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# Do wages matter? An econometric analysis of the nurse labor participation in California.

by

Michelle S. Tellez

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

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Nursing

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of the

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

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Michelle Sardenberg Hersh Téllez

# Dedication

I dedicate this dissertation to my husband Juan Manuel Téllez for his unwavering belief that I could indeed go from G.E.D to PhD and for his wonderful “enjoyment” of independent minded women.

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I am especially grateful for my family and my old friends who continued loving me even when my nerves were brittle and all my shortcomings were blamed on the dissertation. My husband, Juan, and my daughters, Luiza and Maya, were particularly instrumental, keeping me balanced and "disciplined" while juggling personal and academic life. I would also like to thank all my classmates, especially Claire Hauser, Valery Ruth, Meera Nicholls, Sasha Cutler, Mary Foley, Catherine Dodd and Monika Eckfield for their friendship and support through this sometimes-not-so-pleasant process.

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Abstract

Do wages matter?: An Econometric Analysis of the Nurse Labor Participation in California

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Michelle Sardenberg Hersh Téllez

The current nurse shortage is a significant public health problem that hinders the delivery of health care, and is associated with poor health outcomes, poor patient satisfaction, poor working conditions and greater administrative costs. Although the number of nurses working is increasing, the demand for nursing care is increasing even faster, and the shortage of nurses is worsening. It is predicted to reach 340,000 by 2020. According to economic theory, in times of shortage, wages go up and motivate greater labor participation.

The primary purpose of this research project was to increase the understanding of the effect of wages on the level of participation of staff nurses working in California. The secondary purposes were (a) to describe nurse wages across the state and (b) to assess their effect on the number of hours worked, accounting for gender, age, race/ethnicity, marital status, other income, level of education, location of education, location of employment, position held, and region of residence within the state. In order to achieve these goals, cross-sectional analyses were conducted using secondary data collected by the California State University, Chico on behalf of the California Board of Registered Nursing in 2004. Data were collected via an anonymous survey submitted to a random sample of nurses with active licenses in the state.

Using analysis of variance, mean wages were compared across the 10 regions of the state. Post-hoc comparisons found that the Bay Area Region had significantly higher wages than the other regions, while North Counties had significantly lower wages. Using multiple regression and Two-stage-least-squared regression with instrumental variables, wage effects were calculated for the entire sample (n=1638) and for 28 subgroups within the sample. Wages were found to have a non-significant effect on the number of hours nurses work once they are licensed and employed. Findings corroborate the conclusion drawn in previous studies. Theoretical and analytical models need to be broaden in order to more fully represent the decisions made by the nurse population about the number of hours worked.

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# Chapter 1

## Introduction of the Problem and the Purpose of this study

The United States (U.S.) has experienced many nurse shortages throughout the 20th century (Aiken & Mullinix, 1987; Buerhaus, Staiger, & Auerbach, 2003; Friss, 1994; Grumbach, Ash, Seago, Spetz, & Coffman, 2001; Seago, Spetz, Alvarado, Keane, & Grumbach, 2006a). Recurring nurse shortages are a significant problem to the entire society because they hinder the delivery of health care and are specifically linked to selected poor health outcomes, poor patient satisfaction, poor working conditions for health care personnel, and greater administrative costs (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Buerhaus, Needleman, Mattke, & Stewart, 2002; Cordeniz, 2002; Jones, 2005; Lankshear, Sheldon, & Maynard, 2005; Rogers, Hwang, Scott, Aiken, & Dinges, 2004; Seago, Spetz, & Mitchell, 2004). The current shortage of nurses started in 1998 and is projected to worsen in the foreseeable future (Buerhaus et al., 2005b). Therefore, encouraging non-nurses to enter the workforce and persuading registered nurses (RN) to remain maximally employed in acute care settings where shortages are most severe are key strategies to bringing the nursing labor force to equilibrium levels (Buerhaus, Donelan, Norman, & Dittus, 2005a; Buerhaus, Staiger, & Auerbach, 2004).

Labor economic theory suggests that salaries are an effective way to increase the supply of workers and therefore abate labor shortages (Buerhaus, 1991a); and there is evidence that nurse wages have in fact increased during acute shortages over the decades (Spetz, 2004). Nevertheless until recently, very little effort had been made to entice new entrants with financial rewards, retirement packages, and professional recognition as is seen in most other professional careers (Friss, 1994; Spetz & Adams, 2006). Nurse salaries, accounting for inflation, remained virtually flat between 1980 and 2000 (Health Resources and Services Administration [HRSA], 2004), but since then wages have

increased by over 23% (Bureau of Labor Statistics, 2007) and adjusted earnings increased by 14%. This is the largest increase in real wages since 1977 (HRSA, 2006). However, it is less clear if these wage increases have had the desired effect of increasing the labor supply.

Wage effects are especially important to understand in the state of California where the RN shortage is particularly serious and the cost of living is comparatively high. In 2000, the state ranked 50$^{th}$ among the 50 states in RNs per capita (HRSA, 2006). California presently has a shortage estimated to range between 6,872 and 21,161 full-time-equivalents (FTEs) for RNs (Spetz & Dyer, 2005). Therefore, California RNs who are working part-time (roughly 30% of the total workforce) or who are not working in nursing (approximately 13%) are of particular interest to policy makers because they could potentially increase their labor participation and therefore assist in abating the RN shortage (HRSA, 2004).

Moreover, since health care costs are presently responsible for over 15% of the gross domestic product (GDP) (Estes, Harrington, & Pellow, 2001) and nurses comprise the largest professional occupation in healthcare with over 2.9 million nurses (HRSA, 2006), changes in wages could greatly affect the overall cost of healthcare (Chiha & Link, 2003). In conclusion, evaluating the effectiveness of wages as an incentive to increase labor participation is an important policy analysis, contributing to understanding the determinants of the number of hours nurses work and consequently to the best allocation of resources to achieve that goal.

This chapter therefore has three aims: (a) To summarize the history of nurse shortages in acute care settings in the U.S., (b) to highlight the significance of the

shortage problem and its associated factors, and (c) to introduce the purpose and specific aims of this study.

## History of the Nurse Workforce in the U.S.A.

Modern nursing was established during the Crimean War, but only came to prominence in World War I (Friss, 1994; Seago, Ash, Spetz, Coffman, & Grumbach, 2001; Yett, 1975). During the 1920s and 1930s motivated young women came into nursing in large numbers. Some women intended to escape traditional female employment, while others had a religious or civic "calling" (Friss, 1994; Yett, 1975). Hospital jobs were difficult to secure, and most RNs worked as private duty nurses. With the onset of the Depression, the surplus of nurses become large, and it was forecasted to grow even larger in the 1940s (Friss, 1994; Yett, 1975). However, World War II eliminated the surplus because the armed forces required 129% more nurses than in peace time (Yett, 1975).

After a period of relative stability in the labor market for nurses, another surge in demand was sparked by the ratification of the Medicare and Medicaid legislation in 1965, which secured health care services for the aged and the poor. After 1965, a tremendous number of nursing homes, private insurance, large hospital groups and many new types of services were legitimized, creating a "health care industry" (Estes & Linkins, 2001).

The Reagan Era (1980-1988) took the concept of health care as an industry even further by glorifying privatization and competition. The policies associated with Reagan's ideology promoted the rapid deregulation of healthcare and social services (Marmor, 2000). Reagan's measures were intended to increase competition and

encourage organizations to create arrangements to gain leverage in negotiations, hoping to lower health care inflation (Gold, 2001).

President Reagan also made modifications in the payment system that helped shift the financial risk from the insurer to the provider. In 1983, Medicare implemented the prospective payment system (PPS) to finance the care of enrollees. Together the liberalization of contractual agreements and the changes in payment system provided substantial incentives to lower the cost of patient care, leading to great changes in the way health care was provided in the U.S. (Spetz, 1999). Hospital care became focused on the critically and acutely ill who needed vigilant nursing care and advanced medical treatments. All other services were encouraged to move away from the hospitals and into ambulatory care, long-term care, or the home in order to lower patient care costs for healthcare organizations and the federal government.

The 1990s started with a serious recession that created a general unemployment rate of 7.8% (Buerhaus, 1994). Nurses (who were over 95% female) responded to the recession by increasing their employment rate. By 1994, the nurse shortage had disappeared, with vacancies nationwide of only 4% (Buerhaus, 1994). During this period, mergers and acquisitions were promoted as ways to develop economies of scale and capture a larger share of the healthcare market (Shortell, Gillis, Anderson, Erickson, & Mitchell, 2000). Restructuring, re-engineering, and downsizing were the dominant institutional strategies to incur savings.

The strategies of the 1980s and 1990s brought on a perception of decline in nursing hospital employment, which ultimately contributed to a scaling back of the nurse labor supply. Hospitals hired 137,000 RNs but laid off more than 300,000 non-licensed

nursing FTEs, decreasing total nursing personnel by 7.3%, although the "skill mix" (i.e. the ratio of RN to non-licensed personnel) was higher (Aiken, 1989; Aiken, Sochalski, & Anderson, 1996; Spetz, 1999). As a consequence of this perception of low employment availability for nurses, between 1996 and 2000, the number of new entrants into the profession decreased by 9% in comparison to the previous 4 years, and the number of nurses exiting the field increased from 23,000 to 175,000 (American Association of Colleges of Nursing, 2004).

After the 1997 Balanced Budget Act, hospital nurse vacancies began to climb again, first in intensive care units and later through all areas of the hospital (Buerhaus, Donelan, Ulrich, Norman, & Dittus, 2005c). As the economy recovered and the general employment rate began to rise again, RNs no longer felt the economic pressure to remain maximally employed, especially since wages remained flat, only just keeping pace with inflation (Sochalski, 2002).

Furthermore, the growth of managed care in California, Massachusetts, and New York and the restructuring of hospital management across the country generated interest in unionization among nurses. Nurses perceived these changes as threats to job security, to the work environment, and to patient safety (Seago, 2002). Thus, in response to these changes, nurses began to organize. Nurse unions have existed since 1946, when the American Nurses Associated (ANA) elected to become a bargaining unit. However, the growing discontent with the drastic changes in the health care setting, led to an increase in membership. In 1996, 17% of American nurses (450,000) belonged to a union, most commonly the ANA or the Services Employees International Union (SEIU) (Bauer,

2005), and by 2004, over 27% (783,000) of the 2.9 million nurses nationwide were unionized (Buerhaus et al., 2005b).

The outcome of a more robust economy, in which nurses had more employment options, and a more stressful work environment culminated with a nurse labor shortage that started in 1998. Currently (2007) the shortage of nurses is in the midst of its 9th consecutive year with few signs of improvement. In fact, forecasters predict that by 2020 the number of nurses needed but not available will be approximately 340,000 (Auerbach, Buerhaus, & Staiger, 2007). Although the demand for and supply of nurse labor have ebbed and flowed over the years, the current shortage is particularly serious. Its significance is discussed next.

## Significance of the Current Nurse Shortage

Nurse shortages in acute care settings are an especially important public health problem. This chapter reviews the principle effects of the current nurse shortage on patient outcomes and satisfaction, nurse job satisfaction and turnover, and administrative costs. The issues of population and nurse aging, diversity and immigration are also discussed in this chapter.

### *Patient Clinical Outcomes and Satisfaction*

Nursing care requires technical knowledge and skill. Nurses provide surveillance of patients' psychological and physical needs and intervene accordingly. Nurses aim to be vigilant to preserve health, protect from disease, and detect and prevent complications. There is increasing empirical evidence that hospital patient outcomes are compromised when RN-patient ratios are lean (Aiken, Clarke, Sloane, Sochalski, & Silber, 2002b;

Analysis, 2004; Blegen, Goode, & Reed, 1998; Seago, Spetz, Coffman, Rosenoff, & O'Neil, 2003; Seago, Williamson, & Atwood, 2006b).

A review by Lankshear and colleagues (2005) of the international empirical research conducted from 1990 to present, showed that higher nursing staff (RN, LVNs and nurse aids combined) to patient ratios and higher "skill mix" positively impact patient outcomes. Aiken and colleagues (Aiken, Clarke, & Sloane, 2002a) corroborated these findings and calculated that there is a 7% increase in mortality within 30 days of discharge for every additional patient per RN after the fourth patient.

Seago et al. (2006a) approached the relationship of staffing and patient outcomes from another direction and measured positive patient outcomes associated with staffing. They found that in one hospital, over a period of four years, all patient satisfaction measures, including satisfaction with pain management, improved with an increase in the total nursing-care-personnel-hours-per-patient-day (RN and supporting staff). This adds to the evidence that these satisfaction measures are nursing specific and sensitive to the amount of total nursing hours provided. The studies also support the assertion that surveillance and care management provided by nursing staff contributes positively to health outcomes, hence the need for adequate nurse staffing.

*Nurse Job Satisfaction and Turnover*

In addition to affecting patients, staffing also impacts the work environment for nurses, especially in acute care settings, affecting performance, job satisfaction, and intention to leave the present employment (Rogers et al., 2004). Price and Mueller (1981) developed a model for nurse turnover in which the contributing variables to the intention to leave were categorized into economic, structural, and physiological factors. Economic

factors included pay, job market, and training; structural factors included work environment and work content, while psychological factors included individual and demographic characteristics. The model proposes that job satisfaction is a mediator between economic, structural, and physiological factors and turnover (Irvine & Evans, 1995).

Many researchers have tested Price and Mueller's (1981) "Causal Model of Turnover for Nurses." Ulrich, Buerhous and Donelan (2005) found that structural factors of the work environment are the most important and have been the most resistant to change. These structural factors include concepts of respect, support, and recognition measured by the RNs' perceptions about communication, quality of care, trust, emotional exhaustion, remuneration, and staffing. Irvine and Evan (1995), using the same model, presented evidence that, although low autonomy was the greatest contributing factor to turnover, work overload due to low staffing was also an important job characteristic that affected turnover.

Literature reviews of turnover concurred. Blegen's (1993) review of the turnover literature found that job satisfaction was strongly correlated to stress, which was also linked to staffing. Tai et al.'s (1998) review of international studies on turnover from 1977 to 1996 found a strong relationship between low staffing, low morale, and high turnover; whereas Hayes and associates' (2006) review of more recent studies found that the main determinant of nurse turnover is "intention to leave," which is mediated by the stress, job satisfaction, and organizational commitment of the nurse.

Together, these articles provide evidence that high workloads are associated with stress and low job satisfaction, which in turn are associated with intention to leave and

turnover. Aiken's team (2002a), added evidence of this relationship by calculating that each additional patient per nurse was associated with a 23% increase in odds of burnout and a 15% decrease in the odds of job satisfaction, after adjusting for nurse and hospital characteristics. Moreover, a study by Bowles and Candela (2005) that collected information on 352 new Nevada nurses (< 5 years since licensure) found that 30% had left their first job within one year and 57% left within 2 years of hire. Their main reason for leaving was the new nurses' perception of the impact of low staffing levels and compromised patient safety.

Finally, researchers studying "magnet hospitals" have found that hospitals that are "magnets" for nurses are successful primarily because of strong nursing leadership and adequate staffing (Seago et al., 2001; Shader, Broome, Broome, West, & Nash, 2001; Ulrich, Buerhaus, Donelan, Norman, & Dittus, 2005). Magnet status is an award given by the American Nurses' Credentialing Center (ANCC), an affiliate of the ANA, to hospitals that satisfy a set of criteria designed to measure the strength and quality of nursing. A magnet hospital is one where nurses are thought to deliver excellent patient care, where nurses have a high level of job satisfaction, where there is a low staff nurse turnover rate, and where appropriate grievance resolution procedures are in place (ANCC, 2007). In conclusion, researchers have found that heavier workloads, increased stress, and lower job satisfaction are associated with a greater likelihood of turnover in a type of feedback loop.

*Administrative Costs*

Low staffing and turnover are associated with lower productivity of remaining staff nurses and higher administrative costs. Once a nurse chooses to leave, there are

termination costs in the form of severance payments, management time and overhead. There are costs associated with the vacancy via the employment of temporary workers, payment of overtime, closing of available beds, and lower productivity of managers. Recruiting costs are high as well, involving placing advertisements, attending job fairs, and hiring consultants. Hiring new staff is also expensive. Jones (1990, 2005) found that salaries, benefits, bonuses, human resources staff and "paper work" were significant in hiring. In addition, new staff must be trained and orientated to their new jobs, which also involves the salaries of preceptors for new graduates and other types of orientation strategies. Finally, new staff members are generally associated with low productivity at the beginning of their tenure since they are learning the new job.

Jones (2005) found that for 2002 the estimated cost of turnover was between $62,000 and $67,000 per nurse. These costs are significant for organizations such as hospitals, where the profit margin are only about 1%. Retention of staff is therefore an important measure to improve hospitals' "bottom lines."

*Population Aging and Diversity*

A compounding problem that heightens the significance of the present nurse shortage is the aging of the U.S. population. The number of persons over 65 years of age living in the U.S. is estimated to grow from the present 35 million to 71 million in the next 30 years (Aiken et al., 2002a; Janssen, de Jonge, & Bakker, 1999; Morbidity and Mortality Weekly Report, 2003; Ulrich et al., 2005). In order to provide high quality services for a growing group that is living longer with more chronic disease, the U.S. healthcare system must secure adequate numbers of healthcare personnel. Nurses make up the largest percentage of this group.

Changes in demographics not only affect the demand for healthcare but also the supply of health care workers. Aging has been defined by many researchers as a gender issue because females survive males (Estes & Linkins, 2001). Since over 90% of the nurse workforce is female, aging is perhaps a more serious problem for nursing than for other professions (HRSA, 2004). In 2004, the average age of nurses working in acute care settings was estimated to be 46.8 years, with only 26.6% of the workforce below the age of 40 (Norman et al., 2005), as compared to nurses aids whose average age was 38.7 years with 45% under the age of 40 (Chapman, Dronsky, Newcomer, Harrington, & Grumbach, 2006). As the labor force ages, participation decreases as nurses reduce work hours, retire, or die, shrinking the size of the labor pool (Spetz, 2004).

The primary cause of the rapid aging of the nurse workforce is the failure to bring young, male, and ethnically diverse individuals into the profession (U.S. Department of Health and Human Services [U.S. DHHS], 2003). The pool of people in these populations who are interested in nursing is smaller because of shifts in professional alternatives (Buerhaus, Staiger, & Auerbach, 2000). Women have gained access to new professions besides nursing, and therefore are 35% less likely to enter nursing now than before 1980. Male participation remains low. From 2000 to 2004 there was a small increase in males in the profession, from 5.4% to 5.7% (HRSA, 2004).

Additionally, nursing has failed to attract enough people of color into the profession so as to reflect their proportion in the population (Butters & Winter, 2002). Over 86% of the nursing workforce is white non-Hispanic, which is a 20% greater representation of this group in the profession than in the general population (U.S. DHHS, 2003). The nurse labor participation rate in the labor market is approximately 83%, which

is higher than the participation of the general population (i.e. less than 83% of able-body individuals are working at any given time) (HRSA, 2004). However, minority nurses are a particularly valuable labor source because they have the highest labor participation rates. Minority nurses are more likely to work full-time and take fewer breaks throughout their career than whites (Buerhaus & Auerbach, 1999).

Reports of lay-offs, adverse working conditions, and stagnant salaries through the 1990s discouraged students from entering nursing. Between 1995 and 2000 there was a decrease in enrollment in baccalaureate nursing education, which peaked in 1997 with a drop of 6.6% (American Association of Colleges of Nursing [AACN], 2004). In the past 5 years, however, enrollment has begun to increase once again. Unfortunately, nursing programs have had to turned away 26,340 qualified applications to Bachelor's programs in 2004 alone, primarily due to a shortage of educators (AACN, 2004). Nursing programs are required to maintain a high faculty to student ratio, but nursing faculty are also in short supply and aging rapidly (AACN, 2004). Even if nursing programs were able to graduate all matriculated students, the nurse supply would still not suffice to overcome the current and increasing nurse demand.

*Immigration*

The current nurse shortage is not only affecting the U.S. but also many international communities. Similar nursing shortages are occurring simultaneously in many developed countries. As a strategy to increase supply, the richer countries are facilitating the immigration of nurses from developing and under-developed countries. This drain of health care personnel has begun to undermine health care initiatives in developing nations, and threatens to cripple their health care systems (Aiken, Buchan,

Sochalski, Nichols, & Powell, 2004). It is estimated that over 3% of the nurses practicing in the U.S. received their education in a foreign country. Half of them are from the Philippines and another 20% are from Canada (HRSA, 2004). The remaining nurses come from a variety of countries, including Mexico and South Africa.

In summary, a large shortfall of nurses is predicted in the near future because the general population is aging rapidly and living longer with more chronic disease, while the nurse population, although increasing, is not increasing rapidly enough. This shortfall is expected to negatively affect patient clinical outcomes and patient satisfaction, lower nurse job satisfaction and increase turnover and administrative costs, making this shortage a particularly significant public health problem for the U.S. and the world. Wages have recently been used as an incentive to increase nurse supply, but their effects are not well understood. Evaluating the effectiveness of wages as an incentive to boost labor participation is an important policy analysis, contributing to the understanding of the determinants of labor participation.

## Purpose and Aims of this Study

The primary purpose of this study is to increase the understanding of the effect of wages on the level of participation of nurses working in the state of California.

### *Specific Aims*

With this purpose in mind, this research study has two specific aims:

1. To describe wages for RNs licensed in California, examining variations according to the region of the state in which they reside.
2. To examine the effect of wages on California RNs who are presently working with respect to the number of hours worked in 2002, examining variations based

on gender, race/ethnicity, marital status, other income category, age category, level of education, location of education, location of employment, position held and region of the state.

This dissertation research project is presented in four additional chapters. Chapter 2 reviews the theory and the empirical literature that are the basis for this research. Chapter 3 describes the methodology used in this study. Chapter 4 presents the results of the analyses, and Chapter 5 provides a discussion of the findings and implications.

# Chapter 2

## Theoretical Framework and Literature Review

There are many ways to examine the current shortage of registered nurses (RN) in the United States (U.S.), but this chapter will argue that such a complex problem as nursing scarcity is well suited to be examined through an economic lens. This is also the opinion of most researchers in the field, as economic theory has been the main theoretical framework used in the literature (Brewer et al., 2006; Chiha & Link, 2003). This chapter has two main purposes: (a) to explicate the important relationships in labor economic theory, focusing on the Human Capital Model (HCM), and (b) to present the empirical findings as to the effect of wages on nurse labor participation in terms of hours worked. The first part of this chapter will review and critique the theory, while the second part will focus on the empirical literature.

## Economic Theory

Economics is a field that merges social and mathematical sciences to study the production, substitution, and consumption of goods and services (Cleland, Forsey, & DeGroot, 1993). The focus is the study of how groups and organizations respond to pecuniary (monetary) and non-pecuniary incentives as they trade scarce resources in the marketplace. This section of the chapter will introduced the founders of economics and their main contributions, followed by a presentation of the sub-field of labor economics that will include main concepts and variables, as well as the two main branches. The end of this section will focus on the Human Capital Model which is the foundation of the empirical literature reviewed in the second section of this chapter.

It has been argued that the field of economics did not come into being until the concept of "making a living" was established (Heilbroner, 1986). Up to the18$^{th}$ century, when hourly wages were higher than usual, workers simply worked fewer hours

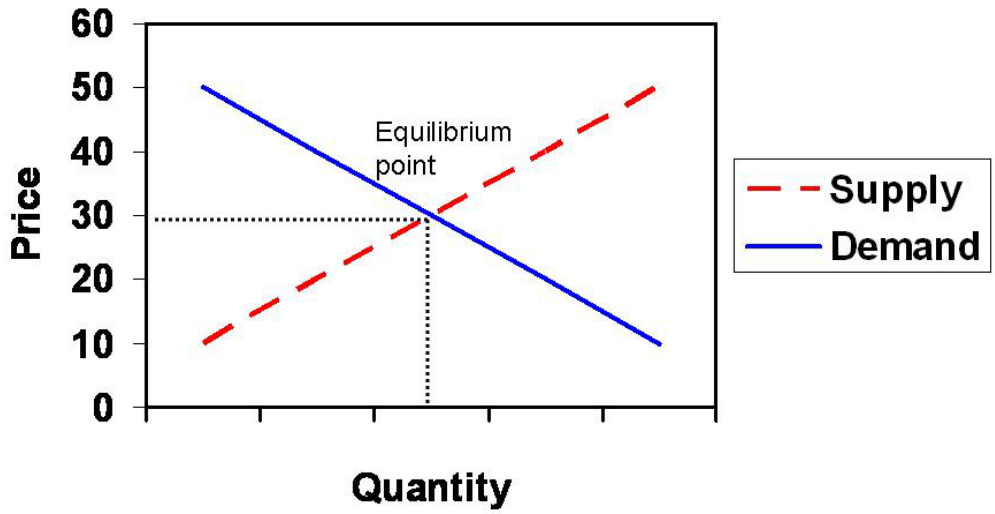
(Heilbroner, 1986). The idea that one could or should accumulate monetary gains was not well integrated in to the psyche of European society. The society's primary concerns were religious and moral.

The European economy of the 1700s was mainly ruled by authority and tradition (Heilbroner, 1986). Lords controlled the lands with the support of increasingly powerful monarchies, and workers were serfs who lived and cultivated the lords' land. However, this economic structure began to change during the Renaissance (1500s to 1700s), as landowners began to rid themselves of serfs. Until that time, laborers lived off the land through subsistence farming and trade, but afterwards, they were paid for their labor with money. As labor became a commodity to be bought and sold, guilds were formed, and a merchant class emerged. Merchants began to trade their skill for payment, and the idea of amassing wealth began to take hold (Heilbroner, 1986).

Adam Smith is said to be the father of economics. Smith published his most famous book, *The Wealth of Nations* in 1776, in which he claimed that a nation's greatest asset was its labor force (1776/1994). He proposed that the true wealth of a nation was the aggregate of all the goods the population produced and consumed, not the amount of gold the kingdom possessed (Smith, 1776/1994). In that same publication, Smith identified the mechanisms that held European society together (Heilbroner, 1986). Smith believed that the "invisible hand" that guided individual interests also brought about the betterment of society. He believed that competition among consumers and sellers was the key ingredient to keeping "ruthlessness" in check (Smith, 1776/1994). He held that consumers were the regulators of the market and that no governmental interference was necessary. Smith (1776/1994) viewed the free-market as a self-regulating body that

always returned to equilibrium, the balance between buyers and seller (Figure 1). Interestingly, Smith held these beliefs at a period of incredible poverty across his homeland, Scotland. In the late 18th century, child labor was a common practice and the Industrial Revolution was welcoming factories with horrendous working conditions (Heilbroner, 1986).

Figure 1 *Supply and Demand Curve*




Many renowned economists have disputed Smith's assertions. Among them are Karl Marx and John Keynes. In 1848, Marx with the help of Friedrich Engels described, in the *Communist Manifesto,* the process by which a materialistic society would self-destruct because of a struggle between the classes (1848/1998). They, unlike Smith, could not see past the effects of the Industrial Revolution on the proletariat (Heilbroner, 1986). Marx and Engles (1848/1998) believed that the "invisible hand of the free-market" pitted capitalists (industrialists) against laborers, with the capitalists controlling the factories and benefiting handsomely from the arduous labor of the proletariat. They viewed capitalists as inventors of labor-saving machines that aimed to maintain a high

surplus of laborers working for the lowest possible wages. They purported that the government had to intervene to control the means of production and to divide the profits among those who actually worked in the factories bringing products into being (Marx & Engels, 1848/1998).

John Keynes was another economist who objected to a totally free-market, but for different reasons than those brought forth by Marx and Engels. He believed that when the "invisible hand" was successfully maintaining economic growth, no intervention was required (Keynes, 1924/2000). However, he thought that governmental intervention was paramount when businesses were unable to save and re-invest or when the labor force was not available (Keynes, 1924/2000). Keynes was able to put his theory in to practice when he was asked to assist the U.S. government in developing an investment program to re-ignite the U.S. economy after the Depression of the 1930s.

The forces and processes involved in reaching equilibrium between supply and demand is therefore the primary investigative aim of the field of economics (Cleland, 1990). Many subfields exist, such as international economics or public economics. The one focused on workers and employers is labor economics, and thus is the field discussed in the next section.

## Labor Economics

Labor economics is the branch of economics that examines a special case of the general model of consumer goods; the case for the supply of workers, the demand for their labor, and their wages (Hamermesh, 1993). The most basic labor economic model is an extension of the supply and demand model discussed earlier (Figure 1). It predicts that workers require wages to work, and as such, higher wages motivate new entrants into the

field and create an incentive for those already in the field to increase their productivity. By the same token, higher wages lower the incentive of employers to employ more workers, so that higher profits can be secured (Hamermesh, 1993).

Theorists create simplified models for broader applicability of theories. In labor economics, the concept of "perfect competition" as initially envisioned by Smith (1776/1994) has at least three implications in the typical labor market. It assumes that there are many actual and potential employers and employees with diverse assets and needs, willing to trade for goods and services. It also assumes that they come to the "marketplace" with all the information and all the flexibility they need to make the best decisions for themselves and/or their organizations (Yett, 1975). The number and diversity of assets and needs that participants bring are important because a larger range of options allows for greater competition among buyers and sellers. In a perfectly competitive market, workers can choose among many employers, and employers can choose among many workers. Information, such as future consumer demand for a service or future scarcity of needed resources, is also keenly important in the planning and decision making processes, as is the flexibility to make adjustments once that information is obtained. The perfect competition model, therefore, assumes that there are many producers and consumers trading at the same time. The large numbers of participants, the information they possess (and share), and the flexibility to make adjustments discourage "ruthlessness" and encourage balance between supply and demand (Smith 1776/1994).

However, all real markets are imperfect, defying theoretical predictions. Often there are only a few homogeneous participants in the marketplace and new entrants face barriers. Information is never complete. Decisions are constantly being made using best

estimates, and flexibility is rarely absolute. Participants are bound by contracts, regulations, and licensing that confine their ability to respond freely to changes in the environment. Competition is therefore rarely unrestricted. Furthermore, markets are replete with oligopolies (few producers) and oligopsonies (few consumers); consequently, power is not evenly distributed among all the entities trading in the market place. In an imperfect market, buyers and sellers band together to share and/or conceal information or increase and/or decrease flexibility to alter the balance of power in the bargaining process.

In acute care settings, nurse labor is traded between nurses (as individual sellers and unionized collectives) and hospitals (as individual buyers or conglomerates). In a perfect competition scenario there would be many nurses available to sell their labor to a multitude of hospitals. These nurses would know all there is to know about the working conditions and compensation packages at every hospital, and they would have total flexibility to change employers at any time. In this scenario, there would be hospitals in every community competing for nurses with all the knowledge and the flexibility to attract them (Scott, Sochalski, & Aiken, 1999).

Obviously, that is not the case. There are too few RNs and they are not a diverse group, being mostly white, married females. There are barriers to entry into the profession, few independent hospitals, and all hospitals are bound by regulations. Hospital income is also restricted by governmental rules. Therefore nurses and hospitals have each, to differing degrees, banded together to increase their "leverage" (power) in the bargaining process. Nurses have increased their power by joining unions, and hospitals have merged into large groups (Buerhaus et al., 2005b).

According to classic labor economic theory, the nurse labor market is therefore imperfect in two important ways. First, buyers of nurse labor (hospitals) and sellers (nurses) are commonly concentrated in terms of their governance, often negotiating in the market place via hospital groups and unions. Second, the labor force is substantially female, responding in distinctive and homogenous ways to economic incentives. These "imperfections," their theoretical explanations, and their consequences in the real word are examined in the next section.

Monopoly (one producer or seller) and monopsony (one consumer or buyer) effects are considered to be regional, although the market determines how region is defined (Adamache & Sloan, 1982). In the case of nurse labor markets, a monopsony or oligospony labor market is one in which there is one or few consumers (employers) of the product (nurses' labor) sold in that market. Such concentration of power offers employers disproportional "leverage" in the negotiation of wages and working conditions. To counter such power, labor unions have formed, bringing forth collective bargaining agreements (Hirsch & Schumacher, 1995). The level of employer concentration (size of hospital group) and level of union membership are characterized by the extent that they exist (numbers and size) and their impact on the local markets (effect size) (Yett, 1975).

In monopsony labor markets, higher wages for marginal workers can hurt the morale of senior workers, eventually increasing wages for all workers or prompting senior workers to leave. Wage increases in these markets come in waves, when one employer "is temporarily strong enough or hard pressed enough to act as the wage leader" (Yett, 1975 p.78). After that, others follow suit to secure the workforce and a period of stability is reached until another cycle begins. Monopsony markets can

therefore produce higher wages without producing a hiring advantage or stagnant wages due to the fear of retaliation from competitors (Yett, 1975).

Modern monopsony research in RN labor markets has attempted to understand the phenomenon by measuring the proportion of new employees coming from competitors as compared to new entrants in the labor pool, and the RN wages relative to that of other local comparison groups (Hirsch & Schumacher, 2005). However, the most direct test of monopsony power is its effect on wages. The theory predicts that employer concentration via mergers and acquisitions has a negative effect on wages, holding other market characteristics constant (Hirsch & Schumacher, 2005).

Since the 1980's, hospitals have faced increasingly restricted revenue sources from third party payers (Spetz, 1999). Therefore, their primary financial strategy has focused on cost-cutting by improving processes and creating economies of scale. Hospital consolidations have aimed to achieve these goals. In 1996 there were 235 mergers involving 15% (768) of all the hospitals in this country (Hirsch & Schumacher, 2005). Since then, this trend has slowed, but in 2003 there were still 65 mergers involving 100 facilities although some of these merger have dissolved (Hirsch & Schumacher, 2005).

Hospital characteristics and concentration are particularly relevant in the study of nurse labor since RNs tend to have low mobility, commonly seeking employment within driving distance from their homes (Seago et al., 2001). In this situation hospitals can set wages according to internal needs, instead of the demands of the workers. Consequently, differences in acute care employers, such as differences in organizational structure, profit status, and size, as well as regional differences like vacancy rates, remuneration regional

index, demand for health services by the population, health care payers, and presence of a strong labor union are predicted to significantly affect the labor demand in regional markets (Seago et al., 2001). Notably, recent studies suggest that the increase in hospital monopsony power did not result in lower wages, although wages were flat through the 1990s, or lower RN staffing levels as labor theory would predict. Instead, hospital consolidation seemed to have increased the productivity demands on the labor force, measured by the intensity of case-mix-adjusted-patient days (Spetz, 2000, 2004).

