THE LABOR SUPPLY OF FEMALE REGISTERED NURSES: A COMPARATIVE STUDY USING THE 2008 NATIONAL SAMPLE SURVEY OF REGISTERED NURSES AND THE 2008 AMERICAN COMMUNITY SURVEY

by

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A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics

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ABSTRACT

There has in the U.S. been a shortage of registered nurses (RNs) for decades. Thus, policy makers would like to know what factors might increase the labor supply from currently trained nurses. In an attempt to provide insights into such factors, the determinants of the labor supply for female RNs are examined using two large micro datasets: the 2008 National Sample Survey of Registered Nurses (NSSRN) and the 2008 American Community Survey (ACS). Each dataset includes over 30,000 RNs' and their demographic characteristics and work characteristics. One set of hypotheses addressed in the dissertation involves the factors that cause currently trained RNs to work and when they work, is it fulltime or part time. The estimation procedure for this part of the dissertation is a bivariate probit model. A second set of hypotheses addresses the question about the factors impacting whether or not a nurse works and if she does, how many hours she works. This portion of the dissertation relies on a standard maximum likelihood selection model. Key variables include the RN wage, other family income and the composition of the nurse's household. Area factors relating to characteristics of the market in which the nurse worked are also discussed in the context of their effectiveness as variables that might help predict the labor supply. The results indicate that the RN wage is not an important determinant of the labor force participation decision, both in the work no work and fulltime part time

bivariate probit models as well as the maximum likelihood participation-hours model. However, in the fulltime part time portion of the bivariate probit estimates, the RN wage was negatively related to working fulltime, as it also was in the hours equation.

The estimation results are corrected for potential selection bias. Selection bias was shown to exist in the models. Labor supply models for female RNs have been estimated separately by marital status and also whether the nurse lived in a metropolitan statistical area or not.

The empirical literature on RN labor supply is brought together and comparisons are made with other studies in the literature of the labor supply of females in the general population and nurses. The results with respect to the key variables such as the nurse wage, other family income, and the family composition of the nurse's household are consistent with the nurse labor supply literature.

Chapter 1

INTRODUCTION

1.1 Thesis Motivation

According to the Bureau of Labor Statistics, as of May 2014 there were 2.6 million[1] registered nurses (RNs) employed in the United States. RNs comprise the largest professional occupation in the health care industry and are critical to that industries' operation, serving as both producers and coordinators of patient care in both acute and non-acute settings (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky 2002). The cost of the health care is closely related to RNs' wages; thus, understanding RNs' labor supply behavior is essential to understanding of the healthcare industry.

The demand for health care professionals such as RNs is derived from society's overall demand for health care. This demand is expected to increase rapidly over the next decade in the United States, as a result of demographic factors, such as population growth and the aging of the "Baby Boomer" generation. Government programs such as the Affordable Care Act have supported the expansion of health insurance coverage and thus increased the demand for healthcare.

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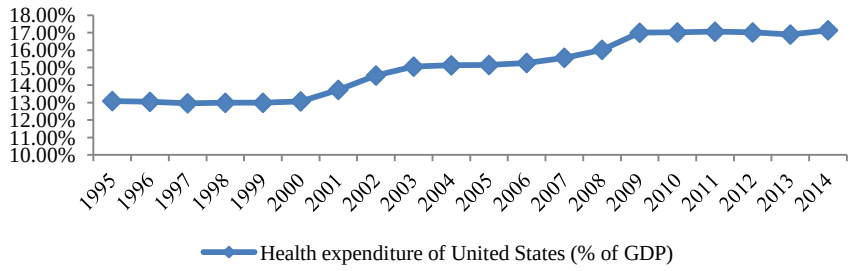
[1] http://www.bls.gov/oes/current/oes291141.htm

There are a number of unique features in the RN labor market which make that market interesting for economists. First, the United States has been dealing with shortages of nurses for several decades. In the report issued by the American Association of Colleges of Nursing in 2014, Robert J. Rosseter demonstrated that the market for nurses has suffered consistent shortage. Furthermore, he emphasizes that this decades long shortage is likely to both continue and intensify in the coming years, noting that "a shortage of Registered Nurses (RNs) is projected to intensify as Baby Boomers age and the need for health care grows with rising demand for healthcare given the national move toward healthcare reform."(2014)

Given the increasing importance of the healthcare sector in the U.S. economy, these shortages could potentially have significant impacts on the overall economy. Figure 1.1 shows total national health care expenditure in the United States as percentage of GDP from 1995-2014.

Figure 1.1 Health Expenditure of United States % of GDP[2]



[2]Data source: http://data.worldbank.org/indicator/SH.XPD.TOTL.ZS

Given that the healthcare sector now accounts for 17.1% of U.S. GDP, any factor which influences costs (such as nursing shortages) should be of particular interest to policymakers.

From an academic standpoint, the RN labor market is unique in that the vast majority of nurses are women. It is well established that females dominate the nursing profession, with males comprising only about 5% of RNs in 2008. The RN labor market is the second most female dominated labor market, with only teachers having a larger number of women employed. Thus, even ignoring any broader macroeconomic implications RN labor market issues might have, the RN labor market presents a unique opportunity to analyze issues relating to female labor supply in general.

A considerable amount of economic research had been devoted to analyzing and predicting nurses' labor supply, in an effort to understand the long-lasting shortages which have plagued this market. Historically, the primary source for data on RNs was the National Sample Survey of Registered Nurses (NSSRN). The NSSRN contains detailed information about RNs' work statuses, work hours, and demographic characteristics such as their education level, marital status, and number of children. The NSSRN first was conducted in 1977 and every 4 years from 1980 to 2008 by the Department of Health and Human Services (DHHS) and the Health Resources and Services Administration (HSRA). The 2008 survey was the last. Until 2008 the NSSRN had been the primary data source behind most of the existing economic literature which analyzes the RN labor market. With the decision of the HRSA to make 2008 the last NSSRN survey, the major source of data for analyzing nurse labor markets was eliminated (Auerbach, Staiger, Muench, & Buerhaus 2012). Auerbach et al. suggested two alternative data sources to deal with the loss of the key national data

source on the nursing workforce: The Current Population Survey (CPS) and the American Communities Survey (ACS).

This thesis estimates labor supply models for female registered nurses (RNs) by marital status (specifically, examining married and single RNs separately), using 2008 data from both the National Sample Survey of Registered Nurses (NSSRN) and the American Communities Survey (ACS). As I am interested in comparing empirical results derived from these two data sets, many of the following chapters report empirical results from repeating identical (or at least similar) models based on each data set.

I use the labor-leisure choice model of neoclassical consumer theory to analyze female RNs' labor supply behavior. In this work, an RN's labor supply is examined as a function of her own wage, other household income, the presence of children in the home, educational attainment, age, and other environmental factors.

The thesis is arranged in the following order;

Chapter 2 provides a review of the existing literature on RN labor supply, emphasizing the results from the existing literature for the key variables affecting female RN labor supply.

Chapter 3 defines the methodology used in this thesis and the data sets and variables used in these estimations.

Chapters 4 and 7 present descriptive statistics, define the sample selection methods for the models, and estimates selection corrected predicted wage for, respectively, the 2008 NSSRN data and the 2008 ACS data.

Chapters 5 and 8 use a bivariate probit model to examine a nurses' choice between working or not working and, if working, working fulltime versus part time

based on, respectively, the NSSRN and ACS data. The model used is an extension of Brewer et al.'s 2006 study, in which they estimated a bivariate probit model based on 2000 NSSRN data. I use similar demographic specifications and variable classifications in these bivariate probit models to ensure that the results are comparable with Brewer et al.'s 2006 results examining the factors affecting the labor supply of RNs who live in Metropolitan Statistical Areas (MSAs). In addition, this analysis expands on the work of Brewer et al. (2006) in the sense that it also includes results examining the labor supply of RNs who live outside of MSAs. I directly examine the importance of environmental (area market variables) factors, with a special focus on their effectiveness as tools to predict and potentially expand RN labor supply.

Chapters 6 and 9 use a maximum likelihood selection model to examine the factors which influence an RN’s decisions to work or not work and, conditional on her choosing to work, how many annual hours she allocates to work based on, respectively, the NSSRN and ACS data. This analysis extends earlier work by Link (1992) and Chiha and Link (2003), in which they use data from the NSSRN. The methodology used in this analysis is identical to the methodology used by Chiha and Link (2003). I correct for selection bias and use separate equations for participation and labor supply. As in the earlier chapters, I examine the importance of environmental factors as well as their effectiveness as a tool to predict or increase RN labor supply.

Finally, Chapter 10 presents a conclusion which summarizes the key results and gives policy recommendations based on these results.

1.2 Contribution to Literature

According to the U.S. Department of Health and Human Services Health Resources and Services Administration (HRSA) "there were an estimated 3,063,162 licensed registered nurses living in the United States, as of March 2008. This is an increase of 5.3 percent from March 2004, representing a net growth of 153,806 RNs. An estimated 444,668 RNs received their first U.S. license from 2004 through 2008, and thus approximately 291,000 RNs allowed their U.S. licenses to lapse, possibly indicating that the substantial retirements that have been anticipated may have begun." (HRSA 2010, p.xxvii) This potential shortage makes it critically important to understand the factors which drive RN labor supply and might thus be used to minimize or prevent this shortage from developing.

By replicating the two most recent studies with more recent 2008 NSSRN data, I update the existing literature and increase our knowledge of the factors which affect the labor supply of female RNs.

I also expand the labor supply models used in the existing literature by introducing a new variable; the percent of hospital RNs who work fulltime in an area. Assuming that an individual RN's behavior cannot impact the percent of RNs who work fulltime, I investigate how the frequency of fulltime work in an area impacts an individual RN's work participation, hours of work, and fulltime versus part time working decision.

Finally, I estimate the same labor supply models using both NSSRN data and ACS data. This allows me to compare the results derived from both data sets to examine whether or not the ACS is likely to serve as an effective replacement for the NSSRN. These results have important implications for both academic researchers (for

whether or not they should rely on the ACS) and for policymakers (for whether or not abandoning the NSSRN was a wise decision).

Chapter 2

SURVEY OF LITERATURE

This chapter summarizes the extent literature related to registered nurses (RNs) labor supply. As I mentioned in the introductory chapter, this thesis builds on two recent pieces of labor supply research which were done by Chiha and Link (2003) and Brewer et al. (2006). Thus, I examine those two papers in great detail in the following chapters, in which I compare my results with their findings; this chapter instead focuses on a broader survey of the literature.

While some studies estimate both female and male RNs' labor supply, this chapter will exclusively focus on the literature related to either female RNs' labor supply or female labor supply in general.

Due to the long lasting shortage of registered nurses in the United States, the factors which affect their work participation are of critical interest to policy makers. Consequently, the literature which examines the factors effecting RNs' labor supply is fairly large. Mirroring broader trends in the empirical analysis of labor economics, this literature has undergone several substantial alterations over time.

RNs' own wage potentially is one of the most important variables in bringing the supply of and demand for nurses into equilibrium. Most existing studies have found inelastic supply responses to wages, although a smaller number have found more substantial effects. These contradictory results are the results of different statistical methods being used by different researchers. The main empirical concern in

the labor supply literature is that labor data are frequently censored, due to the fact that some variables are not observed for individuals who are not working, such as hours of work or working fulltime versus part time. This introduces potential selection bias issues.

Heckman (1979) argued that earlier studies ignored the significant econometric problems created by the selection bias issues prevalent in labor supply data. Selection bias is essentially a problem of ignoring the unobserved reservation wages of non-workers and combining the decision to participate in the labor market with the decision to work a given number of hours. In his 1993 overview of the empirical labor economics literature, Heckman suggests that much of research in the 1960's and 1970's on labor economics was misleading, since they relied on linear ordinary least squares (OLS) estimation based on the observation where they have all variables and thus generally ignored the not working population. Killingsworth (1983) concurred, noting that those early labor supply models reveal more questions than they answered.

Some early studies estimated a Tobit model; generally, these results yielded a higher level of income and wage sensitivity in models for hours worked and participation, particularly for married females.

Due to these significant disparities in methodology and modeling techniques, the literature has not reached a consensus on the vital econometric issues of how sensitive are female labor supply results to the methodology and included variables in the model? That is, are the existing results robust? Mroz (1987) conducted a sensitivity analysis to answer this specific question. Mroz used a simple female labor supply model and a single data source to test how sensitive the results were to changes in the statistical methodology used. There were three key issues he tested for

exogeneity assumptions, control for selection bias, and the impact of incorporating taxes into the model. To test the functional form sensitivity of the model, he used Tobit, conditional Tobit, generalized Tobit, and ordinary least squares. Several distributional assumptions were tested by using various structural specifications, such as a normal and logistic functional form of residuals. The author found considerable evidence of selection bias when experience was included as an independent variable. In addition, the Tobit model assumptions were rejected in his empirical analysis, which suggested a more general technique is necessary for labor supply modeling (such as Heckman's selectivity model). Given these issues, Tobit will likely find exaggerated wage and income effects. Overall, Mroz's study finds a relatively wage inelastic labor supply for working married women. It also suggests that modeling choice does have an impact on the conclusions that are obtained from estimates and thus that more caution should be used in comparing results across methodologies.

Mroz (1987) suggested that the separation of participation equation from the hours of labor equation may be a solution for selection bias issues, since the impact of variables are not constrained to be same in both. Most following studies adapted Mroz's separate equations approach and therefore included two types of dependent variables. One involves whether or not a person participates in the labor force, which is a dummy variable assuming the value of one if the person is in the labor force. The other is the annual hours worked when that participation occurs. As shown in Brewer et al. (2006), the labor supply is not just restricted to the investigation of hours worked but can also include working fulltime versus part time. In this case, the second dependent variable assumes the value of one if the person works fulltime when participation occurs. In another study on the nursing labor force, Link and Settle

(1979) investigated nurses' wage elasticities of labor supply. They utilized a Tobit model to try to obtain efficient and consistent parameter estimates by eliminating the selectivity bias issue. Their results indicate inelastic wage elasticity for married nurses. In addition, the authors found that the presence of young children tended to discourage labor supply in the nursing market. As expected, the presence of a disability was found to significantly reduce hours worked per year. Although the authors found an inelastic labor supply, they did not find evidence of a backward bending labor supply.

Link and Settle (1981) analyzed the labor supply of married registered nurses. They used a simultaneous equation model to analyze female labor supply. Three stage least squares model used to analyze the variation in the nurse labor supply, fertility, and market wages. Though the wage was found to have a positive impact on labor force participation, it did not significantly affect either the labor supply or the fertility behavior of nurses. Consistent with their 1979 study, they found an inelastic wage elasticity. Fertility had the predicted negative coefficient in the hours and wage equations; however, it did not significantly impact wages or hours worked. As expected, husbands' earnings had a negative impact on female nurses' labor participation. Their empirical findings are consistent for the elasticities of non-labor income and husbands' income over the years. This similarity suggests that simultaneity creates only a minor problem, does not significantly impact the conclusions of their previous empirical results.

Link and Settle (1985) analyzed the labor supply of licensed practical nurses (LPNs). Since RNs and LPNs are substitutes, a fall in LPNS wages relative to RN wages creates an incentive for hospitals to hire more LPNs. They estimated a Heckman selection bias model and found no evidence of selection bias.

Buerhaus (1991) estimated two-stage model to estimate the nursing labor supply, utilizing the National Sample Survey of Registered Nurses 1984 data. The author derived a wage rate in the first stage. The sample was then divided by marital status; and the number of hours worked were estimated using these derived wage rates. He did not estimate a separate regression for the decision to work; thus, he did not use a selectivity corrected model. Buerhaus' empirical findings suggest a relatively inelastic labor supply curve. Wage increases did not have a significant impact on annual hours worked by married RNs. There was also no evidence of a backward bending supply for this group, as the wages squared term was not significant. For unmarried nurses, the supply curve was inelastic and there was evidence of a backward bending supply curve for this group. As expected, family income played a significant role in determining the annual hours worked by married nurses. For single nurses, lower family incomes encouraged nurses to work significantly more annual hours.

Link (1992) estimated a labor supply model for female RNs using two separate equations. The first was a participation equation and the second, was an hours equation. The estimates were for data from 1960, 1970, 1977, 1980, 1984, and 1988. He estimated comparable models, using Heckman's estimation procedure to account for selection bias, for the different data sets in order to make the results comparable over the time.

Ault and Rutman (1994) conducted their own survey by sending questionnaires to nurses. They analyzed the labor supply decisions of RNs using two different approaches. Labor supply is the result of two distinct simultaneous decisions: the number of hours worked each week and the number of weeks worked each year. They

employed probit and two-stage least squares to estimate the parameters for the RNs who were employed fulltime and who were employed part time, using Heckman's procedure to correct for selection bias.

Phillips (1995) used a selectivity corrected model to examine the supply of nursing using a sample of British nurses. Phillips first estimated wages with ordinary least squares. He then estimated the probability of participation in the labor force using a probit model with the predicted wage as an independent variable. Finally, using a conditional ordinary least squares model as in the Heckman two-stage selection corrected model, Phillips estimated an hours equation. Phillips found that the UK labor supply of registered nurses was more elastic than the U.S. labor supply. However, Phillips' analysis also suggests that wage increases for UK nurses would likely be an unsuccessful method for increasing hours worked by nurses. In the wage equation, higher education had a positive impact on wages. Potential experience also had a small positive impact on wages. However, having more than one occupation had a negative impact on wages. Phillips did not find evidence for selection bias in his sample. As expected, an increase in children or non-labor income and holding an advanced degree both reduce the number of hours worked. However, Phillips found that as age increases, the likelihood of participation in the labor force increases but the number of hours worked decreases. A surprising result was that holding an advanced degree discouraged participation in the nursing market. Phillips suggests that failure at fulfillment of expectations may be causing this result. Overall, Phillips found that wages can significantly impact British nurses' participation but not nurses' hours of labor supply.

Brewer (1996) included non-working nurses in her sample but did not use any selectivity correction and obtained much higher estimates of wage elasticity compared to previous research (Link and Settle 1979; Phillips 1995). She used a logit regression for the participation decision and estimated annual hours worked via ordinary least squares, with no selectivity correction. The wage used in these equations was the result of an instrumental variables regression, allowing for a predicted wage for both working and non-working nurses. Brewer had three main research hypotheses. First, she argued that the slope of the labor supply curve would not change from 1984 to 1988, resulting in relatively similar wage elasticities in either year. She did not find support for this hypothesis for female nurses. The second hypothesis was that there would be significant differences between male and female labor supply curves in the 1984 and 1988 years, a hypothesis which was generally supported. The third hypothesis was that there would be no backward bending supply curve for the majority of nurses. This third hypothesis was supported for females but not for males.

Schumacher (1997) hypothesizes that increased occupational mobility among registered nurses can explain exit behavior. He specifically compares nurses with secretaries. He looks at three groups of interest: switchers (people who switch occupations), stayers (people who stay in the same position), and quitters (people who leave the workforce). As a preliminary step, the author estimates two wage equations, using the log of wages. He does not correct for selectivity bias. The author found evidence that the decision to leave nursing is correlated with the relative wage of the nurse. The author finds some significant effects from wage changes on the decision to quit, although these effects are fairly small. Schumacher also finds that wages have a small impact on the decision to switch careers and leave nursing, a result which is

similar to Link's elasticity estimate. The author also finds that wages do not significantly impact the probability of leaving the labor force. However, the author does find that wages can impact the decision to enter the nursing labor market.

Buerhaus and Staiger (1999) looked at trends in the Current Population Survey (CPS) data for 1983-1997, examining LPNs and RNs growth opportunities, wage growth, and the impact of managed care on the work environment. They found considerable employment growth for RNs from 1983 to 1994 (3-4% annually). However, after 1994, they found a decrease in employment growth. The authors point to hospital cost cutting and reduced hiring in that sector, which was traditionally the largest employer of RNs. The authors also found slower RN employment growth in states with comparatively high managed care enrollment, particularly in the hospital sector.

Chiha and Link (2003) examined the factors affecting the labor supply of RNs by using National Sample Survey of Registered Nurses data for the years 1992, 1996, and 2000. They utilized a maximum likelihood model, accounting for the Heckman selectivity correction by using a probit functional form for the selection equation. The authors firstly predict a wage which was also obtained from selectivity corrected estimation. In all estimations for predicted wages, selectivity was found and corrected to obtain an unbiased predicted wage. The authors relied on a functional form for identification of the models and used the same set of independent variables. The results indicated that the effect of the RNs' own wage was minimal in the participation decision. Furthermore, in the 1992 and 1996 samples, a nurse's own wage did not impact the amount of hours she worked per year. However, in the 2000 sample, there was a significant, positive wage elasticity of 0.2 with respect to hours worked (Chiha

and Link 2003, p. 358). Though the authors tested for the presence of a backward bending supply curve with dummy variable regressions (to avoid imposing a functional form as with a quadratic wage term), no compelling evidence was observed. Thus the responsiveness of the hours to changes in nurse wages is inelastic but not backward bending. Overall, this implies that wage increases will not stimulate large increases in hours worked by currently working nurses. A small income effect was observed from other family income, which was shown to have a negative impact on hours worked and on the probability of participation by nurses. Family composition was also shown to have a significant impact on both the participation decision and hours worked. Female nurses with children under the age of six had a lower predicted probability of participation and fewer predicted hours worked per annum. The Heckman selection procedure helped to identify positive selection for the 1992 and 2000 single female nurse samples as well as the 1992 sample for married males. This positive selectivity suggested that these workers worked more hours than would have been worked by their non-working cohorts had the non-workers been working. Had this selectivity not been corrected for, then the predicted hours worked would have been overstated for these three cohorts.

Shields (2004) reviewed the extent literature on the labor supply of registered nurses. He points out some of the flaws from ignoring selection bias and issues with identification that arise in using the same variables in both the selection and outcome equations when correcting for selectivity. Shields comments that there is surprisingly little evidence establishing causation behind wage's effects on labor supply. He also indicates the lack of variables included in modeling which would control for individual heterogeneity (intrinsic motivation, skill level and other character traits).

Since weak instruments can cause significantly biased results, Shields advises caution in interpreting models utilizing instruments. He points out that there has been little consistency in the variables included in the supply estimation model and as such, many existing works are difficult to compare directly. In addition, very few longitudinal studies have been conducted which would shed more light on the intertemporal behavior of nurses. Finally, the author cites the lack of generalizability of much of the research beyond the US, since the majority of prior research utilized US data. As the shortage of nurses is expected to worsen, given the aging Baby Boomer population, it is vital to understand which factors can be most effective in increasing the nursing supply of labor.

Though much of the existing research focuses on the impact of wages in terms of increasing supply, it does not discuss the effect of wages on market efficiency. Heyes (2005) addresses this issue. He theorized that increases in wages encourage a less talented and dedicated applicant pool to enter the nursing market, based on an adverse selection argument. His theory is based on his definition of vocation as a career sought for purposes of serving the community, suggesting that nurses who view their jobs as a vocation are intrinsically motivated to enter that career. Thus, nursing candidates who are intrinsically motivated would likely enter the nursing market for other reasons besides pay, while nursing candidates who are not intrinsically motivated toward nursing may only be driven by increased wages to enter the nursing market. Heyes argued that the latter would offer a lower quality of service than the former. Consequently, he modeled vocation as an indicator variable of intrinsic motivation. Using a theoretical framework, the author derived two propositions. The first derived result was that, all things being equal, increasing wages of nurses will

decrease the proportion of nurses who have a vocation. Thus, increasing wages will encourage less motivated and perhaps lower quality nurses to enter the nursing labor market. The second proposition he derived was that if nurses are intrinsically motivated, then they should be paid less and given more direct time with patients.

A recent study by Brewer et al. (2006) addressed at least part of this concern by incorporating levels of satisfaction and variables which could impact intrinsic motivation. In addition, this study also analyzed the impact of market level factors on both labor participation and working behavior (working part time or fulltime). Using the 2000 National Sample Survey of Registered Nurses, the authors estimated a selection corrected bivariate probit model for female nurse working behavior. Their modeling strategy is a departure from those used in previous nursing studies; instead of modeling the labor supply in terms labor force participation and the log of hours worked, the authors modeled the labor supply decision to work fulltime or part time with a probit regression. Using a bivariate probit model adjusts for a relationship between the decision to work and whether or not the nurse chooses to work full or part time. In addition, a selectivity adjusted ordinary least squares regression was estimated to predict nursing wages. Predicted wages for working and non-working nurses were then incorporated into the labor behavior regressions. Several market level metropolitan statistical area or MSA factors were added to the traditional participation decision model (unemployment rate, insurance coverage, HMO competition index). The outcome equation, conditioned on whether the nurse works, was estimated from a different composition of variables. The use of alternative variables (which were allowed to differ between the participation and decision to work fulltime regressions) helped to provide an understanding of the impact of environmental characteristics on

current nursing employment and help identify the model. Examples of these types of variables include work setting variables and current position type in nursing.

Though the results of the Brewer et al. (2006) study yielded some conclusions about nursing labor behavior which were consistent with previous research, there were also some surprising results. Not surprisingly, the authors found a significant correlation between the decision to participate in the nursing labor force and the decision to work fulltime or part time. This suggests that the relationship must be tested and adjusted for in labor supply modeling. As expected, other household income had a small but significant negative impact on the probability of participation. Age also had a negative impact on participation, although only for older nurses. Similar to other research on the nursing labor supply, the presence of small children significantly decreased the probability of participating in the RN market and the probability of working fulltime. However, previous experience in a health occupation had a positive impact on the probability of working and the likelihood of working fulltime. Interestingly, in addition to affecting the participation decision, the HMO and managed care institutional characteristics of a given city were also found to impact nursing labor behavior. Another innovation in this study was the inclusion of work environmental factors into the RNs' work behavior equation. As expected, decreased job satisfaction versus the previous year had a significant negative impact on the likelihood of working fulltime (for married RNs). The authors caveat this result by indicating that the result may reflect reverse causation, i.e. that part time jobs are less satisfying. Differences in work setting had a significant impact on the decision to work fulltime or part time (for married nurses). Consistent with previous research in the literature (Link and Chiha 2003), the authors found evidence that wages do not impact

participation, but do impact the decision to work fulltime or part time. In fact, the authors' results indicated a backward bending supply for married female nurses. Generally, the results suggested that wages are not an effective way to either bring currently trained nurses into the RN market or to increase the number of hours worked.

Given the results of the Brewer et al. 2006 study, Brewer conducted another research study which took a closer look at the work environment, utilizing both economic labor theory and organizational behavior theory to understand factors that affect the nursing labor supply (Brewer, 2008). The authors conducted two national surveys over a two-year period, which resulted in approximately 1200 usable observations. Using this data, the researchers' wanted to gain a better understanding of the role environmental factors had on nurses' intentions to quit and work behaviors. They used multivariate regression to determine the impact of demographic, environmental, movement opportunity, and work factors on the desire to quit working. To estimate working behavior (fulltime or part time) they use a selection corrected bivariate probit model, although in this study the married and single female samples were not estimated separately. Respondent claims on the fulltime/part time response were used to develop the fulltime part time variable. Again, a selectivity adjusted two-stage regression was used to predict wages (OLS was used for the log of wages equation). They estimated an nlogit model for the dependent variable "intent to work." For the selectivity probit (work/not work) and work fulltime/part time equations some additional variables were added to the outcome equation. The additional variables added to the work fulltime/part time equation were work environment variables, i.e. worked in a hospital, level of benefits, position, preferred hours, work transfer, and

attitudinal variables such as satisfaction, importance of benefits and organizational commitment.

Brewer et al.'s results indicate that environmental factors do play a role in work behavior. The study also yielded some surprising results, especially with regards to nurses with young children. Several of these factors were found to contribute to the desire to quit a nursing position, such as higher education (BS or masters degrees), small city size, HMO penetration, having other job opportunities, having a non-nursing job opportunity, and work-family conflict. Thus, having advanced degrees and the opportunity to leave the current job in tandem with work-life balance issues were found to contribute to the probability of a high nurse turnover rate.

In contrast to much of the prior research on the nursing labor supply, nurses with young children (less than 6 years old) indicated that they believed they had advancement opportunities, showed increased levels of satisfaction and commitment with their organization, and showed less overall desire to quit their current position. This is interesting given the historical research which indicated that the presence of small children usually has a negative impact on market participation. In the intent to work logistic regression, the probability of a continued desire to work in nursing was reduced by higher education (BA), if the nurse was black or Asian, if she worked in a non-hospital setting or if she had minimal direct patient care as a portion of her responsibilities, if she wanted to work fewer hours in the future, if she had more benefits, and if she experienced work-family conflict. However, nurses were more likely to want to continue their work in nursing if they had young children (less than 6 years), had higher wages, had better medical insurance, thought that benefits were less important, and were more motivated to work. Their bivariate probit labor supply

behavioral regression analyzes the determinants of fulltime versus part time decisions, conditioned on working or not working. In this analysis, having young children decreased the probability of working fulltime. Several work factors impacted working behavior such as higher levels of direct patient care, having an advanced nursing position, increased benefits, having higher organizational commitment, and higher quantitative workload. Contrary to their 2006 result, Brewer et al. (2008) found that wages significantly impacted the decision to participate in nursing, but also impacted the decision to work fulltime or part time. Overall, the authors concluded that the factors that determine whether or not people choose to work in nursing are fundamentally different from the factors that determine how much they work.

Staiger, Auerbach, and Buerhaus (2012) analyze and make projections about how the registered nurse labor supply will be affected by "expected" unemployment decreases over the 2010 and 2015 period. They claim that the high level of entrants in to the field will not be sustained as the economy improves and, in fact, that shortages of registered nurses will occur. Moreover, the authors state that if these shortages do occur, salaries may need to be increased to attract more people into the field, increasing health care costs and consequently hindering health care reform.

Hirsch and Schumacher (2012) address the question of why registered nurse shortages exist despite what seem to be relatively high wages for college educated women. The authors claim that standard regression estimates indicate that the RN "wage advantage" is about 40%. They estimate the actual wage advantage is closer to 20% when accounting for the high skill level required for the job and the overall demanding working conditions. Their conclusion is that nurses' pay is much closer to opportunity costs than "standard" analysis suggests. The authors do say that wages for

RNs can be above long-run opportunity costs due to the constraints of nurse licensing but that these wages can also be too low in times of growing demand for RNs.

Kaestner and Kaushal (2012) examined the effect of foreign trained RNs on the employment and wages of nurses who are trained in the U.S. The authors find that an increased supply of foreign trained RNs puts downward pressure on the wages of nurses trained in the U.S. They find that a 10% increase in supply due to immigration is associated with a 1-4% decrease in RNs' annual earnings.

Cortes and Pan (2014) examined the effects of immigration of foreign-born registered nurses on the long-run employment and occupational choice of native nurses. They found very large displacement effects and that an increase in the flow of foreign nurses significantly reduces the number of natives sitting for licensure exams in more dependent states (relative to less dependent states). They also found that the part of the displacement effects could be due to a decline in the perceived quality of the workplace environment.

Chapter 3

METHODOLOGY

3.1 Data

The empirical work is based on variables from four datasets, which were used to examine the factors that influence the work behavior of RNs. Two of these datasets, the 2008 National Sample Survey of Registered Nurses (NSSRN) and the 2008 American Communities Survey (ACS), contain individual level data for RNs. The other two data sets, the Area Health Resource File (AHRF) and the 2008 American Hospital Association (AHA), contain county level data for RNs work environment.

3.1.1 NSSRN County Data

The National Sample Survey of Registered Nurses was initially conducted in 1977 and was repeated on 4 year intervals until 2008. It was the largest survey for data on registered nurses in the United States. Nurses with active RN licenses were surveyed regarding their education, employment, intentions regarding nursing work, and other questions related to their socioeconomic status (HRSA, 2010). The final survey collected data on the RN population who were currently licensed as of March 10th, 2008, across all 50 states and the District of Columbia. This empirical work specifically uses the county level public use data file which contains data on 33,179 RNs (HRSA, 2010).

3.1.2 ACS State Data

The American Community Survey is modeled after the long form of the decennial Census. Begun in 2005, the ACS has surveyed more than 2 million households. Since the inception of the ACS in 2005, the public use micro data sample from the ACS has included data on approximately 30,000 RNs per year, almost as much yearly data as the NSSRN. Unlike the NSSRN, however, the ACS questions are not RN specific; RNs are asked the same set of questions as all workers. Thus, the ACS data contains less data on each individual RN. That being said, the ACS still includes information on work hours, wages, household income, and personal characteristics such as race, education, marital status, and socioeconomic status.

3.1.3 AHRF Data

The AHRF is a county-level database assembled annually from over 50 sources by the United States Department of Health and Human Services. I used 2008 data on the county unemployment rate, the percent population without health insurance below age 65, the population below the poverty line, and the number of doctors per 1,000 population.

In order to merge the AHRF data with the individual nurse datasets (NSSRN and ACS), the AHRF data were aggregated from county specific data to MSA and state specific data, using the "CMS's SSA to FIPS CBSA and MSA County Crosswalk" file provided by the National Bureau of Economic Research[3]. This process weighs each county level variable by the county's population and then sums the variables to the MSA or state levels.

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[3] http://www.nber.org/data/cbsa-msa-fips-ssa-county-crosswalk.html

Transformation of the county level AHRF variables to the MSA level was only done for RNs who lived in MSAs.

3.1.4 AHA Data

The AHA Annual Survey Database is a comprehensive census of United States hospitals, based on the AHA Annual Survey of Hospitals, conducted by the American Hospital Association[4]. The number of part time and fulltime RNs from these data are used to create a variable measuring the percentage of RNs who work fulltime in a county and a variable representing the number of nurses per 1,000 population for which fulltime nurses count as one nurse and part time nurses count as a half nurse.

These variables are then scaled to the MSA and state levels using the same methodology used with the AHRF data.

3.2 Estimation Procedure

The labor supply decisions of RNs are investigated using two empirical methods for both the ACS data and the NSSRN data yielding four total sets of empirical results.

The first empirical method uses a bivariate probit model with sample selection to estimate the factors influencing whether the RN works and, if she works whether she works on a fulltime or part time basis (Greene, 2003). This bivariate probit model estimates the simultaneous effect of variables on both aspects of a nurse's labor supply decision: working or not working in nursing and, if working, whether the work is part time or fulltime. This method is designed to model two distinct but potentially

[4] http://www.ahadataviewer.com/book-cd-products/aha-survey/

conditional outcomes and determine whether working part time versus fulltime is conditional on working or not working (Maddala, 1983).

The second empirical method is a more traditional work/no work and hours worked model using maximum likelihood to estimate the determinants of the probability of working and the log of hours actually worked. The dependent variables in this model are a dummy variable for work/no work and the log of hours worked.

For both models, selection corrected wage equations are estimated in order to predict wages for non-working RNs, which are then included in the equations of interest. To predict RN wages, a maximum likelihood (MLE) technique is used to obtain a selection corrected wage equation; this is necessary, as wages are observed only for RNs who work. For full data coverage, it is necessary to estimate potential wages for RNs who do not work. The maximum likelihood technique allows for potential selection between the decision to work and the wage level.

Our primary wage equation is:

$$W_i = \beta V_i + \varepsilon_i$$

where V is a vector of explanatory variables, all of which are exogenous, and ε_i is an error term.

Selection is determined by the equation:

$$Z_i^* = X_i + U_i$$

$$Z_i = \begin{cases} 1 & if\ Z_i^* > 0 \\ 0 & otherwise \end{cases}$$

where Z_i^*= 1 if we observe W_i and zero otherwise, the vector X_i is assumed to contain at least all of the variables in the vector V_i and possibly more terms (unless it is reduced form), and U_i is an error term.

In Chapters 4 and 7, this predicted wage is estimated for the NSSRN and ACS datasets, using individual level micro data, AHRF and AHA county data, and MSA and state data. These predicted wages are then used in the labor supply models in Chapters 5, 6, 8, and 9.

