenopause was also associated with greater declines in physical health measures.

Impact of Health on Labor Market Outcomes

This section reviews literature on the impact of health on labor market outcomes. As mentioned before, no previous studies have analyzed the impact of the menopause transition on labor market outcomes. Therefore, the literature review focuses on the effect of health status on labor market outcomes.

Methodological Issues in Labor Supply Models

Lambrinos (1981) highlights the important issue of endogeniety bias that arises when some measures of health are used in labor supply models. He notes that using a binary measure of health based on the response to a question on whether respondents feel "their health limits their ability to work" results in inconsistent parameter estimates.

The author notes that health can be measured in several ways including pathology (the mobilization of defenses and coping mechanisms), disability (the inability to work or perform some social functions), impairment (a physiological or anatomical or mental loss or other abnormality) or functional limitation (the inability to perform physical or mental functions). He notes that all of these measures of health, except disability, can be used to create an exogenous health index. Because of the desire to use a simple measure, most authors choose to develop health indices based on disability.

Using data from the 1972 Social Security Survey of Disabled and Nondisabled Adults, the author estimates a generalized least squares labor supply model. A binary disability variable is included which captures whether the respondent reported that his health limited him from working or if his health limited the kind or amount of work that he did. The health variable is based on whether respondent reported any activity

limitation. Respondents' reported activities limitations, sensory limitations, psychological limitations and symptoms of poor health (e.g., pain, nervousness) were interacted to form eight principal component analysis.

The regression estimates show that failure to control for health resulted in positively biased wage rate and non-labor income estimates in the labor supply model. However, using a binary indicator of health based on how health limited the ability to work was inadequate and still led to biased estimates.

The author then estimates the labor supply model controlling for health, with the health variable being a continuous variable derived using various combinations of the four principal components (activity limitations, psychological limitations, sensory limitations, and symptoms of poor health). Estimates based on a sample of only unhealthy people revealed that their labor supply estimates were highly sensitive to the measure of health that was used. He notes that this was a disturbing result because the various health measures used in the analysis were just different combinations of the four principal components. There was no a priori indicator of which combination was superior. Another key finding is that health was one of the strongest determinants of labor supply. When he used a continuous measure of health status, the explanatory power of the model increased significantly.

Chirikos and Nestel (1985) suggest a measure of health that is exogenous in the labor supply model. They also address the issue of censoring which is a problem with wage and labor supply data. The measure of health status used by the authors is a 10-year longitudinal retrospective history of agents' self-reported health status, disability limitation and functional limitation. They argue that their measure of health status is

likely to be exogenous based on the argument that a sufficiently long historical measure of health is exogenous to current labor supply decisions and wages, even though it is not exogenous to permanent wages. They use a two-equation model in which the first equation analyzes the effect of health history on wages, after adjusting for sample selectivity. The second equation is a Tobit model where the effect of health history and wages on annual hours worked is analyzed.

The data used for the cross-sectional estimations are drawn from the National Longitudinal Surveys of Older Men in 1976 and Mature Women in 1977. The age range of the respondents is 45-64 years at the time of the survey.

Chirikos and Nestel (1985) find that health has important effects on labor market outcomes, with a history of poor health reducing current economic welfare. This change works through both a reduction in wages and annual hours worked. Even if economic agents are willing to work harder, they find that the legacy of past health follows them. Second, poor health has different effects for men and women and also for different races. For blacks the effect occurs through labor supply. They are less able to sustain their labor market activity when unhealthy, so the stronger economic effect is through a reduction in hours worked.

Ettner (2000) also focuses on the issues of the measurement of health and endogeniety bias. She uses a large set of health measures which includes self-reported overall health, self-assessed mental and physical health, a scale of functional limitation, and self-reported medical conditions and indicators for mental health and substance abuse conditions. She also explores whether treating health status as endogenous affects its estimated impact on labor market outcomes.

The author uses data from the 1995 Midlife in the United States Study (MIDUS). MIDUS data were collected from non-institutionalized U.S. residents between 25 and 74 years of age who had telephones. The sample used in this analysis contained 1,527 women and 1,589 men. The main dependent variables in the econometric models are the person's occupational status, whether the person worked night shift or not, the weekly hours worked, earnings, a job demands scale, a job skills scale, and a job authority scale.

The analysis is undertaken with single equation regression methods. Some of the regressions are estimated as linear equations and others as binary logistic or ordered logistic regressions, depending on the dependent variable used. Where simultaneity bias existed, two stage instrumental variables (IV) regression is used.

Using the sample containing only the respondents in the labor force, the regression results show that the scale of functional limitations is very predictive of employment. Also, mental health affects human capital as much as physical health, although functional limitations are the strongest predictor of employment. Secondly, the author finds that the effect of health on labor market outcomes is not particularly sensitive to reverse causality, i.e., the regression estimates are very similar whether or not she controls for the self-reported impact of the job on health.

The author also finds that the instrumental variables estimates that control for the endogeniety of health in the employment regression are similar to the original estimates where she did not control for this endogeniety. This finding implies that even though health is endogenous to employment, treating it as exogenous does not make a significant difference to the estimation results in this study.

Wilson (2001) critiques past studies noting that most concern in the literature had focused on the possible bias from the use of self-reported conditions by the survey respondents. Wilson argues that the key issue that these studies ignored was the disease-specific effects of health on labor supply. He stresses the importance of simultaneously examining the variety of chronic diseases a person may have. The objective of his paper is to analyze the tradeoff facing a person after the onset of a chronic condition.

The author argues that disease accommodation affects labor supply through at least four channels. First, if productivity is affected, disease accommodation may induce a fall in wages, reducing the probability of employment. Second, if the disease causes a change in abilities, it alters the marginal utility of consumption and leisure and hence affects the decision to work. Third, there is an income effect induced by out-of pocket medical expenses. In the U.S., most medical benefits are tied to employment, so a person may keep their job in order to keep the medical benefits. Fourth, chronic illness requires more time allocated to health maintenance. Illness necessitates time re-allocation, taking time away from both work and leisure. He then argues that because there are multiple ways in which health conditions can affect labor supply, it would be inaccurate to summarize health through one variable that measures the capital stock of health.

The author estimates two single equations separately. The first equation looks at how the probability of employment is affected by the disease state (binary variables which indicate whether or not the agent had some health conditions) and exogenous variables affecting the employment decision. The estimates captured changes in employment rates due to marginal changes in the prevalence of disease. The second equation analyzes the determinants of the disease state. With this latter equation, he notes

that even though endogeniety may be a problem, instrumental variables estimation is not appropriate when the instruments were weak and so he does not use IV estimation.

The data are drawn from the New Jersey Demographics of Disability Survey (NJDDS). The survey data were collected using telephone interviews from over 40,000 people in 14,000 New Jersey households in 1991. The sample includes non-students who were between 35 and 74 years of age and who were free of chronic illnesses before age 25. The sample contains 7,600 women and 7,059 men. Separate regressions are done for men and women.

Wilson (2001) finds that the onset of chronic disease explains very little of the overall variation in employment. However, health conditions that are highly disabling had a strong negative effect on employment, while diseases that are not debilitating such as hypertension, had little effect on employment.

He also develops a disease-status index to capture co-morbidity. This is a summary index of health status that is based on underlying chronic conditions. He argues that the difference between this disease status index and the summary measures of disease used in other studies is that the index is not based on agents' self-assessments of health that are subjective but on reports of physician-diagnosed chronic illnesses. He categorizes the agent's disease index into four groups: no disease, mild, moderate, severe. The finding is that even though chronic disease does not explain much of the variation in employment probability, employment is halved for those in the severe disease group. Wilson (2001) finds that if all chronic diseases affecting the sample individuals are removed, then employment would rise by 5.53% for women and 3% for men.

Summary of the Findings

The methodological literature shows that it is important to control for health when estimating labor supply models. Poor health results in reduced labor force participation, a reduction in hours worked, or reduced employment probability. Failure to control for health will bias the regression estimates in labor supply models.

While controlling for health is important, the literature also stresses the inadequacy of health measures that are derived from questions on how health limits the ability to work. It highlights the importance of selecting measures that are exogenous to labor supply and having a variety of health measures. The literature also shows that it is important to control for co-morbidity.

The problems of endogeniety of the health measures and sample selection need to be considered to obtain unbiased parameter estimates. However, Ettner (2000) found that failure to control for endogeniety of health did not affect the estimates in her employment regression. Wilson (2001) noted that it is better not to use IV estimation if there are no good instruments available.

Health and Labor Market Outcomes for Middle-aged Women

Ruhm (1992) uses data collected through the New England Research Institute's Massachusetts Women's Health Study to explore the link between specific health problems and the labor supply of middle aged women. He wants to determine whether health or economic and demographic factors had a greater influence on labor market choices and to analyze the effects of physical and mental health on labor supply. The

sample of 2,399 women included only those respondents who held a paid job at some point in time.

The author infers the presence of specific health problems or conditions from respondents' information on how frequently they used specified medications. He notes that even though this methodology imperfectly captures the presence of health problems, the specificity of the health data he uses is better than that used by other researchers in previous papers[4]. The author uses the data on medication usage to be indicative of treating specific health problems such as heart problems, cholesterol, blood pressure, migraine headaches, pain, disability, diabetes, thyroid conditions, allergies, hormones, arthritis or rheumatism, sleeping disorders, depression and hypertension. The author then categorizes the inferred health conditions being treated as either physical health or mental health problems. Mental health (depression) is assessed using the CES-D scale.

Ruhm (1992) estimates binary and ordered probit models. The binary probit models use three separate dependent variables: labor force participation, employment, and full time employment (more than 35 hours per week). The ordered probit captures three possible outcomes: non-employment, part-time employment and full-time employment. The author uses longitudinal data for his estimations and notes that one issue of concern, highlighted in previous research, was that schooling and occupational attainment was endogenous in a life-time context. To check for the seriousness of the endogeniety problem, he estimates his models with and without controlling for the schooling and occupation variables. He finds that there was a weak negative link between health problems and schooling and occupational attainment. Thus endogeniety is not a

[4] Data limitations on middle-aged women may have forced this author to use this tenuous method to construct the health variables.

serious problem, and all subsequent estimates include controls for education and occupation.

The regression results for the binary probit and ordered probit models reveal that respondents who used medications that treated mental ailments had statistically significant reductions in labor market supply. The CES-D variables also show that women who had CES-D scores that were greater than 24, had significant reductions in labor supply compared to women with scores which were less than eight (the comparison group). For physical ailments, only women who used pain and muscle or joint medications showed a statistically significant decline in labor supply, with all other medication coefficients being statistically insignificant.

The author then uses the McFadden (1974) decomposition[5] to explore the percentage of health increase explained by physical and mental health and finds that physical health accounted for 48% of the total health effect on labor supply and 42% of the total health effect on employment. On the other hand, mental health accounted for 33% of the total effect of health on labor force participation and 40% of the health effect on employment. The correlation between mental and physical health was approximately 17%. The author also finds that economic and social factors explained more than 80% of labor supply compared to health factors which explained between 7% and 16%.

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[5] McFadden (1974) uses a statistic to measure the increase in the log-likelihood resulting from an inclusion of the vector of covariates as compared to an intercept only model. The statistic is defined as

$$\Im = 1 - \left[\frac{\ell(X)}{\ell(0)} \right]$$

where

$\ell(0)$ is the maximized log-likelihood of the intercept only model

$\ell(X)$ is the maximized log-likelihood of the full model

Ettner et al. (1997) use the National Comorbidity Survey (NCS) to examine the impact of psychiatric disorders on employment, hours of work and personal income. The NCS is a random sample of the non-institutionalized civilian population residing in the 48 coterminous states of the USA. The survey included both men and women between 15 and 54 years of age, and the interviews were conducted between September 1990 and February 1992. The NCS is a two-part survey, the first part being a diagnostic interview and the second part, a risk factor interview. The diagnostic interview was administered to all respondents (8,098 respondents), while the risk factor survey was administered to all respondents aged 15 to 24 years and also to those aged above 24 years who had screened positive for any disorder in the diagnostic interview. One in six of the adults who had not screened positive for any disorder was also administered the risk factor survey.

The Composite International Diagnostic Interview-Short Form (CIDI-SF) is used to diagnose a number of psychiatric disorders. It contains questionnaires on major depressive episodes, generalized anxiety disorder, specific phobia, social phobia, agoraphobia, panic attack, alcohol dependence, drug dependence and obsessive compulsive disorder.

The analyses done by Ettner et al. (1997) used conditional samples because not all data were available for all the survey respondents. These authors use a sample of 4,626 people (2,225 men and 2,401 women) who were non-students aged 18 years and older. The key explanatory variables in the model are dummy variables capturing whether the respondents met diagnostic criteria for each psychiatric disorder over the past 12 months. I focus on the results for women.

The authors note that correlations may exist between the error term and the measures of psychiatric disorders and, as such, instrumental variables estimation methods were used. Because separate identification of each of the psychiatric conditions is not possible, the estimates focus on the impact of having any psychiatric disorder on the labor market outcomes.

The authors find that women with major depression or schizophrenia (mental disorder) were less likely to work. Those who worked earned less compared to women with none of these conditions. However, there was no impact of the illnesses on hours worked among the women who were already working.

The authors also examine the impact of having any psychiatric condition. They find that having any psychiatric disorder reduced the probability of employment by 11% and resulted in an 18% decline in income when compared to respondents with no disorder. There was no significant impact on hours worked.

Because separate identification of the each of the psychiatric conditions is not feasible, instrumental variables estimation is used in the equation controlling for whether the respondent had any psychiatric disorder. The IV estimation results are very similar to the linear model results. The authors find that the effect of having any illness became larger after instrumenting. The IV estimation results show that having any psychiatric condition led to a decline in both employment probability and income, with no effect on hours worked when compared to women without the condition.

Marcotte et al. (1999) use the National Comorbidity Survey[6] to identify the importance of major depressive illness to the labor force. The sample consisted of 8,098 men and women who were between 15 and 54 years of age at the time of the interview.

The authors find that among the people in the labor force, 19.8% of the women and 11.7% of the men had suffered from a major depressive disorder some time in their life. The prevalence of major depression in the lifetime did not differ significantly based on whether someone was in or out of the labor force. Also, people who were in the labor force but were currently unemployed, were found to have suffered from more episodes of depression than any other group. The authors note that this finding implies that even though there was a causal link between unemployment and depression, the depression observed in those who were currently unemployed was based on a history of depression rather than a depressive episode associated with their current unemployment status.

The authors find that there are no large differences in lifetime prevalence of major depression for women when categorized by labor force status. They find that there is a stronger link between labor market status and depression in the 12 months prior to the interview. Of the women reporting a major depressive disorder in the past 12 months, 30.3% were not in the labor force. For the analysis by age, the authors find that depression is higher among the unemployed and those out of the labor force who were between 30 and 50 years old compared to those who were employed. They conclude that these findings implied that depression is more associated with poorer labor market outcomes for middle-aged persons.

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[6] The National Comobidity Survey and the CIDI instrument are discussed in the review of Ettner et al. (1997).

Marcotte et al. (1999) then provide logistic regressions, which capture how labor market outcomes are affected by depression while controlling for other factors. The variables measuring depression include a dummy variable for whether the person had experienced depression or not; the number of episodes experienced; the age at which the first episode was experienced; and the number of years since the last episode.

A woman's history of depression had no significant impact on labor force participation, but it did reduce the probability of employment by 3.9% compared to a woman with no history. The number of episodes of depression was the only significant determinant of labor force participation. On the other hand, depression history, the number of depression episodes, and the time since the last episode all significantly affected the probability of employment. The authors also note that there were reverse causality issues between depression and employment, but they did not address this complex problem in their paper. Their aim was to provide basic facts about the relationship between labor market outcomes and depression.

Summary of the Findings

The studies that examined the relationship between mental and physical health and labor market outcomes used various measures of health derived from both the CES-D and the CIDI-SF scales. Some of the authors note the importance of correcting for endogeneity with the use of instrumental variables estimation, but the instruments are usually weak. However, they note that it was not possible to have separate identification of each of the health variables. The estimation results indicate that women with high CES-D scores and women using pain and muscle or joint medications had significant

declines in labor supply (Ruhm, 1992). Women with any psychiatric condition were less likely to work (Ettner et al., 1997; Marcotte et al., 1999), and those who worked had lower income. There was no impact on the number of hours worked among the women who were already employed (Ettner et al., 1997; Marcotte et al., 1999). Having any psychiatric condition also had no effect on labor force participation (Marcotte et al., 1999).

CHAPTER 3: THEORETICAL AND ECONOMETRIC MODEL

This chapter develops the theoretical model showing the effects of health on labor market outcomes and then discusses the theoretical issues concerning the econometric analysis with health as an explanatory variable. The empirical models that will be used for the econometric analyses are also presented.

The Theoretical Model

Assume the health production function is given as

$$Q = q(G, t; \mu) \tag{1}$$

where Q is an index measuring the individual's health status, G represents health improving goods and services that can be purchased in the market, t is the time used for health production and μ is a shift parameter for health. The health production function assumes that health is increasing in G and t. The parameter μ is a health shock which results in a decrease in health status.

The theoretical framework follows the basic labor-leisure choice model, incorporating health into the utility function. Assume a quasi-concave utility function where utility is a function of the amount of leisure time (L), a composite good (C), the stock of health (Q) and also a vector of exogenous taste shifters (Z). Assume the price of leisure is the real wage rate (w), the price of the composite good is normalized to 1 and the price of health goods and services is P_G. The formal model is presented as

$$\max_{C,L,G,t} U(C,L,Q,Z) \tag{2}$$

subject to

$$wH + I = C + P_G G \tag{3}$$

$$L + H + t = 1 \tag{4}$$

$$\mathrm{Q} = q(G,t;\mu) \tag{5}$$

where H is the number of hours worked and I is non labor income. Equation (3) is the budget constraint while equation (4) is the temporal constraint. Equation (5) shows the health production function.

Utility increases as the amount of leisure time increases, as the consumption of the composite good increases and also as the health stock (health status) increases (improves). Utility declines with an increase in hours worked. The budget constraint states that total income is the sum of labor income (wages multiplied by the hours worked) and non-labor income. Total income is spent on both the composite good and also on purchasing health improving goods and services. The temporal constraint states that the individual spends his time either on leisure or working in the labor market or on health production.

The individual's choice variables are the amount of time for leisure (L), the amount of time for health production (t), the amount of the composite good to consume (C) and also the amount of health improving goods and services to consume (G).

The optimization problem is set up as a Lagrangian function:

$$\max \psi = U(C, L, Q; Z) + \lambda(wH + I - C - P_G G) \tag{6}$$

From equation (4),

$$H = 1 - L - t \tag{4b}$$

Substitute equation (4b) into equation (6)

$$\max \psi = U(C, L, Q; Z) + \lambda(w(1 - L - t) + I - C - P_G G) \tag{7}$$

The first order conditions for the optimization are

$$\frac{\partial \psi}{\partial C} = U'_C - \lambda = 0 \tag{8}$$

$$\frac{\partial \psi}{\partial G} = U'_Q \cdot \frac{\partial Q}{\partial G} - \lambda P_G = 0 \tag{9}$$

$$\frac{\partial \psi}{\partial L} = U'_L - \lambda w = 0 \tag{10}$$

$$\frac{\partial \psi}{\partial \mathrm{t}} = U'_Q \cdot \frac{\partial Q}{\partial t} - \lambda w = 0 \tag{11}$$

$$\frac{\partial \psi}{\partial \lambda} = w(1 - L - t) + I - C - P_G G = 0 \tag{12}$$

From equation (10) and (11) it can be derived that

$$\frac{\partial U}{\partial L} = \frac{\partial U}{\partial Q} \cdot \frac{\partial Q}{\partial t} = \lambda w \tag{13}$$

This implies that for utility maximization, the individual sets the marginal utilities of time allocation to be equal. From equations (8) and (10), it is possible to derive the marginal rate of substitution between the consumption good and leisure given by

$$\frac{\frac{\partial U}{\partial L}}{\frac{\partial U}{\partial C}} = w \tag{14}$$

implying that the marginal rate of substitution between leisure and the consumption good is the real wage. This marginal rate of substitution can be interpreted as follows: if the individual enjoys one more hour of leisure, he foregoes an amount of consumption goods worth one hour's real wage.

The solution to the optimization can be obtained using equations (8) to (12) and it is achieved through expressing the endogenous variables as functions of the exogenous variables. One of the solutions resulting is the labor supply function given as[7]

$$H = h^{*}\left(w, P_G, I, Q, Z\right) \tag{15}$$

[7] The optimization solution also gives the general form of the consumption function for the composite good and for the health goods and also for the time allocation for health production. Because these general solutions are not the focus of this study, they are not presented here.

Labor supply depends on the real wage, the price of the health improving goods and services, the price of the composite good (normalized to 1), non-labor income, health status and other exogenous factors.