A countervailing force to monopsony power is the labor union. Unions function as labor supply monopolies (Farber, 2002). The union leadership aims to secure the best combination of salaries, hours, and number of employees on payroll for their members through collective bargaining agreements (Farber, 2002). The union leadership trade among the three variables using as "leverage" its control of the labor supply via the threat of strikes (Farber, 2002).

Union membership is also considered to be a regional phenomenon (Freeman, 1999). In fact, the unionization of a competitor's workforce threatens to "spillover" to the rest of the workforce in the region (Adamache & Sloan, 1982). To prevent the unionization of workers, organizations often concede benefits similar to those negotiated through collective bargaining by a union in the area (Adamache & Sloan, 1982). From a labor perspective, the greater the proportion of organized labor in a region, the greater collective bargaining power, and the better the working and remuneration contracts (Freeman, 1999). General research on the relationship between unions and wages has shown wage gains for union members ranging from 11 to 18%, depending on the industry, above non-union wage gains (Lewis, 2002).

Wage gains due to union membership have not been as irrefutable in nursing as in other fields. Some wage gap calculations that included adjustments for shift work found a positive union effect (Holmas, 2002), while others did not (Hirsch & Schumacher, 1995). In California, six chains own more than a third of the hospitals, in addition to the Kaiser Permanente hospitals (Currie, Farsi, & Macleod, 2005). In some hospitals, there is a very strong union in place, the California Nurses Association (CNA). Thus far, research indicates that negotiations among nurse unions and hospital groups have kept wages from being lowered although increases in "effort" (higher patient to nurse ratios) have taken place (Currie et al., 2005).

Unions have had positive effects on shaping the work environment, affecting patients and nurses alike. Nurse union membership has been found to have organizational effects that are reflected in positive changes in health outcomes. Seago and Ash (2002) found that having an RN union was associated with lower deaths from myocardial infarction in hospitals in California. Moreover, it is now uncommon to see mandatory over time in a union hospital, instead it is routine to find a variety of work-scheduling programs that accommodate the needs of the workforce.

The nurse workforce in the U.S. is 95% female, 88% white, 70% over the age of 40, 70% married, 65% with children between 6 and 18 years of old, 28% with children under the age of 6, 14% with an adult dependent at home, 83% working in nursing, and 25% working part-time. Acknowledging these rather homogenous characteristics is key to understanding the behaviors of this labor force (HRSA, 2004). Although there are many important characteristics, the most prominent one, and the one found to be most closely related to employment decisions is gender.

Fuchs (1988) purports that women work for full participation in society, as well as the monetary rewards. Although the position of women has changed over the years, in western society, women remain significantly more affected by family issues than men. Fuchs points to differences in the number of hours of paid work, the persistent wage gap between the sexes; and the resistant occupational segregation as evidence that the position of women still does not equal that of men in the workplace.

Women in general make 75% of men's salaries at every level of education (Fuchs, 1988). Even in nursing, a female dominated profession, male wages are approximately 7.8% higher than females (Jones & Gates, 2004a). Although 56% of the gap is unexplained, almost half of the wage difference (46%) is explained by the human capital characteristics (i.e. education and experience). Men are more likely to have uninterrupted work experiences and higher educational levels, for example, a large proportion of nurse anesthetists are male (Jones & Gates, 2004a).

Almost 25% of nurses work part-time, and the largest group among them is composed of married women with children under 6 years of age (HRSA, 2004). To Fuchs "part-time employment status reflects women's choice" (1988, p.45). Women's "demand" for children is higher than men's, hence they are more willing to relinquish income and job advancement to have the flexibility to accommodate their children's needs (Fuchs, 1988). In fact, Fuchs claims that today decisions about fertility and work are made jointly. Women are thought of as workers willing to forgo wages to have flexibility of schedules and work closer to home (Fuchs, 1988). Children affect women's wages in two ways: (a) by introducing an element of uncertainty from an employer's

perspective and (b) by directly affecting pay due to absences, loss of experience, and career choices (Fuchs, 1988).

In conclusion, the RN labor pool is homogeneously female, and the supply and the demand for nurse labor are partially concentrated in the hands of hospital groups and labor unions. These characteristics challenge the classical labor economics theory. They violate the concept of perfect competition suggested by Adam Smith (1776/1994). Hence, applied labor economists have created models to examine equilibrium processes in markets like this. Labor economic definitions and models are presented in the subsequent section.

*Labor Economic Definitions, Variables, and Concepts*

Because economics is a theoretical and empirical field, its vocabulary is often specific and precise, sometimes embracing meanings that differ from common use. Hence, a review of economic definitions that are relevant to this study is presented here. Definitions for shortage, short and long-run periods, labor, productivity, wages, utility, marginality, elasticity, backward bending, and equilibrium will be provided in the next section.

The oldest economic definition of shortage was the one provided by Adam Smith in 1776, who defined it simply as a greater demand for a good or service than is available. Modern economists have expanded Smith's definition to include the notion that shortages can also exist when the rate of quantity demanded for a product (or service) is increasing more rapidly than the rate the product (or service) is being produced (i.e. supplied) (Heilbroner, 1986), which is currently the case for nursing services.

Demand for nurses has steadily increased, while the supply of nurses has not increased as rapidly.

Economists make a poignant distinction between an organization's stated "need" and its "demand" for workers (Hamermesh, 1993; Yett, 1975). Need is an organization's wish or "want." It is independent of affordability, that is the wages required to fulfill that need. Demand, on the other hand, has an inverse relationship with wages. As wages increase, demand falls, although "need or want" may continue. Conversely, economists expect wages to have a positive relationship on supply. They expect wages to increase supply when demand for labor is high and supply is low. Wages are expected to climb until labor supply matches demand, when market equilibrium is reached.

"[Nurse] shortages represent a situation in which hospitals are unable to hire nurses at the prevailing wages to achieve the staffing desired" (Grumbach et al., 2001 p. 388). Grumbach and colleagues (2001) tested correlations between hospital administration perceptions of the nurse shortage and a variety of measures, in an attempt to define objectively the concept of "nurse shortage." They found that nurse shortages are more of a regional phenomenon than a national one, and that it encompasses the sub-concepts of vacancies, adjusted-case-mix, turnover, and RN supply.

Like other scientists, economists study problems either in the short-run (cross-sectionally) or in the long-run (longitudinally). The short-run is a period of time short enough that variables do not have time to change (Yett, 1975). An example of a short-run model is the Blank and Stigler Model of labor supply, which analyzes successive cross-sectional data (1957). These samples of data inform researchers about the choices made by the labor pool in a narrow time frame. Blank and Stigler (1957) conceived of each

cross-sectional sample as equilibrium points where the supply and demand lines are the aggregates of all the choices made by all employers and employees in a given market region for a given period of time (often yearly) at a given wage. The long-run, on the other hand, uses longitudinal data. It is a period of time when all inputs have time to change. Proponents of this model suggest that the labor market cannot be at equilibrium unless all the employers are at equilibrium. Since that is virtually impossible, the model focuses on the path toward equilibrium, rather then the equilibrium points themselves (Arrow & Capron, 1959).

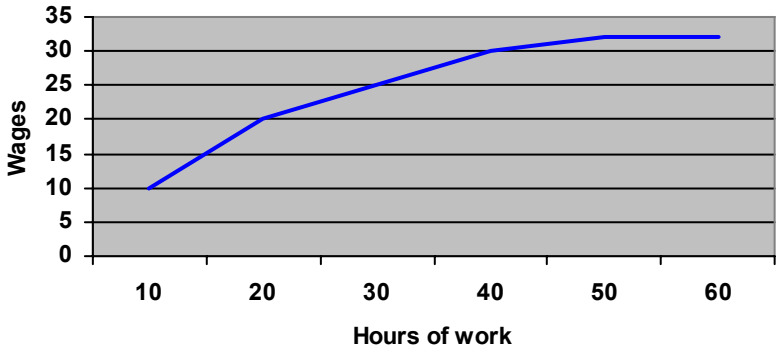
The term labor has two meanings. Labor can be the aggregate of workers or their total input of hours, but it can also mean the amount of effort a worker or a group of workers has put into a project. Productivity is synonymous with the latter meaning of labor. It is the total effort of a worker or group of workers, but it is not measured by the total of hours worked because productivity declines as hours increase. It is measured by the output produced. Wages are the remuneration an employee requires to accept employment. Wage can be measured by the total compensation package (wages, bonuses and benefits) per unit of labor, by median salaries, or by relative wages (wages for the group of interest as compared to wages for a group with similar education and skill) (Yett, 1975). Wages are viewed by demand side economists as the price of labor, or the minimum amount an employer must pay to secure the labor of a group of employees.

The typical worker is thought to require higher wages to increase her working hours. However, employees are heterogeneous. Workers differ in skill, education, desire to work, and taste for leisure (time away from work) (Pencavel, 1986); therefore having different preferences (utility) for different things. The relationship between wages, hours

worked, and hours of leisure is called the "work utility function" (Killingsworth & Heckman, 1986; Pencavel, 1986). This function describes the trade-off individuals make between free-time and work-time at different wages (Figure 2). Using this function, economists can evaluate the marginal rates of substitution between work and leisure (Hamermesh, 1993).

The concept of marginal substitution addresses the utility (value) of each additional unit (e.g. additional hour of work). The marginal wage is the wage required to entice a worker to give up an additional hour of leisure. For this enticement to be effective, the utility of the wage must be higher than the utility of the leisure at that moment in time. Notably, these values are not constant; they change along the work-utility curve (Figure 2). For example, before a 12-hour night-shift, the value of that shift to a nurse is equal to the wages she will earn during the shift, and that amount has a higher value than the worth of her leisure (sleep). However, after working the night shift, the subsequent hours of work (the $13^{th}$, $14^{th}$, and $15^{th}$ hour) will have a marginal monetary value equal to overtime pay. Although these overtime hours of work are associated with a larger monetary value (overtime pay) than during the 12-hour shift, at that moment in time (8am), the additional income may have a lower marginal utility to the nurse than the first few hours of sleep. This supply side example illustrates how marginal decisions (i.e. the decision to work extra hours) take into consideration monetary and non-monetary factors and their temporal dimension. The concept of marginal utility also applies to employers. Employers make profit maximizing decisions at the margin, evaluating the contribution of each addition employee or hour worked to the production of goods and services.

Figure 2 *Marginal Utility Curve.*




Killingsworth and Heckman (1986) constructed marginal-utility-of-wages functions to better understand the effect of wages on the number of hours workers dedicate to work. They assumed that the decision to work or not work was a result of an individual's personal valuation (utility) of free time against the actual wages that could be received for labor. This relationship is represented by the following equation (Link & Settle, 1981; Phillips, 1995):

Probability of Work = Probability (Utility of Wages > Utility of Leisure) (1)

The difference between these two values is a function of the determinants of wages and a function of the nurse's reservation wages (minimum value a nurse would require to give up her leisure or an alternative job) (Skatun, Antonazzo, Scott, & Elliott, 2005). This difference is not directly observed, but its direction is known based on the resulting probability of working.

The degree to which employers, employees and wages adjust at the margin is called elasticity. Elasticity is a measure of responsiveness. The more elastic a variable is, the larger and faster are its responses (Cleland, 1990). That is to say that, the more elastic the labor supply is with respect to wages, the greater its response to small changes in

wages. Elasticity was modeled by Brewer et al. (1996, p.351) with the following formulas computed from the values derived from multiple regression analyses:

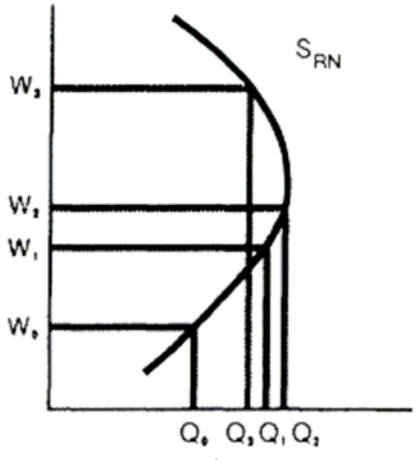
$$E = \beta * (\text{mean wage/mean hours}) \quad (2)$$

$$E = (\beta / \text{wage categories}) * (\text{mean wage/mean hours}) \quad (3)$$

Elasticities are interpreted as percentage change (as opposed to percentage points change). For example, a wage elasticity with respect to hours that is equal to 0.20 indicates that a 10% increase in wages would lead to a 2% increase in the number of hours worked.

The extreme case of labor inelasticity (unresponsiveness) to changes in wage is called backward bending labor supply (Figure 3) (Brewer, 1996). Contrary to the classical labor economics model, in which labor participation is expected to increase with increases in wages, workers with a backward bending labor supply curve value their time away from work more highly than the wages being offered once wages exceed some threshold (Killingsworth & Heckman, 1986). They appear to have, what applied labor economists call, a more family-centered-marginal-wage-utility curve with respect to hours (Killingsworth & Heckman, 1986).

Figure 3 *Backward Bending Labor Supply* (Buerhaus, 1991b)



A backward bending labor supply model investigates if, after reaching a threshold wage ($W_2$), individuals lower their working hours. In order to see a backward bend in the supply of labor, the elasticities would have to be statistically significant and negative, as wages increased past the threshold wage (Chiha & Link, 2003).

Now that the main variables and concepts in labor economics have been reviewed, a discussion of the two sub-branches of labor economics will follow. The goal of the presentation is to evaluate the applicability of labor demand and supply models to the study of nurse labor participation. Both branches aim to understand how organizations and individuals adjust to changes in their environments, while taking prices or wages into consideration (Hamermesh, 1993). They concern themselves mainly with the decisions made by employers and employees. Those who study the supply of labor focus on factors that affect the quantity of workers available to work, such as their choices of employment, hours worked, and educational level. Those who study the labor demand side, on the other hand, focus on the factors that affect the employers demand for workers, such as their decisions to hire, dismiss, remunerate, and train employees (Hamermesh, 1993).

*Demand Side Labor Economics*

Demand side labor economics is concerned with any decision made by employers and government about workers' compensation, employment, or training (Hamermesh, 1993). Historically, the demand for workers was thought to be solely driven by the consumer's demand for the products workers produced. Labor was viewed as just another production input, such as energy and raw materials, which could be bought as needed, without substantial planning (Hamermesh, 1993; Yett, 1975). More recently however,

labor economists have acknowledged the complexity of the labor market, taking into consideration the role of laws and regulations, non-pecuniary factors (i.e. family considerations, taste, or satisfaction), environmental context (i.e. monopsony areas, union membership, or recessionary periods), number of job offered in a regional market, hours employees are required to work, and other forces that impact an organization's ability to secure qualified workers (Hamermesh, 1993). Nevertheless, the decision to employ is still heavily weighted toward profit maximization. For this reason, labor demand economists view employers as capitalists who seek to employ the least expensive workers that will offer the highest productivity (Hamermesh, 1993).

Profit = (Return on investment) – (Cost) or (4)

Profit = (Price of products * Number of patients) – (Price of labor * Number of nurses)

Profit is a positive difference between an investment and the return on that investment, after deducting all the costs (Equation 4). According to this perspective, the "investment" is the cost of gaining access to workers to provide the services or produce the goods to be sold. However, unlike the cost of other production inputs, such as saline or gauze, wages are generally considered to be an exogenous variable. That is to say, wages are set by outside forces, such as the government through minimum wages, the unions through collective bargaining agreements, or the labor force itself through personal wage requirements (Hamermesh, 1993).

Another unusual aspect of the context for nurse labor demand is that the return on the investment is also set by outside forces. The price of the services sold by hospitals to the public in the market place is controlled primarily by Medicare payments through

diagnosis related groups (DRG). These payments reflect governmental budgetary constraints, not the true cost of service (Spetz, 1999). Private insurers have adopted essentially the same criteria and use the government's payment system to negotiate rates.

The demand for nurses therefore has two out of the four traditional variables virtually fixed: the price of labor (costs) and the price of the products (revenues). The only variables relatively under the control of RN employers are the demand for nurses (i.e. the number of nurses hired) and the demands "on" nurses (i.e. the number and acuity of patients RNs care for) (Spetz, 1999).

In order to increase the productivity of employees, labor demand economics predicts that organizations may (a) make substitutions among workers, (b) facilitate higher outputs, or (c) require a greater number of hours worked by the labor force (Hamermesh, 1993). Employers are predicted to substitute workers in such way that the cheapest worker with the most skills will be hired (Hamermesh, 1993). This typically happens when skilled laborers are replaced by unskilled ones because the later group is willing to work for lower wages. However, the converse can also happen. More skilled workers may replace less skilled ones when the wages they require to work are not significantly higher, but their productivity is higher. In the 1980s, RNs were being hired in large numbers, while nurse aids were being laid off. Nurse aids' salaries were 80% that of registered nurses (Aiken, 1989; Aiken et al., 1996; Spetz, 1999). Demand side theory predicts that substitutions ultimately occur when marginal productivity, worker availability, and comparative wages are such that one group of workers makes a greater positive impact in the "bottom line" (profit) than the other group (Hamermesh, 1993).

Changes in labor output can also lower the cost of production and consequently maximize profits (Hamermesh, 1993). These changes can be achieved through demanding higher productivity from individual workers by increasing the speed of production. For hospitals, decreasing patients' lengths of stay using the same amount of staff, results in higher productivity. These productivity increases have often been sought through the use of technologies like electronic medical records, electronic prescribing, bar coding, and electronic health information (e-health). Hospitals view these technologies as ways of increasing efficiency, reducing administrative costs, and improving patient care (Harrison & Lee, 2006). So far these technologies have had mixed results (Saba & McCormick, 2006). For example, e-health has giving patients more power to advocate for themselves, however information is not always complete or accurate, there are dangers of ethical violations, and the initial investments are high, therefore imposing higher requirements for safeguards and training (Harrison & Lee, 2006). Technology has the potential to increase productivity while lowering errors, but the evidence is not conclusive.

Increasing the number of hours worked can also increase productivity in a cost effective way because it is less expensive to make adjustments in working hours than to hire new employees (Topel, 1999). However, achieving this goal involves increasing the marginal utility of each working hour for the worker, so that it is higher than the marginal utility of leisure. As discussed earlier, marginal values, plotted along a work-utility curve, are in units of pecuniary (monetary) and non-pecuniary variables. Therefore, the incentives would have to target financial, as well as non-pecuniary incentives, such as job satisfaction, autonomy, or flexibility; thereby creating a work environment that increases

the commitment of the worker to the organization's success and lowers the incompatibilities between work-life and private-life (Hamermash, 1993).

Employers seem to have focused most of their attention on the pecuniary rewards. As mentioned previously, nurse wages have increased over 23% between 2000 and 2004 (Bureau of Labor Statistics, 2007). Health benefits, sick leave, vacation, and retirement packages have also become important components of retention and recruitment strategies (Spetz & Adams, 2006). Nevertheless, nurse surveys still find that work environment plays an important role in the labor attachment than wages and benefits (Spetz & Adams, 2006).

The ability of an organization to make adjustments regarding the substitution of workers, the capital investments in technologies that may improve productivity, or make changes in the number of workers hired, wages or the number of hours worked often depend on the culture and resources of the organization, as well as regulatory agencies and licensing organizations. Wage and hour adjustments also depend on the organization's expectation of the labor pool's response to these changes (Hamermesh, 1993). It is the organizations' expectations regarding the response of nurses that ultimately impacts the decision to increase wages or to make changes in "the way things are done" (Arrow & Capron, 1959).

Labor demand economic theory predicts many scenarios and relationships that are present in the nurse labor market. This theory predicts that the marginal demand for nurses is weighted toward profit maximization. As such, hospitals have increased the skill mix, substituting RNs for unlicensed personnel, while also embracing processes and making technological investments that are thought to increase RN's productivity. RN

employers aiming to maximize profits have made monetary and non-monetary changes to their labor practices with the expectation of securing the most productive workers at the lowest cost.

While demand side economists study what buyers of nurse labor do to secure the resources they need to remain viable, supply side economists examine the responses of the labor pool. Because supply side economics attempt to understand the choices workers make about the number of hours worked, it will be the focus of the remainder of the theoretical section of this chapter, and it will serve as a guide to the next section, the literature review.

*Supply Side Labor Economics*

Supply side economics focus specifically on career, education, and employment decisions made by workers, accounting for wages and environmental and demographic characteristics (Killingsworth & Heckman, 1986; Pencavel, 1986). Consequently, the supply side perspective provides the most insightful theoretical perspective on the decisions made by nurses regarding their level of participation in the labor market. Within this perspective, there are many models. The Life-Cycle Model, for example, focuses on the age of the worker, suggesting that the relative "price" of consumption and "price" of leisure changes depending on where an individual is in the life-cycle (MaCurdy, Mroz, & Gritz, 1998). Household Production Theory, on the other hand, focuses on families, suggesting that the decision to work is made by a family, accounting for the household needs and the production ability of each individual in the family (Ehrenberg & Smith, 2006). The Human Capital Model (HCM) was chosen for an in depth discussion because it aims to explain the behavior of workers as a group. This

perspective views workers as "entrepreneurs" who seek to maximize the utility of wages. Because of its applicability to nurses and its ubiquitous use in the nurse labor research literature, the HCM is presented here and it is the basis for this research study (Aiken & Mullinix, 1987; Brewer, 1998; Buerhaus, 1991b; Chiha & Link, 2003; Cleland, 1990; Ezrati, 1987; Friss, 1994; Jones & Gates, 2004a; Kovner, Stave, Lavelle, & Ferrara, 1994; Link, 1985; Link & Settle, 1980b; Seago & Spetz, 2002; Sochalski, Aiken, & Fagin, 1997; Spetz, 1998; Yett, 1975).

The HCM predicts that the greater the job-specific skills (education and experience) of an employee, the greater his or her long-term financial rewards (Topel, 1999). The ideas behind the HCM are two fold. First, with more education come more options and larger rewards; second, with longer tenure come higher salaries and job security. Over all, the HCM predicts that people aim to earn increasingly higher wages, and thus will take the steps necessary to secure a larger "stock of human capital" (Topel, 1999).

According to this perspective, individuals make career decisions by estimating the long-run financial rewards of an educational investment and the non-monetary factors that are associated with a particular career choice, as compared to others choices, given the regional socio-economic conditions (Willis & Rosen, 1999). The "return on education" is the financial calculation individuals make to decide how much education to obtain. Schooling is thought to be pursued to the point where its marginal rate of return equals its costs (Willis & Rosen, 1999). It is assumed that the more educated worker is more productive, and therefore will be remunerated at a comparatively higher wage. Economics research has found that each additional year of education increases wages

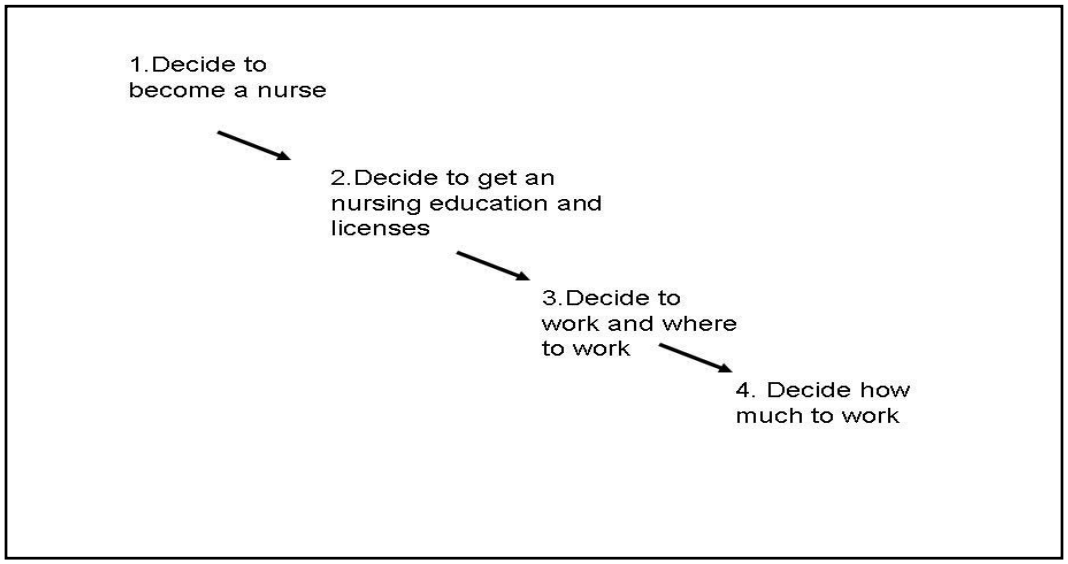
between 12 and 16%, accounting for intellectual ability and self-selection bias in the general population of workers (Ashenfelter & Krueger, 1999). Policies aiming to increase the labor supply often focus interventions at lowering the cost of education. Lower cost education offers a higher return on the educational investment, which incentivizes individuals to pursue education.

The second mainstay of the HCM is the concept of "return on tenure." It contains the assumption that salaries will increase with time worked. It assumes that "on inspection" the employer is not completely certain of the quality of the worker, but with time the employer will offer a salary that is commensurate with the worker's performance (Jovanovic, 1999). From the worker's perspective, she is thought to be willing to accept a lower salary at the beginning with the expectation that she will be rewarded in time for her productivity and dedication to the organization. In fact, Topel (1999) found that "10 years of job seniority raise the wage of the typical male worker in the U.S. by over 25% relative to what he could earn elsewhere" (p. 164). There is "an implicit employment contract under which earnings will grow with time on the job in order to provide workers with appropriate incentives regarding turnover and effort" (Abraham & Farber, 1999). Since higher compensation is deferred to a later time, senior workers run the risk of incurring greater losses if their jobs were to end (Topel, 1999). Indeed, there is strong empirical evidence that this practice lowers turnover among senior workers (Abraham & Farber, 1999; Topel, 1999).

The HCM therefore suggests that individuals must make a series of decisions in order to work as registered nurses (Figure 4). Individuals must first decide to become nurses, then apply to a nursing program, complete the course work, and pass the licensing

examination. These new nurses must then decide to work, chose a work setting, and finally, decide how much to work (part-time, full-time, and/or overtime). At each decision point, the HCM predicts that wages will have an effect, sometimes small, sometimes large, on the decision. A small effect indicates low elasticity and a large effect indicates high elasticity. The more elastic the labor supply is with respect to wages, the greater its reaction in response to small changes in wages (Chiha & Link, 2003).

Figure 4 *Human Capital Decision Tree*




The first two decisions, the decision to become a nurse and the decision to enroll in nursing school, have been found to be significantly affected by wages. Seago et al. (2006a) surveyed 3,000 students eligible to enter nursing programs in California about their perceptions of a career in nursing. They found that nursing, as compared to other occupations, was viewed as relatively financially rewarding, although less respected in the work place and having less autonomy. Over 80% of the students surveyed perceived an education in nursing as a better source of income and job security than other college majors, except for medicine. Buerhaus et al. (2005a) explored the perceptions of students

already enrolled in nursing programs. Most students entered the profession with a high level of altruism. A large proportion enter it expecting nursing to be a stressful profession that receives little respect in the work place and requires physical and intellectual effort. The nursing students in both studies viewed nursing as a secure career, with many jobs available (Buerhaus et al., 2005b; Seago et al., 2006a). These studies of potential and current nursing students suggest that RNs follow the first step in the HCM decision tree (i.e. are affected by wages when deciding to pursuit nursing education). They indicate that job security (a non-pecuniary factor) and income (a pecuniary factor) may have a positive effect on the decision to become a nurse.

Once individuals decide to become nurses, they must decide the type of education they want to obtain, apply to the program of their choice, successfully complete the course work, and pass the licensure exam. Three recent studies of the effect of wages on the decision to enroll in one of the three educational routes in nursing: diploma, associate (ADN), or bachelors' degree (BSN), have used the most reliable statistical methods. Spetz (2002), Seago and Spetz (2002), and Chiha and Link's (2003) used simultaneous equations that account for the decision to work or not work in nursing and the decision to enter into one of the three types of nursing education at the same time. Using national data from the U.S. Census, these researchers have consistently found that there is no life-time financial benefit for staff nurses to get a BSN or higher level of education if they remain in direct patient care (Chiha & Link, 2003; Seago & Spetz, 2002; Spetz, 2002). However, 30% of RNs have a BSN and the number of masters and doctorally prepared nurses has increased by 37% from 2000 to 2004 (HRSA, 2004). Since the return on investment analysis does not show a financial benefit in obtaining a higher level of

education than an associate degree, researchers speculate that there are non-pecuniary factors (non-monetary factors) affecting the decision to attain higher education in nursing (Seago & Spetz, 2002).

When Chiha and Link (2003) compared admission data from 1960-1961 and 1995-1996 academic years, they found that the wage elasticity of admissions (response of the student pool to wage increases) was 2.9 for Diploma, 0.81 for ADN, and 1.13 for BSN ($p<0.05$). That is to say that, a 10% increase in RN wages was associated with a 29% increase in admissions for Diploma, 8.1% increase in admissions for ADN, and 11.3% increase in admissions for BSN. Elasticities close to one or greater are thought to represent medium effects (Skatun et al., 2005). Although there are differences in the elasticity of admissions with respect to wages among the different programs, these findings suggest that wages have the predicted effect on the HCM decision tree, being a positive determinant of the decision to enter nursing, regardless of the venue and final degree. Wages are found to be an effective intervention to increase the number of entrants into nursing, although not through any one educational path.

In addition to gaining education, an individual must also gain work experience in order to increase "human capital," and consequently improve the chances of earning higher wages into the future (Jones & Gates, 2004b). Experience is obtained through the decisions made by nurses in step 3 and 4 of the HCM decision tree (Figure 4). Nurses must first choose to work, and then decide how much to work. These decisions are expected to respond positively to wages, controlling for other factors. Once employed, workers are expected to respond to wage increases by decreasing their leisure time and

increasing their working hours, since “not working becomes more expensive” (Buerhaus, 1991b, p. 1183).

That notwithstanding, the nursing market is unique because nurses are overwhelmingly female, and males and females are thought to choose their careers differently (Goldin, 1999). “Because of their more abbreviated and discontinuous labor force activity, women opt for occupations with lower investment costs and less depreciation with time away from the job than men do” (Goldin, 1999, p. 474). Hence, wages could have at least three effects on the overall labor supply of licensed nurses. First, wages can bring nurses who are working in other fields back in to nursing. Second, wages can increase the number of hours worked by nurses who are presently working in nursing. Finally, wages can have the opposite effect and lower the number of hours nurses work. The remainder of this chapter reviews and critiques the literature that explores these hypotheses.

## Literature Review

This section of the chapter examines in depth the empirical literature with respect to the last two steps in the HCM decision tree (Figure 4). The aim is to critique the empirical literature investigating the wage effect on nurses who are already licensed, focusing on their decision to work and how much to work, measured by the number of hours worked in acute care settings in the U.S. Although this chapter thus far was organized within the context of the labor economic theory and the Human Capital Model (HCM), this section will follow the critique method used in the literature reviews conducted by Antonazzo et al. (2003), Brewer (1998), and Chiha and Link (2003). These critiques assessed the effects of wages on the labor supply of nurses through a

methodological lens, following the advances in sampling, modeling, and analysis over time. Articles are examined in a loosely chronological fashion. The literature is divided into first, second, third and fourth generation studies.

The literature was searched using the following electronic libraries: Pub Med, CINAHL, EconLit, Business Source Premier, and Web of Science. The search terms used were: nursing staff, hospital nursing, and salaries, wages, or earnings. The search was limited to articles published in English between January 1980 and April 2006. Articles were excluded if published in non-peered reviewed journals as defined by the ISI Web of Knowledge Citation Reports. Research conducted outside of the U.S. was also excluded since the health care financing systems and professional structures are non-equivalent, and therefore have limited applicability to the U.S. labor markets. Articles that were not empirical in nature, without clearly explained sample, data collection, analytical methods, results, and discussion sections were also excluded from this review, as well as qualitative research articles, dissertations, books, or reports. Over 720 articles were reviewed, but only 74 met the inclusion criteria, most aiming to identify the determinants of wages, career commitment, or exit behavior. Eight publications measured the effect of wages on the labor participation, and they are examined here. A brief summary of these articles' findings is provided in Table 1 and an extended version is offered in Appendix A. For clarity, the definitions of the various methods are provided in Table 2.

*First Generation Studies*

The earliest assessments of the effect of wages on the labor supply took place in the 1970s, after the creation of Medicare. The Medicare law of 1965 stimulated the creation of an array of health care services, which became a significant part of the

economy, “the health care industry” (Estes et al., 2001). As a new industry, the health care sector sparked interest from applied economists who began their inquiries with methods that are now found to be inadequate, but at the time were viewed as sophisticated.

Yett (1970, 1975) conducted the first descriptive investigations of the nursing workforce. Others like Benham (1971) and Bishop (1973) designed correlation studies to investigate the responses of the workforce to a small number of explanatory variables, such as wages, age, and presence of children at home. They excluded single females, males and non-working individuals, substantially biasing their samples. By excluding these segments of the workforce, information from unobserved variables that potentially affect the decision to work and the decision of how much to work was omitted from the models.

Using U.S. Census data from 1960 (data that were over 14 years old at the time and that did not differentiate between LVNs and RNs), Bognanno et al. (1974) and Sloan and Richupan (1975) performed “cutting-edge” work by including non-working nurses in their samples and by using instrumental variable techniques (IV) (Table 2). These methods intended to decrease the sampling bias by estimating wages for RNs who were not working and better approximate the behavior of the entire labor pool.

Using multiple regression analysis or ordinary least squares (OLS) (Table 2), these early studies found positive wage elasticities that ranged from 0.54 to 0.89 (Brewer, 1998). These results suggest that a 10% increase in wages would lead to a 5.4 to 8.9% increase in hours worked, a range considered by economists to be small (Skatun et al., 2005). Critics point out that OLS alone was not appropriate to estimate wage effects on

hours worked since OLS assumes a linear relationship among the variables. The relationship was found later to be curvilinear and non-continuous since wages cannot be lower than zero (Brewer, 1998).