3.3 Variables in Labor Supply Equations

Labor supply models are based on the neoclassical work-leisure choice model, in which various measures of labor supply are a function of the own wage, other household income, various personal characteristics, tastes, and preferences.

In the "Participation and Fulltime - Part Time Work Decision Model," two binary dependent variables represent whether or not a nurse chooses to work, and, if she works, whether she works fulltime or part time.

The "Participation and Hours of Work Decision Model" also has two dependent variables. One dependent variable represents whether or not a nurse chooses to work and is a binary variable, while the other dependent variable, the logarithm of hours worked, is a continuous variable.

As established at the beginning of this chapter, these estimates are based on two micro datasets (NSSRN and ACS). Beyond these overall results, for the NSSRN the same empirical results are estimated for two subsets of data. The first subset includes observations for people who live in metropolitan statistical areas (MSAs), while the second subset includes observations for people who live outside of an MSA; I refer to the latter group as a non-MSA. Brewer et al. (2006) defined MSA sizes as follows: small (population less than 250,000), medium (population between 250,000 and 999,999), or large (population more than 1,000,000), which are converted into mutually exclusive dummy variables.

For the MSA subset of the NSSRN data, county level area variables from the AHRF and the AHA are aggregated to MSA level variables, while for the non-MSA subset of the NSSRN data, the variables are left at the county level.

For the ACS data, county level area variables from the AHRF and the AHA are aggregated to state level data. Thus, all county level area variables used for any estimates are all drawn from the same data source. The ACS data does not provide data lower than the state level.

As one of the purposes of this thesis is comparing the outcomes from the NSSRN data and the ACS data, both tests rely on similar individual variables.

The NSSRN data provides information at the county and MSA level, while the ACS data provides information only at the state level; thus, some variable definitions could not be matched precisely in both empirical tests.

3.3.1 Micro Variables from the NSSRN Data

The log RN wage: The logarithm of an RN's wage is calculated by dividing her annual earnings by her total hours worked per year for any observations with non-zero salary and non-zero total hours worked per year.

The log of hours worked: The logarithm of RNs hours worked is computed from the total hours worked per year.

The log of other household income variable: The NSSRN includes data on RNs' salaries from all jobs and a categorical variable indicating total family income. Other household income variable is computed by subtracting the RNs' total wages from the midpoint of the categorical NSSRN variable measuring total household income. Following Brewer et al. (2006), negative values for other family income were assigned a value of 1.

Age: Age in the NSSRN is given as a categorical variable measured in five year intervals. Mutually exclusive dummy variables are created for each of these age bracket below the age of 65. The categories representing age 65 and older are combined into a single dummy variable.

Race: Race is a binary dummy variable which assumes the value of one if the RN is non-white, as the NSSRN did not provide more detailed race data in the county data file.

Presence and age of children: Mutually exclusive dummy variables represent the presence and age of children in an RNs' home. The variables measure the presence of children in different age groups: all children less than age six, all children greater than age six, some children greater than age six and some less than six, and no children at home.

Region of Employment: Two region variables are available in the data; region of employment and region of residence. Since one of the goals of this thesis is to compare empirical estimates for RNs who work in MSA to RNs who work in non-MSA, the region of employment variable is a more appropriate measure. However, the region of employment variable from the NSSRN dataset was available only for RNs who work. If the nurse worked, the region of employment was used. For non-working RNs the region of residence was used. Empirical results also include regions dummies for the following regions: East North Central, East South Central, Middle Atlantic, Mountain, New England, Pacific, South Atlantic, West North Central and West South Central.

Education Attainment: Mutually exclusive dummy variables are used to represent the following educational categories: associate degree, diploma degree, baccalaureate degree, and Master's degree or higher.

Foreign Education Status: A dummy variable assumes at value of one for foreign educated nurses.

Employment Status: The data in the NSSRN provides information about the employment status of each RN. Dummy variables are used to represent working fulltime, working part time, and not working.

Student Status: Mutually exclusive dummy variables are used to represent the following student statuses: fulltime student, part time student, and not a student.

Satisfaction: The NSSRN contains data on an RNs reported job satisfaction, on a 1-5 scale, with 1 representing extremely satisfied and 5 representing extremely dissatisfied.

Previous position in health care: The data in the NSSRN provides information about an RNs previous employment position in health care before the RN position. Mutually exclusive dummy variables are created to represent the following previous positions in health care: allied health, licensed practical/vocational nurse, managerial, no previous health care job, nurse aid, other health, and other.

Employment setting: Mutually exclusive dummy variables represent the following employment settings: academic education, ambulatory care, home health, hospital, insurance benefits/utilization review, nursing home/extended care, occupational health, public/community health, school health, unknown, and other for working RNs, or not applicable for non-working RNs.

Position title: Mutually exclusive dummy variables are used to represent the following position titles: clinical nurse specialist, consultant, informatics, instruction, management/administration, nurse anesthetist, nurse midwife, nurse practitioner, patient coordinator, patient educator, researcher, staff nurse, surveyor/auditor/regulator, unknown, and other for working RNs or not applicable for not working RNs.

3.3.2 Micro Variables from the ACS Data

The log RN wage: The logarithm of RNs wage is computed by dividing RNs total annual earnings by their total hours worked per year. Hours per year are calculated as the product of the hours per week multiplied by the average weeks worked per year for observations with non-zero earnings and non-zero total hours worked per week. The total weeks worked per year variable was measured as a categorical variable. I used the midpoint of each category to measure weeks for each working RN.

The log of hours worked: The logarithm of an RNs' annual work hour is computed from total hours worked per week and total weeks worked per year. The total weeks worked per year variable was measured as a categorical variable. I used the midpoint of each category to measure weeks for each working RN and multiplied it by total hours worked per week.

The log of other household income variable: Other household income is computed by subtracting the nurse's wages from household income. Unlike the NSSRN data, household income is measured as a continuous variable in the ACS data.

Age: Age is given as continuous variable in the ACS data. In order to match the variables used in the NSSRN data, this continuous variable is transformed into

mutually exclusive dummy variables representing the same age brackets as are in the NSSRN data.

Race: Unlike the NSSRN data, the ACS data provides a detailed race breakdown. As a result, I created dummy variables representing white, black, Hispanic/Latin, and other.

Presence and age of children: Mutually exclusive dummy variables are created to signify the presence of children in different age groups: all children less than age six, all children greater than age six, some children greater than six and some less than six, and no children at home.

Region of Employment: Unlike the NSSRN data, the ACS data does not include two separate variables for region of residence and region of employment. In the ACS data, region indicates region of residence. Binary dummy variables are used for the following regions: East North Central, East South Central, Middle Atlantic, Mountain, New England, Pacific, South Atlantic, West North Central and West South Central.

Educational Attainment: Unlike the NSSRN data, the ACS data does not include a diploma degree as a possibility for highest degree earned. In the ACS, nurses with a diploma degree may have reported their degree as an associate degree, some college without a degree, or even as a baccalaureate degree. While creating dummy variables for educational attainment, I considered some college degree response as a diploma degree and created mutually exclusive dummy variables representing the following degree categories: associate degree, diploma degree, baccalaureate degree, and Master's or higher degree.

Foreign Education Status: Unlike the NSSRN data, the ACS data does not have a foreign education status variable. However, it does have a variable measuring the year of entrance to the United States. I used the year of this variable to create a dummy variable for foreign education. All RNs who entered the United States at age 25 or above are assumed to have received their nursing degree abroad.

Employment Type: Unlike the NSSRN data, the ACS data does not have an employment type variable. So mutually exclusive dummy variables are created based on the hours of work variable for fulltime, part time, and not working. To keep these definitions consistent with the broader literature, nurses who work more than 30 hours per week are defined as fulltime nurse. (Auerbach, Staiger, Muench, & Buerhaus, 2012).

Descriptive statistics of NSSRN data are available in Chapter 4 and descriptive statistics of ACS data are available in Chapter 7.

Chapter 4

PREDICTED WAGE ESTIMATIONS WITH NSSRN DATA

4.1 Descriptive Statistics

4.1.1 Descriptive Statistics for RNs Residing in an MSA

Table 4.1 shows the number of observations and percentage distribution of binary variables, such as age bracket, employment status, etc., for married and single female RNs. Table 4.2 shows the means and standard deviations for the continuous variables, RN wage, other household income and hours worked per week, for married and single females.

Employment Status: According to the NSSRN data the work participation rate for married female RNs with an active registered nurse license and ages 21 to 75 is 85.4%, while it is 86.5% for single female RNs.

The overall participation rates in 2008 for married and single RNs are both 85%. However, there is a large difference between married and single RNs fulltime versus part time work behavior. Among the working RNs, 68.6% of married female and 83.2% of single females work fulltime, implying that the part time working RN rates are, respectively, 31.4% and 16.8%.

Table 4.1 Demographic and Work Characteristics of Female RNs Residing in an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Employment Status												
Employed in nursing	12971	(85.4)	4832	(86.5)	0	0	0	0	12971	(100.0)	4832	(100.0)
Not employed in nursing	2217	(14.6)	753	(13.5)	2217	(100.0)	753	(100.0)	0	0	0	0
Employment Type												
Fulltime	8904	(58.6)	4021	(72.0)	0	0	0	0	8904	(68.6)	4021	(83.2)
Not employed in nursing	2217	(14.6)	753	(13.5)	2217	(100.0)	753	(100.0)	0	0	0	0
Part time	4067	(26.8)	811	(14.5)	0	0	0	0	4067	(31.4)	811	(16.8)
Age												
24 or less	207	(1.4)	241	(4.3)	6	(0.3)	11	(1.5)	201	(1.5)	230	(4.8)
25-29	869	(5.7)	389	(7.0)	45	(2.0)	14	(1.9)	824	(6.4)	375	(7.8)
30-34	1267	(8.3)	382	(6.8)	125	(5.6)	21	(2.8)	1142	(8.8)	361	(7.5)
35-39	1554	(10.2)	386	(6.9)	172	(7.8)	19	(2.5)	1382	(10.7)	367	(7.6)
40-44	1775	(11.7)	472	(8.5)	179	(8.1)	31	(4.1)	1596	(12.3)	441	(9.1)
45-49	2268	(14.9)	681	(12.2)	228	(10.3)	56	(7.4)	2040	(15.7)	625	(12.9)
50-54	2923	(19.2)	946	(16.9)	348	(15.7)	82	(10.9)	2575	(19.9)	864	(17.9)
55-59	2170	(14.3)	888	(15.9)	297	(13.4)	122	(16.2)	1873	(14.4)	766	(15.9)
60-64	1336	(8.8)	650	(11.6)	381	(17.2)	133	(17.7)	955	(7.4)	517	(10.7)
65 and above	819	(5.4)	550	(9.8)	436	(19.7)	264	(35.1)	383	(3.0)	286	(5.9)
Race												
Other	2146	(14.1)	1036	(18.5)	248	(11.2)	112	(14.9)	1898	(14.6)	924	(19.1)
White	13042	(85.9)	4549	(81.5)	1969	(88.8)	641	(85.1)	11073	(85.4)	3908	(80.9)
Educational Attainment												
Associate degree	4881	(32.1)	1876	(33.6)	544	(24.5)	200	(26.6)	4337	(33.4)	1676	(34.7)
Baccalaureate degree	5843	(38.5)	2122	(38.0)	822	(37.1)	252	(33.5)	5021	(38.7)	1870	(38.7)
Diploma degree	2261	(14.9)	751	(13.4)	506	(22.8)	167	(22.2)	1755	(13.5)	584	(12.1)
Master degree or more	2203	(14.5)	836	(15.0)	345	(15.6)	134	(17.8)	1858	(14.3)	702	(14.5)
Foreign Education												
Educated in US	14437	(95.1)	5347	(95.7)	2134	(96.3)	723	(96.0)	12303	(94.9)	4624	(95.7)

Table 4.1 Demographic and Work Characteristics of Female RNs Residing in an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Foreign educated	751	(4.9)	238	(4.3)	83	(3.7)	30	(4.0)	668	(5.1)	208	(4.3)
Student Status												
Fulltime student	370	(2.4)	181	(3.2)	45	(2.0)	19	(2.5)	325	(2.5)	162	(3.4)
Not student	14092	(92.8)	5097	(91.3)	2120	(95.6)	712	(94.6)	11972	(92.3)	4385	(90.7)
Part time student	726	(4.8)	307	(5.5)	52	(2.3)	22	(2.9)	674	(5.2)	285	(5.9)
Presence and Age of Children												
All 6 years and older	4329	(28.5)	951	(17.0)	452	(20.4)	73	(9.7)	3877	(29.9)	878	(18.2)
All <6 years old	1572	(10.4)	148	(2.6)	166	(7.5)	12	(1.6)	1406	(10.8)	136	(2.8)
No children at home	8192	(53.9)	4376	(78.4)	1453	(65.5)	659	(87.5)	6739	(52.0)	3717	(76.9)
Some <6, some >6	1095	(7.2)	110	(2.0)	146	(6.6)	9	(1.2)	949	(7.3)	101	(2.1)
Region of Employment												
East North Central	1769	(11.6)	628	(11.2)	276	(12.4)	99	(13.1)	1493	(11.5)	529	(10.9)
East South Central	875	(5.8)	289	(5.2)	116	(5.2)	30	(4.0)	759	(5.9)	259	(5.4)
Middle Atlantic	1761	(11.6)	666	(11.9)	315	(14.2)	132	(17.5)	1446	(11.1)	534	(11.1)
Mountain	1546	(10.2)	640	(11.5)	204	(9.2)	82	(10.9)	1342	(10.3)	558	(11.5)
New England	1497	(9.9)	504	(9.0)	184	(8.3)	63	(8.4)	1313	(10.1)	441	(9.1)
Pacific	1538	(10.1)	625	(11.2)	238	(10.7)	75	(10.0)	1300	(10.0)	550	(11.4)
South Atlantic	3360	(22.1)	1246	(22.3)	533	(24.0)	165	(21.9)	2827	(21.8)	1081	(22.4)
West North Central	1632	(10.7)	491	(8.8)	166	(7.5)	54	(7.2)	1466	(11.3)	437	(9.0)
West South Central	1210	(8.0)	496	(8.9)	185	(8.3)	53	(7.0)	1025	(7.9)	443	(9.2)
Previous Position in Health Care												
Allied health	374	(2.5)	142	(2.5)	38	(1.7)	15	(2.0)	336	(2.6)	127	(2.6)
Licensed practical/vocational nurse	930	(6.1)	419	(7.5)	128	(5.8)	48	(6.4)	802	(6.2)	371	(7.7)
Managerial	43	(0.3)	19	(0.3)	8	(0.4)	3	(0.4)	35	(0.3)	16	(0.3)
No previous health care job	4941	(32.5)	1843	(33.0)	935	(42.2)	331	(44.0)	4006	(30.9)	1512	(31.3)
Nurse aid	5671	(37.3)	1890	(33.8)	734	(33.1)	213	(28.3)	4937	(38.1)	1677	(34.7)
Other	60	(0.4)	28	(0.5)	8	(0.4)	5	(0.7)	52	(0.4)	23	(0.5)

Table 4.1 Demographic and Work Characteristics of Female RNs Residing in an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Other health	3169	(20.9)	1244	(22.3)	366	(16.5)	138	(18.3)	2803	(21.6)	1106	(22.9)
Employment Setting												
Academic education	515	(3.4)	192	(3.4)	0	0	0	0	515	(4.0)	192	(4.0)
Ambulatory care	1547	(10.2)	410	(7.3)	0	0	0	0	1547	(11.9)	410	(8.5)
Home health	800	(5.3)	278	(5.0)	0	0	0	0	800	(6.2)	278	(5.8)
Hospital	7558	(49.8)	2955	(52.9)	0	0	0	0	7558	(58.3)	2955	(61.2)
Insurance/benefits/utilization review	377	(2.5)	132	(2.4)	0	0	0	0	377	(2.9)	132	(2.7)
Not Applicable	2217	(14.6)	753	(13.5)	2217	(100.0)	753	(100.0)	0	0	0	0
Nursing home/extended care	572	(3.8)	253	(4.5)	0	0	0	0	572	(4.4)	253	(5.2)
Occupational health	113	(0.7)	49	(0.9)	0	0	0	0	113	(0.9)	49	(1.0)
Other	458	(3.0)	228	(4.1)	0	0	0	0	458	(3.5)	228	(4.7)
Public/Community health	431	(2.8)	180	(3.2)	0	0	0	0	431	(3.3)	180	(3.7)
School health service	489	(3.2)	116	(2.1)	0	0	0	0	489	(3.8)	116	(2.4)
Unknown	111	(0.7)	39	(0.7)	0	0	0	0	111	(0.9)	39	(0.8)
Position Title												
Clinical Nurse Specialist	132	(0.9)	50	(0.9)	0	0	0	0	132	(1.0)	50	(1.0)
Consultant	136	(0.9)	56	(1.0)	0	0	0	0	136	(1.0)	56	(1.2)
Informatics	74	(0.5)	20	(0.4)	0	0	0	0	74	(0.6)	20	(0.4)
Instruction	537	(3.5)	170	(3.0)	0	0	0	0	537	(4.1)	170	(3.5)
Management/Administration	1515	(10.0)	557	(10.0)	0	0	0	0	1515	(11.7)	557	(11.5)
No job title	77	(0.5)	32	(0.6)	0	0	0	0	77	(0.6)	32	(0.7)
Not Applicable	2217	(14.6)	753	(13.5)	2217	(100.0)	753	(100.0)	0	0	0	0
Nurse Anesthetist	132	(0.9)	38	(0.7)	0	0	0	0	132	(1.0)	38	(0.8)
Nurse Midwife	42	(0.3)	7	(0.1)	0	0	0	0	42	(0.3)	7	(0.1)
Nurse Practitioner	511	(3.4)	182	(3.3)	0	0	0	0	511	(3.9)	182	(3.8)
Other	346	(2.3)	128	(2.3)	0	0	0	0	346	(2.7)	128	(2.6)
Patient Coordinator	901	(5.9)	360	(6.4)	0	0	0	0	901	(6.9)	360	(7.5)

Table 4.1 Demographic and Work Characteristics of Female RNs Residing in an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Patient Educator	154	(1.0)	47	(0.8)	0	0	0	0	154	(1.2)	47	(1.0)
Researcher	121	(0.8)	29	(0.5)	0	0	0	0	121	(0.9)	29	(0.6)
Staff Nurse	8173	(53.8)	3102	(55.5)	0	0	0	0	8173	(63.0)	3102	(64.2)
Surveyor/Auditor/Regulator	58	(0.4)	27	(0.5)	0	0	0	0	58	(0.4)	27	(0.6)
Unknown	62	(0.4)	27	(0.5)	0	0	0	0	62	(0.5)	27	(0.6)

For comparison, in 2000 the percentage of married female RNs working fulltime was 57.2% and 75.8% for single female RNs. The overall participation rates were, respectively, 80.5% and 83.2% (Brewer et al., 2006). Thus, the participation rates and the percentage of RNs who work fulltime have all increased between 2000 and 2008.

Educational Attainment: The distribution of RNs by type of degree to qualify as an RN has changed over time. The percent of working RNs with diploma degrees in 2008 was 13.5% for married females and 12.1% for single females. In 2000, in contrast, these numbers were 20.7% and 18.9% (Brewer et al., 2006). Since diploma degrees are not common among young RNs, this drastic drop is likely explained by aging RNs leaving the labor force. The percent of working RNs with diploma degrees is 13.5% for married females and 12.1% for single females, while these ratios are, respectively, 22.8% and 22.2% among RNs who are not working. The percent of married female RNs with associate degrees was 44.8% in 1992, 45.3% in 1996, and

34% in 2000; by 2008 it had fallen to 32.1%. The percent of married female RNs with baccalaureate degrees was 32.5% in 1992, 32.6% in 1996, and 35% in 2000; by 2008 it had risen to 38.5% (Brewer et al., 2006; Chiha and Link, 2003). Finally, the percent of married female RNs with the Master's degrees or higher was 8.5% in 1992, 9.3% in 1996, and 11% in 2000; by 2008 it had risen to 14.5% (Brewer et al., 2006; Chiha and Link, 2003). Thus, there is a clear trend towards higher education levels for RNs.

Race: 85.9% of married RNs are white and 85.4% of white married RNs participate in the work force, these numbers are, respectively, 81.5% and 80.9% for single RNs.

Presence of children: Approximately 53.9 % of married RNs and 78.4% of single RNs do not have children at home. Approximately 28.5% of married RNs have children age 6 or older, while this ratio is 17% for single RNs and approximately 10.4% of married RNs have children age 6 or below, while this ratio is only 2.6% for single RNs.

Previous work position: Approximately 33% of all RNs have not had a previous job in a health care position, while 37.3% of married RNs and 33.8% of single RNs previously worked as a nurse aide.

Age: The mean age is 46.87 for married RNs and 48.01 single RNs[5]. The age distributions of married female RNs and single married RNs are slightly different. As shown in Figure 4.1, both age distributions are skewed towards older ages. In fact, both peak in the 50-54 age bracket which contains between 15% and 20% of the RNs in both marital status categories. The mean age was 44.85 for married RNs and 46.19

[5] These average ages are calculated by multiplying the midpoints of each age bracket by the number of observations then dividing by the total number of observations.

single RN in 2000 (Brewer et al., 2006). These results confirm that the population of RNs is aging which has important implications for the delivery of health care in the future.

Figure 4.1 Age Distribution of Female RNs Residing in an MSA by Marital Status (Data: NSSRN 2008)

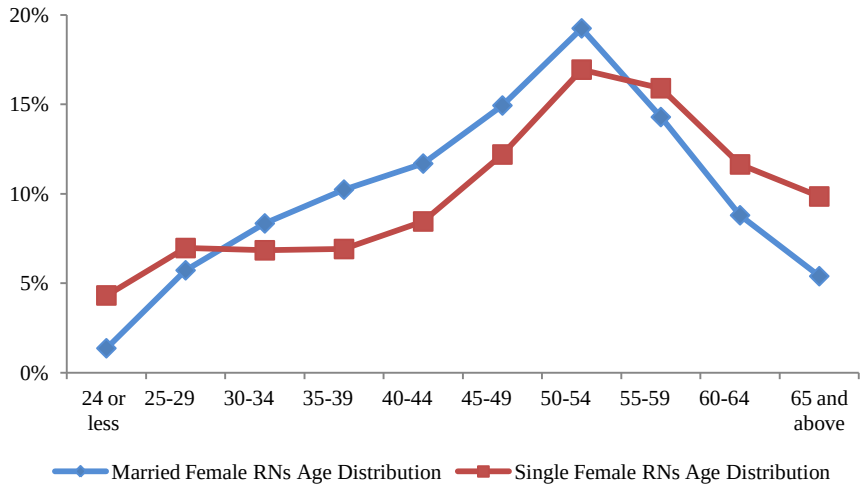

Table 4.2 Income and Work Hours of Female RNs Residing in an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008)

	Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
Total RN hours worked per year	0.0	0.0	0.0	0.0	1,860.6	612.7	2,027.3	531.9
Other house hold income	121,248	83,367	55,186	46,452	60,384	56,918	13,236	25,079
RNs hourly wage	0.0	0.0	0.0	0.0	32.0	13.4	31.8	12.3

Table 4.2 shows means for annual hours, other household income, and the RN wage for RNs residing in an MSA. As shown in Table 4.2, the mean of other household income is $121,248 for non-working married RNs and $60,384 for working married RNs. These figures are, respectively, $55,186 and $13,234 for single RNs. Thus, for married women, other household income for the non-working is more than twice other household income for working RNs; this same difference is almost six times for single females.

The average annual earnings for RNs who were employed fulltime in 2008 were $66,973, an increase of 15.9 percent over the 2000 average of $57,785. When annual earnings are adjusted for inflation (using 1980 dollars), earnings increased by only 1.7 percent between 2000 and 2008 (HRSA, 2010).

The mean total hours of work per year for married females is 1,860 hours, while it is 2,027 hours for single females. This is consistent with married females' lower rate of fulltime work participation.

Table 4.3 Categorized Work Hours of Employed Female RNs Residing in an MSA by Marital Status (Data: NSSRN 2008)

Hours	Married Female RNs (%)	Single Female RNs (%)
Fewer than 500	3.74	3.04
500-749	2.52	1.52
750-999	3.69	1.43
1000-1499	11.66	6.26
1500-2000	25.85	28.09
2000-2500	37.10	40.79
2500 and more	15.43	18.87

Table 4.3 shows the distribution of work hours by marital status for working RNs. The mean of total annual hours worked for married females is 1,860 hours, while it is 2,027 hours for single females. This is consistent with married females' lower rate of fulltime work participation. Approximately 3.7% of married female RNs work between 750-999 hours and 11.66% work between 1000-1499 hours, while these numbers are, respectively, 1.43% and 6.26% for single female RNs. From Table 4.3, it is clear that single RNs work longer hours than their married counterparts.

4.1.2 Descriptive Statistics for RNs Residing Outside of an MSA

Table 4.4 shows the number of observations and percentage distribution of binary variables for married and single female RNs who live in non-MSA areas.

Although the means of most variables are similar for RNs living in MSAs and non-MSAs, there are some substantial differences for certain variables.

Employment Status: In non-MSAs the participation rate for married female RNs is 84.8% and 85.5% for single RNs. These numbers are fairly close to the work participation rates for RNs in MSAs which were, respectively, 85.4% and 86.5%. In non-MSAs 71.9% of working married female RNs and 82.2% of single female RNs work fulltime.

Educational Attainment: There are substantial difference in the educational attainment of RNs living in MSAs and non-MSAs. In MSAs, 32.1% of married RNs have an associate degree and 38.5% have baccalaureate degree, while these values are 43.5% and 31.5% respectively for married RNs living in non-MSAs. In MSAs, 33.6% of single RNs have an associate degree and 38% have baccalaureate degree, while these values are 41.9% and 30.7% respectively for single RNs living in non-MSAs.

Table 4.4 Demographic and Work Characteristics of Female RNs Residing Outside of an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Employment Status												
Employed in nursing	3687	(84.8)	1118	(85.5)	0	0	0	0	3687	(100.0)	1118	(100.0)
Not employed in nursing	660	(15.2)	190	(14.5)	660	(100.0)	190	(100.0)	0	0	0	0
Employment Type												
Fulltime	2652	(61.0)	919	(70.3)	0	0	0	0	2652	(71.9)	919	(82.2)
Not employed in nursing	660	(15.2)	190	(14.5)	660	(100.0)	190	(100.0)	0	0	0	0
Part time	1035	(23.8)	199	(15.2)	0	0	0	0	1035	(28.1)	199	(17.8)
Age												
24 or less	71	(1.6)	54	(4.1)	3	(0.5)	5	(2.6)	68	(1.8)	49	(4.4)
25-29	215	(4.9)	73	(5.6)	11	(1.7)	6	(3.2)	204	(5.5)	67	(6.0)
30-34	351	(8.1)	80	(6.1)	23	(3.5)	4	(2.1)	328	(8.9)	76	(6.8)
35-39	437	(10.1)	83	(6.3)	31	(4.7)	5	(2.6)	406	(11.0)	78	(7.0)
40-44	469	(10.8)	115	(8.8)	47	(7.1)	9	(4.7)	422	(11.4)	106	(9.5)
45-49	698	(16.1)	164	(12.5)	74	(11.2)	13	(6.8)	624	(16.9)	151	(13.5)
50-54	800	(18.4)	230	(17.6)	108	(16.4)	18	(9.5)	692	(18.8)	212	(19.0)
55-59	648	(14.9)	212	(16.2)	105	(15.9)	33	(17.4)	543	(14.7)	179	(16.0)
60-64	378	(8.7)	157	(12.0)	113	(17.1)	38	(20.0)	265	(7.2)	119	(10.6)
65 and above	280	(6.4)	140	(10.7)	145	(22.0)	59	(31.1)	135	(3.7)	81	(7.2)
Race												
Other	358	(8.2)	136	(10.4)	41	(6.2)	12	(6.3)	317	(8.6)	124	(11.1)
White	3989	(91.8)	1172	(89.6)	619	(93.8)	178	(93.7)	3370	(91.4)	994	(88.9)
Educational Attainment												
Associate degree	1892	(43.5)	548	(41.9)	238	(36.1)	71	(37.4)	1654	(44.9)	477	(42.7)
Baccalaureate degree	1370	(31.5)	402	(30.7)	205	(31.1)	44	(23.2)	1165	(31.6)	358	(32.0)
Diploma degree	604	(13.9)	194	(14.8)	156	(23.6)	50	(26.3)	448	(12.2)	144	(12.9)
Master degree or more	481	(11.1)	164	(12.5)	61	(9.2)	25	(13.2)	420	(11.4)	139	(12.4)
Foreign Education												
Educated in US	4265	(98.1)	1292	(98.8)	647	(98.0)	189	(99.5)	3618	(98.1)	1103	(98.7)

Table 4.4 Demographic and Work Characteristics of Female RNs Residing Outside of an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Foreign educated	82	(1.9)	16	(1.2)	13	(2.0)	1	(0.5)	69	(1.9)	15	(1.3)
Student Status												
Fulltime student	92	(2.1)	33	(2.5)	11	(1.7)	7	(3.7)	81	(2.2)	26	(2.3)
Not student	4053	(93.2)	1221	(93.3)	634	(96.1)	180	(94.7)	3419	(92.7)	1041	(93.1)
Part time student	202	(4.6)	54	(4.1)	15	(2.3)	3	(1.6)	187	(5.1)	51	(4.6)
Presence and Age of Children												
All 6 years and older	1213	(27.9)	234	(17.9)	123	(18.6)	16	(8.4)	1090	(29.6)	218	(19.5)
All <6 years old	393	(9.0)	43	(3.3)	40	(6.1)	3	(1.6)	353	(9.6)	40	(3.6)
No children at home	2446	(56.3)	1002	(76.6)	467	(70.8)	167	(87.9)	1979	(53.7)	835	(74.7)
Some <6, some >6	295	(6.8)	29	(2.2)	30	(4.5)	4	(2.1)	265	(7.2)	25	(2.2)
Region of Employment												
East North Central	702	(16.1)	224	(17.1)	113	(17.1)	28	(14.7)	589	(16.0)	196	(17.5)
East South Central	399	(9.2)	98	(7.5)	52	(7.9)	16	(8.4)	347	(9.4)	82	(7.3)
Middle Atlantic	203	(4.7)	74	(5.7)	42	(6.4)	13	(6.8)	161	(4.4)	61	(5.5)
Mountain	544	(12.5)	169	(12.9)	99	(15.0)	15	(7.9)	445	(12.1)	154	(13.8)
New England	323	(7.4)	132	(10.1)	36	(5.5)	16	(8.4)	287	(7.8)	116	(10.4)
Pacific	481	(11.1)	175	(13.4)	69	(10.5)	22	(11.6)	412	(11.2)	153	(13.7)
South Atlantic	540	(12.4)	161	(12.3)	93	(14.1)	28	(14.7)	447	(12.1)	133	(11.9)
West North Central	795	(18.3)	180	(13.8)	87	(13.2)	32	(16.8)	708	(19.2)	148	(13.2)
West South Central	360	(8.3)	95	(7.3)	69	(10.5)	20	(10.5)	291	(7.9)	75	(6.7)
Previous Position in Health Care												
Allied health	75	(1.7)	28	(2.1)	10	(1.5)	6	(3.2)	65	(1.8)	22	(2.0)
Licensed practical/vocational nurse	356	(8.2)	103	(7.9)	46	(7.0)	14	(7.4)	310	(8.4)	89	(8.0)
Managerial	11	(0.3)	5	(0.4)	2	(0.3)	0	0	9	(0.2)	5	(0.4)
No previous health care job	1284	(29.5)	423	(32.3)	258	(39.1)	66	(34.7)	1026	(27.8)	357	(31.9)
Nurse aid	1698	(39.1)	481	(36.8)	226	(34.2)	72	(37.9)	1472	(39.9)	409	(36.6)
Other	13	(0.3)	2	(0.2)	1	(0.2)	0	0	12	(0.3)	2	(0.2)
Other health	910	(20.9)	266	(20.3)	117	(17.7)	32	(16.8)	793	(21.5)	234	(20.9)

Table 4.4 Demographic and Work Characteristics of Female RNs Residing Outside of an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Employment Setting												
Academic education	151	(3.5)	55	(4.2)	0	0	0	0	151	(4.1)	55	(4.9)
Ambulatory care	378	(8.7)	105	(8.0)	0	0	0	0	378	(10.3)	105	(9.4)
Home health	322	(7.4)	93	(7.1)	0	0	0	0	322	(8.7)	93	(8.3)
Hospital	2067	(47.6)	642	(49.1)	0	0	0	0	2067	(56.1)	642	(57.4)
Insurance/benefits/utilization/ review	29	(0.7)	10	(0.8)	0	0	0	0	29	(0.8)	10	(0.9)
Not Applicable	660	(15.2)	190	(14.5)	660	(100.0)	190	(100.0)	0	0	0	0
Nursing home/extended care	297	(6.8)	104	(8.0)	0	0	0	0	297	(8.1)	104	(9.3)
Occupational health	24	(0.6)	7	(0.5)	0	0	0	0	24	(0.7)	7	(0.6)
Other	54	(1.2)	18	(1.4)	0	0	0	0	54	(1.5)	18	(1.6)
Public/Community health	203	(4.7)	54	(4.1)	0	0	0	0	203	(5.5)	54	(4.8)
School health service	141	(3.2)	21	(1.6)	0	0	0	0	141	(3.8)	21	(1.9)
Unknown	21	(0.5)	9	(0.7)	0	0	0	0	21	(0.6)	9	(0.8)
Position Title												
Clinical Nurse Specialist	21	(0.5)	5	(0.4)	0	0	0	0	21	(0.6)	5	(0.4)
Consultant	34	(0.8)	9	(0.7)	0	0	0	0	34	(0.9)	9	(0.8)
Informatics	11	(0.3)	2	(0.2)	0	0	0	0	11	(0.3)	2	(0.2)
Instruction	155	(3.6)	37	(2.8)	0	0	0	0	155	(4.2)	37	(3.3)
Management/Administration	583	(13.4)	169	(12.9)	0	0	0	0	583	(15.8)	169	(15.1)
No job title	20	(0.5)	5	(0.4)	0	0	0	0	20	(0.5)	5	(0.4)
Not Applicable	660	(15.2)	190	(14.5)	660	(100.0)	190	(100.0)	0	0	0	0
Nurse Anesthetist	21	(0.5)	13	(1.0)	0	0	0	0	21	(0.6)	13	(1.2)
Nurse Midwife	8	(0.2)	5	(0.4)	0	0	0	0	8	(0.2)	5	(0.4)
Nurse Practitioner	142	(3.3)	49	(3.7)	0	0	0	0	142	(3.9)	49	(4.4)
Other	95	(2.2)	19	(1.5)	0	0	0	0	95	(2.6)	19	(1.7)
Patient Coordinator	184	(4.2)	54	(4.1)	0	0	0	0	184	(5.0)	54	(4.8)
Patient Educator	30	(0.7)	11	(0.8)	0	0	0	0	30	(0.8)	11	(1.0)

Table 4.4 Demographic and Work Characteristics of Female RNs Residing Outside of an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Researcher	15	(0.3)	5	(0.4)	0	0	0	0	15	(0.4)	5	(0.4)
Staff Nurse	2348	(54.0)	720	(55.0)	0	0	0	0	2348	(63.7)	720	(64.4)
Surveyor/Auditor/Regulator	10	(0.2)	9	(0.7)	0	0	0	0	10	(0.3)	9	(0.8)
Unknown	10	(0.2)	6	(0.5)	0	0	0	0	10	(0.3)	6	(0.5)

Also, in MSAs, approximately, 4.5% of RNs had a foreign education, while less than 2% of RNs in non-MSAs had a foreign education.

Race: In non-MSAs 91.8% of married RNs and 89.6% of single RNs are white, while 85.9% of married RNs and 81.5% of single RNs are white in MSAs.