From equation (15) it is possible to investigate the effect of a health shock on labor supply which is given as

$$\frac{\partial H}{\partial \mu} = \frac{\partial h^*}{\partial Q} \cdot \frac{\partial Q}{\partial \mu} \tag{16}$$

The effect of a health shock on labor supply depends on the effect of a change in health status on labor supply $\left(\frac{\partial h^*}{\partial Q}\right)$ and also on the effect of a health shock on health status $\left(\frac{\partial Q}{\partial \mu}\right)$. The health production function assumes that a health shock results in the deterioration of health status i.e. $\left(\frac{\partial Q}{\partial \mu} < 0\right)$.

To determine the sign of $\left(\frac{\partial h^*}{\partial Q}\right)$ one can use a simpler model for expositional purposes. Assume a simpler model which is given below where variables are defined as before:

$$\max \quad U(C, L; Q) \tag{17}$$

subject to

$$wH + I = C \tag{18}$$

$$L + H = 1 \tag{19}$$

The optimization problem can be recast as

$$\max \psi_H = U\left(wH + I, \quad 1 - H; \quad Q\right) \tag{20}$$

The first order conditions for the optimization is

$$\psi'_H = U'_C \cdot w - U'_L = 0 \tag{21}$$

The second order condition is given as

$$\psi''_{HH} = U''_{CC} \cdot w^2 + U''_{LL} - 2w \cdot U''_{CL} < 0 \tag{22}$$

The second order condition is negative under the assumption of a quasi-concave utility function.

Comparative statics can be used on equations (21) and (22) to explore the effect of a change in health status on labor supply.

$$\frac{\partial h^*}{\partial Q} = \frac{\psi''_{HQ}}{\psi''_{HH}} \tag{23}$$

The numerator in equation (23) is found by differentiating equation (21) with respect to Q and is given by

$$\psi''_{HQ} = w \cdot U''_{CQ} - U''_{LQ} \tag{24}$$

The model assumes that health status will increase the marginal utility for the consumption of both leisure and the consumption good, that is

$$U''_{CQ} > 0$$
$$and$$
$$U''_{LQ} > 0$$

This implies that the sign of equation (24) cannot be determined from the theoretical model and its underlying assumptions. As a result the sign of equation (23) cannot be determined solely on the basis of the theoretical model. That is

$$\frac{\partial h^*}{\partial Q} = \frac{w \cdot U''_{Cq} - U''_{Lq}}{U''_{CC} \cdot w^2 + U''_{LL} - 2w \cdot U''_{CL}} = sign\ ? \tag{25}$$

DeLeire and Manning (2004) recommend the use of empirical regularities to inform us on the direction of change of $\left(\frac{\partial h^*}{\partial Q}\right)$. Based on empirical regularities $\left(\frac{\partial h^*}{\partial Q} > 0\right)$, implying that as health status improves, labor supply increases. From this it

is possible to conclude that $\frac{\partial H}{\partial \mu} < 0$, that is, a health shock results in a decrease in labor supply.

Based on the theoretical model, hours worked decrease if the person experiences a health shock. Thus a person may move from full-time work to part-time work in response to the health shock. A corner solution is also possible where the health shock results in the person exiting employment and working zero hours. A health shock can also move a person out of the labor force. This outcome is possible if the health shock results in an increase in the reservation wage such that the market wages fall below the reservation wage and the person maximizes utility by exiting the labor market.

Estimation Theory for Labor Market Outcomes Models

According to equation (15) the general form of the labor supply function is given as $h = h^*(w, P_G, I, Q, Z)$. The individual chooses to participate in the labor market if the market wage is greater than the reservation wage. Let r be the reservation wage, which is the wage that makes an individual indifferent between working and not working. Thus the reservation wage is the wage such that the person works zero hours, i.e.

$$0 = h^*(w, I, Q, Z) \tag{26}$$

Let the reservation wage be defined as

$$r = r(I, Q, A) \tag{27}$$

where the reservation wage depends on non-labor income, health and other factors , A , some of which may be included in the vector Z . Higher non-labor income and poor health imply a larger reservation wage. Let the market wage be defined as

$$w = w(Q, A) \tag{28}$$

Thus the market wage depends on health and other factors. A person with better health is offered a higher market wage, holding all other things constant.

The individual works if the market wage is greater than or equal to the reservation wage

$$\text{if } w(Q, A) \geq r(I, Q, A) \text{ then } h > 0 \tag{29}$$

$$\text{if } w(Q, A) < r(I, Q, A) \text{ then } h = 0 \tag{30}$$

Since there are unobservable determinants of wages, both the market wage and the reservation wages are estimated with error. Let w^* be the observed market wage and let r^* be the reservation wage which is not observed. Thus

$$w^* = \beta_w Q + A\gamma_W = w + \varepsilon_w \tag{31}$$

$$r^* = \beta_r Q + A\gamma_r + \delta_r I = r + \varepsilon_r \tag{32}$$

where β, γ and δ are the parameters of the wage equations that need to be estimated (note: γ is a vector of parameters) and ε_w and ε_r are the measurement errors for the

market wages and reservation wages. From equation (29), a person participates in the labor force if the market wage is greater than the reservation wage. Thus the probability of participating in the labor force is the probability that the market wage is greater than the reservation wage, that is

$$P = \Pr(w \geq r) = \Pr(w^* \geq r^*) \tag{33}$$

Substituting equations (31) and (32) into equation (33) yields

$$\begin{aligned} P &= \Pr(w^* - \varepsilon_w \geq r^* - \varepsilon_r) = \Pr(\varepsilon_w - \varepsilon_r \leq w^* - r^*) \\ P &= \Pr[\varepsilon_w - \varepsilon_r \leq (\beta_w - \beta_r)Q + A(\gamma_w - \gamma_r) + \delta_r I] \\ P &= \Pr(\mu \leq X\vartheta) \end{aligned} \tag{34}$$

Given the observed outcomes for the individuals in the sample, one can use equation (34) to construct indicator variables of the women's labor force participation. Let the labor force participation equation be given as

$$Y_i = X_i\vartheta + \mu_i \tag{35}$$

where Y_i takes the value of 0 (if not in the labor force) or 1 (if in the labor force). Thus

$$\begin{aligned} Y_i &= 0 \text{ if } \mu_\mathrm{i} > X_i\vartheta \\ Y_i &= 1 \text{ if } \mu_i \leq \mathrm{X_i}\vartheta \end{aligned} \tag{36}$$

Employment equations result if one focuses only on individuals who are in the labor force, thus giving conditional estimates. For people in the labor force, employment depends on the difference between the offered wage and the reservation wage. If the

offered wage is greater than the reservation wage, the person takes up employment and similarly if the offered wage is less than the reservation wage, the person chooses to remain unemployed and continue searching. Let the employment equation be defined as

$$E_i = X_i\vartheta + \upsilon$$

where E_i takes the value of 0 if the person is not employed or 1 if the person is employed. Thus

$$E_i = 0 \quad \text{if} \quad \upsilon > X_i\vartheta$$
$$E_i = 1 \quad \text{if} \quad \upsilon \leq X_i\vartheta$$

One can also define a trichotomous outcome variable for employment which is defined as equal to 0 for non-employment, equal to 1 for part time employment (working less than 35 hours a week) and equal to 2 for full time employment (working at least 35 hours a week). The equations are specified as

$$\begin{aligned} P_i &= 0 \text{ if } \upsilon_i > X_i\vartheta \\ P_i &= 1 \text{ if } X_i\vartheta - 35 < \upsilon_i \leq X_i\theta \\ P_i &= 2 \text{ if } \upsilon_i \leq X_i\vartheta - 35 \end{aligned} \tag{37}$$

The Econometric Models

Menopause Transition and Health

This section explores the determinants of physical and mental health. The main task is to determine the effect of menopause transition on health, while controlling for other variables. Two separate equations are estimated and these are:

$$Depression_i = f\left(Menopause\ Stage,\ Health\ Shocks,\ Demographics \right) \quad (38)$$

$$ADL_i = f\left(Menopause\ Stage,\ Health\ Shocks,\ Demographics \right) \quad (39)$$

where *depression* an indicator variable equal to 1 if the person is depressed and zero otherwise and ADL is the person's score on the activities of daily living scale. The key explanatory variables are the menopause stage (premenopause, perimenopause, surgical menopause or natural postmenopause). The model also includes health shocks captured through two variables: having a hysterectomy and having early menopause. Furthermore, the model includes interaction terms for the menopause stage and hormone use, in order to capture the effect of hormone use on health. Also, control variables for several demographic and socio-economic variables are included.

The menopause variables capture the effect of menopause transition on health. The literature review suggests that women in premenopause have better health than women in other menopause stages, holding all other things constant. Also, women who had surgical menopause have poorer health than women who experienced natural postmenopause. Women who experienced early menopause and had hysterectomies, also

have poorer health. The results from this study are expected to be similar to previous findings on the link between the menopause transition and health.

The regressions include interaction terms between the menopause variables and hormone use. One reason why women use hormones is to relieve menopause symptoms and so one would expect women who are using hormones to have better health, as a result of the benefits of hormone use. However, a woman may opt to use hormones because she has severe menopause symptoms and so the use of hormones may signal poor initial health. As a result, in the regressions it is possible to find that women using hormones have worse health than women who do not use hormones because they have poor initial health. Thus the effect of hormone use on health is not easy to determine theoretically.

The regressions also control for socio-economic control variables like age, race, education, marital status, income and health insurance coverage. As people age, their health deteriorates and so holding other things equal, health should decrease with age, implying a negative coefficient on the age variable. Previous studies have found racial differences in health with Caucasians having better mental health than other races, and we expect the study to confirm these previous findings. Some studies have found that health improves with education. This may be because those who are more educated are generally more informed about health and also have better incomes and so can invest in health and this study expects to find the same positive relationship between health and education. Similarly, previous studies show that people with more income have better health, holding all other things constant, because they are able to invest in their health, have better health insurance coverage, and have more access to health care and so a

positive relationship between income and health is expected. Also we expect that people with health insurance will have better health as they have better access to quality care.

The regressions also include control variables for whether the woman has been diagnosed with cancer, high blood pressure, and/or heart disease. Control variables are also included for women's smoking habits and alcohol consumption, with a negative relationship between health and these behaviors expected.

The econometric models above are estimated using the linear regression model (where the dependent variable is the score on activities of daily living), and a probit model (where the dependent variable is the indicator of depression derived from the CES-D scale). The probit model assumes the errors follow a normal distribution and so is estimated using the maximum likelihood estimation technique. T-statistics and goodness of fit tests are used to evaluate the performance of each of the models.

Menopause Transition and Labor Market Outcomes

Five separate regressions are estimated to explore the effect of the menopause transition on labor market outcomes with the following outcome variables: labor force participation (a dummy variable equal to 1 if the woman is in the labor force and 0 otherwise); labor supply (weekly hours worked); full-time employment (working more than 38 hours per week); wages; and an indicator for self-employment. The labor supply equation, the choice to work full-time, and the wage equation models are estimated as conditional on employment. The models can be specified as:

$$LFP_{it} = M_{it}\beta_1 + X_{1it}\beta_2 + Z_{1i}\beta_3 + \gamma_i + \varepsilon_{it} \tag{40}$$

$$F = M_{it}\phi_1 + X_{2it}\phi_2 + Z_{2i}\phi_3 + \gamma_i + \upsilon_{it} \tag{41}$$

$$H = M_{it}\theta_1 + X_{3it}\theta_2 + Z_{3i}\theta_3 + \gamma_i + \xi_{it} \tag{42}$$

$$\ln W = M_{it}\vartheta_1 + X_{4it}\vartheta_2 + Z_{4i}\vartheta_3 + \gamma_i + \zeta_{it} \tag{43}$$

$$S = M_{it}\alpha_1 + X_{5it}\alpha_2 + Z_{5i}\alpha_3 + \gamma_i + \varsigma_{it} \tag{44}$$

where LFP is labor force participation, F is an indicator of full-time employment, H represents hours worked, *ln* W is the log of wages, and S is an indicator of self-employment. M is a vector of the key independent variables which are indicator variables to capture the menopause transition stage: premenopause, perimenopause and surgical menopause (I exclude natural postmenopause which serves as the reference); and a dummy to control for early menopause (menopause occurring before the age of 40). The models also include an indicator variable for whether the woman has had a hysterectomy. The augmented models include interaction terms between hormone use and the menopause stage variables.

The models also control for time-variant and time-invariant socioeconomic and demographic variables. X_1, X_2, X_3, X_4 and X_5 are vectors of time-variant control variables, such as age, years of work experience and household income. Variables in each vector have some overlap. Z_1, Z_2, Z_3, Z_4 and Z_5 are vectors of time-invariant variables, including race and family background. Variables such as marital status, years of education, number of children, occupation, and health insurance coverage will also be included. These are time-invariant for most people but time variant for some.

$\beta_1, \phi_1, \theta_1, \vartheta_1$ and α_1 are the parameters to be estimated; these capture the effect of menopause transition on labor market outcomes. $\beta_2, \phi_2, \theta_2, \vartheta_2, \alpha_2$ and $\beta_3, \phi_3, \theta_3, \vartheta_3, \alpha_3$ are parameter vectors to be estimated which capture the impact of socioeconomic and demographic variables on labor market outcomes. γ_i is the individual fixed effect and $\varepsilon_{it}, \upsilon_{it}, \xi_{it}, \zeta_{it}$ and ς_{it} are the error terms.

As the literature shows, the menopause transition may have either positive or negative effects on women's health and their labor market outcomes. The literature has shown two schools of thought on the menopause transition. The first is that menstrual cycles lead to poor health for some women and hence the cessation of menstrual cycles should bring better health and relief for these women. The other literature argues that the menopause transition is itself associated with poor health for certain women. Thus, the effect of menopause on labor market outcomes depends on the effect of the cessation of reproductive cycles on women's health.

Women experience early menopause because of poor reproductive health. Therefore, holding other things constant, the expected result is that women who had early menopause should be less likely to participate in the labor force and, if employed, to be more likely to work fewer hours. The literature also shows that women with hysterectomies have poorer health than women without hysterectomies, so the expected result is lower participation and employment probabilities and fewer hours worked for women with hysterectomies.

The regressions also include controls for socioeconomic and demographic variables in the regressions such as age, race, education, marital status, number of children in the household and, health. The expected result is that labor market outcomes

will differ by age with the older people having lower outcomes than the younger people, holding all other things constant. The regressions also include an age-squared variable to account for any non-linear relations between age and labor market outcomes.

Racial differences in labor market outcomes for women exist mainly because of economic responsibilities. Previous studies have found that African American women work more than Caucasian women and the study expects the same finding. Also educational attainment explains differences in labor market outcomes. Individuals who have invested more in human capital tend to have better labor market outcomes than those with lower levels of human capital investment. Education is also used as a signal of higher productivity, so employers tend to demand more educated workers to less educated workers. Thus, the expect result in this study is that more educated people should have a higher probability of participating in the labor force, being employed, and working more hours.

Married women have less financial responsibility than single women so their reservation wage is higher than that of single women and so the expected findings are that married women will be less likely to participate in the labor force. Because of the reduced financial burden, their search effort when unemployed is reduced. Therefore, they are less likely to be employed if in the labor force. If employed, they are likely to work fewer hours than single women.

Furthermore, having young dependent children in the home increases the reservation wage (because of the costs of child care) and makes women less likely to work. The expected finding is that women who have small dependent children in the home will be less likely to work and if they work, they will work fewer hours than

women without small dependent children in the home. Also, having older dependent children has a smaller effect on participation and work hours, but still results in a decrease in labor force participation and hours worked.

Health also has an effect on labor market outcomes, with previous researchers finding that people in better health have better labor market outcomes. Furthermore, non-labor income affects the decision to be in the labor force. A high non-labor income increases the reservation wage and makes people less likely to participate in the labor force. It reduces the effort to seek employment and so reduces employment probabilities for those in the labor force. It makes employed individuals less likely to work longer hours. Thus non-labor income will be negatively related to labor market outcomes.

The models are run first with the control variables stated above. In the models where the results indicate that the transition to menopause has significant effects on labor market outcomes will then be estimated using an augmented set of control variables in order to decompose the effects of the menopause transition. The augmented variables set includes variables such as self-reported health status, whether the woman reports that a family member's health limits her ability to work, smoking habits, alcohol consumption, items from the Center for Epidemiological Studies Depression scale and controls for whether the woman has been diagnosed with cancer, high blood pressure or heart disease.

Estimation Techniques and Issues for Labor Supply Models

Several estimation methods are used to estimate the effect of menopause on labor market outcomes. The main estimation methods are pooled ordinary least squares, the fixed effects model, the random effects model and the family fixed effects model. A discussion of the theoretical underpinnings of each estimation method follows.

Assume a model given as

$$y_{it} = X_{it}\beta + c_i + \mu_{it} \tag{45}$$

where X_{it} contains variables which can change cross time (t) but not across individuals (i), variables that change across individuals but not across time and variables that change across both time and individuals. c_i represents the unobserved individual heterogeneity (unobserved effect) that does not vary over time and u_{it} represents the idiosyncratic errors.

The estimation method for the equation depends on the assumptions that we make on the relationship between c_i, X_{it} and μ_{it}. Ordinary least squares is the consistent estimator if there is no correlation between X_{it} and μ_{it} and also when there is no correlation between X_{it} and c_i . That is, we assume exogeneity between both the unobserved effects and the idiosyncratic errors and the explanatory variables. That is, we assume that:

$$E(X'_{it}\mu_{it}) = 0 \tag{46}$$

$$E(X'_{it}c_i) = 0 \tag{47}$$

An alternative estimation procedure is based on the generalized least squares procedure because it assumes serial correlation in the composite error, $v_{it} = c_i + \mu_{it}$. This is the random effects model which assumes that the unobserved effects are strictly exogenous and orthogonal to the explanatory variables. The assumptions of the random effects model are:

$$E(\mu | X_{it}, c_i) = 0 \tag{48}$$

$$E(c_i | X_i) = 0 \tag{49}$$

Another alternative estimator is the fixed effects estimator which assumes equation (48) only. The fixed effects estimator is based on the assumption that the idiosyncratic errors are exogenous to both the explanatory variables and the unobserved effect but it allows for correlation between the explanatory variables and the unobserved effects. This estimator is consistent under weaker assumptions; however the use of the fixed effects precludes the use of time invariant regressors.

Two post-estimation tests are used to check the validity of the findings. The Breusch and Pagan Lagrange multiplier test (Breusch & Pagan, 1980) can be used to test for the presence of unobserved effects. It uses the Lagrange multiplier principle to test the null hypothesis of no unobserved effects in the data. The test, which is chi-squared distribution under the null, uses the OLS residuals to compute the variance of the

unobserved effects which is the key component in the test statistic. The Hausman test (Hausman, 1978) is used to determine whether the random effects model is the correct specification. The null hypothesis, states that there is no correlation between the unobserved effects and the independent variables. Thus, both the pooled OLS estimator and the random effects estimator are consistent, but the pooled OLS estimator is inefficient. Under the alternative hypothesis, the OLS estimator is consistent, but the random effects estimator is not. The test statistic's key component is the covariance matrix of the difference between the OLS and random effects model coefficient estimates. This test is also based on the chi-squared distribution.

The results of the Breusch and Pagan Lagrangian Multiplier test and the Hausman test indicate which estimation technique's underlying assumptions are violated and aid in the choice between the pooled OLS, fixed effects, and random effects models. If the results indicate that there are unobserved effects, this implies that the pooled OLS model is not the correct specification because this model assumes that there are no unobserved effects. The Hausman test will help me choose between the random effects and the fixed effects models.

The individual fixed effects and random effects models focus on unobserved heterogeneity among individuals. An alternative specification, the family/sibling fixed effects model, controls for unobserved heterogeneity across families. This model uses only the sample of respondents who have at least one sibling to be able to control for unobserved family heterogeneity. The individual fixed effects model corrects for unobserved, time-invariant characteristics that differ across individuals. The family/sibling fixed effects model corrects for unobserved, time-invariant differences

across families, but it does not adequately correct for differences between individuals. Chatterji and Markowitz (2001) note that similar results of the individual fixed effects and the family/sibling fixed effects models would imply that the relevant unobserved effects lie within families. Both the individual and the family fixed effects models would adequately correct for these unobserved effects. However, differing results of the two models would imply that individual unobserved effects are important and the family/sibling model would not adequately correct for this problem. The empirical analysis estimates both types of models and compares the results.