The first exemplar of the Tobit Model (Table 2), also known as the Heckman Model (Table 2), found that the elasticity of the nurse's own wage was 2.8, suggesting that nurses were extremely responsive to wage changes (Sloan & Richupan, 1975). According to this result, a 10% increase in wage could lead to a 28% increase in labor participation. Even though Tobit regression models handle discontinuous data more accurately than OLS so that non-working nurses could be included, results using Tobit remained consistent with those of OLS. In the first generation studies, nurses were found to be positively responsive to wages.

Table 1 *Chronological Summary of U.S. Studies from 1980 to 2006*

| **Authors & Date** | **Sample** | **Methods** | **Wage Elasticity (E)** |
|---|---|---|---|
| Link and Settle (1980) | U.S. Census, 1970<br>Married females<br>N = n/a | Tobit<br>t-tests | Mostly non-sign<br>Negative, p>0.05<br>For whites <25 yrs old, the effect = 0.23. |
| Link and Settle (1981) | U.S. Census, 1970<br>Married females<br>N = n/a | IV<br>Tobit<br>t-tests | Non-significant<br>Negative, p>0.05 |
| Bahrami (1988) | Non-standardized survey<br>Females from Nebraska, 1982<br>n=325 | OLS | E=0.40 at the mean, p<0.01 |
| Buerhaus (1991) | NSSRN, 1984,<br>RNs who spent >50% in direct pt care<br>n=16,880 | IV<br>OLS | E=0.49 to 0.89<br>p<0.05 |
| Ault & Rutman (1994) | Non-standard survey, 1981 and 1988<br>Female in urban centers<br>n=2,356 | Heckman | E= 0.24 to 0.39, p<0.01 |
| Brewer (1996) | NSSRN, 1984 and 1988<br>n= 28,790 for 1984<br>n= 30,208 for 1988<br>n=4,025 random selection from the 1984 sample was used to validate the model prior to testing it on the rest of the sample. | OLS<br>Logit<br>Chow test | Males:<br>E= -0.19 to 2.03, p>0.05<br>Female:<br>E= 0.59 to 3.48, p<0.05 |
| Chiha & Link (2003) | U.S. Census for 1960 and 1970<br>NSSRN for 1977, 1980, 1984, 1988, 1992, 1996 and 2000<br>n=76,625 | Heckman | Non-significant effects |
| Brewer, Kovner, Wu, Greene, Liu, & Reimers (2006) | NSSRN 2000<br>n=25,741, females only | Reduced Model Bivariate Probit | Single:<br>E= -0.40, p<0.05<br>Married :<br>E=-0.63, p<0.05 |

Table 2 *Definitions of Statistical Terms.*

| | |
|---|---|
| Exogenous Variables | A variable that is independent from the relationship tested in the model. A change in an exogenous variable cannot be explained by the model (Kennedy, 2003). For example the gender of the nurse is exogenous (i.e. outside or independent) from any of the variables in the model. |
| Endogenous Variable | A variable that is affected by other variables in the model. Endogenous variables are not independent from each other. Endogeneity is the situation in which there is a relationship of reciprocal causation between them (Singer & Willett, 2003). |
| Backward Bending Labor Supply | It is the phenomenon in which wages have the unexpected effect of lowering the number of hours worked, instead of increasing it. When wages increase, workers can reach their target income more quickly, with fewer hours worked (Chiha & Link, 2003). |
| Instrumental Variables (I.V.) | Variables that are correlated to a specific "troublesome," most often endogenous variable but not correlated to the error term. They are often difficult to identify (Murray, 2005). |
| Heckman Model | A modification of the Tobit single equation model into a two equation model. Heckman is a statistical approach that aims to compensate for the selection bias from the sample, so that results can be generalized to a larger population. The first stage of the Heckman model estimates the expected values for the error term and the second re-analyses the data using the estimated error (inverse Mills ratio) as an additional independent variable in the model. It works best for truncated data (Kennedy, 2003). |
| Multiple Regression | A general term for tests that use the OLS techniques to evaluate the relationship between two or more independent variables and one continuous dependent variable. |
| Ordinary Least Squares (OLS) | A statistical technique that uses values from independent variables or parameter characteristics to estimate a dependent variable. This method constructs the best linear relationships, so that when estimations are subtracted from the actual parameter variables the results are smallest. These residuals are estimations of the disturbance or error in the data set (Polit, 1996). A good estimator is one that has the smallest sum of square residuals and the largest coefficient of determination or $R^2$. |
| Coefficient of Determination ($R^2$) | The coefficient of determination is a representation of the proportion of the variance that is explained by the model (Kennedy, 2003). It serves as an evaluation of model. |
| Maximum Likelihood Estimates (MLE) | A statistical techniques used to estimate the most probable coefficient(s) for a variable or model, such that the likelihood of getting the data at hand is maximized (Kennedy, 2003). Its results are derived from the product of all the probabilities of obtaining each observation, and the probability for the limits. The function is a mixture of density and cumulative densities of the probabilities of the likelihood of an event (Kennedy, 2003) |
| Tobit | An appropriate method to use when the dependent variable is continuous but censured, such as wages that are always greater or equal to zero. It uses maximum likelihood estimates (MLE). Tobit, in it original form, offers the same equation for the sample selection correction and for the estimation of the outcome, therefore not allowing coefficients to vary for each of the decisions |

| | |
|---|---|
| | (Chiha & Link, 2003). The decision to work comes before the decision about how many hours to work, hence the coefficients for each of the parameters must be free to vary, and therefore have an independent effect at each of decision points. Heckman made improvements on the Tobit Model, so that the decisions are represented by two equations. |
| Logistic Regression (Logit) | A statistical technique that analyzes the relationship between two or more independent variables and one dichotomous variable. It predict the probability of an event, offering relative risks among the dependent characteristics (Polit, 1996) |
| Probit | A statistical analysis that can be used to evaluate the relationship between multiple independent variables and a dichotomous dependent variable. Probit results are evaluated similarly to logistic regression (Polit, 1996). Dependent variables can be represented as dummies. The analysis involves maximum likelihood estimations that transform the dependent variables into cumulative probability functions. |
| Bivariate Probit Model | It is a special case of Probit in which two dependent variables are analyzed simultaneously with the purpose to ascertain their relationship to each other as well as their relationships to the independent variables in the model (Fabbri, Monfardini, & Radice, 2004). |

*Second Generation Studies*

As "Reagonomics" took hold of the organizational strategy of hospitals with mergers and acquisitions, diagnosis related groups, and preferred provider organizations, researchers began to incorporate the organizational structural context into studies. Bahrami (1988) and Buerhaus (1991) made valuable contributions to model specification by including such variables.

Bahrami (1988), looking at a small sample (n=325) of nurses from the state of Nebraska, developed a comprehensive model that explained 36% of the variance ($p<0.05$) in the number of hours worked using OLS. The researcher included institutional variables, such as the presence of a career ladder and job satisfaction ratings in a mailed questionnaire, as well as regional characteristics, such as relative wage index. Bahrami (1988) found a wage elasticity of 0.40 at the mean wage ($p<0.01$), suggesting that for the average nurse in this study, a 10% increase in wages would lead to a 4% increase in the

weekly hours worked. Two work related variables were found to significantly impact the number of hours worked by RNs. The variables were the quality of the relationship with physicians (-1.96) and the level of participation in decision making processes of the organization (-1.99). The coefficients for these variables translated into small negative elasticities (-0.11 and -0.05) with respect to the number of hours worked. These findings suggest that wages had a small effect and that modifications in working conditions were important strategies for retention, since unattended they were found to be detrimental to labor attachment.

Similarly, Buerhaus (1991b) integrated a more comprehensive set of variables in the analysis. He was the first to use data from the National Sample Survey of Registered Nurses (NSSRN). This is a publicly available survey that has been conducted every four years since 1977 by the Health Resources and Services Administration (HRSA). It provides detailed information from a large random sample of nurses from the 50 states and the District of Colombia. Buerhaus (1991b) also included some regional characteristics, drawn from metropolitan statistical area (MSA) categories and the presence of collective bargaining agreements. The MSA dataset is produced by the Office of Management and Budget and recognizes population centers and their adjacent communities, such that statistical representations of the social and economic characteristics of the urban centers can be made (Spotalia, 2000).

Buerhaus (1991b) used IV techniques to calculate predicted wages for non-working RNs, aiming to obtain more inclusive results. However, this technique is no longer used for this purpose because the Heckman Model is considered to be more appropriate. Finally using OLS, he developed different models based on marital status

and found significant differences. The overall elasticity for married nurses was 0.49 and for unmarried nurses the elasticity was 0.89, both at $p<0.05$. When he tested for a backward bend in the nurse supply, Buerhaus (1991b) found no evidence of bending, except for unmarried nurses who had a negative response ($p<0.05$) when wages were squared. The squaring of explanatory variables tests for a curvature in the linear relationship between the squared variable and the dependent variable (Glantz & Slinker, 2001). Buerhaus (1991b) concluded that this group of nurses was possibly already maximally employed and could not respond with more hours worked, regardless of the wages offered.

A shortcoming of Buerhaus' (1991b) study was the pooling of males and females into one sample, which is thought to offer a less accurate representation of the subjects' behavior. Later studies (Brewer et al., 2006; Chiha & Link, 2003) found that each gender requires different sets of explanatory variables for the models to explain a significant proportion of variance in the dependent variable (hours worked). The percentage of the explained variance in this study ranged from 0.06 and 0.14, which are relatively low.

Buerhaus (1991b) and Bahrami (1988) brought forth the importance of including variables that account for the general state of the economy and the organizational environment. They offered the most inclusive models at the time and highlighted the importance of variables that represent the context in which the nurse works.

Another set of studies that are thought of as second generation studies were conducted by Link and Settle (1980b, 1981). They explored the effect of wages on married female nurses using data drawn from the 1970 U.S Census. In the 1980 study, they found non-significant or negative wage elasticities for all ages and races, except for

whites less than 25 years of old, whose elasticity was 0.23. This result meant that a 10% increase in wages would bring about a mere 2.3% increase in hours worked for white RNs less than 25 years old.

A year later, while testing the responses of the nurse labor supply in more detail, Link and Settle (1981) re-analyzed the previously studied data. This time, they used dummy variables for the wage categories instead of leaving them as continuous variables, and they developed a more comprehensive model that included taxation, regional characteristics, health status, and family composition variables. They found evidence of a backward bending labor supply. Whites showed the largest negative elasticity value (-1.49) between the ages of 25 and 35 and less negative values after that. The authors' suggest that these elasticies may show a link between age and childbearing. Non-whites, on the other hand, showed elasticity values increasingly negative with more advanced age, with the largest negative elasticity (-1.54) between 45 and 55 years old, as individuals got closer to retirement age.

Negative wage elasticity suggests backward bending labor supply, indicating that after reaching a threshold wage, individuals lower their hours (Killingsworth & Heckman, 1986). This response is not congruent with the expectations of classical labor economics. Unlike the general labor pool, nurses in these studies seemed to value their time away from work more highly than the wages being offered. They appear to have, what applied labor economists call, a more family-centered marginal wage utility curve with respect to hours (Killingsworth & Heckman, 1986).

As economists by training, Link and Settle (1980, 1981) led the way in analytical techniques by using Tobit to calculate wage effects on the number of hours worked.

Although at the time this was an improvement over OLS, Tobit was later found to not separate the decision to work from the decision about how many hours to work (Chiha and Link, 2003). The problem with this technique is that it fixed the coefficients, not allowing them to vary for each of the decisions (Chiha & Link, 2003). The decision to work comes before the decision about how many hours to work, hence the coefficients for each of the parameters must be free to differ, and therefore have an independent effect at each decision point (Chiha and Link 2003). Because both of these studies used Tobit, their results are not as reliable as recent research that used more sophisticated methods.

*Third Generation Studies*

Third generation studies aimed to fine tune the measures and models developed in the 1980s. With the advent of restructuring and re-engineering, health care integration, health maintenance organizations, and finally the recession of the early 1990's, researchers scrutinized more closely the impact of organizational culture and environmental characteristics on the number of hours worked, although still through an economic lens.

Ault and Rutman (1994) focused primarily on the evaluation of different measurements of labor participation, but they also investigated wage elasticity among urban female RNs working in Chicago, St. Louis, and Kansas City in 1981 and 1989, using a mailed questionnaire. The models they developed used annual hours worked, hours worked per week, or weeks worked per year as dependent variables and compared the results to a model that categorized individuals as working either part-time or full-time. Ault and Rutman (1994) found that all the measures of labor participation (annual hours, hours per week, and weeks per year) provided similar results, indicating that all

three were comparable. In addition, researchers found wage elasticities of 0.39 in 1981 and 0.24 in 1988 for female nurses under 63 years of age. Moreover, all the models developed by Ault and Rutman (1994) indicated that wages had no effect on labor participation after controlling for demographics and family characteristics. However, they used OLS in their calculation, a statistical technique that assumes a linear relationships between dependent and independent variables. However, the relationship between wages and labor participation has been shown to be non-linear (Brewer, 1996).

Brewer (1996), expanded on Buerhaus' (1991b) hypothesis that the general economy affected labor participation. She used a similar dataset but for different years, the NSSRN for 1984 and 1988. She chose these years to evaluate the number of hours worked in a year of supply and demand equilibrium (1984) and one of labor shortage (1988). She divided "wage" into intervals (dummies codes), pooled married and unmarried nurses, and divided them by gender.

Using OLS, Brewer's (1996) models had adjusted $R^2$s of 0.17 for males to 0.28 for females. With her models she was also able to ascertain that the regression slope for females changed over the two periods but not for males, using the Chow test (Table 2). These differences indicated that females were more elastic than males in regards to their labor participation. She found that in 1984 (period of equilibrium), at the mean wage, a 10% increase in wages could increase hours worked for female nurses by 13.5%, while in 1988 (period of shortage) the number of hours worked by female nurses would increase by 14.5% ($p<0.05$). These values are considered to be substantial because wage increases were producing an effect higher than the financial investment.

Brewer (1996) then used logistic regression (Table 2) to analyze the probability derivatives of working part-time or full-time. Her findings showed that wage elasticity, with respect to hours worked, is not linear; it changes over wage categories. For females, wage elasticity ranged from 0.59 to 3.48 in 1984 (period of equilibrium) and from 1.21 to 2.61 in 1988 (period of shortage), while for males, wage effects were smaller, ranging from 0.63 to 1.19 in 1984 and from –0.19 to 2.03 in 1988. These findings stand out among studies because they suggest that females are highly responsive to wages, potentially increasing hours worked by 26.1%.

Most importantly, Brewer's (1996) models suggested that males and females respond to different influences. Females were more affected by children, family income, student status, race and wages, while males were only affected by family income and full-time student status. Brewer (1996) found no backward bending labor supply, except for females at the highest salary bracket in 1988, suggesting that backward bend may only exist in the presence of shortage. She noted that since most nurses were within the middle wage categories, there were too few nurses in the higher categories to demonstrate a backward bend in the other models tested. This last observation suggests that nurse may also experience wage compression (no significant wage increases with increased experience).

Together Ault and Rutman (1994) and Brewer (1996) offered a better understanding of the variables and the measurements of labor participation. They showed that male and female behaviors are explained by different variables, but all of the measures (annual hours, hours per week, and weeks per year) of labor participation are reliable.

*Fourth Generation Studies*

In an attempt to resolve the remaining problems caused by inadequate sampling and analytical techniques, two recent studies provide the most reliable and congruent results about the relationship between wages and hours. Chiha and Link (2003) compiled 40 years of research and updated the estimates of the effect of wage on the number of hours worked. They re-calculated results from the 1960 and 1970 U.S. Census and from the 1977, 1980, and 1984 NSSRN. In addition Chiha and Link (2003) performed a new analysis on the 1992, 1996, and 2000 NSSRN. They limited the sample to RNs between the ages of 20 to 64, assuming that younger nurses would not be licensed yet and older nurses would be retiring soon. They separated the sample by gender. Data were manipulated to compensate for the inconsistencies in the surveys that spanned 40 years, and then analyzed using the Heckman approach. Chiha and Link (2003) found that the effect of the RN's own wages was not significant on the decision to work, regardless of marital status or gender. For number of hours worked, their results also showed that wages were not-significant for all years, except 1996 for married females (-0.24, $p<0.05$) and 2000 for single females (0.21, $p<0.05$).

In addition, Chiha and Link (2003) tested the hypothesis that nurses have a backward bend in their labor supply for 1992, 1996 and 2000. Dummy variables for wage categories were created for each of the years, with the reference being the category within which the mean was located. Hence, in order to see a backward bend in the supply of nurses, the coefficients would have to be significant and negative as wages increased past the reference group (Chiha & Link, 2003). That was true only for single males in 1992 at the unconventional significance level of 0.10. Wage coefficients were not consistent and

very few were statistically significant. The trend seems to be of small increasingly positive, although non-significant effects of wages on hours, with more positive coefficients in 2000 than in 1992. The results indicate that the supply of nurses is fairly inelastic to their own wage levels regardless of gender and marital status. The authors point out that labor responsiveness should be low among nurses because their labor participation is already high, over 80%, which is higher than the participation of the general labor force (HRSA, 2004). Additionally, age and presence of children were uniformly statistically significant, supporting the evidence for a family-center-marginal-wage utility with respect to hours worked for this group (Killingsworth & Heckman, 1986).

Brewer, Kovner, Wu, Greene, Liu, and Reimers (2006) performed the latest evaluation of this relationship among female nurses. Males were excluded because previous work had found that males and females required different explanatory variables for models to reach significance (Brewer, 1996; Chiha & Link, 2003). Researchers studied the factors that affect the RN's labor participation rates by assembling information from individuals, jobs, and labor market characteristics. They gathered nurse related information from the NSSRN 2000 survey (n=25,471) and linked it with data from the MSA – Inter Study Competitive Edge Part III, Regional Market Analysis Data (Brewer et al., 2006). The latter are a group of surveys of institutional environment data. It provides information, such as organizational size, specialty and primary care physicians per 100,000 people, regional HMO penetration, and percentage of Medicaid patients in the local population. Brewer et al. (2006) also used the Area Resource Files (ARF) for 2000, which provided information about regional unemployment rate. Data

from the ARF and the MSA were linked to the NSSRN individual files. Nurses who lived in rural areas were excluded from the regional analysis since no rural data were available in the MSA data files. These combined datasets provided the richest representation of the national RN workforce and its work environment found in the empirical literature.

Instead of using the Heckman Model, Brewer's team (2006) used an equally reliable method to estimate wages, a "reduced form" equation derived from data from nurses presently working which included all the demographic and regional information available. The OLS coefficients were then used to compute predicted wages for all nurses, regardless of their working status. After that, using the predicted wages and a large array of variables that included personal, family, job characteristics, and market characteristics drawn from the surveys, a Bivariate Probit Model (Table 2) with selection bias correction was used to estimate the probabilities for the decision to work or not work; and if the nurse worked, whether she worked part-time or full-time. These more sophisticated statistical models offer results that are interpreted as changes in probability of each of the decisions between each of the groups. The interpretation of one of these marginal effects is as follows. Married females were found to have marginal effects that were increasingly negative with age. Married females age 60 to 64, for example, had a wage marginal effect of -0.383. That is to say that these women were 38.3 percentage points less likely to work than the reference group (married female nurses < 25 years of age). Therefore, if the probability of working for the nurses who are <25 years old was 70%, than the probability of the older groups would be 31.7%.

The models developed by Brewer and colleagues (2006) indicated that working as an RN was positively related to the ability to work part-time versus full-time for females,

regardless of marital status. While wage did not affect the decision to work, it did affect the decision to work part-time versus full-time. The decision to work full-time was found to be negatively related to wage (-0.404 for single females and -0.628 for married females, both at $p<0.001$). Non-whites and nurses without children were generally more likely to work full-time. Brewer et al.'s (2006) findings support the inclusion of market factors and MSA characteristics, as well as job related variables, when modeling the decision to work full-time or part-time. Moreover, it suggests that further exploration of a backward bending labor supply among married females must be conducted.

There are two limitation of this study. The first is the endogeneity of job-related satisfaction. Endogeneity is a characteristic of the data which makes it biased (Kennedy, 2003). Satisfaction with nursing job, for example, is only present for a specific group, those with nursing jobs. As addressed by the authors, no good instrumental variables have yet been created to ameliorate this problem (Brewer et al., 2006). The second is that Brewer et al. (2006) did not offer any information about male or rural nurses, both critically under-represented populations in nursing.

Although Chiha and Link (2003) and Brewer et al. (2006) presented cross-sectional studies using secondary data analysis with many of the important variables not directly observed, the data sources, sample selection, and analytical methods of these two studies are appreciably better than their predecessors. Conclusions derived from these most recent studies are that, when the models are rich representations of the work and personal experiences of nurses, RN's own wages have no effect on the decision to work. However, the effect of wages on the decision of how much to work is still not clearly assessed. Chiha and Link (2003) did not find statistically significant results, although

they trended toward positive values, while Brewer (2006) found small, negative, significant effects. Researchers interpreted the wage effects that contradict the theoretical expectations established by labor economics by suggesting that even nurses who work part-time are working a substantial number of hours each year, and therefore may be unable to work more.

## Conclusion

Although earlier reviews by Antonazzo et al. (2003), Brewer (1998), and Chiha and Link (2003) found large inconsistencies among the studies reviewed, the fourth generations studies reviewed here are congruent in findings, in so far as the decision to work is concerned (Figure 4). Once an individual has become a registered nurse, wages do not seem to be as important as they were before the individual obtained the license. However, wage effects differ among the fourth generation studies, although not radically. Chiha and Link (2003) found non-significant incongruent effects (some positive, some negative) and Brewer et al. (2006) found small, negative and significant effects on the decision of how much to work, step four in the HCM decision tree (Figure 4).

These findings run counter to the Human Capital Model (HCM) on which these studies are based. Theory predicts that labor will increase participation as wages increase, such that equilibrium between the forces of supply and demand can be reached. However, in an imperfect market, as seen in the health care industry where employer and employee are concentrated in the form of hospital groups and unions, and the workforce is predominantly female, there are many other forces at play.

Several explanations were suggested. One is that nurses may already be maximally employed and cannot respond to increases in wages with increases in hours

(Brewer, 2006). This potential inability to increase hours, in spite of the fact that at least a third of the workforce works part-time, substantiates the idea that as an overwhelmingly female workforce, nurses have other interests that compete with work and wages for their time. Another explanation is that there are too few individuals in the higher wage categories for the models to find a difference in labor participation. That notwithstanding, wages are suspected to have an impact on the hiring time of new employees. Finally, findings suggest that backward bending may be a fluid phenomenon that changes with the state of the economy, the seriousness of the nurse shortage, and perhaps other unknown factors.

While this review concludes that the state of the science is advanced and reliable, even the most recent articles are cross-sectional secondary data analyses of random samples of the national nurse population. Therefore the results from these studies are interpreted as broad generalizations about the white, married, female, national nurse population. However, since labor shortages are thought to be regional phenomena, empirical literature is lacking understanding of the effect of wages in the regional communities.

## Conceptual Framework

Borrowing heavily from the supply side labor economic theory and from the empirical literature presented in this chapter, a conceptual framework for the effect of wages on the number of hours nurses work was created (Figure 5). This framework is the basis for this research study.

Figure 5 *Conceptual Framework.*

| **RN Supply=** | **Wages +** | **Regional + Characteristics** | **Demographic + Characteristics** | **Organizational Characteristics** |
|---|---|---|---|---|
| ・Number of hours worked | ・Hourly wages from RN work<br>・Hourly wages squared<br>・Other income | ・Region of the states (DOF)<br>・Instrumental variables (MDs per capita, in patient days per 100,000) | ・Gender<br>・Age<br>・Yeas of experience<br>・Years of experience squared<br>・Race<br>・Marital status<br>・Children and/or other dependents<br>・Educational level<br>・Location of education | ・Position held<br>・Location of employment |

## Assumptions

Based on the information derived from theory literature, empirical research, and personal experience, the following assumptions are embedded in this research study.

1. Nurses require income to survive in the U.S., a capitalist society. Income offers nurses purchasing power. Income can also be a measure of success and/or value in this society.
2. Income is not the only variable that affects nurse labor participation in the workforce. Family circumstances, race and ethnicity, age, other income, level of education, region of residence, satisfaction with the work environment (organizational and network) also have an effect on the level of labor participation of nurses.

3. Different variables affect male and female labor participation because each gender has a different marginal utility of work.
4. If the decision of how many hours to work is less represented via functions that takes all the contextual variables described in the conceptual model (Figure 5), the effect of wages can be estimated. This estimation is informative in so far as it represents the contribution of wages in the success of motivating nurses to maximize their hours of work.
5. The relationship between wages and hours is curvilinear and start at minimum wage ($6.75).

# Chapter 3

# Methodology

All of the empirical research presented in Chapter 2 used econometric methods. Econometrics is the application of statistical methods to problems that violate standard statistical assumptions because of the nature of the economic relationship among the variables (Kennedy, 2003). Wages, for example are truncated at zero and skewed to the right. An important aspect of econometrics is its attention to the error term, also known as the "disturbance term" or the "stochastic term" (Kennedy, 2003). The stochastic term offers information about the variability in the findings due to possible measurement error, to the omission of influential variables, or to human indeterminacy (personal variability) (Kennedy, 2003).

With stochastic terms in mind, econometricians aim to develop good estimates of events in the broader population. That is done through a "formula or recipe by which the data are transformed into an actual estimate" (Kennedy, 2003, p. 5). A "good" estimate of the effect of wages on number of hours worked by nurses would therefore have a suitable research design, be derived from an unbiased sample, be based on relevant models, and be the result of appropriate analytical techniques so that the disturbance (error) is minimized (Kennedy, 2003). These elements are discussed in this chapter. They are introduced by way of a critique of the empirical research presented in Chapter 2, and then evaluated in terms of their applicability to this specific study. This chapter is divided into the following sections: research design, setting, data collection methodology, sampling, procedures, and statistical analyses.

## Research Design

The broadest ways to classify research are as cross-sectional (short-run) or longitudinal (long-run) designs. Cross-sectional research requires the collection of data at

one point in time, during a single period of data collection (Polit & Hungler, 1999). This approach is particularly useful for describing the relationships among variables and their distribution (Hulley et al., 2001). All the articles presented in Chapter 2 have cross-sectional designs. When answering a question about the relationship between wages and hours of work in a specific year, such as will be done in this study, a cross-sectional design is ideal. Cross-sectional research designs are relatively fast and simple to conduct and analyze since data are collected only once. It is also relatively economical, since there are no follow up or retention interventions to conduct (Hulley et al., 2001). This method however is impractical for studying the incidence of rare occurrences, and results do not infer causation or describe long-term trends (Hulley et al., 2001).

Evaluation of data over time requires a longitudinal design (Polit & Hungler, 1999). Longitudinal designs, also known in the biomedical sciences as "repeated measures" and in economics as "panel studies," are particularly useful at describing trends or examining specific populations (cohorts) over time. This type of design yields a wealth of information regarding changes over temporal sequences, however it is expensive to use and complicated to manage. Data are more complex to analyze since there are repeated measures for each participant that are not independent from each other; thus, more sophisticated statistical methods are required (Hulley et al., 2001). Furthermore, attrition is always a problem when data are collected more than once. Therefore when considering a longitudinal design the cost associated with keeping participants engaged and the potential for attrition bias must be evaluated (Polit & Hungler, 1999).

Both designs are informative, with the cross-sectional approach offering direction and magnitudes of correlational relationships, and the longitudinal approach offering trends for panels. Since, to date, there are no sources of longitudinal data for nurse wages or hours worked in the U.S., this dissertation research project is a cross-sectional study. Data were collected at one point in time, early in 2004.

## Setting

This study examines data collected from registered nurses (RN) licensed in the state of California. As mentioned in Chapter 1, California is the 50$^{th}$ state in the nation in terms of RN per capita, with a current nurse shortage of approximately 17,000 nurses (HRSA, 2006; Spetz & Dyer, 2005). The state as a whole, and the nursing population specifically, are slightly older and more diverse than the rest of the country (Fletcher, Guzley, Barnhill, & Philhour, 2004). The average age of California nurses (2004) is 47.7 years and 46.6% of them are older than 50; meanwhile the national average is 46.8 years old with 41% of nurses over the age of 50 (Fletcher et al., 2004; HRSA, 2004).

The ethnic and gender diversity of the state are also substantially different from the rest of the nation. Only 64% of California nurses are white-non-Hispanic, as compared to 88% nationwide (Fletcher et al., 2004; HRSA, 2004). In California, Asian-Pacific Islanders, mostly from the Philippines, make up the second largest group of nurses, comprising 22% of the total nurse population, while Latinos follow with 6% (Fletcher et al., 2004). These values nationally are considerably lower, 3.3% and 1.8% respectively. Male nurses are also more represented in California than in the rest of the nation. They comprise only 5.7% of the RN population nationally, but in California, males make up over 8% of all RNs (Fletcher et al., 2004; HRSA, 2004). Finally, wages in

California are almost 15% higher than the national average. The mean gross income nationally for full-time nurses in 2004 was $57,785 (HRSA, 2006), while in California that value was $65,700 (Fletcher et al., 2004). Because of the unique characteristics in California, national surveys of the labor force are not necessarily generalizable. Hence, more targeted evaluations of the effect of wages on this distinct population are needed.

## Data Collection Methods

There are multiple methods of data collection available to researchers: observation, personal interviews, and questionnaires are among the most common. Most of the literature examined in Chapter 2 used secondary data (data collected by others) and all used data from questionnaire. This study uses secondary data collected via an anonymous survey on behalf of the California Board of Registered Nursing (BRN). Because of the relevance of these two data collection methods to this research study, they are discussed in more detail.

### *Secondary Data Analysis*

Secondary data analysis is the use of existing data, previously collected either by the researcher for a different study or by another entity (Hulley et al., 2001). Researchers and organizations often gather more data than they can analyze. Therefore, allowing others to ask new questions from data collected from human subjects is an ethical and efficient way to build knowledge. This method also offers speed and economy to research (Hulley et al., 2001). However, researchers doing secondary data analysis have no control over the selection of the variables, selection of the sample, or the quality of the data collected (Hulley et al., 2001).

Secondary data analysis was the most frequently used method of obtaining data for the studies reviewed in Chapter 2. The most recent studies used data from the National Sample Survey of Registered Nurses (NSSRN), a survey conducted by the Health Resources and Services Administration (HRSA) while some early studies used data collected by U.S. Census Bureau. Bahrami (1988) and Ault and Rutman (1994) used non-standard surveys (not validated in the literature). Researchers also have incorporated data from additional sources. Brewer et al. (2006), for example, merged the NSSRN with data from the Metropolitan Statistical Areas (MSA) Inter Study Competitive Edge Part III Regional Market Analysis Data and the Area Resource File (ARF).

The study in this report uses secondary data collected in 2004 by the Program of Applied Research and Evaluation at California State University, Chico (Chico State) on behalf of the California BRN. The BRN successfully conducted this survey in 1990, 1993, 1997, 2004 and 2006. Different organizations were contracted to conduct each of the surveys. For this study, the survey data were merged with data from the California ARF, which are collected by HRSA and provide county based health resource information. Data from both sources were merged into one data file using "county" as the linking variable. The ability to link data from various sources offers substantial strength to the empirical conclusions.

*Surveys*

Surveys, in the form of questionnaires, are instruments that allow researchers to make inferences about unobserved phenomena based on the observed answers (Groves et al., 2004). Mailed surveys are ideal for gathering quantitative information in a systematic fashion (Groves et al., 2004). Such surveys are administered in the same way for each

respondent, via the post office. Each respondent receives the same survey instrument, with the same wording, and with a consistent number of items. They are powerful instruments to collect data about large populations that share a relatively similar culture, such as nurses (Groves et al., 2004).

Surveys are best used for asking standardized questions that measure constructs with high validity and reliability (Groves et al., 2004). Questions must encompass and measure as many elements of the construct as possible (Nunnally & Bernstein, 1994). Additionally, questions must be asked in such a way that participants interpret them correctly and consistently. When incorrect (or inaccurate) answers are provided, measurement errors occur. Measurement errors are defined by the difference between the true answer and the response observed in the questionnaire. If these errors repeatedly appear in one direction, the results are biased (Groves et al., 2004). Thus, using an instrument with high validity and reliability is extremely important for the success of a research study. None of the articles presented in Chapter 2 discussed validity or reliability of the surveys used. The researchers perhaps assumed that surveys administered by governmental entities like the U.S. Census and the NSSRN were thoroughly tested, although that may be an incorrect assumption.

One drawback to mailed surveys is that the researcher has no control over the way in which the survey is administered to the participant (Groves et al., 2004). Some participants may complete the survey in sections with long stretches in between, while others may complete it in one sitting. These differences may affect the participants' memory and judgments of previous events, introducing error to the data. This is

particularly true when estimations of variables that may have social desirability bias, like income or number of hours worked are made (Askildsen et al., 2003).

The same strengths and limitations of the national surveys apply to the California BRN Survey. It is a standardized survey that used a systematic process of data collection, the mail. However, the main shortcoming of the California BRN Survey (which is also true for the NSSRN) is that "hourly wages" and "other income" are not directly measured and must be derived. They are derived from estimations made by the participants. If there are errors of measurement present in the participants' estimations, the errors are carried over to the relationships between wages and hours, leading researchers to erroneous conclusions (Antonazzo, Scott, Skatun, & Elliott, 2003). Nevertheless, most of the items in the California BRN Survey asked factual questions that are measured by single question items. All items had face validity.

## Instrument

The California BRN Survey is a recurring cross-sectional anonymous survey aiming "to collect and evaluate nursing workforce data to address the nursing shortage and workplace issues" (Fletcher et al., 2004, p. 4). The questionnaire has been administered in 1990, 1993, 1997, and 2004 (2006 was recently released) and reviewed each time by the California BRN Nursing Workforce Advisory Committee. The 2004 questionnaire was comprised of 68 questions (Appendix B). Nurses who were not working in nursing were asked to answer 35 questions, and those who were working were asked to answer 60. Length of time to complete the survey was not found in any publication, but it is estimated to be less than 30 minutes. The response rate was 65.2% in 2004, indicating that the survey was a relative burden to the participants, although the

surveyors claim that the response rate was adequate (Fletcher et al., 2004). They purport that 2004 had the lowest response rate among all of the California BRN Surveys because it was the first to include participants with out-of-state addresses.