Presence of children: In non-MSAs 56.3% of married RNs and 76.6% of single RNs do not have children at home. The presence and age of children have fairly similar characteristics for RNs living in MSAs and non-MSAs.

Age: In non-MSAs the mean age is 47.27 for married RNs and 48.77 for single RNs. These mean ages are not substantially different from the mean ages of RNs living in MSAs, which are, respectively, 46.87 and 48.01. As shown in Figure 4.2, the age distributions for RNs living in non-MSAs are similar to the age distributions of RNs living in MSAs.

Table 4.5 shows means for annual hours, other household income, and the RN wage for RNs residing outside of an MSA. Comparing Table 4.2 and 4.5, while total hours worked is similar for RNs who live in MSAs and RNs who don't live in an

MSA other household income and hourly wage are not. Specifically, the means of both other household income and hourly wage are higher for RNs who live in MSAs.

Table 4.5 Income and Work Hours of Female RNs Residing Outside of an MSA by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008)

	Not Working				Working			
	Married Female RNs		Single Female RNs		Married Female RNs		Single Female RNs	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
Total RN hours worked per year	0.0	0.0	0.0	0.0	1,879.8	613.8	2,007.1	552.9
Other house hold income	93,277	71,032	47,750	48,656	51,106	50,437	10,659	19,979
RNs hourly wage	0.0	0.0	0.0	0.0	28.6	12.0	29.9	13.9

Figure 4.2 Age Distribution of Female RNs Residing Outside of an MSA by Marital Status (Data: NSSRN 2008)

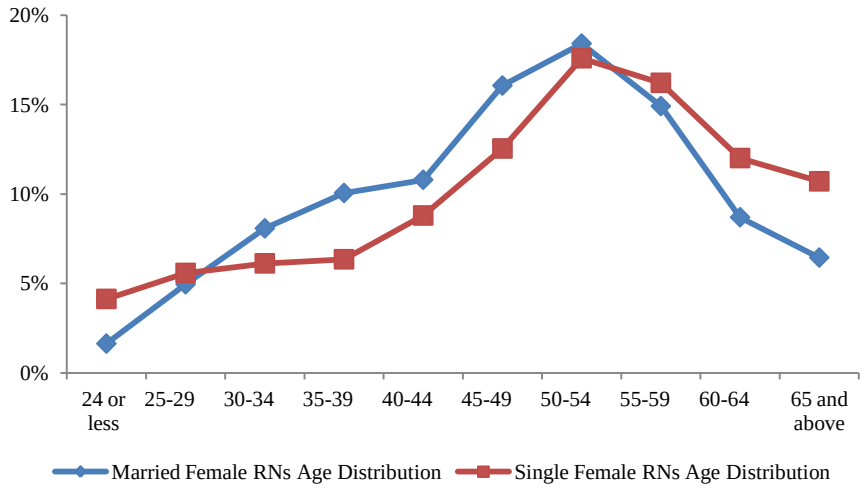

Table 4.6 Work Hours of Employed Female RNs Residing Outside of an MSA by Marital Status (Data: NSSRN 2008)

Hours	Married Female RNs (%)	Single Female RNs (%)
Fewer than 500	3.29	1.86
500-749	2.58	1.66
750-999	3.15	1.32
1000-1499	14.71	6.44
1500-2000	27.77	29.08
2000-2500	32.50	39.55
2500 and more	16.00	20.10

Table 4.6 shows the distribution of annual work hours by marital status for working RNs. It is clear that single RNs work longer hours than married RNs. As with the mean of annual hours, the distribution of work hours for RNs in non-MSAs is similar to the distribution of work hours for RNs in MSAs.

4.2 Wage Equation Corrected for Sample Selection

All the empirical results based on NSSRN data are estimated for four different data subsets. The first includes observations with the age restricted to 65 or below and unrestricted work hours. The second includes observations with the age restricted to 64 and below and unrestricted work hours. The third includes observations with the age restricted to 65 or below and the work hours restricted to a maximum of 3,200 hours. The fourth includes observations with the age restricted to 64 and below, and the work hours restricted to a maximum of 3,200 hours.

While most empirical studies ignore RNs above an age of 65 with active licenses, Brewer et al. included RNs age above 65 in their labor supply estimations with NSSRN data for 2000 (2006). The 2008 data show that more than 50% of the

RNs in this age group were still working and, as mentioned previously, RNs who retire revoke their license[6].

Using data which includes RNs above the age of 65 has important consequences. Most significantly, because this age group has a lower participation rate than all other age groups, their inclusion will lead to a lower overall rate of participation. Chiha and Link (2003) did not include RNs above the age of 65 in their samples. Compared to either 2000 or 2008, they reported higher work participation rates. For married female RNs they found work participation rates of 89.25% in 1992 and 88.7% in 1996, while for single female RNs they found participation rates of 90.6% in 1992 and 90.5% in 1996.

I decided to include observations with ages above 65 in the sample but use a pooled single dummy variable for these higher ages in regressions. I dropped all observations reporting annual hours of work greater than 3,200 hours[7].

As shown in Appendix A, models based on the different samples yield broadly similar coefficients, suggesting that these empirical results are robust to the subset used.

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[6] From the Table 4.7, the number of not working married RNs is 581 and not working single RNs is 323, giving a total of 904. The number of working married RNs is 518 and working single RNs is 367, giving a total of 885. Approximately one out of two RNs above the age of 65 is participating in the labor force.

[7] The estimation output Tables are available in Appendix A for RNs who live in an MSA.

4.3 Wage Equation

This section explains the wage equation used to construct the predicted wage variable which will be used in the labor supply models.

Table 4.7 reports the coefficients and standard errors for these predicted wages[8]. As the dependent variable is in logarithms, the coefficients of the explanatory variables can be interpreted as percentages. Columns 1 and 2 contain results for the wage equations for RNs, respectively, living in MSAs and living in non-MSAs.

The variables used in the wage equation are race, age, region, educational attainment, and the number of doctors per 1,000 population, and the number of RNs per 1,000 population. In addition to the variables just noted, the participation equation includes other household income and the presence of children variables.

Brewer et al. (2006) estimate the predicted wage with a simple OLS regression by using the working sample of RNs to estimate the model and then using this equation to predict wage, which is then used as a variable in their labor supply models. They did not account for possible selection bias. Chiha and Link (2003) used the maximum likelihood technique to account for selection bias and found selection bias in the wage model. In this thesis, I control for selection bias in the wage equation.

Table 4.8 reports the marginal effects of logarithm of wage variable.

4.4 Empirical Results

Table 4.7 displays the values of the maximum likelihood estimates of rho, which represents the correlation between the error terms of the participation and wage

[8] The estimation output Tables for participation part of the MLE wage equations are available in appendix B.

equations. The estimation results show that there is evidence for the existence of selection bias in the MSA sample but not in the non-MSA sample. Hence, employment of OLS regression in this working sample to predict both working and non-working RN wages would be a valid approach only for the non-MSA sample. Appendix C shows regression estimates of the fulltime/part time and hours worked labor supply models for RNs who live in non-MSAs based on OLS estimated predicted wages. These results are consistent with the results based on the predicted wage from the maximum likelihood model.

4.4.1 Comparing Wage Estimation Results for RNs Residing in or Not Residing in an MSA

As shown in the Table 4.7, the number of doctors per 1,000 population in non-MSAs is associated with a higher probability of working, while it is not statistically significant for RNs who live in MSAs. The RN wage is also positively related with the number of doctors per 1,000 population. From Table 4.8, a one unit increase in the number of doctors per 1,000 population increases the hourly wage of RNs by 0.05 cents in MSAs and 0.02 cents in non-MSAs. A one unit increase in the number of nurses per 1,000 population decreases the RN wage by 0.03 cents per hour.

The educational attainment coefficients are all significant, with the same signs in both areas (higher degrees lead to more income). Table 4.7 shows that all non-associate degrees increases RN wage relative to an associate degree.

Table 4.7 Wage Equations: Female RNs Residing in or Not Residing in an MSA (Data: NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	MSA (Col. 1)	non-MSA (Col. 2)
Race other (white)	0.01733**	0.02708
	(0.00719)	(0.01768)
Number of doctors per 1,000 population	0.38720***	0.09988***
	(0.02102)	(0.02985)
Number of nurses per 1,000 population	-0.26279***	0.00001***
	(0.01467)	(0.00000)
Education - Diploma (associate)	0.02785***	0.02966*
	(0.00801)	(0.01649)
Education - Baccalaureate (associate)	0.05644***	0.07056***
	(0.00564)	(0.01151)
Education - Masters or more (associate)	0.21942***	0.20842***
	(0.00752)	(0.01628)
Foreign Education (in US)	0.05587***	0.06565*
	(0.01203)	(0.03818)
Age < 25 (25-29)	-0.09592***	-0.09489**
	(0.01767)	(0.03687)
Age 30-34 (25-29)	0.05414***	0.01978
	(0.01221)	(0.02620)
Age 35-39 (25-29)	0.10655***	0.07073***
	(0.01186)	(0.02538)
Age 40-44 (25-29)	0.10765***	0.09277***
	(0.01152)	(0.02505)
Age 45-49 (25-29)	0.11280***	0.09490***
	(0.01104)	(0.02370)
Age 50-54 (25-29)	0.12237***	0.10001***
	(0.01069)	(0.02336)
Age 55-59 (25-29)	0.12243***	0.09077***
	(0.01118)	(0.02423)
Age 60-64 (25-29)	0.10687***	0.09435***
	(0.01268)	(0.02740)
Age ≥ 65 (25-29)	0.02159	0.05386*
	(0.01614)	(0.03241)
Region of employment - Middle Atlantic (New England)	0.03464***	-0.14009***
	(0.01042)	(0.02884)
Region of employment - East North Central (New England)	-0.05224***	-0.11214***
	(0.01065)	(0.02177)
Region of employment - West North Central (New England)	-0.05502***	-0.15738***
	(0.01128)	(0.02270)
Region of employment - South Atlantic (New England)	-0.01801*	-0.09749***
	(0.00934)	(0.02356)
Region of employment - East South Central (New England)	-0.07790***	-0.10601***
	(0.01291)	(0.02548)

Table 4.7 Wage Equations: Female RNs Residing in or Not Residing in an MSA (Data: NSSRN 2008) (Continued)

Explanatory Variable (Reference Category in Parentheses)	MSA (Col. 1)	non-MSA (Col. 2)
Region of employment - West South Central (New England)	-0.04791***	-0.07018***
	(0.01157)	(0.02640)
Region of employment - Mountain (New England)	-0.00141	-0.07183***
	(0.01082)	(0.02380)
Region of employment - Pacific (New England)	0.12800***	0.12323***
	(0.01081)	(0.02338)
Constant	3.28679***	3.17624***
	(0.01712)	(0.03486)
Rho	-0.06256**	-0.05611
	(0.02508)	(0.04964)
Number of observations	20773	5655
Censored observations	2970	850
Uncensored observations	17803	4805
Log likelihood	-10924.48	-3336.267

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

With all gaps measured relative to associate degree, RNs with diploma degrees earn 2.7% more in an MSA, while this gap is 3% higher in non-MSA. RNs with baccalaureate degrees earn 5.6% more in an MSA and 7% more in non-MSA. RNs with a masters or higher degrees earn 21% more in both MSAs and non-MSAs. As shown in table 4.8, an RN holding a diploma degree earns 0.003 cents per hour more than an RN holding an associate degree, while a baccalaureate degree holder earns 0.007 cents more, and a Master's degree or higher earns 0.03 cents in MSAs. In non-MSAs these values are, respectively, 0.005, 0.01, and 0.04 cents.

Table 4.8 Marginal Effects of Wage Equation (Data: NSSRN 2008)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	dy/dx (Col. 1)	Std.Err (Col. 2)	dy/dx (Col. 3)	Std.Err (Col. 4)
Race other (white)	0.0000226	9.46E-06	0.0000517	0.0000339
Number of doctors per 1,000 population	0.0005045	0.0000283	0.0001907	0.0000575
Number of nurses per 1,000 population	-0.0003424	0.0000197	2.14E-08	5.58E-09
Education - Diploma (associate)	0.0000364	0.0000105	0.0000566	0.0000315
Education - Baccalaureate (associate)	0.0000737	7.45E-06	0.0001347	0.0000223
Education - Masters or more (associate)	0.0002866	0.0000106	0.0003979	0.0000333
Foreign Education (in US)	0.000073	0.0000158	0.0001253	0.0000731
Age < 25 (25-29)	-0.0001253	0.0000233	-0.0001812	0.0000708
Age 30-34 (25-29)	0.0000707	0.000016	0.0000378	0.0000501
Age 35-39 (25-29)	0.0001392	0.0000157	0.000135	0.0000487
Age 40-44 (25-29)	0.0001406	0.0000152	0.0001771	0.0000481
Age 45-49 (25-29)	0.0001473	0.0000146	0.0001812	0.0000455
Age 50-54 (25-29)	0.0001598	0.0000142	0.0001909	0.0000449
Age 55-59 (25-29)	0.0001599	0.0000148	0.0001733	0.0000464
Age 60-64 (25-29)	0.0001396	0.0000166	0.0001801	0.0000522
Age ≥ 65 (25-29)	0.0000282	0.0000211	0.0001028	0.0000616
Region of employment - Middle Atlantic (New England)	0.0000452	0.0000137	-0.0002675	0.0000558
Region of employment - East North Central (New England)	-0.0000682	0.000014	-0.0002141	0.0000421
Region of employment - West North Central (New England)	-0.0000719	0.0000149	-0.0003004	0.0000442
Region of employment - South Atlantic (New England)	-0.0000235	0.0000123	-0.0001861	0.0000455
Region of employment - East South Central (New England)	-0.0001018	0.000017	-0.0002024	0.0000491
Region of employment - West South Central (New England)	-0.0000626	0.0000152	-0.000134	0.0000507
Region of employment - Mountain (New England)	-1.84E-06	0.0000142	-0.0001371	0.0000457
Region of employment - Pacific (New England)	0.0001672	0.0000143	0.0002353	0.0000452

From Table 4.8, holding a foreign nursing degree increase RN wage by 0.007 cent for RNs living in MSAs and 0.01 cents in non-MSA while holding a foreign nursing degree does not have any impact on an RN's work decision.

From the Table 4.7, the coefficient for the race variable is around 0.02 in both models but is not significant for RNs who live in non-MSAs. While white RNs who live in MSA earn 2% more per hour, race does not appear to have an effect on RN

earning in non-MSA. From the Table 4.8, a non-white RN earns 0.002 cents more than a white RN in MSAs. Since non-MSA areas are more dominated by white nurses, (from the Table 4.4 only 8.2% of married RNs and 10.4% of single RNs living in non-MSAs are non-white) the fact that there is no racial premium in these areas is significant.

From the Table 4.7, there is a clear pattern for how age impacts on RNs wage, for both RNs who live in MSAs and non-MSAs; the wage increases by age but this increase becomes almost flat by age 35 and increases very slowly until age 60 then drops. The age earnings profile is very flat and is similar to the pattern found in earlier NSSRN samples dating back to 1977. This flat profile is shown in Figure 4.4. Nurses have an initially high starting salary with a relatively flat progression as her experience accumulates.

Figure 4.3 Predicted Wage Distribution of Female RNs by Age and Residence (Data: NSSRN 2008)

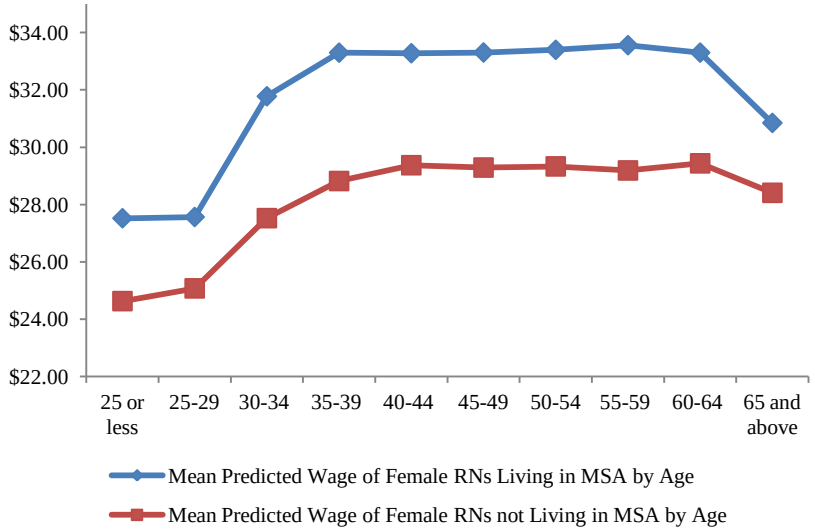

Figure 4.4 shows that RNs face a flat age earning profile. For RNs living in MSA, the starting hourly wage is approximately $24 which rapidly increases to $30 by ages 30-35 and reaches its peak at ages 50-55 at $31 dollars. RNs living in non-MSA areas face a very similar flat age earning profile but at a lower hourly wage levels. This flat age earning profile for RNs is consistent with the broader literature.

4.4.2 Comparing Wage Estimation Results for RNs Residing in MSAs with Brewer et al. (2006)

Compared with Brewer et al.'s results for 2000, these 2008 wage regression result for RNs who live in MSAs have the same coefficient signs for race, education, age, and region variables, except for the Middle Atlantic.

Brewer et al. report the coefficients of the education dummies for diploma degrees, baccalaureate degrees and master's degrees as, respectively, 0.006, 0.053 and 0.228 based on 2000 data, with all of these effects statistically significant except for the associate degree. In these results, the estimated coefficients are 0.027 for diploma degrees, 0.056 for baccalaureate degrees, and 0.22 for the masters and higher degrees, with all effects statistically significant. While there was no statistically significant difference in 2000, in these results RNs with diploma degrees earn 2.7% more than RNs with associate degrees.

As mentioned before, Brewer et al. had access to private market data, so area variables in wage equations are not directly comparable since the models have different area variables.

Chapter 5

PARTICIPATION AND FULLTIME - PART TIME WORK DECISION MODEL WITH NSSRN DATA

5.1 Model

In this chapter my objective is to determine factors impacting whether a nurse works; and conditional on working, does she work fulltime or part time. To accomplish the objective, I estimate bivariate probit models with selection correction (reduced form selection corrected model) as was done by Brewer, et al. (2006).

The bivariate probit model is designed for situations in which there are two potentially corrected outcomes, where the occurrence of the second outcome is conditional on the first outcome. In this analysis, the first outcome is whether or not the nurse works and if this outcome is choosing to work, is that work on a fulltime or part time basis.

Given that the work/no work and fulltime/part time choices are binary outcomes, a bivariate probit model is an appropriate method for examining the determinants behind the work decision of RNs. One of the main assumptions in this empirical approach is that the error terms for each equation are jointly and normally distributed with correlation rho (ρ) and unit variances. In other words, ρ is a measure of the correlation between the unobservable variables of each equation. A likelihood ratio test for significance of ρ tests whether or not the labor supply choice should be treated as endogenous (Wooldridge, 2002). If ρ is not significantly different from 0, the more suitable approach would be to estimate each equation independently using a

univariate probit model. However, if $\rho \neq 0$, estimating a single equation probit model will yield inconsistent estimates (Wooldridge, 2002, p.478).

The model is based on the following structure:

$$y_1^* = \beta_1' x_1 + \varepsilon_1, y_1 = 1(y_1^* > 0)$$

$$y_2^* = \beta_2' x_2 + \varepsilon_2, y_2 = 1(y_2^* > 0)$$

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} \sim \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right]$$

where y_1^* and y_2^* are latent variables where y_1^* assumes a value of 1 when the nurse works and y_2^* assumes the value of 1 if the nurse works fulltime given that she works; and x_1 and x_2 are vectors of independent variables. These independent variable vectors x_1 and x_2 are not required to be identical. The two equations do not have to include their own specific variables. Rho (ρ) is the conditional correlation between y_1^* and y_2^* .

To estimate the bivariate probit model, the following log L is maximized

$$\log L = \sum_{i=1}^{n} \log \phi_2 \begin{bmatrix} (2y_{i1} - 1)\beta_1' x_{i1} \\ (2y_{i2} - 1)\beta_2' x_{i2} \\ (2y_{i1} - 1)(2y_{i2} - 1)\rho \end{bmatrix}$$

$$= \sum_{i=1}^{n} \log \phi_2 \left[q_{i1}\beta_1' x_{i1}, q_{i2}\beta_2' x_{i2}, q_{i1}q_{i2}\rho \right]$$

where $q_{i1} = (2y_{i1} - 1) = -1$ if $y_{i1} = 0$ and $q_{i1} = (2y_{i1} - 1) = 1$ if $y_{i1} = 1$ and the bivariate normal cumulative distribution function is computed (Greene, 2003).

This chapter focuses on the following questions:

1. Is the work/no work decision correlated with the decision to work fulltime/given that she works?
2. Is the RN wage related to work participation and/or fulltime versus part time work decisions?
3. Do area factors such as number of doctors, unemployment rate, and % of population without health insurance, influence work participation?
4. Does the percentage of hospital RNs who are fulltime in the area (either in MSAs or non-MSAs) influence the fulltime versus part time work decision?

The work/no work (WK/NW) and the fulltime/part time (FT/PT) equations include the following variables: the predicted RN wage, age, race, ages of children in the home, marital status, educational attainment, current student status, if RN is foreign trained, previous job position , other household income, MSA size, area unemployment rate, percentage of population below the poverty line, percentage of population without health insurance below the age of 65, the ratio in the area (MSA or county if the RN does not reside in an MSA) of fulltime to total hospital RN, and doctors per 1,000 population. Some additional variables are only available for working nurses and are only included in the fulltime-part time equation. Specifically, for each responding nurse these variables include their work setting, work title, work position, and job satisfaction. Initially the model is estimated for pooled female RNs, both married and single. Then separate equations are estimated for married and single

RNs. On the basis of a likelihood ratio test it was determined that the models for single and married females are and should be estimated separately[9].

Besides standardized coefficients, marginal effects are also reported. The reference (omitted) category of each binary explanatory variable is indicated in parenthesis. The marginal effects shown for the first stage of the bivariate probit model are the effects of the independent variables on the probability of working. The second equation shows the marginal effects of the independent variables on the probability of working fulltime, conditional on the RN working. The bivariate probit model is estimated for married and single female RNs. Table 5.1 shows the participation part (WK/NW) of the bivariate probit regression results for married and single RNs living in MSAs and Table 5.2 shows the fulltime/part time (FT/PT) part of the bivariate probit regression results for married and single RNs living in MSAs. The empirical results are discussed in the following sections.

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[9] Likelihood-ratio test of the models for all female RNs combined against married and single female RNs showed that married and single females had different explanatory models and should be reported separately.

LR chi2(96) = 806.96

Prob>chi2 = 0

Assumption: (pooled) nested in (single, married)

Akaike's information criterion and Bayesian information criterion

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
pooled	20773	.	-15072.97	97	30339.94	31110.26
single	5585	.	-3082.11	97	6358.22	7001.121
married	15188	.	-11585.13	97	23364.25	24104.19

5.2 Empirical Results

5.2.1 Significant Variables in the Participation Equation for RNs Residing in an MSA

Socioeconomic and Demographic Variables

The coefficient of predicted RN wage is not significant for either married or single RNs, while the coefficient for the log of other household income is negative and significant for both single and married female RNs. Specifically, a 1 percentage point increase in the log of other household income decreases the probability of married female RNs work participation by 6.8% and single female RNs work participation hardly at all. The impact of other household income on the work participation of married RNs is larger than the impact on the work participation of single RNs.

Presumably, for married female RNs there is at least one other household income source, their husbands salary, while other household income is zero for 27% of single female RNs which explains the lower sensitivity toward changes in other household income by single female RNs[10].

Both married and single female nurses holding Master's degree or higher are 25% more likely to work than nurses whose highest education is an associate degree. RNs who are either not students or part time students are more likely to work than RNs who are fulltime students.

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[10] Other household income is less than $5,000 for approximately 45% of single female RNs, and less than $10,000 for approximately 59% of single RNs. Moreover only 15% of single female RNs' other household income is greater than $40,000 and only 10% of single female RNs' other household income is greater than $50,000.

Table 5.1 Participation Equations: Married and Single Female RNs Residing in an MSA (Data: NSSRN 2008)[11]

Explanatory Variable (Reference Category in Parentheses)	Married Female RNs		Single Female RNs	
	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Predicted log market wage	-0.10790	-0.0100898	0.59257	0.0002962
	(0.19915)		(0.38828)	
Log other income	-0.76909***	-0.0679239	-0.83951***	-0.0004174
	(0.02061)		(0.03342)	
Race other (white)	-0.00144	-0.0004803	0.04030	0.0000225
	(0.04910)		(0.08391)	
Number of doctors per 1,000 population	0.15287	0.0113886	0.26225	0.000136
	(0.12914)		(0.21893)	
% of population below poverty	-0.00544	-0.0006204	-0.00687	-0.00000187
	(0.00682)		(0.01380)	
% of uninsured population below age 65	-0.00787*	-0.0009841	0.00302	0.00000343
	(0.00422)		(0.00814)	
% of unemployment	-0.00616	-0.000263	-0.02539	-0.0000157
	(0.01751)		(0.03539)	
Education - Diploma (associate)	-0.04847	-0.004601	-0.00668	-0.00000335
	(0.04678)		(0.09103)	
Education - Baccalaureate (associate)	-0.00122	-0.0001221	0.02210	0.0000115
	(0.03829)		(0.07651)	
Education - Masters or more (associate)	0.24872***	0.0188186	0.24660**	0.0000921
	(0.06482)		(0.12494)	
Foreign Education (in US)	0.05846	0.0049162	0.04666	0.0000268
	(0.08075)		(0.15952)	
Not student (full-time student)	0.18729**	0.0192374	0.17847	0.0001167
	(0.09485)		(0.16418)	
Part time student (full-time student)	0.47132***	0.0287895	0.38820*	0.0001104
	(0.12298)		(0.20903)	
Age < 25 (25-29)	0.05980	0.0049387	-0.03465	-0.000014
	(0.20935)		(0.24511)	

[11] The previous work position variables are excluded from Table 5.1 and are available at appendix D.

Table 5.1 Participation Equations: Married and Single Female RNs Residing in an MSA (Data: NSSRN 2008)[11] (Continued)

Explanatory Variable (Reference Category in Parentheses)	Married Female RNs		Single Female RNs	
	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Age 30-34 (25-29)	-0.17253*	-0.0173129	-0.48931**	-0.0005771
	(0.09508)		(0.20936)	
Age 35-39 (25-29)	-0.22299**	-0.0229757	-0.33467	-0.0002968
	(0.09540)		(0.22170)	
Age 40-44 (25-29)	-0.21737**	-0.0222409	-0.64886***	-0.00099
	(0.09655)		(0.20270)	
Age 45-49 (25-29)	-0.20639**	-0.0207241	-0.78348***	-0.0013978
	(0.09644)		(0.19145)	
Age 50-54 (25-29)	-0.29824***	-0.0310248	-0.80240***	-0.0013163
	(0.09504)		(0.18442)	
Age 55-59 (25-29)	-0.50325***	-0.0604554	-1.09471***	-0.0030244
	(0.09768)		(0.18333)	
Age 60-64 (25-29)	-1.09342***	-0.1954554	-1.33832***	-0.0065367
	(0.09933)		(0.18402)	
Age ≥ 65 (25-29)	-1.83246***	-0.4652116	-1.73374***	-0.0178987
	(0.10083)		(0.17664)	
Children at home - all < 6 years (no children at home)	-0.18515***	-0.0185636	-0.11314	-0.0000658
	(0.06427)		(0.19707)	
Children at home - all > 6 years (no children at home)	0.01663	0.0016209	0.15060	0.0000628
	(0.04182)		(0.09214)	
Children at home - both >6 years and <6 years (no children at home)	-0.32087***	-0.0357031	-0.12833	-0.0000768
	(0.06753)		(0.23090)	
Small MSA (large MSA)	0.03673	0.003542	0.05989	0.0000183
	(0.05103)		(0.10719)	
Medium MSA (large MSA)	-0.06470*	-0.0061778	0.09174	0.0000414
	(0.03552)		(0.07123)	
% of hospital RNs in an area who work full-time	-0.29131**	-0.0257011	0.37673	0.0001831
	(0.14077)		(0.27730)	
Constant	10.59056***		7.84150***	
	(0.68915)		(1.31764)	
Rho	-0.73651***		-0.64543***	
	(0 .03467)		(0.06594)	

Table 5.1 Participation Equations: Married and Single Female RNs Residing in an MSA (Data: NSSRN 2008)[11] (Continued)

Explanatory Variable (Reference Category in Parentheses)	Married Female RNs		Single Female RNs	
	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Number of observations	15188		5585	
Censored observations	2217		753	
Uncensored observations	12971		4832	
Log likelihood	-11585.13		-3082.11	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Married females, when all of their children are age 6 or below are less likely to work, a result which is equally true for married RNs with some who are children age 6 or below and some age 6 or above. However, the presence and age of children does not have an impact on single RNs work decisions. This result is not surprising, since most single females are the main provider of household income, and therefore must work.

The probability of married RNs living in medium size MSAs is 0.6% less than for married RNs who live in a large size MSA.

Age has a significant and negative effect on RNs participation rates, while race and the dummy variables for RNs' previous position have no significant effect. Married RNs between the ages of 30-50 work approximately 2% less than married RNs between the ages of 25-29, while the probability of participating drops rapidly after age 55. Married RNs over the age of 65 are 46% less likely to work than nurses

between the ages of 25-29. For single RNs there is gradual decline in work participation that increases rapidly after age 50.

Area Variables

An important contribution of this study is to investigate the impact of the area variables influence on the work/no work and fulltime/part time decisions of RNs. These variables have a surprisingly small effect in MSAs, only two of the variables were significant determinants of RNs labor supply decisions.

The percentage of the population in the MSA under age 65 and not having health insurance are associated with a lower probability of working for a married RN. Specifically, a 1 percentage point increase in the percentage of the population without health insurance decreases the probability of married RNs work participation by 0.1%. The negative effect of the population without health insurance below the age of 65 is expected, since the absence of the health insurance reduces the demand for health care and thus demand for nurses.

The percentage of hospital RNs in the MSA who work fulltime has a negative effect on married RNs work participation.

None of the other area variables are significant determinants of whether or not either married or single RNs work.

5.2.2 Significant Variables in the Fulltime/Part Time Equation for RNs Residing in an MSA

Socioeconomic and Demographic Variables

The income effect of the predicted RN wage is clearly visible in the empirical results for both married and single RNs. The predicted RN wage has a statistically significant negative effect on a RNs' decision to work fulltime. The coefficients on the

log of other household income are also significant and negative for both single and married RNs and the marginal effects are, respectively, -0.005 and - 0.04. A 1 percentage increase in the log of other household income decreases the probability of single working RNs working fulltime by 0.5% and the probability of married working RNs work fulltime by 4%.

Non-white working married female RNs are 11% more likely to work fulltime than their white colleagues. Race does not impact single female RNs' labor supply choice of working fulltime.

Educational attainment appears to have a major effect on labor supply decisions. Both married and single RNs with a diploma degree are less likely to work fulltime than RNs with only an associate degree. Considering that the nurses with diploma degrees are generally older, and to the extent that the age variables in our model does not fully capture the total effect of age, this result supports the idea that age has a negative effect on RNs fulltime labor supply decision.

Compared to RNs with an associate degree, married female RNs with baccalaureate degrees are less likely to work fulltime, while married RNs with a Master's degree or higher are 9% more likely to work fulltime. Both single and married RNs who received their nursing degree in a foreign country are more likely to work fulltime by, respectively, 12% and 7%. Student status is another significant factor; single RNs who are not students are more likely to work fulltime.

Age is a major factor in RNs fulltime versus part time work decisions. Older RNs are less likely to work fulltime and this effect is more important for married RNs, who are more likely to work part time at earlier ages than single RNs. Working married RNs ages between 35 and 55 are about 10% less likely to work fulltime than

Table 5.2 Fulltime/Part Time Equations: Married and Single Female RNs Residing in an MSA (Data: NSSRN 2008)[12]

Explanatory Variable (Reference Category in Parentheses)	Married Female RNs		Single Female RNs	
	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Predicted log market wage	-0.95223***	-0.3271522	-0.58251*	-0.129296
	(0.16389)		(0.30710)	
Log other income	-0.06725***	-0.0422393	-0.02535***	-0.0056835
	(0.00574)		(0.00568)	
Race other (white)	0.31453***	0.1073392	0.03292	0.0071879
	(0.04072)		(0.06440)	
Number of doctors per 1,000 population	0.30074***	0.1059908	0.15902	0.035479
	(0.09821)		(0.17113)	
% of population below poverty	0.01340**	0.0045067	0.01035	0.0022034
	(0.00575)		(0.01113)	
% of uninsured population below age 65	0.01506***	0.0050307	-0.00460	-0.0010975
	(0.00359)		(0.00657)	
% of unemployment	-0.02953**	-0.0103462	-0.04821*	-0.0105503
	(0.01430)		(0.02838)	
Education - Diploma (associate)	-0.10886***	-0.0392559	-0.13821*	-0.0323871
	(0.03989)		(0.07568)	
Education - Baccalaureate (associate)	-0.11197***	-0.038533	0.01429	0.0031128
	(0.03042)		(0.05946)	
Education - Masters or more (associate)	0.26005***	0.0875393	0.01843	0.0041181
	(0.06174)		(0.11030)	
Foreign Education (in US)	0.40445***	0.1215959	0.37535***	0.0682835
	(0.06857)		(0.13315)	
Not student (full-time student)	-0.01913	-0.0013083	0.43264***	0.1147248
	(0.07924)		(0.11981)	
Part time student (full-time student)	0.08327	0.0349249	0.20029	0.040233
	(0.09563)		(0.14676)	

[12] The previous work position, employment setting and position title variables are excluded from Table 5.2 and are available in Appendix D.

Table 5.2 Fulltime/Part Time Equations: Married and Single Female RNs Residing in an MSA (Data: NSSRN 2008)[1.] (Continued)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Age < 25 (25-29)	0.29810**	0.0926074	0.35185**	0.0650165
	(0.12805)		(0.16493)	
Age 30-34 (25-29)	-0.08840	-0.0361555	0.21304	0.0427357
	(0.06369)		(0.13318)	
Age 35-39 (25-29)	-0.17943***	-0.0714613	-0.18949	-0.0458678
	(0.06563)		(0.12691)	
Age 40-44 (25-29)	-0.25577***	-0.1000263	-0.18729	-0.0452697
	(0.06692)		(0.12439)	
Age 45-49 (25-29)	-0.29826***	-0.1152695	-0.03485	-0.008132
	(0.06672)		(0.12025)	
Age 50-54 (25-29)	-0.26602***	-0.1058681	-0.19070*	-0.0453565
	(0.06667)		(0.11444)	
Age 55-59 (25-29)	-0.45752***	-0.1948653	-0.27335**	-0.0673249
	(0.06987)		(0.11616)	
Age 60-64 (25-29)	-0.53835***	-0.2985694	-0.48940***	-0.132167
	(0.07672)		(0.11960)	
Age ≥ 65 (25-29)	-1.05310***	-0.6290824	-1.13422***	-0.3672038
	(0.09635)		(0.13293)	
Children at home - all < 6 years (no children at home)	-0.64806***	-0.2561655	-0.10521	-0.0245859
	(0.04950)		(0.14669)	
Children at home - all > 6 years (no children at home)	-0.34721***	-0.1227651	-0.07316	-0.0166512
	(0.03324)		(0.06535)	
Children at home - both >6 years and <6 years (no children at home)	-0.57398***	-0.2358054	-0.33292**	-0.0870992
	(0.05385)		(0.15296)	
Small MSA (large MSA)	-0.05410	-0.0178895	-0.18306**	-0.0432593
	(0.03959)		(0.07904)	
Medium MSA (large MSA)	-0.03242	-0.0127019	-0.10343*	-0.0234354
	(0.02952)		(0.05597)	
% of hospital RNs in an area who work full-time	0.89440***	0.287651	1.26541***	0.2899323
	(0.11155)		(0.21417)	

Table 5.2 Fulltime/Part Time Equations: Married and Single Female RNs Residing in an MSA (Data: NSSRN 2008)[12]

(Continued)

Explanatory Variable (Reference Category in Parentheses)	Married Female		Single Female RNs	
	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Feeling about job (1=extremely satisfied, 5=extremely dissatisfied)	-0.02187*	-0.007471	-0.00548	-0.001232
	(0.01244)		(0.02247)	
Constant	3.99644***		2.25438**	
	(0.53996)		(1.00321)	
Number of observations	15188		5585	
Censored observations	2217		753	
Uncensored observations	12971		4832	
Log likelihood	-11585.13		-3082.11	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

working married RNs age 25-29. The coefficients of the age dummies become statistically significant and negative for single RNs only after age 55 (compared to RNs age 25-29). Working single RNs ages 55 to 60 are 6% less likely to work fulltime than working RNs age 25-29 and working married RNs age 55-60 are 20% less likely to work fulltime. These reductions for working single and married RNs are, respectively, 13% and 30% for ages between ages 60 and 65 and 37% and 63% for those above age 65.