Other issues of concern are the endogeniety and measurement errors in the measures of health which lead to inconsistent estimates. Self-reported measures of health are the most widely available measures in survey data, but they have the problem of being endogenous. Bound (1991) argues that self-reported health status is subject to both negative and positive biases which result from measurement error and endogeneity respectively. He argues that survey respondents are asked for subjective judgments on their health status, so these judgments may not be entirely comparable across the respondents, which results in measurement error. At the same time, the responses may not be independent of labor market outcomes as some respondents may use their self-reported health status to justify their current labor market status. This leads to endogeneity in the self-reported measure. Bound argues that measurement error led to underestimation of the impact of health on labor force participation, while the endogeneity bias led to overestimation of the impact of health on labor force participation. One can argue that the correction for endogeneity bias but not measurement error will bias the results toward zero.

The key explanatory variables are the menopause transition variables which are derived from self-reported responses of women on whether they had menstrual cycles within the 12 months prior to the interview and also responses to the question "Are you going through or have you gone through menopause?" The response to the question on whether the woman had a menstrual cycle within the previous 12 months should not be subject to measurement error as it is unlikely that a woman would fail to recall whether she was still having menstrual cycles. Possible measurement error of the menopause variables may arise from the failure of women to accurately say whether they were going through menopause, especially among women who had non-regular menstrual cycles for all their lives. This may introduce bias due to measurement error since the menopause stage is self-reported.

The Hausman test (Hausman, 1978, 1983) is used to test for endogeneity in the menopause variables. The Hausman test compares the variances of the estimates of the OLS and 2SLS models. The null hypothesis is that the key explanatory variable is uncorrelated with the idiosyncratic errors. Under the null hypothesis, the OLS estimator is consistent but it becomes inconsistent under the alternative hypothesis. The 2SLS estimator is the consistent estimator under both the null and the alternative hypothesis but it is inefficient under the null hypothesis. The test is based on the Chi-square distribution.

If the Hausman test suggests that the menopause variables are endogenous, we will use instrumental variables estimation techniques when estimating the equations for the hours worked and wage equation models. In the first stage of the instrumental variables technique, we run the regression with the menopause variable as the dependent variable and the instruments and the other control variables as the explanatory variables

and obtain the fitted values of the menopause variables. In the second stage, we run the regression with either the hours worked or the wages as the dependent variables and the fitted values of the menopause variable and the other control variables as the explanatory variables.

Theory dictates that the characteristics of a good instrument are that it should be correlated with the variable it is instrumenting and yet at the same time uncorrelated with the error term in the regression. Based on this criterion, we choose the following possible instruments for menopause stage: (1) the number of years a woman has used hormones; (2) the percentage of women in the respondent's region of residence not having a Pap smear in the past three years; and, (3) health expenditure as a percentage of gross state product in the respondent's region of residence. The justification for the use of these instruments is that even though hormone use may have an effect on health and hence labor market outcomes, the number of years a woman uses hormones only affects the menopause experience but not labor market outcomes. The latter two variables capture availability of health care services in the region of residence, which affects menopausal health but not labor market outcomes. The Pap smear variable also captures demand-side issues as there are differences by race in the use of the tests. The limitation of the instruments measured at the regional level is that the regions are only defined as south and non-south, and this reduces the quality of the instruments. One limitation of the instrumental variable technique is how to find good instruments.

To test the validity of the instruments, the procedure is to run the regressions with each menopause variable as the dependent variable, and use the set of instruments and the other control variables as the explanatory variables. If the explanatory power of these

regressions is high, and the instruments are significant in the equations then these variables are valid instruments based on F-tests.

Another issue of concern in labor supply equations is sample selection. Sample selection issues arise because we do not observe market wages for individuals who are not employed, even though we observe all the other characteristics. The reservation wage is not observed for all people. However, people only work if the market wage is greater than the reservation wage, so that my sample selects only those for whom the market wage is greater than the reservation wage. Heckman (1976) developed a two-step estimator to correct for the selectivity bias. It requires the estimation an equation to predict labor force participation. This allows for the construction of the inverse Mills ratio, which is then used in a second stage regression of hours worked. The procedure requires identification which is attained by having some explanatory variables in the labor force participation equation which are excluded from the hours worked equation.

Wooldridge (2002) notes that using the inverse Mills ratio in the fixed effects model does not produce consistent results. In order to get consistent results, he suggests a procedure where the inverse Mills ratio is included in the pooled OLS regression. This study uses the Heckman procedure to correct for sample selection.

In summary, five separate regressions are estimated with the dependent variables as labor force participation, hours worked, full time employment, wages, and self-employment. Each regression will be estimated using the pooled OLS, fixed effects, random effects, and the family fixed effects models. The Breusch and Pagan test and the Hausman specification tests will be used on the fixed effects and random effects models. Tests for endogeneity of the menopause variables will be done and instrumental variables

estimation will be used for the wage and hours worked equations, if necessary. Furthermore, tests for sample selection will be done and the two-step procedure will be used to correct for this problem, if needed.

CHAPTER 4: DATA AND DESCRIPTIVE STATISTICS

The data for the study are drawn from the National Longitudinal Survey of Young Women (NLSYW), a data set sponsored by the Bureau of Labor Statistics. The NLSYW was designed to represent civilian non-institutionalized women in the United States who were aged between 14 and 24 years as of December 31, 1967. The 1968 survey included 5,159 respondents, and the retention rate was 57% (2,806) of the living respondents in the 2001 survey. These data include extensive information for each respondent including labor market behavior, family background, and demographic characteristics.

In 1995, the NLSYW respondents were aged between 42 and 52 years, so some of them were going through menopause. Hence in 1995, 1997, 1999, 2001, and 2003 the data collection included questions on menopause, such as whether the respondents were going through menopause, the age when they had their last menstrual period (for those whose menstrual cycles had ceased), whether they had surgery to remove the uterus or ovaries, and whether they had ever or were currently taking hormonal supplements to relieve menopause symptoms.

The data also include self-assessed health measures where the woman ranks her health in comparison to similarly aged women. Information on health insurance coverage and the source of the health insurance is available. Data on whether the woman reported problems with restless sleep and depressed symptoms (felling sad or blue) within the week prior to the survey are also available. The NLSYW also includes data on diagnosis of depression (available in the 1993 and 2003 surveys only) and assessment of physical limitations (available in the 1995 survey only).

The NLSYW is the only panel data set containing information on menopause, objective measures of mental and physical health, together with detailed labor market data. The sample size for the empirical analysis will be approximately 14,633 person-year observations from the five waves of the survey for which the menopause data are available.

As with every data set, there are limitations with the NLSYW data. The main limitation is that the data set does not provide detailed information on menopause symptoms, and so does not permit the analysis of the effect of the severity of menopause symptoms on labor market outcomes. Also the data are collected every two years. This may be a period of time that is too long to pick up the short-term effects of menopause. However, the data set is used because it is the one containing the most diverse set of information to best address the research questions at hand.

Construction of the Variables

The labor market variables used in the regressions are constructed as follows:

1. Labor force participation: This is a binary variable equal to one if the person is in the labor force and zero otherwise.
2. Weekly hours: This variable, which is conditional on employment, is defined as the number of hours the person worked per week at the main job.
3. Fulltime employment: The fulltime employment variable is also conditional on employment because it includes only women who were currently employed. Fulltime employment is defined as equal to one if the person works full time (more than 38 hours a week) or zero otherwise.

4. Hourly wage: Again this variable is conditional on employment and includes wage data only for the women who were not self employed. This variable is defined as the average hourly wage for the respondent's main job. The sample includes only respondents who earned a minimum of $1.00 per hour with a maximum of $150 per hour. Annual earnings are defined as the hourly wage multiplied by the number of hours worked per week multiplied by the number of weeks the respondent worked in the previous calendar year.

5. Self employment: The variable is defined as equal to one if the person is self employed and zero if the person is not self employed.

The discussion of the dependent variables for the determinants of heath regressions follow. Women in the NLSYW were asked whether they had any limitations in performing basic and intermediate activities of daily living, and the possible responses were "not at all difficult, a little difficult, somewhat difficult, very difficult/can't do." The responses are coded as 0 for "not at all difficult," 1 for "a little difficult," 2 for somewhat difficult and 3 for "very difficult/can't do." For the basic activity limitations, the respondents were asked to rank their ability to walk across the room, sit up for 2 hours, get up after sitting for a long time, get out of bed without help, pick up a dime from the table, bathe or shower without help, extend arms above shoulder level, eat without help, and dress without help. Thus, the basic activities of daily living scores range from zero to 27, with a higher score being indicative of greater activity limitation. The intermediate activity limitations questions asked the respondents to rank their ability to walk several blocks, walk one block, climb several flights of steps without resting,

climb one flight of steps without resting, lift heavy objects, stoop, kneel, or crouch, or push large objects. The intermediate activity of daily living scores range from zero to 24, with a higher score indicative of greater activity limitation.

The other dependent variable for the health models is depression which is assessed using the CES-D depression scale. Respondents with a score of 16 or higher are categorized as depressed. Hence depression is included as a dummy variable equal to 1 if the respondent had a CES-D score greater than or equal to 16 and zero otherwise.

This section includes the discussion of the construction of the key explanatory variables, which are the menopause stages: premenopause, perimenopause, having surgical menopause or having natural postmenopause. Each of these stages is represented by an indicator variable. A woman is classified as being premenopause if she reported that she had a menstrual cycle within the 12 months prior to the survey and reported that she was not going through menopause. The woman is classified as perimenopause if she had a menstrual cycle within the previous 12 months and reported that she was going through menopause. The woman is classified as having surgical menopause if she reported that she had not had a menstrual cycle within the previous 12 months and also that she had surgery to remove both ovaries. The woman is classified as being naturally postmenopause if she reported that she had not had any menstrual cycle within the previous 12 months, had not had any surgery to removed her ovaries and she also reported that she had gone through menopause.

An indicator variable is created to indicate if a woman had early menopause. A woman had early menopause if she reported that she was postmenopause before the age of 40. An indicator variable for having a hysterectomy is also included with a woman

considered as having a hysterectomy if she reported that she had surgery that removed her uterus. Also included is an indicator variable for hormone use which is defined as equal to 1 if the woman reported that she was currently using hormones to relieve menopause symptoms and zero otherwise.

Finally, this section includes the discussion of the other control variables that are included in the regressions which include the demographic and socio-economic variables. These are age, race, education, whether the respondent has any children in the household aged below six years, and whether she has children in the household aged between seven and thirteen years. Also included are controls for marital status, region of residence, and lifestyle behavior which includes smoking and alcohol use.

Another control variable is non-labor income which is defined as the total family income less the respondent's annual earnings. This variable includes the husband's earnings for married women.

Respondents were asked to rank their health as poor, fair, good, very good or excellent, in comparison to similar aged women. Ordinal scores are assigned to the responses as: excellent (4), very good (3), good (2), fair (1) and poor (0). The respondents also ranked their health as "much better, worse or the same" in comparison to their health at the last interview. Dummy variables are created for each response category. Women were also asked if the health of a family member affected their ability to work, and dummy variables are created as equal to 1 for women who say that the health of a family member limited their ability to work and zero otherwise. Indicator variables are also included to control for women who report that a doctor has diagnosed

them as having cancer, heart problems or high blood pressure, and an indicator variable measuring whether the woman has health insurance coverage is also created.

Furthermore, control variables are included for the years of work experience and the occupational classification for the respondent's main job based on the 2000 Standard Occupational Classification (DOL, 2000).

Descriptive Statistics

Table 1 presents the means and standard deviations for the demographic variables used in the analysis. For the years 1995 to 2003 the sample had 14,633 person-year observations of which 3,019 women were interviewed in 1995, 3,049, in 1997, 2,900, in 1999, 2,806, in 2001 and 2,859, in 2003.

Over the five waves of the survey, the mean age of is 50 years. Twenty-five percent of the sample is black, and 74% is white. Comparing the marital status variables over the five survey periods, Table 1 shows that 62.5% of the women were married, 4% were widowed, 20.3% were divorced, and 3.6% were separated, while 9.3% had never married. There is not much variability in marital status across the surveys, except that widowhood increased slightly over the years with 3.2% of the women reporting being widows in 1995 and 5.5%, by 2003.

Table 1: Means for Demographic Variables

Variable	Full sample	1995 survey	1997 survey	1999 survey	2001 survey	2003 survey
			Mean and standard deviation			
Age	50.214	46.266	48.225	50.209	52.650	54.167
	(4.228)	(3.078)	(3.081)	(3.107)	(3.110)	(3.087)
Race=black	0.25	-	-	-	-	-
	(0.433)					
Race=white	0.739	-	-	-	-	-
	(0.439)					
Race=other race	0.011	-	-	-	-	-
	(0.105)					
Married	0.625	0.633	0.627	0.627	0.622	0.605
	(0.484)	(0.482)	(0.484)	(0.484)	(0.485)	(0.489)
Widowed	0.042	0.032	0.037	0.039	0.046	0.055
	(0.200)	(0.175)	(0.188)	(0.194)	(0.209)	(0.228)
Divorced	0.203	0.191	0.205	0.204	0.210	0.211
	(0.402)	(0.394)	(0.404)	(0.403)	(0.407)	(0.408)
Separated	0.036	0.044	0.039	0.037	0.032	0.037
	(0.188)	(0.206)	(0.194)	(0.188)	(0.177)	(0.189)
Never marry	0.093	0.099	0.093	0.092	0.088	0.093
	(0.29)	(0.298)	(0.290)	(0.289)	(0.283)	(0.290)
Children in household aged 0 to 6 years	0.09	0.141	0.109	0.071	0.062	0.061
	(0.395)	(0.503)	(0.447)	(0.325)	(0.313)	(0.335)
Children in household aged 7 to 13 years	0.172	0.297	0.205	0.151	0.108	0.089
	(0.494)	(0.628)	(0.535)	(0.455)	(0.402)	(0.361)
Years of schooling	13.46	13.420	13.459	13.441	13.494	13.474
	(2.66)	(2.666)	(2.626)	(2.668)	(2.659)	(2.683)
Education: 0 to 11 years of schooling	0.126	0.128	0.127	0.123	0.127	0.126
	(0.332)	(0.334)	(0.333)	(0.329)	(0.333)	(0.332)
Education: 12 years of schooling	0.366	0.367	0.365	0.373	0.361	0.365
	(0.482)	(0.482)	(0.481)	(0.484)	(0.480)	(0.482)
Education: 13 to 14 years of schooling	0.183	0.183	0.185	0.183	0.182	0.184
	(0.387)	(0.386)	(0.388)	(0.387)	(0.386)	(0.388)
Education: 15 to 16 years of schooling	0.170	0.174	0.172	0.168	0.171	0.164
	(0.376)	(0.379)	(0.377)	(0.374)	(0.377)	(0.370)
Education: 17 to 18 years of schooling	0.154	0.149	0.152	0.152	0.159	0.160
	(0.361)	(0.356)	(0.359)	(0.359)	(0.365)	(0.367)
Household size	2.682	3.043	2.822	2.648	2.501	2.369
	(1.388)	(1.491)	(1.443)	(1.338)	(1.283)	(1.257)
Observations	14,633	3,019	3,049	2,900	2,806	2,859

The women had an average of 13.46 years of schooling. 12.6% of the women did not complete high school, 36.6% were high school graduates, 18.3% had 2 years of post-high school education, and 17% had 4 years of post high school education, while 15.4% of the women had six years of post-high school education. Again there is not much variability in schooling across the five survey periods.

Six percent of the respondents had children aged six years or less in the household, while 13.1% had children aged between seven and thirteen years in the household.

Table 2 presents the descriptive statistics for the health variables. Over the five survey periods, an average of 84.6% of the women had health insurance coverage and of those with health insurance coverage, 40% of them had the insurance coverage through their employer.

Several measures of health status are available in the data. Based on the sample average for the five survey periods, 6% of the women ranked their health as poor, 14.9% ranked their health as fair, 46.3% ranked it as good, and 32.9% ranked it as excellent compared to the health of similarly aged women. Nine percent of the respondents said their health was better, 72.3% said their health was the same, while 17.2% said their health was worse than the previous year. There is not much variability in the responses across the survey periods for women who rate their health as better or the same, but there is some variability in responses for women who rate their health as worse than the previous year. In 1995, 15.2% rated their health as worse than the previous year while by 2003, 19.4% of the women rate their health as worse than the previous year.

Table 2: Means for Health Status Variables

Variable	Full sample	1995	1997	1999	2001	2003
			Mean and standard deviation			
Health insurance	0.846 (0.361)	0.843 (0.364)	0.827 (0.378)	0.829 (0.376)	0.860 (0.347)	0.873 (0.333)
Health comparison to similar aged women (1=poor; 4=excellent)	3.06 (0.844)	3.142 (0.805)	3.087 (0.844)	3.040 (0.833)	3.040 (0.854)	2.984 (0.879)
Health better than previous year	0.088 (0.283)	0.088 (0.283)	0.088 (0.283)	0.083 (0.276)	0.091 (0.287)	0.090 (0.287)
Health same compared to previous year	0.723 (0.447)	0.754 (0.431)	0.720 (0.449)	0.723 (0.448)	0.721 (0.449)	0.698 (0.459)
Health worse than previous year	0.172 (0.377)	0.152 (0.359)	0.168 (0.374)	0.169 (0.375)	0.176 (0.381)	0.194 (0.396)
Cancer	0.036 (0.185)	0.027 (0.162)	0.029 (0.168)	0.035 (0.183)	0.047 (0.212)	0.041 (0.199)
High blood pressure	0.235 (0.424)	0.162 (0.368)	0.195 (0.396)	0.232 (0.422)	0.282 (0.450)	0.315 (0.465)
Heart problem	0.024 (0.154)	0.017 (0.129)	0.025 (0.157)	0.023 (0.151)	0.029 (0.167)	0.027 (0.163)
Health limit work	0.125 (0.330)	0.119 (0.324)	0.133 (0.340)	0.127 (0.333)	0.122 (0.328)	0.122 (0.327)
Family limit work	0.040 (0.196)	0.041 (0.199)	0.039 (0.194)	0.036 (0.185)	0.040 (0.197)	0.045 (0.207)
Depressed (using CESD score)[8]	-	-	-	-	-	0.164 (0.370)
Problem keeping mind on tasks (0=rarely; 3=most of the time)	0.461 (0.811)	0.308 (0.701)	0.487 (0.811)	0.489 (0.817)	0.523 (0.848)	0.507 (0.859)
Restless sleep (0=rarely; 3=most of the time)	0.755 (1.015)	0.675 (0.947)	0.754 (1.001)	0.761 (1.025)	0.818 (1.048)	0.775 (1.054)
Everything took extra effort (0=rarely; 3=most of the time)	0.529 (0.906)	0.400 (0.786)	0.562 (0.918)	0.557 (0.921)	0.563 (0.924)	0.570 (0.967)
Felt sad (0=rarely; 3=most of the time)	0.433 (0.783)	0.424 (0.749)	0.469 (0.812)	0.429 (0.776)	0.454 (0.822)	0.387 (0.753)
Couldn't get going (0=rarely; 3=most of the time)	0.498 (0.829)	0.445 (0.758)	0.525 (0.840)	0.501 (0.826)	0.523 (0.861)	0.499 (0.861)
Basic activities of daily living scores	-	1.412 (2.604)	-	-	-	-
Intermediate activities of daily living scores	-	2.963 (4.170)	-	-	-	-

[8] Only for the 2003 wave of the survey

The women were also asked whether a doctor had ever diagnosed them as having some specific illnesses, specifically cancer, high blood pressure and heart problems. The incidence of these three illnesses increased over the surveys. In 1995, 2.7% of the women reported having a cancer diagnosis and by 2003, 4.1% reported such a diagnosis. In 1995 16.2% reported a diagnosis of high blood pressure and by 2003, 31.5% reported high blood pressure. In 1995, 1.7% reported a diagnosis of heart problems and by 2003, 2.7% reported such a diagnosis.

Over the five survey periods, an average of 12.5% of the respondents said that their health limited the amount of work that they could do, with little variability across the surveys. Furthermore, an average of 4% of the respondents said that the health of a family member limited their ability to work.

Women were asked to rate their feelings during the week prior to the survey based on selected items from the Center of Epidemiological Studies Depression Scale (CES-D). Twelve percent of the women reported problems with keeping their mind on tasks occasionally (3-4 days prior to interview) or most of the time (5-7days prior to interview). Table 2 shows a slight increase in the reported scores on each item over the years. Over the five survey periods, an average of 20.6% of the women had problems with restless sleep occasionally or most of the time, while 10.4% reported problems with sadness occasionally or most of the time. Fourteen percent of the women reported that they felt that everything took extra effort occasionally or most of the time while 11.3% reported that they felt that they could not get going. The complete CES-D scale was administered in 2003, and at this time 16.4% of the women were diagnosed as depressed.

The activity limitations scale was administered in the 1995 survey. The average basic activity of daily living (BADL) score was 1.4, while the average intermediate activity of daily living (IADL) score was 2.97, indicating that the women were more likely to have limitations in performing intermediate activities rather than basic activities of daily living. Thirty-five percent of the women reported no limitations with any of the IADL items while 56% reported no limitation with any of the BADL items.