Non-response bias can plague mailed surveys and is defined as the difference between the mean answers provided by respondents (those who completed all the questions appropriately and consistently) and partial respondents (those who left some questions blank or had inconsistent responses) or non-respondents (those who did not answer any of the questions) (Groves et al., 2004). This type of measurement error can sometimes be addressed by contacting participants; however that is not possible in anonymous surveys, such as the California BRN Survey. Instead, Fletcher et al. (2004) tracked the proportion of respondents to non-respondents.

In order to minimize the impact of non-responders, the California BRN implemented a few procedural safeguards (Fletcher et al., 2004). First, the sample received, via first class mail, an introductory letter that explained the goals of the survey and its value to the community. Most recent addresses were collected at the RNs' last licensing renewal. Second, the survey was mailed with all the items needed to facilitate completion and return of the survey. These items were a pencil, the survey, and a return envelope with the needed postage. Third, a reminder poster card was mailed two weeks after the survey was sent, encouraging recipients who had not yet responded to participate in the survey. Fourth, 796 surveys were sent as replacements for non-deliverables. Finally, an assessment of the non-response bias was done through a comparison between the ages and the region of residence of the respondents to the California BRN Survey (n = 5,187) and the California RN population (n = 281,250) (Fletcher et al., 2004). Age and

region of residence were compared because these are the only two variables available for all RNs licensed in the state, since they are collected by the California BRN during licensing and renewals. Fletcher et al. (2004) found that the proportions were sufficiently similar (<2.37%) and therefore concluded that non-response bias was not a problem in the California BRN Survey of 2004 (specifics are discussed in the sample selection and size section of this chapter).

The California BRN Survey therefore is found to be the most appropriate instrument available to empirically study the effect of wages on RN labor participation in the state. It is a standardized measure of an array of variables, collected from a random sample of a uniquely diverse population. The California BRN Survey promises to provide an accurate estimation of the determinants of labor participation in the state.

## The Sample

### *Human Subjects Assurance*

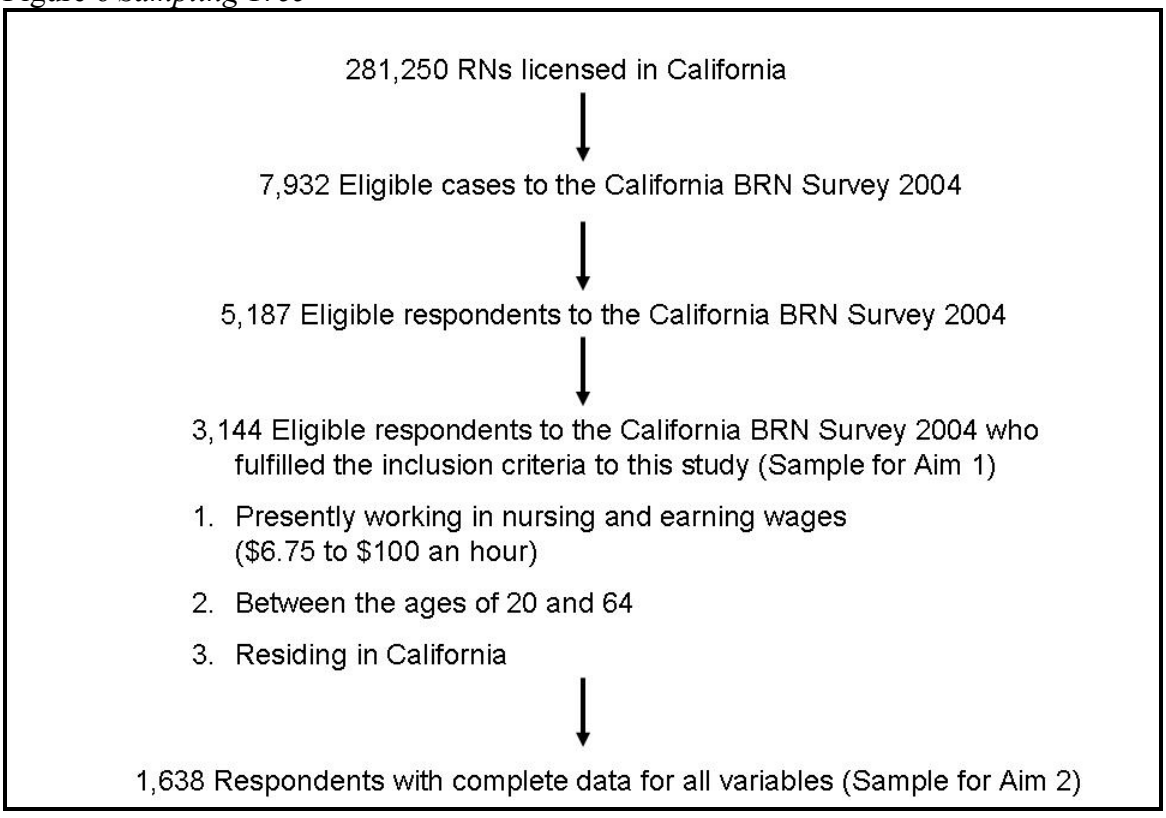
This project is a secondary data analysis of an anonymous survey conducted by the Program for Applied Research and Evaluation at the California State University, Chico on behalf of the California BRN in 2004 and approved by that university's Committee on Human Subjects (CHS) (Fletcher et al., 2004). The use of the California BRN data for this research project was also approved by the CHS at the University of California, San Francisco on November 22, 2006 (Appendix C). There are no threats to the study's participants. Data were analyzed in aggregate form with no identifiers.

### *Sample Selection and Size*

A key step in designing empirical research is deciding on the sample. A sample is the subset of individuals drawn from a population to represent the population in question

(Polit & Hungler, 1999). "Sampling" is the process used to select a sample. It requires inclusion and exclusion criteria. Sampling can be done at random, when all individuals from a population have an equal chance to be included in the sample, or through a non-probability (non-random) strategy (Polit & Hungler, 1999). Non-probability sampling provides a less general representation of the population and can be biased, but may be used for various purposes (Polit & Hungler, 1999). Some examples of non-random sampling are: convenience sampling, where a sample is composed of readily available individuals, or a stratified (or weighted) sample, where segments of the population are mutually exclusive and recruited separately to enhance the representativeness of the overall sample or specific sub-samples (Polit & Hungler, 1999). Regardless of the sampling strategy, researchers can analyze sub-samples. That is to say, they can define sub-groups from within the larger initial sample.

Figure 6 *Sampling Tree*



The sampling frame (population of interest) for the 2004 California BRN Survey consisted of all RNs with active California licenses as of November 2003, including individuals with out-of-state addresses (n=281,250) (Fletcher et al., 2004) (Figure 6). The California BRN staff created a file with all the names, addresses, dates of birth, and dates of licensing for the entire population. From this file, staff at Chico State selected a random sample of 9,000 nurses, from which 8,000 were selected to receive a pre-survey letter by mail. Two weeks later, the eligible cases were sent the questionnaire in a packet with a number 2 pencil, a return addressed envelope, and another letter from the California BRN. Three weeks after that, a post card reminder was sent to all of those who had not yet returned the survey (Fletcher et al., 2004). Another random sample of 796 was selected from the 1,000 remaining in the initial sample. They were mailed the survey as replacements for those whose packets were returned as undeliverable by the U.S. Post Office (Fletcher et al., 2004).

Of the 8,796 mailed questionnaires, 9.8% were not eligible to participate in the California BRN Survey. Eight hundred fifty four were undeliverable and not replaced, 10 were deceased, and 14 refused. Therefore the initial sample of eligible cases for the California BRN Survey was 7,932, of which 5,187 (65.2%) responded (Figure 6). A comparison of the sample (n=5,187) to the population (n=281,250) was done based upon age and region of residence. Although many of the proportions in the sample were found to be significantly different from the proportion in the population (Table 3), the differences were within the sampling tolerance (+/- 1.36%) for a sample of 5,169 participants, assuming a 95% confidence interval (Fletcher et al., 2004).

Analysis of the response rate indicated that the sample of respondents was similar (within the sampling tolerance) to the population and therefore was representative of the different regions of the state, except for the San Diego and Mountain Counties Regions (Fletcher et al., 2004) (Table 3 ). These two areas had a smaller proportion of participants than expected based upon the number of licenses registered. Additionally, a positive relationship between response and age was found. Nurses under 44 years of age were slightly under-represented (between -0.65% and -2.21%) and nurses over 50 were somewhat over-represented (between 0.88% and 2.37%) (Fletcher et al., 2004). Although not perfect, the data obtained by the California BRN from the eligible respondents were presented as representative of the California active licensed nurse population (Fletcher et al., 2004).

Table 3 *Representativeness of Nurses with Active Licenses who Responded to the 2004 California BRN Survey.*

| **Characteristics** | **Population (%)** | **Sample (%)** | **Difference (%)** | **z-test** |
|---|---|---|---|---|
| **Age Group** | | | | |
| Under 30 | 5.50 | 4.17 | -1.33 | **-4.406 |
| 30-34 | 10.02 | 7.81 | -2.21 | **-5.454 |
| 35-39 | 10.23 | 8.57 | -1.66 | **-3.927 |
| 40-44 | 12.46 | 11.81 | -0.65 | *-1.334 |
| 45-49 | 17.08 | 17.32 | 0.24 | 0.420 |
| 50-54 | 17.27 | 19.64 | 2.37 | **3.951 |
| 55-59 | 12.49 | 13.74 | 1.26 | **2.405 |
| 60-64 | 7.85 | 8.73 | 0.88 | **2.065 |
| ≥65 | 7.12 | 8.21 | 1.09 | **2.623 |
| **California Region** | | | | |
| San Diego Region | 9.43 | 8.4 | -1.03 | **-2.459 |
| Inland Empire | 10.18 | 9.9 | -0.28 | -0.621 |
| Los Angeles Region | 34.38 | 34.1 | -0.28 | -0.391 |
| Central Coast | 3.12 | 4.1 | 0.98 | **3.273 |
| Mountain Counties | 0.64 | 0.7 | 0.06 | 0.477 |
| San Joaquin Valley | 8.36 | 8.1 | -0.26 | -0.631 |
| Bay Area | 23.59 | 23.6 | 0.01 | 0.016 |
| Sacramento Region | 7.18 | 7.6 | 0.42 | 1.050 |
| North Sacramento Valley | 1.72 | 1.9 | 0.18 | 0.873 |
| North Counties | 1.40 | 1.6 | 0.20 | 1.056 |

* $p<0.05$, ** $p<0.01$

Data were cleaned for use in this study using the steps described in the procedures section of this chapter. Briefly, the procedures included computing and recoding variables, and selecting out participants that did not fulfill the inclusion criteria for this study. The criteria were that participants (a) be working in a nursing job and earning hourly wages between $6.75 (minimum wage) and $100, (b) be between the ages of 20 and 64, and (c) reside in one of the ten regions of the state, as defined by the California Department of Finance (CA DOF). These criteria were set forth to target nurses who were potentially available to work more hours. The sample size of eligible respondents to the California BRN Survey who fulfilled the inclusion criteria for this study was 3,144 (Figure 6).

There are two aims to this study. Aim 1 is to describe wages for RNs licensed and working in California, examining variation according to the region of the state. To address Aim 1, the entire sample of individuals who fulfilled the inclusion criteria for this study was used (n=3,144). Aim 2 is to examine the effect of wages on nurses presently working with respect to the number of hours worked, investigating variations based on gender, age, race/ethnicity, marital status, level of education, and location of education. To address Aim 2, a sub-sample of individuals with complete data on all the variables included in the model was used (n=1,638).

Because the sample with complete data (Aim 2, n=1,638) was 52.1% of the sample of respondents who fulfilled the study's criteria (n=3,144), questions as to its adequacy in size and representativeness had to be addressed before the analyses were begun. Two strategies were used to address these issues: power analysis and an analysis of the sample proportions.

*Power Analysis.* Power analysis is "the systematic determination of the probability that the statistical tests proposed for [a] study will lead to the rejection of stated null hypotheses" (Paul, 1994, p. 491). The testing of null hypotheses involves four parameters: (a) the power of the test, (b) the alpha level, (c) the sample size, and (d) the effect size.

Using the software program nQuery Advisor, a power analysis was conducted (Table 4). To test a model takes fewer participants than to test the unique contribution of an additional variable; therefore the power analysis was done using the latter strategy, the most conservative scenario. Notably the models tested in this study contained between 31 and 36 variables (including dummies and transformed variables), had overall $R^2$s that ranged from 0.178 to 0.640, and had a sample of 1,638.

Table 4 *Power Analyses*.

| **Components of the Analysis** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| Significance Level, α | 0.05 | 0.05 | 0.05 | 0.05 |
| Number of prior covariates, A* | 36 | 36 | 36 | 36 |
| Correlation, $R_A^2$, A covariates* | 0.35 | 0.35 | 0.20 | 0.20 |
| Number of covariates to add, B* | 1 | 1 | 1 | 1 |
| Increase in $R^2 = R_{AB}^2 - R_A^2$ | 0.01 | 0.0036 | 0.01 | 0.0045 |
| Power (%) | 80 | 80 | 80 | 80 |
| N | 505 | 1400 | 623 | 1400 |

* Assumes covariates are independent variables.

The first scenario indicates that for a multiple linear regression model that has 36 independent variables and an $R^2 = 0.35$, therefore explaining 35% of the variance in the dependent variable, a sample size of 505 will have 80% power to detect, at $\alpha = 0.05$, an increase in $R^2$ of 1% due to the inclusion of an additional independent variable. Scenario 2 shows that for a multiple regression model that includes 36 independent variables and has an $R^2 = 0.35$, a sample size of 1400 will have 80% power to detect, at $\alpha = 0.05$, an

increase in $R^2 = 0.0036$ or 0.36% due to the inclusion of an additional independent variable. This scenario supports the power of the California BRN Survey sample with complete data that is being used in this study. Moreover, the unique contribution (effect size) of additional variables to changes in the $R^2$ in a sample this large could be as small as one third of a percentage point.

Two additional scenarios are included to evaluate the power when the model explains less of the variance in the independent variables (number of hours worked). In scenario 3, a multiple regression model that includes 36 independent variables and has an $R^2 = 0.2$, explaining 20% of the variance in the independent variable, a sample size of 623 will have 80% power to detect, at $\alpha = 0.05$, an increase in $R^2 = 0.01$ (or 1%) due to the inclusion of an additional independent variable. Finally, scenario 4 suggests that for a multiple regression model that includes 36 independent variables and has an $R^2 = 0.2$, a sample size of 1400 will have 80% power to detect, at $\alpha = 0.05$, an increase in $R^2$ of 0.0045 or 0.45% (less than half of a percent change in the explained variance in the dependent variable) due to the inclusion of one additional independent variable. These last two scenarios are the most conservative and indicate that the study sample with complete data (n=1,638) is large enough to detect very small effect sizes and correctly reject the null hypothesis when it is not true.

*Comparing the Groups.* Although the power analysis indicated that the size of the sample of respondents with complete data (n=1,638) was sufficiently large, questions as to its representativeness remained. As discussed earlier, the original sample of eligible respondents to the California BRN Survey in 2004 (n=5,187) was found to be representative of the California active licensed nurse population (Table 3) (Fletcher et

al., 2004). Results derived from this sample of respondents were therefore found to be generalizable to that population. This assertion was made by the original surveyors based upon comparisons between the eligible respondents to California BRN Survey (n=5,187) and data collected from all RNs upon licensing and renewal (n=281,250). The two variables compared were age of the nurse at the time of the survey and region of the state in which the nurse resided (Table 3). When these proportions were not statistically equal, the percent differences were calculated and compared to the estimated sample tolerance (Fletcher et al., 2004). Using this technique, the comparisons of the proportions of each variable indicated that, although there were some differences in age and region of residence between the California RN population and the eligible respondents to the California BRN Survey, the sample was similar enough to be representative of the population.

Following a similar strategy, Chi-Square tests were run to compare the proportions between the respondents who fulfilled the study criteria (n=3,144) and the sample of individuals with complete data (n=1,638) in all the categorical variables included in the model, not just age and region. “Hourly wages” and “hours worked” were dichotomized, and “other income” was recoded into categories, so that these critical variables could also be compared using Chi-Square. In order to reduce redundancy, the table displaying this information is located in Chapter 4 (Table 7). T-tests were not used to compare the original continuous variables because the larger group contained the smaller group, so the observations were not independent.

The null hypothesis for the Chi-Square test states that there is no difference in the proportions among the actual and the expected values for any of the groups in all

categories. The expected values in these comparisons were derived from the proportions of the sample of respondents who fulfilled the study criteria (n=3,144). These expected values were then compared to the observed proportions in the sample of individuals with complete data (n=1,638). The groups can be treated as equal if the results are not statistically significant ($p > 0.05$). However, if results are significant ($p<0.05$), we must reject the null and conclude that there is a difference somewhere among the groups. Although statistically significant differences were disregarded by the California BRN original surveyors if they were less than the sampling tolerance, they were not disregarded in this study. Instead, all statistically significant differences were highlighted to be taken in consideration when evaluating the findings of this study.

The sample of participants with complete data in all variables (n=1,638) is statistically similar to the larger sample of eligible respondents to the California BRN Survey who fulfilled this study's criteria (n=3,144) in terms of gender, age, race, presence of other dependents, level of education, in or planning to be in school, position held, location of employment, region of residence and wages (Table 7). They differ in so far that the group with complete data is more likely to be married (18%), have children under 6 years old living at home (2.1%), have children 6 and over living at home (6.3%), be educated in the state of California (3.4%), and be working part-time (6.1%) (Table 7). Since the two groups are statistically similar in the same variables deemed critical by the Chico State (age and region), and in eight additional characteristics, while differing in only five, the sample with complete data is sufficiently representative of the California RN population with active licenses, between the ages of 20 and 64, who are presently

working and earning a wage. However, RNs who are California educated, working part-time and married with children are over-represented.

## Definition of Variables

This section of the chapter will present all the variables included in this study and explain the ways in which each was calculated or recoded.

Table 5 *Definition of Variables in the California BRN Survey.*

| **Variables** | **Definitions** | **Recoding/Calculation question number (Q#)** |
|---|---|---|
| Hourly wage | An estimation of pre-tax hourly remuneration from "nursing work" in 2002. | Derived by dividing income from nursing (Q66) by average hours worked a week multiplied (Q5) by 52 weeks. Values below $6.75 and greater than $100 were discarded. |
| Predicted wage | An estimation of pre-tax hourly remuneration from nursing work in 2002 | Derived by 2SLS, using instrumental variables: MDs per capita, inpatient hospital days per 100K. |
| Other income | An estimation of pre-tax other income shared in the household in 2002. | Derived by subtracting income from nursing (Q66) from total household income (Q67). Participants with negative values were selected out. |
| Hours worked per week | Average number of hours worked a week as a registered nurse | Participants with negative values or values greater than 80 were selected out (Q5). |
| Region of the State | Defined according to the Department of Finance (DOF). They are San Diego Region, Inland Empire, Los Angeles Region, Central Coast, Mountain Counties, San Joaquin Valley, Bay Area, Sacramento Region, Northern Sacramento Valley, and North Counties. | Home zip code was associated with a region in the state (Q65) |
| Age | Age at the time of the survey | Year the survey was administered (2004) minus year of birth (Q60) |
| Gender | Female or male | (Q59) |
| Race/Ethnicity | Background individual most identify with. | The 10 options were collapsed into five: Hispanic, Asian, black, white, and other race. (Q61) |
| Marital status | Currant marital status. | The 4 options were collapsed into two: presently married or not presently marries (Q62) |
| Children under 6 | Presence of children under 6 years old living at home | Derived from the multiplication of presence of children living at home (Q62) and children ages (Q63) |

| | | |
|---|---|---|
| Children over 6 | Presence of children who are 6 years old or older living at home | Derived from the multiplication of presence of children living at home (Q62) and children ages (Q63 |
| Other dependents | Presence of other dependents under the participant's care | (Q64) |
| Student status | Planning or presently enrolled in a nursing program | (Q51) |
| Highest degree | Highest level of education obtained. | The 4 options were collapsed into 3: Diploma, Associate, Bachelor's, and Master's or doctoral degree (Q53) |
| Location of education | State or country where the participant received pre-licensure education. | The write-in answers were collapsed into 3 categories: California, other U.S., and foreign.(Q50) |
| Years of experience | Years of practices as a nurse, subtracting years not employed as an RN | (Q27) |
| Job location | Type of organization that best described the location in which the participant worked most hours. | The 19 categories were dichotomized into acute care or non-acute care setting.(Q20) |
| Position held | Job title that best described the RN position in which the participant worked most hours. | The 20 categories were dichotomized into direct patient care and non-direct patient care.(Q18) |

Table 6 *Definition of Variables from the California ARF*

| **Variables** | **Definitions** | **Recoding/Calculation** |
|---|---|---|
| MDs per capita | Active MDs per capita in the county in 2004 | Total MDs per county (federal and non-federal) divided by county population |
| Inpatient days per 100,000 population | Number of inpatient days per 100,000 population in the county in 2003. | Number of in patient days in 2003 per county divided by 100,000 population |

As is shown in Tables 5 and 6, often the data collected cannot be used in its original form. Data transformation sometimes is necessary, so that statistical analysis can be performed (Polit & Hungler, 1999). The most common methods of data transformation seen in the reviewed literature were: logging, squaring, and dummy coding. All three were tested or used in this study and therefore are presented in this section.

*Logging*. Logging of data is commonly done, particularly in econometric analyses since wages are, more often than not, skewed to the right and truncated at zero. This

transformation of variables that are not normally distributed changes them into a normal distribution configuration, so that data no longer violate the normal distribution assumption of many statistical techniques (Kennedy, 2003). Logging of data makes it possible to describe non-linear relationships using linear regression techniques (Glantz & Slinker, 2001). Since wages and hours have been previously found to have a non-linear relationship (Chiha & Link, 2003), "hourly wages" and "hours worked per week" were logged and tested in the regression analyses. The model did not improve, so logging was not used in the final analyses.

*Squaring.* Squaring of variables can also be used to make data more normally distributed, but is primarily done when testing for a curvature in a relationship. Chiha and Link (2003), for example, used linear wages and squared wages to test for "backward bend" in the labor supply with the intent of testing for a curve in the linear relationship between wages and hours worked (see Table 2, Chapter 2 for definition).

Since scatter plots of the data suggested that there was a curvature in the relationship between hours and wages (Figure 7), "hourly wages" was squared and both variables (hours and hours squared) were entered in the regression analyses. "Years of experience" was also squared because it was thought to have curvilinear effect on hours, with more experienced (older) individuals working less.

*Dummy Coding.* Dummy variables are artificially constructed, so that categorical variables, such as race or marital status, take on a unit value when they are present and a zero value when they are not (Polit & Hungler, 1999). One of the possible value options is purposely omitted, such that comparisons to that reference groups can be made in the interpretation of the coefficients (Kennedy, 2003).

Dummy codes were used in this study similarly to those reviewed in the literature. Race/ethnicity, region of the state, level of education, and location of education were dummy coded with whites, Los Angeles County, Associate Degree and California educated being the respective reference groups. Dummy variable coefficients are interpreted as to the extent to which behavior in one group deviates from the reference group (Kennedy, 2003).

## Procedures

This section on procedures is divided into two parts. The first itemizes all the data preparation steps taken in this study, while the second outlines the analytical steps taken which are more fully presented in Chapter 4.

### *Data Preparation*

1. Access to the 2004 California BRN Survey was obtained from the Center for California Health Workforce Studies, which has been contracted by the California BRN to conduct and analyze various surveys. The Area Resource Files for California Counties was obtained through public access, downloaded from http://datawarehouse.hrsa.gov/default.htm.
2. Demographic variables were manipulated as follows:
    a. Age was calculated by subtracting year of birth from year of the survey (2004).
    b. The ten options of race/ethnicity were recoded into five categories: Hispanics, whites, blacks, Asians, and others. The five categories were further collapsed into four with blacks and others as one group because

the sub-groups were too small. The categories were then dummy coded with whites as the reference group.

c. The four options of marital status were recoded into two categories: presently married and not presently married (single, divorced or widowed).

d. Children under the age of 6, children 6 and older, and other dependents were multiplied by other variables that inquired about their presence at home and their numbers. The resulting variables were recoded into dichotomies that represent the presence in the home of children under 6, children 6 and older, and other dependents. They remained as three separate dichotomous variables.

e. The five levels of education were collapsed into four options: Diploma, Associate (ADN), Bachelor's (BSN), and Master's (MS) or doctoral degree (PhD) combined. The options were dummy coded with ADN as the reference group.

f. Since location of education was a write-in answer, the multiple levels were recoded into three groups: California educated, educated in other state in the U.S., and foreign educated. The groups were then dummy coded with California educated as the reference group.

g. The ten regions of residence were collapsed into eight because some of the regions contained too small of a group for analysis. Mountain Counties residents were grouped with San Joaquin Valley residents

and Northern Sacramento Region residents were grouped with those residing in the North Counties.

h. The 20 options of work setting were recoded and dichotomized into acute care settings and non-acute care settings.

i. The 19 options of type of position held were recoded and dichotomized into direct patient care and non-direct patient care.

3. Data were cleaned as follows:

   a. "Hours worked per week" were evaluated for outliers through frequencies and graphs. Individuals with values above 80 hours a week were selected out.

   b. "Hourly wage" was calculated for all eligible respondents to the California BRN Survey who had data on "annual income from nursing" and on "hours worked per week." This calculation was done by dividing "annual income from nursing" by "hours worked per week" multiplied by 52 weeks. Frequencies were run to ascertain the range of valid values, particularly the maximum. Since only 59 individuals had values above $100, and these values range from $108 to $650, values above $100 were discarded. Wages less than the California minimum wage ($6.75) were also discarded. "Hourly wage squared" was calculated.

   c. "Other income" was calculated by subtracting "annual income from nursing" from "total annual household income." Individuals with

negative “other income” were selected out. This variable was recoded into categories that represented its quartiles.

4. Inclusion criteria were imposed. They were that participants were presently working in an RN position and earning a wage, were between the ages of 20 and 64, and resided in the state. Individuals who did not fulfilled the inclusion criteria were selected out.

5. Individuals who fulfilled the inclusion criteria but had missing data in at least one variable were compared to those with complete data. Because the two samples were found to differ, an analysis of the proportions of all the categorical variables was done using Chi-Square to evaluate the representativeness of the sample with complete data to the California nurse population.

*Analytical Steps*

1. Descriptive statistics were done for all the variables for the respondents who fulfilled the inclusion criteria (n=3,144) and for the sub-sample of individuals with complete data (n=1,638).

2. Using the sample of respondents who met the inclusion criteria (n=3,144), a one-way analysis of variances (ANOVA) test that compared the mean wages of the different regions was done, followed by post-hoc tests to find where the differences occurred (i.e. among which regions).

3. Using the sample with complete data (n=1,638), an ordinary least squares (OLS) regression was run. “Hours worked per week” was the dependent

variable and gender, race, marital status, presence of children living at home, presence of other dependent, level of education, location of education, location of employment, position held, in or planning to be in school, and region of the state were the independent variables.

4. The model described in step 3 was tested in 34 sub-groups within the sample of individuals with complete data (n=1,638): males, females, Hispanics, whites, Asians, and individuals of other races, married, non-married, working in acute care settings, working in non-acute care settings, working in a direct patient care position, working in non-direct patient care position, Diploma or Associate degree, and Bachelor's degree or higher, U.S educated, foreign educated, seven age categories, six regions of the state and four other income categories. Because results showed "hourly wages" only significant in 9 of the 32 groups tested (5consistently had negative, statistically significant effects, which ran counter to the theoretical expectations of the Human Capital Model, endogeneity was suspected and had to be addressed (see Table 2, Chapter 2 for definitions).

5. Using the sample with complete data (n=1,638) a two-stage least squared (2SLS) procedure for instrumental variables (IV) was done to estimate "predicted wages" in the first step and then use it to estimate "hours worked per week" in the second step. This 2SLS procedure is thought to correct for the endogenous relationship between wages and the error term. The following county variables were tested as instruments for "hourly wages" and "hourly wages squared": number of active physicians in 2004, number of active non-

federal physicians in 2004, physicians (MDs) per capita in 2004, number of hospitals in 2003, number of total hospital beds in 2003, number of emergency room visits in 2003, hospital admissions per capita in 2003, number of people eligible for Medicare in 2004, percent of Medicare managed care penetration in 2004, estimated population 65 years of age or older in 2003, number of births 7/01/03 - 6/30/04, birth per 100,000 population, percent of the population in poverty in 2002, estimated percent uninsured in 2000, unemployment rate in 2004, and median home price in 2000. Of these, only two significantly improved the coefficient of determination of the model that was regressed on "hourly wages." The significant variables were MDs per capita in 2004, inpatient days per 100,000 population. Hence, they were retained in the first stage of the 2SLS regression.

6. The 2SLS procedure was run for the following sub-groups within the sample of respondents with complete data: males, females, Hispanics, whites, Asians, individuals of other races, married, non-married, working in acute care settings, working in non-acute care settings, working in a direct patient care position, working in non-direct patient care position, Diploma or Associate degree, and Bachelor's degree or higher, U.S educated, foreign educated, and seven age categories, six region of the state and four other income categories.

## Data Analyses

The analyses for this study were conducted using SPSS Graduate Package version 13.0 and Intercooled Stata version 9. In order to evaluate research questions and extrapolate findings to a larger population, researchers must test models on data. The

most reliable results are derived from analyses that have a strong match between the assumptions of statistical technique and the characteristics of the data. The congruence between the data from the 2004 California BRN Survey and the analyses conducted in this study are presented in this section.

*Descriptive Statistics*

Descriptive statistics were used to describe and summarize the data. Analyses included mean, frequencies, proportions, standard deviations, and standard errors. They were used to describe the samples.

*Aim 1 - One-Way Analysis of Variances (ANOVA)*

Aim 1 is to describe wages for RNs licensed in California, examining variations according to the region of the state in which they reside; therefore ANOVA is the most adequate test available. It is used to make comparisons between three or more population means (Shott, 1990). The ANOVA provides an F-statistic that tests the equality of the population means among the groups. If the null hypothesis is rejected, the means are not statistically equal, and post-hoc tests of multiple comparisons may be used to identify where the difference lies (Shott, 1990).

One-way analysis of variances was used to test for differences among the mean wages of the respondents who fulfilled the criteria for this study (n=3,144). Respondents were grouped based on region of residence in the state, according to California DOF, addressing Aim 1. Since our results found a significant difference among the ten mean wages, a post-hoc test was used to identify where the differences occurred (i.e. among which of the regions). Since the variances of the mean wages were not equal, Dunnet's C was the most appropriate post-hoc test to use (Glantz & Slinker, 2001).

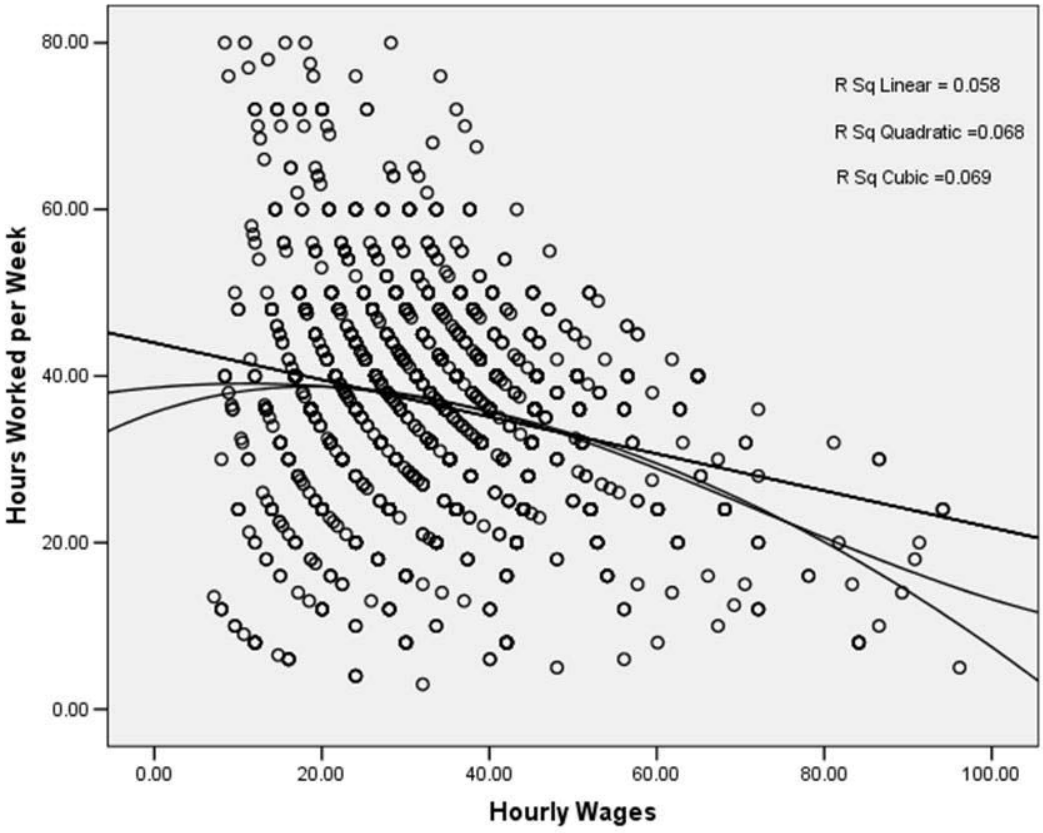
*Aim 2 - Ordinary Least Squares (OLS) and 2-Stage Least Squares Regressions (2SLS)*

Aim 2 is to examine the effect of wages on California RNs who are presently working with respect to the number of hours worked in 2002, examining variations based on gender, race/ethnicity, marital status, other income category, age category, level of education, location of education, location of employment, position held and region of the state. Simple linear regression is a statistical method that uses one dependent variable to predict one continuous outcome by drawing the best straight line through the data (Polit & Hungler, 1999). Multiple linear regression, also known as ordinary least square (OLS), is its equivalent for many predictors. All linear regression techniques compute coefficients that minimize the sum of square differences between the predicted and the observed values (Glantz & Slinker, 2001). The resulting coefficient of determination ($R^2$) is a representation of the proportion of the variance in the dependent variable that is explained by the linear model (Kennedy, 2003). It is an evaluation of the linear fit of the model.