Married female RNs who have children of any age are less likely to work fulltime, while single RNs are only affected if some children are age 6 or below and some children are age 6 or above. In addition, the marginal effect of the presence of children at home is relatively larger for married RNs. Working married RNs who have

some children that are age 6 or below and some children that are age 6 or above are 23% less likely to work fulltime than working married RNs who do not have any children. Working single RNs who have some children that are age 6 or below and some children that are age 6 or above are only 9% less likely to work fulltime compared to corresponding RNs who do not have any children. The smaller effect of children in the home on labor supply of single RNs is undoubtedly related at least in part to the fact that a single RN is the prime bread winner for her family.

Relative to working in a hospital setting, working in a home health setting or ambulatory care setting decreases the probability of working fulltime, while working in a public/community health setting, an insurance/benefits/utilization setting, or a school health setting increases the probability of working fulltime for married female RNs. Single female RNs are not as responsive as married RNs to work setting. Relative to a hospital setting, only working in a school health setting or other work settings have negative and statistically significant coefficients.

Work positions also influence the RNs' choice of fulltime/part time work. Relative to RNs who work as staff nurses, RNs who work in management, instruction, clinical nurse specialist, nurse anesthetist, researcher, informatics nurse practitioner, surveyor/auditor/regulator, or in patient care are more likely work fulltime. The increased probability of working fulltime in these work positions might be the result of fulltime job requirements in these jobs.

These results show that married RNs with lower job satisfaction are less likely to be working fulltime. There is no significant effect of job satisfaction for single RNs, which supports the idea of higher mobility for single RNs, i.e. that they can more easily switch employers and locations to find desirable working conditions.

Previous work position does not have a significant effect on the fulltime part time decisions of RNs.

Area Variables

The area variables have a moderate influence on working RNs fulltime versus part time decisions. The area variables seem to have little effect on whether RNs work (only two out of the six area variables were significant in Table 5.1), but do influence how much they work.

Single RNs living in small or medium size MSAs are less likely to work while MSA size does not affect married RNs part time versus fulltime decisions. These results suggest that single RNs living in a large size MSA are more career oriented since they prefer to work fulltime over part time relative to single RNs living in small or medium sized MSAs and married RNs in general. Another possibility is that large MSAs offer more opportunities for fulltime work.

Married RNs are more susceptible to environmental factors such as the number of doctors per 1,000 population, the percentage of the population below the poverty line and the percentage of the population under age 65 without health insurance. All of these factors have significant positive impacts on married RNs' fulltime work decisions, while the coefficients for those variables are not significant for single female RNs. Single female RNs may switch among employers and locations to find desirable working conditions more easily than married female RNs as married female RNs' mobility is inherently restricted by their husbands' job.

The results support the idea that RNs and doctors are complements in production since an increase in the number of the doctors is associated with an increase in the probability of an RN working fulltime.

The only negative marginal effect on married female RNs choice of fulltime work is the percentage of unemployment in MSA. The higher is the unemployment rate, the less likely is that married RNs work fulltime.

The percentage of fulltime RNs in the hospital work force in an MSA has a statistically significant effect on both single and married RNs fulltime versus part time work decision. A higher percentage of RNs in the MSA who work fulltime is associated with a higher probability of an individual RN working fulltime. I assume that there is no two-way causality, since the unit of analysis is the individual RN and the percentage of the RNs working fulltime is at the aggregate area level. Thus it is unlikely that an individual RN's decision would affect the area variable reflecting the percent of hospital nurses who work fulltime.

From the previous part, the percentage of hospital RNs in the MSA who work fulltime affects married RNs work participation negatively. This negative relationship between the percentage of hospital RNs who work fulltime and RNs labor participation can be explained by the discouragement on RNs who prefer to work part time. Once the market is fully occupied by fulltime RNs, the RNs who are not working and prefer to work part time might not be able to find a part time position in the workforce. Thus, if the nurse is not in the labor force, she simply does not enter. In the FT/PT model, the coefficient is positive. Thus, the positive coefficient supports the argument that RNs who prefer to work part time leave the market. Also while the coefficient of the percentage hospital RNs in area who work fulltime does not have significant effect on single female work participation, it is significant at the fulltime/part time decision. Thus, single RNs either do not prefer to work part time as

much as married RNs, leaving their participation decision unaffected, or single RNs who prefer to work part time can more easily change their location than married RNs.

5.3 Summary of Key Results for Married and Single RNs Residing in an MSA and Comparisons with Results Found by Brewer et al. (2006)

Brewer et al. using the 2000 NSSRN also used a bivariate probit model to estimate the work\no work and fulltime versus part time work decisions of female RNs who live in MSAs. They ran two separate regressions for single and married RNs. Besides the individual level micro NSRRN data they had access to a data set called the "InterStudy Competitive Edge Part III Regional Market Analysis Data." This data set included InterStudy's National Health Maintenance Organizations (HMO) Census Survey (2006, p.865) which is not publically available.

Brewer et al. selected and analyzed the following MSA level area variables: medical, surgical, and other specialist per 1,000 population, primary care practitioners per 1,000 population, an index of HMO competition, the percent of HMO hospital services paid though fee schedules, non-HMO Medicaid beneficiaries as a percent of total MSA population and the percent of the population without health insurance below the age of 65. They also included three dummy variables for MSA size, based on the definitions used by InterStudy and the unemployment rate and the poverty level in 2000 from the Area Resource File.

While investigating the factors that influence labor supply decisions of RNs, I try to use similar MSA level area variables, in order to replicate the Brewer, et al. model as closely as is possible.

As found by Brewer et al. for 2000, the rho in this empirical work is statistically significant in bivariate probit estimations for both married and single RNs

who lived in MSAs in 2008. The estimated ρ was -0.56 for single RNs and -0.82 for married RNs in 2000; in these data it is, respectively, -0.65 and -0.74 in 2008.

5.3.1 Comparing the Participation Empirical Results

Socioeconomic and Demographic Variables

Mirroring Brewer et al.'s results, I find that RN wage is not a significant determinant of whether an RN works.

Table 5.3 shows labor force participation rates for nurses and for various other reference groups in the U.S. for the period 1960-2009. Comparisons of the nurse participation rates to these other groups demonstrates why wage is unlikely to be an effective tool for increasing the supply of RNs from the current stock of nurses. Labor force participation of female RNs stands out compared to females in the general U.S. population. In 1960, only 44% of single females and 30% of married females with spouses present were participating in the labor force while these ratios were, respectively, 78% and 45% for single and married female RNs. Fast forwarding to 2008, where in the general U.S. population 76% of single females and 61% of married females with spouses present were participating in the labor force, these same ratios were, respectively, 90% and 87% for single and married female RNs. In fact, the participation rate of single (married) RNs has exceeded the participation rate of prime age men since 1977 (1984). Thus, since all currently trained nurses are, for all intents and purposes, already in the labor force, it should not be surprising that the nurse wage does not stimulate a significant increase in participation of nurses.

Table 5.3 Participation Rates: US Men and Women, and Female RNs in percent, 1960-2008

Year (Col.1)	Woman age 20+ (Col.2)	Single Woman age 20+ (Col.3)	Married women with spouses present (Col. 4)	Married women with children under age 6 (Col.5)	Single female RNs ages 20-64 (Col. 6)	Married female RNs with children under age 6 (Col.7)	Married female RNs ages 20-64 (Col. 8)	Men age 20+ (Col. 9)
1960[a]	37.6	44.1	30.5	18.6	78.1	28.5	45.8	86.0
1970[a]	43.3	53.0	40.8	30.3	82.1	42.5	59.8	82.6
1977[a]	48.1	59.2	46.6	36.8	87.1	62.5	70.7	79.7
1980[a]	51.3	61.5	50.1	45.1	89.6	67.8	73.0	79.4
1984[a]	53.7	63.1	52.8	54.8	91.4	76.6	79.8	78.3
1988[a]	56.8	65.2	56.5	57.1	93.6	86.7	87.1	77.9
1992[b]	58.5	66.2	59.3	59.9	90.6	89.5	89.2	77.2
1996[b]	59.9	67.1	61.1	62.7	90.5	89.6	88.7	76.8
2000[b]	60.9	76.8	62.0	62.8	89.3	82.3	83.9	76.6
2008	61.1[c]	76.9[c]	61.4[c]	61.6[c]	90.0[d]	88.9[d]	87.6[d]	75.4[c]

[a] Source for figures from 1960 - 1988 for RNs: Link 1992

[b] Source for figures from 1992 - 2000 for RNs: Chiha and Link 2003

[c] Sources for non RN participation rates: BLS web site for Column 2 and 9. US Bureau of the Census, Statistical Abstract of the United States: (113th, 117th, 120th, 129th and 131th editions.) Washington DC, 1993,1997,2000,2010 and 2012. The participation rate is obtained by dividing the number of people in the labor force for a particular group by the non-institutional population for that group. Column 3-5 are from the Current Population Survey, March 2000 and March 2008 Supplement, Bureau of the Census.

[d] The participation rate measures the percentage of RNs in a particular cohort who participate in the labor force. Data is obtained from National Sample Survey of Registered Nurses County Data, 2008.

Other household income has a small negative effect on single RNs but a larger negative effect for married RNs in both 2000 and 2008. Numerically, the estimated coefficients are very close for both years for single RNs respectively at -0.85 and -0.84. For married RNs these coefficients are respectively -0.91 and -0.77. Mirroring the results for 2000, race does not influence RNs work participation decision in 2008.

Brewer et al. found that there is small negative effect on the probability of working for married RNs with diploma versus an associate degree and a positive effect from a Master's degree or higher for both single and married RNs. In 2008, a Master's degree or higher has the same effect for both single and married RNs. However, none

of the other education levels has a statistically significant effect on the RNs work participation decision. As expected, being a fulltime student decreases the probability of working in both years.

Brewer et al. found that age has a negative effect on RNs work participation only for nurses age 50 and above; however, in 2008, this negative effect appears to take hold at age 30 for married RNs and age 40 for single RNs.

The presence of children, particularly those under age 6, has the expected negative effect on married RNs work participation in both years. For single RNs there is an interesting outcome in both years. The presence of children age 6 or above increases the probability of working, while the presence of children age 6 or below does not have any effect. However, these effects are not statistically significant in 2008.

Area Variables

Among the area variables, the marginal effect associated with the percentage of the population without health insurance below the age of 65 is negative and significant for married RNs in 2008 but not in 2000. None of the other area variables are statistically significant in 2008. Also, the size of an MSA was not a statistically significant determinant of the work/no work decision in 2000 or 2008.

5.3.2 Comparing Working Fulltime/Part Time Empirical Results

Socioeconomic and Demographic Variables

The predicted RN wage has negative and statistically significant effects on the probability of working fulltime in both 2000 and 2008. As Brewer et al. note "the likelihood of working fulltime decreasing as the wage rate increases, suggesting a backward bending labor supply curve." (Brewer et al, 2006, p.878). They also found

the probability of working fulltime decreases as other family income rises for married RNs.

Both married and single non-white RNs are more likely to work fulltime versus part time in 2000, while race appears to affect only married female RNs' labor supply choices in 2008.

Educational attainment has substantial effect in 2008. RNs with a diploma degree are less likely to work fulltime than RNs with an associate degree in 2008, working RNs with a diploma degree, approximately, 3% less likely to work fulltime then working RNs with an associate degree. Having a diploma degree did not have a significantly different effect than having an associate degree in 2000. Married female RNs with baccalaureate degrees were more likely to work fulltime in 2008 but not in 2000. RNs with a Master's degree or higher are more likely to work fulltime than RNs with an associate degree in both years, although the marginal effects vary in magnitude. Working married RNs with a Master's degree or higher are 8% more likely to work fulltime in 2008 while this number is 14% in 2000.

Single RNs are more likely to work fulltime if they are not fulltime students in 2000 and 2008, while student status is not significant in the statistical sense for married RNs.

Brewer et al. stated that the hypothesis that age is negatively related to working fulltime is only marginally supported, as in their results only being single and age 65 or older has statistically significant effects in 2000. However, these 2008 estimation results show much stronger support for that hypothesis, especially for married RNs.

However, a look at the participation and fulltime work behavior of RNs indicates a very high participation rate as well as a stable percentage of fulltime workers.

Table 5.4 Employment Status of Female RNs Residing in an MSA by Age and Marital Status (Data: NSSRN 2008)

	Married Female RNs			Single Female RNs		
	Employed (%)	Fulltime (%)	Part time (%)	Employed (%)	Fulltime (%)	Part time (%)
Age 24 or less	97.10	87.56	12.44	95.44	94.35	5.65
25-29	94.82	72.69	27.31	96.40	88.00	12.00
30-34	90.13	67.69	32.31	94.50	91.41	8.59
35-39	88.93	66.35	33.65	95.08	84.20	15.80
40-44	89.92	66.73	33.27	93.43	85.71	14.29
45-49	89.95	69.61	30.39	91.78	88.64	11.36
50-54	88.09	73.79	26.21	91.33	85.76	14.24
55-59	86.31	70.42	29.58	86.26	83.81	16.19
60-64	71.48	62.72	37.28	79.54	76.02	23.98
65 and above	46.76	35.51	64.49	52.00	44.41	55.59

Age is expected to have a negative influence on work participation decisions. Table 5.4 shows the employment, fulltime, and part time working ratios of RNs by age and marital status. The employment ratios of both married and single RNs show a decreasing pattern by age. Approximately 95% of married RNs age 30 or less are employed, this percentage drops to 90% for RNs age 30-50, and keeps dropping up to 47% by age 65. The employment percentage of single RNs are higher than married RNs in same age group. Approximately 95% of single RNs who are younger than age 40 are employed; this ratio drops to 90% by age 54 and keeps dropping up to 52% by age 65.

RNs with young children are less likely to work fulltime for both years and, while for both years only having children older than age 6 only has a negative effect for married RNs. The marginal effects for both years are very close. Working married RNs with children age 6 or below are 27% less likely to work fulltime than working married RNs with no children at home in 2000 and 26% in 2008. Working married RNs with children age 6 and above are 10% less likely to work fulltime in 2000 and 12% in 2008. Having children has smaller impact on single RNs relative to married RNs in both years. Working single RNs with some children age 6 and below and some children age 6 and above 13% less likely to work fulltime in 2000 and 8% in 2008 while these numbers are, respectively 25% and 23% for working married RNs.

Table 5.5 shows the probability of working and probability of working fulltime for both married and single RNs with respect to presence and the age of children at home. As the table shows, it is clear that the probability of work participation of married RNs is always lower than single RNs. However, the work participations of both married and single RNs are very similar for all of the presence of children variables. This reflects the estimation results from tables 5.1 and 5.2, where the presence of children at home variables did not have significant coefficients. The probability of working fulltime is 51% for married RNs who have children under age 6 and 81% for single RNs who have children under age 6.

Brewer et al. hypothesized that job satisfaction with work should be positively related to participation and that decreased job satisfaction compared with a year ago should have a negative effect on the probability that a RN works fulltime. They interpreted this finding as follows: “this negative effect may reflect 'reverse causation' if part time jobs are less satisfying rather than indicating that RNs who are less

satisfied chose to work fewer hours" (Brewer et al., 2006, p.879). As in their results for 2000, in these 2008 results this hypothesis is only supported for married RNs.

Table 5.5 Probability of Work Participation of Female RNs Residing in an MSA by Marital Status (Data: NSSRN 2008)

Probability of work participation for RNs with	Married Female (%)	Single Female (%)
No children at home	86.12	86.36
Children at home - all < 6 years	81.67	84.69
Children at home - all > 6 years	85.58	87.94
Children at home - both >6 years and <6 years	79.18	84.66
Probability of fulltime work participation for RNs with		
No children at home	76.74	83.54
Children at home - all < 6 years	51.25	80.74
Children at home - all > 6 years	62.63	81.7
Children at home - both >6 years and <6 years	52.59	74.94

Brewer et al. further hypothesized that there should be a positive relationship between job satisfaction and fulltime work participation. They comment that this hypothesis is supported only for married RNs in 2000. This result is mirrored in 2008. Brewer et al. explained the negative relation between job satisfaction and working part time as "reverse causation" by saying "if part time jobs are less satisfying, rather than indicating that RNs who are less satisfied choose to work fewer hours" (2006, p.879).

Relative to a hospital setting, student health, ambulatory care and education settings reduce the probability of working fulltime in 2000, while working in a home health setting or ambulatory care setting reduces the probability of working fulltime for married RNs in 2008. Married RNs who work in insurance settings are more likely to work fulltime in 2000, while public/community health, school health and insurance/benefits/utilization settings increase the probability of working in 2008.

Work positions also influence the RNs choice of fulltime/part time. The probability of working fulltime is higher for staff RN positions (the omitted group) than most other positions in both years.

Area Variables

Working single RNs living in small and medium MSAs are less likely to work fulltime than working single RNs living in large MSAs in 2008 by, respectively, 4% and 2%, while MSA size does not affect married RNs' labor supply decisions. The same MSA size dummies have positive marginal effects in 2000 and suggest higher probability of working fulltime in small and medium size MSAs versus large MSAs.

As established in previous sections, not all area variables are comparable in 2000 and 2008. Both the percentage of population below the poverty line and the percentage of the population under age 65 without health insurance have significant effects on married female RNs' fulltime work decisions in 2008. However, only the percentage of the population under age 65 without health insurance had a significant effect in 2000.

The percent unemployment in an MSA has negative marginal effect on married female RNs probability of fulltime work in 2008, but was insignificant in 2000. In the current literature there is some controversy over the impact of unemployment. Brewer et al. did not find any impact of unemployment as they cited "[like] Dusansky et al. (1985) and Lake (1998), I found no relationship between MSA unemployment rates and nurses' work behavior. Buerhaus (1995) reported an inverse relationship..." (Brewer et al, 2006, p.879).

The area variables do not affect single RNs' labor supply in either 2000 and 2008 as much as strongly as they effect married RNs' labor supply, which supports the

concept that single female RN are more mobile and may switch among employers and locations to find desirable working conditions more easily.

5.4 Comparing Estimation Results for RNs Residing in an MSA and Residing Outside of an MSA

As explained in Chapter 4, the area variables used in the model were based on county level data which were aggregated into MSA level data for the MSA subset of the NSSRN. The non-MSA (rural) data subset uses the county level area variables. Since the dummy variables for MSA size were only computed for MSA data, the non-MSA sample does not include those variables in the model. Also the non-MSA sample is considerably smaller than the MSA sample. As a result, some of the work position and work setting variables had to be excluded.

Table 5.6 shows results for the participation part (WK/NW) of the bivariate probit regression for married and single RNs living outside of an MSA (non-MSAs) .

As in the bivariate models for both married and single RNs living in MSAs, ρ is significant for RNs who live in areas not classified as MSAs

5.4.1 Comparing the Participation Empirical Results

Socioeconomic and Demographic Variables

Consistent with the MSA results, the predicted RN wage does not appear to impact labor market participation for married RNs in non-MSA model; however, it has positive and significant but very small effect on single RNs' labor supply decision. Specifically, a 1 percentage point increase in the log of RN wage will increase the probability of work participation by 0.004%.

Other household income has the expected negative effect on work participation of both single and married RNs in non-MSAs.

Table 5.6 Participation Equations: Single Female RNs Residing Outside of an MSA (Data: NSSRN 2008) [13]

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Predicted log market wage	0.38323	0.0406975	1.53942**	0.0004587
	(0.34594)		(0.76150)	
Log other income	-0.68754***	-0.0734137	-0.89799***	-0.0002842
	(0.03708)		(0.07307)	
Race other (white)	-0.06248	-0.0076086	0.23483	0.0000693
	(0.11304)		(0.23455)	
Number of doctors per 1,000 population	0.60972***	0.0653493	0.58952	0.0002045
	(0.18478)		(0.43579)	
% of population below poverty	0.00850	0.0008211	-0.01847	-0.00000744
	(0.00670)		(0.01505)	
% of uninsured population below age 65	-0.01097*	-0.0012533	0.03629***	0.0000108
	(0.00582)		(0.01311)	
% of unemployment	0.01522	0.0016818	0.01569	0.00000732
	(0.01875)		(0.04389)	
Education - Diploma (associate)	-0.02962	-0.0032462	-0.28647	-0.0001288
	(0.08238)		(0.17808)	
Education - Baccalaureate (associate)	0.01503	0.0013978	0.07790	0.0000267
	(0.06990)		(0.16379)	
Education - Masters or more (associate)	0.31461**	0.0275487	0.05535	0.0000211
	(0.12240)		(0.26474)	
Foreign Education (in US)	-0.28918	-0.0383447	0.12025	0.0000158
	(0.20374)		(0.68319)	
Not student (full-time student)	0.18967	0.0232209	0.48406	0.0003437
	(0.19575)		(0.33181)	
Part time student (full-time student)	0.45377*	0.0347797	0.91587*	0.0000896
	(0.24089)		(0.49140)	

[13] The previous work position variables are excluded from Table 5.6 and are available in Appendix D.

Table 5.6 Participation Equations: Single Female RNs Residing Outside of an MSA (Data: NSSRN 2008) [13] (Continued)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Age < 25 (25-29)	0.04966	0.0050914	0.47631	0.0000705
	(0.35035)		(0.45802)	
Age 30-34 (25-29)	0.01935	0.0016644	0.30537	0.0000593
	(0.19606)		(0.43389)	
Age 35-39 (25-29)	-0.15929	-0.0191915	-0.06935	-0.0000337
	(0.19558)		(0.43534)	
Age 40-44 (25-29)	-0.43162**	-0.0605212	-0.15019	-0.0000616
	(0.19699)		(0.38142)	
Age 45-49 (25-29)	-0.50897***	-0.0711139	-0.01413	-0.00000538
	(0.19294)		(0.37165)	
Age 50-54 (25-29)	-0.68428***	-0.1034121	0.08693	0.00003
	(0.19365)		(0.35175)	
Age 55-59 (25-29)	-0.83376***	-0.1393088	-0.14660	-0.00005
	(0.19707)		(0.34175)	
Age 60-64 (25-29)	-1.34813***	-0.3047039	-0.50009	-0.0003501
	(0.20245)		(0.34847)	
Age ≥ 65 (25-29)	-1.91759***	-0.525622	-0.66745*	-0.0006575
	(0.20381)		(0.34187)	
Children at home - all < 6 years (no children at home)	-0.46225***	-0.065983	0.15808	0.0000324
	(0.13480)		(0.43186)	
Children at home - all > 6 years (no children at home)	-0.01285	-0.0011651	0.30068	0.0000686
	(0.07937)		(0.20353)	
Children at home - both >6 years and <6 years (no children at home)	-0.35200**	-0.0470271	0.34208	0.0000573
	(0.14500)		(0.43100)	
% of hospital RNs in an area who work full-time	-0.16099	-0.0171556	-0.63532	-0.0002027
	(0.17642)		(0.40855)	
Constant	7.79734***		4.08031*	
	(1.14692)		(2.40156)	
Rho	-0.77338***		-0.82625***	
	(0.05637)		(0.1674)	
Number of observations	4342		1308	

Table 5.6 Participation Equations: Single Female RNs Residing Outside of an MSA (Data: NSSRN 2008) [13] (Continued)

Explanatory Variable (Reference Category in Parentheses)	Married Female RNs		Single Female RNs	
	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Censored observations	660		190	
Uncensored observations	3682		1118	
Log likelihood	-3231.025		-727.541	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

For married and single nurses residing in an MSA, attainment of a Master's degree or higher is associated with a higher probability of working. This only holds for married RNs who live in non-MSAs. Student status has similar effects on RNs' work/no work decision in both MSAs and non MSAs; specifically, part time students are more likely to work fulltime than fulltime students.

Age is expected to have a negative influence on work participation decisions. Married female RNs who live in non-MSAs are less likely to work at older ages relative to married RNs who live in MSAs; however, estimation results for non-MSAs do not show any impact of age on single RNs' work participation decisions for any age below 65. Table 5.7 shows the employment, fulltime, and part time working ratios of RNs by age and marital status. The employment ratios of married RNs who live in non-MSA show a decreasing pattern by age similar to the pattern shown in married RNs who lives in MSAs. However, the employment ratios of single RNs who live in non-MSAs do not show a clear pattern until the age of 50 and then start decreasing.

Table 5.7 Employment Status of RNs Residing outside of an MSA by Age and Marital Status (Data: NSSRN 2008)

	Married Female RNs			Single Female RNs		
	Employed (%)	Fulltime (%)	Part time (%)	Employed (%)	Fulltime (%)	Part time (%)
Age 24 or less	95.77	88.24	11.76	90.74	91.84	8.16
25-29	94.88	72.06	27.94	91.78	88.06	11.94
30-34	93.45	75.00	25.00	95.00	86.84	13.16
35-39	92.91	70.69	29.31	93.98	85.90	14.10
40-44	89.98	77.01	22.99	92.17	86.79	13.21
45-49	89.40	74.68	25.32	92.07	89.40	10.60
50-54	86.50	75.14	24.86	92.17	84.91	15.09
55-59	83.80	75.87	24.13	84.43	80.45	19.55
60-64	70.11	55.09	44.91	75.80	78.15	21.85
65 and above	48.21	31.85	68.15	57.86	46.91	53.09

Having small children has a major effect on work participation for married RNs who live in non-MSAs. The presence of children has very similar effects for RNs who living in and out of MSAs. Married RNs whose children are all under the age 6 as well as RNs whose children are both under and over the age 6 are less likely to work. The probability of both married RNs living in MSAs and non-MSAs who have some children under the age 6 and some children above the age 6 working is approximately 4% less than RNs without any children at home. The effect of having children under the age of 6 is three times larger in non-MSAs. These marginal effects are, respectively, -1.9% and -6%.

Area Variables

RNs living outside of an MSA are more responsive to area variables than RNs living in an MSA. Unlike the results for RNs who live in an MSA, where the coefficient of the doctors per 1000 population variable is never statistically significant

in the work/no work equation, the number of doctors per 1000 population has a positive and significant coefficient for married RNs who live in non-MSAs. The only area factor which influenced the work participation decision of RNs who lived in MSAs was the percentage of the population under the age 65 without health insurance and this result only held for married RNs for whom it had a negative effect on work participation. In non-MSAs, not having insurance negatively impacts married RNs labor participation and positively impacts single RNs labor participation, which is a highly unexpected result. Table 5.6 shows the positive effect of the percentage of the uninsured population below age 65 on the labor participation of single RNs who live in non-MSAs.

As was the case for RNs living in MSAs, the unemployment rate does not have any influence on RNs decision to work in non-MSAs.

An increase in the percentage of hospital RNs in an area who work fulltime is only statistically significant and negative for married nurses residing in an MSA. Otherwise it is not a statistically significant determinant of whether a married or single nurse participates in the labor force.

Table 5.8 shows results for the fulltime/part time (FT/PT) portion of the bivariate probit regression for married and single RNs living in non MSA areas. Empirical results are discussed in the following sections.

Table 5.8 Fulltime/Part Time Equations: Married and Single Female RNs Residing Outside of an MSA (Data: NSSRN 2008)[14]

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Predicted log market wage	-0.60292**	-0.1840031	-0.62829	-0.1370468
	(0.27569)		(0.55673)	
Log other income	-0.05120***	-0.0351863	-0.00730	-0.0015151
	(0.01054)		(0.01199)	
Race other (white)	0.29702***	0.0937343	-0.14186	-0.0288421
	(0.09517)		(0.15968)	
Number of doctors per 1,000 population	-0.08535	-0.0106186	-0.29951	-0.0642988
	(0.12652)		(0.25965)	
% of population below poverty	0.01429**	0.0048359	0.00325	0.0007998
	(0.00577)		(0.01261)	
% of uninsured population below age 65	-0.00482	-0.0018161	-0.00676	-0.001354
	(0.00513)		(0.01026)	
% of unemployment	0.01946	0.0066099	0.05780	0.0122362
	(0.01589)		(0.03712)	
Education - Diploma (associate)	-0.11679	-0.0395835	0.03851	0.0084162
	(0.07663)		(0.15551)	
Education - Baccalaureate (associate)	-0.15589***	-0.050423	0.03037	0.0065104
	(0.05884)		(0.12622)	
Education - Masters or more (associate)	0.09475	0.0360587	0.39031*	0.0711905
	(0.11896)		(0.23687)	
Foreign Education (in US)	0.29299	0.0772475	0.73340	0.1018667
	(0.19287)		(0.57353)	
Not student (full-time student)	0.29844*	0.1119819	0.41040	0.106358
	(0.15396)		(0.29087)	
Part time student (full-time student)	0.42719**	0.121159	0.22185	0.0425177
	(0.18588)		(0.36049)	

[14] Previous work position, employment setting and position title variables are excluded from Table 5.8 and available at appendix D.

Table 5.8 Fulltime/Part Time Equations: Married and Single Female RNs Residing Outside of an MSA (Data: NSSRN 2008)[14]

(Continued)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Age < 25 (25-29)	0.48668**	0.127976	0.15814	0.0305759
	(0.23159)		(0.34501)	
Age 30-34 (25-29)	0.06770	0.0217875	-0.17258	-0.0403396
	(0.12542)		(0.28630)	
Age 35-39 (25-29)	-0.11664	-0.0441537	-0.31116	-0.0767129
	(0.12626)		(0.29087)	
Age 40-44 (25-29)	-0.02359	-0.0240569	-0.31522	-0.0773903
	(0.13462)		(0.28131)	
Age 45-49 (25-29)	-0.16951	-0.0787974	-0.22264	-0.0522014
	(0.12980)		(0.27419)	
Age 50-54 (25-29)	-0.14827	-0.0814831	-0.41224	-0.1017978
	(0.13078)		(0.25674)	
Age 55-59 (25-29)	-0.19840	-0.1145867	-0.56814**	-0.1474666
	(0.13644)		(0.25731)	
Age 60-64 (25-29)	-0.62089***	-0.3898111	-0.49416*	-0.1287937
	(0.14857)		(0.27260)	
Age ≥ 65 (25-29)	-0.90221***	-0.6320259	-1.38950***	-0.4446749
	(0.17487)		(0.29108)	
Children at home - all < 6 years (no children at home)	-0.51034***	-0.2138955	-0.53486**	-0.1468501
	(0.10279)		(0.25252)	
Children at home - all > 6 years (no children at home)	-0.19880***	-0.066102	0.05828	0.0123836
	(0.06381)		(0.14624)	
Children at home - both >6 years and <6 years (no children at home)	-0.47152***	-0.190858	0.04263	0.008683
	(0.11052)		(0.36933)	
% of hospital RNs in an area who work full-time	1.03727***	0.3230066	0.85943***	*0.1667773*
	(0.15070)		(0.32730)	
Feeling about job (1=extremely satisfied, 5=extremely dissatisfied)	-0.02732	-0.0087904	0.06631	*0.0142282*
	(0.02361)		(0.05062)	
Constant	2.26804***		2.21251	
	(0.87529)		(1.78844)	

Table 5.8 Fulltime/Part Time Equations: Married and Single Female RNs Residing Outside of an MSA (Data: NSSRN 2008)[14]

(Continued)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Number of observations	4342		1308	
Censored observations	660		190	
Uncensored observations	3682		1118	
Log likelihood	-3231.025		-727.541	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

5.4.2 Fulltime/Part Time Empirical Results

Socioeconomic and Demographic Variables

Fulltime work participation decreases with the predicted RN wage for both married and single RNs who live in MSAs; however, this negative effect is not statistically significant for single RNs who live in non-MSA.

Other household income and race variables have very similar effects for RNs who live in MSAs and non-MSAs. Non-white working married RNs are 11% more likely to work fulltime than white working married RNs regardless of where she resides while race does not have an effect on single RNs.

The similarity in behavior between RNs in MSAs and non MSAs does not apply to the effects of educational attainment. Compared to RNs who have associate degrees, those holding diploma and baccalaureate degrees are less likely to work

fulltime, while RNs holding a Master's degree or higher are more likely to work fulltime in MSAs. However, only the coefficient on the baccalaureate degrees is significant for married RNs who live in non-MSAs. Working married RNs holding a baccalaureate degree are 5% less likely to work fulltime than a working married RNs holding an associate degree in a non- MSA and 4% less likely in an MSA.

Receiving a nursing degree abroad had a significantly positive effect on fulltime work participation for RNs who live in MSAs, but has no effect for RNs who live in non-MSAs. This difference can be explained by the different percentages of the RNs holding a foreign degree in MSAs and non-MSAs. Table 4.1 shows that 5% of the total RNs who live in MSAs obtained their nursing degree abroad while this percentage is less than 2% for RNs living outside of MSAs (as shown in Table 4.4).

As was the case for nurses residing in an MSA, age negatively effects the decision to work fulltime versus part time. The negative effect appears to occur earlier for married nurses living outside of an MSA. There is no trend for single nurses until they hit the age of 65.

Table 5.9 shows the probability of working, and probability of working fulltime for both married and single RNs with respect to presence and the age of children at home. From the table, it is clear that, as expected, the probability of work participation of married RNs is always lower than single RNs in non-MSA. The probability of working fulltime is 60% for married RNs with children under the age of 6 living in non-MSAs. Married RNs who live in non-MSAs with children at any age have higher probability of working fulltime than the corresponding group who lives in MSAs.

Table 5.9 Probability of Work Participation of Female RNs Residing Outside of an MSA by Marital Status (Data: NSSRN 2008)

Probability of work participation for RNs with	Married Female (%)	Single Female (%)
No children at home	85.73	88.92
Children at home - all < 6 years	75.29	88.31
Children at home - all > 6 years	84.68	88.95
Children at home - both >6 years and <6 years	77.72	87.84
Probability of fulltime work participation for RNs with		
No children at home	77.6	83.49
Children at home - all < 6 years	59.15	69.83
Children at home - all > 6 years	69.6	84.37
Children at home - both >6 years and <6 years	59.99	83.49

The position title and work settings have fairly similar effects for RNs who live in MSAs and non-MSAs.

Area Variables

In the MSA results, all area variables (the number of doctors per 1,000 population, the percent of the population below the poverty line, the percent of the population without health insurance under the age 65, and the unemployment rate) impacted the fulltime versus part time labor supply decision for married RNs, while only the unemployment rate has an effect on single RNs. However, the same conclusion does not hold for RNs who live outside of an MSA. Only an increase in the percent of the population below the poverty line increases the probability of working fulltime for married RNs who live in non-MSAs.

An increase in the percentage of hospital RNs in an area who work fulltime increase the probability of both single and married RNs working fulltime in all models

with significant and large marginal effects. A one percent point increase in the percentage of hospital RNs in an area who work fulltime increases the probability of work for RNs who live MSAs by approximately 29%, married RN in non-MSAs by 32%, and single RNs in non-MSAs by 17%.