Table 3 shows the reproductive health stage and reproductive health status of the women.

Table 3: Means for Reproductive Health Variables

Variable	Full sample	1995 survey	1997 survey	1999 survey	2001 survey	2003 survey
			Mean and standard deviation			
Premenopause	0.251	0.497	0.346	0.251	0.071	0.065
	(0.433)	(0.500)	(0.476)	(0.434)	(0.256)	(0.246)
Perimenopause	0.157	0.157	0.187	0.199	0.123	0.118
	(0.364)	(0.364)	(0.390)	(0.399)	(0.328)	(0.323)
Postmenopause	0.558	0.306	0.412	0.513	0.788	0.799
	(0.497)	(0.461)	(0.492)	(0.500)	(0.409)	(0.401)
Surgical menopause	0.168	0.129	0.150	0.180	0.186	0.199
	(0.374)	(0.335)	(0.357)	(0.384)	(0.389)	(0.400)
Early menopause	0.179	0.162	0.168	0.182	0.196	0.187
	(0.383)	(0.368)	(0.374)	(0.386)	(0.397)	(0.390)
Hysterectomy	0.281	0.250	0.266	0.289	0.296	0.308
	(0.450)	(0.433)	(0.442)	(0.453)	(0.456)	(0.462)
Ever used hormones	0.415	0.258	0.339	0.462	0.498	0.558
	(0.493)	(0.438)	(0.474)	(0.499)	(0.500)	(0.497)
Currently use hormones	0.196	0.209	0.132	0.282	0.264	0.094
	(0.397)	(0.407)	(0.339)	(0.450)	(0.441)	(0.292)
Observations	14,134	2,898	2,882	2,792	2,755	2,807

In 1995, 49.7% of the women were premenopause and by 2003 only 6.5% remained premenopause. Over the five-year survey period, 15.7% of the women reported being perimenopausal. In 1995, 30.6% of the women were already postmenopause and by 2003, 80% of the women had reached postmenopause.

Over the five survey periods, an average of 16.8% of the women reported surgical menopause, while 28.1% of the women reported having a hysterectomy. Eighteen percent of the sample had experienced early menopause. In 1995, 25.8% of the women reported that they had at some time used hormone therapy to alleviate menopause symptoms and by 2003, 55.8% reported ever having used hormones. In 1995, 20.9% of the women reported that they were currently using hormones. There was some variability in hormone use over the surveys and a notable drop in hormone use from 26.4% in 2001 to 9.4% in 2003, possibly due to controversies on the risks of HRT.

Table 4 presents the means and standard deviations for the labor market variables. An average of 76.3% of the women were in the labor market over the five survey periods. There is some variability in labor force participation over the surveys, with 79% of the women being in the labor force in 1995 and a gradual drop to 70.8% in the labor force by 2003. Over the five survey periods, an average of 97.3% of the women in the labor force were employed. The respondents who were employed worked an average of 50.5 weeks of the year and an average of 37.95 hours per week. Sixty-nine percent of the employed women worked full time (38 or more hours per week). Years of labor market experience ranged from zero to 36 years, with the average woman having 19 years of work experience. Fifteen percent of the women were self employed and the proportion of self-employed women increased over the years.

Table 4: Means for Labor Market Variables

Variable	Full sample	1995 survey	1997 survey	1999 survey	2001 survey	2003 survey
			Mean and standard deviation			
Labor force participation	0.763 (0.425)	0.790 (0.408)	0.802 (0.399)	0.777 (0.416)	0.733 (0.442)	0.708 (0.455)
Employed	0.973 (0.162)	0.977 (0.149)	0.968 (0.177)	0.978 (0.147)	0.978 (0.146)	0.963 (0.188)
Hours worked per week	37.947 (11.815)	38.162 (11.152)	37.304 (12.427)	38.314 (11.550)	38.344 (12.129)	37.665 (11.796)
Working full time (>=38 hours per week)	0.692 (0.462)	0.683 (0.465)	0.679 (0.467)	0.709 (0.454)	0.705 (0.456)	0.686 (0.464)
Number of weeks worked per year	50.507 (6.541)	50.541 (6.407)	50.568 (6.301)	50.506 (6.610)	50.599 (6.377)	50.292 (7.071)
Hourly wage ($)	15.016 (14.935)	13.547 (8.761)	14.546 (10.788)	15.222 (10.126)	16.190 (28.698)	16.126 (10.498)
Annual earnings ($)	30,392 (21,470)	27,926 (18,190)	29,138 (20,145)	31,154 (21,742)	32,321 (24,997)	32,528 (22,706)
Non labor income ($)	44,100 (54,398)	43,369 (51,698)	40,935 (51,861)	48,546 (59,730)	46,656 (56,763)	41,345 (51,462)
Experience	19.162 (8.070)	16.237 (6.871)	17.835 (7.326)	19.312 (7.778)	20.689 (8.262)	22.015 (8,735)
Self employed	0.145 (0.352)	0.114 (0.318)	0.136 (0.343)	0.131 (0.338)	0.188 (0.391)	0.169 (0.375)

Data for wages are available only for employed women who were not self-employed, so the wage and labor earnings data are only reported for these women (9,924 person-year observations). All income data are adjusted for inflation with the year 2000 as the base year. The average real wage was $15, and the average real annual labor earnings were $30,392. The average real non-labor income was $44,100 which includes the husband's earnings for married women.[9]

Table 5 presents the occupational classification of the jobs held and the average percentage of women in each occupation classification over the five survey periods.

Table 5: Proportion in Occupational Classification

Occupational description	Percentage in occupation
Occupation A: Management	10.3%
Occupation B: Business & financial operation; computer & mathematical; architecture and engineering; life, physical & social services; community & social services; legal;	12.2%
Occupation C: Education, training & library;	10.7%
H Occupation D: Health care practitioners & technical;	6.7%
Occupation E: Health care support; protective services; food preparation & serving related; building &ground cleaning & maintenance; personal care and service	13.6%
Occupation F: Sales & related	8.4%
O Occupation G: Office & administrative support	24.4%
Occupation H: Farming, forestry & fishing; construction & extraction; installation, repair & maintenance; production; transportation &material moving;	9.6%

Based on the 2000 standard occupational classification system, 24.4% of the women held a job that was in the office and administrative support field. This was the largest occupational category. Ten percent of the women held a managerial position in their workplace.

[9] Previous studies have also defined the non-labor income as total family income minus wife's labor income e.g., Mroz (1987). This definition assumes that the wife takes the husband earnings as exogenous.

CHAPTER 5: EMPIRICAL FINDINGS

This chapter presents the results of the empirical models and a discussion of these findings. The first section includes the findings from the examination of the effect of the menopause transition on health outcomes and the second section presents the results from the analyses of the effect of the menopause transition on labor market outcomes.

Menopause Transition and Health

The main purpose of these regressions is to see whether previous findings in the medical literature suggesting that women in perimenopause and postmenopause are more likely to be depressed and more likely to report activity limitations than women in premenopause hold true in this data set.

The dependent variables used for this analysis are (1) the scores on the activities of daily living scale (a higher score is indicative of having greater limitation in performing either basic activities of daily living or intermediate activities of daily living) and (2) an indicator of depression. The activities of daily living scores are drawn from the 1995 wave of the survey, and the depression scores, from the 2003 wave. Cross-sectional analysis is used because the relevant data are available only in these two waves of the survey.

Empirical Results: Effect of Menopause Transition on Activity Limitations

Table 6 presents the cross tabulations of the menopause data and the health data. These are bi-variate regressions with the health variable as the dependent variable while the explanatory variables are the menopause variable and a constant.

Table 6: Cross Tabulations of Menopause and Health Variables

	Basic activities of daily living (BADL)	Intermediate activities of daily living (IADL)	Depression
Premenopause	-0.822***	-1.297***	-0.065***
Perimenopause	0.166	0.273	0.025
Natural postmenopause	0.548***	0.886***	0.027
Surgical menopause	0.893***	1.590***	0.067***
Early menopause	0.730***	1.437***	0.070***
Hysterectomy	0.730***	1.140***	0.045***

* difference of means are statistically significant at $p<0.10$
** difference of means are statistically significant at $p<0.05$
*** difference of means are statistically significant at $p<0.01$

The results show that women in premenopause reported fewer activity limitations than all other women. There was no significant difference in reported activities limitations between perimenopause women and all other women. Women in natural menopause reported more activity limitations compared to all other women as did women with surgical menopause, women with hysterectomies, and women who had early menopause.

Table 7 presents the results of the ordinary least squares and the ordered probit regressions with the activity limitations score as the dependent variable. Control variables similar to those used in previous studies are included in the analyses. Both the OLS and the ordered probit models treat the outcome variables as ordinal but OLS treats the

difference between two rankings as the same, that is, OLS treats the rankings 4 and 5 as the same as the difference between the rankings 3 and 4. The ordered probit model on the other hand, incorporates the information that 4 is a better ranking than 5 in the estimation technique. In this study however, the results of the OLS model and the ordered probit model are similar and so using ordered probit does not make any major difference. As a result, only the results of the OLS model are discussed.

Table 7: OLS and Ordered Probit Estimates (Dependent Variable –ADL)

	Basic activities of daily living		**Intermediate activities of daily living**	
Variable	**OLS Coefficient and std. dev**	**Ordered Probit Coefficient and std. dev**	**OLS Coefficient and std. dev**	**Ordered Probit Coefficient and std. dev**
Premenopause	-0.319** (0.143)	-0.203*** (0.068)	-0.409* (0.215)	-0.168*** (0.065)
Surgical menopause	0.462 (0.348)	0.141 (0.138)	1.411*** (0.534)	0.338** 0.134)
Natural postmenopause	0.234 (0.221)	0.017 (0.094)	0.570* (0.317)	0.120 (0.090)
Hysterectomy	-0.111 (0.216)	-0.015 (0.094)	-0.814** (0.320)	-0.186** (0.091)
Experienced early menopause	0.010 (0.204)	0.044 (0.082)	0.466 (0.304)	0.124 (0.080)
Perimenopause & hormones	0.022 (0.206)	0.008 (0.114)	0.151 (0.358)	0.026 (0.110)
Surgical menopause & hormones	-0.091 (0.365)	-0.013 (0.128)	-0.546 (0.540)	-0.147 (0.127)
Natural menopause & hormones	-0.045 (0.238)	0.015 (0.113)	-0.341 (0.369)	-0.053 (0.108)
Race: White	0.041 (0.138)	0.121** (0.060)	-0.050 (0.189)	-0.021 (0.057)
Race: other race (non-black)	-0.087 (0.346)	0.115 (0.230)	0.328 (0.537)	0.280 (0.212)
Age: 45 to 50 years	-0.118 (0.103)	-0.043 (0.055)	0.033 (0.164)	0.023 (0.051)
Age: 50 to 55 years	0.157 (0.172)	0.133* (0.071)	0.041 (0.236)	0.046 (0.069)
Education: 0 to 12 years	0.740*** (0.196)	0.274*** (0.072)	1.251*** (0.291)	0.307*** (0.071)

Education: 13 to 14 years	-0.007 (0.115)	-0.017 (0.066)	-0.258 (0.184)	-0.023 (0.062)
Education: 15 to 16 years	-0.149 (0.130)	-0.184*** (0.071)	-0.480** (0.193)	-0.153** (0.065)
Education: 17 to 18 years	-0.197* (0.113)	-0.147* (0.078)	-0.729*** (0.187)	-0.276*** (0.072)
Children under 6 years	0.139 (0.123)	0.033 (0.044)	0.300* (0.155)	0.077* (0.041)
Children 7 years to 13 years	0.003 (0.071)	0.004 (0.039)	-0.257** (0.108)	-0.083** (0.037)
Marital status: Married	-0.473** (0.186)	-0.205** (0.083)	-1.115*** (0.287)	-0.296*** (0.079)
Marital status: Widowed	-0.068 (0.347)	0.035 (0.137)	-0.259 (0.558)	-0.086 (0.133)
Marital status: Divorced	-0.327 (0.222)	-0.193** (0.091)	-0.970*** (0.317)	-0.249*** (0.086)
Marital status: Separated	-0.438 (0.339)	-0.219 (0.140)	-1.232*** (0.464)	-0.298** (0.133)
Health worse than previous year	2.119*** (0.187)	0.901*** (0.061)	4.241*** (0.285)	1.038*** (0.062)
Health better than previous year	0.199 (0.129)	0.150* (0.086)	0.296 (0.232)	0.068 (0.080)
Has health insurance coverage	-0.305* (0.170)	-0.184*** (0.066)	-0.775*** (0.253)	-0.192*** (0.064)
Illness: cancer	0.216 (0.328)	0.096 (0.134)	-0.225 (0.509)	-0.148 (0.131)
Illness: high blood pressure	0.134 (0.147)	0.131** (0.062)	0.853*** (0209)	0.350*** (0.059)
Illness: heart problem	3.468*** (0.764)	0.933*** (0.155)	5.616*** (0.800)	0.983*** (0.167)
Lifestyle: is a smoker	0.055 (0.110)	0.054 (0.054)	0.256 (0.175)	0.081 (0.052)
Lifestyle: drinks alcohol	-0.143 (0.090)	-0.087* (0.050)	-0.643*** (0139)	-0.159*** (0.047)
Family income	-0.000002** (0.000001)	-0.000001) (0.000001)	-0.000002* (0.000001)	-0.000001* (0.000001)
R^2	0.245	-	0.355	-
Log likelihood	-	-3705.461	-	-5008.576
Observations	2,564	2,564	2,468	2,468

The coefficient on premenopause is negative and significant for both the BADL and IADL regressions suggesting that premenopause women had lower scores (fewer limitations) than perimenopause women (the omitted category). Thus perimenopause women tended to report more limitations in performing both basic and intermediate

activities of daily living when compared to premenopause women. This finding is consistent with the finding by Mishra et al. (2003). One possible explanation for this finding is that women in perimenopause experience menopause symptoms that affect their ability to perform activities of daily living. The results also suggest that there is no significant difference in basic activity scores between women in postmenopause, women with surgical menopause and women in perimenopause.

The coefficient on the surgical menopause variable is positive and significant for the intermediate activity regression suggesting that women who had undergone surgical menopause reported greater limitations than women in perimenopause. This finding is consistent with the finding by Sowers et al. (2001). A possible reason for this result is that the health problems which resulted in the women having surgical menopause also affect their ability to perform activities of daily living. The coefficient on the natural postmenopause variable is positive and significant suggesting that women in postmenopause also reported greater activity limitations than women in perimenopause.

The coefficient on the hysterectomy variable is negative and insignificant in the BADL regression, but it is negative and significant in the IADL regression. Contrary to expectation, there is some evidence that women with hysterectomies experienced fewer activity limitations than women without hysterectomies.

The coefficient on the early menopause variable is positive but insignificant suggesting that there was no significant difference between activity limitations in women who experienced early menopause and other women. Thus, having early menopause does not appear to affect women's physical functioning.

When interaction terms between menopause stage and hormone use are included in the regressions, the finding is that women in perimenopause who used hormones had greater activity limitations, but the coefficient is insignificant. Also women who had either surgical menopause or natural postmenopause and used hormones reported fewer activity limitations, but the coefficient is also insignificant. These results suggest that hormone use did not have any major effects on reported activity limitations.

The results for the socioeconomic and demographic variables suggest that more educated women are less likely to have activity limitations. This result may reflect the fact that more educated women take better care of themselves and so may have fewer activity limitations in midlife. As expected, women who report that their health was worse than the previous year reported greater activity limitations. Women with health insurance coverage also reported fewer limitations, possibly because health insurance coverage permits better access to care. Furthermore, women who had been diagnosed with heart problems or high blood pressure reported more limitations in performing activities of daily living. Women with higher family incomes reported fewer activity limitations. A possible explanation of this finding is that wealth ensures access to health care services and also knowledge about health.

Empirical Results: Effect of Menopause Transition on Depression

This section explores the effect of menopause transition on depression. Table 6 presents the cross tabulations of the menopause variables and depression. These bi-variate regression results suggest that premenopause women are less likely to be depressed compared to all other women. The coefficients on the perimenopause and

natural postmenopause variables are positive but insignificant. The results suggest that women who had surgical menopause, early menopause, and hysterectomies are more likely to be depressed.

Table 8 presents the results including controls for menopause stage, health, and socioeconomic variables. The results suggest that women in premenopause are less likely to be depressed when compared to women in perimenopause, and the result is significant. This finding is consistent with the studies that find a significant negative link between menopause and depression such as Freeman et al. (2004) and Maartens et al. (2002). This result may be due to the fact that the biological and social changes that coincide with the transition to menopause may be stressful for women in perimenopause.

Table 8: Probit Model Estimates (Dependent Variable-Depression)

Variable	Coefficient and std. dev
Premenopause	-0.287*
	(0.172)
Surgical menopause	-0.113
	(0.111)
Natural postmenopause	-0.052
	(0.147)
Hysterectomy	-0.156
	(0.107)
Experienced early menopause	0.257***
	(0.095)
Perimenopause & hormones	-0.144
	(0.240)
Surgical menopause & hormones	0.301
	(0.201)
Natural menopause & hormones	0.110
	(0.162)
Race: White	-0.016
	(0.075)
Race: other race (non-black)	0.543**
	(0.263)
Age	-0.015
	(0.011)
Education: 0 to 12 years	0.311***
	(0.094)
Education: 13 to 14 years	-0.180*
	(0.093)

Education: 15 to 16 years	-0.054
	(0.098)
Education: 17 to 18 years	-0.054
	(0.104)
Children under 6 years	-0.048
	(0.087)
Children 7 years to 13 years	0.198**
	(0.080)
Marital status: Married	-0.295***
	(0.105)
Marital status: Widowed	-0.085
	(0.152)
Marital status: Divorced	-0.009
	(0.110)
Marital status: Separated	-0.188
	(0.180)
Health worse than previous year	0.824***
	(0.073)
Health better than previous year	-0.167
	(0.123)
Has health insurance coverage	-0.232**
	(0.095)
Illness: cancer	0.155
	(0.137)
Illness: high blood pressure	0.203***
	(0.068)
Illness: heart problem	0.432***
	(0.165)
Lifestyle: is a smoker	0.217***
	(0.078)
Lifestyle: drinks alcohol	0.070
	(0.069)
Family income	-0.000002***
	(0.000001)
Log-likelihood	-1015.951
Observations	2,718

The coefficient on surgical menopause is positive but insignificant, while the coefficients on natural postmenopause and hysterectomy are negative but insignificant. The results also suggest that women who experienced early menopause are more likely to be depressed than other women. This outcome may reflect the fact that events that occur off-schedule may result in stress or that there are other medical problems that lead to early menopause that also increase the stress levels of the women.

The results of the socioeconomic and demographic variables suggest that women with less than high school education are more likely to be depressed than women with a high school education. Also women with children aged between 7 and 13 years are more likely to be depressed. Women who report that their health was worse than the previous year are also more likely to be depressed and so are women who had been diagnosed with high blood pressure or heart problems. Women with greater family incomes are less likely to be depressed.

The objective of this section was to explore whether the respondents in this data set showed the same characteristics in terms of the effect of menopause on health as previous studies. The findings agree with the literature that suggests that health declines as women go through the menopause transition. Women in premenopause are healthier than perimenopause women even after controlling for other health, socioeconomic and demographic factors. Furthermore, the findings are that hormone use has no significant effect on reported activity limitations or depression. Women using hormones do not seem to have any advantages or disadvantages compared to women not using hormones.

Both analyses are done using cross-sectional data because the NLSYW does not have longitudinal data for the depression and activity limitations scales for the years that the menopause questions are included. The limitation of cross-sectional data is that you cannot control for transitions over time. The data does not permit the analysis of whether a woman who reported having physical limitations or depression at one point in time continued in that state or improved over time. Furthermore there may be unobserved individual heterogeneity which is driving the results, and this problem cannot be controlled for in cross-sectional data.

However, the results are still informative about the effects of menopause on health. This study makes a contribution to the literature on the effect of menopause transition on activity limitations. A previous study that examined physical functioning among women in menopause used cross-sectional data, but the activity limitations scale was administered only to 20% of the sample (2,765 women) who had answered affirmatively that they had limitations in performing activities due to health problems (Sowers et al., 2001). Thus there is a possibility that some women may be misclassified in terms of physical functioning, depending on how well they understood the screener question and how accurately they answered it. This study has the advantage that the activity limitations scale was administered to all the women and so there is there is no bias resulting from misclassification.

The following section examines the effect of the menopause transition on labor market outcomes. Because this research agrees with the medical literature that the menopause transition results in poor health, the question that we seek to answer is whether this poor health reduces labor supply.