The dependent variables in OLS regression models must be continuous and normally distributed to meet the assumptions of this statistical technique, but the independent variables do not have this requirement. This freedom allows researchers to test models that combine all the variable types (dummy, categorical, continuous or ordinal) (Glantz & Slinker, 2001). Methods based on linear regression assume that (a) the relationships between dependent and independent variables are linear (b) but not multicollinear, (c) that the errors are homoskedastic, and (d) that the observations on the independent variable are considered fixed in repeated samples (Kennedy, 2003).

The first assumption specifies that the relationship in the model be estimated linearly. This assumption is violated when important independent variables are omitted, when irrelevant variables are included, or when parameters are non-linear in a model (Kennedy, 2003). There are no means to test whether a model is correctly specified, but there are ways to transform the independent variable to insure that the relationship is linear (Kennedy, 2003). Variable transformation in terms of logging and squaring of the key continuous independents variables was done and tested. “Hourly wages” and “hourly wages squared” were found to best describe the curvilinear relationship between wages and hours (Figure 7).

Figure 7 *Scatter plot of Hours Worked a Week against Hourly Wages.*

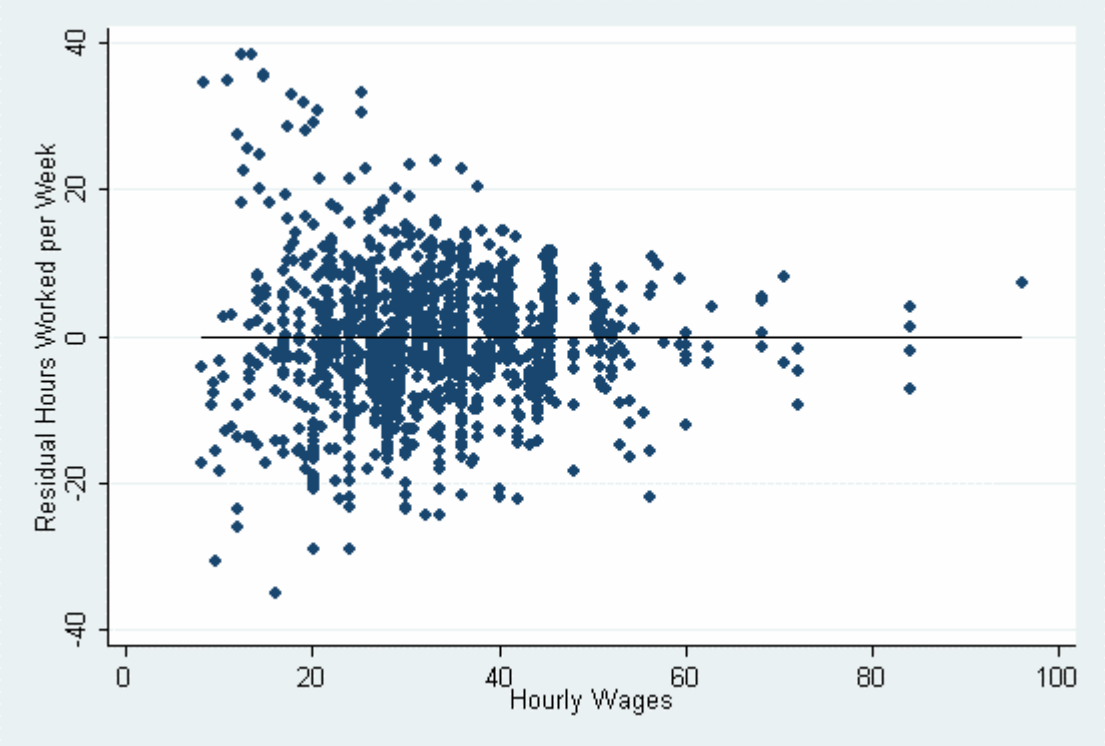


The second assumption specifies that there is "no exact linear relationship between the independent variables" or multicollinearity (Kennedy, 2003, p. 205). Although this phenomenon is rare, if this assumption is violated, it is not possible to calculate the OLS. Multicollinearity is detected through correlation matrixes. All the independent variable correlations had absolute values under 0.4, most under 0.1. Multicollinearity therefore was not a problem in the California BRN Survey data.

The third assumption specifies that the variables in the model have uniform and identically distributed (uncorrelated) variances, also known as "spherical disturbances" or "homoskedastic error terms" (Kennedy, 2003). These characteristics are described in terms of variance-covariance matrixes of the disturbance vector (Kennedy, 2003). If the variances of the error terms are the same, the variance is uniform (homoskedastic). Graphs are expected to show points distributed evenly along a horizontal line. If the correlations of the variances of the error terms differ, the disturbances are uncorrelated (heteroskedastic) (Kennedy, 2003).

In order to test for heteroskedasticity in the California BRN Survey data two methods were used. The first was a visual inspection of the residuals (Kennedy, 2003). Figure 8 shows that the variability of the residuals is similar, but not identical, through all the values of "hourly wages." The second method used to test for hetersokedasticity was the Breusch-Pagan / Cook-Weisberg test (Stata, Corp, 2007). The null hypothesis for this test is that the variance is constant. The null was rejected (Chi Square = 10.74, $p = 0.001$) and the California BRN Survey data were found to be heteroskedastic, violating an assumption of the OLS. In order to decrease the correlation between "hourly wages" and the error term, a 2-Stage Least Squared (2SLS) procedure was used.

Figure 8 *Testing for Heteroskedasticity.*




The final assumption is that observations of the independent variable can be considered fixed in repeated samples (Kennedy, 2003). If the regressors are not fixed, they are "contemporaneously" correlated to the error term. This may occur because of measurement error or autoregression. Measurement error is introduced when variables are incorrectly measured, and autoregression is present when a variable is influenced by its own value in previous periods (Kennedy, 2003).

Autoregression was not a problem in this study since it was a cross-sectional design. However, since the measurement of "hourly wages" in this study is derived from an estimation of "annual income from nursing" and an estimation of "average hours of work per week," measurement error is suspected in the data. When measurement error is present in the data, it is assumed that the variable that introduced the error is correlated to the error term, and that variable is characterized as endogenous (Kennedy, 2003).

Endogeneity is the situation in which there is a relationship of "reciprocal causation" between two or more variables in a model (Singer & Willett, 2003). When that is true, the OLS regression "credits" the endogenous variable with too much of the error in the variance of the dependent variable. In order to correct this problem, econometricians use instrumental variables (IV), a general estimation procedure in which the "best instrument" is created (Kennedy, 2003). The "best instrument" is a variable that is highly correlated to an endogenous predictor but not to the error term (Buerhaus, 1991a). It is created by combining all the exogenous variables available to the researcher (variables uncorrelated to the error) and "instruments" to estimate the endogenous variable (Kennedy, 2003).

A two-stage least squares (2SLS) procedure for instrumental variables was used to estimate the instrumental variables and regress "hours worked per week" using the "instrumented" "predicted wage" variable. As the name suggests, this estimation equation is run in two steps. In the first step the endogenous variable (hourly wages) is regressed in a "reduced model" (the most complete model available to the researcher) and the instruments (variables that are correlated to the endogenous variable but not to the error term) (Kennedy, 2003). Using the coefficients derived from this OLS regression, a predicted value for the endogenous variable is computed. The second step consists of regressing the independent variable (hours worked per week) on the same model; except that the instruments are excluded and the "instrumented" predicted variable is substituted in place of the endogenous variable.

The "instrumented" predicted variables must be correctly "identified." That is to say that, the estimated variable must in fact be estimating the parameter of interest and

not something else (Kennedy, 2003). There is little consensus of what constitutes a valid and sufficiently predictive IV; therefore results derived from these methods must be tested and interpreted carefully (Kennedy, 2003; Murray, 2005). Four post-hoc tests were done to assess the procedure. They were the Anderson canonical correlational likelihood ratio, the Cragg-Donald test, the Anderson-Rubin and the Sargan's test. These tests will be discussed in detail in Chapter 4.

In summary, this cross-sectional study examined the relationship between wages and hours among California RNs by using data collected on behalf of the California BRN via an anonymous survey. Nurses included in this study were eligible respondents to the 2004 California BRN Survey who also fulfilled this study's inclusion criteria. Power analysis and comparison of means found the samples used in this study to be adequate in size and sufficiently similar to the California RN population to be representative, although the RNs who are California educated, working part-time, and married with children are over-represented. Statistical analyses were conducted using this sample, and their results are presented in the next chapter.

# Chapter 4

# Results

The main goal of this chapter is to present the findings from the data analyses discussed in Chapter 3. Before the results for the specific aims of this study are presented, the descriptive statistics for all the variables will be outlined to clearly describe the samples (Table7). Descriptive statistics are important because they illustrate the characteristics of the samples, such that an evaluation of its representativeness can be made. After that, results will be presented following the order of the specific aims of this study. First, California RN wages will be described, followed by a comparison among the ten regions of the state. Second, the results from the ordinary least squares (OLS) model testing will be presented, followed by the results of a detailed examination of the effect of wages on hours worked using the two-stage least squares (2SLS) procedure with instrumental variables (IV).

Table 7 *Descriptive Statistics of the Samples*.

| **Characteristics** | **Sample of eligible respondents to the CA BRN Survey who fulfilled the study inclusion criteria (Aim 1) N=3,144 n [[a] %] or (%)** | **Sample of respondents with complete data for all variables (Aim 2) N=1,638 n (%)** |
|---|---|---|
| **Gender** | | |
| Female | 2801 [92.3] | 1527 (93.2) |
| Male | 233 [7.7] | 111 (6.8) |
| Missing | 110 (3.5) | |
| **Age Categories** | | |
| 20-29 years old | 141 [4.5] | 67 (4.1) |
| 30-34 | 268 [8.5] | 142 (8.7) |
| 35-39 | 284 [9.0] | 164 (10.0) |
| 40-44 | 410 [13.0] | 244 (14.9) |
| 45-49 | 617 [19.6] | 318 (19.4) |
| 50-54 | 687 [21.9] | 345 (21.1) |
| 55-59 | 483 [15.4] | 241 (14.7) |
| 60-64 | 254 [8.1] | 117 (7.1) |
| Mean {SD} | 47.1 {9.3} | 46.7 {9.2} |
| **Race-Ethnicity** | | |
| Hispanic | 201 [6.6] | 121 (7.4) |
| White | 1912 [62.8] | 1064 (65.0) |

| Characteristics | Sample of eligible respondents to the CA BRN Survey who fulfilled the study inclusion criteria (Aim 1) N=3,144 n [[a] %] or (%) | Sample of respondents with complete data for all variables (Aim 2) N=1,638 n (%) |
|---|---|---|
| Black | 100 [3.3] | 49 (3.0) |
| Asian | 727 [23.9] | 348 (21.2) |
| Other | 105 [3.4] | 56 (3.4) |
| Missing | 99 (3.1) | |
| **Marital Status**** | | |
| Not married | 948 [31.1] | 214 (13.1) |
| Married | 2105 [68.9] | 1424 (86.9) |
| Missing | 91 (2.9) | |
| **Children under 6 years old**** | | |
| No | 2385 [78.1] | 1245 (76.0) |
| Yes | 668 [21.9] | 393 (24.0) |
| Missing | 91 (2.9) | |
| **Children 6 and older**** | | |
| No | 1642 [52.8] | 761 (46.5) |
| Yes | 1467 [47.2] | 877 (53.5) |
| Missing | 35 (1.1) | |
| **Other Dependents** | | |
| No | 2244 [73.7] | 1237 (75.5) |
| Yes | 799 [26.3] | 401 (24.5) |
| Missing | 101 (3.2) | |
| **Highest Level of Education** | | |
| Diploma | 382 [12.7] | 206 (12.6) |
| Associate degree | 1219 [40.4] | 669 (40.8) |
| Bachelor's degree | 1150 [38.1] | 624 (38.1) |
| Masters or Doctorate | 266 [8.8] | 139 (8.5) |
| Missing | 127 (4.0) | |
| **Location of Education**** | | |
| California | 2041 [65.5] | 1128 (68.9) |
| Other state in the U.S. | 623 [20.0] | 311 (19.0) |
| Foreign | 454 [14.6] | 199 (12.1) |
| Missing | 26 (0.8) | |
| **In or planning to be in school** | | |
| No | 2266 [79.0] | 1311 (80.0) |
| Yes | 601 [21.0] | 327 (20.0) |
| Missing | 277 (8.8) | |
| **Location of Employment** | | |
| Non-acute care setting | 1161 [38.3] | 643 (39.3) |
| Acute care setting | 1870 [61.7] | 995 (60.7) |
| Missing | 113 (3.6) | |
| **Position Held** | | |
| Non-direct patient care | 1405 [47.2] | 772 (47.1) |

| Characteristics | Sample of eligible respondents to the CA BRN Survey who fulfilled the study inclusion criteria (Aim 1) N=3,144 n [[a] %] or (%) | Sample of respondents with complete data for all variables (Aim 2) N=1,638 n (%) |
|---|---|---|
| Direct patient care | 1572 [52.8] | 866 (52.9) |
| Missing | 167 (5.3) | |
| **Hour Worked**** | | |
| ≤ 32 hours (part-time) | 935 [29.7] | 587 (35.7) |
| > 32 hours (full-time) | 2209 [70.3] | 1051 (64.2) |
| Mean {SD} | 36.7 {10.2} | 35.2 {10.6} |
| **RN Hourly Wages** | | |
| ≤ $32.81 | 1707 [54.3] | 896 (54.7) |
| > $32.81 | 1437 [45.7] | 742 (45.3) |
| Mean {SD} | $32.81 {11.1} | $32.55 {10.6} |
| **Other Income (annual)** | | |
| 0 to $20,000 | 538 [25.6] | 412 (25.2) |
| $20,001 to $40,000 | 585 [27.9] | 437 (26.5) |
| $40,001 to $60,000 | 529 [25.2] | 435 (26.6) |
| $60,001 to highest | 446 [21.3] | 354 (21.7) |
| Missing | 1046 (33.3) | |
| Mean {SD} | $44,031 {25,226} | $44,677 {25,312} |
| **Region of the State** | | |
| San Diego Region | 266 [8.5] | 145 (8.9) |
| Inland Empire | 334 [10.6] | 181 (11.1) |
| Los Angeles Region | 1054 [33.5] | 529 (32.3) |
| Central Coast | 123 [3.9] | 67 (4.1) |
| Mountain Counties | 23 [0.7] | 15 (0.9) |
| San Joaquin Valley | 276 [8.8] | 152 (9.3) |
| Bay Area | 735 [23.4] | 366 (22.3) |
| Sacramento Region | 228 [7.3] | 125 (7.6) |
| North Sacramento Valley | 57 [1.8] | 31 (1.9) |
| North Counties | 48 [1.5] | 27 (1.6) |
| **Years of experience** | | |
| Mean {SD} | 17.8 {10.4} | 17.7 {10.3} |

* $p < 0.05$ two-tailed, ** $p < 0.01$ two-tailed.

*Note.* N= sample size, n = number of observations.

[[a] %] = Valid percentages within the sample, exclude missing cases.

(%) = Percentages within the group.

*Aim 1*

The first aim of this study was to describe wages for California RNs, examining variations according to the region of the state, as designated by the California Department of Finance (DOF). All of the 3,144 eligible respondents to the California BRN Survey who fulfilled the inclusion criteria for this study were included in the analysis for Aim 1 (Figure 9 and10). The mean wage for the sample of RNs who fulfilled the inclusion criteria was $32.81 per hour (SD 11.16); the median was $31.25, and the range varied from $7.12 to $96.15 per hour. The Bay Area region had the highest mean salaries ($37.97 per hour) and North Counties had the lowest ($26.46 per hour). In order to evaluate if these differences in mean wages were significant, an analysis of variance (ANOVA) was conducted. This test had the following null hypothesis: The mean wages for nurses licensed in California are equal among the ten regions of the state.

Results from the ANOVA showed that a difference existed among the means by region ($F=26.440$, $p<0.001$) (Table 8). Therefore a post-hoc test for pair wise multiple comparisons was done to determine which of the pairs of means differed (Table 9). There are many tests available for these comparisons, but the one most appropriate for groups with non-equal variances, such as the ones found in this study, is the Dunnett's C (Glantz & Slinker, 2001). Results from the ANOVA and the post-hoc comparisons indicated that the Bay Area and North Counties regions were significantly different from the rest of the regions, with the Bay Area having a higher mean wage and North Counties a lower mean wage than the other counties. All other regional differences were not significant (Table 9).

Figure 9 *Histogram of Hourly Wages*

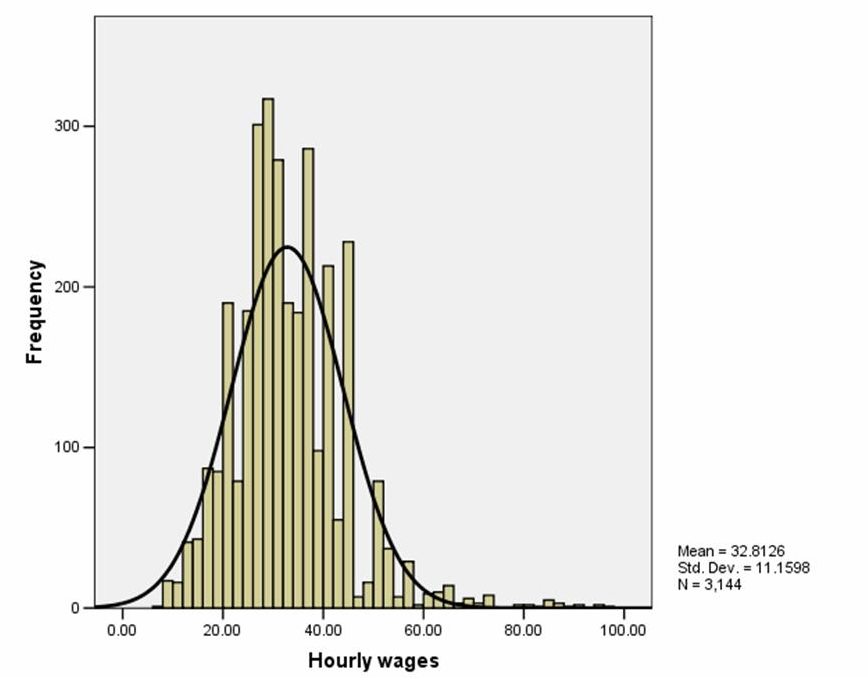



Figure 10 Plot of Mean Wages According to Region of the State of California.

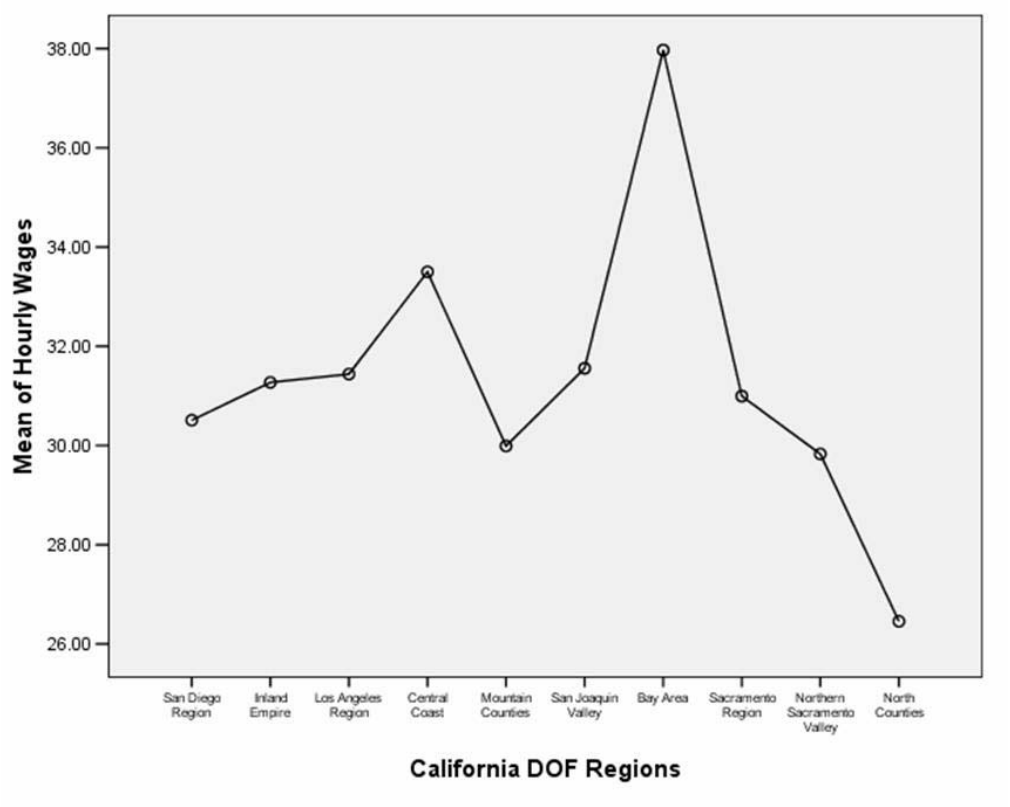



Table 8 *Comparing Mean Wages among the Regions of California.*
ANOVA F = 26.440, p <0.001

| Regions | N | Mean Wage | Std. Deviation | Std. Error |
|---|---|---|---|---|
| San Diego Region | 266 | 30.51 | 10.668 | 0.654 |
| Inland Empire | 334 | 31.27 | 10.532 | 0.576 |
| Los Angeles Region | 1054 | 31.44 | 9.880 | 0.304 |
| Central Coast | 123 | 33.50 | 12.104 | 1.091 |
| Mountain Counties | 23 | 29.99 | 8.166 | 1.702 |
| San Joaquin Valley | 276 | 31.56 | 12.076 | 0.726 |
| Bay Area | 735 | 37.97 | 11.487 | 0.423 |
| Sacramento Region | 228 | 30.99 | 10.911 | 0.722 |
| North Sacramento Valley | 57 | 29.83 | 10.778 | 1.427 |
| North Counties | 48 | 26.46 | 9.349 | 1.349 |
| Total | 3144 | 32.81 | 11.159 | 0.199 |

Table 9 *Post-hoc tests for multiple comparisons – Dunnett C*
Dependent Variable: Hourly wages from nursing work

| (A) California Regions | (B) California Regions | Mean Difference (A-B) | Std. Error |
|---|---|---|---|
| San Diego Region | Inland Empire | -0.760 | 0.872 |
| | Los Angeles Region | -0.928 | 0.721 |
| | Central Coast | -2.989 | 1.272 |
| | Mountain Counties | 0.520 | 1.824 |
| | San Joaquin Valley | -1.046 | 0.978 |
| | Bay Area | *-7.460 | 0.779 |
| | Sacramento Region | -0.484 | 0.975 |
| | North Sacramento Valley | 0.682 | 1.570 |
| | North Counties | 4.054 | 1.499 |
| Inland Empire | San Diego Region | 0.760 | 0.872 |
| | Los Angeles Region | -0.168 | 0.652 |
| | Central Coast | -2.229 | 1.234 |
| | Mountain Counties | 1.280 | 1.798 |
| | San Joaquin Valley | -0.286 | 0.928 |
| | Bay Area | *-6.700 | 0.715 |
| | Sacramento Region | 0.276 | 0.924 |
| | Northern Sacramento Valley | 1.442 | 1.539 |
| | North Counties | 4.815 | 1.467 |
| Los Angeles Region | San Diego Region | 0.928 | 0.721 |
| | Los Angeles Region | 0.168 | 0.652 |
| | Central Coast | -2.061 | 1.133 |
| | Mountain Counties | 1.449 | 1.730 |
| | San Joaquin Valley | -0.118 | 0.788 |
| | Bay Area | *-6.531 | 0.522 |
| | Sacramento Region | 0.444 | 0.784 |
| | Northern Sacramento Valley | 1.610 | 1.460 |
| | North Counties | *4.983 | 1.383 |
| Central Coast | San Diego Region | 2.989 | 1.272 |
| | Los Angeles Region | 2.229 | 1.234 |
| | Central Coast | 2.061 | 1.133 |
| | Mountain Counties | 3.509 | 2.022 |
| | San Joaquin Valley | 1.943 | 1.311 |
| | Bay Area | *-4.471 | 1.171 |
| | Sacramento Region | 2.5048 | 1.309 |
| | Northern Sacramento Valley | 3.671 | 1.797 |
| | North Counties | *7.044 | 1.736 |
| Mountain Counties | San Diego Region | -0.520 | 1.824 |
| | Los Angeles Region | -1.280 | 1.798 |
| | Central Coast | -1.449 | 1.730 |
| | Mountain Counties | -3.510 | 2.022 |
| | San Joaquin Valley | -1.566 | 1.851 |
| | Bay Area | *-7.980 | 1.755 |
| | Sacramento Region | -1.005 | 1.850 |
| | Northern Sacramento Valley | 0.162 | 2.222 |
| | North Counties | 3.534 | 2.173 |
| San Joaquin Valley | San Diego Region | 1.046 | 0.978 |
| | Los Angeles Region | 0.286 | 0.928 |
| | Central Coast | 0.118 | 0.788 |
| | Mountain Counties | -1.943 | 1.311 |
| | San Joaquin Valley | 1.566 | 1.851 |
| | Bay Area | *-6.414 | 0.841 |
| | Sacramento Region | 0.562 | 1.025 |
| | Northern Sacramento Valley | 1.728 | 1.602 |
| | North Counties | *5.101 | 1.533 |
| Bay Area | San Diego Region | *7.460 | 0.779 |
| | Los Angeles Region | *6.700 | 0.715 |
| | Central Coast | *6.531 | 0.522 |
| | Mountain Counties | *4.471 | 1.171 |

| | | | |
|---|---|---|---|
| | San Joaquin Valley | *7.980 | 1.755 |
| | Bay Area | *6.414 | 0.841 |
| | Sacramento Region | *6.975 | 0.838 |
| | Northern Sacramento Valley | *8.142 | 1.489 |
| | North Counties | *11.515 | 1.414 |
| Sacramento Region | San Diego Region | 0.485 | 0.975 |
| | Los Angeles Region | -0.276 | 0.924 |
| | Central Coast | -0.444 | 0.784 |
| | Mountain Counties | -2.508 | 1.309 |
| | San Joaquin Valley | 1.005 | 1.850 |
| | Bay Area | -0.562 | 1.025 |
| | Sacramento Region | *-6.975 | 0.838 |
| | Northern Sacramento Valley | 1.166 | 1.600 |
| | North Counties | 4.539 | 1.531 |
| North Sacramento Valley | San Diego Region | -0.682 | 1.570 |
| | Los Angeles Region | -1.442 | 1.540 |
| | Central Coast | -1.610 | 1.459 |
| | Mountain Counties | -3.671 | 1.797 |
| | San Joaquin Valley | -0.162 | 2.222 |
| | Bay Area | -1.728 | 1.602 |
| | Sacramento Region | *-8.142 | 1.489 |
| | Northern Sacramento Valley | -1.166 | 1.600 |
| | North Counties | 3.373 | 1.964 |
| North Counties | San Diego Region | -4.054 | 1.499 |
| | Los Angeles Region | -4.815 | 1.467 |
| | Central Coast | *-4.983 | 1.383 |
| | Mountain Counties | *-7.044 | 1.736 |
| | San Joaquin Valley | -3.534 | 2.173 |
| | Bay Area | *-5.101 | 1.533 |
| | Sacramento Region | *-11.515 | 1.414 |
| | Northern Sacramento Valley | -4.539 | 1.531 |
| | North Counties | -3.373 | 1.965 |

* Mean difference is significant at the p<0 .05.

*Aim 2*

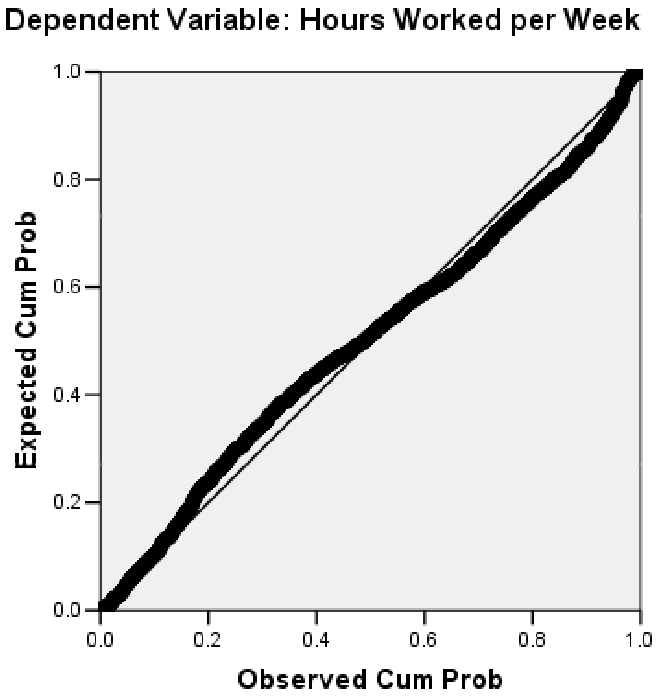
Aim 2 was to examine the effect of wages on weekly hours worked by licensed California RNs who were presently working and were between the ages of 20 and 64, examining variations based on gender, race/ethnicity, marital status, age category, level of education, location of education, location of employment, position held, other income, and region of the state. To evaluate this aim, a model was created that included the variables suggested by the Human Capital Model (HCM) to influence the decision to work (discussed in Chapter 2). Work experience was measured by years of experience and number of hours worked. In this study, "hours worked per week" was the measure of interest because if this variable can be influenced, it could have the most immediate impact on the nurse shortage in the state. Hence, OLS regression equations were

estimated in which "hours worked per week" was the dependent variable and wage, wage squared, other household income, gender, race/ethnicity, marital status, children at home, other dependents, in or planning to be in school, level of education, location of education, location of employment, position held, and region of the state where participants resided were the independent variables.

Plots were used to visually assess the fitness of the model and the assumptions of the analytical method. A scatter plot of the dependent variable (hours worked per week) and the most important independent variable (hourly wages) illustrates that there was a curvilinear relationship between these variables, hence the inclusion of wage squared in the model (Chapter 3, Figure 7). Wage cubed was also tested but dropped because it was not significant. More importantly, the plot suggests that there is a negative relationship between the variables, with values of "hours worked per week" decreasing as values of "hourly wages" increased (Chapter 3, Figure 7). Data also were found to be skewed to the right (i.e. clustered within the lower values of "hourly wages").

The "normal probability" or the percentiles of the error distribution in the data were plotted against a normal distribution line with the same mean and variance is displayed in the P-P plot (Figure 11) (Norusis, 2004). If the error term were normally distributed, the points would closely match the diagonal straight line, suggesting that the coefficients were good estimations of the effects of the tested variables on the dependent variable (Norusis, 2004). The plot suggests that error in the California BRN Survey data was normally distributed, and therefore appropriate for use in an OLS regression analysis (Figure 11).

Figure 11 *P-P Plot of Regression.*




A plot of the actual outcomes versus the unstandardized predicted values of that outcome was also done to assess if the data fitted a linear model (Figure 12) (Norusis, 2004). In this plot, points were expected to be symmetric along the diagonal line. Points were distributed in a shape that approximated the diagonal line but most were found below the diagonal line. Estimates appeared more accurate at the higher values. The plot illustrates that the predictions of the model tested in this study were not ideal, possibly due to the omission of at least one important variable that affected the number of hours worked. Finally, a plot of unstandardized residuals versus unstandardized predicted values was graphed (Figure 13). In this plot, the points were expected to be symmetric around the horizontal line and they were. The graph shows that the data were consistent

through all values, suggesting that there were no systematic errors in the data and that errors were random (Figure 13).

Three out of the four plots suggest that the model in this study fits the assumptions of a linear relationship and normality required by OLS. The tests also indicated that the variables proposed by the HCM provide a good estimation of the number of hours worked by California licensed RNs, although one suggests that the model may omit important variables. In conclusion, all the variables tested in this model were found to be important and therefore were retained in the analyses.