An increase in the percentage of hospital RNs in an area who work fulltime increases the probability of both single and married RNs working fulltime in all models with significant and large marginal effects. A one percent point increase in the percentage of hospital RNs in an area who work fulltime increase the probability of work for RNs who live in MSAs by approximately 29%, married RN in non-MSAs by 32%, and single RNs in non-MSAs by 17%.

Chapter 6

PARTICIPATION AND HOURS OF WORK DECISION MODEL WITH NSSRN DATA

6.1 Model

This chapter analyzes the determinants of the annual hours worked by nurses utilizing a standard maximum likelihood model (MLE) in a form proposed by Link (1992) based on Heckman's (1979) and Mroz's (1987) earlier studies. The equations take the following form:

$$Y_{i1} = \beta X_{i1} + \varepsilon_{i1}$$

$$Y_{i2}^{*} = \delta X_{i2} + \varepsilon_{i2}$$

where Y_{i1} is the logarithm of hours worked by RNs; Y_{i2} is a latent variable indicating whether or not a person works; and X_{i1} and X_{i2} are vectors of explanatory variables for individual i. X_{i1} and X_{i2} include, among other variables, the logarithm of the RN wage, other family income, and the composition of the nurse's family. ε_{i1} and ε_{i2} are assumed to be bivariate normal with a correlation of ρ. The estimation strategy yields consistent and efficient estimates of β, δ, ρ and σ, where σ is the standard error of Equation 1; and also allows for the possibility that there are unobservable variables

affecting the decisions to work and, if hours worked are greater than zero, the number of hours worked.

This chapter focuses on the following questions:

1. Are work participation and hours of work provided related to the wage rate, other family income, and the presence of children in the home?
2. Do area factors, such as the number of doctors, the unemployment rate, and the percent of the population without health insurance below age of 65, influence the hours of work supplied by nurses?

The variables included in both the work/no work equation and the hours of work equations include the following variables: the RN wage, age, race, ages of children in the home, marital status, educational attainment, current student status, RN is foreign trained, previous job position, other household income, MSA size, unemployment rate, percentage of the population below poverty line, the percentage of population without health insurance below the age of 65, the percentage of hospital nurses in the MSA that are employed fulltime, and doctors per 1,000 population. Some additional variables are only available for working nurses and thus, are only included in the hours worked equation. They include work setting, work title, work position, and job satisfaction.

The model is estimated for married and single female RNs who live in MSAs and non-MSAs. The reference category of each binary explanatory variable is indicated in parentheses. Empirical results are discussed in the following sections.

6.2 Empirical Results

The results for the participation equation are shown in Table 6.1Columns 1 and 2 are the results respectively for married and then single RNs who reside in MSAs. Columns 3 and 4 are results for non-MSAs.

6.2.1 Significant Variables in the Participation Regression

Socioeconomic and Demographic Variables

The wage rate has two effects on the labor supply decision: income and substitution effects. An income effect, representing the change in hours worked caused by an increase in the RNs' income, would presumably cause a decline in hours worked, as leisure is a normal good. The substitution effect, representing the change in hours worked caused by a shift in the relative value of an hour of labor versus and hour of leisure, would presumably cause an increase in hours worked due to the substitution of more (valuable) hours of labor for hours of leisure (Reynolds, et al, 1986). In the participation equation, the income effect should not be observed, because if an RN does not currently work, higher wages could not reduce the probability of working. Thus, only the positive substitution effect should be observed in the participation model. In the hours model, the effect of higher wages is ambiguous since it is not clear whether the income or substitution effect will dominate. As mentioned in the chapter 2, most recent research on nurses' labor supply behavior suggests that their labor supply is inelastic but not backward bending.

Only single RNs living outside of an MSA show a positive and significant coefficient on the RN wage variable. Participation rates of married RNs living in

Table 6.1 Participation Equations: Female RNs Residing in or Not Residing in an MSA by Marital Status (Data: NSSRN 2008)[15]

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Predicted log market wage	-0.01591	0.40001	0.24624	1.58336**
	(0.15571)	(0.39195)	(0.26513)	(0.78197)
Log other income	-0.29882***	-0.85865***	-0.21100***	-0.92613***
	(0.01582)	(0.03421)	(0.02660)	(0.07518)
Race other (white)	-0.06194	0.03332	0.01216	0.21725
	(0.03790)	(0.08501)	(0.08485)	(0.24201)
Number of doctors per 1,000 population	0.09044	0.29942	0.32692**	0.67475
	(0.09763)	(0.22331)	(0.14488)	(0.44672)
% of population below poverty	-0.00308	-0.00799	0.00464	-0.01852
	(0.00533)	(0.01399)	(0.00531)	(0.01544)
% of uninsured population below age 65	-0.00571*	0.00273	-0.00285	0.03280**
	(0.00332)	(0.00825)	(0.00455)	(0.01350)
% of unemployment	0.00585	-0.02547	0.00941	0.01955
	(0.01400)	(0.03603)	(0.01402)	(0.04430)
Education - Diploma (associate)	-0.00206	-0.00740	-0.04022	-0.32694*
	(0.03712)	(0.09253)	(0.06657)	(0.18356)
Education - Baccalaureate (associate)	0.02286	0.02523	0.02493	0.12350
	(0.02973)	(0.07766)	(0.05356)	(0.16564)
Education - Masters or more (associate)	0.15113***	0.30119**	0.31092***	0.04525
	(0.05091)	(0.12667)	(0.09634)	(0.27218)
Foreign Education (in US)	0.00651	0.06539	-0.26927*	0.34469
	(0.06218)	(0.16252)	(0.15738)	(0.65621)
Not student (full-time student)	-0.05726	0.19705	-0.03028	0.52172
	(0.07494)	(0.16846)	(0.14466)	(0.34593)
Part time student (full-time student)	0.04486	0.39516*	0.12795	1.00152**
	(0.09577)	(0.21344)	(0.17841)	(0.50397)

[15] The previous work position variables are excluded from Table 6.1 and are available at Appendix E.

Table 6.1 Participation Equations: Female RNs Residing in or Not Residing in an MSA by Marital Status (Data: NSSRN 2008)[15] (Continued)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Age < 25 (25-29)	-0.10932	-0.06290	-0.00275	0.57903
	(0.14867)	(0.24662)	(0.24077)	(0.46116)
Age 30-34 (25-29)	-0.06317	-0.49594**	-0.06239	0.50510
	(0.07057)	(0.21140)	(0.14337)	(0.43838)
Age 35-39 (25-29)	-0.04383	-0.31282	-0.07510	-0.11998
	(0.07095)	(0.22477)	(0.14613)	(0.44251)
Age 40-44 (25-29)	-0.00573	-0.64400***	-0.19515	-0.21291
	(0.07138)	(0.20511)	(0.14931)	(0.38910)
Age 45-49 (25-29)	-0.01333	-0.77848***	-0.27438*	0.04483
	(0.07056)	(0.19380)	(0.14613)	(0.37927)
Age 50-54 (25-29)	-0.03222	-0.80239***	-0.31271**	0.12371
	(0.06976)	(0.18702)	(0.14864)	(0.35974)
Age 55-59 (25-29)	-0.06805	-1.11116***	-0.33617**	-0.14334
	(0.07199)	(0.18603)	(0.15236)	(0.34667)
Age 60-64 (25-29)	-0.30470***	-1.34891***	-0.41853***	-0.42559
	(0.07436)	(0.18663)	(0.15911)	(0.35454)
Age ≥ 65 (25-29)	-0.56353***	-1.78334***	-0.65471***	-0.64123*
	(0.07878)	(0.17920)	(0.16247)	(0.34897)
Children at home - all < 6 years (no children at home)	0.17249***	-0.14610	-0.17417*	0.33294
	(0.04857)	(0.20023)	(0.10234)	(0.43869)
Children at home - all > 6 years (no children at home)	0.10466***	0.14898	0.00790	0.34961*
	(0.03215)	(0.09333)	(0.06154)	(0.20824)
Children at home - both >6 years and <6 years (no children at home)	0.06858	-0.13406	-0.08024	0.30525
	(0.05249)	(0.23618)	(0.11091)	(0.44102)
Small MSA (large MSA)	0.05415	0.01941		
	(0.03924)	(0.10875)		
Medium MSA (large MSA)	-0.01314	0.07573		
	(0.02819)	(0.07225)		
% of hospital RNs in an area who work full-time	-0.20480*	0.46367*	-0.31528**	-0.68766*
	(0.11019)	(0.28021)	(0.13689)	(0.41689)

Table 6.1 Participation Equations: Female RNs Residing in or Not Residing in an MSA by Marital Status (Data: NSSRN 2008)[15] (Continued)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Constant	4.44648***	8.64546***	2.63999***	4.19484*
	(0.54284)	(1.33042)	(0.86104)	(2.46157)
Rho	-0.97367***	-0.22973***	-0.98189***	-0.77113***
	(0.00250)	(0.04365)	(0.00374)	(0.10821)
Number of observations	15188	5585	4342	1308
Censored observations	2217	753	660	190
Uncensored observations	12971	4832	3682	1118
Log likelihood	-12916.5	-3258.062	-3887.609	-959.2972

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

MSAs and non-MSAs are not affected by the wage. The same goes for married RNs outside of the MSAs.

An increase in the log of other household income is associated with a decrease in the probability of work participation for both single and married female RNs regardless of where they live, with a particularly strong effect (more than twice as strong) for single RNs. The impact of the other household income on the work participation of single RNs' being larger than the impact on the work participation of married RNs was also an outcome of the participation part of the bivariate probit model in Chapter 5. Holding a Master's degree or a higher versus an associate degree is associated with an increase in the probability of participation for both married and single RNs who live in MSAs but only increased the work participation probability for

married RNs who live outside of an MSA. Being a part time student versus fulltime student increases the probability of participation for single RNs who live in or out of an MSA. Married RNs who live in MSAs and hold a Master's degree or more, are 15% more likely to work than an RN with an associate degree. This figure is 30% for single RNs who live in MSAs.

The negative age effect on participation is present and was discussed earlier in Chapter 5.

The regression results indicate that the effect of having children age 6 or below and having some children age 6 or below and some children age 6 and above is positive on work participation decision of married female RNs who live in MSAs. This outcome is not expected and not plausible as well. A married female with a small child having a higher work probability than a married female without any children present at home cannot be explained and is contradictory to results in the labor supply literature. This outcome is likely due to a misspecification in the MLE participation-hours model. I was forced to use the nonlinearity of the estimation procedure to identify the model. This was the case since the surveys underlying the dissertation did not provide suitable information to create instrumental variables that could be used to identify the structural model. The participation part of the WK/NW and FT/PT model from Chapter 5 as well as simple univariate probit model for participation indicate negative coefficients of mentioned children variables of married RNs for same dataset[16]. Married RNs who live outside of an MSA with children age 6 and below in the household are less likely to work than RNs with no children. Rho is negative and

[16] Univariate probit result is available at appendix F.

statistically significant for all models in Table 6.1, indicating that the decision to work and hours worked are correlated.

Area Variables

As it turns out, the area variables are not very important determinants of RN participation rates. For married nurses living in an MSA none of the coefficients of the area variables were significant at the 5 % level. Only the percent of the population under age 65 without health insurance was significant, but only for single nurses residing outside of an MSA. The number of doctors per 1,000 population has a positive effect on work participation but just for married RNs who live outside of an MSA.

The percent of population without health insurance below the age of 65 has a positive effect on the RNs participation rate, but the effect is statistically significant at 5% level for single RNs who live in outside of an MSA. A one percentage point increase in the percent of the population without health insurance below the age of 65 increases the probability that single female RNs participates by 3%. For RNs who lived in an MSA, its size does not affect participation; nor does the previous job position held by the nurse prior to becoming an RN.

6.2.2 Significant Variables in Logarithm of Hours Regression

Table 6.2 shows the results for the annual hours equations for RNs.

Socioeconomic and Demographic Variables

Since the RN wage and other household income variables are measured in logarithms in the equation for hours worked, the coefficients for these variables measure the elasticity of hours of labor with respect to wage and other household income.

Table 6.2 Log of Hours Equation: Female RNs Residing in or Not Residing in an MSA by Marital Status (Data: NSSRN 2008)[17]

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Predicted log market wage	-0.06249	-0.08681	-0.16897	-0.12286
	(0.06163)	(0.07343)	(0.11063)	(0.16184)
Log other income	-0.00565***	-0.00782***	-0.00815**	-0.00853**
	(0.00179)	(0.00131)	(0.00366)	(0.00349)
Race other (white)	0.08322***	0.00994	0.03495	0.05693
	(0.01463)	(0.01482)	(0.03529)	(0.04705)
Number of doctors per 1,000 population	-0.01757	0.00315	-0.01538	0.02817
	(0.03656)	(0.04080)	(0.05136)	(0.07731)
% of population below poverty	0.00441**	0.00343	0.00085	0.00222
	(0.00213)	(0.00256)	(0.00220)	(0.00331)
% of uninsured population below age 65	0.00304**	0.00044	-0.00182	-0.00062
	(0.00132)	(0.00152)	(0.00200)	(0.00289)
% of unemployment	-0.00341	-0.00411	0.00730	-0.00196
	(0.00542)	(0.00672)	(0.00625)	(0.00996)
Education - Diploma (associate)	-0.02934*	-0.01853	-0.01536	-0.00474
	(0.01525)	(0.01890)	(0.03040)	(0.04639)
Education - Baccalaureate (associate)	-0.03928***	0.00005	-0.05072**	-0.03026
	(0.01155)	(0.01382)	(0.02333)	(0.03560)
Education - Masters or more (associate)	0.01656	0.01813	-0.02582	0.00640
	(0.02160)	(0.02623)	(0.04319)	(0.06685)
Foreign Education (in US)	0.06722***	0.06602**	0.16942**	0.06161
	(0.02382)	(0.02912)	(0.07095)	(0.11800)
Not student (full-time student)	0.02044	0.09251***	0.07821	0.23822***
	(0.02904)	(0.03009)	(0.06239)	(0.09066)
Part time student (full-time student)	0.05714	0.08265**	0.11709	0.19311*
	(0.03495)	(0.03659)	(0.07363)	(0.10864)

[17] The previous work position, employment setting and position title variables are excluded from Table 6.2 and are available at appendix E.

Table 6.2 Log of Hours Equation: Female RNs Residing in or Not Residing in an MSA by Marital Status (Data: NSSRN 2008)[17] (Continued)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Age < 25 (25-29)	0.03795	0.02439	0.06135	0.06415
	(0.04232)	(0.03208)	(0.07975)	(0.08684)
Age 30-34 (25-29)	0.00313	0.02557	-0.00115	0.01631
	(0.02439)	(0.02805)	(0.05061)	(0.07554)
Age 35-39 (25-29)	-0.01349	0.00377	-0.04582	-0.02581
	(0.02493)	(0.02894)	(0.05112)	(0.07794)
Age 40-44 (25-29)	-0.01688	0.00865	-0.03222	0.03712
	(0.02523)	(0.02806)	(0.05310)	(0.07505)
Age 45-49 (25-29)	0.00440	0.02528	0.02289	0.02141
	(0.02493)	(0.02651)	(0.05121)	(0.07148)
Age 50-54 (25-29)	0.01930	0.00616	0.02656	-0.01454
	(0.02469)	(0.02570)	(0.05149)	(0.06829)
Age 55-59 (25-29)	-0.02529	-0.01686	-0.01377	-0.00189
	(0.02583)	(0.02646)	(0.05334)	(0.06960)
Age 60-64 (25-29)	-0.05208*	-0.10736***	-0.12721**	-0.14538*
	(0.02813)	(0.02802)	(0.05836)	(0.07509)
Age ≥ 65 (25-29)	-0.14425***	-0.49724***	-0.17825***	-0.58591***
	(0.03212)	(0.03200)	(0.06342)	(0.08264)
Children at home - all < 6 years (no children at home)	-0.16211***	-0.00340	-0.10884***	-0.05499
	(0.01864)	(0.03314)	(0.04032)	(0.07524)
Children at home - all > 6 years (no children at home)	-0.07824***	0.00495	-0.03597	0.01420
	(0.01233)	(0.01506)	(0.02498)	(0.03867)
Children at home - both >6 years and <6 years (no children at home)	-0.13757***	-0.03105	-0.09958**	0.10290
	(0.02048)	(0.03812)	(0.04333)	(0.09475)
Small MSA (large MSA)	-0.01077	-0.04361**		
	(0.01504)	(0.01898)		
Medium MSA (large MSA)	0.01390	-0.02586*		
	(0.01118)	(0.01333)		
% of hospital RNs in an area who work full-time	0.12798***	0.10778**	0.24968***	0.03485
	(0.04280)	(0.05259)	(0.05914)	(0.09530)

Table 6.2 Log of Hours Equation: Female RNs Residing in or Not Residing in an MSA by Marital Status (Data: NSSRN 2008)[17] (Continued)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Feeling about job (1=extremely satisfied, 5=extremely dissatisfied)	0.00575	-0.00176	0.00695	0.00296
	(0.00368)	(0.00528)	(0.00691)	(0.01405)
Constant	7.64248***	7.75709***	7.93387***	7.75886***
	(0.20265)	(0.24070)	(0.35118)	(0.51909)
Number of observations	15188	5585	4342	1308
Censored observations	2217	753	660	190
Uncensored observations	12971	4832	3682	1118
Log likelihood	-12916.5	-3258.062	-3887.609	-959.2972

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

The wage coefficients all have a minus sign but none approach statistical significance. As suggested by Brewer et al, and Link and Chiha, this result suggests that increasing wages is likely to be an expensive way to increase labor hours among currently trained RNs. The small wage elasticity can be explained by relatively the high participation rate in this work force (see the discussion in Chapter 5 for a more detailed discussion).

Elasticity of hours with respect to other household income is -0.006 for married RNs who live in MSAs, - 0.008 for single RNs who live in MSAs, and -0.008 for RNs who live in non-MSAs.

Married RNs who live in an MSA with a baccalaureate or diploma degree tend to work fewer hours than associate degree holders. All nurses holding a foreign

diploma tend to work longer hours. Single RNs who are either fulltime or part time students, tend to work longer hours compared to fulltime students. There is no effect for married nurses.

Married female RNs who are non-white and who live in MSAs tend to work longer hours than whites Race does not affect single female RNs' labor hours.

The negative effect of aging on RNs labor hours decision becomes significant at age 60 for both single and married RNs. RNs above age 60 are both less likely to participate and when they do participate, they work fewer hours. The presence of children in the home, some or all of whom are under age 6, has the expected negative effect on hours for married as well as single nurses. However, the coefficient is only statistically significant for married nurses. This result for single nurses is not surprising since single nurses are more likely than married nurses to be the sole breadwinner.

Table 6.3 Probability of Work Participation and Hours Worked by Female RNs by Marital Status and Residence (Data: NSSRN 2008)

	MSA		Non-MSA	
Probability of work participation for RNs with	Married Female (%)	Single Female (%)	Married Female (%)	Single Female (%)
No children at home	86.12	86.36	85.73	88.92
Children at home - all < 6 years	81.67	84.69	75.29	88.31
Children at home - all > 6 years	85.58	87.94	84.68	88.95
Children at home - both >6 years and <6 years	79.18	84.66	77.72	87.84
Hours worked by RNs with				
No children at home	1970.083	1881.444	1953.873	1834.056
Children at home - all < 6 years	1622.139	1875.495	1723.198	1744.318
Children at home - all > 6 years	1773.819	1882.564	1853.815	1860.419
Children at home - both >6 years and <6 years	1651.074	1825.304	1733.823	1840.736

Relying on the results from Tables 6.1 and 6.2, Table 6.3, shows the probability of working and hours worked by RNs based on the presence and age of children at home. The computations show the probability of participation and hours worked for each category of child composition in the home. From the table, it is clear that the probability of participation of married RNs is always lower than single RNs regardless of their residence in or out of an MSA. Married RNs who do not live in MSAs and who have children of any age do work. In addition, they work longer hours than their counterparts residing in MSAs. Finally, given their overall high participation rates indicate that nurses are very much tied to the labor market (see the discussion of this idea in Chapter 4). As can be seen in the table, participation rates are almost at or greater than 80% for all categories of RNs.

Married RNs with no children at home work more hours than their married counterparts who have any children present in the home. Having children does not affect single RNs hours except for single RNs who live in outside of an MSA and have children at home all of whom are age 6 or below. Also single RNs with no children at home works less hours than married RNs. This result is intuitive, single RNs without children are capable to allocate more time for leisure.

Area Variables

The percentage of fulltime RNs in the hospital work force in the area of residence has a statistically significant effect on both single and married RNs hours. A higher percentage of RNs in the area who work fulltime is associated with longer work hours. Relative to a hospital setting, school health services and ambulatory health care work settings are associated with lower hours worked. Nurse practitioners, managers, nurse midwives, nurse anesthetists, researchers, and informatics, and patient

coordinators work longer hours than do staff nurses, while nurse consultants work less.

The area variables have practically no influence on RN hours. For married nurses living in an MSA, only two of the coefficients of the area variables were significant at the 5 % level. They were the percent of the population under age 65 without health insurance which has a negative effect on hours; and the percent of the population below the poverty line which had a positive effect on hours worked. None of the other area variables were important determinants of the log of annual hours.

6.3 Comparing Estimation Results with Chiha and Link (2003)

6.3.1 Comparing Participation Regression Empirical Results

Chiha and Link found that the RN wage had no significant effect on RNs' work participation decisions in 1992, 1996, and 2000; and the 2008 results are broadly consistent with this conclusion. Other household income negatively impacts the work participation of RNs regardless of marital status, MSA status. From a policy perspective, it is clear that the wage is not an efficient policy tool for increasing the participation or hours worked of currently trained nurses. Chiha and Link used continuous age in a quadratic form in their models. Their results suggest a clear relationship between age and participation, indicating that participation is likely to increase with age up to certain age and then decline. A similar continuous age variable was not available in the 2008 county level NSSRN data. Even so, the results for the age brackets available in 2008 data support Chiha and Link's result of decreasing work participation as nurses age.

Chiha and Link found that holding a diploma degree versus an associate degree increased the probability of participation for both single and married RNs in 1992 but neither 1996 nor 2000. This effect is not reproduced in the 2008 results, in which diploma degrees decrease the probability of work participation for single RNs who reside in outside of an MSA. A Master's or higher degree consistently increases the probability of working for all years and foreign nursing degrees have a similar effect.

One other factor expected to influence female RNs participation and hours decisions is the presence of young children in the home. In the participation equations, the presence of children age 6 or below versus not having any children decreases the probability of married RNs work participation in 1992, 1996, and 2000, this is valid in 2008 for married RNs (with the exception of married RNs residing in an MSA where we got an implausible result) regardless of where they reside. The implausible result goes away if a simple probit is employed for the participation equation. The presence of children age 6 or above increases the probability of RNs work. Chiha and Link found that the presence of only some children below the age of 6 had a negative effect on married RNs participation in both years; this result does not appear in 2008 as the coefficients are not significant.

6.3.2 Comparing Hours of Work Empirical Results

The combined empirical results on 1992, 1996, 2000, and 2008 (Table 6.2) provide evidence that the elasticity of hours with respect to the wage is inelastic. Chiha and Link only found a statistically significant wage coefficient for married RNs in 1996 and for single RNs in 2000. In my 2008 results, the wage coefficient is never statistically significant. Other household income has a consistently negative effect on RNs hours of work across all years, while being non-white increases hours of work for

married RNs. All estimations for year 1992, 1996, 2000, and 2008 show a clear declining pattern of hours of labor at older ages.

Holding a Master's or higher degree versus an associate degree and holding a foreign RN degree increase the hours of work for married females in 1992, 1996, and 2000. In 2008 having a master's degree does not significantly affect the number of hours worked. In year 2008, holding a diploma or baccalaureate degree versus an associate degree decreases hours of labor for married females. Nurses who earned their RN degree in a foreign country tend to work longer hours.

Chiha and Link results maximum likelihood estimates of ρ were only statistically significant for single RNs in 1992 and 2000. My results for 2008 revealed estimates for Rho that are statistically significant regardless of marital status and whether the nurse lived in an MSA.

Chapter 7

PREDICTED WAGE ESTIMATIONS WITH ACS DATA

7.1 Descriptive Statistics

In this chapter I show the descriptive statistics and results for wage regressions using American Community Survey (ACS) data and then compares these ACS based results to the NSSRN based results for all RNs regardless of they live in an MSA or non-MSA.

In order to conduct comparable analysis of labor supply models based on the NSSRN and ACS data, the models are estimated using the same variables and selection criteria.

Table 7.1 shows the number of observations and percentage distribution of binary variables, such as age categories, employment status, etc., for married and single female RNs for ACS data. Table 7.2 shows the same variables from Table 7.1 for NSSRN data.

Employment Status: According to the ACS data the work participation rate for married female RNs is 89.3% for RNs whose ages are between 21 and 75 while it is 89.7% for single female RNs in the same age range. In the NSSRN data, these ratios are 85.3% for married RNs and 86.3% for single female RNs as shown in Table 7.2. This difference can be explained by the differences in the two data set's survey questions. The NSSRN is conducted for the registered nurse population and

Table 7.1 Demographic and Work Characteristics of Female RNs by Marital Status: Working in Nursing or Not Working (Data: ACS 2008)

	Overall				Not Working				Working			
	Married		Single		Married		Single		Married		Single	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Employment Status												
Employed in nursing	17743	(89.3)	8045	(89.7)	0	0	0	0	17743	(100.0)	8045	(100.0)
Not employed in nursing	2137	(10.7)	927	(10.3)	2137	(100.0)	927	(100.0)	0	0	0	0
Employment Type												
Fulltime	14201	(71.4)	7319	(81.6)	0	0	0	0	14201	(80.0)	7319	(91.0)
Not employed in nursing	2137	(10.7)	927	(10.3)	2137	(100.0)	927	(100.0)	0	0	0	0
Part time	3542	(17.8)	726	(8.1)	0	0	0	0	3542	(20.0)	726	(9.0)
Age												
24 or less	267	(1.3)	564	(6.3)	9	(0.4)	35	(3.8)	258	(1.5)	529	(6.6)
25-29	1308	(6.6)	908	(10.1)	91	(4.3)	24	(2.6)	1217	(6.9)	884	(11.0)
30-34	2015	(10.1)	682	(7.6)	159	(7.4)	23	(2.5)	1856	(10.5)	659	(8.2)
35-39	2461	(12.4)	720	(8.0)	214	(10.0)	31	(3.3)	2247	(12.7)	689	(8.6)
40-44	2438	(12.3)	906	(10.1)	150	(7.0)	44	(4.7)	2288	(12.9)	862	(10.7)
45-49	2998	(15.1)	1070	(11.9)	121	(5.7)	65	(7.0)	2877	(16.2)	1005	(12.5)
50-54	3314	(16.7)	1339	(14.9)	211	(9.9)	68	(7.3)	3103	(17.5)	1271	(15.8)
55-59	2528	(12.7)	1146	(12.8)	255	(11.9)	100	(10.8)	2273	(12.8)	1046	(13.0)
60-64	1614	(8.1)	843	(9.4)	417	(19.5)	159	(17.2)	1197	(6.7)	684	(8.5)
65 and above	937	(4.7)	794	(8.8)	510	(23.9)	378	(40.8)	427	(2.4)	416	(5.2)
Race												
Black	1108	(5.6)	1111	(12.4)	88	(4.1)	109	(11.8)	1020	(5.7)	1002	(12.5)
Hispanic/Latin	675	(3.4)	379	(4.2)	68	(3.2)	23	(2.5)	607	(3.4)	356	(4.4)
Other	1751	(8.8)	638	(7.1)	127	(5.9)	54	(5.8)	1624	(9.2)	584	(7.3)
White	16346	(82.2)	6844	(76.3)	1854	(86.8)	741	(79.9)	14492	(81.7)	6103	(75.9)
Educational Attainment												
Associate degree	7823	(39.4)	3470	(38.7)	751	(35.1)	352	(38.0)	7072	(39.9)	3118	(38.8)
Baccalaureate degree	8318	(41.8)	3686	(41.1)	816	(38.2)	300	(32.4)	7502	(42.3)	3386	(42.1)
Diploma degree	1331	(6.7)	697	(7.8)	303	(14.2)	153	(16.5)	1028	(5.8)	544	(6.8)
Master degree or more	2408	(12.1)	1119	(12.5)	267	(12.5)	122	(13.2)	2141	(12.1)	997	(12.4)

Table 7.1 Demographic and Work Characteristics of Female RNs by Marital Status: Working in Nursing or Not Working (Data: ACS 2008)
(Continued)

	Overall				Not Working				Working			
	Married		Single		Married		Single		Married		Single	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Foreign Education Status												
Foreign educated	1337	(6.7)	452	(5.0)	140	(6.6)	53	(5.7)	1197	(6.7)	399	(5.0)
Not foreign educated	18543	(93.3)	8520	(95.0)	1997	(93.4)	874	(94.3)	16546	(93.3)	7646	(95.0)
Presence and Age of Children												
All 6 and older	5500	(27.7)	1400	(15.6)	276	(12.9)	52	(5.6)	5224	(29.4)	1348	(16.8)
All <6 years old	2137	(10.7)	236	(2.6)	227	(10.6)	10	(1.1)	1910	(10.8)	226	(2.8)
No children at home	10413	(52.4)	7118	(79.3)	1466	(68.6)	852	(91.9)	8947	(50.4)	6266	(77.9)
Some <6, some>6	1830	(9.2)	218	(2.4)	168	(7.9)	13	(1.4)	1662	(9.4)	205	(2.5)
Region of Employment												
East North Central	3483	(17.5)	1407	(15.7)	309	(14.5)	138	(14.9)	3174	(17.9)	1269	(15.8)
East South Central	1331	(6.7)	569	(6.3)	152	(7.1)	64	(6.9)	1179	(6.6)	505	(6.3)
Middle Atlantic	2935	(14.8)	1329	(14.8)	310	(14.5)	136	(14.7)	2625	(14.8)	1193	(14.8)
Mountain	1209	(6.1)	538	(6.0)	167	(7.8)	53	(5.7)	1042	(5.9)	485	(6.0)
New England	1179	(5.9)	552	(6.2)	138	(6.5)	51	(5.5)	1041	(5.9)	501	(6.2)
Pacific	2350	(11.8)	1231	(13.7)	248	(11.6)	121	(13.1)	2102	(11.8)	1110	(13.8)
South Atlantic	3736	(18.8)	1889	(21.1)	455	(21.3)	217	(23.4)	3281	(18.5)	1672	(20.8)
West North Central	1733	(8.7)	569	(6.3)	135	(6.3)	58	(6.3)	1598	(9.0)	511	(6.4)
West South Central	1924	(9.7)	888	(9.9)	223	(10.4)	89	(9.6)	1701	(9.6)	799	(9.9)

Table 7.2 Demographic and Work Characteristics of Female RNs by Marital Status: Working in Nursing or Not Working in Nursing (Data: NSSRN 2008)

	Overall				Not Working				Working			
	Married		Single		Married		Single		Married		Single	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Employment Status												
Employed in nursing	16658	(85.3)	5950	(86.3)	0	0	0	0	16658	(100.0)	5950	(100.0)
Not Employed in nursing	2877	(14.7)	943	(13.7)	2877	(100.0)	943	(100.0)	0	0	0	0
Employment type												
Fulltime	11556	(59.2)	4940	(71.7)	0	0	0	0	11556	(69.4)	4940	(83.0)
Not employed in nursing	2877	(14.7)	943	(13.7)	2877	(100.0)	943	(100.0)	0	0	0	0
Part time	5102	(26.1)	1010	(14.7)	0	0	0	0	5102	(30.6)	1010	(17.0)
Age												
24 or less	278	(1.4)	295	(4.3)	9	(0.3)	16	(1.7)	269	(1.6)	279	(4.7)
25-29	1084	(5.5)	462	(6.7)	56	(1.9)	20	(2.1)	1028	(6.2)	442	(7.4)
30-34	1618	(8.3)	462	(6.7)	148	(5.1)	25	(2.7)	1470	(8.8)	437	(7.3)
35-39	1991	(10.2)	469	(6.8)	203	(7.1)	24	(2.5)	1788	(10.7)	445	(7.5)
40-44	2244	(11.5)	587	(8.5)	226	(7.9)	40	(4.2)	2018	(12.1)	547	(9.2)
45-49	2966	(15.2)	845	(12.3)	302	(10.5)	69	(7.3)	2664	(16.0)	776	(13.0)
50-54	3723	(19.1)	1176	(17.1)	456	(15.8)	100	(10.6)	3267	(19.6)	1076	(18.1)
55-59	2818	(14.4)	1100	(16.0)	402	(14.0)	155	(16.4)	2416	(14.5)	945	(15.9)
60-64	1714	(8.8)	807	(11.7)	494	(17.2)	171	(18.1)	1220	(7.3)	636	(10.7)
64 and more	1099	(5.6)	690	(10.0)	581	(20.2)	323	(34.3)	518	(3.1)	367	(6.2)
Race												
Other	2504	(12.8)	1172	(17.0)	289	(10.0)	124	(13.1)	2215	(13.3)	1048	(17.6)
White	17031	(87.2)	5721	(83.0)	2588	(90.0)	819	(86.9)	14443	(86.7)	4902	(82.4)
Educational Attainment												
Associate degree	6773	(34.7)	2424	(35.2)	782	(27.2)	271	(28.7)	5991	(36.0)	2153	(36.2)
Baccalaureate degree	7213	(36.9)	2524	(36.6)	1027	(35.7)	296	(31.4)	6186	(37.1)	2228	(37.4)
Diploma degree	2865	(14.7)	945	(13.7)	662	(23.0)	217	(23.0)	2203	(13.2)	728	(12.2)
Master degree or more	2684	(13.7)	1000	(14.5)	406	(14.1)	159	(16.9)	2278	(13.7)	841	(14.1)
Foreign Education												
Educated in US	18702	(95.7)	6639	(96.3)	2781	(96.7)	912	(96.7)	15921	(95.6)	5727	(96.3)

Table 7.2 Demographic and Work Characteristics of Female RNs by Marital Status: Working in Nursing or Not Working in Nursing (Data: NSSRN 2008) (Continued)

	Overall				Not Working				Working			
	Married		Single		Married		Single		Married		Single	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Foreign educated	833	(4.3)	254	(3.7)	96	(3.3)	31	(3.3)	737	(4.4)	223	(3.7)
Presence and age of children												
All 6 years and older	5542	(28.4)	1185	(17.2)	575	(20.0)	89	(9.4)	4967	(29.8)	1096	(18.4)
All <6 years old	1965	(10.1)	191	(2.8)	206	(7.2)	15	(1.6)	1759	(10.6)	176	(3.0)
No children at home	10638	(54.5)	5378	(78.0)	1920	(66.7)	826	(87.6)	8718	(52.3)	4552	(76.5)
Some <6, some >6	1390	(7.1)	139	(2.0)	176	(6.1)	13	(1.4)	1214	(7.3)	126	(2.1)
Region of Employment												
East North Central	2471	(12.6)	852	(12.4)	389	(13.5)	127	(13.5)	2082	(12.5)	725	(12.2)
East South Central	1274	(6.5)	387	(5.6)	168	(5.8)	46	(4.9)	1106	(6.6)	341	(5.7)
Middle Atlantic	1964	(10.1)	740	(10.7)	357	(12.4)	145	(15.4)	1607	(9.6)	595	(10.0)
Mountain	2090	(10.7)	809	(11.7)	303	(10.5)	97	(10.3)	1787	(10.7)	712	(12.0)
New England	1820	(9.3)	636	(9.2)	220	(7.6)	79	(8.4)	1600	(9.6)	557	(9.4)
Pacific	2019	(10.3)	800	(11.6)	307	(10.7)	97	(10.3)	1712	(10.3)	703	(11.8)
South Atlantic	3900	(20.0)	1407	(20.4)	626	(21.8)	193	(20.5)	3274	(19.7)	1214	(20.4)
West North Central	2427	(12.4)	671	(9.7)	253	(8.8)	86	(9.1)	2174	(13.1)	585	(9.8)
West South Central	1570	(8.0)	591	(8.6)	254	(8.8)	73	(7.7)	1316	(7.9)	518	(8.7)

specifically asks if an individual works as a nurse. In contrast, the ACS, using U.S. Census procedures, is conducted for the general population and asks about each individual's job occupation and whether or not they are working. Nurses in the ACS data were selected based on the person responding to the survey saying that she is a registered nurse (occupation code (OCCP) = 3130). The portion of the sample recorded as working is defined by their response to the question are you working.