Menopause Transition and Labor Market Outcomes

Table 9 presents the results of tests of differences between means of labor market outcomes and menopause or reproductive health status. These are bi-variate regressions with each labor market outcome as the dependent variable and the menopause stage variable as the independent variable (including a constant).

Table 9: Cross-tabulations of Labor Market and Reproductive Health Variables

	Labor force participation	Full-time employment	Weekly hours	Earnings	Self-employed
Premenopause	0.079***	-0.010	-0.15	1097**	-0.034***
	(0.008)	(0.010)	(0.286)	(530)	(0.008)
Perimenopause	0.036***	-0.015	0.211	-409	0.015*
	(0.010)	(0.012)	(0.312)	(638)	(0.009)
Postmenopause	-0.079***	0.015*	0.282	-338	0.024***
	(0.007)	(0.009)	(0.232)	(477)	(0.007)
Surgical menopause	-0.043***	0.032***	0.762**	-732	0.002
	(0.009)	(0.012)	(0.315)	(644)	(0.009)
Hysterectomy	-0.03***	0.033***	0.957***	-2216***	0.003
	(0.008)	(0.010)	(0.259)	(530)	(0.008)
Early menopause	-0.047***	0.029**	0.739**	-4341***	0.005
	(0.009)	(0.012)	(0.308)	(633)	(0.009)

The bi-variate regression results in Table 9 suggest that women in premenopause are 7.9% more likely to be in the labor force than non-premenopause women (perimenopause and postmenopause women), while perimenopausal women are 3.6% more likely to be in the labor force than non-perimenopausal women (premenopause and postmenopause women). Furthermore, women in postmenopause are 7.9% less likely to be in the labor force than non-postmenopause women (premenopause and perimenopause women). The results suggest that women in premenopause are more likely to be in the labor force than women in perimenopause.

Women with hysterectomies are less likely to be in the labor market when compared to women without hysterectomies and similarly, women who became postmenopause because of surgery are less likely to be in the labor market when compared to women who were not surgically postmenopause. Women who had early menopause are also less likely to be in the labor force.

Menopause stage is found to have an insignificant effect on the difference in the means for the choice to work full-time or part-time and on the number of hours women

worked per week. However there is a significant difference in means on the choice to be self-employed based on menopause stage. Women in premenopause are less likely to be self-employed, while self-employment is more likely among perimenopause and postmenopausal women. Furthermore, premenopause women have significantly larger earnings than non-premenopause women.

The data in Table 9 indicate that women with hysterectomies earned less than women without hysterectomies. Also women who experienced early menopause earned less than women who did not have early menopause.

Contrary to expectations, the tests of differences between means show that women with surgical menopause and women with hysterectomies are more likely to be employed than women who did not undergo these medical procedures. These women are also more likely to work a greater number of hours on average and are more likely to work full-time. In the next section, I explore whether these results still hold after including more control variables in the regressions.

Multivariate Empirical Results

The section below presents the regression results using pooled ordinary least squares, the fixed effects model, and the random effects model. The key explanatory variables in all the regressions are the menopause stage, where the comparison is between women in premenopause, perimenopause and those who had surgical menopause to women who had natural postmenopause (the excluded category). Also included are controls for whether the woman had a hysterectomy or early menopause.

Each model is tested for the presence of unobserved effects using the Breusch and Pagan Lagrangian Multiplier test, and the null hypothesis of no unobserved effects is rejected in all the models. The Hausman test is then used to determine if the random effects model is the correct specification. In all the models, the null hypothesis that the random effects model is the correct specification is rejected. Therefore, based on these tests, the consistent model is the fixed effects model. However, the results for all three models (the pooled OLS, the fixed effects, and the random effects) are reported, for comparison purposes. All regression results report robust standard errors.

The models corrected for sample selection are also estimated for the wage and hours worked equations. Sample selection bias may arise because wages and hours worked are observed only for women who are in the labor market, so the observed sample becomes non-random.

The Hausman test is used to test for the endogeneity of the menopause transition variables in the hours worked and wage equations, and the finding is that the menopause variables are not endogenous. However the results for the instrumental variables estimation technique are also presented for comparison purposes. The instruments that are used are the number of years a woman has used hormones, the percentage of women in the respondent's region of residence not having a Pap smear in the past three years, and health expenditure as a percentage of gross state product in the respondent's region of residence.

The endogeneity of the hysterectomy and hormone use variables are also tested. These variables may be endogenous as they are choice variables in the sense that a woman has a choice on whether to have a hysterectomy and also on whether to use

hormones. However, the results indicate that both of these variables are not endogenous in the wage and hours worked equations.

The family fixed effects model is also estimated for each dependent variable using only the sample of women who have a sibling in the data. There are 285 families in the sibling models. The family fixed effects model controls for endogeniety that arises from family specific unobserved effects. The regression results are presented below.

Empirical Results: Effect of Menopause Transition on Labor Force Participation

Table 10 shows the results with labor force participation as the dependent variable. The pooled OLS results imply that women in premenopause are significantly more likely to be in the labor force than women who had experienced natural post menopause. Also women in perimenopause are more likely to be in the labor force than women who had experienced natural postmenopause and the coefficient is significant.

Using the fixed effects model, the results suggest that women in premenopause are less likely to be in the labor force than postmenopause women and the coefficient is significant. This is a reversal of the results of the pooled OLS. The random effects model suggests that premenopause women are less likely to be in the labor force but the coefficient is insignificant. The coefficient on perimenopause is positive in both the fixed effects model and the random effects model but it is significant only in the random effects model.

As discussed in the previous section, the data are tested to see if the underlying assumption of the pooled OLS that there are no unobserved effects is correct and the assumption of no unobserved effects if rejected. The Hausman test is also run to test if

the random effects model is the correct specification and the results indicate that the random effects model is not the correct specification. Based on these results, the fixed effects model is the correct specification. The rejection of the underlying assumptions of each of these models may explain the difference in findings between these models and the fixed effects model.

Another possible explanation for the difference between the results of the pooled OLS and fixed effects model may arise from the exclusion of time-invariant variables like race in the fixed effects model. Later analyses explore if the results of the fixed effects model differ by race and if the exclusion of the race variable in the fixed effects model can explain the different results.

Table 10: OLS, FE and RE Estimates (Dependent Variable – LFP)

Variable	Pooled OLS	Fixed effects	Random effects
Premenopause	0.021** (0.010)	-0.028** (0.011)	-0.007 (0.009)
Perimenopause	0.023** (0.010)	0.014 (0.010)	0.021** (0.009)
Surgical menopause	-0.033*** (0.012)	-0.014 (0.023)	-0.031** (0.015)
Early menopause	-0.013 (0.011)	0.012 (0.024)	-0.005 (0.014)
Hysterectomy	0.021* (0.012)	0.011 (0.023)	0.015 (0.014)
Race=white	0.049*** (0.008)	-	0.044*** (0.012)
Race= other race	0.059* (0.033)	-	0.059 (0.051)
Age	0.042** (0.017)	0.050** (0.019)	0.043*** (0.014)
Age squared	-0.001*** (0.0002)	-0.001*** (0.0002)	-0.001*** (0.0001)
Education: 0 to 12 years	-0.001 (0.012)	-0.006 (0.094)	0.0013 (0.018)
Education: 13 to 14 years	0.0003 (0.009)	0.093* (0.054)	0.005 (0.013)

Education: 15 to 16 years	-0.006 (0.009)	0.138 (0.104)	-0.005 (0.014)
Education: 17 to 18 years	0.008 (0.010)	0.293** (0.122)	0.026* (0.015)
Resides in south	-0.019*** (0.007)	-0.018 (0.04)	-0.022** (0.010)
Children under 6 years	-0.007 (0.009)	-0.020** (0.009)	-0.014* (0.008)
Children 7 years to 13 years	-0.023*** (0.007)	-0.035*** (0.008)	-0.027*** (0.007)
Married	-0.037*** (0.007)	-0.005 (0.015)	-0.020** (0.009)
Experience	0.058*** (0.001)	0.048*** (0.006)	0.052*** (0.002)
Experience squared	-0.001*** (0.00004)	-0.0004*** (0.0001)	-0.001*** (0.0001)
Non labor income	-0.0003*** (0.0001)	-0.0005*** (0.0001)	-0.0004*** (0.0001)
R^2	0.348	0.307	0.346

All three models results agree that having surgical menopause has a negative effect on labor force participation, but the coefficient is insignificant in the fixed effects model while significant in the pooled OLS and random effects models. The random effects and pooled OLS models suggest that experiencing early menopause has a negative but insignificant effect on labor force participation, while the effect is positive but still insignificant in the fixed effects model.

Table 11 presents the results for the menopause variables after adding the health variables to fixed effects regression model. Two measures of health are used. The first is the woman's ranking of her health status compared to that of similar aged women, and the second is whether the woman says her health is better, the same (excluded category) or worse when compared to the previous year. The regressions also include controls for whether the woman says that the health of a family member limits her ability to work.

The CES-D or the activity limitations scores are not used in this longitudinal analysis because they are only available as cross-sectional measures in the data and would be dropped out of the fixed effects regressions.

The results of the fixed effects model remain unchanged even after controlling for these health variables. Premenopausal women are less likely to work than postmenopausal women. Thus in terms of labor force participation, moving from premenopause to natural post menopause increases labor force participation, showing the positive impact of natural postmenopause.

Table 11: FE Estimates including Health (Dependent Variable-LFP)

	Fixed effects		
Premenopause	-0.029**	-0.027**	-0.027***
	(0.011)	(0.011)	(0.011)
Perimenopause	0.011	0.014	0.012
	(0.010)	(0.010)	(0.010)
Surgical menopause	-0.019	-0.016	-0.018
	(0.023)	(0.023)	(0.023)
Early menopause	0.001	0.011	0.010
	(0.024)	(0.024)	(0.024)
Hysterectomy	0.012	0.012	0.011
	(0.023)	(0.023)	(0.023)
Health	0.056***	-	
	(0.006)		
Health better	-	-0.003	-0.004
		(0.011)	(0.011)
Health worse	-	-0.058***	-0.057***
		(0.010)	(0.010)
Family limit ability to work	-	-	-0.072***
			(0.018)
R^2	0.325	0.312	0.315

Column (i) of Table A1 in Appendix A shows the regression results that include an augmented set of control variables measuring health insurance coverage, marital status transitions, whether the woman has been diagnosed with cancer, heart problems or high blood pressure, whether the woman drinks, and whether the woman smokes. Also included are five items from the CES-D scale indicating whether the woman reported problems with keeping her mind on tasks, restless sleep, feeling sad, that she could not get going, or she felt that everything took extra effort. Column (ii) of the same table shows the results when interaction terms between the menopause stage and the woman's age are included in the regressions.

In both sets of results, the finding is that premenopausal women are less likely to be in the labor market when compared to women who experienced natural postmenopause and the coefficient is significant. The only interaction term that is significant is the interaction between premenopause and age, but the overall result still implies that premenopause women are less likely to be in the labor market than women in postmenopause.

Further analyses explore the effect of hormone use on labor market outcomes by adding interaction terms between the menopause stage and the variable capturing whether the woman is currently using hormones to alleviate menopause symptoms. The results, shown in Appendix A, Table A2, indicate that there is no significant difference in labor force participation for women in perimenopause and naturally postmenopause women who are using hormones. However, women who had surgical menopause and are using hormones are more likely to be in the labor force, indicating the benefits of hormone use among these women.

Furthermore, we explore these results using separate regressions by race. The results, shown in Table A1 columns (iii) and (iv) in Appendix A, suggest differences in labor force participation between premenopause women and postmenopause women based on race. In the regression for the sample of white women the coefficient on the premenopause variable is negative and significant, while it is positive and insignificant in the sample of black women. The coefficient on perimenopause is positive in both regressions, but it is significant only in the sample of black women. The coefficient on surgical menopause is negative and insignificant for both samples.

The difference in the impact of menopause between the races may arise from differences in cultures, coping strategies or disease burdens from menopause. As white women move from premenopause to postmenopause, their labor force participation increases, while the opposite occurs for the black women.

Column (v) of Table A1 presents the results controlling for family fixed effects using only respondents in the sample who have at least one sibling. The results for the family fixed effects models suggest that there is no significant difference in labor force participation due to menopause stage. However, women with hysterectomies are more likely to be in the labor force.

Coefficient estimates for the socio-economic and demographic variables in Table A1 column (i) show that labor force participation increases with age but had the expected quadratic effects. Labor force participation also increases with education, while having young children reduce participation. Women with higher non-labor incomes are less likely to be in the labor force, showing that leisure is a normal good. Women who reported that their health is worse than the previous year are less likely to be in the labor

force. Women who are widowed are less likely to be in the labor force when compared to women who were never married (the excluded group). Also based on the responses of the CES-D item, women who reported that they felt that they could not get going and women who reported that they felt that everything they did took extra effort are less likely to be in the labor force. Women who had been diagnosed with cancer are significantly less likely to be in the labor force, while having a diagnosis of heart problems or high blood pressure does not have a significant effect on labor force participation.

Empirical Results: Effect of Menopause Transition on Hours

Table 12 shows the results of regressions with the hours per week worked as the dependent variable. All three models show that premenopause women work more hours per week than women in natural postmenopause, but all the coefficients are insignificant. Also women in perimenopause and women who experienced surgical menopause work fewer hours than women who experienced natural menopause, but the coefficients are also insignificant. The pooled OLS and the random effects models suggest that women with hysterectomies work more hours than women without hysterectomies, but the fixed effects model suggests that women with hysterectomies work fewer hours. Having experienced early menopause is shown to have a positive but insignificant effect on the hours worked.

Table 12: OLS, FE and RE Estimates (Dependent Variable – Hours)

	Pooled OLS	Fixed Effects	Random Effects
Premenopause	0.133	0.196	0.264
	(0.348)	(0.408)	(0.339)
Perimenopause	-0.019	-0.014	-0.021
	(0.349)	(0.375)	(0.320)
Surgical menopause	-0.296	-0.32	-0.308
	(0.425)	(0.960)	(0.572)
Hysterectomy	1.074**	-0.470	0.447
	(0.420)	(0.983)	(0.558)
Early menopause	0.089	0.849	0.507
	(0.394)	(0.873)	(0.504)
Race=white	-0.132	-	-0.289
	(0.269)		(0.426)
Race= other race	1.524	-	1.158
	(1.179)		(1.727)
Age	1.056*	2.151***	1.771***
	(0.621)	(0.666)	(0.510)
Age squared	-0.012**	-0.022***	-0.020***
	(0.006)	(0.005)	(0.005)
Education: 0 to 12 years	0.033	-2.060	0.400
	(0.423)	(2.664)	(0.641)
Education: 13 to 14 years	-0.502*	-3.071	-0.730
	(0.310)	(2.575)	(0.480)
Education: 15 to 16 years	0.364	-0.612	0.308
	(0.314)	(3.06)	(0.484)
Education: 17 to 18 years	1.620***	0.438	1.457***
	(0.362)	(3.645)	(0.552)
Resides in south	0.920***	-0.366	0.891**
	(0.241)	(1.745)	(0.370)
Children under 6 years	-0.570*	-0.590	-0.611*
	(0.337)	(0.400)	(0.328)
Children 7 years to 13 years	-1.514***	-0.702**	-0.938***
	(0.265)	(0.326)	(0.263)
Married	-2.628***	-0.606	-2.122***
	(0.229)	(0.587)	(0.307)
Experience	0.566***	1.712***	0.704***
	(0.098)	(0.328)	(0.106)
Experience squared	-0.006**	-0.016***	-0.009***
	(0.002)	(0.004)	(0.003)
R^2	0.054	0.031	0.052
Observations	10,321	10,321	10,321

Column (ii) of Table A2 in Appendix A, shows the results when the interaction terms of the hormone use and menopause variables are included in the fixed effects regression of the hours worked equations. All the interaction terms are insignificant,

implying that hormone use does not have any effect on the outcomes of the women in the different menopause stages. Column (i) of Table A3 in Appendix A shows the results for the hours worked model corrected for sample selection. The coefficient on the Inverse Mills ratio is significant implying that sample selection bias may exist in the estimates. When one corrects for sample selection, the signs of the coefficients are very similar to the previous models except that the coefficient on the perimenopause variable becomes negative. However, all coefficients are still insignificant.

The results from the Hausman test indicate that the menopause variables are exogenous to the number of hours worked. However, the results for the instrumental variables method are still presented for comparison purposes. The first stage of the instrumental variables procedure indicates that the instruments are fairly good as the explanatory power of the models is above 10%. Column (ii) in Table A3 presents the results which show that there is no significant difference in hours worked due to differences in the menopause stage.

Column (iii) of Table A3 shows the results for the sibling model. As discussed in the methodology section, if the results of the individual fixed effects and the sibling fixed effects models are similar, it implies that the relevant unobserved effects lie within families and both the individual and the family fixed effects models would adequately correct for these unobserved effects. However if the results of the two models are different, it would imply that individual unobserved effects are important and the sibling model would not correct for this problem.

Table A3, column (iii) in Appendix A shows that the results of the sibling model do differ with those of the individual fixed effects model shown in Table 12. The results

of the sibling model suggest that women in premenopause and perimenopause work significantly more hours per week than women in natural menopause. It also suggests that women who had surgical menopause work significantly fewer hours than women who experienced natural menopause. The difference between the individual fixed effects and the sibling model suggest that individual differences at the individual level are important, so the sibling model does not adequately correct for these differences.

Empirical Results: Effect of Menopause Transition on Full-time Employment

This section presents the findings of the analysis of the effect of the menopause transition on the choice to work full-time or part-time. Table 13 shows that all three models agree that both premenopause and perimenopause women are less likely to work full-time than postmenopause women. The fixed effects model shows that women in both premenopause and perimenopause are significantly less likely to work full-time compared to women in natural postmenopause. The pooled OLS and fixed effects models suggest that women with surgical menopause are less likely to work full-time than women who experienced natural menopause, but both models have insignificant coefficients. Also the fixed effects and random effects models suggest that women with hysterectomies are less likely to work full-time when compared to women without hysterectomies, with the coefficient on the fixed effects model being significant. The fixed effects and random effects models also suggest that women who experienced early menopause are more likely to work full-time, but again both model coefficients are insignificant.

Table 13: OLS, FE and RE Estimates (Dependent Variable- Full-time Employment)

	Pooled OLS	Fixed Effects	Random Effects
Premenopause	-0.019	-0.033**	-0.024*
	(0.014)	(0.015)	(0.013)
Perimenopause	-0.020	-0.026*	-0.024**
	(0.014)	(0.014)	(0.012)
Surgical menopause	-0.001	-0.002	0.0004
	(0.015)	(0.038)	(0.021)
Hysterectomy	0.021	-0.058*	-0.020
	(0.016)	(0.034)	(0.021)
Early menopause	-0.001	0.058	0.027
	(0.015)	(0.037)	(0.020)
Race=white	-0.018**	-	-0.032**
	(0.011)		(0.017)
Race= other race	0.069*	-	0.040
	(0.036)		(0.059)
Age	0.041*	0.059**	0.046**
	(0.024)	(0.026)	(0.020)
Age squared	-0.001	-0.001***	-0.001***
	(0.0002)	(0.0002)	(0.0002)
Education: 0 to 12 years	-0.013	0.082	0.011
	(0.018)	(0.148)	(0.027)
Education: 13 to 14 years	-0.021*	0.087	-0.014
	(0.012)	(0.070)	(0.018)
Education: 15 to 16 years	-0.011	0.133	-0.007
	(0.013)	(0.115)	(0.019)
Education: 17 to 18 years	0.033**	0.161	0.036*
	(0.013)	(0.135)	(0.020)
Resides in south	0.067***	-0.012	0.063***
	(0.009)	(0.055)	(0.014)
Children under 6 years	-0.016	-0.013	-0.015
	(0.013)	(0.014)	(0.012)
Children 7 years to 13 years	-0.049***	-0.024*	-0.033***
	(0.010)	(0,013)	(0.010)
Married	-0.099***	-0.040*	-0.082***
	(0.009)	(0.022)	(0.012)
Experience	0.015***	0.033***	0.021***
	(0.004)	(0.012)	(0.004)
Experience squared	0.00001	0.0003**	0.0001
	(0.0001)	(0.0001)	(0.0001)
R^2	0.063	0.033	0.061
Observations	10,321	10,321	10,321

When control variables for health and whether the woman reports that the health of the family member affects their ability to work are included (Table 14), the coefficients on the premenopause, perimenopause and hysterectomy variables remain

negative and significant. The coefficients still retain the same signs and significance when the augmented set of variables is used as shown in Appendix A, Table A4, column (i).

Columns (ii) and (iii) of Table A4 in Appendix A show the results when the fixed effects model is run for the different races. The coefficient signs are the same for the two races, but all coefficients for the sample of black women are insignificant. The results suggest that white women in premenopause and perimenopause are significantly less likely to work full-time than white women in postmenopause.