Figure 12 *Actual versus Unstandardized Predicted Hours Worked*

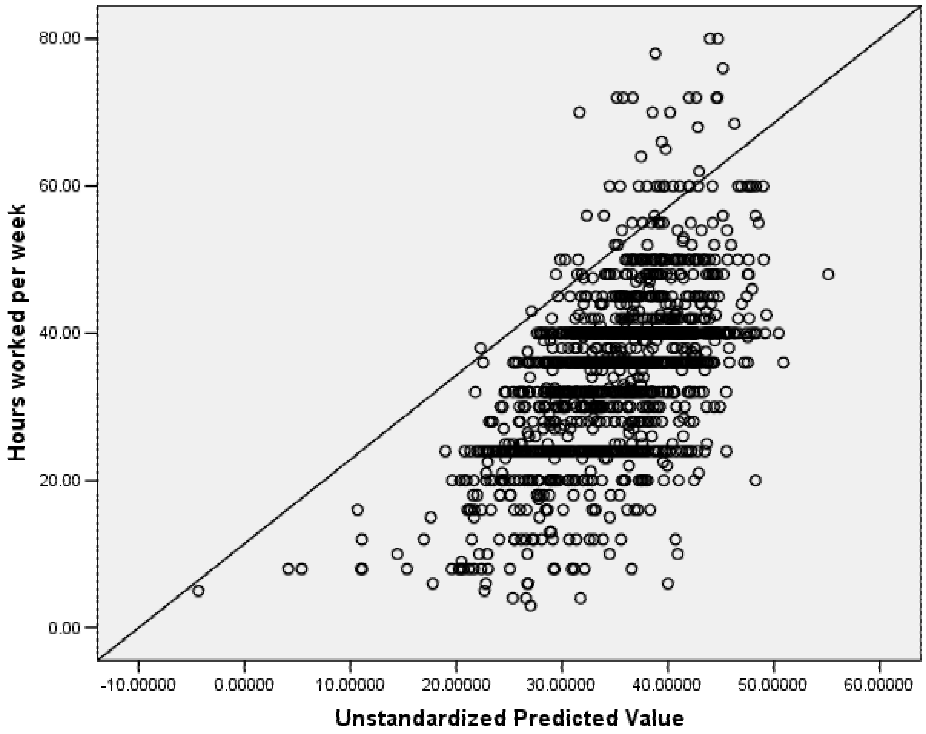
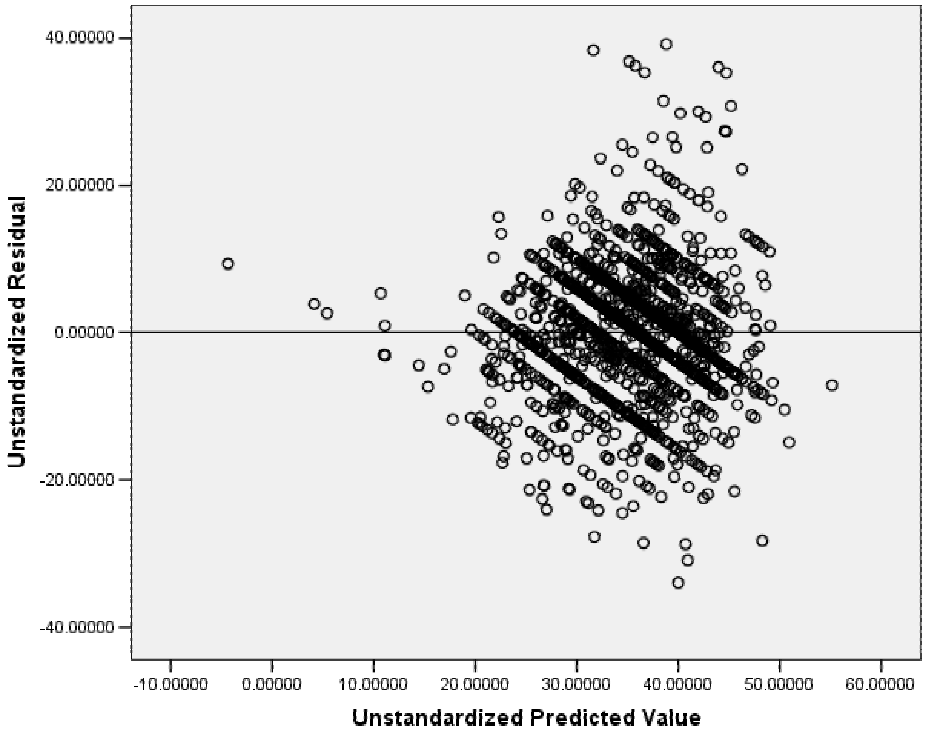


Figure 13 *Unstandardized Residuals versus Unstandardized Predicted Values*




Results from the OLS regression suggested that the model is statistically significant, explaining 33.3% ($F = 28.72$, $p<0.001$) of the variance in the number of hours worked in the sample of individuals with complete data (n=1,638) (Table 10). The model indicates that in our sample, hourly wages had a small, positive, but not significant effect ($\beta = 0.079$, $p=0.317$) on the number of hours worked. Wage squared and other income had significant, although minute, negative effects on hours. This reversal of sign from wages to wages square is consistent with the observed curvilinear relationship (Chapter 2, Figure 7).

Results indicated that marital status, location of education, years of experience, and location of employment (acute vs. non-acute care setting) did not significantly affect the labor participation of presently working RNs licensed in California who were between the ages of 20 and 64 (Table 10). In contrast, female gender, working in a direct

patient care position, or living in the Central Coast, Northern Sacramento Area or in the North Counties region had strong negative relationship with the number of hours worked. As compared to whites, Hispanic ethnicity had no significant effect on hours worked, however being of Asian decent or being identified with "other" race had a strong positive significant effect on hours worked. Young children (< 6 years old) living at home had a significant negative effect on hours worked, but older children (≥ 6 years old) did not affect hours worked. Other dependents, on the other hand, had a positive effect on hours worked. Master's education or higher was found to have a positive effect on hours worked, while lower levels of education had a negative non-significant effect. Being in school or planning to be in school had a positive effect on hours worked. And finally, all regions had a negative effect on hours worked as compared to the Los Angeles region, suggesting that RNs in the Los Angeles region worked more hours than RNs in the rest of the state, although only RNs from the Central Coast, Bay Area, Northern Sacramento Region or North Counties reached a significant difference.

In order to test our model and measure the effect of wages on the number of hours worked in more detail, OLS regressions were done on 34 sub-groups within the sample of participants with complete data (Table 11). These groups were: females, males, Hispanics, whites, Asians, other races, married, non-married, acute care nurses, non-acute care nurses, nurses working in direct patient care, nurses working in non-direct patient care positions, those with less than BSN degree, those with a BSN degree or higher, nurses educated in California, nurses educated in other states of the U.S, and nurses educated out side of the country, age categories, region of residence and other income. When testing the model in these sub-groups, the independent variables were the same,

except for the characteristic on which the groups were selected. For example, when testing the model on females, gender was omitted from the model and males were selected out. The same was done for all the other characteristics (Table 11).

Table 10 *Summary of OLS for Predicting Hours Worked.*

Sample of participants with complete data (n = 1,638)
$R^2 = 0.333$, F= 28.727, p <0.001

| **Variables in the model** | **β** | **Std. Error** |
|---|---|---|
| Constant | **51.320 | 1.946 |
| Hourly wages | 0.079 | 0.079 |
| Hourly wage squared | **-0.005 | 0.001 |
| Other income | **-1.49e-4 | 9.14e-6 |
| Female [δ] | **-4.137 | 0.876 |
| Hispanic [δ] | 0.008 | 0.872 |
| Asian [δ] | **2.687 | 0.641 |
| Other races [δ] | **2.383 | 0.916 |
| Presently married [δ] | -1.063 | 0.671 |
| Children <6 years old [δ] | **-2.171 | 0.676 |
| Children 6 years old or older [δ] | 0.074 | 0.476 |
| Other dependents [δ] | **1.700 | 0.641 |
| Diploma [δ] | -1.432 | 0.780 |
| Bachelors in Nursing [δ] | -0.713 | 0.526 |
| Master's or PhD. [δ] | *1.799 | 0.875 |
| Other state in the U.S [δ] | -0.799 | 0.609 |
| Foreign country [δ] | 1.327 | 0.795 |
| Years in of experience | -0.061 | 0.081 |
| Years in of experience squared | 0.003 | 0.002 |
| In or planning to be in school [δ] | **1.753 | 0.574 |
| Acute care setting [δ] | 0.545 | 0.509 |
| Direct patient care [δ] | **-3.803 | 0.509 |
| San Diego Region [δ] | -1.255 | 0.827 |
| Inland Empire [δ] | -0.708 | 0.764 |
| Central Coast [δ] | **-4.865 | 1.148 |
| Mountain Counties and San Joaquin Valley [δ] | -0.971 | 0.794 |
| Bay Area [δ] | **-1.779 | 0.623 |
| Sacramento Region [δ] | -1.673 | 0.886 |
| Northern Sacramento Valley and Northern Counties [δ] | **-3.447 | 1.231 |

*p<0.05 level, **p<0.01 level

[δ] Reference groups for selected dummy variables were males, whites, not presently married, without children or dependents at home, Associate Degree, educated in California, not in or planning to be in school, employed in non-acute care settings, employed in non-direct patient care positions, and residing in the Los Angeles region.

Table 11 *Summary Statistics for OLS Model Testing in Separate Sub-Groups of Nurses*. Sample of participants with complete data (n= 1,638). Dependent variable: "average hours worked per week."

| Subgroup | n | $R^2$ | β for wage (Std Error) | B for wage$^2$ (Std Error) |
|---|---|---|---|---|
| **Gender:** | | | | |
| Females | 1527 | **0.314 | 0.079 (0.082) | **-0.005 (0.001) |
| Males | 111 | **0.417 | -0.200 (0.413) | -0.001 (0.006) |
| **Ethnicity:** [δ] | | | | |
| Hispanics | 121 | **0.461 | 0.078 (0.326) | -0.003 (0.005) |
| Whites | 1064 | **0.344 | 0.169 (0.097) | -0.006 (0.001) |
| Asians | 348 | **0.299 | -0.314 (0.196) | -0.001 (0.003) |
| Other races | 105 | **0.640 | -0.443 (0.252) | -0.001 (0.003) |
| **Marital status:** | | | | |
| Presently married | 1424 | **0.361 | 0.100 (0.082) | ** -0.005 (0.001) |
| Presently not married | 214 | **0.253 | -0.227 (0.261) | -0.002 (0.003) |
| **Location of employment:** | | | | |
| Non-acute care settings | 643 | **0.314 | *0.257 (0.114) | **-0.007 (0.001) |
| Acute care settings | 995 | **0.333 | -0.147 (0.115) | -0.002 (0.001) |
| **Position held:** | | | | |
| Non-direct patient care positions | 772 | **0.308 | **0.301 (0.108) | **-0.007 (0.001) |
| Direct patient care | 866 | **0.311 | *-0.231 (0.118) | -0.001 (0.002) |
| **Educational level:** | | | | |
| Diploma or Associate Degree | 875 | **0.309 | -01.83 (0.109) | -0.002 (0.001) |
| Bachelor's Degree or higher degree | 763 | **0.336 | **0.372 (0.116) | **-0.008 (0.001) |
| **Location of education:** | | | | |
| California | 1013 | **0.324 | 0.053 (0.101) | **-0.004 (0.001) |
| Other state in the U.S. | 326 | **0.396 | 0.324 (0.177) | **-0.007 (0.002) |
| Foreign country | 263 | **0.395 | *-0.552 (0.231) | 0.004 (0.003) |
| **Age:** [δ] | | | | |
| 20-34 | 209 | **0.371 | *-0.974 (0.379) | 0.009 (0.006) |
| 35-39 | 164 | **0.431 | *0.627 (0.264) | **-0.010 (0.003) |
| 40-44 | 244 | **0.529 | -0.176 (0.185) | -0.002 (0.002) |
| 45-49 | 318 | **0.406 | 0.054 (0.160) | *-0.004 (0.002) |
| 50-54 | 345 | **0.314 | 0.268 (0.211) | ** -0.007 (0.003) |
| 55-59 | 241 | **0.410 | 0.175 (0.237) | *-0.007 (0.003) |
| 60-64 | 117 | **0.561 | 0.366 (0.312) | -0.007 (0.004) |
| **Other income:** | | | | |
| 0 to $20,000 | 412 | **0.275 | -0.306 (0.164) | $-1.1e^{-4}$ (0.002) |
| $20,001 to $40,000 | 437 | **0.233 | 0.096 (0.191) | *-0.005 (0.002) |
| $40,001 to $60,000 | 435 | **0.250 | *0.358 (0.160) | ** -0.008 (0.002) |
| $60,001 to highest | 354 | **0.328 | 0.271 (0.149) | **-0.007 (0.002) |
| **Region of residence:** [δ] | | | | |
| San Diego Region | 145 | **0.337 | 0.323 (0.322) | * -0.008 (0.004) |
| Inland Empire | 181 | **0.378 | 0.410 (0.166) | *-0.010 (0.004) |
| Los Angeles Region | 529 | **0.341 | -0.241 (0.144) | -0.001 (0.002) |
| Mountain Counties & San Joaquin Valley | 167 | **0.314 | 0.472 (0.252) | **-0.008 (0.003) |
| Bay Area | 366 | **0.432 | 0.077 (0.177) | *-0.005 (0.002) |
| Sacramento Region | 125 | **0.366 | 0.279 (0.257) | *-0.007 (0.003) |

* $p<0.05$, ** $p<0.01$

[δ] Selected categories were merged or omitted due to small numbers. Blacks were grouped with individuals of other races, individuals age 20 to 29 were grouped with individuals ages 30 to 34, and Mountain Counties residents were grouped with those residing in San Joaquin Valley. Individuals residing in the Central Coast, Northern Sacramento Region and North Counties were omitted.

The OLS model tested on the entire sample of respondents with complete data (n=1,638) was found to be significant and consistent for all the 34 sub-samples, explaining from 23.3 to 64.0% of variance in the number of hours worked by RNs with California active licenses between the ages of 20 and 64 at $p<0.01$ (Table 11). Hourly wages, on the other hand, were found to have a significant effect on only 9 of the 34 sub-groups, of which 5 had positive effects and 4 had negative. Of the other 25 groups with non-significant effects, 17 had positive values and 8 had negative values.

Negative and/or non-significant coefficients for wages run counter to the supply and demand model that is the theoretical basis of the HCM. This labor economics model (HCM) predicts that wages should have a positive significant effect on labor supply in terms of hours worked. Because of this theoretical paradox, and because "hourly wages" was suspected to contain measurement error, an alternative analytical approach was use to further investigate the effect of hourly wages on hours worked. A Two-Stage-Least-Square (2SLS) regression procedure with instrumental variables (IVs or instruments) was used to correct for the endogeneity of "hourly wages" (Tables 12 and 14). The IVs used were MDs per capita and inpatient days per 100,000 population. These instruments were calculated based on the counties in which the nurses resided. More detailed explanations are presented in the procedures section of Chapter 3.

The first step of the 2SLS was done to correct for the endogeneity (see Table 2 for definition) between "hourly wages" and "the number of hours worked" (Table 12). Using the β-coefficients from this regression, "predicted wages" and "predicted wage squared" values were computed. These values were then used in the second step (Table 14) as independent variables regressed on "hours worked per week." These predicted values are

thought to represent the effect of wages in the "hours worked per week" without a strong association with the error term.

Table 12 *First Stage of the 2SLS. Equation to Estimate Hourly Wages.*
Dependent variable: hourly wages.
n=1,638, $R^2 = 0.125$, F= 10.970, p<0.001

| **Hourly wages** | **β** | **Std. Err.** |
|---|---|---|
| Other income | **-3.3e-5 | 1.0e-5 |
| Female [δ] | -1.495 | 0.999 |
| Hispanic [δ] | -0.630 | 0.994 |
| Asian [δ] | **2.040 | 0.727 |
| Other races [δ] | -1.138 | 1.043 |
| Presently married [δ] | **2.859 | 0.764 |
| Child under 6 years old | 0.502 | 0.770 |
| Children 6 or older | -0.311 | 0.542 |
| Other dependents | -0.697 | 0.731 |
| Diploma [δ] | -0.749 | 0.889 |
| Bachelor's [δ] | 0.154 | 0.596 |
| Master's or PhD [δ] | **4.479 | 0.993 |
| Educated in other U.S state [δ] | -1.066 | 0.693 |
| Educated Foreign country [δ] | -0.380 | 0.908 |
| Years of experience | **0.530 | 0.092 |
| Years of experience squared | **-0.009 | 0.002 |
| In or planning to be in school | 1.226 | 0.654 |
| Employed in acute care | **4.325 | 0.567 |
| Working in direct patient care | -0.915 | 0.578 |
| **MDs per capita** | **648.2 | 124.3 |
| **In patient days per 100,000** | **-3.4e-7 | 9.8e-8 |
| Constant | **21.999 | 1.658 |

[δ] List wise comparison groups: Males, whites, not presently married, individuals without children living at home, individuals without other dependents, Associate Degree, educated in California, not in or planning to be in school, employed in a non-acute care setting, holding a position that does not require direct patient care.

Table 13 *Post-Hoc Tests*

| **Underindentification Tests** | **Chi-Squared** | **p-value** |
|---|---|---|
| Anderson canon. corr. likelihood ratio stat | 34.90 | 0.0001 |
| Cragg-Donald N*minEval stat | 35.28 | 0.0001 |
| | | |
| **Weak identification statistics** | **F-Stat** | |
| Cragg-Donald (N-L)*minEval/L2 F-stat | 17.41 | |
| | | |
| **Test for joint significance** | **Chi-Squared** | **p-value** |
| Anderson-Rubin test | 26.24 | 0.0001 |
| | | |
| **Test of overidentification** | **Chi-Squared** | **p-value** |
| Sargan statistic | 8.671 | 0.0032 |

A series of tests were done to evaluate the fit of the 2SLS procedure (Table 13). The F-statistic of the Cragg-Donald test can be used to identify weak instruments. Weak instruments are those with F-statistic values less than 10 (Stata Corp., 2007). The Cragg-Donald test (F-stat = 17.41) for the instruments used in this study suggested that the instruments were significantly and moderately correlated with the endogenous variables ($r = 0.351$, $p<0.001$). Additionally the Anderson-Rubin test, a robust measure even in the presence of weak instruments, checked the significance of the endogenous regressors in the structural equation being estimated (step 1) (Stata Corp., 2007). Our results rejected the null (Chi Squared = 26.24, $p<0.001$), suggesting that the instruments were appropriate for use.

Two more tests were done to evaluate the validity of the instruments (Table 13). The Anderson canonical correlational likelihood ratio is an "identification statistic" aiming to test whether the instrumental variables are relevant (i.e. MDs per capita and inpatient days) (Stata Corp., 2007). The null hypothesis for this test states that the equation for the estimation is "underidentified" or not relevant enough. The results for the Anderson test (Chi Square = 34.90, $p<0.001$) rejected the null, therefore the instruments

used in this study were found to be correctly identified (Stata Corp., 2007). Finally, the Sargan test was run. It has a null hypothesis that the instruments are uncorrelated to the error term. Our results for the Sargan test (Chi Squared =8.671, p= 0.0032) cast doubt on the validity of the instrument (Stata Corp., 2007). According to these four tests, our instruments are found to be strongly correlated to the endogenous variable and relevant, but they may not be valid because they are possibly correlated to the error term, just as the endogenous variable.

Table 14 *Summary of Second-Stage of 2SLS.*
Dependent variable: hour worked per week.
n =1,638, $R^2$ =0.261, F =20.246, p< 0.001

| **Hours worked per week** | **B (Std Err.)** |
|---|---|
| Predicted hourly wages | -0.985 (0.876) |
| Predicted hourly wages squared | 0.013 (0.012) |
| Other income | **-1.5e-4 (1.2e-5) |
| Female | **-4.108 (1.00) |
| Hispanic | -0.068 (0.935) |
| Asian | **2.633 (0.786) |
| Other | *2.544 (1.009) |
| Presently married | -1.310 (0.925) |
| Child under 6 years old | **-2.198 (0.723) |
| Children 6 or older | 0.180 (0.513) |
| Other dependents | **1.730 (0.700) |
| Diploma | -1.146 (0.833) |
| BSN | -0.572 (0.554) |
| Masters or PhD | 0.993 (1.354) |
| Educated in other U.S state | -0.671 (0.696) |
| Educated Foreign country | 1.175 (0.849) |
| Years of experience | -0.094 (0.146) |
| Years of experience squared | 0.004 (0.003) |
| In or planning to be in school | *1.578 (0.652) |
| Employed in acute care | 0.174 (1.074) |
| Direct patient care | *-3.626 (0.566) |
| San Diego Region | -1.204 (0.919) |
| Inland Empire | -0.643 (0.806) |
| Central Coast | **-5.068 (1.242) |
| Mountain Counties or San Joaquin Valley | -1.285 (0.836) |
| Bay Area | **-3.315 (0.826) |
| Sacramento Region | -1.798 (0.976) |
| North Sacramento Valley or North Counties | *-2.618 (1.306) |
| Constant | **67.420 (15.147) |

* p<0.10, **p<0.05

The second stage found that the model explained 26.1% of variance in the "hours worked per week" at $p<0.001$. The effect of "predicted hourly wages" using 2SLS was found to be negative but not significant ($\beta = -0.985$, $p = 0.261$). Although this value is non-significant it indicates that this sample may have an elasticity of wages equal to -0.911 (see definition and formula p.36), which suggests that a 10% increase in wages could lead to a 9% decrease in hours worked per week.

As with the OLS, the 2SLS found that "predicted hourly wages" and "predicted hourly wages squared" had opposite signs, indicating that the relationship between wages and hours worked is non-linear. Moreover, "other income" was found to have a negative significant effect, suggesting that higher values of other income are associated with lower number of hours worked. The same was true for female gender, presence of children <6 years old living at home, and holding a direct patient care position. Living in the Central Coast, Bay Area or Northern Sacramento and North Counties areas was also found to have significant negative effects on hours worked, indicating that living in this region was associated with working fewer hours per week as compared to nurses living in the Los Angeles region. In addition the results from the 2SLS indicate that being Asian or other races (except for Hispanics) had a positive effect on the number of hours worked as compared to whites. Having other dependents and being in or planning to be in school also had a significant positive effect on hours. Finally, children 6 and older, educational level, location of education, location of employment, and years of experience did not appear to affect number of hours worked.

The last step to address aim 2 is to evaluate the effect of "predicted hourly wages" on "hours worked" using the 2SLS procedure on 28 of the 34 sub-groups used to test the model with OLS (Table 15). Groups defined by the region of the state in which the RN resided were not testable using 2SLS because the IVs are measured at the regional level and thus are perfectly collinear. For the other sub-groups, none had coefficients for "predicted hourly wages" that were statistically significant at conventional levels. Two had coefficients significant at the 10% level, they were individuals between the ages of 20 and 34 ($\beta$= -5.064) and those between the ages of 45 and 49 ($\beta$= -3.579). Twenty-one of the 28 sub-groups had "predicted wage" effects that were negative using this technique, while the other 7 groups had positive effects.

Table 15 *Summary of Statistics for 2SLS Model Testing for Sub-Populations*.

| Subgroup | N | $R^2$ for the 2nd stage | β for predicted hourly wages (Std Err) | β for predicted wage$^2$ (St Err) |
|---|---|---|---|---|
| **Gender:** | | | | |
| Females | 1527 | ***0.253 | -1.123 (0.926) | 0.015 (0.013) |
| Males | 111 | **0.362 | 0.887 (2.485) | -0.018 (0.034) |
| **Ethnicity:** [δ] | | | | |
| Hispanics | 121 | ***0.456 | -2.913 (2.538) | 0.030 (0.034) |
| Whites | 1064 | ***0.274 | -0.845 (1.164) | 0.014 (0.016) |
| Asians | 348 | ***0.178 | -1.558 (2.159) | 0.016 (0.029) |
| Other races | 105 | ***0.455 | 3.250 (4.944) | -0.047 (0.073) |
| **Marital Status:** | | | | |
| Presently married | 1424 | ***0.287 | -0.134 (1.003) | 0.004 (0.013) |
| Not presently married | 214 | **0.190 | -2.226 (2.694) | 0.021 (0.040) |
| **Location of employment:** | | | | |
| Non-acute care settings | 643 | ***0.265 | -0.360 (1.702) | -0.002 (0.025) |
| Acute care settings | 995 | ***0.281 | -0.267 (1.332) | 0.007 (0.018) |
| **Position held:** | | | | |
| Non-direct patient care positions | 772 | ***0.244 | 0.502 (1.230) | -0.008 (0.017) |
| Direct patient care | 866 | ***0.262 | -2.210 (1.384) | 0.030 (0.019) |
| **Educational level:** | | | | |
| Diploma or Associate degree | 875 | ***0.244 | -1.199 (1.469) | 0.014 (0.021) |
| BSN, MS or PhD degree | 763 | ***0.297 | -0.817 (1.224) | 0.012 (0.016) |
| **Location of education:** | | | | |
| California educated | 1013 | ***0.252 | -1.316 (1.132) | 0.015 (0.015) |
| Educated in another state in U.S. | 326 | ***0.333 | 0.009 (2.382) | 0.006 (0.034) |
| Foreign educated | 263 | ***0.330 | -1.965 (2.007) | 0.027 (0.027) |
| **Age:** [δ] | | | | |
| Age 20-34 | 209 | ***0.295 | *-5.064 (2.790) | 0.097 (0.045) |
| Age 35-39 | 164 | ***0.365 | 2.030 (4.158) | -0.025 (0.058) |
| Age 40-44 | 244 | ***0.435 | -0.174 (2.433) | -0.002 (0.034) |
| Age 45-49 | 318 | ***0.350 | *-3.579 (2.159) | 0.047 (0.030) |
| Age 50-54 | 345 | ***0.277 | 1.666 (2.030) | -0.027 (0.028) |
| Age 55-59 | 241 | ***0.281 | -2.243 (3.326) | 0.025 (0.043) |
| Age 60-64 | 117 | ***0.524 | -1.425 (4.233) | 0.022 (0.055) |
| **Other income:** | | | | |
| 0 to $20,000 | 412 | ***0.184 | 1.199 (1.815) | -0.020 (0.025) |
| $20,001 to $40,000 | 437 | ***0.161 | -0.448 (1.776) | 0.005 (0.024) |
| $40,001 to $60,000 | 435 | ***0.174 | -2.611 (1.950) | 0.036 (0.026) |
| $60,001 to highest | 354 | ***0.415 | -1.340 (1.860) | 0.023 (0.027) |

* p<0.1, ** p<0.05, *** p<0.01

[δ] Selected categories were merged due to small numbers. Blacks were grouped with individuals of other races and individuals age 20 to 29 were groups with individuals ages 30 to 34.

In summary, this study finds that there were differences in mean wages among the regions of the state of California. The Bay Area was found to have the highest wages in the state, while the North Counties had the lowest. Hourly wages, at their present level, were found to have at best, a non-significant positive effect on the number of hours RNs worked, and at worst, a significant negative effect on hours worked. A discussion of the meaning of these findings will be presented in the following chapter.

# Chapter 5

# Discussion

This chapter is organized around four topics: (a) the meaning of findings presented in Chapter 4 and their congruence with the expectations of the HCM and with previous studies; (b) the significance of these findings; (c) the limitations of this study, and (d) the implications for future research.

## Meaning of Findings

The first aim of this study was to describe the wages for RNs licensed and working in California, examining variations according to the region of the state in which the RN resided. Findings for Aim 1 showed that the mean wages for nurses licensed in the state in 2002 were $ 32.81 an hour. Hourly wages ranged from $26.46 in the most rural counties of the state to $37.97 in the most urban areas. The Bay Area and the Central Coast regions had the highest wages. These are the most expensive regions of the state to live in and also are the most unionized (California Nurses Association, 2005). Testing of these two effects was not done in this study.

The second aim was to examine the effect of wages on nurses presently working with respect to the number of hours worked, investigating variations based on gender, age, race/ethnicity, marital status, level of education, location of education, other income and region of the state. Findings for Aim 2 suggest that wages were not as important to nurses already licensed, working and residing in California as theory suggests. Results from the OLS regression indicated that the model explained 33.3% of the overall variance in the number of hours worked. Using this analytical method, wages were found to have a positive but insignificant effect on the number of hours worked per week for the sample of individuals with complete data. When that effect was tested on selected sample sub-groups, wages remain non-significant for most. Nine had significant effects, with 5 being

positive and 4 negative. Moreover, wage squared was significant but negative, indicating that there was a curvilinear relationship between wages and hours and a possible backward bend effect of wages on the labor supply. Backward bend is when workers work fewer hours as a response to higher wages, beyond a threshold wage (see discussion in Chapter 2). Overall this indicates that the nurses own wages are not an important determinant of the number of hours nurses work in 2004 in the state of California.

However, the data violated the OLS assumption of collinearity between wages and the error term, therefore a 2SLS regression procedure with instrumental variables was used to address this problem and further explore the effects of wages. Results from the 2SLS procedure differed from those of the OLS regression. The 2SLS procedure found that the model explained less (26.1%) of the variance in the number of hours worked ($p<0.01$). Using this technique "predicted wages" were found to have a negative non-significant effect on the number of hours worked by the sample with complete data. The 2SLS also found mixed (some positive, some negative) non-significant effects at the conventional level for all the 28 sub-groups on which the model was tested. Two groups however, had significant negative results at $p<0.10$. They were individuals less than 35 years old and those between the ages of 45 and 49.

The two methods indicate that nurses' wages, at their present level, are not as important a determinant of the number of hours nurses worked as the economic theory and the HCM suggest. The HCM suggests that wages are the "great mediator" between supply and demand, motivating individuals to increase the number of hours worked (Brewer, 1998; Cleland, 1990; Link & Settle, 1980a; Link & Settle, 1981). Therefore, non-significant or negative wage effects are incongruent with the labor economic model

which was used to predict the outcome of this and most of the empirical literature investigating this phenomenon. Nurses in this study seemed to have reached an income level that is sufficient for their level of consumption. Notably, "total household income" was consistently significant, affecting hours negatively in every sub-group.

This study does not suggest that wage effects are constant throughout all possible wage values. Results presented here are weighted toward the mean wage value and could be drastically different if wages were higher or lower. Consequently, the wage effects found here do not imply that higher wages would lower participation in the workforce or that lower wages would increase the number of hours worked by nurses. It is important to note that wages have an effect at all the four levels of the HCM decision tree (Chapter 2, Figure 4). Wages have been consistently found to have a positive significant effect on the decision to become a nurse and get a nursing education (decisions 1 and 2 in the HCM decision tree) (Chiha & Link, 2003; Seago et al., 2006a; Spetz, 2002). Lowering wages in order to increase hours worked would certainly be an erroneous interpretation of the findings in this study since, at a minimum; it would decrease the number of individuals deciding to enter the profession. Results from this study corroborate previous empirical studies conducted on national samples that indicate that wages, at their present levels, are not an effective incentive to maximize the labor supply of nurses already licensed and working in a nursing job.

## Significance

Findings for Aim 1 add to the body of knowledge because they describe the hourly wages of the California RNs between the ages of 20 and 64 who were working in nursing in 2002; data which were not available previously. Descriptions of nursing

income were generally presented in terms of annual income (Fletcher et al., 2004). However, hourly wage distribution across the state is important because it provides researchers and policy makers with data at the smallest incremental unit of analysis. This micro-level unit of analysis can be used to test the effect of employer monopsony, union membership, and general cost of living on RN labor attachment.

Findings for Aim 2 are important for two reasons. First, results suggest that California nurses behave similarly to their national counterparts. Although more ethnically diverse than the national sample, nurses included in this study were no more responsive to wages than the national average (Brewer et al., 2006; Chiha & Link, 2003). This low elasticity of the labor supply was surprising, given the fact that California wages are higher than the national average, and higher wages were predicted by the HCM to have a positive effect on hours worked (HRSA, 2006). Second, the findings suggest that although economic models are important, they do no sufficiently account for RNs' behavior in the labor market. The economic model tested in this study left 73.9% of the variance in hours worked unexplained. For this reason, findings highlight the fact that alternative theoretical models must be explored.

## Limitations

There were limitations in this study, primarily related to the data and the analytical methods used in this study.

*Data.* Although the survey used was called the California BRN Survey of 2004, it asked questions regarding employment in 2002. While it is the most current dataset available to researchers, the data were analyzed in 2007. Information that is five years old is not as useful to administrators and policy makers as more up-to-date information.

Nevertheless, the information derived from these data can provide insights about the fourth year of the current nurse shortage, which can then be compared to previous or future years for better long-run understanding of RN labor participation in the workforce.

The sample of participants with complete data were equivalent to the sample of eligible participants to the California BRN Survey who also fulfilled the inclusion criteria in 11 of 16 variables compared (gender, age, race, other dependents, level of education, location of education, location of employment, position held, wage, region of residence, and presently in school). They differed in so far as the sample was more likely to be California educated, working part-time, and married with children living at home. It is possible that these participants spend more time at home and consequently were more willing to thoroughly complete the questionnaire. The sample with complete data therefore, although not identical to the larger sample selected to represent the California nurse population, is similar in key ways. Specifically, the sample used in this study was found to be sufficiently similar and therefore representative of the California RN population between the ages of 20 and 64 who were working in nursing in 2002. Findings from this study are generalizable to that population.

This study excluded RNs who were not working in nursing or not working at all because, unlike other studies, this project assumed that these nurses had already made the decision to not work in a nursing job. Most recent articles in the nurse workforce literature (Brewer et al, 2006 and Chiha & Link, 2003) tested the effect of wages on hours worked on samples that included non-working nurses. This inclusion aimed to curb the effect of sample selection bias since non-working nurses are thought to bring with them information about unobserved characteristics of the RN population. These

unobserved characteristics could affect all nurses' decision to work and how much to work, including working RNs (Chiha and Link, 2003). In order to include non-working RNs, researchers must therefore estimate the wages needed to bring these nurses back into the workforce (i.e. their reservation wages). However, that was not the aim of this study. Instead, the aim was to assess the effect of wages on working RNs with the purpose of exploring the determinants of labor attachment of RNs that are committed to the workforce and could contribute to the abatement of the nursing shortage in the state. The exclusion of non-working RNs is a limitation to this study in that results from this study cannot be generalized to the entire California RN population (i.e. working and non-working) and cannot be thought of as a replication of Brewer et al. (2006) or Chiha and Link (2003).

*Analysis.* The model tested in this study aimed to evaluate the effect of "hourly wages," demographic characteristics and human capital characteristics (education and experience) on the decision of how much to work. As stated earlier, using OLS the model explained 33.3% of the variance in the number of hours worked for the average nurse, while using the 2SLS the model explained 26.1%. Although, in comparison to other studies in the literature these are relatively high coefficients of determination, 67% to 73.9% of the variance is still unexplained (Bahrami, 1988; Brewer, 1996). The economic model tested here is not broad enough to fully capture the context in which nurses work and live, and consequently, the choices they make.

Moreover, wages were suspected of endogeneity. As with other studies conducted in the U.S., this study used estimated values of "annual income from nursing" and estimated "average number of hours worked in nursing" to calculate "hourly wages"

(Brewer, 1996; Brewer et al., 2006; Buerhaus, 1991b; Chiha & Link, 2003). Because this variable is associated with social desirability bias, it is thought to be inherently correlated to the error term (Askildsen et al., 2003). The potential endogeneity problem caused by this correlation between hourly wages and the error term was addressed by using 2SLS.

The 2SLS procedure for IV proved relatively successful. The first part of the process, the discovery of "good" instruments, was done testing a selected group of county variables. The result was a moderate coefficient of determination ($R^2$=0.125) for the first step of the 2SLS procedure. The best model to estimate the troublesome variable (hourly wages) only explained 12.5% of its variance, and the post-hoc tests indicated that the instruments were significantly correlated to hourly wages ($r = 0.351$, $p<0.001$) but possibly also correlated to the error term.