As in the NSSRN data, the ACS data also show significant differences between married and single RNs fulltime versus part time work participation decisions

although their overall work participation rates are quite close. In the ACS data, the fulltime work participation of married female RNs is 80% of the total working married RNs, while the ratio is 91% for single female RNs. Comparatively, the same figures were, respectively, 69.4% and 83% in the NSSRN data.

Educational Attainment: These two surveys differ significantly in the available data related to educational attainment. The NSSRN specifically asks about the highest degree obtained and one of the options that can be selected is "diploma degree". However, since a diploma degree is nurse specific, it is not an option that can be selected in the ACS questionnaire, which simply asks about the "highest" degree attained. A nursing diploma degree is traditionally a 3 year special program. In the absence of a diploma degree option, registered nurses with a diploma degree might respond to the highest degree earned question by selecting either an associate degree, or baccalaureate degree, or even simply some college level courses. While creating dummy variables for diploma degree, I assign "some college level courses" to be diploma degree. In the NSSRN data, the percentage of diploma degree holders was 14.7% for married RNs and 13.7% for single RNs. These same percentages are 6.7% and 7.8% in the ACS data. It is very clear that some of diploma degree holders are misidentified as having either an associate or baccalaureate degree in the ACS data. Auerbach et al. (2012) suggest that diploma educated RNs may tend to report baccalaureate degrees in the ACS.

Table 7.3 shows the educational attainment distribution of RNs by marital status for ACS and NSSRN data and partially supports the suggestion of Auerbach et al. Approximately 35% of all RNs hold an associate degree in the NSSRN data.

Table 7.3 Educational Attainment of Female RNs by Survey and Marital Status, 2008 (Data: ACS and NSSRN)

Educational Attainment	NSSRN				ACS			
	Married		Single		Married		Single	
	N	(%)	N	(%)	N	(%)	N	(%)
Associate degree	6773	(34.7)	2424	(35.2)	7823	(39.4)	3470	(38.7)
Baccalaureate degree	7213	(36.9)	2524	(36.6)	8318	(41.8)	3686	(41.1)
Diploma degree	2865	(14.7)	945	(13.7)	1331	(6.7)	697	(7.8)
Master's degree or higher	2684	(13.7)	1000	(14.5)	2408	(12.1)	1119	(12.5)

However, this percentage is 39% in the ACS data. Also,37% of RNs in the NSSRN earned the baccalaureate degree. This percentage is 41.8% for married and 41.1% for single RNs in the ACS. Also from Table 7.3, the percentage of RNs with a Master's degree or higher in the NSSRN is slightly higher than the ratio of RNs with a Master's degree or higher in the ACS.

Foreign Education: The ACS does not provide information regarding to the country where the nursing degree was received. However, it asks the year of the entry to the United States. From the year of entry, assuming that any individual who entered to the United States after age 25 received their nursing degree abroad before age 26, I created a dummy variable for foreign education similar to NSSRN foreign education status variable. Auerbach et al. (2012) also used the same approach to come up with a foreign education status variable for the ACS dataset. In the NSSRN survey, approximately, 4.4% of married RNs and 3.7% of single RNs received their nursing degree abroad. The results are, respectively, 6.7% and 5% in the ACS data.

Presence and Age of Children: The distributions for the presence and age of children in the household are very similar in both data sets. In the ACS (NSSRN) data, 52.4% (54.5%) of married RNs and 79.3% (78%) of single RNs report the presence of no children in the household, which is an expected outcome given the aging nurse population.

Race: In the NSSRN data, an individual's race is coded as a 1 if the nurse is non-white. In the ACS data a more detailed racial breakdown is given. In the NSSRN (ACS) data, the percentage of the sample that is white is 87.2% (82.1%)for married RNs and 83% (76%)for single RNs.

Age: The mean age for both married and single RNs is 46.3 in the ACS data[18] while it is 46.87 for married RNs and 48.01 single RNs in NSSRN data[19]. The distributions among age brackets are quite similar in both the NSSRN and the ACS, with the notable exception that the single young RN population (ages 21-30) is larger in the ACS data.

7.4 Table shows the means and standard deviations for the continuous variables, RNs wage, other household income and hours worked per week for ACS data, for married and single females and Table 7.5 shows the same variables from Table 7.4 for NSSRN data.

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[18] The means of age for RNs are calculated from the continuous age variable.

[19] These average ages are calculated by multiplying the midpoints of each age bracket by the number of observations then dividing by the total number of observations.

Table 7.4 Income and Work Hours of Female RNs by Marital Status: Working or Not Working in Nursing (Data: ACS 2008)

	Not Working				Working			
	Married		Single		Married		Single	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
Total RN hours worked per year	0.0	0.0	0.0	0.0	1,764.9	553.5	1,891.2	496.7
Other house hold income	103,631	100,729	43,497	54,137	70,569	66,226	26,994	46,436
RNs hourly wage	0.0	0.0	0.0	0.0	30.5	13.4	30.1	13.4

Table 7.5 Income and Work Hours of Female RNs by Marital Status: Working or Not Working in Nursing (Data: NSSRN 2008)

	Not Working				Working			
	Married		Single		Married		Single	
	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
Total RN hours worked per year	0.0	0.0	0.0	0.0	1,864.9	613.0	2,023.5	535.9
Other house hold income	114,831	81,545	53,688	46,973	58,330	55,681	12,752	24,222
RNs real hourly wage	0.0	0.0	0.0	0.0	31.3	13.2	31.4	12.6

From Table 7.4, the mean of the variable defining ‘other household income’ is $103,631 for non-working married RNs and $70,569 for working married RNs in the ACS. These figures are, respectively, $114,831 for non-working married RNs and $58,330 for working married RNs for NSSRN data. The differences in the mean of other household income variables are the result of the ways these two surveys collected the information regarding to household income which was explained at Chapter 3.

The mean hourly wage is $31.3 for married female RNs and $31.4 for single female RNs in the NSSRN data as shown in Table 7.5, while the mean hourly wages

are similar, and respectively, $30.5 and $30.1 in the ACS data. In the ACS data the mean total hours worked per year is smaller than the same figure from the NSSRN data, with mean total hours worked per year of 1,764 for married female RNs and 1,891 for single RNs in the ACS data, while these same numbers are, respectively, 1,864 and 2,023 in the NSSRN data.

7.2 Sample Selection

The sample selection criteria used in Chapter 4 are also used in the analysis of the ACS data. Specifically, the samples are restricted to RNs who worked fewer than 3,200 hours and whose age was between 21 and 75.

7.3 Wage Equation

The wage equation used to construct a predicted wage variable for these ACS results is similar to the wage equation used for the NSSRN results presented in Chapter 4. Unlike the NSSRN data where the data are collected at the county level, the ACS data are collected at the state level. For purposes of comparing the results from the ACS and NSSRN surveys. The county level area variables are aggregated into state-level data and merged with the ACS data. Similar explanatory variables are used to create comparable estimation outcomes. Specifically, the ACS wage equation includes race, age, region, educational attainment and the percentage of doctors and the fulltime nurses per 1,000/population. In addition to these variables, the participation equation includes other household income and the presence of children.

The design of the MLE model used in this chapter is identical to the model used in Chapter 4 (refer to Chapter 4 for details).

7.4 Empirical Results

Table 7.6 reports the estimated coefficients and standard errors from this wage equation.[20] The coefficients for the explanatory variables can be interpreted as percentage changes since the dependent variable is the logarithm of the hourly wage.

The wage equations for both the NSSRN and the ACS datasets have the same explanatory variables except for the more detailed race classification in the ACS data.

Column 1 reports the results for the wage equation with the race variable is defined in the way it is in the NSSRN, white/nonwhite. Column 2 shows the results for the race variables when they are defined more specifically as Black and Hispanic/Latin. Column 3 reports the results for wage equation with NSSRN data when the models are specified in exactly the same way.

As shown in Table 7.6, rho was essentially zero and never approached being statistically significant for ACS models. Thus, there is no evidence for the existence of selection bias in the model with ACS data. This result conflicts with the NSSRN data wage model. Table 7.7 shows the marginal effects of the wage equation for ACS and NSSRN models.

[20] The participation equations associated with the wage regressions are available at appendix G.

Table 7.6 Wage Equations: Female RNs (Data: ACS and NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	ACS, uses detailed race variables (Col 1.)	ACS-uses white/non white for race (Col 2.)	NSSRN (Col. 3)
Race other (white)	0.06767***	0.07802***	0.02093***
	(0.01170)	(0.01146)	(0.00674)
Race black (white)	-0.02973***		
	(0.01052)		
Race Hispanic/Latin (white)	-0.05989***		
	(0.01469)		
Number of doctors per 1,000 population	0.44553***	0.44000***	0.15524***
	(0.06714)	(0.06714)	(0.01023)
Number of nurses per 1,000 population	-0.37632***	-0.36131***	0.00000***
	(0.03219)	(0.03203)	(0.00000)
Education - Diploma (associate)	-0.02815**	-0.02960**	0.02666***
	(0.01205)	(0.01204)	(0.00725)
Education - Baccalaureate (associate)	0.08108***	0.08097***	0.06134***
	(0.00611)	(0.00611)	(0.00509)
Education - Masters or more (associate)	0.20232***	0.20247***	0.22031***
	(0.00898)	(0.00898)	(0.00688)
Foreign Education (in US)	0.02115	0.01303	0.06112***
	(0.01314)	(0.01298)	(0.01159)
Age < 25 (25-29)	-0.26444***	-0.26267***	-0.09891***
	(0.01822)	(0.01823)	(0.01606)
Age 30-34 (25-29)	0.07757***	0.07833***	0.05034***
	(0.01292)	(0.01292)	(0.01116)
Age 35-39 (25-29)	0.12959***	0.13070***	0.10096***
	(0.01255)	(0.01254)	(0.01083)
Age 40-44 (25-29)	0.14907***	0.15062***	0.10679***
	(0.01235)	(0.01235)	(0.01056)
Age 45-49 (25-29)	0.17370***	0.17645***	0.11260***
	(0.01189)	(0.01187)	(0.01008)
Age 50-54 (25-29)	0.17430***	0.17775***	0.12171***
	(0.01168)	(0.01166)	(0.00981)
Age 55-59 (25-29)	0.19053***	0.19377***	0.12050***
	(0.01237)	(0.01234)	(0.01024)
Age 60-64 (25-29)	0.18379***	0.18661***	0.10949***
	(0.01516)	(0.01496)	(0.01160)
Age ≥ 65 (25-29)	0.10438***	0.10570***	0.03593**
	(0.02323)	(0.02242)	(0.01451)
Region of employment - Middle Atlantic (New England)	-0.06830***	-0.07043***	-0.01245
	(0.01349)	(0.01348)	(0.00977)
Region of employment - East North Central (New England)	-0.10289***	-0.10379***	-0.11727***
	(0.01500)	(0.01500)	(0.00938)

Table 7.6 Wage Equations: Female RNs (Data: ACS and NSSRN 2008)
(Continued)

Explanatory Variable (Reference Category in Parentheses)	ACS, uses detailed race variables (Col 1.)	ACS-uses white/non white for race (Col 2.)	NSSRN (Col. 3)
Region of employment - West North Central (New England)	-0.12516***	-0.12699***	-0.15397***
	(0.01690)	(0.01690)	(0.00930)
Region of employment - South Atlantic (New England)	-0.11106***	-0.11503***	-0.05966***
	(0.01486)	(0.01481)	(0.00849)
Region of employment - East South Central (New England)	-0.13680***	-0.14067***	-0.14279***
	(0.01759)	(0.01754)	(0.01101)
Region of employment - West South Central (New England)	-0.11992***	-0.12609***	-0.09687***
	(0.01743)	(0.01739)	(0.01040)
Region of employment - Mountain (New England)	-0.09578***	-0.09773***	-0.04308***
	(0.01908)	(0.01908)	(0.00965)
Region of employment - Pacific (New England)	0.05894***	0.05539***	0.10035***
	(0.01634)	(0.01633)	(0.00985)
Constant	3.29747***	3.28541***	3.19390***
	(0.03223)	(0.03209)	(0.01398)
Rho	0.0044	0.00344	-0.05149**
	(0.04951)	(0.04542)	(0.02248)
Number of observations	28852	28852	26428
Censored observations	3064	3064	3820
Uncensored observations	25788	25788	22608
Log likelihood	-23270	-23285.62	-14416.09

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table 7.7 Marginal Effects of Wage Equation (Data: ACS and NSSRN 2008)

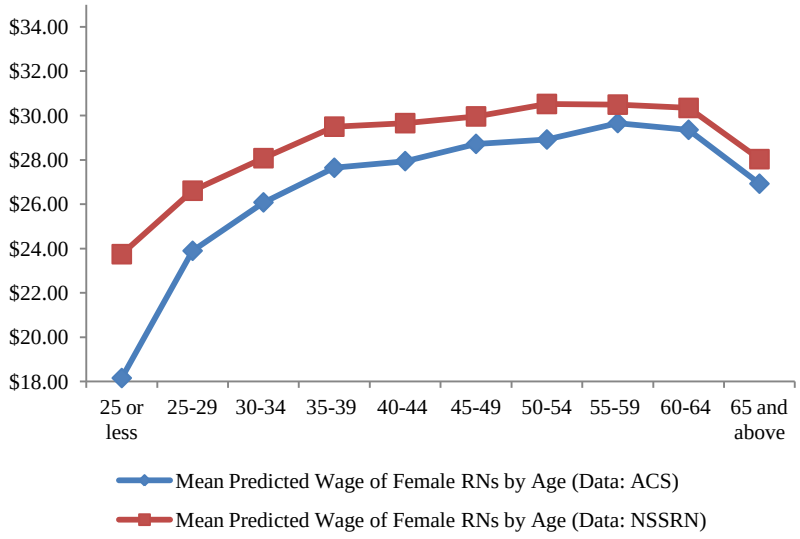
	ACS uses detailed race variables		ACS uses white / non white for race variables		NSSRN	
Explanatory Variable (Reference Category in Parentheses)	dy/dx (Col. 1.)	Std.Err. (Col. 2)	dy/dx (Col. 3)	Std.Err (Col. 4)	dy/dx (Col. 5)	Std.Err (Col. 6)
Race other (white)	0.000125	2.19E-05	0.000144	2.15E-05	0.00003	9.69E-06
Race black (white)	-5.5E-05	1.94E-05				
Race Hispanic/Latin (white)	-0.00011	2.72E-05				
Number of doctors per 1,000 population	0.00082	0.000125	0.000812	0.000125	0.0002221	0.0000151
Number of nurses per 1,000 population	-0.00069	6.06E-05	-0.00067	6.03E-05	6.45E-09	4.78E-10
Education - Diploma (associate)	-5.2E-05	2.24E-05	-5.5E-05	2.24E-05	0.0000381	0.0000104
Education - Baccalaureate (associate)	0.00015	1.17E-05	0.00015	1.17E-05	0.0000878	7.38E-06
Education - Masters or more (associate)	0.000373	1.83E-05	0.000374	1.82E-05	0.0003152	0.0000107
Foreign Education (in US)	0.000039	2.43E-05	2.41E-05	0.000024	0.0000875	0.0000167
Age < 25 (25-29)	-0.00049	3.55E-05	-0.00049	3.55E-05	-0.0001415	0.0000232
Age 30-34 (25-29)	0.000143	0.000024	0.000145	0.000024	0.000072	0.000016
Age 35-39 (25-29)	0.000239	2.35E-05	0.000241	2.35E-05	0.0001445	0.0000156
Age 40-44 (25-29)	0.000275	2.35E-05	0.000278	2.35E-05	0.0001528	0.0000153
Age 45-49 (25-29)	0.00032	0.000023	0.000326	0.000023	0.0001611	0.0000146
Age 50-54 (25-29)	0.000321	2.25E-05	0.000328	2.25E-05	0.0001742	0.0000142
Age 55-59 (25-29)	0.000351	2.34E-05	0.000358	2.34E-05	0.0001724	0.0000148
Age 60-64 (25-29)	0.000339	0.000027	0.000345	2.69E-05	0.0001567	0.0000166
Age ≥ 65 (25-29)	0.000192	4.13E-05	0.000195	0.00004	0.0000514	0.0000207
Region of employment - Middle Atlantic (New England)	-0.00013	0.000025	-0.00013	0.000025	-0.0000178	0.000014
Region of employment - East North Central (New England)	-0.00019	2.78E-05	-0.00019	2.79E-05	-0.0001678	0.0000137
Region of employment - West North Central (New England)	-0.00023	3.15E-05	-0.00023	3.15E-05	-0.0002203	0.0000137
Region of employment - South Atlantic (New England)	-0.0002	2.78E-05	-0.00021	2.77E-05	-0.0000854	0.0000123
Region of employment - East South Central (New England)	-0.00025	0.000033	-0.00026	3.29E-05	-0.0002043	0.0000161
Region of employment - West South Central (New England)	-0.00022	3.25E-05	-0.00023	3.25E-05	-0.0001386	0.0000151
Region of employment - Mountain (New England)	-0.00018	3.54E-05	-0.00018	3.55E-05	-0.0000616	0.0000139
Region of employment - Pacific (New England)	0.000109	3.03E-05	0.000102	3.03E-05	0.0001436	0.0000142

7.4.1 Comparing Wage Estimation Results with ACS and NSSRN Data

As shown in Table 7.6, the coefficients for the non-white race dummy, the black dummy, and the Hispanic/Latin dummy are all significant in the wage equation. Moreover, while the coefficient of the other non-white variable is positive in both models (mirroring the NSSRN based results), the coefficients for the black and Hispanic/Latin race dummies have negative signs.

The number of doctors per 1,000 population is associated with higher wages for both the ACS and the NSSRN data, while the number of hospital nurses per 1,000 population only has a negative effect in the ACS data. From table 7.7, one unit increase in the number of doctor per 1,000 population increases the hourly wage of RNs by 0.8 cents while one unit increase in the number of nurses per 1,000 population decreases the hourly wage of RNs by 0.7 cents.

Figure 7.1 Predicted Wage Distribution of Female RNs by Age (Data: ACS and NSSRN 2008)



The coefficients of the age variables suggest a quadratic functional form for the age earnings profile. Figure 7.1, which plots age against hourly earnings associated with the ACS and NSSRN regressions, supports this and also that RNs face a rather flat age earning profile. In the ACS data the starting RN hourly wage is approximately $18 which rapidly increases up to $28 by ages 30-35 and reaches its peak at ages 50-55 as $29 dollars.

In both models, holding a baccalaureate or a Master's or higher degree (relative to an associate degree) increases the wage. In the ACS data holding a diploma degree has a negative effect on wages. This contradiction between the two data sets is most likely the result of the issues in properly identifying which RNs have diploma degrees in the ACS data. From table 7.6, RNs with a masters or higher degree earn 20% more than RNs with an associate degree, this ratio was 21% in NSSRN model. Unlike the NSSRN model, foreign education does not increase the wage in the ACS model.

Chapter 8

PARTICIPATION AND FULLTIME - PART TIME WORK DECISION MODEL WITH ACS DATA

8.1 Model

In this chapter my objective is to determine factors impacting whether or not a nurse works; and conditional on working, does she work fulltime or part time using the American Community Survey (ACS) data. The objective is to then compare these factors for the ACS and NSSRN models. As mentioned previously, the NSSRN data stopped being collected and several experts suggested that the ACS might be a good alternative data source for analyzing RN labor market behavior (Auerbach et. al., 2012). The results from this chapter provides an opportunity to see if the ACS is up to the task of replacing the NSSRN as the prime data source for estimating labor supply models. A reduced form selection corrected model is used to estimate these labor supply models. The design of the bivariate probit model used in this chapter is identical to the models used in Chapter 5. Please refer to that chapter for details.

This chapter focuses on the following questions:

1. Is the work/no work decision correlated with the decision to work fulltime/given that the nurse works?
2. Is the RN wage related to the work/no work decision and fulltime versus part time work decision?
3. Do area factors such as the number of doctors, unemployment rate, and population without health insurance, influence work participation?

4. Does the percentage of hospital RNs who are fulltime in the area influence the work/no work and fulltime versus part time work decisions?
5. Are these ACS-based estimation results similar to the NSSRN-based results?

In previous chapters using NSSRN data, it was possible to analyze how specific job settings impacted the nurse's labor supply decisions. Such characteristics included the nurse's previous job prior to becoming a nurse, work setting, position, and job satisfaction. The ACS does not collect these types of data but does collect all essential information about each individual such as age, education, household income, and the presence of children. For these characteristics it is possible to compare ACS data based results with NSSRN data based results.

In this chapter the bivariate probit model is estimated with the same variables for the ACS and NSSRN models. The variables included in both the work/no work and the fulltime/part time equations include the following variables: the predicted RN wage, age, race, ages of children in the home, marital status, education attainment, RN is foreign trained, other household income, area unemployment rate, percentage of population below poverty line, percentage of population without health insurance below the age of 65, the percentage of hospital RNs in a local area who work fulltime, and doctors per 1,000 population.

The bivariate probit model is estimated for married and single female RNs. Estimated results are presented in the following sections. Standardized coefficients and marginal effects are reported. The reference (omitted) category of each binary explanatory variable is indicated in parentheses.

8.2 Empirical Results

Table 8.1 shows the participation equation results for married and single female RNs based on the NSSRN data and while Table 8.2 shows same results for the ACS data. Table 8.3 and Table 8.4 show the fulltime/part time results respectively for married and single RNs with NSSRN and ACS data.

For the model involving single RNs in the ACS data, the bivariate probit model did not converge. Table 8.2 and 8.4 show the results for single female RNs which are based on two simple univariate probit regressions. In models where the bivariate probits converged, selection bias is found.

8.2.1 Comparing the Participation Empirical Results

Socioeconomic and Demographic Variables

The coefficient of the RN wage is positive in all models except for married RNs in the ACS model, where it is not statistically significant. In the NSSRN (ACS) results, a one dollar increase in the RN wage increases the probability that married RNs work by 5% (2%). The marginal effect for single RNs is 0.07% in NSSRN model.

As expected, the log of other household income variable has significant and negative coefficient for both single and married RNs in all models. The negative marginal effect is larger for married than single RNs in both the ACS and NSSRN models, however the gap is much larger in the NSSRN model. A one unit increase in the log of other household income decreases the probability that married RNs will work by 1.8% and single RNs by 1% in ACS model while these decreases are, respectively, 6.9% and 0.05% in NSSRN model.

Table 8.1 Participation Equations: Female RNs by Marital Status (Data: NSSRN 2008)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col. 2)	Coefficient (Std.Err.) (Col. 3)	Marginal Effect (Col. 4)
Predicted log market wage	0.56557***	0.0528828	1.10081***	0.000708
	(0.16668)		(0.32366)	
Log other income	-0.73995***	-0.069188	-0.82431***	-0.00053
	(0.01791)		(0.02938)	
Race other (white)	-0.06085	-0.005914	0.01726	0.0000109
	(0.04466)		(0.07792)	
Number of doctors per 1,000 population	0.49674***	0.0464472	0.52828***	0.0003398
	(0.08347)		(0.15048)	
% of population below poverty	0.01675***	0.0015659	0.00409	2.63E-06
	(0.00385)		(0.00785)	
% of uninsured population below age 65	-0.00849***	-0.000794	0.00929	5.98E-06
	(0.00318)		(0.00623)	
% of unemployment	0.00291	0.0002725	-0.01252	-8.05E-06
	(0.01204)		(0.02508)	
Education - Diploma (associate)	-0.04974	-0.004792	-0.08206	-5.89E-05
	(0.03977)		(0.07745)	
Education - Baccalaureate (associate)	-0.02609	-0.002454	0.00466	2.99E-06
	(0.03297)		(0.06678)	
Education - Masters or more (associate)	0.11872**	0.0103187	0.10569	0.0000597
	(0.05618)		(0.10889)	
Foreign Education (in US)	-0.04196	-0.004053	-0.03898	-2.68E-05
	(0.07458)		(0.15127)	
Age < 25 (25-29)	0.13063	0.0109578	0.12296	0.000065
	(0.17744)		(0.20999)	
Age 30-34 (25-29)	-0.13526	-0.01392	-0.34000*	-0.000386
	(0.08479)		(0.18309)	
Age 35-39 (25-29)	-0.24924***	-0.027572	-0.32019*	-0.000351
	(0.08484)		(0.19008)	
Age 40-44 (25-29)	-0.29598***	-0.033573	-0.52903***	-0.00082
	(0.08593)		(0.17402)	
Age 45-49 (25-29)	-0.31142***	-0.035036	-0.60618***	-0.001002
	(0.08526)		(0.16375)	
Age 50-54 (25-29)	-0.43099***	-0.050697	-0.61692***	-0.000943
	(0.08430)		(0.15691)	
Age 55-59 (25-29)	-0.62573***	-0.084979	-0.90826***	-0.002285
	(0.08641)		(0.15421)	
Age 60-64 (25-29)	-1.19256***	-0.233824	-1.13913***	-0.004835
	(0.08800)		(0.15494)	
Age ≥ 65 (25-29)	-1.85594***	-0.483859	-1.47227***	-0.011778
	(0.08896)		(0.14935)	

Table 8.1 Participation Equations: Female RNs by Marital Status (Data: NSSRN 2008) (Continued)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col. 2)	Coefficient (Std.Err.) (Col. 3)	Marginal Effect (Col. 4)
Children at home - all < 6 years (no children at home)	-0.25336***	-0.028121	-0.05607	-3.97E-05
	(0.05780)		(0.17573)	
Children at home - all > 6 years (no children at home)	0.02838	0.0026266	0.17719**	0.0000938
	(0.03698)		(0.08254)	
Children at home - both >6 years and <6 years (no children at home)	-0.30114***	-0.034989	-0.00981	-6.42E-06
	(0.06112)		(0.20271)	
% of full-time RN in work force	-0.32158***	-0.03007	0.06577	0.0000423
	(0.09954)		(0.20321)	
Constant	7.87280***		5.78974***	
	(0.55137)		(1.05469)	
Rho	-0.69938***		-0.67295***	
	(0.0322)		(0.05723)	
Number of observations	19529		6893	
Censored observations	2876		943	
Uncensored observations	16653		5950	
Log likelihood	-15407.37		-3956.664	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table 8.2 Participation Equations: Female RNs by Marital Status (Data: ACS 2008)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col. 2)	Coefficient (Std.Err.) (Col. 3)	Marginal Effect (Col. 4)
Predicted log market wage	-0.22012	-0.033304	0.19939	0.0248436
	(0.17938)		(0.27425)	
Log other income	-0.12156***	-0.018392	-0.08154***	-0.010159
	(0.01094)		(0.00585)	
Race other (white)	0.33053***	0.0412387	0.01772	0.0021819
	(0.06381)		(0.09595)	
Race black (white)	0.20729***	0.0275304	-0.02094	-0.002641
	(0.06277)		(0.06554)	
Race Hispanic/Latin (white)	0.05958	0.008671	0.20379*	0.0219889
	(0.07296)		(0.12340)	
Number of doctors per 1,000 population	0.54411	0.0823233	0.70273	0.087557
	(0.33818)		(0.53092)	
% of population below poverty	-0.00549	-0.00083	-0.01341	-0.00167
	(0.01046)		(0.01655)	
% of uninsured population below age 65	-0.00339	-0.000512	0.00204	0.0002543
	(0.00540)		(0.00830)	
% of unemployment	0.05382***	0.0081435	0.03729	0.0046462
	(0.02021)		(0.03323)	
Education - Diploma (associate)	-0.27679***	-0.049229	-0.12968*	-0.017554
	(0.04784)		(0.07066)	
Education - Baccalaureate (associate)	-0.01385	-0.002099	0.08110	0.0099969
	(0.03327)		(0.05319)	
Education - Masters or more (associate)	0.10826*	0.0154658	0.05718	0.0068945
	(0.05756)		(0.08838)	
Foreign Education (in US)	-0.18378***	-0.030996	0.04582	0.005532
	(0.06281)		(0.09977)	
Age < 25 (25-29)	0.20607	0.0270382	-0.29052**	-0.04373
	(0.16693)		(0.14496)	
Age 30-34 (25-29)	-0.04919	-0.007648	-0.24816*	-0.036197
	(0.07019)		(0.13321)	
Age 35-39 (25-29)	-0.17356**	-0.028726	-0.36356***	-0.056784
	(0.07249)		(0.13128)	
Age 40-44 (25-29)	-0.06599	-0.010335	-0.39844***	-0.062832
	(0.07814)		(0.12489)	
Age 45-49 (25-29)	0.10302	0.0148221	-0.54477***	-0.091972
	(0.08202)		(0.12143)	
Age 50-54 (25-29)	-0.10659	-0.016942	-0.42352***	-0.065899
	(0.07916)		(0.12000)	
Age 55-59 (25-29)	-0.34442***	-0.061983	-0.70667***	-0.128561
	(0.08195)		(0.12007)	
Age 60-64 (25-29)	-0.97147***	-0.237974	-1.13958***	-0.259702
	(0.08174)		(0.11781)	

Table 8.2 Participation Equations: Female RNs by Marital Status (Data: ACS 2008)

(Continued)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col. 2)	Coefficient (Std.Err.) (Col. 3)	Marginal Effect (Col. 4)
Age ≥ 65 (25-29)	-1.70475***	-0.521292	-1.77812***	-0.491712
	(0.08033)		(0.10727)	
Children at home - all < 6 years (no children at home)	-0.37463***	-0.069032	-0.05062	-0.006541
	(0.05683)		(0.15854)	
Children at home - all > 6 years (no children at home)	0.07405*	0.0109493	0.16576**	0.0189341
	(0.04313)		(0.07465)	
Children at home - both >6 years and <6 years (no children at home)	-0.25321***	-0.044079	-0.15348	-0.021343
	(0.05901)		(0.14802)	
% of full-time RN in work force	-0.40470**	-0.061232	0.19196	0.0239175
	(0.18587)		(0.30689)	
Constant	3.66915***		1.58033*	
	(0.54461)		(0.83560)	
Rho	-0.72237***		NA	
	(0.08122)		NA	
Number of observations	19880		8972	
Censored observations	2137		NA	
Uncensored observations	17743		NA	
Log likelihood	-13814.92		-2322.9827	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

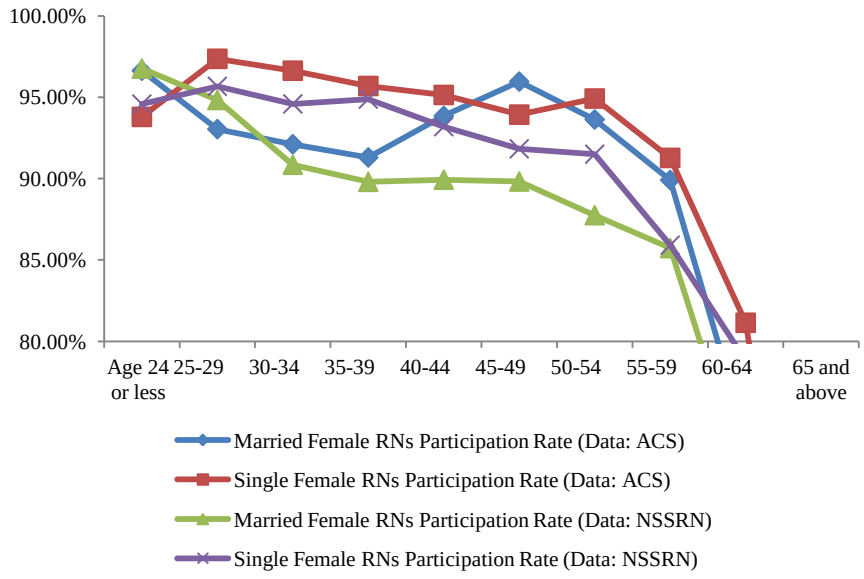
***Significant at 1% level

Black and other non-white married RNs are more likely to be in the labor force relative to their white counterparts in ACS model. Specifically, the results suggest that black married RNs have a 2.8% and other non-white RNs have 4.1% higher probability of participating in the labor market. As mentioned in chapter 7, the NSSRN county level data file does not have detailed race categories like ACS. The non-white variable in NSSRN model is never statistically significant for married or single RNs.

RNs with a Master's degree or higher are more likely to participate in the work force (relative to nurses who hold associate degrees) in all models, while this effect is only statistically significant for married RNs in both ACS and NSSRN samples. For married nurses, holding a Master's degree or higher increases probability of working by approximately 1% in both data sets.

RNs with a diploma degree are less likely to participate in the labor force compared to those holding an associate degree. The coefficients of diploma degree are only significant for married RNs in both the ACS and NSSRN data sets. In spite of the differences in the definitions of the diploma degree in the two data sets (which was described in Chapter 7), the regression results are similar for the ACS and NSSRN models.

Figure 8.1 Participation and age distribution of Female RNs by Marital Status (Data: ACS and NSSRN)



Age has a negative effect on RNs' work decisions in all models. This negative effect becomes significant for single RNs at earlier ages in both ACS and NSSRN models, as well as married RNs in NSSRN model. From Table 8.1 and Table 8.2, the negative marginal effects of the older age categories are very similar for models based on the ACS and NSSRN data. Specifically, the negative effects for married RNs ages 55-59 are 6-8%, RNs age 60-64 are 23% and RNs over 65 years old are approximately 50% less likely to work than the omitted age group (25-29).

One unexpected result arose from the foreign education. The impact of holding a foreign nursing degree is not consistent between the models as well as between married and single RNs in the same data set. However, the coefficient of foreign education is only significant for married RNs in ACS model where being foreign educated decreases the probability of work participation by 3%.

The employment ratios of both married and single RNs for the ACS and NSSRN data show a decreasing pattern by age starting around age 50, but the biggest declines occur when nurses approach and reach age 60. Approximately 90% of married RNs age less than 50 are employed. This percentage drops to 45-47% by the age 65. For single RNs participation rates are around 90% through age 55-59 for the nurses in the ACS and age 50-54 for the nurses in the NSSRN.

The presence of children under the age of six decreases the probability of RNs participation relative to not having children in all models but is only significant for married RNs. The presence of children above the age of six increases the probability of RNs work participation in all models but is only significant at the 5% level for single RNs.

Area Variables

From Tables 8.1 and 8.2, the number of doctors per 1,000 population in the area increases the probability of RNs working. The coefficient of the number of doctors per 1,000 population variable has positive sign for both single and married RNs with ACS and NSSRN models. It is only significant in the NSSRN model where a one unit increase in the number of doctors per 1,000 population increases the probability of labor force participation for married (single) RNs by 4.6% (0. 03%).The percentage of the population below the poverty only influences married female RNs work participation positively in the NSSRN model. The percentage of the uninsured population below age 65 also only influences married RNs work participation in NSSRN model but negatively. The negative effect of the population without health insurance below the age of 65 is expected since the absence of the health insurance will reduce the demand for health care and demand for nurses. However, both marginal effects are small.

The unemployment rate has a statistically significant positive effect on married RNs' participation in the ACS model but this positive effect is not significant in the NSSRN model. A one percentage point increase in the unemployment rate increases the probability of RNs working by 0.8% in ACS model.

The percentage of hospital RNs in an area who work fulltime affects the labor participation of married RN negatively in both ACS and NSSRN models. The marginal effects are, respectively, 6% and 3%.

8.2.2 Comparing Working Fulltime/Part Time Empirical Results

Table 8.3 and Table 8.4 show the fulltime/part time results respectively for married and single RNs with the ACS and the NSSRN data.