Table 14: FE Estimates with Health (Dependent Variable-Full-time Employment)

Variable	Fixed Effects		
Premenopause	-0.036**	-0.033**	-0.035**
	(0.015)	(0.015)	(0.016)
Perimenopause	-0.026*	-0.027**	-0.026*
	(0.014)	(0.014)	(0.014)
Surgical menopause	0.016	-0.002	0.016
	(0.038)	(0.038)	(0.038)
Hysterectomy	-0.071**	-0.058*	-0.071**
	(0.034)	(0.034)	(0.034)
Early menopause	0.052	0.058	0.052
	(0.037)	(0.037)	(0.037)
Health	0.020**	-	0.020**
	(0.008)		(0.008)
Health better	-	-0.019	-
		(0.014)	
Health worse	-	-0.012	-
		(0.014)	
Family limit ability to work	-	-	-0.001
			(0.030)
R^2	0.036	0.034	0.036

The Table A4 results also show that women who had hysterectomies are significantly less likely to work full-time. However, having surgical menopause or having experienced early menopause does not have any significant effect on the decision of women to work full-time or part-time.

The results for the interaction terms with the menopause stage variables are all insignificant showing that women using hormones do not have any benefit from hormone use, compared to women who do not use hormones. The results for the sibling model are shown in Table A4, column (iv). The premenopause, perimenopause and surgical menopause coefficients all have positive signs, but they are all insignificant. The signs of the coefficients in the sibling model are all different from the other three models. Again, the finding that there are large differences between the results of the individual fixed effects model and the sibling model, implying that the sibling model does not correctly control for underlying unobserved effects at the individual level which are important in these data.

The results for the other control variables show that older women are more likely to work full-time, but there are quadratic effects on age. Increasing years of education has the expected positive signs, but the coefficients are insignificant. Women with children aged between 7 and 13 years are to be less likely to work full-time as are married women. Women with more experience are more likely to work full-time, but there are quadratic effects on the experience variable. Furthermore, women who had been diagnosed with cancer or heart problems are less likely to work full-time.

Empirical Results: Effect of Menopause Transition on Wages

Table 15 shows the regression results with the log of hourly wages as the dependent variable. The regressions include only women who are not self-employed because wage data are not available for women in self employment. The data used in the analyses include women who earned a minimum of $1 and a maximum of $150 per hour.

Across all three models, the coefficient on the premenopause variable is positive and significant implying that women who are in premenopause earn more than women in postmenopause. The coefficient on the perimenopause variable is positive but insignificant across all three models. The results also suggest that having surgical menopause has a negative but insignificant effect on wages when compared having natural menopause. The coefficient on the hysterectomy variable is positive but insignificant across all the models, while there is a negative wage effect for women who had early menopause, with the coefficient being significant in the OLS and random effects model.

Table 15: OLS, FE and RE Estimates (Dependent Variable-Wages)

	Pooled OLS	**Fixed Effects**	**Random effects**
Premenopause	0.041***	0.023*	0.026**
	(0.014)	(0.013)	(0.011)
Perimenopause	0.012	0.007	0.007
	(0.014)	(0.012)	(0.010)
Surgical	-0.002	-0.007	-0.007
menopause	(0.016)	(0.034)	(0.022)
Hysterectomy	0.003	0.006	0.005
	(0.016)	(0.032)	(0.021)
Early menopause	-0.028*	-0.006	-0.032*
	(0.015)	(0.032)	(0.020)
Race=white	0.045***	-	0.062***
	(0.011)		(0.018)
Race= other race	0.036	-	0.031
	(0.040)		(0.077)
Age	-0.019	0.029	0.019

	(0.025)	(0.022)	(0.017)
Age squared	0.0001	0.0003**	0.0003
	(0.0002)	(0.0001)	(0.0002)
Education: 0 to 12 years	-0.106***	-0.041	-0.108***
	(0.016)	(0.044)	(0.025)
Education: 13 to 14 years	0.112***	-0.003	0.122***
	(0.013)	(0.090)	(0.020)
Education: 15 to 16 years	0.217***	-0.008	0.251***
	(0.014)	(0.099)	(0.022)
Education: 17 to 18 years	0.473***	0.187	0.508***
	(0.018)	(0.118)	(0.028)
Resides in south	-0.109***	-0.052	-0.101***
	(0.010)	(0.051)	(0.016)
Children under 6 years	-0.005	0.012	0.011
	(0.011)	(0.010)	(0.008)
Children 7 years to 13 years	-0.006	0.001	-0.002
	(0.010)	(0.010)	(0.009)
Married	-0.006	0.006	0.005
	(0.009)	(0.019)	(0.012)
Experience	0.029***	0.078***	0.039***
	(0.004)	(0.012)	(0.004)
Experience squared	0.0001	-0.001***	0.0003***
	(0.0001)	(0.0001)	(0.0001)
Occupation B	-0.101***	0.021	-0.002
	(0.021)	(0.024)	(0.019)
Occupation C	-0.262***	-0.053	-0.133***
	(0.022)	(0.047)	(0.028)
Occupation D	0.005	0.058	0.091***
	(0.021)	(0.041)	(0.025)
Occupation E	-0.520***	-0.176***	-0.299***
	(0.024)	(0.031)	(0.025)
Occupation F	-0.405***	-0.103***	-0.196***
	(0.027)	(0.030)	(0.025)
Occupation G	-0.280***	-0.067***	-0.123***
	(0.019)	(0.022)	(0.018)
Occupation H	-0.325***	0.0002	-0.124***
	(0.023)	(0.030)	(0.023)
R^2	0.442	0.267	0.430
Observations	8,464	8,464	8,464

When control variables for the effect of health are included (Table 16), the results show that the coefficient on the premenopause variable is sensitive to which measure of health is used. When the variable capturing the rating of the health of a woman compared to similar aged women is included, the coefficient on the premenopause variable becomes insignificant. However, when a measure of health based on whether the health of the

women is better or worse than the previous year is included, the coefficient on the premenopause variable is significant.

Table 16: FE Estimates with Health (Dependent Variable-Wages)

	Fixed effects	
Premenopause	0.020	0.023*
	(0.013)	(0.013)
Perimenopause	0.004	0.007
	(0.012)	(0.012)
Surgical menopause	-0.014	-0.007
	(0.033)	(0.034)
Hysterectomy	0.012	0.006
	(0.032)	(0.032)
Early menopause	-0.004	-0.006
	(0.031)	(0.032)
Health	0.006	-
	(0.007)	
Health better	-	-0.008
		(0.013)
Health worse	-	-0.008
		(0.010)
R^2	0.272	0.267

Column (i) of Table A5 in Appendix A shows the results when controls for sample selection are included. The coefficient on the Inverse Mills ratio is significant in these regressions suggesting that there may be sample selection bias in the data. After controlling for sample selection, the finding is that women in premenopause earn significantly more than women in postmenopause.

Column (ii) presents the results for the instrumental variables regression. This model suggests that there is a negative but insignificant coefficient on the premenopause variable. However, unlike the other models, the instrumental variables model suggests that women in perimenopause earn significantly less than women in natural

postmenopause. Column (iii) of the same table presents the results for the sibling model. This model also shows results that are contrary to the three baseline models and hence are questionable. Again for the wage models, there are no effects of hormone use on wages.

Table A6 in Appendix A presents the results for the annual earnings equation which are very similar to the findings of the wage equations for premenopause and perimenopause women. However, the earnings equations results show that the coefficient on the surgical menopause variable is positive but insignificant, while the coefficient on the hysterectomy variable is negative but still insignificant. For the earnings equation, the coefficient signs from the 2SLS regression and the sibling models are similar to those of the fixed effects model.

Empirical Results: Effect of Menopause Transition on Self-employment

Table 17 explores the effect of reproductive health on the choice to be self-employed. All three models show that there is a positive but insignificant coefficient on the premenopause variable, while there is a positive but significant coefficient on the perimenopause variable suggesting that perimenopause women are more likely to opt for self-employment than postmenopause women. The models also agree that women who had surgical menopause are more likely to opt for self-employment, but the coefficient is only significant in the fixed effects model. Furthermore, women with hysterectomies are less likely to be self-employed, and again the coefficient is significant only on the fixed effects model. All three models agree that women who had early menopause are more likely to be self-employed, but the coefficient is significant only in the pooled OLS model.

The fixed effects model has a poor fit compared to the pooled OLS and the random effects models, but the signs of the significant coefficients are the same in all three models. The poor fit in the fixed effects model may be due to the way the time-invariant and unobserved effects are dropped from the regressions, so they do not contribute to the explanatory power of the model. The F-statistic shows that not all coefficient estimates are zero, so the model results are still valid.

Table 17: OLS, FE and RE Estimates (Dependent Variable -Self-employment)

	Pooled OLS	Fixed effects	Random effects
Premenopause	0.015	0.012	0.008
	(0.010)	(0.011)	(0.009)
Perimenopause	0.024**	0.016*	0.016*
	(0.011)	(0.010)	(0.008)
Surgical menopause	0.003	0.045*	0.020
	(0.013)	(0.024)	(0.016)
Hysterectomy	-0.003	-0.042*	-0.022
	(0.013)	(0.023)	(0.015)
Early menopause	0.030**	0.019	0.022
	(0.012)	(0.025)	(0.015)
Race=white	0.058***	-	0.061***
	(0.008)		(0.013)
Race= other race	0.038	-	0.074
	(0.030)		(0.063)
Age	-0.024	-0.007	-0.012
	(0.019)	(0.017)	(0.013)
Age squared	0.0003	0.0001	0.0002
	(0.0002)	(0.0001)	(0.0001)
Education: 0 to 12 years	0.027*	-0.069	0.007
	(0.014)	(0.089)	(0.020)
Education: 13 to 14 years	-0.009	-0.023	-0.010
	(0.009)	(0.042)	(0.014)
Education: 15 to 16 years	0.001	-0.016	0.003
	(0.010)	(0.054)	(0.016)
Education: 17 to 18 years	-0.001	-0.065	-0.001
	(0.011)	(0.090)	(0.018)
Resides in south	0.037***	-0.008	0.024**
	(0.008)	(0.028)	(0.011)
Children under 6 years	-0.001	0.015*	0.012
	(0.009)	(0.009)	(0.008)

Children 7 years to 13 years	-0.005	0.005	0.004
	(0.007)	(0.008)	(0.006)
Married	-0.007	0.022*	0.014*
	(0.008)	(0.013)	(0.009)
Experience	-0.006**	0.007	-0.004
	(0.003)	(0.009)	(0.003)
Experience squared	0.0001*	0.00003	0.0001
	(0.0001)	(0.0001)	(0.0001)
Non labor income	0.001***	0.0002**	0.0004***
	(0.0001)	(0.0001)	(0.0001)
R^2	0.032	0.003	0.028
Observations	9,189	9,189	9,189

Table A7 column (i) in Appendix A shows that the coefficients for the fixed effects model remains significant after including the augmented set of control variables in the regressions. Columns (ii) and (iii) show the results where separate regressions are run by race. White women who have undergone surgical menopause are more likely to be self-employed when compared to women who had experienced natural postmenopause. The results also show that women who had a hysterectomy are less likely to be self-employed. None of the menopause stage variables for the sample of black women are significant showing that reproductive health may not be a determinant of the self-employment choice for black women.

Column (iv) suggests that for the sibling model, women who had surgical menopause are significantly more likely to opt for self-employment than women who experienced natural menopause. Also, similar to the other models, women with hysterectomies are less likely to be self-employed.

For the other control variables, the findings suggest that more educated women are less likely to be self-employed. Also women who are self-employed are less likely to be covered with health insurance. Furthermore, married women are more likely to opt for

self-employment while women who have been diagnosed with cancer are more likely to be self-employed than women without cancer.

Discussion of Empirical Findings

Table 18 presents the results for the F-tests (for the ordinary least squares model)[10] and the Wald test (for the fixed effects model) that test the joint null hypothesis that the entire menopause coefficient estimates are zero. As the results show, these tests reject the null hypothesis that all the menopause coefficients are jointly zero in the regressions with the dependent variable as the labor force participation, the choice to work full time, wages, and the choice to be self-employed. The F-test and the Wald test both imply that menopause has no effect in the earnings equation. The F-test suggests that the menopause variables are not all zero in the hour's equation, but the Wald test suggests that they are jointly zero. Overall, the results suggest that the menopause variables are not all jointly zero implying that these variables do jointly explain the labor market outcomes.

Table 18: F-test and Wald Test Results

	Labor force participation	Hours worked	Full time	Hourly wage	Earnings	Self employed
F statistic	2.226**	3.316***	3.126**	2.511**	1.497	1.986*
Wald test statistic	5.26***	1.09	2.64**	2.04*	1.18	2.33*

[10] I use the OLS model here because the test statistic it is based on the total and residual sum of squares which is only available for the OLS model.

The empirical analyses used the pooled OLS, fixed effects, random effects, 2SLS, and family fixed effects models to estimate the impact of menopause transition on labor market outcomes. The results in the previous section show that the pooled OLS model is rejected based on the failure of its underlying assumption that there are no unobserved effects between the individuals. The random effects model is also rejected because it assumes that the unobserved effects are not correlated with the explanatory variables, and this assumption is rejected using the Hausman test. The models are also tested for possible endogeneity of the menopause variables using the Hausman test, and the findings is that the menopause variables are exogenous. The results of the 2SLS model are presented for comparison purposes, but the 2SLS model does not perform well. Estimating the wage and hours worked regressions controlling for sample selection shows that sample selection bias may exist in the data.

Variations in the underlying assumptions for the empirical models may explain the differences in the findings across the models. Only the assumptions of the fixed effects model and the model corrected for sample selection are not rejected, so these are the best models which are use to interpret the findings. Also for logical reasons, the use of the fixed effects model is plausible because there are unobserved differences at the individual level which affect the menopause transition, such as the ability to cope with biological and social changes that are part of the transition. Failure to control for this unobserved heterogeneity leads to inconsistent estimates.

As the discussion in the previous section has shown, the results of the family fixed effects model and the individual effects model differ significantly. This implies that there is unobserved heterogeneity at the individual level which the family fixed effects

model fails to correct. This finding suggests that even though there may be genetic characteristics that are similar between family members, there are also non-genetic differences which are important in the menopause transition that differ even among members of the same family. Given the varying results of the two fixed effects models, the unobserved differences at the individual level are more important than the unobserved differences at the family level.

Table 19 summarizes the signs and significance of each of the menopause transition variables based on the results of the fixed effects model. Table A8 in Appendix A presents the summary results for all the estimation models.

Table 19: Summary of the Findings

	LFP	**Hours**	**Full time**	**Wage**	**Self-employment**
Premenopause	- S	+ NS	- S	+ S	+ NS
Perimenopause	+ NS	- NS	- S	+ NS	+ S
Surgical menopause	- NS	- NS	- NS	- NS	+ S
Early menopause	+ NS	+ NS	+ NS	- NS	+ NS
Hysterectomy	+ NS	- NS	- S	+ NS	- S

Key: S - significant at at least 10%; NS - not significant

The cross tabulation results in Table 9 for the menopause variables and labor market outcomes suggest that women in premenopause are more likely to be in the labor force. When control variables for socio-economic and health variables are included in the regression models but without controlling for individual heterogeneity (the OLS model), the results indicate that women in premenopause are still more likely to be in the labor force. However, when control variables for individual heterogeneity are included, the

finding is that women in premenopause are 2% less likely to be in the labor force than women who were in natural postmenopause. The difference between the OLS and fixed effects model may be due to the fact that there is important unobserved individual heterogeneity that is correlated with the menopause transition. For example, there may be differences in individual ability to cope with the physical, emotional, and biological changes that occur during the menopause transition. Failure to control for such unobserved heterogeneity results in inconsistent estimates.

The finding that women in premenopause are less likely to be in the labor force could arise from the time demands for child care because these women are likely to have young children. This hypothesis is tested by estimating the labor force participation regression using only the sample of women who do not have any children aged seven years or younger in the household, and the finding is that the results remain the same. Regression are also run using the full sample while including an interaction term to capture premenopause women with young children. The interaction term is insignificant, and the other results are unchanged. Thus, the finding that women in premenopause are less likely to be in the labor force is not driven by the time demands for child care.

The empirical results also suggest that there is no significant difference in labor force participation between women in perimenopause, women with surgical menopause, and women who had natural postmenopause. There was also no significant difference in labor force participation for women who had early menopause or a hysterectomy compared to other women.

When the regression are run by race, the finding is that white women in premenopause are 4% less likely to be in the labor force when compared to white women

in natural postmenopause. There is no significant difference in labor force participation between white women in perimenopause, those with surgical menopause, and those who had natural postmenopause. For the sample of black women, there is no difference in labor force participation between those in premenopause and those in natural postmenopause. However, black women in perimenopause are significantly more likely to be in the labor force than black women in natural postmenopause. The results suggest that for white women, the transition from premenopause to natural postmenopause increases labor force participation, while for the black women, the move from perimenopause to natural postmenopause reduces labor force participation. This finding may reflect a difference in coping strategies and experience of menopause between the two races as previous studies have shown that there are differences in symptom reporting and social stresses during the menopause transition between races. Also, black women generally have poorer health than white women, so this difference may be showing how their health limits their ability to continue to be in the labor force once they are in postmenopause.

The results also suggest that there are benefits of hormone use for women who have surgical menopause. Women with surgical menopause who used hormones are more likely to be in the labor market than women with surgical menopause who did not. Women undergo surgical menopause because they have reproductive health problems. Hormone use can alleviate some of problems resulting from the surgical procedure, and, as the results show, the use of hormones can improve health and increase labor force participation.

The findings indicate that there is no significant difference in hours worked by women in different stages of menopause. Thus, among women who are in employed, menopause does not seem to affect the number of hours that they work. The results are the same, even after controlling for sample selection.

Another finding is that women in premenopause and women in perimenopause are less likely to work full-time than women in natural postmenopause. When the models are run using the sample of women with no dependent children under the age of seven and also using the full sample but with an interaction term for premenopause and children under seven, the same results are found. This implies that these results are not driven by the effect of the time demands for child care by these women.

When the regressions are run by race, both races show the same effects, but only the coefficients for the sample of white women are significant. Also the finding is that women with hysterectomies are less likely to work full-time. This finding may reflect that women who had hysterectomies had underlying health problems that affect their ability to work full-time.

For the wage equations, the results suggest that women in premenopause earn 2% more than women in postmenopause. After controlling for sample selection, the finding is that they earn 4% more. Thus even though women in premenopause are less likely to be in the labor force and less likely to work full-time, they earn more than women in postmenopause. The employer's negative view of the menopause transition, may explain part of this wage penalty on postmenopause women. The results reveal that there is no significant difference in wages between women in perimenopause, women with surgical menopause and women in natural postmenopause.

The regression is also run for the choice to be self-employed, and the finding is that women in perimenopause are 2% more likely to be self-employed than women in natural postmenopause. The results also indicate that women who had surgical menopause are 5% more likely to be self-employed than women in natural postmenopause. When the regressions by race, the finding is that among black women, the menopause transition has no significant effects on the choice to be self-employed. However for the sample for white women, women with surgical menopause are 8% more likely to be self employed.

These results may suggest that as women enter perimenopause, some of them face the stress associated with the menopause transition and in response to this change in life, they choose self-employment which enables then to have more control of their work schedules. A possible explanation for the finding that perimenopausal white women are more likely to be self-employed than black women is that opportunities for self-employment may be more available for white women.

In summary the results from this study show that among a generally healthy population, the menopause transition leads to an increase in labor force participation and an increase in the probability of working full-time. The menopause transition however does not have significant effects on the number of hours worked.

CHAPTER 6: CONCLUSION AND POLICY IMPLICATIONS

The objective of this dissertation was, first, to explore the impact of the menopause transition on health. Menopause transition is defined with an indicator variable for each reproductive stage (premenopause, perimenopause, natural postmenopause and surgical menopause). The models also include control variables indicating if the woman had early menopause or if she had a hysterectomy. Health is measured with two variables: (1) the scores of functional limitations derived from an instrument measuring the severity of limitations in performing basic and intermediate activities of daily living; and (2) an indicator variable for depression derived from the CES-D scale.

The second and main objective of the dissertation was to explore the effect of the menopause transition on the following labor market outcomes: labor force participation, hours worked, full-time employment, wages and self-employment. The empirical analyses used panel data drawn from the National Longitudinal Survey of Young Women (NLSYW). This is the first study to explore the effects of menopause transition on labor market outcomes.

The key findings regarding the menopause transition and health show that women in premenopause reported fewer activity limitations than women in perimenopause. The results indicate that women who had surgical menopause and women in natural postmenopause had more limitations than women who were perimenopause. Women who had surgical menopause also reported more limitations with activities of daily living than those with natural menopause. These findings imply that as women move from premenopause to postmenopause, the reported activity limitations increase. Also women

who had surgical menopause showed the greatest limitations with activities of daily living.