Using the β coefficients from the first step, a wage equation was created and "predicted wages" were computed for the entire sample in the second step. The computed predicted wage values were used instead of hourly wages which were derived from the participants' estimations of annual income from nursing and hours worked per week. In the second step, a coefficient of determination ($R^2 = 0.261$, $p<0.001$) was computed. Its value implies that the model with "predicted wages" and "predicted wages squared" explained approximately a quarter of the variance in the labor supply of nurses licensed and working in California in 2002. In conclusion, the two types of cross-sectional analyses conducted in this study were limited because they did not explain a large portion of the variance in hours worked. Moreover, although their results for wage effects differ, both indicated that wages were not a significant determinant of hours worked.

## Future Research

Findings from this study corroborate results from previous studies of national samples. Wages, at their present level, were found to be *not* as critical to the decision of how many hours nurses work, as once thought (Brewer et al., 2006; Chiha & Link, 2003). Future research therefore must explore what factors do influence this decision.

The theoretical foundation of this study was labor economics, and as a result the emphasis was economic (i.e. wages). This emphasis was a practical one because economic variables are more easily manipulated by administrators and policy makers than any other variable within their sphere of influence. Nonetheless, results indicated that alternative frameworks could provide a better foundation for studying the RN workforce. One of these alternatives which appear particularly promising is organizational theory (OT).

OT is an interesting source of information and models about the effects of organizational characteristics on the ability to gain and maintain competitive advantage (Luke & Walston, 2003). OT assumes that organizations take specific courses of action to gain advantage, so that they can survive and thrive in the market place. Examinations of these strategies offer researchers an array of new variables to test that could aid in the understanding of this labor force (Luke & Walston, 2003). Researchers could broaden their theoretical framework considering workplace organizational factors, such as percent of nurses in the higher echelons of the organization, nurse managers' direct reports, magnet and profit status, hospital relationship with a temporary agency or a nursing school, use of technical staff or retention strategy in their models.

Moreover, by combining institutional variables (macro-level data) with hourly wages (micro-level data) models can be analyzed with more flexible forms using techniques like hierarchical linear models (Singer & Willett, 2003). Researchers can move from individual models to nested models, so that findings can be interpreted as changes within the individual RN, accounting for the group or changes within the settings he/she is in (Singer & Willett, 2003). Therefore, comparisons among the nurses' responses to wages, accounting for the organizational context, can be made analytically. The difficulty of these types of analyses is the unavailability of data. However, California is in the privileged position of having yearly hospital data collected by the Office of Statewide Health Planning and Development (OSHPD) as mandated by the California Health and Human Services Agency. The combination of the California BRN Survey data and the OSHPD data could yield important information.

Merging these datasets could also be done with the purpose of further validating the "hourly wage" calculations derived from participants' estimations of "annual income from nursing" and "average hours worked per week." Comparison between the participants' estimations and the hospital administrative data, which is thought to have less error associated with it, may be valuable (Holmas, 2002). Concordance among these datasets could strengthen the validity and reliability of conclusion drawn from the California BRN Survey.

Valid and reliable sources of information regarding RN hourly wages in the state could aid in the study of differences among the regions. The reasons for the differences found in this study were not explored here. However, because the Bay Area has an extremely high cost of living and it is highly unionized, a union wage effect may be

present. In the future, researchers could further explore these and other regional characteristics like employer monopsony or population density on RN labor attachment. In addition, backward bending of the labor supply could be more directly assessed by testing the effect of "hourly wages" divided into quartile or decile wage categories. In that way, the specific effect of different wage levels could be assessed and the point of inflection could be determined.

Finally, more targeted research of part-time nurses could be a way of highlighting the determinants of labor attachment in this population of nurses who could be most helpful in abating the nursing shortage. If special effort is made to understand part-time RNs, better interventions could be designed to motivate their labor attachment. This is an important pursuit because well targeted interventions are critical to insure nurse labor self-sufficiency in the U.S. Hence, maximizing the labor participation of the nurses already licensed and residing in California is an important pursuit to the equitable distribution of health care workers around the world.

Although this study has limitations, findings corroborate the conclusion drawn in previous studies (Brewer et al., 2006; Chiha & Link, 2003). Theoretical and analytical models need to be broadened in order to more fully represent the decisions made by the RN population about the number of hours worked. Findings from the two analytical strategies used in this study vary in magnitude, but they agree that wages have a neutral effect on the decision of how much to work once nurses are already employed in nursing.

# References


Abraham, K. G., & Farber, H. S. (1999). Job duration, seniority, and earnings. In O. Ashenfelter (Ed.), *Worth series in outstanding contributions: Labor economics* (pp. 133-161). New York: Worth.

Adamache, K. W., & Sloan, F. A. (1982). Unions and hospitals: some unresolved issues. *Journal Health Economics, 1*(1), 81-108.

Aiken, L. H. (1989). The hospital nursing shortage. A paradox of increasing supply and increasing vacancy rates. *West Journal of Medicine, 151*(1), 87-92.

Aiken, L. H., Buchan, J., Sochalski, J., Nichols, B., & Powell, M. (2004). Trends in international nurse migration. *Health Affairs, 23*(3), 69-77.

Aiken, L. H., Clarke, S. P., Cheung, R. B., Sloane, D. M., & Silber, J. H. (2003). Educational levels of hospital nurses and surgical patient mortality. *Journal of the American Medical Association, 290*(12), 1617-1623.

Aiken, L. H., Clarke, S. P., & Sloane, D. M. (2002a). Hospital, staffing, organization, and quality of care: Cross-national findings (Reprinted from International Journal for Quality in Health Care, vol 14, 2002). *Nursing Outlook, 50*(5), 187-194.

Aiken, L. H., Clarke, S. P., Sloane, D. M., Sochalski, J., & Silber, J. H. (2002b). Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *Jama-Journal of the American Medical Association, 288*(16), 1987-1993.

Aiken, L. H., & Mullinix, C. F. (1987). The nurse shortage. Myth or reality? *New England Journal of Medicine, 317*(10), 641-646.

Aiken, L. H., Sochalski, J., & Anderson, G. F. (1996). Downsizing the hospital nursing workforce. *Health Affairs, 15*(4), 88-92.

American Association of Colleges of Nursing. (2004). *Enrollment Increases at U.S. Nursing Schools Are Moderating While Thousands of Qualified Students Are Turned Away*. Retrieved April 14, 2006, from http://www.aacn.nche.edu/Media/newsreleases/enrl04.htm

American Nurses Credentialing Center. (2007, February 5, 2007). *What is the Magnet Recognition Program?* Retrieved May 10, 2007, from http://www.nursingworld.org/ancc/magnet/index.html

Antonazzo, E., Scott, A., Skatun, D., & Elliott, R. F. (2003). The labour market for nursing: A review of the labour supply literature. *Health Economics, 12*(6), 465-478.

Arrow, K. J., & Capron, W. M. (1959). Dynamic shortages and price rises: The engineer-scientist case. *Quarterly Journal of Economics, 73*(2), 292-308.

Ashenfelter, O., & Krueger, A. (1999). Estimates of the economic return to schooling from a new sample of twins. In O. Ashenfelter (Ed.), *Worth series in outstanding contributions: Labor economics* (pp. 90-110). New York: Worth.

Askildsen, J. E., Baltagi, B. H., & Holmas, T. H. (2003). Wage policy in the health care sector: a panel data analysis of nurses' labour supply. *Health Economics, 12*(9), 705-719.

Auerbach, D. I., Buerhaus, P. I., & Staiger, D. O. (2007). Better late than never: Workforce supply implications of late entry into nursing. *Health Affairs, 26*(1), 178-185.

Ault, D. E., & Rutman, G. L. (1994). On Selecting a Measure of Labor Activity - Evidence from Registered Nurses, 1981 and 1989. *Applied Economics, 26*(9), 851-863.

Bahrami, B. (1988). Hours of work offered by nurses. *Social Science Journal, 25*(3), 325-335.

Bauer, J. (2005). 2005 Earings survey: How does your pay stack up? *RN, 68*(10), 46-52.

Benham, L. (1971). The Labor Market for Registered Nurses: A Three-Equation Model. *The Review of Economics and Statistics, 53*, 246-252.

Bishop, C. E. (1973). Manpower Policy and Supply of Nurses. *Industrial Relations, 12*(1), 86-94.

Blank, D. M., & Stigler, G. J. (1957). *The demand and supply of scientific personnel*. New York: National Bureau of Economic Research.

Blegen, M. A. (1993). Nurses Job-Satisfaction - a Meta analysis of Related Variables. *Nursing Research, 42*(1), 36-41.

Blegen, M. A., Goode, C. J., & Reed, L. (1998). Nurse staffing and patient outcomes. *Nursing Research, 47*(1), 43-50.

Bognanno, M. F., Hixson, J. S., & Jeffers, J. R. (1974). Short-Run Supply of Nurses Time. *Journal of Human Resources, 9*(1), 80-94.

Bowles, C., & Candela, L. (2005). First job experiences of recent RN graduates: Improving the work environment. *Journal of Nursing Administration, 35*(3), 130-137.

Brewer, C. S. (1996). The roller coaster supply of registered nurses: lessons from the eighties. *Research in Nursing and Health, 19*(4), 345-357.

Brewer, C. S. (1998). The history and future of nursing labor research in a cost-control environment. *Research in Nursing and Health, 21*(2), 167-177.

Brewer, C. S., Kovner, C. T., Wu, Y.-W., Greene, W., Liu, Y., & Reimers, C. W. (2006). Factors influencing female registered nurses' work behavior. *Health Services Research, 41*(3p1), 860-866.

Buerhaus, P. I. (1991a). Dynamic shortages of registered nurses. *Nursing Economics, 9*(5), 317-328.

Buerhaus, P. I. (1991b). Economic determinants of annual hours worked by registered nurses. *Medical Care, 29*(12), 1181-1195.

Buerhaus, P. I. (1994). Price controls, health care reform, and new RN shortages. *Nursing Economics, 12*(6), 309-317.

Buerhaus, P. I., & Auerbach, D. (1999). Slow growth in the United States of the number of minorities in the RN workforce. *Image - the Journal of Nursing Scholarship, 31*(2), 179-183.

Buerhaus, P. I., Donelan, K., Norman, L., & Dittus, R. (2005a). Nursing students' perceptions of a career in nursing and impact of a national campaign designed to attract people into the nursing profession. *Journal of Professional Nursing, 21*(2), 75-83.

Buerhaus, P. I., Donelan, K., Ulrich, B. T., Kirby, L., Norman, L., & Dittus, R. (2005b). Registered nurses' perceptions of nursing. *Nursing Economics, 23*(3), 110-118, 143, 107.

Buerhaus, P. I., Donelan, K., Ulrich, B. T., Norman, L., & Dittus, R. (2005c). Is the shortage of hospital registered nurses getting better or worse? Findings from two recent national surveys of RNs. *Nursing Economics, 23*(2), 61-71, 96, 55.

Buerhaus, P. I., Needleman, J., Mattke, S., & Stewart, M. (2002). Strengthening hospital nursing. *Health Affairs (Millwood), 21*(5), 123-132.

Buerhaus, P. I., Staiger, D. O., & Auerbach, D. I. (2000). Implications of an aging registered nurse workforce. *Journal of the American Medical Association, 283*(22), 2948-2954.

Buerhaus, P. I., Staiger, D. O., & Auerbach, D. I. (2003). Is the current shortage of hospital nurses ending? *Health Affairs (Millwood), 22*(6), 191-198.

Buerhaus, P. I., Staiger, D. O., & Auerbach, D. I. (2004). New signs of a strengthening U.S. nurse labor market? *Health Affairs (Millwood), Suppl Web Exclusives*, W4-526-533.

Bureau of Labor Statistics. (2007). *Weekly and Hourly Earnings Data from Current Population Survey*. Retrieved January 28, 2007, from http://data.bls.gov/PDQ/servlet/SurveyOutputServlet

Butters, J. M., & Winter, P. A. (2002). Professional motivation and career plan differences between African-American and Caucasian dental students: implications for improving workforce diversity. *Journal of the National Medical Association, 94*(6), 492-504.

California Nurses Association (2005). *Represented Hospitals by Region.* Retrieved May 12, 2007 from http://www.calnurses.org/facilities-bargaining/hospitals-by-regions.html

Chapman, S. A., Dronsky, M., Newcomer, R. J., Harrington, C., & Grumbach, K. (2006). *An aging U.S. population and the health care workforce: Factors affecting the need for geriatric care workers.* (No. U79-HP0004): Health Resources and Services Administration.

Chiha, Y. A., & Link, C. R. (2003). The shortage of registered nurses and some new estimates of the effects of wages on registered nurses labor supply: a look at the past and a preview of the 21st century. *Health Policy, 64*(3), 349-375.

Cleland, V. S. (1990). *The Economics of Nursing*. Norwalk, CT.: Appleton & Lange.

Cleland, V. S., Forsey, L., & DeGroot, H. A. (1993). Computer simulations of the differentiated pay structure model. *Journal of Nursing Administration, 23*(3), 53-59.

Cordeniz, J. A. (2002). Recruitment, retention, and management of Generation X: A focus on nursing professionals. *Journal of Healthcare Management, 47*(4), 237-249.

Currie, J., Farsi, M., & Macleod, W. B. (2005). Cut to the bone? Hospital takeovers and nurse employment contracts. *Industrial and Labor Relations Review, 58*(3), 471-493.

Dixon, J. K. (1997). Grouping Techniques. In B. H. Munro (Ed.), *Statitical Methods for Health Care Research* (pp. 310-325). New York: Lippincott.

Ehrenberg, R. G., & Smith, R. S. (2006). *Modern Labor Economics: Theory and Public Policy* (9th ed.). Boston: Pearson Addison Wesley.

Estes, C., Harrington, C., & Pellow, D. N. (2001). Medical-Industrial Complex. In C. Estes & C. Harrington (Eds.), *Health policy: Crisis and reform in the U.S. health care delivery system* (3rd ed., pp. 136-148). Sudbury: Jones and Barlett.

Estes, C. L., & Linkins, K. W. (2001). Critical perspective on Health and Aging. In H. Estes (Ed.), *Health Policy: Crisis and Reform in U.S. Health Care Delivery System*.

Ezrati, J. (1987). Labor force participation of registered nurses. *Nursing Economics, 5*(2), 82-85, 89.

Fabbri, D., Monfardini, C., & Radice, R. (2004). *Testing exogeneity in the bivariate probit model: Monte Carlo evidence and an application to health economics.* Retrieved Aug 8, 2006, from http://amsacta.cib.unibo.it/archive/00001552/01/514_new.pdf

Farber, H. S. (2002). The analysis of union behavior. In O. Ashenfelter & R. Layard (Eds.), *Handbook of Labor Economics* (4th ed., Vol. II, pp. 1039-1089). San Francisco: Elsevier Science.

Fletcher, J., Guzley, R. M., Barnhill, J., & Philhour, D. (2004). *Survey of Registered Nurses in California*. Chico: California Board of Registered Nursing.

Freeman, R. B. (1999). Longitudinal analysis of the effects of trade unions. In O. Ashenfelter (Ed.), *Worth Series in Outstanding Contributions: Labor Economics*. New York: Worth.

Friss, L. (1994). Nursing studies laid end to end form a circle. *Journal of Health Politics, Policy and Law, 19*(3), 597-631.

Fuchs, V. R. (1988). *Women's quest for economic equality*. Cambridge: Harvard University Press.

Glantz, S., & Slinker, B. (2001). *Primer of Applied Regression and Analysis of Variance* (2nd ed.). New York: McGraw-Hill.

Gold, M. (2001). The changing U.S. health care system: Challenges for responsible public policy. In C. Harrington & C. L. Estes (Eds.), *Health Policy: Crisis and Reform in the U.S. Health Care Delivery System*.

Goldin, C. (1999). Monitoring costs and occupational segregation by sex: A historical analysis. In O. Ashenfelter (Ed.), *Worth series in outstanding contributions: Labor economics* (pp. 473-496). New York: Worth.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2004). *Survey Methodology*. Hoboken, NJ.: Wiley & Sons, Inc.

Grumbach, K., Ash, M., Seago, J. A., Spetz, J., & Coffman, J. (2001). Measuring shortages of hospital nurses: How do you know a hospital with a nursing shortage when you see one? *Medical Care Research and Review, 58*(4), 387-403.

Hamermesh, D. S. (1993). *Labor Demand*. Princeton, NJ.: Princeton University Press.

Harrison, J. P., & Lee, A. (2006). The role of E-health in the changing health care environment. *Nursing Economics, 24*(6), 283-288.

Hayes, L. J., O'Brien-Pallas, L., Duffield, C., Shamian, J., Buchan, J., Hughes, F., et al. (2006). Nurse turnover: A literature review. *International Journal of Nursing Studies, 43*(2), 237-263.

Health Resources and Services Administration. (2004). *Preliminary findings 2004 national sample survey of registered nurses*. Washington, DC: U.S. Department of Health and Human Services.

Health Resources and Services Administration. (2006). *The Registered Nurse Population: Findings from March 2004, National Sample Survey of Registeres Nurses*: Department of Health and Human Services.

Heilbroner, R. L. (1986). *The worldly philosophers: The lives, times and ideas of great economic thinkers*. New York: Simon & Schuster, Inc.

Hirsch, B. T., & Schumacher, E. J. (1995). Monopsony power and relative wages in the labor market for nurses. *J Health Econ, 14*(4), 443-476.

Hirsch, B. T., & Schumacher, E. J. (2005). Classic or new monopsony? Searching for evidence in nursing labor markets. *Journal of Health Economics, 24*(5), 969-989.

Holmas, T. H. (2002). Keeping nurses at work: A duration analysis. *Health Economics, 11*(6), 493-503.

Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D., Hearst, N., & Newman, T. B. (2001). *Designing Clinal Research*. Philadelphia: Lippincott.

Irvine, D. M., & Evans, M. G. (1995). Job satisfaction and turnover among nurses: Integrating research findings across studies. *Nursing Research, 44*(4), 246-253.

Janssen, P. P. M., de Jonge, J., & Bakker, A. B. (1999). Specific determinants of intrinsic work motivation, burnout and turnover intentions: a study among nurses. *Journal of Advanced Nursing, 29*(6), 1360-1369.

Jones, C. B. (1990). Staff Nurse Turnover Costs .2. Measurements and Results. *Journal of Nursing Administration, 20*(5), 27-32.

Jones, C. B. (2005). The costs of nurse turnover, part 2: application of the Nursing Turnover Cost Calculation Methodology. *Journal of Nursing Administration, 35*(1), 41-49.

Jones, C. B., & Gates, M. (2004a). Gender-based wage differentials in a predominantly female profession: observations from nursing. *Economics of Education Review, 23*(6), 615-631.

Jones, C.-B., & Gates, M. (2004b). Gender-Based Wage Differentials in a Predominantly Female Profession: Observations from Nursing. *Economics of Education Review, 23*(6), 615-631.

Jovanovic, B. (1999). Job matching and turnover. In O. Ashenfelter (Ed.), *Worth series in outstanding contributions: Labor economics* (pp. 113-132). New York: Worth.

Kennedy, P. (2003). *A guide to econometrics* (5th ed.). Malden MA.: Backwell.

Keynes, J. (1924/2000). *A Tract on Monetary Reform*. New York: Prometheus Books.

Killingsworth, M. R., & Heckman, J. (1986). Female labor supply: A survey. In O. C. Ashenfelter & R. Layard (Eds.), *Handbook of Labor Economics* (Vol. 1, pp. 103-204). New York: North-Holland.

Kovner, C., Stave, C. M., Lavelle, K., & Ferrara, E. (1994). An analysis of vacancy rates, turnover, and wages among nursing occupations in New York state hospitals, nursing homes, and diagnostic and treatment facilities. *Journal of the New York State Nurses Association, 25*(3), 20-27.

Lankshear, A. J., Sheldon, T. A., & Maynard, A. (2005). Nurse staffing and healthcare outcomes - A systematic review of the international research evidence. *Advances in Nursing Science, 28*(2), 163-174.

Lewis, G. H. (2002). Union relative wage effects. In O. C. Ashenfelter & R. Layard (Eds.), *Handbook of Labor Economics* (4th ed., Vol. II, pp. 1139-1181). San Francisco: Elsevier.

Link, C. R. (1985). Labor supply responses of licensed practical nurses: A partial solution to a nurse shortage? *Journal of Economic Business, 37*(1), 49-57.

Link, C. R., & Settle, R. (1980a). Financial Incentive and Labor Supply of Married Professional Nurses. *Nursing Research, 29*(4), 238-243.

Link, C. R., & Settle, R. F. (1980b). Financial incentive and labor supply of married professional nurses: an economic analysis. *Nursing Research, 29*(4), 238-243.

Link, C. R., & Settle, R. F. (1981). Wage incentives and married professional nurses: a case of backward-bending supply? *Economic Inquiry, 19*(1), 144-156.

Luke, R. D., & Walston, S. L. (2003). Strategy in an Institutional Environment: Lessons Learned from the 1990s "Revolution" in Health Care. In S. S. Mick & M. E. Wyttenbach (Eds.), *Advances in Health Care Organization Theory* (pp. 289-323). San Francisco: Jossey-Bass.

MaCurdy, T., Mroz, T., & Gritz, R. M. (1998). An evaluation of the national longitudinal survey on youth. *Journal of Human Resources, 33*(2), 345-436.

Marmor, T. R. (2000). *The Politics of Medicare.* (2nd ed.). New York: Aldine de Guyter.

Marx, K., & Engels, F. (1848/1998). *The Communist Manifesto*: Signet Classic.

Morbidity and Mortality Weekly Report. (2003, February). *Public health and aging: Trends in aging - United States and worldwide.* Retrieved June 18, 2003, from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5206a2.htm

Murray, M. P. (2005). The bad, the weak and the ugly: Avoiding the pitfalls of instrumental variables estimation.

Norman, L. D., Donelan, K., Buerhaus, P. I., Willis, G., Williams, M., Ulrich, B., et al. (2005). The older nurse in the workplace: does age matter? *Nursing Economics, 23*(6), 282-289, 279.

Norusis, M. J. (2004). SPSS 13.0 Guide ti Data Analysis. Chicago: Prentice Hall.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*. New York: McGraw-Hill

Paul, S. M. (1994). Computer Support for Power Analysis in Nursing Research. In S. J. Grobe & E. S. P. Pluyter-Wenting (Eds.), *Nursing Informatics: An International Overview for Nursing in a Technological Era* (pp. 491-494). Amsterdam: Elsevier.

Pencavel, J. (1986). Labor Supply of Men: A Survey. In O. Ashenfelter & R. Layard (Eds.), *Handbook of Labor Economics* (Vol. 1, pp. 3-102). New York: North-Holland.

Phillips, V. L. (1995). Nurses' labor supply: participation, hours of work, and discontinuities in the supply function. *Journal of Health Economics, 14*(5), 567-582.

Polit, D. F. (1996). *Data analysis and statistics for nursing research*. Upper Saddle River, NJ.: Prentice Hall.

Polit, D. F., & Hungler, B. P. (1999). *Nursing research: Principles and methods*. Philadelphia: Lippincott.

Price, J. L., & Mueller, C. W. (1981). A causal model for turnover for nurses. *Academy of Management Journal, 24*(3), 543-565.

Rogers, A. E., Hwang, W. T., Scott, L. D., Aiken, L. H., & Dinges, D. F. (2004). The working hours of hospital staff nurses and patient safety. *Health Affairs (Millwood), 23*(4), 202-212.

Saba, V. K., & McCormick, K. A. (2006). Overview of Computers and Nursing. In V. K. Saba & K. A. McCormick (Eds.), *Essentials of nursing informatics* (4th ed., pp. 3-8). New York: McGraw-Hill.

Scott, J. G., Sochalski, J., & Aiken, L. (1999). Review of magnet hospital research: Findings and implications for professional nursing practice. *Journal of Nursing Administration, 29*(1), 9-19.

Seago, J. A. (2002). Registered nurse unions and patient outcomes - Reply. *Journal of Nursing Administration, 32*(9), 439-439.

Seago, J. A., & Ash, M. (2002). Registered nurse unions and patient outcomes. *Journal of Nursing Administration, 32*(3), 143-151.

Seago, J. A., Ash, M., Spetz, J., Coffman, J., & Grumbach, K. (2001). Hospital registered nurse shortages: Environmental, patient, and institutional predictors. *Health Services Research, 36*(5), 831-852.

Seago, J. A., & Spetz, J. (2002). Registered nurse pre-licensure education in California. *Nursing Economics, 20*(3), 113-117, 125.

Seago, J. A., Spetz, J., Alvarado, A., Keane, D., & Grumbach, K. (2006a). The nursing shortage: Is it really about image? *Journal of Healthcare Management, 51*(2), 96-108.

Seago, J. A., Spetz, J., Coffman, J., Rosenoff, E., & O'Neil, E. (2003). Minimum staffing ratios: the California workforce initiative survey. *Nursing Economics, 21*(2), 65-70.

Seago, J. A., Spetz, J., & Mitchell, S. (2004). Nurse staffing and hospital ownership in California. *Journal of Nursing Administration, 34*(5), 228-237.

Seago, J. A., Williamson, A., & Atwood, C. (2006b). Longitudinal analyses of nurse staffing and patient outcomes - More about failure to rescue. *Journal of Nursing Administration, 36*(1), 13-21.

Shader, K., Broome, M. E., Broome, C. D., West, M. E., & Nash, M. (2001). Factors influencing satisfaction and anticipated turnover for nurses in an academic medical center. *Journal of Nursing Administration, 31*(4), 210-216.

Shortell, S. M., Gillis, R. R., Anderson, D. A., Erickson, K. M., & Mitchell, J. B. (2000). *Remaking Health Care in America: The Evolution of Organized Delivery Systems* (2nd ed.). San Francisco: Jossey-Bass.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurence*. Oxford: Oxford University Press.

Skatun, D., Antonazzo, E., Scott, A., & Elliott, R. F. (2005). The supply of qualified nurses: a classical model of labour supply. *Applied Economics, 37*(1), 57-65.

Sloan, F. A., & Richupan, S. (1975). Short-Run Supply Responses of Professional Nurses - Microanalysis. *Journal of Human Resources, 10*(2), 241-257.

Smith, A. (1776/1994). *The Wealth of Nations*. New York: Random House.

Sochalski, J. (2002). Nursing shortage redux: Turning the corner on an enduring problem. *Health Affairs, 21*(5), 157-164.

Sochalski, J., Aiken, L. H., & Fagin, C. M. (1997). Hospital restructuring in the United States, Canada, and Western Europe: an outcomes research agenda. *Medical Care, 35*(10 Suppl), OS13-25.

Spetz, J. (1998). Hospital employment of nursing personnel. Has there really been a decline? *Journal of Nursing Administration, 28*(3), 20-27.

Spetz, J. (1999). The effects of managed care and prospective payment on the demand for hospital nurses: Evidence from California. *Health Services Research, 34*(5), 993-1010.

Spetz, J. (2000). Hospital use of nursing personnel - Holding steady through the 1990s. *Journal of Nursing Administration, 30*(7-8), 344-346.

Spetz, J. (2002). The value of education in a licensed profession: The choice of associate or baccalaureate degrees in nursing. *Economics of Education Review, 21*, 73-85.

Spetz, J. (2004). Hospital nurse wages and staffing, 1977 to 2002 - Cycles of shortage and surplus. *Journal of Nursing Administration, 34*(9), 415-422.

Spetz, J., & Adams, S. (2006). How can employment-based benefits help the nurse shortage? *Health Affairs, 25*(1), 212-218.

Spetz, J., & Dyer, W. (2005). *Forecasts of the Registered Nurse Workforce in California*. Sacramento: California Board of Registered Nursing.

Spotalia, J. T. (2000). *Notice of decision: Standards for defining metropolitan and micropolitical statistical areas* (No. 82228): Office of Management and Budget.

Stata Corp. (2007). Stata help for Stata. College Station, TX: Stata Corp.

Tai, T. W. C., Bame, S. I., & Robinson, C. D. (1998). Review of nursing turnover research, 1977-1996. *Social Science & Medicine, 47*(12), 1905-1924.

Topel, R. (1999). Specific capital, mobility, and wages: Wage rise with job security. In O. Ashenfelter (Ed.), *Worth series in outstanding contributions: Labor economics* (pp. 162-190). New York: Worth.

Ulrich, B. T., Buerhaus, P. I., Donelan, K., Norman, L., & Dittus, R. (2005). How RNs view the work environment: Results of a national survey of registered nurses. *Journal of Nursing Administration, 35*(9), 389-396.

U.S. Department of Health and Human Services. (2003). *Changing demographics: Implications for physicians, nurses and other health care workers*. Washington DC: Health Resources and Services Administration, National Center for Health Workforce Analysis.

Willis, R. J., & Rosen, S. (1999). Education and Self-Selection. In O. Ashenfelter (Ed.), *Worth series in outstanding contributions: Labor economics* (pp. 1-30). New York: Worth.

Yett, D. E. (1970). Causes and Consequences of Salary Differentials in Nursing. *Inquiry, 7*(1), 78-99.

Yett, D. E. (1975). *An economic analysis of the nurse shortage*. Lexington, MA.: Lexington Books.

# Appendices

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| 1. Ault, D. E., & Rutman, G. L. (1994). On selecting a measure of labor activity: Evidence from registered nurses, 1981 and 1989. *Applied Economics, 26*(9), 851-863. | What measures of labor participation best measure the effect of wages on hours?<br><br>Mailed questionnaire to N=2356 RNs in Chicago, St. Louis and Kansas City<br>1981 and 1988<br>Only females<br><br>Heckman<br>Probit | DV:<br>- Annual hours worked<br>- Hours worked per week<br>- Weeks worked per year<br>IV:<br>- Age<br>- Children at home<br>- Ages of children<br>- Marital status<br>- Level of education<br>- Years worked since licensure<br>- Spouse employment<br>- Other income<br>- | For 1981 E=0.39<br>For 1988 E=0.24<br><br>But once controlled for heterogeneity, no effect<br><br>All three measures are equivalent | Low response rate<br>No validity or reliability of the questionnaire provided |
| 2. Bahrami, B. (1988). Hours of work offered by nurses. *Social Science Journal, 25*(3), 325-335. | What are the factors the influence the number of hours RNs offer in the labor market?<br><br>Mailed questionnaire to 644 random female nurses from Nebraska in 1982<br>N= 325<br><br>Tested the Arrow-Capron model of dynamic equilibrium vs. the Archibald Model of monopsony | DV:<br>- RN hours<br>IV:<br>- Marital status<br>- Employment status<br>- FT or PT<br>- Age<br>- Level of education<br>- Location of employment<br>- Wage<br>- Yrs of active service<br>- Number of children<br>- Age of the children<br>- Race<br>- Relative wage index in comparison to wages of teachers in the region<br>- Satisfaction with work | Elasticity = 0.40 at the mean but elasticity was not a linear function.<br><br>$R^2 = 0.36$, wage was sign at $p<0.01$<br><br>Other variables:<br>Experience =(+) non-sign<br>Other income = (-) and sign<br>Children <6 = (-) and sign<br>Wages was affected by regional and institutional characteristics<br><br>Younger more likely to work<br>There were indications of a backward bending labor | Very low response rate.<br><br>Nice discussion of marginal utility of work and leisure. Used the concept of family utility function for the married females.<br><br>Claim to be first to include family and institutional factors into the equations. But no spousal income was included anywhere!<br><br>Findings suggest that nurses are relatively responsive to wage increases. |

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| | | relationships<br>- Level of autonomy<br>- Presence of a professional ladder | supply. | E = 0.40 means a 10% increase in wages will increase the number of hours worked by the average nurse by 4% each week. |
| 3. Brewer, C. S. (1996). The roller coaster supply of registered nurses: lessons from the eighties. *Research in Nursing and Health, 19*(4), 345-357. | What are the labor supply responses of nurses in different economic environments: 1984 (no shortage) and 1988 (shortage)<br><br>Hyp 1: slope of labor supply is equal for both years<br>Hyp 2: slope will not be equal for males and females<br>Hyp 3: slope not backward bending<br><br>National Sample Survey of Nurses for 1984-1988 All RN in US, working or not, under 65 yr of age.<br><br>1984 N= 28,790<br>1988 N= 30,208<br>N=4,025 random selection from the 1984 sample was used to | DV:<br>- Working or not<br>- Annual hrs worked for 1st and 2nd jobs<br>IV:<br>- Wage categories<br>- Instrumental wage cat<br>- Age<br>- Gender<br>- Marital status<br>- Children at home<br>- Other family income<br>- Race<br>- Level of education<br>- Current student status<br>- # of jobs<br>- Work status (PT/FT)<br>- Mandatory CE state | Adjusted $R^2$ ranged from 0.17 for males in 1988 to 0.28 for females for both years<br><br>Hyp 1: The slope for males did not change over the 2 periods but for females it did. Males are less elastic than females. Confirmed by Chow Test, sign for females but not males.<br><br>Elasticity not linear, changed over the wage categories<br><br>In 1984 at the mean wage a 10% increase would increase hrs worked on the female nurse by 13.5%. In 1988 the # hrs worked would increase by 14.5%. Both $p<0.05$<br><br>For males, in 1984 E =0.85 and in 1988 E=0.26 non-sign<br><br>Hyp 2: There were different | Definition of elasticity, backward bending supply (extreme inelasticity).<br><br>Elasticity formula: (Beta/Wage cat) x (mean wage/mean hrs) pg 351.<br><br>Health status, job satisfaction not included as explanatory var. Included number of jobs and student status<br>Small sample of males, so not generalizable to all males.<br><br>Elasticities were calculated based on all female and male nurses, could be further calculated accounting for marital status, children at home, region, race, age, etc…<br><br>Although slopes changed btw the yrs, there was much |