Table 8.3 Fulltime/Part Time Equations: Female RNs by Marital Status (Data: NSSRN 2008)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Predicted log market wage	-0.90751***	-0.293582	-0.48929**	-0.111729
	(0.13227)		(0.24085)	
Log other income	-0.06129***	-0.040242	-0.02129***	-0.004943
	(0.00492)		(0.00490)	
Race other (white)	0.29088***	0.0903393	-0.01672	-0.003843
	(0.03633)		(0.05734)	
Number of doctors per 1,000 population	0.05989	0.0333834	0.01132	0.0026364
	(0.06068)		(0.10954)	
% of population below poverty	0.00941***	0.003637	0.00448	0.0010236
	(0.00316)		(0.00623)	
% of uninsured population below age 65	0.01069***	0.0034097	-0.00002	-3.64E-06
	(0.00265)		(0.00483)	
% of unemployment	-0.01343	-0.004487	-0.00239	-0.000548
	(0.00966)		(0.02028)	
Education - Diploma (associate)	-0.11032***	-0.039866	-0.08041	-0.018956
	(0.03387)		(0.06423)	
Education - Baccalaureate (associate)	-0.06818***	-0.024003	0.06448	0.0146033
	(0.02582)		(0.05067)	
Education - Masters or more (associate)	0.37423***	0.1173713	0.23226***	0.0485341
	(0.04579)		(0.08570)	
Foreign Education (in US)	0.34965***	0.1050279	0.34390***	0.0657496
	(0.06255)		(0.12243)	
Age < 25 (25-29)	0.30134***	0.0942527	0.31744**	0.061715
	(0.11113)		(0.14474)	
Age 30-34 (25-29)	0.00652	-0.001701	0.22715*	0.0465649
	(0.05596)		(0.11616)	
Age 35-39 (25-29)	-0.08019	-0.036272	-0.10270	-0.024635
	(0.05707)		(0.11079)	
Age 40-44 (25-29)	-0.09203	-0.042408	-0.05206	-0.0123
	(0.05860)		(0.10826)	
Age 45-49 (25-29)	-0.12649**	-0.055268	0.10395	0.0226523
	(0.05786)		(0.10394)	
Age 50-54 (25-29)	-0.10396*	-0.051841	-0.03380	-0.00796
	(0.05781)		(0.09771)	
Age 55-59 (25-29)	-0.24464***	-0.117864	-0.11753	-0.028385
	(0.06033)		(0.09810)	
Age 60-64 (25-29)	-0.40913***	-0.253763	-0.28740***	-0.07433
	(0.06604)		(0.10162)	
Age ≥ 65 (25-29)	-0.88131***	-0.570814	-0.92792***	-0.292213
	(0.08206)		(0.11008)	

Table 8.3 Fulltime/Part Time Equations: Female RNs by Marital Status (Data: NSSRN 2008) (Continued)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Children at home - all < 6 years (no children at home)	-0.63491***	-0.254635	-0.16405	-0.040574
	(0.04377)		(0.12245)	
Children at home - all > 6 years (no children at home)	-0.30493***	-0.106678	-0.04018	-0.009297
	(0.02858)		(0.05746)	
Children at home - both >6 years and <6 years (no children at home)	-0.55115***	-0.224955	-0.22305	-0.056741
	(0.04725)		(0.13599)	
% of full-time RN in work force	0.82717***	0.272677	1.05537***	0.2412238
	(0.07969)		(0.15867)	
Constant	3.85173***		2.18053***	
	(0.41864)		(0.76212)	
Number of observations	19529		6893	
Censored observations	2876		943	
Uncensored observations	16653		5950	
Log likelihood	-15407.37		-3956.664	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table 8.4 Fulltime/Part Time Equations: Female RNs by Marital Status (Data: ACS 2008)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Predicted log market wage	-0.67080***	-0.183052	-0.10831	-0.01509
	(0.14931)		(0.27055)	
Log other income	-0.16169***	-0.046056	-0.04327***	-0.006028
	(0.01048)		(0.00496)	
Race other (white)	0.49202***	0.1082787	0.06452	0.0086355
	(0.05518)		(0.09742)	
Race black (white)	0.45365***	0.098846	0.00131	0.0001821
	(0.05986)		(0.06861)	
Race Hispanic/Latin (white)	0.09370	0.0250338	0.00449	0.000624
	(0.06296)		(0.10857)	
Number of doctors per 1,000 population	0.56755**	0.164973	-0.22178	-0.030901
	(0.28548)		(0.53012)	
% of population below poverty	0.00776	0.0018902	0.00448	0.0006238
	(0.00910)		(0.01775)	
% of uninsured population below age 65	0.01036**	0.0026344	-0.00375	-0.000522
	(0.00474)		(0.00887)	
% of unemployment	-0.02705	-0.005612	-0.09863***	-0.013743
	(0.01685)		(0.03413)	
Education - Diploma (associate)	-0.05532	-0.025213	-0.05839	-0.008438
	(0.04811)		(0.08297)	
Education - Baccalaureate (associate)	-0.06789**	-0.018394	-0.01687	-0.002355
	(0.02741)		(0.05326)	
Education - Masters or more (associate)	0.24019***	0.0597853	0.05555	0.0075087
	(0.04910)		(0.09056)	
Foreign Education (in US)	0.24254***	0.0530447	0.37086***	0.0403595
	(0.06093)		(0.12244)	
Age < 25 (25-29)	-0.17935	-0.04506	-0.16926	-0.026193
	(0.12621)		(0.12290)	
Age 30-34 (25-29)	-0.07343	-0.021486	0.05077	0.0068592
	(0.05801)		(0.10454)	
Age 35-39 (25-29)	-0.16973***	-0.05417	0.02650	0.0036345
	(0.06070)		(0.10854)	
Age 40-44 (25-29)	-0.25123***	-0.074955	0.10126	0.0133133
	(0.06402)		(0.10679)	
Age 45-49 (25-29)	-0.27056***	-0.074377	0.16957	0.0215342
	(0.06586)		(0.10729)	
Age 50-54 (25-29)	-0.28515***	-0.086396	-0.04072	-0.005789
	(0.06669)		(0.09950)	
Age 55-59 (25-29)	-0.37439***	-0.129995	-0.04120	-0.005869
	(0.07082)		(0.10461)	
Age 60-64 (25-29)	-0.50540***	-0.251338	-0.35980***	-0.061791
	(0.07544)		(0.10606)	

Table 8.4 Fulltime/Part Time Equations: Female RNs by Marital Status (Data: ACS 2008) (Continued)

	Married Female		Single Female	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Age ≥ 65 (25-29)	-0.87415***	-0.578678	-1.18648***	-0.307163
	(0.10605)		(0.09758)	
Children at home - all < 6 years (no children at home)	-0.78539***	-0.2925	-0.14054	-0.021527
	(0.04784)		(0.13145)	
Children at home - all > 6 years (no children at home)	-0.43564***	-0.122997	-0.07563	-0.010928
	(0.03245)		(0.06553)	
Children at home - both >6 years and <6 years (no children at home)	-0.74953***	-0.269771	-0.29396**	-0.049784
	(0.04738)		(0.12698)	
% of full-time RN in work force	0.54973***	0.1335009	1.18149***	0.1646161
	(0.14559)		(0.29994)	
Constant	4.74569***		1.88077**	
	(0.45118)		(0.82093)	
Number of observations	19880		8045	
Censored observations	2137		NA	
Uncensored observations	17743		NA	
Log likelihood	-13814.92		-2183.27	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Socioeconomic and Demographic Variables

As expected, wage and other household income has negative effect on RNs decision to work fulltime though all models for both single and married RNs. From Table 8.3 the marginal effects of the other household income are approximately 4 - 4.5% for married RNs and from Table 8.4, 0.5 - 0.6% for single RNs.

Being non-white or black (relative to white) increases the probability that married RNs work fulltime by between 9% and 10%.

Race is not a significant determinant of the decision to work fulltime for single nurses. This is not surprising given how tightly they connected to the labor force.

Married RNs with a diploma or baccalaureate degree are less likely to work fulltime compared to nurses who earned an associate degree. This is true in both the ACS and NSSRN samples. When compared to their counterparts who earned the associate degree, married RNs with a diploma (B.S.) degree are 2 - 4% (2%) less likely to work fulltime.

Consistent with the results in Chapter 5, Nurses holding a Master's degree or higher are more likely to work fulltime. RNs with a master's degree or higher are 5-11% more likely to work fulltime than RNs with associate degrees. This result is expected since the RNs with a master's degree or higher are more likely to be career oriented compared to those who have an associate degree. Despite the differences in definitions of educational attainment in the ACS and NSSRN data, the fulltime-part time models show very similar sized effects for the education variables for models based on these two data sets.

Holding a foreign nursing degree increases the probability of fulltime work participation for both single and married RNs in ACS and NSSRN models. Working RNs who received their nursing degree abroad are 4 - 10% more likely to work fulltime than working RNs studied in United States.

Age is an important factor in RNs fulltime versus part time decision work decision. Older RNs are less likely to work fulltime and this effect is more significant and occurs earlier for married RNs relative to single RNs in both ACS and NSSRN models.

Table 8.5 Employment Status by Age and Marital Status (Data: ACS and NSSRN 2008)

	ACS				NSSRN			
	Married		Single		Married		Single	
Age	Fulltime (%)	Part time (%)	Fulltime (%)	Part time (%)	Fulltime (%)	Part time (%)	Fulltime (%)	Part time (%)
Age 24 or less	89.92	10.08	89.6	10.4	87.73	12.27	93.91	6.09
25-29	84.55	15.45	92.53	7.47	72.57	27.43	88.01	11.99
30-34	78.99	21.01	93.78	6.22	69.32	30.68	90.62	9.38
35-39	76.77	23.23	93.32	6.68	67.34	32.66	84.49	15.51
40-44	77.49	22.51	94.08	5.92	68.88	31.12	85.92	14.08
45-49	80.47	19.53	95.02	4.98	70.8	29.2	88.79	11.21
50-54	83.95	16.05	92.76	7.24	74.07	25.93	85.59	14.41
55-59	83.28	16.72	92.83	7.17	71.65	28.35	83.17	16.83
60-64	77.86	22.14	87.72	12.28	61.07	38.93	76.42	23.58
65 and above	54.1	45.9	60.1	39.9	34.56	65.44	44.96	55.04

Table 8.5 shows the percentage of RNs, who work fulltime, and who work part time by age for the ACS and NSSRN data. Columns 1-2 show the percentages of nurses in the ACS who are employed fulltime, and employed part time. Columns 2 through 4 show the same data for single nurses in the ACS. Finally, the last 4 columns do the same for married and single RNs from the NSSRN. The by age fulltime working ratios of married RNs have an interesting pattern. As expected, married RNs are more likely to work fulltime at early and late ages compared to ~~the~~ middle ages which are usually child bearing ages. However, the same pattern does not apply to single RNs.

The presence of children at any age in the household, has a negative and significant effect on married RNs fulltime work force participation in both data sets. For married RNs in the ACS (NSSRN) the presence of only children less than age 6 lowers the probability of working fulltime by 29% and 25% respectively. The figures

for all above age 6 are respectively, 12% and 11%; and finally figures for when some children are above age 6 and some are below age 6, are respectively 27% and 22%.

The fulltime work participation of single RNs is also affected by presence of children negatively but it is only significant for single RNs with children some age below 6 and some age above 6.

Area Variables

From Table 8.3 and 8.4, the number of doctors per 1,000 population, the percentage of the population below poverty and the percentage of the uninsured population below age 65 have a positive influence on the probability of married RNs fulltime work participation in both ACS and NSSRN models where the coefficient on the number of doctors per 1,000 population is only significant for ACS model, and the percentage of the population below the poverty level is only significant for NSSRN model. Married and single married RNs fulltime work participation is negatively impacted by the unemployment rate in both model, but is only significant for single RN in ACS model. None of the other area variables has a statistically significant effect for single RNs.

The percentage of fulltime RNs in the area working in hospitals has a statistically significant effect on both single and married RNs fulltime versus part time work decisions in both data sets. A higher percentage of hospital RNs who are employed in the labor market is associated with a higher probability of the individual nurse working fulltime. The marginal effects are, respectively, 13% and 27% for married RNs in the ACS and NSSRN models and 16% and 24% for single RNs.

The estimation results for the labor supply models discussed in this chapter show more similarities than differences for NSSRN and ACS data sets. However,

there is one very important qualification we should make while evaluating these results, which is the omitted variables in NSSRN model. Since we purposely omitted variables from the NSSRN regressions that are included in the regressions in Chapter 5 (some with statistically significant coefficients) to match the variables from the ACS dataset, NSSRN models in this chapter are not picking up some of the effects that were seen in Chapter 5. Those models in Chapter 5 have many more variables than the NSSRN models in this chapter. Thus some variables like the wage are picking up the effects of these missing variables.

In spite of these omissions, the results for some key variables like the RNs wage, other household income, and the presence of children in the household, yield results that are qualitatively the same.

Chapter 9

PARTICIPATION AND HOURS OF WORK DECISION MODEL WITH ACS DATA

9.1 Model

This chapter analyzes the determinants of the annual hours worked by nurses utilizing a standard maximum likelihood model (MLE) which was explained in Chapter 6. I focus on the following questions:

1. Are work participation and hours of work related to the wage rate, other family income, and the presence of children in the home?
2. Do area factors, such as the number of doctors, the unemployment rate, and the percent of the population without health insurance below age of 65, influence the hours of work by nurses?
3. Are these ACS-based estimation results similar to the NSSRN-based results?

The variables included in both the work/no work equation and the hours of work equations include the following variables: the RN wage, age, race, ages of children in the home, marital status, educational attainment, if RN is foreign trained, other household income, unemployment rate, percentage of the population below poverty line, the percentage of population without health insurance below the age of 65, the percentage of hospital nurses in the MSA who are employed fulltime, and doctors per 1,000 population.

The model is estimated for married and single female RNs for the ACS and NSSRN data. The reference category of each binary explanatory variable is indicated in parentheses. Empirical results are discussed in the following sections.

9.2 Empirical Results

The results for the participation equation are shown in Table 9.1. Columns 1 and 2 are the results respectively for married and then single RNs with ACS data. Columns 3 and 4 are results for NSSRN data.

9.2.1 Comparing the Participation Empirical Results

Socioeconomic and Demographic Variables

For married RNs the wage effect on labor force participation is 0.33884 and statistically significant in NSSRN model. The coefficient of the RN wage variable is positive but insignificant in the ACS model.

Single RNs' participation rate is also positively affected by the wage. The coefficients of the wage variable are statistically significant in both ACS and NSSRN models. These results differ from literature. Earlier studies of Link (1992) and Chiha and Link (2003) found insignificant wage effects for single RNs.

From Chapter 6, only single RNs living outside of an MSA show a positive and significant coefficient on the RN wage variable. Participation rates of married RNs living in MSAs and non-MSAs are not affected by the wage. The same goes for married RNs residing outside of an MSAs. Thus the regressions using the NSSRN and those using the ACS data yield different results.

Table 9.1 Participation Equations: Married and Single Female RNs (Data: ACS and NSSRN 2008)

	ACS		NSSRN	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Predicted log market wage	0.09018	0.37855*	0.33884***	0.97361***
	(0.14136)	(0.21296)	(0.12863)	(0.32797)
Log other income	-0.04618***	-0.03227***	-0.25700***	-0.84370***
	(0.00943)	(0.00463)	(0.01392)	(0.03012)
Race other (white)	0.06313	0.03347	-0.09815***	0.01312
	(0.05162)	(0.07596)	(0.03406)	(0.07897)
Race black (white)	0.03351	0.01226		
	(0.04975)	(0.05018)		
Race Hispanic/Latin (white)	0.06562	-0.01833		
	(0.05940)	(0.09051)		
Number of doctors per 1,000 population	0.31611	0.85911**	0.24126***	0.60725***
	(0.26327)	(0.42184)	(0.06352)	(0.15360)
% of population below poverty	-0.00789	-0.01361	0.01054***	0.00280
	(0.00848)	(0.01299)	(0.00303)	(0.00798)
% of uninsured population below age 65	0.00002	0.00614	-0.00391	0.00945
	(0.00423)	(0.00645)	(0.00247)	(0.00633)
% of unemployment	0.03399**	0.05487**	-0.00184	-0.00836
	(0.01622)	(0.02587)	(0.00923)	(0.02554)
Education - Diploma (associate)	-0.18850***	-0.09704*	0.00546	-0.08742
	(0.03907)	(0.05643)	(0.03157)	(0.07903)
Education - Baccalaureate (associate)	0.02487	-0.02741	0.02781	0.00187
	(0.02638)	(0.04077)	(0.02534)	(0.06794)
Education - Masters or more (associate)	0.02231	0.01060	0.09316**	0.14358
	(0.04498)	(0.06872)	(0.04353)	(0.11092)
Foreign Education (in US)	-0.12451**	-0.03428	-0.05087	-0.02652
	(0.05040)	(0.07807)	(0.05738)	(0.15397)
Age < 25 (25-29)	0.20017	0.11000	-0.04587	0.12279
	(0.12335)	(0.11314)	(0.12533)	(0.21158)
Age 30-34 (25-29)	-0.01754	-0.24614**	-0.05313	-0.32374*
	(0.05560)	(0.10260)	(0.06314)	(0.18511)
Age 35-39 (25-29)	-0.05554	-0.31827***	-0.06894	-0.29228
	(0.05721)	(0.10074)	(0.06311)	(0.19297)
Age 40-44 (25-29)	0.05282	-0.36650***	-0.04673	-0.52207***
	(0.06122)	(0.09591)	(0.06376)	(0.17635)
Age 45-49 (25-29)	0.12438*	-0.40735***	-0.07663	-0.58948***
	(0.06431)	(0.09387)	(0.06273)	(0.16581)
Age 50-54 (25-29)	0.04040	-0.33024***	-0.10472*	-0.60799***
	(0.06273)	(0.09287)	(0.06230)	(0.15918)
Age 55-59 (25-29)	-0.04824	-0.52642***	-0.16071**	-0.91372***
	(0.06576)	(0.09363)	(0.06411)	(0.15624)
Age 60-64 (25-29)	-0.33436***	-0.74630***	-0.31213***	-1.12679***
	(0.06651)	(0.09221)	(0.06695)	(0.15698)

Table 9.1 Participation Equations: Married and Single Female RNs (Data: ACS and NSSRN 2008) (Continued)

	ACS		NSSRN	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Age ≥ 65 (25-29)	-0.62034***	-0.87526***	-0.57365***	-1.49531***
	(0.06678)	(0.08537)	(0.06973)	(0.15154)
Children at home - all < 6 years (no children at home)	0.06501	0.04382	0.10163**	-0.06886
	(0.04463)	(0.12150)	(0.04383)	(0.17972)
Children at home - all > 6 years (no children at home)	0.16756***	0.13645**	0.09115***	0.18410**
	(0.03351)	(0.05841)	(0.02828)	(0.08382)
Children at home - both >6 years and <6 years (no children at home)	0.19421***	0.00376	0.04463	-0.03866
	(0.04605)	(0.11752)	(0.04679)	(0.20768)
% of full-time RN in work force	-0.19502	-0.06705	-0.28487***	0.11028
	(0.14603)	(0.24629)	(0.07749)	(0.20642)
Constant	1.12438***	0.00931	2.63852***	6.35900***
	(0.42861)	(0.65535)	(0.42766)	(1.06808)
Rho	-0.97975***	-0.97696***	-0.97487***	-0.21968***
	(0.00149)	(0.00287)	(0.00221)	(0.03943)
Number of observations	19880	8972	19529	6893
Censored observations	2137	927	2876	943
Uncensored observations	17743	8045	16653	5950
Log likelihood	-16136.88	-6185.228	-17436.1	-4510.31

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

An increase in the log of other household income substantially decreases the probability of work participation for both single and married female RNs in both ACS and NSSRN models.

Holding a Master's degree or a higher versus an associate degree increases the probability of working for married RNs in the ACS model. Married RNs who hold a Master’s degree or higher are 9% more likely to work than an RN with an associate degree. While holding a Master's degree does not have a statistically significant effect

on either married or single RNs in ACS model, holding a diploma degree reduces the probability of work participation by 19% for married RNs and 10% for single RNs. The negative age effect on participation is at present for both models.

As it was in chapter 6, I found that the presence of children age 6 or below in the household is associated with a higher probability of working. This outcome is not plausible and it is probably due to a misspecification in the reduced form MLE model.

Rho is negative and statistically significant for all models in Table 9.1 indicating that the decision to work and hours worked are related.

Area Variables

As explained at Chapter 3, area variables are used at county level in the labor supply model with NSSRN data and at the state level in the labor supply models with ACS data. The estimation results show considerable different effects of area variable on RNs work participation decision which might be the result of the using different level data since by transforming the county level area variables into the state level I am restricting over 3,000 county specific values into 52 state level values.

The area variables are not very important determinants of RN participation rates. Only the number of doctors per 1,000 population has a positive effect on work participation of RNs and it is statistically significant for all models except for married RNs from the ACS model.

The percent of population below the poverty has an inconsistent effect on the RNs participation rate. However, only has statistically significant positive effect married RNs in NSSRN model. A one percentage point increase in the percent of population below the poverty increases the probability that single female RNs work by 1%.

9.2.2 Comparing Hours Regression Empirical Results

Table 9.2 shows the results for the annual hours equations for RNs.

Socioeconomic and Demographic Variables

Since the RN wage and other household income variables are measured in logarithms in the equation for hours worked, the coefficients for these variables measure the elasticity of hours of labor with respect to wage and other household income.

The wage coefficients all have a minus sign and statistically significant except for single RNs in NSSRN model. This result contradicts the literature. Chiha and Link (2003) and Brewer et al. (2006) comment that while the wage effect is negative, it is insignificant and not a valid policy tool to increase the labor supply.

Elasticity of hours with respect to other household income is -0.02 for married RNs and- 0.01 for single RNs in ACS model and respectively, -0.006 and -0.008 in the NSSRN model.

Married RNs with a baccalaureate or diploma degree tend to work fewer hours than associate degree holders in NSSRN model, while there is no evidence of similar effects in ACS model. Both single and married RNs holding Master's degree or higher tent to work longer hours in both models.

Non-white working married female RNs tent to work longer hours than white working married female RNs; however, race does not appear to impact single female RNs' labor supply of hours in neither model.

The negative effect of aging on RNs labor hours' decision becomes significant at age 60 for both single and married RNs in NSSRN model while aging does not affect RNs labor hours' decision in ACS model.

Table 9.2 Log of Hours Equation: Married Female RNs (Data: ACS and NSSRN 2008)

	ACS		NSSRN	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Predicted log market wage	-0.17300***	-0.22225***	-0.14638***	-0.01739
	(0.05193)	(0.06586)	(0.05388)	(0.06413)
Log other income	-0.01851***	-0.00146	-0.00612***	-0.00896***
	(0.00208)	(0.00107)	(0.00167)	(0.00128)
Race other (white)	0.07562***	0.03589	0.07616***	0.00539
	(0.01718)	(0.02220)	(0.01393)	(0.01480)
Race black (white)	0.06229***	0.00778		
	(0.01686)	(0.01553)		
Race Hispanic/Latin (white)	0.01739	0.00697		
	(0.02111)	(0.02485)		
Number of doctors per 1,000 population	-0.05301	-0.03111	-0.02414	0.00892
	(0.09851)	(0.12602)	(0.02455)	(0.02842)
% of population below poverty	0.00272	-0.00351	0.00007	0.00221
	(0.00310)	(0.00401)	(0.00125)	(0.00158)
% of uninsured population below age 65	0.00061	0.00127	0.00225**	0.00071
	(0.00159)	(0.00203)	(0.00105)	(0.00125)
% of unemployment	-0.01217**	-0.00683	0.00147	-0.00067
	(0.00583)	(0.00794)	(0.00390)	(0.00522)
Education - Diploma (associate)	0.02600	0.02779	-0.02764**	-0.01093
	(0.01633)	(0.02008)	(0.01385)	(0.01797)
Education - Baccalaureate (associate)	-0.00805	0.01941	-0.03382***	-0.00241
	(0.00952)	(0.01253)	(0.01054)	(0.01317)
Education - Masters or more (associate)	0.08680***	0.08506***	0.07851***	0.05100**
	(0.01663)	(0.02130)	(0.01825)	(0.02244)
Foreign Education (in US)	0.05513***	0.03186	0.07702***	0.04723
	(0.01806)	(0.02447)	(0.02316)	(0.02937)
Age < 25 (25-29)	-0.11891***	-0.20682***	0.03097	0.03090
	(0.03778)	(0.03044)	(0.03865)	(0.03150)
Age 30-34 (25-29)	0.03560*	0.09082***	0.02380	0.03466
	(0.01936)	(0.02397)	(0.02274)	(0.02748)
Age 35-39 (25-29)	0.03853*	0.11696***	0.01460	0.00920
	(0.02025)	(0.02504)	(0.02311)	(0.02809)
Age 40-44 (25-29)	0.01359	0.12050***	0.01769	0.02760
	(0.02117)	(0.02421)	(0.02351)	(0.02716)
Age 45-49 (25-29)	0.00627	0.14809***	0.05098**	0.04347*
	(0.02132)	(0.02417)	(0.02302)	(0.02542)
Age 50-54 (25-29)	0.02770	0.12447***	0.05796**	0.02399
	(0.02125)	(0.02335)	(0.02283)	(0.02437)
Age 55-59 (25-29)	0.03629	0.14312***	0.01502	0.00825
	(0.02261)	(0.02462)	(0.02380)	(0.02488)
Age 60-64 (25-29)	0.04596*	0.13118***	-0.03205	-0.10405***
	(0.02419)	(0.02597)	(0.02592)	(0.02660)

Table 9.2 Log of Hours Equation: Married Female RNs (Data: ACS and NSSRN 2008) (Continued)

	ACS		NSSRN	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Age ≥ 65 (25-29)	0.02369	0.02285	-0.12759***	-0.51734***
	(0.02700)	(0.02566)	(0.02922)	(0.03003)
Children at home - all < 6 years (no children at home)	-0.17577***	-0.05499*	-0.15812***	-0.00931
	(0.01574)	(0.03099)	(0.01752)	(0.03149)
Children at home - all > 6 years (no children at home)	-0.10412***	-0.02805*	-0.07689***	0.00779
	(0.01075)	(0.01475)	(0.01142)	(0.01465)
Children at home - both >6 years and <6 years (no children at home)	-0.20411***	-0.06839**	-0.13506***	-0.00979
	(0.01618)	(0.03262)	(0.01917)	(0.03687)
% of full-time RN in work force	0.22324***	0.17083**	0.17130***	0.09966**
	(0.05222)	(0.07462)	(0.03259)	(0.04297)
Constant	8.14666***	8.13679***	7.98488***	7.58894***
	(0.15498)	(0.19933)	(0.17010)	(0.20303)
Number of observations	19880	8972	19529	6893
Censored observations	2137	927	2876	943
Uncensored observations	17743	8045	16653	5950
Log likelihood	-16136.88	-6185.228	-17436.1	-4510.31

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

The presence of children in the home, some or all of whom are under age 6, has the expected negative effect on hours for married as well as single nurses in both models. However, the coefficient is not statistically significant for single RNs in NSSRN model and only significant at 10% level for single RNs in ACS model. That the effect of children in the home on labor supply is weaker for single nurses is not surprising since single nurses are more likely to be the sole breadwinner than are married nurses.

Married RNs with no children at home work more hours than their married counterparts who have any children present in the home. Having children does not affect single RNs hours of labor supply at all except for single RNs who live in non-MSAs and have children at home age 6 or below. Also single RNs with no children at home works less hours than married RNs. This result is intuitive, single RNs without children are able to allocate more time for leisure.

Area Variables

An increase in the unemployment rate decreases the hours worked by married RNs in the ACS model, which does not show a significant effect in the NSSRN model. The percent of the population without health insurance below the age of 65 has a positive effect on married RNs work participation in the NSSRN model, which is absent in ACS model. As in Chapter 6, an increase in the percent of hospital RNs who work fulltime in the area is associated with greater numbers of hours worked. I also found that RNs are more likely to work fulltime (results from Chapter 5), the higher is the percent of hospital RNs who work fulltime in an area.

Chapter 10

CONCLUSION

Registered Nurses (RNs) comprise the largest group of workers in the health care industry. The rising importance and costs of the health care industry imply that RN shortages could have substantial economic effects. Thus, it is vitally important that policymakers have a clear understanding of the factors that influence an RN's labor market behavior, both in terms of the extensive margin (the decision to work) and the intensive margin (how many hours to work).

In this thesis I examined the determinants of labor supply for female married and single RNs, using data from both the National Sample Survey of Registered Nurses (NSSRN) and the American Communities Survey (ACS). I estimated two distinct labor supply models for each dataset, with both models employing well established techniques to control for the possibility of selection bias.

The first model used is a bivariate probit model, which simultaneously estimates the factors influencing the decision between working or not (WK/NW) and, if working, the decision between working fulltime versus part time (FT/PT). For both single and married RNs living in metro statistical areas (MSAs), results based on 2008 NSSRN data are broadly consistent with earlier results from Brewer et al. (2006) based on 2000 NSSRN data.

Specifically, I find that RN wage is not a significant determinant of whether an RN chooses to work but has a significant and negative effect on the probability of working fulltime, while other household income has a negative effect on both labor

force participation and the probability of working fulltime. I find that RNs with young children (all less than age 6) are less likely to work fulltime, while having children older than age 6 only has a negative effect for married RNs. Having children has smaller impacts on single RNs relative to married RNs. All of these results are consistent with those of Brewer et al.

Expanding on Brewer et al.'s results (which only examined RNs living in MSAs), I also estimated the same bivariate probit model for RNs who are not living in MSAs (non-MSAs). For the most part these non-MSA estimation results are similar to the MSA results; however, there is considerably less statistical significance in the non-MSA results. Still, these results broadly support the concept that RNs who live in non-MSAs have generally similar determinants of labor supply.

Beyond expanding the results of Brewer et al. to newer data and a broader geographic coverage, another major contribution of this work is to examine how RN labor supply is impacted by environmental (area labor market) factors. I find that married RNs are more susceptible to environmental factors than single RNs. Presumably this is because single RNs may switch among employers and locations to find desirable working conditions more easily than married RNs, since married RNs' are restricted by their husbands' jobs.

I find that the most significant environmental factor is the percentage of hospital RNs in the labor market who work fulltime. For married RNs who live in MSAs, this fulltime ratio had a negative effect on their workforce participation. This negative relationship between the fulltime ratio and RNs' labor participation can be explained by the discouragement of RNs who prefer to work part time. Once the market is occupied by fulltime RNs, RNs who are not working and would prefer to

work part time might not be able to find a suitable part time position in the workforce. Thus, when fulltime work is frequent, many nurses who would otherwise choose to work part time are not able to work at all. This argument is confirmed in the FT/PT model, in which the fulltime ratio has a positive effect on the probability that a nurse works fulltime, supporting the possibility that RNs who prefer to work part time leave these markets. While the fulltime ratio has no effect on single RNs' work participation, it does have a significant and positive effect on the probability that single RNs work fulltime. This suggests that single RNs either do not prefer to work part time as much as married RNs, leaving their participation decisions unaffected, or that single RNs who prefer to work part time can more easily change their location than can married RNs.

The second model I estimated is a maximum likelihood model analyzing the factors which influence the decisions between working or not and, if working, the number of hours worked. These results on the key factors which influence both single and married RNs labor supply decisions, based on 2008 NSSRN data, are broadly consistent with older results from Chiha and Link based on 1992, 1996, and 2000 NSSRN data.

The combined empirical results from 1992, 1996, 2000, and 2008 provide evidence that the elasticity of hours with respect to wage is inelastic. Chiha and Link only found statistically significant wage coefficients for married RNs in 1996 and for single RNs in 2000. Based on 2008 data, I find no statistically significant wage coefficients for any group. Other household income has a consistently negative effect on RNs' hours of work across all years, while being non-white increases hours of

work for married RNs. The combined empirical results from 1992, 1996, 2000, and 2008 show a clear declining pattern in hours of labor at older ages.

Finally, I estimated both the fulltime/part time bivariate probit model and the maximum likelihood hours model with 2008 ACS data instead of 2008 NSSRN data. Since the ACS data set does not have all the variables found in the NSSRN data set, I was forced to use an abbreviated version of these models in these estimations. To allow comparisons between the two data sets, I also estimated these abbreviated models with the NSSRN data. In general, the NSSRN and ACS results are qualitatively similar but are substantially quantitatively different in the magnitude of some variables. Thus, some of the variables included in the NSSRN models (but missing from these abbreviated models) are capturing quantitatively significant effects and, in their absence, these effects are being (erroneously) captured by variables present in both models, such as wage.

I can thus conclude that the ACS does not provide an adequate replacement for the NSSRN; there are variables which have a significant effect on RNs' labor supply which are present in the NSSRN but absent in the ACS, biasing ACS based results. Abandoning the NSSRN has thus seriously impacted the viability of studying RN labor supply, because, at least as the ACS is currently structured, there is no viable replacement for the NSSRN.