The results suggest that women in premenopause are less likely to be depressed compared to women who are perimenopausal. There is no significant differences in depression probabilities between women with surgical menopause, women who experienced natural menopause and women who are perimenopausal. However the finding is that women who experienced early menopause are more likely to be depressed.

The finding that the menopause transition results in an increase in functional limitations is consistent with previous findings by other researchers (Mishra et al., 2003; Sowers et al., 2001). Furthermore, the finding that women in perimenopause are more likely to be depressed is also consistent with findings by other researchers (Freeman et al., 2004; Maartens et al., 2002; Mishra et al., 2003).

The main objective of the dissertation was to explore whether the menopause transition had any effect on labor market outcomes. One key finding is that women in premenopause are less likely to be in the labor force than women who experienced natural postmenopause. Thus as women move from premenopause to natural postmenopause, their labor force participation increases. The results also suggest racial differences in labor force participation and the menopause transition. White women in premenopause are less likely to be in the labor force compared to white women in natural postmenopause, implying an increase in labor force participation as white women move from premenopause to natural postmenopause. However, the finding is that black women in perimenopause are more likely to be in the labor force than black women in natural postmenopause, implying that as black women move from premenopause to natural

postmenopause, their labor force participation declines. This finding agrees with previous literature that shows that there are differences in symptom reporting, coping strategies and the menopause experience between the races (Avis et al., 2001; Ballard et al., 2001; Bromberger et al., 2001). Because black women report more health problems than white women, their labor force participation declines as they move into menopause.

The analysis also explores the effect of hormone use during the menopause transition. The finding is that, among the women with surgical menopause, those who used hormones are more likely to be in the labor force than those not using hormones. For all other labor market outcomes, there are neither benefits nor disadvantages of hormone use for women in the labor market.

The results indicate that the menopause transition does not have any effect on the number of hours that women in the dataset worked. However when the dependent variables is an indicator variable for whether the woman works full-time or part-time, the finding is that as women move from premenopause to natural postmenopause, they are more likely to work full-time.

In the wage model, the results indicate that women in premenopause earn more than women in natural postmenopause, implying that there is a wage premium on being premenopause or a wage penalty on being postmenopause.

The findings also suggest that women in perimenopause and those with surgical menopause are more likely to choose to be self-employed. When the results are analyzed by race, the implication of the results is that these results hold true for white women rather than black women, showing differences in responses between the races to the menopause transition.

The empirical models are run using pooled OLS, the fixed effects model, the random effects model, the family fixed effects model and 2SLS. Only the assumptions of the fixed effects model are not rejected. This implies that there are important unobserved characteristics at the individual level that affect the menopause transition. This finding highlights the limitation of studies that rely on cross sectional data or models that fail to correct for unobserved individual heterogeneity.

Several limitations of this study can be noted and they arise from a problem with the available data. The NLSYW does not have detailed information menopause symptoms, which would have enabled a deeper exploration of the labor market decisions faced by women with differing severity of menopause symptoms.

Furthermore, the data were collected biennially. Given this long period of time between observations, it becomes difficult to capture short-term responses to health problems arising from the menopause transition. Also, only cross-section data on depression and physical functioning are available which limited my ability to explore the effects of menopause transition as women progressed into menopause. However this study is the first to explore this topic and has provided some important results.

Several policy implications can be drawn from the above findings. First, the findings show an increase in labor supply as women move from premenopause to postmenopause. This implication is that among a generally healthy population, the menopause transition is not disruptive to women's lives. As the literature review shows, the menstrual cycles result in increased absenteeism from work and also poor performance at the workplace for some women, and so the cessation of menstrual cycles brings relief and an improvement in labor market outcomes.

The medical literature has also medicalized the menopause transition by focusing on the ill-health that some women experience during the transition. In this study the finding is that even though the data agree with the findings of the medical studies that the menopause transition increases the likelihood of depression and physical limitations, the results show that the menopause transition increases labor supply. Thus, menopause transition should be viewed in a social and cultural context as a time when women explore life and expand their horizons. The changes that occur during the menopause transition may open up possibilities for positive individual development. Thus, employers should not shy away from employing women in midlife, for fear of reduced labor supply as they progress into menopause. These women actually increase their labor force attachment as they go through the menopause transition and are open for individual growth as they enter menopause.

Another policy implication is that hormone use can be beneficial for women with reproductive health problems. This is based on the finding that women who had surgical menopause and are using hormones are more likely to be in the labor force than women with surgical menopause who were not using hormones. However, in as much as the finding is that hormone use seem to be beneficial for some women, recent reports note that researchers have observed a decline in breast cancer rates that coincided with the reduction in the use of hormone replacement therapy (Grady, 2007). These recent findings provide arguments against advocating an increase in hormone use, as the disadvantages may outweigh the advantages.

Controlling for other influences, the results show that women in postmenopause had lower wages than women in premenopause. This finding may result from bias or

discrimination against menopausal women. The policy implication is that with the increase in the number of menopausal women in the workplace, more effort should be placed on educating employers and removing any stigma or misperceptions of menopause that may result in such wage penalties. Employers could promote seminars where both male and female workers can discuss menopause issues with the aim of correcting workplace culture and the negative views of the menopause transition.

The findings of this study are not meant to belittle the negative health effects that some women experience as they go through the menopause transition. However, these results suggest that menopause is not only a medical issue but should be viewed in a holistic manner, taking into account the social and cultural context.

This is the first study to explore the effects of the menopause transition on labor market outcomes. This research explored the long-term effects of the transition because the interviews were done at two year intervals. As more data become available, future research can explore the short-term effects of the menopause transition and the effects of the severity of different menopause symptoms on labor market outcomes. Future research can also analyze the effects of the menopause transition on other labor market outcomes such as absenteeism. More research is needed to be able to fully understand the effect of the menopause transition on labor market outcomes. However, the main limitation that exists is the availability of a detailed data set that will enable an in-depth exploration of this topic.

APPENDIX A

Table A 1: Augmented FE, FE by Race and Sibling Model Estimates (Dependent Variable - LFP)

	(i)	(ii)	(iii)	(iv)	(v)
Variable	**Individual effects (Full sample)**	**Individual effects (with interactions)**	**Individual effects (white)**	**Individual effects (black)**	**Sibling model**
Premenopause	-0.024** (0.011)	-0.267** (0.121)	-0.039*** (0.013)	0.030 (0.024)	0.018 (0.024)
Perimenopause	0.013 (0.010)	-0.084 (0.142)	0.001 (0.012)	0.056** (0.023)	0.031 (0.023)
Surgical menopause	-0.019 (0.023)	0.049 (0.136)	-0.001 (0.028)	-0.041 (0.040)	0.023 (0.036)
Hysterectomy	0.016 (0.023)	0.016 (0.023)	0.008 (0.028)	0.016 (0.038)	0.085** (0.036)
Experienced early menopause	-0.004 (0.025)	-0.003 (0.025)	-0.018 (0.036)	0.012 (0.035)	-0.022 (0.034)
Premenopause*Age	-	0.005** (0.002)	-	-	-
Perimenopause*Age	-	0.002 (0.003)	-	-	-
Surgical menopause*Age	-	-0.001 (0.003)	-	-	-
Age	0.048** (0.019)	-0.012 (0.009)	0.032 (0.023)	0.090*** (0.034)	0.096** (0.045)
Age2	-0.001*** (0.0002)	-	-0.0004** (0.0002)	-0.001*** (0.0003)	-0.001** (0.0005)
Education: 0 to 12 years	0.0003 (0.101)	0.003 (0.101)	0.014 (0.152)	-0.068 (0.115)	0.165*** (0.047)
Education: 13 to 14 years	0.088 (0.053)	0.095* (0.053)	0.099* (0.052)	0.015 (0.149)	0.072** (0.030)
Education: 15 to 16 years	0.147 (0.105)	0.151 (0.105)	0.179 (0.115)	-0.055 (0.197)	0.028 (0.036)
Education: 17 to 18 years	0.299** (0.123)	0.306** (0.123)	0.324** (0.138)	0.105 (0.220)	0.060* (0.037)
Resides in south	-0.002 (0.039)	-	-0.017 (0.047)	0.028 (0.069)	0.029 (0.028)
Children under 6 years	-0.015 (0.009)	-0.016* (0.009)	-0.036** (0.015)	0.004 (0.012)	-0.021 (0.019)
Children 7 years to 13 years	-0.034*** (0.008)	-0.036*** (0.008)	-0.036*** (0.010)	-0.030** (0.013)	0.009 (0.016)
Experience	0.045*** (0.006)	0.047*** (0.006)	0.047*** (0.007)	0.035*** (0.012)	0.058*** (0.005)

Experience squared	0.0004*** (0.0001)	-0.0004*** (0.0001)	-0.0004*** (0.0001)	0.0003 (0.0002)	-0.001*** (0.0001)
Non labor income	-0.001*** (0.0001)	-0.001*** (0.0001)	-0.001*** (0.0001)	-0.001** (0.0002)	-0.0001 (0.0002)
Health worse than previous year	-0.047*** (0.010)	-0.047*** (0.010)	-0.037*** (0.011)	-0.077*** (0.019)	-0.046** (0.022)
Health better than previous year	-0.006 (0.011)	-0.006 (0.011)	-0.008 (0.012)	0.015 (0.023)	0.003 (0.026)
Family member health limits work	-0.075*** (0.019)	-0.075*** (0.019)	-0.067*** (0.023)	-0.091*** (0.034)	-0.131*** (0.044)
Has health insurance coverage	0.060*** (0.012)	0.060*** (0.012)	0.073*** (0.017)	0.042** (0.019)	0.039 (0.026)
Marital status: Married	-0.105 (0.073)	-0.103 (0.074)	-0.194** (0.095)	-0.018 (0.107)	-0.063 (0.035)
Marital status: Widowed	-0.133* (0.077)	-0.136* (0.078)	-0.216** (0.101)	-0.056 (0.117)	-0.087 (0.057)
Marital status: Divorced	-0.081 (0.074)	-0.078 (0.074)	-0.154 (.095)	-0.053 (0.109)	0.012 (0.037)
Marital status: Separated	-0.122 (0.076)	-0.118 (0.076)	-0.223** (0.100)	-0.044 (0.108)	0.035 (0.052)
CES-D item: problem keeping mind on tasks	-0.007 (0.005)	-0.007 (0.005)	-0.009 (0.006)	-0.002 (0.008)	-0.003 (0.012)
CES-D item: everything took extra effort	-0.009* (0.005)	-0.008* (0.005)	-0.008 (0.006)	-0.009 (0.008)	-0.014 (0.011)
CES-D item: had restless sleep	-0.001 (0.004)	-0.001 (0.004)	-0.001 (0.005)	-0.003 (0.008)	-0.013 (0.009)
CES-D item: felt sad	0.001 (0.005)	0.002 (0.005)	0.002 (0.006)	-0.001 (0.009)	0.008 (0.012)
CES-D item: couldn't get going	-0.015*** (0.005)	-0.015*** (0.005)	-0.014** (0.006)	-0.016* (0.008)	-0.047*** (0.012)
Illness: cancer	-0.040** (0.019)	-0.042** (0.019)	-0.041* (0.022)	-0.052 (0.047)	0.013 (0.053)
Illness: high blood pressure	0.009 (0.011)	0.009 (0.011)	0.016 (0.014)	-0.004 (0.020)	-0.044** (0.022)
Illness: heart problem	-0.003 (0.024)	-0.002 (0.024)	-0.007 (0.032)	0.015 (0.036)	-0.095* (0.058)
Lifestyle: is a smoker	0.048*** (0.015)	0.049*** (0.015)	0.057*** (0.017)	0.031 (0.031)	0.014 (0.022)
Lifestyle: drinks alcohol	0.028*** (0.009)	0.028*** (0.009)	0.025** (0.010)	0.037* (0.021)	0.066*** (0.019)
R^2	0.317	0.317	0.279	0.407	0.502

Table A 2: FE Estimates on Effects of Hormone Replacement Therapy

	LFP	Hours	Fulltime	Wage	Earnings	Self employed
Premenopause	-0.022*	0.130	-0.029*	0.018	0.042*	0.013
	(0.011)	(0.429)	(0.016)	(0.013)	(0.024)	(0.011)
Perimenopause	0.017	-0.154	-0.020	0.007	0.003	0.019*
	(0.012)	(0.433)	(0.016)	(0.013)	(0.024)	(0.011)
Surgical menopause	-0.033	0.236	0.027	-0.005	0.055	0.052**
	(0.024)	(1.023)	(0.040)	(0.035)	(0.061)	(0.026)
Hysterectomy	0.012	-0.449	-0.061*	0.012	-0.083	-0.042*
	(0.023)	(1.029)	(0.035)	(0.032)	(0.058)	(0.024)
Experienced early menopause	-0.003	0.744	0.046	0.003	0.086	0.016
	(0.025)	(0.901)	(0.039)	(0.032)	(0.058)	(0.027)
Perimenopause & hormones	-0.003	0.141	-0.009	-0.028	0.006	-0.011
	(0.016)	(0.576)	(0.023)	(0.019)	(0.034)	(0.015)
Surgical menopause & hormones	0.035**	-0.165	-0.009	-0.013	-0.003	-0.014
	(0.014)	(0.563)	(0.021)	(0.018)	(0.030)	(0.012)
Natural postmenopause & hormones	0.005	-0.003	0.018	-0.012	-0.004	-0.008
	(0.012)	(0.422)	(0.016)	(0.014)	(0.026)	(0.012)

Table A 3: Sample Selection, Instrumental Variables and Sibling Model Estimates (Dependent Variable – Hours)

	(i)	(ii)	(iii)
Variable	**Sample selection**	**Instrumental variables**	**Sibling model**
Premenopause	0.195 (0.346)	0.134 (6.284)	1.908** (0.944)
Perimenopause	-0.168 (0.343)	-1.800 (3.939)	1.492* (0.906)
Surgical menopause	0.265 (0.396)	9.494 (13.593)	-3.037** (1.443)
Hysterectomy	0.649 (0.400)	-6.398 (7.605)	3.489** (1.351)
Experienced early menopause	0.248 (0.374)	0.528 (1.080)	3.168** (1.305)
Race= white	-0.499* (0.263)	-	-
Race:=other race	2.285** (1.060)	-	-
Age	0.383 (0.587)	2.545 (1.699)	-0.515 (1.832)
Age2	-0.005 (0.006)	-0.027* (0.015)	0.007 (0.018)
Education: 0 to 12 years	0.084 (0.401)	-2.990 (4.215)	-1.508 (2.356)
Education: 13 to 14 years	-0.461 (0.285)	-3.418* (1.922)	-3.367*** (1.101)
Education: 15 to 16 years	0.587* (0.317)	-0.095 (3.393)	-1.200 (1.394)
Education: 17 to 18 years	2.265*** (0.364)	0.216 (3.819)	-0.198 (1.425)
Resides in south	0.930*** (0.239)	-	1.149 (1.128)
Children under 6 years	-0.560* (0.320)	-0.612 (0.398)	-0.563 (0.779)
Children 7 years to 13 years	-1.241*** (0.264)	-0.739** (0.311)	-0.267 (0.629)
Experience	0.175 (0.158)	1.772*** (0.295)	1.188*** (0.277)
Experience squared	-0.001 (0.003)	-0.015*** (0.003)	-0.023*** (0.007)
Health worse than previous year	0.495 (0.367)	-0.104 (0.356)	-0.541 (0.934)
Health better than previous year	0.195 (0.424)	-0.339 (0.396)	-1.446 (0.957)

Family member health limits work	-1.058 (0.872)	-0.292 (0.717)	-2.359 (2.172)
Has health insurance coverage	0.747* (0.449)	0.365 (0.459)	2.928*** (1.069)
Marital status: Married	-0.992** (0.399)	0.883 (2.986)	-2.145 (1.42)
Marital status: Widowed	0.520 (0.603)	0.466 (3.109)	-0.425 (2.361)
Marital status: Divorced	1.551*** (0.447)	1.923 (3.067)	-0.002 (1.477)
Marital status: Separated	0.866 (0.677)	0.477 (3.080)	-0.914 (2.181)
CES-D item: problem keeping mind on tasks	-0.392** (0.197)	0.038 (0.188)	-0.694 (0.478)
CES-D item: everything took extra effort	0.377** (0.185)	0.183 (0.183)	0.874* (0.458)
CES-D item: had restless sleep	0.079 (0.141)	0.213 (0.157)	0.389 (0.362)
CES-D item: felt sad	-0.232 (0.201)	0.168 (0.191)	-0.680 (0.477)
CES-D item: couldn't get going	-0.270 (0.196)	-0.150 (0.193)	0.415 (0.504)
Illness: cancer	-1.183* (0.660)	-1.471* (0.789)	-2.890 (1.895)
Illness: high blood pressure	0.055 (0.273)	-0.457 (0.498)	-1.578* (0.887)
Illness: heart problem	-1.001 (1.004)	-2.157* (1.346)	-4.362 (3.244)
Lifestyle: is a smoker	0.597** (0.271)	0.510 (0.550)	-0.915 (0.859)
Lifestyle: drinks alcohol	-0.306 (0,240)	0.693** (0.323)	0.044 (0.718)
Inverse Mills	-4.450*** (1.497)	-	-
Inverse Mills * 1997 year dummy	-1.568 (1.131)	-	-
Inverse Mills * 1999 year dummy	0.159 (1.086)	-	-
Inverse Mills * 2001 year dummy	1.411 (1.206)	-	-
Inverse Mills * 2003 year dummy	-0.726 (1.243)	-	-
R^2	0.068	0.030	0.283

Table A 4: Augmented FE, FE by Race and Sibling Model Estimates (Dependent Variable - Full-time Employment)

	(i)	(ii)	(iii)	(iv)
Variable	**Individual effects (Full sample)**	**Individual effects (white)**	**Individual effects (black)**	**Sibling model**
Premenopause	-0.033**	-0.032*	-0.033	0.037
	(0.016)	(0.018)	(0.034)	(0.036)
Perimenopause	-0.027*	-0.027*	-0.020	0.036
	(0.014)	(0.015)	(0.035)	(0.034)
Surgical menopause	0.028	0.008	0.053	0.017
	(0.038)	(0.047)	(0.068)	(0.054)
Hysterectomy	-0.071**	-0.054	-0.098	0.094*
	(0.035)	(0.043)	(0.062)	(0.051)
Experienced early menopause	0.056	0.066	0.064	0.103**
	(0.039)	(0.051)	(0.063)	(0.049)
Age	0.051*	0.075**	-0.018	-0.080
	(0.026)	(0.032)	(0.054)	(0.069)
Age2	-0.001**	-0.001***	-0.0001	0.001
	(0.0002)	(0.0003)	(0.001)	(0.001)
Education: 0 to 12 years	0.076	0.074	-0.081**	-0.047
	(0.144)	(0.165)	(0.039)	(0.089)
Education: 13 to 14 years	0.099	0.037	0.426**	-0.093**
	(0.072)	(0.075)	(0.189)	(0.041)
Education: 15 to 16 years	0.149	0.082	0.481**	-0.153***
	(0.112)	(0.118)	(0.203)	(0.052)
Education: 17 to 18 years	0.185	0.202	0.346	-0.102*
	(0.134)	(0.145)	(0.237)	(0.054)
Resides in south	-0.020	0.005	-0.066	0.048
	(0.059)	(0.067)	(0.116)	(0.042)
Children under 6 years	-0.010	0.003	-0.023	0.003
	(0.014)	(0.017)	(0.023)	(0.029)
Children 7 years to 13 years	-0.023*	-0.025	-0.011	0.035
	(0.013)	(0.016)	(0.025)	(0.024)
Experience	0.034***	0.039***	0.028	0.037***
	(0.012)	(0.013)	(0.027)	(0.010)
Experience squared	-0.0003**	-0.0003**	-0.0004	-0.001***
	(0.0001)	(0.0002)	(0.0003)	(0.0003)
Health worse than previous year	-0.010	-0.008	-0.020	0.003
	(0.014)	(0.016)	(0.030)	(0.035)
Health better than previous year	-0.016	-0.010	-0.039	-0.040
	(0.014)	(0.016)	(0.032)	(0.036)
Family member health limits work	-0.001	0.011	-0.059	0.086
	(0.031)	(0.036)	(0.069)	(0.082)
Has health insurance coverage	0.048**	0.062**	0.014	0.110***
	(0.020)	(0.026)	(0.034)	(0.040)
Marital status: Married	-0.058	0.052	-0.239**	-0.077
	(0.070)	(0.075)	(0.114)	(0.053)
Marital status: Widowed	-0.062	0.003	-0.117	-0.003
	(0.084)	(0.093)	(0.142)	(0.089)
Marital status: Divorced	0.001	0.115	-0.206*	0.008
	(0.072)	(0.079)	(0.117)	(0.056)
Marital status: Separated	-0.025	0.059	-0.166	-0.083
	(0.076)	(0.090)	(0.112)	(0.082)
CES-D item: problem keeping mind on	0.004	0.004	0.002	-0.017

tasks	(0.007)	(0.008)	(0.015)	(0.018)
CES-D item: everything took extra effort	-0.006	-0.003	-0.007	0.018
	(0.007)	(0.009)	(0.013)	(0.017)
CES-D item: had restless sleep	0.002	0.004	-0.007	-0.002
	(0.006)	(0.006)	(0.013)	(0.014)
CES-D item: felt sad	0.002	0.002	0.003	-0.016
	(0.007)	(0.008)	(0.017)	(0.018)
CES-D item: couldn't get going	0.002	0.001	0.002	-0.004
	(0.008)	(0.009)	(0.015)	(0.019)
Illness: cancer	-0.062**	-0.061**	-0.100	-0.133*
	(0.028)	(0.030)	(0.083)	(0.071)
Illness: high blood pressure	0.005	0.029	-0.034	-0.007
	(0.016)	(0.020)	(0.029)	(0.033)
Illness: heart problem	-0.108**	-0.109*	-0.096	-0.062
	(0.049)	(0.056)	(0.095)	(0122)
Lifestyle: is a smoker	0.023	0.010	0.063	-0.054*
	(0.021)	(0.024)	(0.044)	(0.032)
Lifestyle: drinks alcohol	-0.012	-0.010	-0.038	0.020
	(0.012)	(0.013)	(0.027)	(0.027)
R^2	0.037	0.037	0.026	0.320