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Appendix A

ESTIMATION RESULTS BY VARIOUS RESTRICTIONS

Table A.1 Participation Equations of Bivariate Probit : Married Female RNs Residing in an MSA by Various Restrictions / Key Variables Reported Only (Data: NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	Hours<3200 Coefficient (Std.Err.) (Col.1)	No restriction Coefficient (Std.Err.) (Col. 2)	Age<65 Coefficient (Std.Err.) (Col. 3)	Hours<3200 Age<65 Coefficient (Std.Err.) (Col. 4)
Predicted log market wage	-0.10790	-0.07629	-0.04019	-0.07721
	(0.19915)	(0.19668)	(0.20537)	(0.20828)
Log other income	-0.76909***	-0.76992***	-0.79739***	-0.79724***
	(0.02061)	(0.02054)	(0.02184)	(0.02194)
Children at home - all < 6 years (no children at home)	-0.18515***	-0.19416***	-0.20720***	-0.19727***
	(0.06427)	(0.06396)	(0.06412)	(0.06443)
Children at home - all > 6 years (no children at home)	0.01663	0.00987	-0.01861	-0.01170
	(0.04182)	(0.04163)	(0.04211)	(0.04231)
Children at home - both >6 years and <6 years (no children at home)	-0.32087***	-0.32286***	-0.34006***	-0.33879***
	(0.06753)	(0.06711)	(0.06718)	(0.06762)
% of hospital RNs in an area who work full-time	-0.29131**	-0.28134**	-0.33285**	-0.34654**
	(0.14077)	(0.13997)	(0.14804)	(0.14898)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table A.2 Fulltime/Part time Equations of Bivariate Probit : Married Female RNs Residing in an MSA by Various Restrictions / Key Variables Reported Only (Data: NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	Hours<3200 Coefficient (Std.Err.) (Col.1)	No restriction Coefficient (Std.Err.) (Col. 2)	Age<65 Coefficient (Std.Err.) (Col. 3)	Hours<3200 Age<65 Coefficient (Std.Err.) (Col. 4)
Predicted log market wage	-0.95223***	-0.93120***	-0.90379***	-0.92829***
	(0.16389)	(0.16097)	(0.16201)	(0.16518)
Log other income	-0.06725***	-0.06896***	-0.07059***	-0.06903***
	(0.00574)	(0.00559)	(0.00568)	(0.00584)
Children at home - all < 6 years (no children at home)	-0.64806***	-0.63878***	-0.63779***	-0.64681***
	(0.04950)	(0.04892)	(0.04872)	(0.04930)
Children at home - all > 6 years (no children at home)	-0.34721***	-0.34313***	-0.34771***	-0.35176***
	(0.03324)	(0.03276)	(0.03271)	(0.03318)
Children at home - both >6 years and <6 years (no children at home)	-0.57398***	-0.57335***	-0.57084***	-0.57154***
	(0.05385)	(0.05325)	(0.05291)	(0.05351)
% of hospital RNs in an area who work full-time	0.89440***	0.89988***	0.91692***	0.91201***
	(0.11155)	(0.11003)	(0.11127)	(0.11284)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table A.3 Participation Equations of MLE model : Married Female RNs Residing in an MSA by Various Restrictions / Key Variables Reported Only (Data: NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	Hours<3200 Coefficient (Std.Err.) (Col.1)	No restriction Coefficient (Std.Err.) (Col. 2)	Age<65 Coefficient (Std.Err.) (Col. 3)	Hours<3200 Age<65 Coefficient (Std.Err.) (Col. 4)
Predicted log market wage	-0.01591	-0.06156	-0.03044	-0.01552
	(0.15571)	(0.17544)	(0.18130)	(0.16032)
Log other income	-0.29882***	-0.51378***	-0.51110***	-0.29667***
	(0.01582)	(0.01970)	(0.01980)	(0.01605)
Children at home - all < 6 years (no children at home)	0.17249***	0.00482	0.00429	0.18285***
	(0.04857)	(0.05674)	(0.05661)	(0.04851)
Children at home - all > 6 years (no children at home)	0.10466***	0.05518	0.02863	0.08222**
	(0.03215)	(0.03706)	(0.03743)	(0.03235)
Children at home - both >6 years and <6 years (no children at home)	0.06858	-0.12993**	-0.13351**	0.07591
	(0.05249)	(0.05996)	(0.05966)	(0.05231)
% of hospital RNs in an area who work full-time	-0.20480*	-0.19371	-0.20430	-0.21701*
	(0.11019)	(0.12459)	(0.12979)	(0.11431)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table A.4 Hours Equations of MLE : Married Female RNs Residing in an MSA by Various Restrictions / Key Variables Reported Only (Data: NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	Hours<3200 Coefficient (Std.Err.) (Col.1)	No restriction Coefficient (Std.Err.) (Col. 2)	Age<65 Coefficient (Std.Err.) (Col. 3)	Hours<3200 Age<65 Coefficient (Std.Err.) (Col. 4)
Predicted log market wage	-0.06249	-0.06245	-0.06252	-0.06957
	(0.06163)	(0.06097)	(0.05891)	(0.05893)
Log other income	-0.00565***	-0.01172***	-0.01290***	-0.00801***
	(0.00179)	(0.00173)	(0.00166)	(0.00171)
Children at home - all < 6 years (no children at home)	-0.16211***	-0.16921***	-0.17243***	-0.16544***
	(0.01864)	(0.01845)	(0.01765)	(0.01759)
Children at home - all > 6 years (no children at home)	-0.07824***	-0.07599***	-0.07792***	-0.07965***
	(0.01233)	(0.01216)	(0.01166)	(0.01165)
Children at home - both >6 years and <6 years (no children at home)	-0.13757***	-0.15427***	-0.15591***	-0.13989***
	(0.02048)	(0.02034)	(0.01943)	(0.01929)
% of hospital RNs in an area who work full-time	0.12798***	0.11718***	0.12690***	0.13819***
	(0.04280)	(0.04248)	(0.04136)	(0.04119)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Appendix B

NSSRN DATA WAGE PARTICIPATION ESTIMATION RESULTS

Table B.1 Participation Equations: Female RNs Residing in or Not Residing in an MSA (Data: NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	MSA (Col. 1)	non-MSA (Col. 2)
Race other (white)	-0.02480	-0.04968
	(0.04139)	(0.09720)
Number of doctors per 1,000 population	-0.00635	0.38178**
	(0.12842)	(0.18117)
Number of nurses per 1,000 population	0.21233***	0.00002*
	(0.07904)	(0.00001)
Education - Diploma (associate)	-0.02160	-0.08806
	(0.04026)	(0.07147)
Education - Baccalaureate (associate)	-0.02080	0.02358
	(0.03168)	(0.05827)
Education - Masters or more (associate)	0.19262***	0.29843***
	(0.04063)	(0.08435)
Foreign Education (in US)	0.07851	-0.13771
	(0.06927)	(0.18894)
Age < 25 (25-29)	-0.13384	-0.24188
	(0.14335)	(0.23667)
Age 30-34 (25-29)	-0.16985**	0.15520
	(0.08391)	(0.16960)
Age 35-39 (25-29)	-0.20574**	0.03760
	(0.08287)	(0.16609)
Age 40-44 (25-29)	-0.22481***	-0.20725
	(0.08306)	(0.16479)
Age 45-49 (25-29)	-0.23983***	-0.22406
	(0.08149)	(0.15957)
Age 50-54 (25-29)	-0.33035***	-0.35499**
	(0.07923)	(0.15828)
Age 55-59 (25-29)	-0.58029***	-0.53972***
	(0.08062)	(0.16063)
Age 60-64 (25-29)	-1.11107***	-1.02450***
	(0.08223)	(0.16410)
Age ≥ 65 (25-29)	-1.82713***	-1.57101***
	(0.08395)	(0.16582)
Region of employment - Middle Atlantic (New England)	-0.27862***	-0.30188**
	(0.05490)	(0.13658)

Table B.1 Participation Equations: Female RNs Residing in or Not Residing in an MSA (Data: NSSRN 2008) (Continued)

Explanatory Variable (Reference Category in Parentheses)	MSA (Col. 1)	non-MSA (Col. 2)
Region of employment - East North Central (New England)	-0.26785***	-0.11474
	(0.05771)	(0.11011)
Region of employment - West North Central (New England)	-0.04921	0.08084
	(0.06447)	(0.11309)
Region of employment - South Atlantic (New England)	-0.21723***	-0.17188
	(0.05092)	(0.11443)
Region of employment - East South Central (New England)	-0.24922***	-0.13455
	(0.07180)	(0.12618)
Region of employment - West South Central (New England)	-0.25604***	-0.22436*
	(0.06414)	(0.12510)
Region of employment - Mountain (New England)	-0.15155**	-0.10341
	(0.06040)	(0.11556)
Region of employment - Pacific (New England)	-0.14341**	-0.06531
	(0.05911)	(0.11773)
Children at home - all < 6 years (no children at home)	-0.06679	-0.17788
	(0.05880)	(0.12120)
Children at home - all > 6 years (no children at home)	0.10268***	0.10478
	(0.03729)	(0.07229)
Children at home - both >6 years and <6 years (no children at home)	-0.17824***	-0.15035
	(0.06260)	(0.13258)
Log other income	-0.60728***	-0.54949***
	(0.01586)	(0.02926)
Constant	8.20684***	7.34811***
	(0.20652)	(0.37295)
Rho	-0.06256	-0.05611
	(0.02508)	(0.04964)
Number of observations	20773	5655
Censored observations	2970	850
Uncensored observations	17803	4805
Log likelihood	-10924.48	-3336.267

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Appendix C

NSSRN DATA WAGE OLS ESTIMATION RESULS

Table C.1 Wage Equation: Female RNs Residing outside of an MSA / Estimated by OLS Regression (Data: ACS and NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)
Race other (white)	0.07978
	(0.05799)
Number of doctors per 1,000 population	0.28000***
	(0.09771)
Number of nurses per 1,000 population	0.00002**
	(0.00001)
Education - Diploma (associate)	-0.09200*
	(0.05050)
Education - Baccalaureate (associate)	-0.01884
	(0.03705)
Education - Masters or more (associate)	0.25633***
	(0.05251)
Foreign Education (in US)	0.04189
	(0.12264)
Age < 25 (25-29)	-0.09877
	(0.12371)
Age 30-34 (25-29)	0.00164
	(0.08803)
Age 35-39 (25-29)	0.03989
	(0.08513)
Age 40-44 (25-29)	-0.03704
	(0.08360)
Age 45-49 (25-29)	-0.04978
	(0.07914)
Age 50-54 (25-29)	-0.11013
	(0.07773)
Age 55-59 (25-29)	-0.23959***
	(0.07988)
Age 60-64 (25-29)	-0.62911***
	(0.08629)

Table C.1 Wage Equation: Female RNs Residing outside of an MSA / Estimated by OLS Regression (Data: ACS and NSSRN 2008) (Continued)

Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)
Age ≥ 65 (25-29)	-1.29735***
	(0.09107)
Region of employment - Middle Atlantic (New England)	-0.29434***
	(0.09077)
Region of employment - East North Central (New England)	-0.17545**
	(0.07008)
Region of employment - West North Central (New England)	-0.08823
	(0.07297)
Region of employment - South Atlantic (New England)	-0.20674***
	(0.07522)
Region of employment - East South Central (New England)	-0.14815*
	(0.08182)
Region of employment - West South Central (New England)	-0.23442***
	(0.08357)
Region of employment - Mountain (New England)	-0.13709*
	(0.07600)
Region of employment - Pacific (New England)	0.03985
	(0.07532)
Constant	3.04620***
	(0.09835)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table C.2 Participation Equation of Bivariate Probit: Married and Single Female RNs Residing Outside of an MSA with OLS Estimated Predicted Wage / Only Key Variables Reported (Data: NSSRN 2008)

	Married Female RNs	Single Female RNs
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Coefficient (Std.Err.) (Col.2)
Predicted log market wage	1.11015***	1.44641**
	(0.29846)	(0.65464)
Log other income	-0.69005***	-0.90252***
	(0.03715)	(0.07381)
Children at home - all < 6 years (no children at home)	-0.46304***	0.13953
	(0.13501)	(0.43273)
Children at home - all > 6 years (no children at home)	-0.01446	0.28609
	(0.07964)	(0.20389)
Children at home - both >6 years and <6 years (no children at home)	-0.36187**	0.30446
	(0.14540)	(0.43244)
% of hospital RNs in an area who work full-time	-0.11612	-0.55569
	(0.17733)	(0.40774)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table C.3 Fulltime/Part Time Equation of Bivariate Probit: Married and Single Female RNs Residing Outside of an MSA with OLS Estimated Predicted Wage / Only Key Variables Reported (Data: NSSRN 2008)

	Married Female RNs	Single Female RNs
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Coefficient (Std.Err.) (Col.2)
Predicted log market wage	-0.57181**	-0.42056
	(0.24083)	(0.47997)
Log other income	-0.05133***	-0.00781
	(0.01054)	(0.01205)
Children at home - all < 6 years (no children at home)	-0.51037***	-0.53264**
	(0.10268)	(0.25266)
Children at home - all > 6 years (no children at home)	-0.19822***	0.06808
	(0.06381)	(0.14603)
Children at home - both >6 years and <6 years (no children at home)	-0.46754***	0.05654
	(0.11052)	(0.36926)
% of hospital RNs in an area who work full-time	1.00892***	0.82739**
	(0.15110)	(0.32739)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table C.4 Participation Equation of MLE Model: Married and Single Female RNs Residing Outside of an MSA with OLS Estimated Predicted Wage / Only Key Variables Reported (Data: NSSRN 2008)

	Married Female RNs	Single Female RNs
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Coefficient (Std.Err.) (Col.2)
Predicted log market wage	0.60181***	1.53719**
	(0.22856)	(0.67658)
Log other income	-0.21117***	-0.89398***
	(0.02664)	(0.93451)
Children at home - all < 6 years (no children at home)	-0.17752*	0.21578
	(0.10244)	(0.44280)
Children at home - all > 6 years (no children at home)	0.00527	0.30702
	(0.06171)	(0.20938)
Children at home - both >6 years and <6 years (no children at home)	-0.08582	0.16365
	(0.11100)	(0.44026)
% of hospital RNs in an area who work full-time	-0.28754**	-0.68611
	(0.13719)	(0.41759)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table C.5 Hours Equation of MLE Model: Married and Single Female RNs Residing Outside of an MSA with OLS Estimated Predicted Wage / Only Key Variables Reported (Data: NSSRN 2008)

	Married Female RNs	Single Female RNs
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Coefficient (Std.Err.) (Col.2)
Predicted log market wage	-0.34068***	0.82888
	(0.09622)	(0.63818)
Log other income	-0.00814**	-0.18291***
	(0.00366)	(0.01476)
Children at home - all < 6 years (no children at home)	-0.10759***	0.02137
	(0.04027)	(0.35771)
Children at home - all > 6 years (no children at home)	-0.03558	0.06781
	(0.02496)	(0.18234)
Children at home - both >6 years and <6 years (no children at home)	-0.09731**	-0.17621
	(0.04329)	(0.43732)
% of hospital RNs in an area who work full-time	0.23315***	-0.74259*
	(0.05930)	(0.42964)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Appendix D

NSSRN BIVARIATE PROBIT ESTIMATION RESULS

Table D.1 Participation Equations: Married and Single Female RNs Residing in an MSA / Missing Variables from Table 5.1 (Data: NSSRN 2008)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Previous position - No previous health job (nurse aide)	-0.01930 (0.03471)	-0.0019768	-0.11539 (0.07068)	-0.0000621
Previous position - Licensed practical/vocational nurse (nurse aide)	-0.08748 (0.06524)	-0.0085116	0.06254 (0.11961)	0.0000286
Previous position - Allied health (nurse aide)	0.14443 (0.10208)	0.0112015	0.06807 (0.19437)	0.0000278
Previous position - Other healthcare (nurse aide)	0.05940 (0.04108)	0.0050002	-0.09806 (0.08189)	-0.000054
Previous position - Managerial (nurse aide)	-0.05645 (0.26323)	-0.0055449	-0.19772 (0.43647)	-0.0001445
Previous position - Other (nurse aide)	-0.15525 (0.22665)	-0.0164315	-0.69425* (0.37052)	-0.0014446

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table D.2 Fulltime/ Part Time Equations: Married and Single Female RNs Residing in an MSA / Missing Variables from Table 5.2 (Data: NSSRN 2008)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Previous position - No previous health job (nurse aide)	-0.02908	-0.01034	0.00442	0.001039
	(0.02937)		(0.05744)	
Previous position - Licensed practical/vocational nurse (nurse aide)	0.07055	0.0215386	0.08892	0.0188894
	(0.05412)		(0.09358)	
Previous position - Allied health (nurse aide)	-0.12793*	-0.04146	0.06031	0.0131822
	(0.07548)		(0.14985)	
Previous position - Other healthcare (nurse aide)	0.01441	0.0063807	0.03864	0.0085002
	(0.03232)		(0.06269)	
Previous position - Managerial (nurse aide)	0.24089	0.0746494	-0.25192	-0.0631067
	(0.23580)		(0.36684)	
Previous position - Other (nurse aide)	0.14701	0.0440159	-0.13767	-0.0322199
	(0.19004)		(0.30839)	
Work setting - Unknown (hospital)	-0.07391	-0.0259045	-0.60611***	-0.1767896
	(0.12714)		(0.22755)	
Work setting - Nursing home/extended care (hospital)	0.07466	0.024779	-0.07095	-0.0162397
	(0.06340)		(0.10674)	
Work setting - Academic education (hospital)	-0.01197	-0.0043556	-0.15384	-0.0369982
	(0.07343)		(0.12670)	
Work setting - Home health (hospital)	-0.10611**	-0.0373274	-0.31566***	-0.0810259
	(0.04953)		(0.09560)	
Work setting - Public/Community health (hospital)	0.15658**	0.0507814	0.04984	0.0107716
	(0.06704)		(0.12297)	
Work setting - School health service (hospital)	0.46795***	0.1353099	0.15909	0.0323278
	(0.06184)		(0.14414)	
Work setting - Occupational health (hospital)	0.05499	0.0182079	0.19349	0.0384236
	(0.11948)		(0.23732)	
Work setting - Ambulatory care (hospital)	-0.08814**	-0.0306647	-0.09069	-0.0210557
	(0.03706)		(0.08563)	
Work setting - Insurance/benefits/utilization review (hospital)	0.45479***	0.1318727	0.21976	0.0433849
	(0.09090)		(0.18306)	

Table D.2 Fulltime/ Part Time Equations: Married and Single Female RNs Residing in an MSA / Missing Variables from Table 5.2 (Data: NSSRN 2008)

(Continued)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Work setting - Other (hospital)	0.04838	0.0162284	-0.25270**	-0.0630743
	(0.07019)		(0.12045)	
Work position - Unknown (stuff nurse)	0.00267	0.0008064	0.18563	0.0369284
	(0.15977)		(0.29425)	
Work position - Management/Administration (stuff nurse)	1.03957***	0.2507294	0.81749***	0.1239451
	(0.04946)		(0.09289)	
Work position - Consultant (stuff nurse)	-0.17236	-0.0616214	0.17869	0.035786
	(0.11255)		(0.20774)	
Work position - Instruction (stuff nurse)	0.28310***	0.0880906	0.37621***	0.0680939
	(0.07241)		(0.14000)	
Work position - Nurse Practitioner (stuff nurse)	0.09459	0.0313059	0.46328***	0.0799119
	(0.07160)		(0.14406)	
Work position - Nurse Midwife (stuff nurse)	0.20468	0.0646537	0.09823	0.0205489
	(0.20424)		(0.57234)	
Work position - Clinical Nurse Specialist (stuff nurse)	0.49645***	0.1404997	0.07814	0.0165966
	(0.12307)		(0.20430)	
Work position - Nurse Anesthetist (stuff nurse)	0.33601***	0.1014242	-0.02526	-0.0062742
	(0.11554)		(0.22742)	
Work position - Researcher (stuff nurse)	0.46463***	0.1334611	0.49851	0.0829429
	(0.12335)		(0.32047)	
Work position - Info (Continued)	1.28289***	0.248081	0.41684	0.0727672
	(0.24586)		(0.33889)	
Work position - Surveyor/Auditor/Regulator (stuff nurse)	0.33385**	0.1011856	0.40570	0.0710701
	(0.17014)		(0.32278)	
Work position - Patient Coordinator (stuff nurse)	0.44520***	0.1311801	0.63530***	0.1019595
	(0.05112)		(0.10675)	
Work position - Patient Educator (stuff nurse)	0.09191	0.0303984	0.49529**	0.0824967
	(0.10421)		(0.25087)	
Work position - Other (stuff nurse)	0.46140***	0.1333496	0.38258**	0.0688704
	(0.07984)		(0.15202)	
Work position - No job title (stuff nurse)	-0.32291**	-0.1197329	-0.41536*	-0.1119775
	(0.13413)		(0.23077)	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table D.3 Participation Equations: Married and Single Female RNs Residing Outside of an MSA / Missing Variables from Table 5.7 (Data: NSSRN 2008)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Previous position - No previous health job (nurse aide)	-0.10348	-0.0115053	0.26517*	0.0000706
	(0.06462)		(0.14796)	
Previous position - Licensed practical/vocational nurse (nurse aide)	0.01378	0.0013357	0.05359	0.0000167
	(0.10772)		(0.22201)	
Previous position - Allied health (nurse aide)	-0.07027	-0.0072177	-0.68842*	-0.0007896
	(0.20847)		(0.38246)	
Previous position - Other healthcare (nurse aide)	-0.04111	-0.0044313	-0.09626	-0.0000304
	(0.07425)		(0.16919)	
Previous position - Managerial (nurse aide)	-0.14407	-0.0165159	6.64825	0.0000871
	(0.47863)		(15079.64819)	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table D.4 Fulltime / Part Time Equations: Married and Single Female RNs Residing Outside of an MSA / Missing Variables from Table 5.8 (Data: NSSRN 2008)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Previous position - No previous health job (nurse aide)	-0.01152	-0.006795	0.06961	0.0145074
	(0.05640)		(0.11786)	
Previous position - Licensed practical/vocational nurse (nurse aide)	0.13636	0.0422354	0.43463**	0.0746606
	(0.09272)		(0.20914)	
Previous position - Allied health (nurse aide)	0.03827	0.0097916	0.18622	0.037809
	(0.17153)		(0.37679)	
Previous position - Other healthcare (nurse aide)	0.09745	0.0294093	-0.04980	-0.0107842
	(0.06180)		(0.13162)	
Previous position - Managerial (nurse aide)	0.58980	0.145169	-0.57207	-0.1604107
	(0.60117)		(0.61174)	
Work setting - Unknown (hospital)	0.39537	0.1077068	0.07980	0.0159399
	(0.39809)		(0.57242)	
Work setting - Nursing home/extended care (hospital)	-0.03588	-0.011603	-0.05623	-0.0126274
	(0.09358)		(0.17117)	
Work setting - Academic education (hospital)	0.02336	0.0073428	-0.30148	-0.0773202
	(0.14417)		(0.25989)	
Work setting - Home health (hospital)	-0.15660*	-0.0525186	-0.24049	-0.0571096
	(0.08484)		(0.18448)	
Work setting - Public/Community health (hospital)	0.23606**	0.0694773	0.14829	0.0291689
	(0.10637)		(0.24595)	
Work setting - School health service (hospital)	0.23445**	0.0688392	-0.08051	-0.0159646
	(0.11367)		(0.32594)	
Work setting - Occupational health (hospital)	-0.01107	-0.0033402	-0.09003	-0.0193713
	(0.26685)		(0.55192)	
Work setting - Ambulatory care (hospital)	-0.21813***	-0.0743916	0.06751	0.0147028
	(0.07714)		(0.17900)	
Work setting - Insurance/benefits/utilization review (hospital)	0.01852	0.0064222	0.11747	0.0223688
	(0.25680)		(0.72994)	

Table D.4 Fulltime / Part Time Equations: Married and Single Female RNs Residing Outside of an MSA / Missing Variables from Table 5.8 (Data: NSSRN 2008) (Continued)

	Married Female RNs		Single Female RNs	
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)	Marginal Effect (Col.2)	Coefficient (Std.Err.) (Col.3)	Marginal Effect (Col.4)
Work setting - Other (hospital)	-0.37933**	-0.1360775	0.38707	0.0676769
	(0.19089)		(0.40644)	
Work position - Unknown (stuff nurse)	-0.52714	-0.1972208	0.24881	0.0458468
	(0.36370)		(0.54716)	
Work position - Management/Administration (stuff nurse)	0.94660***	0.2228032	0.75133***	0.1163854
	(0.08138)		(0.16696)	
Work position - Consultant (stuff nurse)	-0.39243*	-0.1415856	-0.88649*	-0.2801027
	(0.22087)		(0.51672)	
Work position - Instruction (stuff nurse)	0.26941*	0.0779937	0.35591	0.0636021
	(0.14077)		(0.35630)	
Work position - Nurse Practitioner (stuff nurse)	0.38864***	0.1071596	0.00343	-0.0005441
	(0.14602)		(0.29507)	
Work position - Nurse Midwife (stuff nurse)	0.02800	0.0088326	0.14070	0.0277605
	(0.47317)		(0.59940)	
Work position - Clinical Nurse Specialist (stuff nurse)	0.40883	0.1105522	0.18469	0.0351523
	(0.28908)		(0.71162)	
Work position - Nurse Anesthetist (stuff nurse)	0.49409*	0.1285048	0.07308	0.0147173
	(0.28249)		(0.34917)	
Work position - Researcher (stuff nurse)	0.15310	0.0463295	0.35790	0.0609042
	(0.35474)		(0.76111)	
Work position - Patient Coordinator (stuff nurse)	0.52852***	0.1375543	0.90504***	0.1174876
	(0.11408)		(0.31101)	
Work position - Patient Educator (stuff nurse)	-0.39613*	-0.143178	-0.65378*	-0.1824936
	(0.22506)		(0.38975)	
Work position - Other (stuff nurse)	0.28968**	0.0828456	0.52692	0.0827353
	(0.14405)		(0.42390)	
Work position - No job title (stuff nurse)	-0.35417	-0.1282824	-0.66413	-0.1926975
	(0.26580)		(0.58683)	

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Appendix E

NSSRN BIVARIATE PROBIT ESTIMATION RESULTS

Table E.1 Participation Equations: Female RNs Residing in or Not Residing in an MSA by Marital Status / Missing variables from Table 6.1 (Data: NSSRN 2008)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Previous position - No previous health job (nurse aide)	-0.01637	-0.10888	-0.03520	0.25837*
	(0.02738)	(0.07169)	(0.05085)	(0.15194)
Previous position - Licensed practical/vocational nurse (nurse aide)	0.01177	0.07609	-0.02069	0.03659
	(0.05171)	(0.12125)	(0.08420)	(0.22861)
Previous position - Allied health (nurse aide)	0.07683	0.04748	-0.00729	-0.78542**
	(0.07883)	(0.19672)	(0.15467)	(0.39939)
Previous position - Other healthcare (nurse aide)	0.06607**	-0.11714	-0.01375	-0.10239
	(0.03186)	(0.08294)	(0.05732)	(0.17319)
Previous position - Managerial (nurse aide)	-0.22455	-0.26364	-0.38462	9.29488
	(0.19612)	(0.45078)	(0.36996)	(2.1e+08)
Previous position - Other (nurse aide)	0.03436	-0.74381**		
	(0.18974)	(0.37407)		

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Table E.2 Participation Equations: Female RNs Residing in or Not Residing in an MSA by Marital Status / Missing variables from Table 6.2 (Data: NSSRN 2008)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Previous position - No previous health job (nurse aide)	-0.00481	-0.02874**	0.01166	-0.02220
	(0.01110)	(0.01354)	(0.02227)	(0.03358)
Previous position - Licensed practical/vocational nurse (nurse aide)	0.01780	-0.03395	0.04094	0.01324
	(0.01990)	(0.02181)	(0.03478)	(0.05312)
Previous position - Allied health (nurse aide)	-0.02449	-0.01207	0.00083	0.00772
	(0.02918)	(0.03422)	(0.06888)	(0.09951)
Previous position - Other healthcare (nurse aide)	-0.00490	0.00143	0.03865	0.02305
	(0.01229)	(0.01457)	(0.02418)	(0.03760)
Previous position - Managerial (nurse aide)	0.08879	-0.05336	0.13279	-0.23881
	(0.08543)	(0.09318)	(0.17839)	(0.20135)
Previous position - Other (nurse aide)	0.02559	-0.02250		
	(0.07135)	(0.07797)		
Work setting - Unknown (hospital)	-0.06381*	-0.30667***	-0.02523	-0.01974
	(0.03641)	(0.06158)	(0.08164)	(0.15341)
Work setting - Nursing home/extended care (hospital)	-0.00917	-0.00404	-0.02438	-0.00531
	(0.01827)	(0.02541)	(0.02588)	(0.04974)
Work setting - Academic education (hospital)	-0.03075	-0.03934	0.00130	-0.11539
	(0.01981)	(0.03130)	(0.04524)	(0.07744)
Work setting - Home health (hospital)	0.01154	-0.03818	-0.01291	-0.05440
	(0.01452)	(0.02403)	(0.02455)	(0.05246)
Work setting - Public/Community health (hospital)	-0.03361*	-0.05409*	-0.02498	-0.01480
	(0.01908)	(0.02877)	(0.02887)	(0.06479)
Work setting - School health service (hospital)	-0.15782***	-0.18355***	-0.14037***	-0.57867***
	(0.01721)	(0.03544)	(0.03180)	(0.10030)
Work setting - Occupational health (hospital)	-0.01736	0.02038	-0.05655	-0.07717
	(0.03444)	(0.05377)	(0.07809)	(0.17006)
Work setting - Ambulatory care (hospital)	-0.06439***	-0.06091***	-0.08110***	0.03535
	(0.01099)	(0.02029)	(0.02364)	(0.05063)
Work setting - Insurance/benefits/utilization review (hospital)	0.01019	-0.06423*	0.08499	-0.31997**
	(0.02322)	(0.03596)	(0.08762)	(0.15127)
Work setting - Other (hospital)	0.00451	-0.04897*	-0.15843***	-0.07808
	(0.01950)	(0.02959)	(0.04544)	(0.11693)

Table E.2 Participation Equations: Female RNs Residing in or Not Residing in an MSA by Marital Status / Missing variables from Table 6.2 (Data: NSSRN 2008) (Continued)

	MSA		non-MSA	
Explanatory Variable (Reference Category in Parentheses)	Married Female (Col. 1)	Single Female (Col. 2)	Married Female (Col. 3)	Single Female (Col. 4)
Work position - Unknown (staff nurse)	-0.08800**	-0.11339	-0.04885	-0.35909**
	(0.04170)	(0.07347)	(0.11423)	(0.18197)
Work position - Management/Administration (staff nurse)	0.27716***	0.20087***	0.23903***	0.20906***
	(0.01253)	(0.01843)	(0.02127)	(0.04096)
Work position - Consultant (staff nurse)	-0.05102*	0.10781**	-0.07144	-0.19849
	(0.03010)	(0.05230)	(0.05259)	(0.16213)
Work position - Instruction (staff nurse)	0.04825**	0.02331	0.06942	-0.02130
	(0.01985)	(0.03419)	(0.04303)	(0.09583)
Work position - Nurse Practitioner (staff nurse)	0.12953***	0.15015***	0.18531***	0.13551
	(0.02178)	(0.03291)	(0.04612)	(0.08311)
Work position - Nurse Midwife (staff nurse)	0.18173***	0.37477***	0.18612	0.12335
	(0.06058)	(0.14050)	(0.17182)	(0.20399)
Work position - Clinical Nurse Specialist (staff nurse)	0.17784***	0.06976	0.26304***	0.06620
	(0.03497)	(0.05342)	(0.09358)	(0.20604)
Work position - Nurse Anesthetist (staff nurse)	0.12183***	0.01486	0.14362	0.22386*
	(0.03337)	(0.06151)	(0.08823)	(0.12808)
Work position - Researcher (staff nurse)	0.18745***	0.15867**		
	(0.03797)	(0.06950)		
Work position - Informatics (staff nurse)	0.19074***	0.11282		
	(0.04934)	(0.08434)		
Work position - Surveyor/Auditor/Regulator (staff nurse)	0.10776**	0.10995	0.06682	0.12114
	(0.04727)	(0.07334)	(0.10298)	(0.20347)
Work position - Patient Coordinator (staff nurse)	0.13364***	0.13763***	0.15851***	0.24592***
	(0.01527)	(0.02316)	(0.03382)	(0.06885)
Work position - Patient Educator (staff nurse)	0.02764	0.12270**	-0.05343	-0.17904
	(0.02954)	(0.05743)	(0.06133)	(0.13747)
Work position - Other (staff nurse)	0.10485***	0.10960***	0.05144	0.09611
	(0.02303)	(0.03505)	(0.04301)	(0.10425)
Work position - No job title (staff nurse)	-0.12135***	-0.52868***	-0.25845***	-0.93065***
	(0.03281)	(0.06626)	(0.06552)	(0.20201)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Appendix F

NSSRN UNIVARIATE PROBIT ESTIMATION RESULTS

Table F.1 Participation Equations by Univariate Probit Model: Married Female RNs Residing in an MSA / Coefficients of Children Variables (Data: NSSRN 2008)

	Married Female RNs
Explanatory Variable (Reference Category in Parentheses)	Coefficient (Std.Err.) (Col. 1)
Children at home - all < 6 years (no children at home)	-0.22264***
	(0.06663)
Children at home - all > 6 years (no children at home)	0.00840
	(0.04271)
Children at home - both >6 years and <6 years (no children at home)	-0.34634***
	(0.06906)

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level

Appendix G

ACS WAGE PARTICIPATION ESTIMATION RESULTS

Table G.1Participation Equations: Female RNs (Data: ACS and NSSRN 2008)

Explanatory Variable (Reference Category in Parentheses)	ACS, uses detailed race variables (Col 1.)	ACS-uses white/non white for race (Col 2.)	NSSRN (Col. 3)
Race other (white)	0.20484***	0.17958***	-0.06884*
	(0.05017)	(0.04919)	(0.03803)
Race black (white)	0.11454**		
	(0.04485)		
Race Hispanic/Latin (white)	0.08593		
	(0.06257)		
Number of doctors per 1,000 population	0.58484**	0.61341**	0.51608***
	(0.27103)	(0.27072)	(0.06149)
Number of nurses per 1,000 population	0.23774*	0.20290	0.00001***
	(0.13344)	(0.13280)	(0.00000)
Education - Diploma (associate)	-0.22918***	-0.22834***	-0.03282
	(0.03955)	(0.03953)	(0.03499)
Education - Baccalaureate (associate)	-0.00126	-0.00101	-0.01940
	(0.02503)	(0.02501)	(0.02771)
Education - Masters or more (associate)	0.06149*	0.06150*	0.18989***
	(0.03591)	(0.03589)	(0.03643)
Foreign Education (in US)	-0.08123	-0.05537	0.02718
	(0.05225)	(0.05128)	(0.06507)
Age < 25 (25-29)	-0.10843	-0.11100	-0.16709
	(0.08723)	(0.08725)	(0.12223)
Age 30-34 (25-29)	-0.11130*	-0.11329*	-0.10358
	(0.06023)	(0.06020)	(0.07517)
Age 35-39 (25-29)	-0.24653***	-0.24970***	-0.15309**
	(0.05922)	(0.05914)	(0.07421)
Age 40-44 (25-29)	-0.17681***	-0.18052***	-0.21804***
	(0.06161)	(0.06154)	(0.07424)
Age 45-49 (25-29)	-0.09606	-0.10258*	-0.23726***
	(0.06140)	(0.06130)	(0.07260)
Age 50-54 (25-29)	-0.19997***	-0.20692***	-0.33904***
	(0.05883)	(0.05873)	(0.07092)

Table G.1Participation Equations: Female RNs (Data: ACS and NSSRN 2008)

(Continued)

Explanatory Variable (Reference Category in Parentheses)	ACS, uses detailed race variables (Col 1.)	ACS-uses white/non white for race (Col 2.)	NSSRN (Col. 3)
Age 55-59 (25-29)	-0.44774***	-0.45361***	-0.56811***
	(0.05901)	(0.05892)	(0.07214)
Age 60-64 (25-29)	-1.01907***	-1.02553***	-1.08210***
	(0.05903)	(0.05894)	(0.07359)
Age ≥ 65 (25-29)	-1.71421***	-1.71888***	-1.76101***
	(0.06038)	(0.06027)	(0.07493)
Region of employment - Middle Atlantic (New England)	0.03904	0.04603	-0.28946***
	(0.05332)	(0.05325)	(0.05023)
Region of employment - East North Central (New England)	0.13176**	0.13680**	-0.21978***
	(0.05980)	(0.05976)	(0.04966)
Region of employment - West North Central (New England)	0.13941**	0.14549**	0.00525
	(0.06900)	(0.06898)	(0.05193)
Region of employment - South Atlantic (New England)	-0.02938	-0.01642	-0.20196***
	(0.05844)	(0.05823)	(0.04529)
Region of employment - East South Central (New England)	-0.12725*	-0.11317*	-0.19438***
	(0.06862)	(0.06842)	(0.05966)
Region of employment - West South Central (New England)	-0.01301	0.00107	-0.23193***
	(0.06854)	(0.06833)	(0.05533)
Region of employment - Mountain (New England)	0.00522	0.00730	-0.13205**
	(0.07402)	(0.07398)	(0.05188)
Region of employment - Pacific (New England)	0.11313*	0.11886*	-0.15313***
	(0.06435)	(0.06427)	(0.05254)
Children at home - all < 6 years (no children at home)	-0.31706***	-0.31886***	-0.08730*
	(0.04856)	(0.04847)	(0.05289)
Children at home - all > 6 years (no children at home)	0.12997***	0.13161***	0.11614***
	(0.03621)	(0.03618)	(0.03315)
Children at home - both >6 years and <6 years (no children at home)	-0.19663***	-0.19544***	-0.15014***
	(0.05135)	(0.05129)	(0.05654)
Log other income	-0.07888***	-0.07979***	-0.59591***
	(0.00466)	(0.00465)	(0.01391)
Constant	2.16774***	2.19647***	8.00105***
	(0.13944)	(0.13897)	(0.17572)
Rho	0.0044	0.00344	-0.05149**
	(0.04951)	(0.04542)	(0.02248)
Number of observations	28852	28852	26428
Censored observations	3064	3064	3820
Uncensored observations	25788	25788	22608
Log likelihood	-23270	-23285.62	-14416.09

Notes: Standard error in parentheses

* Significant at 10% level

** Significant at 5% level

***Significant at 1% level