Table A 5: Sample Selection, Instrumental Variables and Sibling Model Estimates (Dependent Variable - Wages)

	(i)	(ii)	(iii)
Variable	**Sample Selection**	**Instrumental variables**	**Sibling model**
Premenopause	0.040***	-0.071	-0.021
	(0.014)	(0.254)	(0.033)
Perimenopause	0.019	-0.233*	0.038
	(0.014)	(0.135)	(0.033)
Surgical menopause	-0.0003	-0.224	0.098*
	(0.016)	(0.521)	(0.054)
Hysterectomy	0.004	0.112	-0.048
	(0.016)	(0.300)	(0.050)
Experienced early menopause	-0.023	0.013	-0.039
	(0.015)	(0.055)	(0.047)
Race=white	0.024**		-
	(0.012)		
Race= other race	0.053		-
	(0.039)		
Age	-0.001	0.076	-0.003
	(0.024)	(0.062)	(0.066)
Age2	-0.0001	-0.001*	-0.0002
	(0.0002)	(0.001)	(0.001)
Education: 0 to 12 years	-0.082***	-0.052	-0.168**
	(0.016)	(0.124)	(0.081)
Education: 13 to 14 years	0.095***	-0.034	0.159***
	(0.013)	(0.061)	(0.042)
Education: 15 to 16 years	0.196***	0.005	0.232***
	(0.014)	(0.099)	(0.053)
Education: 17 to 18 years	0.438***	0.198*	0.429***
	(0.019)	(0.114)	(0.057)
Resides in south	-0.102***		-0.026
	(0.010)		(0.041)
Children under 6 years	-0.004	0.004	0.017
	(0.011)	(0.012)	(0.027)
Children 7 years to 13 years	-0.004	-0.007	-0.004
	(0.010)	(0.010)	(0.023)
Experience	0.037***	0.076***	0.042***
	(0.006)	(0.010)	(0.010)
Experience squared	-0.0002	-0.0005***	-0.0003
	(0.0001)	(0.0001)	(0.0002)
Health worse than previous year	-0.021	-0.008	0.016
	(0.015)	(0.011)	(0.033)
Health better than previous year	-0.018	-0.011	-0.004
	(0,016)	(0.013)	(0.034)
Family member health limits work	-0.091***	0.004	0.112
	(0.030)	(0.025)	(0.079)
Has health insurance coverage	0.202***	0.032**	0.085**
	(0.016)	(0.015)	(0.040)
Marital status: Married	0.012	0.016	0.075
	(0.018)	(0.095)	(0.054)
Marital status: Widowed	0.032	0.040	0.114
	(0.027)	(0.103)	(0.084)
Marital status: Divorced	0.082***	0.005	0.141**
	(0.019)	(0.099)	(0.056)

Marital status: Separated	0.019	-0.022	0.126*
	(0.027)	(0.095)	(0.074)
CES-D item: problem keeping mind on tasks	-0.001	0.010	0.020
	(0.007)	(0.007)	(0.017)
CES-D item: everything took extra effort	-0.015**	-0.005	-0.0004
	(0.007)	(0.006)	(0.015)
CES-D item: had restless sleep	-0.001	-0.010*	-0.012
	(0.005)	(0.005)	(0.013)
CES-D item: felt sad	-0.003	0.001	0.024
	(0.007)	(0.006)	(0.017)
CES-D item: couldn't get going	-0.018**	0.008	-0.033*
	(0.008)	(0.006)	(0.017)
Illness: cancer	-0.030	0.009	-0.019
	(0.026)	(0.026)	(0.071)
Illness: high blood pressure	-0.039***	0.014	0.027
	(0.011)	(0.016)	(0.032)
Illness: heart problem	-0.092**	-0.013	-0.167
	(0.036)	(0.045)	(0.117)
Lifestyle: is a smoker	-0.018	-0.014	-0.121***
	(0.012)	(0.017)	(0.031)
Lifestyle: drinks alcohol	0.082***	-0.006	-0.005
	(0.010)	(0.010)	(0.026)
Occupation B	-0.090***	0.028	-0.048
	(0.020)	(0.021)	(0.045)
Occupation C	-0.250***	-0.067**	-0.194***
	(0.022)	(0.030)	(0.054)
Occupation D	0.019	0.068*	0.092
	(0.021)	(0.035)	(0.056)
Occupation E	-0.484***	-0.189***	-0.427***
	(0,024)	(0.033)	(0.053)
Occupation F	-0.384***	-0.089***	-0.152***
	(0.027)	(0.024)	(0.050)
Occupation G	-0.272***	-0.069***	-0.146***
	(0.019)	(0.021)	(0.040)
Occupation H	-0.304***	-0.005	-0.005
	(0.022)	(0.029)	(0.052)
Inverse Mills	0.118**	-	-
	(0.055)		
Inverse Mills * 1997 year dummy	0.025	-	
	(0.039)		-
Inverse Mills * 1999 year dummy	0.069*	-	
	(0.041)		-
Inverse Mills * 2001 year dummy	0.037	-	
	(0.039)		-
Inverse Mills * 2003 year dummy	0.026	-	-
	(0.043)		
R^2	0.461	0.242	0.681

Table A 6: Augmented FE, Sample Selection, Instrumental Variables and Sibling Model Estimates (Dependent Variable – Earnings)

	(i)	(ii)	(iii)	(iii)
Variable	**Individual effects**	**Sample selection**	**Instrumental variables**	**Sibling model**
Premenopause	0.047*	0.051**	0.178	0.060
	(0.024)	(0.021)	(0.417)	(0.055)
Perimenopause	0.011	0.025	0.008	0.075
	(0.021)	(0.022)	(0.216)	(0.054)
Surgical menopause	0.045	0.031	0.170	0.113
	(0.059)	(0.024)	(0.884)	(0.091)
Hysterectomy	-0.077	-0.006	-0.140	-0.094
	(0.057)	(0.026)	(0.521)	(0.085)
Experienced early menopause	0.081	0.008	0.068	0.053
	(0.058)	(0.023)	(0.087)	(0.078)
Race= white	-	-0.024		-
		(0.018)		
Race=other race	-	0.115**		-
		(0.056)		
Age	0.082**	-0.007	0.128	-0.021
	(0.040)	(0.039)	(0.110)	(0.108)
Age2	-0.001***	-0.00002	-0.001	-0.00001
	(0.0001)	(0.0004)	(0.001)	(0.001)
Education: 0 to 12 years	-0.092	-0.072**	-0.092	0.078
	(0.107)	(0.030)	(0.215)	(0.139)
Education: 13 to 14 years	-0.086	0.060***	-0.091	0.189***
	(0.131)	(0.020)	(0.106)	(0.070)
Education: 15 to 16 years	-0.102	0.168***	-0.103	0.295***
	(0.150)	(0.023)	(0.176)	(0.088)
Education: 17 to 18 years	0.131	0.434***	0.134	0.471***
	(0.165)	(0.029)	(0.203)	(0.094)
Resides in south	-0.137	-0.069***		0.018
	(0.112)	(0.015)		(0.069)
Children under 6 years	-0.020	-0.024	-0.019	0.013
	(0.023)	(0.022)	(0.022)	(0.044)
Children 7 years to 13 years	-0.010	-0.039**	-0.013	0.004
	(0.022)	(0.018)	(0.017)	(0.037)
Experience	0.309***	0.049***	0.319***	0.113***
	(0.026)	(0.011)	(0.019)	(0.017)
Experience squared	-0.002***	-0.0004*	-0.002***	-0.002***
	(0.0002)	(0.0002)	(0.0002)	(0.0004)
Health worse than previous year	0.016	0.008	0.015	0.050
	(0.023)	(0.024)	(0.020)	(0.055)
Health better than previous year	-0.023	-0.022	-0.024	-0.158***
	(0.023)	(0.026)	(0.023)	(0.057)
Family member health limits work	-0.033	-0.129**	-0.029	0.079
	(0.049)	(0.052)	(0.043)	(0.128)
Has health insurance coverage	0.092**	0.295***	0.093***	0.154**
	(0.036)	(0.029)	(0.027)	(0.068)
Marital status: Married	0.027	-0.009	0.003	-0.002
	(0.137)	(0.026)	(0.155)	(0.089)
Marital status: Widowed	0.052	0.097**	0.002	0.166
	(0.148)	(0.040)	(0.174)	(0.139)
Marital status: Divorced	0.101	0.114***	0.076	0.139
	(0.138)	(0.028)	(0.163)	(0.093)

Marital status: Separated	-0.005 (0.144)	0.022 (0.046)	-0.045 (0.158)	0.178 (0.126)
CES-D item: problem keeping mind on tasks	0.020* (0.011)	-0.002 (0.013)	0.022** (0.011)	0.020 (0.028)
CES-D item: everything took extra effort	-0.002 (0.010)	-0.005 (0.011)	-0.004 (0.010)	0.012 (0.026)
CES-D item: had restless sleep	-0.009 (0.009)	0.001 (0.009)	-0.008 (0.009)	-0.008 (0.021)
CES-D item: felt sad	-0.004 (0.012)	-0.013 (0.012)	-0.005 (0.011)	-0.030 (0.027)
CES-D item: couldn't get going	-0.002 (0.012)	-0.019 (0.012)	-0.001 (0.011)	-0.035 (0.028)
Illness: cancer	-0.037 (0.043)	-0.043 (0.040)	-0.033 (0.046)	-0.170 (0.116)
Illness: high blood pressure	0.014 (0.023)	-0.017 (0.017)	0.009 (0.028)	0.049 (0.053)
Illness: heart problem	-0.053 (0.055)	-0.070 (0.063)	-0.056 (0.075)	-0.481** (0.197)
Lifestyle: is a smoker	-0.003 (0.029)	-0.019 (0.017)	-0.005 (0.031)	-0.080 (0.051)
Lifestyle: drinks alcohol	0.028 (0.019)	0.061*** (0.015)	0.028 (0.018)	-0.018 (0.043)
Occupation B	-0.033 (0.045)	-0.190*** (0.028)	-0.032 (0.038)	-0.196*** (0.074)
Occupation C	-0.178** (0.076)	-0.330*** (0.031)	-0.172*** (0.052)	-0.312*** (0.089)
Occupation D	-0.012 (0.088)	-0.181*** (0.032)	-0.022 (0.063)	-0.072 (0.096)
Occupation E	-0.357*** (0.064)	-0.778*** (0.037)	-0.351*** (0.055)	-0.788*** (0.088)
Occupation F	-0.219*** (0.059)	-0.595*** (0.044)	-0.208*** (0.043)	-0.395*** (0.084)
Occupation G	-0.132*** (0.044)	-0.431*** (0.028)	-0.131*** (0.038)	-0.216*** (0.066)
Occupation H	-0.089 (0.067)	-0.417*** (0.034)	-0.102* (0.053)	-0.059 (0.088)
Inverse Mills	-	-0.212* (0.110)	-	-
Inverse Mills * 1997 year dummy	-	-0.075 (0.081)	-	-
Inverse Mills * 1999 year dummy	-	0.074 (0.079)	-	-
Inverse Mills * 2001 year dummy	-	0.099 (0.086)	-	-
Inverse Mills * 2003 year dummy	-	-0.021 (0.095)	-	-
R^2	0.196	0.376	0.197	0.559

Table A 7: Augmented FE, FE by Race and Sibling Model Estimates (Dependent Variable - Self-employment)

	(i)	(ii)	(iii)	(iv)
Variable	**Individual effects (full sample)**	**Individual effects (white)**	**Individual effects (black)**	**Sibling model**
Premenopause	0.013 (0.011)	0.007 (0.012)	0.017 (0.023)	0.008 (0.025)
Perimenopause	0.017* (0.010)	0.012 (0.011)	0.027 (0.023)	0.037 (0.024)
Surgical menopause	0.047* (0.025)	0.083*** (0.030)	-0.007 (0.045)	0.083** (0.038)
Hysterectomy	-0.045* (0.024)	-0.077*** (0.028)	0.011 (0.043)	-0.107*** (0.036)
Experienced early menopause	0.016 (0.027)	0.026 (0.033)	-0.003 (0.048)	0.051 (0.036)
Age	-0.008 (0.017)	-0.024 (0.021)	0.043 (0.031)	-0.105*** (0.048)
Age2	0.0001 (0.0001)	0.0003 (0.0002)	-0.0003 (0.0003)	0.001** (0.0004)
Education: 0 to 12 years	-0.064 (0.090)	-0.083 (0.107)	0.015 (0.045)	-0.098 (0.065)
Education: 13 to 14 years	-0.018 (0.044)	-0.016* (0.009)	-0.020 (0.255)	-0.101*** (0.029)
Education: 15 to 16 years	-0.016 (0.057)	-0.007 (0.048)	-0.049 (0.255)	-0.106*** (0.037)
Education: 17 to 18 years	-0.067 (0.092)	-0.051 (0.120)	-0.147 (0.261)	-0.178*** (0.037)
Resides in south	-0.007 (0.028)	-0.018 (0.034)	0.048 (0.049)	0.053* (0.030)
Children under 6 years	0.014 (0.009)	0.020 (0.013)	0.009 (0.012)	-0.002 (0.020)
Children 7 years to 13 years	0.005 (0.008)	0.008 (0.010)	-0.005 (0.013)	0.005 (0.017)
Experience	0.008 (0.009)	0.014 (0.011)	-0.023 (0.015)	-0.027*** (0.007)
Experience squared	0.00005 (0.0001)	-0.0001 (0.0001)	-0.00004 (0.0002)	0.001*** (0.0002)
Health worse than previous year	0.012 (0.009)	0.017* (0.010)	-0.015 (0.018)	0.001 (0.025)
Health better than previous year	0.012 (0.011)	0.016 (0.013)	-0.004 (0.023)	0.005 (0.025)
Family member health limits work	0.015 (0.021)	0.024 (0.025)	-0.012 (0.040)	0.112 (0.055)

Has health insurance coverage	-0.042*** (0.014)	-0.045** (0.019)	-0.039* (0.022)	-0.140*** (0.029)
Marital status: Married	0.072** (0.037)	0.094* (0.056)	0.043 (0.032)	0.152*** (0.039)
Marital status: Widowed	0.058 (0.051)	0.068 (0.072)	0.061 (0.059)	0.149** (0.062)
Marital status: Divorced	0.054 (0.038)	0.070 (0.058)	0.057 (0.040)	0.156*** (0.040)
Marital status: Separated	0.013 (0.040)	0.024 (0.063)	0.026 (0.035)	0.045 (0.058)
CES-D item: problem keeping mind on tasks	0.0001 (0.005)	-0.003 (0.006)	0.009 (0.008)	-0.006 (0.013)
CES-D item: everything took extra effort	-0.002 (0.005)	-0.007 (0.006)	0.001 (0.008)	-0.003 (0.012)
CES-D item: had restless sleep	-0.001 (0.004)	0.0002 (0.004)	-0.005 (0.008)	0.003 (0.009)
CES-D item: felt sad	0.008* (0.005)	0.008 (0.005)	0.017* (0.009)	0.002 (0.012)
CES-D item: couldn't get going	0.003 (0.005)	0.011* (0.006)	-0.009 (0.009)	-0.020 (0.013)
Illness: cancer	0.029 (0.020)	0.017 (0.022)	0.135** (0.067)	0.106** (0.052)
Illness: high blood pressure	-0.006 (0.010)	-0.022* (0.013)	0.015 (0.019)	-0.023 (0.024)
Illness: heart problem	-0.005 (0.023)	0.012 (0.025)	0.017 (0.034)	0.080 (0.087)
Lifestyle: is a smoker	-0.001 (0.013)	0.001 (0.015)	-0.002 (0.026)	-0.004 (0.022)
Lifestyle: drinks alcohol	-0.008 (0.008)	-0.008 (0.008)	0.003 (0.020)	-0.001 (0.019)
Non labor income	0.0002** (0.0001)	0.0002 (0.0001)	0.0005** (0.0002)	0.001*** (0.0002)
R^2	0.010	0.001	0.016	0.457

Table A 8: Summary of the Signs of the Estimation Models

		OLS	Individual effects	Random effects	Sample selection	IV	Sibling model
LFP	Premenopause	+ S	- S	- NS			+ NS
	Perimenopause	+ S	+ NS	+ S			+ NS
	Surgical menopause	- S	- NS	- S			+ NS
	Early menopause	- NS	+ NS	- NS			- NS
	Hysterectomy	+ S	+ NS	+ NS			+ S
Hours	Premenopause	+ NS	+ NS	+ NS	+ NS	- NS	+ S
	Perimenopause	- NS	- NS	- NS	- NS	- NS	+ S
	Surgical menopause	- NS	- NS	- NS	+ NS	- NS	- S
	Early menopause	+ NS	+ NS	+ NS	+ NS	+ NS	+ S
	Hysterectomy	+ S	- NS	+ NS	+ NS	- NS	+ S
Full-time	Premenopause	- NS	- S	- S			+ NS
	Perimenopause	- NS	- S	- S			+ NS
	Surgical menopause	- NS	- NS	+ NS			+ NS
	Early menopause	- NS	+ NS	+ NS			+ S
	Hysterectomy	+ NS	- S	- NS			+ S
Wage	Premenopause	+ S	+ S	+ S	+ S	- NS	- NS
	Perimenopause	+ NS	+ NS	+ NS	+ NS	- S	+ NS
	Surgical menopause	- NS	- NS	- NS	- NS	- NS	+ S
	Early menopause	- S	- NS	- S	- NS	- NS	- NS
	Hysterectomy	+ NS	+ NS	+ NS	+ NS	+NS	- NS
Earnings	Premenopause		+ S		+ S	+ NS	+ NS
	Perimenopause		+ NS		+ NS	+ NS	+ NS
	Surgical menopause		+ NS		+ NS	+ NS	+ NS
	Early menopause		+ NS		+ NS	+ NS	+ NS
	Hysterectomy		- NS		- NS	- NS	- NS
Self-employed	Premenopause	+ NS	+ NS	+ NS			+ NS
	Perimenopause	+ S	+ S	+ S			+ NS
	Surgical menopause	+ NS	+ S	+ NS			+ S
	Early menopause	+ S	+ NS	+ NS			+ NS
	Hysterectomy	- NS	- S	- NS			- S

Key: S - significant at at least 10%; NS - not significant

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VITA

Mercy Mvundura was born in Gweru, Zimbabwe in 1973. She attended elementary and high school in Gweru and then moved to Harare, the capital city of Zimbabwe, after being accepted into the economics program at the University of Zimbabwe. She earned the Bachelor of Science Honors in economics degree in 1995 and the Master of Science in economics degree in 1997. During her undergraduate and graduate studies at the University of Zimbabwe, she obtained several awards and scholarships for outstanding academic performance.

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In May 2002, Mercy was awarded the Fulbright scholarship and she moved to Georgia State University where she began her doctoral studies in August 2002. In August 2004, she earned a Master of Arts degree in economics from Georgia State University. While at Georgia State University, she worked as a research assistant for Dr. Paul Farnham, who later became her dissertation supervisor. Mercy also attended leading health conferences where she participated in the poster sessions. During the time she was at Georgia State university, Mercy obtained several awards and scholarships for outstanding academic performance.

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