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| | validate the model prior to testing it in the rest of the sample.<br><br>1st Model used OLS to analyze the selection of the number of hours worked<br>2nd Model used Logistic to analyze the probabilities of working PT, FT or not working (only intercepts changed)<br><br>Chow test to find differences in slopes | | btw males and females. Females were more affected by: children, family income, student status, race and wages. But males also by fam income or FT student.<br><br>Hyp 3: That was no backward bending labor supply, except for females at the highest salaries for 1984.<br><br>Other:<br>Participation rates changed by 2.2 % (more FT) and 0.3% (less PT) for women<br>2% more working | that changed as far as nurses were concerned except their level of education, which increased.<br><br>The economy and institutional characteristics (non-wage incentives) seemed to be an important determinate, not included here.<br><br>Backward bend may only exist in the presence of shortage- wage response is not constant.<br><br>States w/ mandatory CE for renewing licenses makes that only those interested in working would incur the costs, which could create a selection bias. This variable may represent structural differences btw the states<br><br>Important to learn more about the variables that affect male nurses, which seem to be different to female nurses. Additionally, understanding what affect PT nurses is important for they are the ones with flexibility in hours. |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
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| | | | | Important to learn about the effect of a second job. To measure wages directly instead of through estimates. Couldn't find out if wage compression was also an important factor from these data. Would have been useful to have more institutional data (size, ownership, benefit packages, scheduling systems) |
| 4. Brewer, C. S., Kovner, C. T., Wu, Y.-W., Greene, W., Liu, Y., & Reimers, C. W. (2006). Factors influencing female registered nurses' work behavior. *Health Services Research, 41*(3p1), 860-866. | What are the factors that affect a RN's decision to work and how much to work?<br><br>National Sample Survey of RN 2000, individual level info N= 35,579 and the InterStudy Competitive Edge Part III Regional Market Analysis (2001), MSA level data, and the Area Resource File (2002).<br><br>N=25,741 female RNs, 21,007 working in RN and 4,464 not.<br>Males were excluded because diff explanatory | DV:<br>- Working in RN or not<br>- Working FT/PT<br><br>IV:<br>- Annual salary from 1st and 2nd jobs categorized<br>- Total household income<br>- FT or PT<br>- Work setting<br>- Job satisfaction<br>- Position held<br>- Med-surg /100,000 pop<br>- Primary care/100,000 pop<br>- HMO penetration rate<br>- Insurance/Medicaid rate<br>- Poverty rate<br>- Unemployment rate<br>- MSA size<br>- Region of the country | Working as RN is RELATED TO working PT/FT.<br>Other family income, age (> 55), other work exp in health care are (-) related to working<br><br>Wage does not affect decision to work but (+) affects decision to work PT or FT.<br><br>Work FT is (-) related to wage, age, children, minority, student status, employment, other income, work setting, and low job satisfaction. | Included market, job and individual characteristics<br><br>Equation for FT/PT are corrected for selectivity bias<br>Market factors (regional and institutional characteristics) affect more the decision to work FT/PT than to work or not.<br><br>MSA variable are very important and have different impact on married vs single<br><br>Wages may be an important policy tool to attract people into nursing<br><br>Nice explanation of the |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| | variables<br><br>Cross-sectional design, Used reduced-form to create a wage equation then bivariate probit model for the condition of working or not | - Age<br>- Race<br>- Children at home<br>- Marital status<br>- Level of education<br>- Previously LPN<br>- Years since graduation | Effects on WK/NW:<br>% HMO and # of specialist per 100,000 (+), large (-) effect of age over 55and married on decision to work. Children under 6 (-), older children no effect<br><br>Effects on FT/PT:<br>All market level variables were sig in this decision for married RNs, several to single RNs.<br>(-) # of primary care/100,000, but specialist had a (+) effect, unemployment and uninsured (+), % of HMO (+).<br><br>Likelihood of FT decreases as wage increases, supporting backward bending for married only.<br><br>Non-whites, no kids, and higher edu are more likely to wk FT.<br><br>Job satisfaction has small effect, | model specifications<br>Good explanation as to how she manipulated the wage cat<br>Used predicted wage squares to examine backward bending labor supply.<br><br>Marginal effects = coefficients for the probit change from 0 to 1 (from not-working to working)<br><br>Interpretation of marginal effect from probit equations: a coefficient of -0.25 for nurses over 65 yrs of age means they are 25% points less likely to work than the reference group. So if the probability of working is 0.6 for a nurse 25 yrs old, than the probability of a nurse age 65 is 25points less, which is 0.35.<br><br>Limitations: job-related variables and endogeneity, need instrumental var. Satisfaction as compared to last year question and FT/PT. MSA and HMO does not account to all env var and are difficult to |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| | | | | interpret. |
| 5. Buerhaus, P. I. (1991). Economic determinants of annual hours worked by registered nurses. *Medical Care, 29*(12), 1181-1195. | What is the effect of socio-demographic and economic variables on the number of hours worked by RNs?<br><br>What is the wage elasticity of supply for RNs?<br><br>Is there backward bending in the labor supply in respect to wages?<br><br>Are there differences in the number of hours work attributed to age, gender, presence of children and educational level?<br><br>NSSPRN, Nov 1984<br>N= 16,880 RNs who spent more than 50% in direct pt care, working in the 50 states and DC<br><br>OLS,<br>Stepwise multiple regression analysis<br>Instrumental variables | DV:<br>- Hours worked per week<br><br>IV:<br>- Hourly wage<br>- Total family income<br>- Race<br>- Marital status<br>- Age categories<br>- Children at home<br>- Age of children<br>- Credentials<br>- Educational level<br>- Enrollment in school<br>- Position title<br>- Work setting<br>- MSA<br>- Region of the country<br>- Location of education<br>- Collective bargaining agreement | Model $R^2 = 0.06$ to 0.14<br><br>Marital status, gender education, race, other family income and children at home under the age of 5 have a significant negative effect on the number of hours worked<br><br>The effect of wages on hours worked for the entire sample was 75.27, meaning that a $1 increase in the hourly wages would increase annual hrs worked by 75 hrs (2 wks).<br><br>Wage elasticity for the sample was estimated to be 0.49, which means that at the mean a 10% increase in wages would lead to a 4.9% increase in annual hrs worked.<br><br>Different values were obtained when population was divided into groups.<br><br>Unmarried RNs worked more than others, 0.89 elasticity.<br><br>Men, non-whites, lower edu worked more Hrs. | Overview of the economic theory of decision to work. Description of utility maximization and substitutions<br><br>Backward bending nursing supply is explored.<br><br>Wages were not directly observed and needed to be calculated indirectly based on annual earnings and annual hrs worked. Since these were estimates, they introducing error.<br><br>Correlation btw predicted wage (IV) and number of hours worked, even though SD of IV was small. This implies that this model under-estimates the effect of true wages on hrs.<br><br>Should have used direct measures of RN wages.<br><br>Detailed discussion and calculation of the effects of wage in different segments of the RN population number of hours worked. |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| | He divided the sample based on marital status and calculated wage eq for each of them. | | Married with kids worked least. Childcare facilities could help<br>RN's age affected # of hrs negatively | Author discuss the increases in wages in the 3 years before the survey, stating that wages were increase substantially while unemployment was high with recession in 1981<br><br>Other important factors to consider, not included here are other income sources, unemployment rates, Latinas, job satisfaction information, institutional variables |
| 6. Chiha, Y. A., & Link, C. R. (2003). The shortage of registered nurses and some new estimates of the effects of wages on registered nurses labor supply: a look at the past and a preview of the 21st century. *Health Policy, 64*(3), 349-375. | What is the effect of wages on the RN labor supply from 1960 to 2000.<br><br>NSSRN from 1992, 1996 and 2000 N= 76,625<br>Addition re-calculation and critiques of previous surveys, gathering information since 1960.<br><br>Heckman model, Maximum likelihood estimates<br>OLS<br>Inverse Mills ratios | DV<br>- Yearly # of hr worked<br>- Choice of participation<br><br>IV:<br>- Inflation adjusted hr wages (calculated using maximum likelihood) and then predicted wages were calculated for all nurses.<br>- Family income<br>- Gender<br>- Marital status<br>- Age<br>- Race<br>- Level of education | RN's own wage is not as important as in labor participation and number of hrs worked but important for decision of entering the profession.<br><br>Issues of collenearity when use the same variables in the 2 related equations | Data from 1960 to 2000. Very thorough theoretical explanation of the concepts, especially of family income in the female workforce, estimation strategies<br><br>Review many articles<br><br>Critique the previous lit based on the assumption of the Tobit Models – they had combined the decision to work and the decision to work a certain number of hours in the same equation – they must be separated |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| | | - Location of edu<br>- Presence of children<br>- Yr since graduation<br>- Previously an LVN<br>- Region of residence<br>- MSA<br>- # MD/100,000 pop<br>- Manufacturing wages in the state<br>- # of labor force unionized | | into 2 equations this way the variable coefficients are not constrained to be the same in both equations<br><br>Previous studies have not considered the selection bias – dealing with the endogeity of wages when you only study presently working nurses.<br>Best articles used the Heckman model that includes unobserved variables that affect the decision to work and no-work as well as the number of hours worked. |
| 7. Link, C. R., & Settle, R. F. (1980). Financial incentive and labor supply of married professional nurses: an economic analysis. *Nursing Research, 29*(4), 238-243. | What is the effect of wages in the number hrs worked by the present stock of female married RNs?<br><br>1-in-100 U.S. Census 1970 data<br><br>N= n/a<br><br>Pop – female, married RNs and LVN living in MSA. Active and inactive RNs | DV<br>- Annual hours worked<br><br>IV<br>- Estimated RN hourly earnings<br>- Spouse's earnings<br>- Family wealth<br>- Her productivity as a mother and wife<br>- Family attitude toward wife working<br>- Number of children and their ages<br>- Foreign born or nat'l | All the sub-groups except for one showed non-significant wage effects or a neg effect for wages.<br><br>For whites <25 yrs old, the effect = 0.23. An increase of 10% in after tax-wages would increase annual hrs worked by 2.3%).<br><br>Non-wage income had an effect of -0.008 to -0.16 (greater effect on older RNs) | Start with a review of previous work done on wage elasticity, critiquing articles previous to 1980. Some just survey RN opinions and could not measure the actual effect of wages on the # of hrs worked. Some were based on aggregate data that lacked many of the key variables. Some used appropriate variables (individual) but not always the right methods. Results |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| | Tobit with Maximum Likelihood procedure (non-linear effects)<br><br>t-test comparing wage variables among the sub-groups | - Husband working or not<br>- RN disable or not<br>- # of yr of RN edu<br>- Region of the country<br>- Race | Most RNs were induced to work less hrs = backward bending labor supply<br><br>Husband's income has an effect of -0.5 to -1.7<br><br>Young children and disability had neg effects.<br><br>RNs worked more hrs in the South<br><br>Place of birth and edu level had no effect | did not agree.<br><br>Census had not differentiated btw LVNs and RNs, but researcher feels that both groups respond similarly and results will not be compromised<br><br>Found that wages lowered the number of Hrs RNs work<br><br>Wages and non-wage income are adjusted to reflect taxes<br><br>Author finds that increasing wages is not an effective way to induce greater number of hrs worked. In fact increasing RN supply and childcare are better measures. |
| 8. Link, C. R., & Settle, R. F. (1981). Wage incentives and married professional nurses: a case of backward-bending supply? *Economic Inquiry, 19*(1), 144-156. | What is the wage elasticity for married nurses?<br><br>1-in-100 U.S. Census 1970<br>N=5,000 female married RNs and LVNs residing | DV<br>- Annual hours worked<br><br>IV<br>- Estimated RN hourly earnings<br>- Estimated Spouse's earnings | Wages are not good motivators for increasing the number of hours worked – backward bending supply of labor particularly for whites<br><br>The wage that leads to bend can be tested. Equations are | Review the lit. Pointing out much disagreement as to the elasticity of the nurse supply and the study's shortcomings.<br><br>Good explanation of the Tobit function as a non- |

| Author, Year, Title & Journal | Hypothesis, Data, Sample & Analysis | Variables | Findings | Comments |
|---|---|---|---|---|
| | in one of the MSA.<br><br>Sample was partitioned into groups by age (groups of 10 yrs) and race (whites/non-whites)<br><br>Chow test<br>Tobit, a maximum likelihood estimate, useful when the error terms of the parameter estimates are truncated normal<br>Instrumental variables to predict the wages for all RNs and their husbands<br>Step functions for wages | - Family wealth<br>- Her productivity as a mother and wife<br>- Family attitude toward wife working<br>- Number of children and their ages<br>- Foreign born or nat'l<br>- Husband working or not<br>- RN disable or not<br>- # of yr of RN edu<br>- Region of the country<br>- Race<br>- | on the text. That is the wage interval that yields the largest positive coefficient.<br><br>Neg relationship btw husband's income and labor participation | linear function, which the coefficient is the result for the mean values for all the variables. Hence variations would require additional analysis<br><br>Labor participation rates at this time were around 30% for the general female pop but higher for non-whites |

# Appendix B – California BRN Survey 2004

## 2003 Survey of Registered Nurses

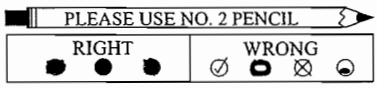
Thank you for agreeing to complete this survey on issues that affect nursing in California. These first few questions ask your opinions about your most recent employment in nursing.

**Even if you are not currently employed in nursing, please complete Section I.**

## SECTION I: OPINIONS ABOUT YOUR MOST RECENT NURSING POSITION

**1. The following items have been identified as factors that can make nursing rewarding or unrewarding. Please rate your level of satisfaction or dissatisfaction with each factor during your most recent work experience by marking the appropriate circle.**

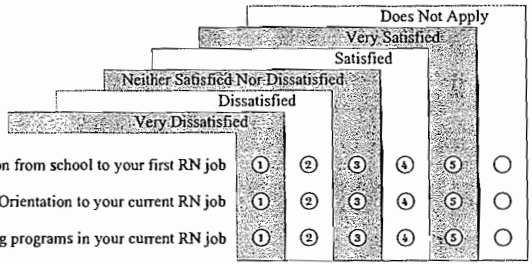
*Please fill in the circle that best describes your beliefs or feelings using the scale to the right. Please use a No. 2 pencil. Thank you!*




| | Very Dissatisfied | Dissatisfied | Neither Satisfied Nor Dissatisfied | Satisfied | Very Satisfied | Does Not Apply |
|---|---|---|---|---|---|---|
| a. Your starting salary | 1 | 2 | 3 | 4 | 5 | ○ |
| b. Salary range for your position | 1 | 2 | 3 | 4 | 5 | ○ |
| c. Employee benefits | 1 | 2 | 3 | 4 | 5 | ○ |
| d. Skill of RNs where you work | 1 | 2 | 3 | 4 | 5 | ○ |
| e. Adequacy of RN staffing where you work | 1 | 2 | 3 | 4 | 5 | ○ |
| f. Adequacy of clerical support services | 1 | 2 | 3 | 4 | 5 | ○ |
| g. Non-nursing tasks required (housekeeping, lab, transportation) | 1 | 2 | 3 | 4 | 5 | ○ |
| h. Amount of paperwork required | 1 | 2 | 3 | 4 | 5 | ○ |
| i. Physical work environment | 1 | 2 | 3 | 4 | 5 | ○ |
| j. Work schedule | 1 | 2 | 3 | 4 | 5 | ○ |
| k. Job security | 1 | 2 | 3 | 4 | 5 | ○ |
| l. Opportunities for advancement | 1 | 2 | 3 | 4 | 5 | ○ |
| m. Support from nurses with whom you work | 1 | 2 | 3 | 4 | 5 | ○ |
| n. Support from your nursing administration | 1 | 2 | 3 | 4 | 5 | ○ |
| o. Relations with physicians | 1 | 2 | 3 | 4 | 5 | ○ |
| p. Relations with other non-nursing staff | 1 | 2 | 3 | 4 | 5 | ○ |
| q. Relations with temporary agency/traveling agency/registry staff | 1 | 2 | 3 | 4 | 5 | ○ |
| r. Interaction with patients | 1 | 2 | 3 | 4 | 5 | ○ |
| s. Time available for patient education | 1 | 2 | 3 | 4 | 5 | ○ |
| t. Involvement in policy and management decisions | 1 | 2 | 3 | 4 | 5 | ○ |
| u. Opportunities to use your skills | 1 | 2 | 3 | 4 | 5 | ○ |
| v. Opportunities to learn new skills | 1 | 2 | 3 | 4 | 5 | ○ |
| w. Opportunities at work for CE courses, tuition reimbursement for degrees | 1 | 2 | 3 | 4 | 5 | ○ |
| x. Quality of patient care where you work | 1 | 2 | 3 | 4 | 5 | ○ |
| y. Feeling that work is meaningful | 1 | 2 | 3 | 4 | 5 | ○ |
| z. Your job overall | 1 | 2 | 3 | 4 | 5 | ○ |
| aa. Other (please describe)_____ | 1 | 2 | 3 | 4 | 5 | ○ |

Continued →

2. **Now, please rate your personal level of satisfaction or dissatisfaction with the following items.**




*****IMPORTANT*****

**Before proceeding, please respond to the following question.**

3. **Are you currently employed in nursing? You should answer "yes" if you are now working in nursing, even if it is only part-time, and then answer the questions in Section II below. If you are NOT currently employed in nursing, please skip to Section III.**

◯ No (Skip to Section III)
◯ Yes (Continue with Section II, question 4)

## SECTION II: FOR NURSES EMPLOYED IN NURSING

(Including those employed part-time)

***These next few questions ask about the amount of time you are employed, the kinds of work you do, and the places where you practice.***

4. How many hours a day do you usually work as a registered nurse? _____

5. How many hours a week do you usually work as a registered nurse? _____

6. How many hours per week do you usually work mandatory overtime as a registered nurse? _____

7. How frequently do you work longer than 12 consecutive hours in nursing? This could be with one or more employers.

_____ times a month.

8. Do you currently hold more than one nursing position? ("Position" refers to more than one employer, job title, classification, or being self-employed.)

◯ No
◯ Yes. Please write in the number of nursing positions you currently hold: _____

9. How long have you been employed in the current nursing position which requires the greatest number of hours per month?

_____Years_____Months

10. Have any of your nursing employers changed your time base (number of hours worked per pay period) within the last 12 months?

◯ No, no change to time base
◯ Yes, laid off
◯ Yes, reduced hours worked
◯ Yes, increased hours worked
◯ Yes, other (please describe) _____

11. Are you currently employed in any nursing position through a temporary agency, traveling agency, or registry?

◯ No (Skip to question 18)
◯ Yes (continue with question 12)

**********

***Questions 12-17 are for RNs who are employed by temporary or traveling agencies or registries.***

**********

12. With which of the following are you currently employed? **Please mark all that apply:**

◯ Temporary Agency
◯ Traveling Agency
◯ Registry

13. Is the temporary agency, traveling agency, or registry located in California or another state?

◯ California
◯ Another State(s)

Names(s) of Other State(s) _____

14. Please indicate which of the following reasons describe why you work for a temporary agency, traveling agency, or registry. **Mark all that apply.**

- ◯ Wages
- ◯ Benefits
- ◯ Control of schedule
- ◯ Control of work location
- ◯ Control of work conditions
- ◯ Supplemental income
- ◯ Maintain skills/get experience
- ◯ Waiting for a desirable permanent position
- ◯ Other (please describe)_____

15. If you work for a temporary or traveling agency or registry, who primarily orients you to a new facility assignment? **Mark all that apply.**

- ◯ Temporary agency, traveling agency, or registry
- ◯ Employing facility (formal)
- ◯ Unit staff only (informal)
- ◯ No orientation
- ◯ Other_____

16. As a temporary, traveling, or registry RN, in general, how would you rate your orientation to a new facility assignment?

- ◯ Excellent
- ◯ Adequate
- ◯ Needed some improvement
- ◯ Unacceptable

17. If you work for a temporary or traveling agency or registry, in general, how are you accepted by facility employed RNs?

- ◯ Fully accepted
- ◯ Somewhat accepted
- ◯ Not accepted

**********

***These next few questions ask about your current employment duties.***

**********

18. Please mark the job title that best describes the nursing position in which you spend the greatest number of hours per month. **Mark only one.**

- ◯ Senior management, service setting (Vice President, Healthcare Administrator, Nursing Executive, Administrator, Asst. Administrator, etc.)
- ◯ Middle management, service setting (Nursing House Supervisor, Nurse Manager, Head Nurse, Nurse Director)
- ◯ First-line management (Assistant Nurse Manager, Charge Nurse, Supervisor)
- ◯ Direct patient care provider
- ◯ Clinical Nurse Specialist
- ◯ Certified Registered Nurse Anesthetist
- ◯ Certified Nurse-Midwife
- ◯ Nurse Practitioner
- ◯ Educator, service setting (in-service, staff developer)
- ◯ Patient Clinical Nurse Educator
- ◯ Management/Administrator, academic setting
- ◯ Educator, academic setting
- ◯ School Nurse
- ◯ Public Health Nurse
- ◯ Discharge Planner
- ◯ Case Manager
- ◯ Utilization Review
- ◯ Consultant
- ◯ Researcher
- ◯ Other (please describe)_____

18a. Now please mark the job title(s) below that describe other nursing positions in which you spend a portion of your time during a typical work month. **Please mark all that apply.**

- ◯ Senior management, service setting (Vice President, Healthcare Administrator, Nursing Executive, Administrator, Asst. Administrator, etc.)
- ◯ Middle management, service setting (Nursing House Supervisor, Nurse Manager, Head Nurse, Nurse Director)
- ◯ First-line management (Assistant Nurse Manager, Charge Nurse, Supervisor)
- ◯ Direct patient care provider
- ◯ Clinical Nurse Specialist
- ◯ Certified Registered Nurse Anesthetist
- ◯ Certified Nurse-Midwife
- ◯ Nurse Practitioner
- ◯ Educator, service setting (in-service, staff developer)
- ◯ Patient Clinical Nurse Educator
- ◯ Management/Administrator, academic setting
- ◯ Educator, academic setting
- ◯ School Nurse
- ◯ Public Health Nurse
- ◯ Discharge Planner
- ◯ Case Manager
- ◯ Utilization Review
- ◯ Consultant
- ◯ Researcher
- ◯ Other (please describe)_____

19. Approximately what percentage of your time is spent on each of the following functions during a typical month?

_____% Administration/management
_____% Direct client care (includes hands-on care and documentation EXCLUDING patient education)
_____% Patient education (e.g., cardiac, rehabilitation, diabetes, neurological)
_____% Indirect client care (e.g., planning, consulting, assigning and teaching staff; evaluating care)
_____% Education of student nurses (including preparation time)
_____% Other (please specify)_____

20. **Please mark the category** that best describes the type of organization in which you **work the most hours each month**. If you work through a temporary agency, traveling agency or registry, please mark the type of organization where you most frequently staff. **Mark only one.**

- ◯ Acute hospital
- ◯ Skilled nursing/extended care facility
- ◯ Academic nursing program
- ◯ Public health department
- ◯ Home health nursing agency
- ◯ Hospice
- ◯ Ambulatory care setting (clinic, physician's office)
- ◯ Outpatient surgery center
- ◯ Telenursing organization/distance disease management
- ◯ Occupational health/employee health
- ◯ Student health service (college, university)
- ◯ School nursing (K-12)
- ◯ Mental health
- ◯ Drug, alcohol treatment
- ◯ Insurance organization
- ◯ Self-employed
- ◯ Forensic setting (correctional facility, prison, jail)
- ◯ Government agency (local, state, federal)
- ◯ Other (please describe)_____

21. **Mark the one** category that best describes the clinical area in which you **most frequently** practice.

- ◯ Medical/surgical
- ◯ Geriatrics
- ◯ Pediatrics
- ◯ Obstetrics/reproductive health
- ◯ Neonatal/newborn
- ◯ Family practice
- ◯ Assistive living
- ◯ Hospice
- ◯ Home health
- ◯ College/university health
- ◯ School health (K-12)
- ◯ Employee/occupational health
- ◯ Public health
- ◯ Psychiatric/mental health
- ◯ Drug/alcohol treatment
- ◯ Peri-operative/post-anesthesia/anesthesia
- ◯ Emergency/trauma/urgent care
- ◯ Cosmetic procedures
- ◯ Quality assurance/infection control
- ◯ Rehabilitation
- ◯ Case management
- ◯ Critical care (write in type)_____
- ◯ Other (write in type)_____

21a. **Mark all the other categories** that describe clinical areas in which you practice a **portion** of your time.

- ◯ Medical/surgical
- ◯ Geriatrics
- ◯ Pediatrics
- ◯ Obstetrics/reproductive health
- ◯ Neonatal/newborn
- ◯ Family practice
- ◯ Assistive living
- ◯ Hospice
- ◯ Home health
- ◯ College/university health
- ◯ School health (K-12)
- ◯ Employee/occupational health
- ◯ Public health
- ◯ Psychiatric/mental health
- ◯ Drug/alcohol treatment
- ◯ Peri-operative/post-anesthesia/anesthesia
- ◯ Emergency/trauma/urgent care
- ◯ Cosmetic procedures
- ◯ Quality assurance/infection control
- ◯ Rehabilitation
- ◯ Case management
- ◯ Critical care (write in type)_____
- ◯ Other (write in type)_____

22. If you do not currently work in an acute hospital, have you been employed in an acute hospital within the last 24 months?
- ○ No
- ○ Yes

23. Do you supervise any unlicensed assistive personnel?
- ○ No
- ○ Yes

24. Do you practice telehealth/telemedicine across state lines?
- ○ No
- ○ Yes

25. Mark the category below which best describes the location of the organization where you currently work the most hours each month.
- ○ Large central city (400,000 or more population)
- ○ Suburbs of a large city (400,000 or more population)
- ○ Medium-sized city (100,000 up to 399,999 population)
- ○ Suburbs of a medium-sized city (100,000 up to 399,999 population)
- ○ Small city (50,000 up to 99,999)
- ○ Town (2,500 up to 49,999 population)
- ○ Rural areas (areas with less than 2,500 people in an urbanized area)
- ○ Other (Please deseribe) _____

26. How many miles is it from your home to the nursing job where you currently work the most hours each month? (If you work through an agency/registry, write the average one-way distance to your employment. If your employment requires routine travel (i.e. home care), write in half of the average number of miles you travel in a day.)

_____Number of miles one-way

27. How long have you practiced as a registered nurse? Subtract any periods of time since licensure when you were not employed as an RN.

_____Years _____Months

28. Have you ever stopped working as a registered nurse for a period of more than one year?
- ○ No (skip to question 33)
- ○ Yes (continue with question 29)

**********

***Questions 29-32 are for RNs who have ever stopped working as an RN for a period of more than one year.***

**********

29. Please indicate the reasons you stopped working as a registered nurse for a period of more than one year. **Mark all that apply.**
- ○ Child eare responsibilities
- ○ Other family responsibilities
- ○ Moving to a different area
- ○ Stress on the job
- ○ Job-related injury or illness
- ○ Non-job-related injury or illness
- ○ Salary
- ○ Deereased benefits
- ○ Other dissatisfactions with your job
- ○ Dissatisfaction with the nursing profession
- ○ Return to school
- ○ Travel
- ○ To try another occupation
- ○ Laid off
- ○ Other (please describe) _____

30. When you returned to nursing, did you take a refresher course?
- ○ No
- ○ Yes

31. What barriers, if any, were there to taking a refresher course? **Mark all that apply.**
- ○ No refresher course available within 50 miles
- ○ Refresher course did not include clinical component
- ○ Employers did not regard refresher course as useful
- ○ Course was expensive
- ○ Course was too lengthy
- ○ Hours of course conflicted with job
- ○ No barriers
- ○ Other _____

32. How long did it take to demonstrate competency in your RN duties after returning to work?

_____ Months

33. Within the next five years, what are your intentions regarding the amount of time you intend to spend in nursing? **Mark only one.**
- ◯ Plan to increase hours of nursing work
- ◯ Plan to work approximately as much as now
- ◯ Plan to reduce hours of nursing work
- ◯ Plan to leave nursing entirely
- ◯ Plan to retire from the nursing profession

34. Do you reside outside California?
- ◯ No (Skip to question 39)
- ◯ Yes (Continue with question 35)

**********

***Questions 35-38 are for RNs who reside outside California.***

**********

35. If you reside outside California, please **mark all of the following that apply** regarding the past 12 months.
- ◯ Worked as an RN in California for a temporary or traveling agency or registry
- ◯ Worked as an RN for a California employer in a telenursing capacity
- ◯ Worked as an RN for an out-of-state telenursing/telemedicine employer with California clients
- ◯ Lived in a border state and commuted to California to work as an RN
- ◯ Worked as an RN in California, but have subsequently moved out of state
- ◯ Did not work as an RN in California
- ◯ Other (specify) _____

36. If you reside outside California, how many months did you work in California during the past 12 months?

_____Months

37. If you reside outside California, do you plan to work as an RN in California during the next 5 years?
- ◯ Yes, I plan to travel to California to work as an RN intermittently.
- ◯ Yes, I plan to relocate to California and work as an RN.
- ◯ Yes, I plan to perform telenursing/telemedicine for a California employer.
- ◯ Yes, I plan to perform telenursing/telemedicine for an out-of-state employer with California clients.
- ◯ Yes, I plan to commute from a border state.
- ◯ No, I plan to keep my California RN license renewed, but have no plans to work there as an RN.
- ◯ No, I plan to let my California RN license lapse, and have no plans to work there as an RN.

38. If you reside outside California, do you currently work as an RN in your state of residency?
- ◯ No
- ◯ Yes

**********

If you are currently employed in nursing and have completed Section II,
please skip to Section IV and complete the rest of the questionnaire.

**********

## SECTION III: FOR PERSONS NOT PRESENTLY EMPLOYED IN NURSING

**The purpose of this section is to learn why persons not employed in nursing left nursing practice and to determine whether or not they intend to return to nursing in California.**

39. Which category best describes your current employment situation? **Mark only one.**
- ◯ Employed outside nursing (go to question 40)
- ◯ Seeking work in nursing (go to question 40)
- ◯ Seeking work outside nursing (go to question 40)
- ◯ Not currently seeking work (skip to question 42)
- ◯ Retired (skip to question 42)
- ◯ Other (please describe) _____

40. Does your position utilize any of your nursing knowledge?
- ◯ No
- ◯ Yes

41. How many hours per week do you usually work?

_____ Hours per week

42. What was the last year you worked as a registered nurse for at least six months?

_____ Year

43. How many years had you practiced as a registered nurse before leaving nursing? Subtract any periods of time since licensure when you were not employed as an RN.

_____ Number of years

44. Please rate the importance of each of the following factors in your decision to leave nursing.

| | Not at All Important | Somewhat Important | Important | Very Important | Does Not Apply |
|---|---|---|---|---|---|
| Child care responsibilities | ① | ② | ③ | ④ | ○ |
| Other family responsibilities | ① | ② | ③ | ④ | ○ |
| Moving to a different area | ① | ② | ③ | ④ | ○ |
| Stress on the job | ① | ② | ③ | ④ | ○ |
| Job-related injury or illness | ① | ② | ③ | ④ | ○ |
| Non-job-related injury or illness | ① | ② | ③ | ④ | ○ |
| Salary | ① | ② | ③ | ④ | ○ |
| Decreased benefits | ① | ② | ③ | ④ | ○ |
| Other dissatisfactions with your job | ① | ② | ③ | ④ | ○ |
| Dissatisfaction with the nursing profession | ① | ② | ③ | ④ | ○ |
| Return to school | ① | ② | ③ | ④ | ○ |
| Travel | ① | ② | ③ | ④ | ○ |
| Try another occupation | ① | ② | ③ | ④ | ○ |
| Laid off | ① | ② | ③ | ④ | ○ |
| Retired | ① | ② | ③ | ④ | ○ |
| Other (please describe) _____ | ① | ② | ③ | ④ | |

45. Which of the following best describes your current intentions regarding work in nursing? **Mark only one.**

- ○ Definitely will not return to nursing (skip to question 46)
- ○ Undecided at this time (skip to question 46)
- ○ Currently seeking employment in nursing (skip to question 46)
- ○ Plan to return to nursing in the future (go to question 45a)

45a. Within what time frame do you plan to return to nursing? **Please mark only one.**

- ○ Less than one year
- ○ 1 to 2 years
- ○ 2 to 3 years
- ○ 3 to 4 years
- ○ 4 to 5 years
- ○ More than 5 years

46. What would it take for you to return to work as a registered nurse? How important are each of the following factors in encouraging you to return to work as a registered nurse?

| | Not at All Important | Somewhat Important | Important | Very Important | Does Not Apply |
|---|---|---|---|---|---|
| Affordable childcare at or near work setting | ① | ② | ③ | ④ | ○ |
| Flexible work hours | ① | ② | ③ | ④ | ○ |
| Modified physical requirements of job | ① | ② | ③ | ④ | ○ |
| Nursing salary and benefits | ① | ② | ③ | ④ | ○ |
| Support from nursing management | ① | ② | ③ | ④ | ○ |
| Support from other registered nurses | ① | ② | ③ | ④ | ○ |
| Newly adopted nurse to patient ratios | ① | ② | ③ | ④ | ○ |
| Adequate support staff for non-nursing tasks (housekeeping, lab, transportation) | ① | ② | ③ | ④ | ○ |
| Availability of re-entry programs | ① | ② | ③ | ④ | ○ |
| Re-entry mentoring | ① | ② | ③ | ④ | ○ |
| Nothing would change my mind | ① | ② | ③ | ④ | ○ |
| _____ Other | ① | ② | ③ | ④ | ○ |

**********

**If you are not currently employed in nursing and you completed Section III, please continue with Section IV and complete the remainder of the questionnaire.**

**********

## SECTION IV: EDUCATION

**This section asks for information about your educational experiences in nursing and in other areas, and your plans for future education.**

### Education Prior to Nursing

47. What was the **highest level of education** you had completed prior to your basic nursing education? **Mark only one.**
- ○ Less than a High School Degree
- ○ High School Degree
- ○ Associate Degree
- ○ Baccalaureate Degree
- ○ Master's Degree
- ○ Doctoral Degree

### Pre-RN Licensure Nursing Education

48. In what kind of program did you receive your **initial, pre-licensure** registered nursing education? **Mark only one.**
- ○ Diploma Program
- ○ Associate Degree Program
- ○ Baccalaureate Degree Program
- ○ Master's Degree Program
- ○ Entry-level Master's Program
- ○ Doctoral Degree Program

49. In what year did you graduate from that program?

Year _____

50. In what state or country did you receive your pre-licensure nursing education?

_____ (state or country)

## Additional Post-RN Licensure Education

51. Are you currently enrolled in or planning to attend a nursing degree program within the next three years?
- ○ No (Skip to question 53)
- ○ Yes (Continue to question 52)

52. If you are enrolled in or planning to attend a **nursing degree program** within the next three years, what is your degree objective? **Mark only one.**
- ○ Associate Degree
- ○ Baccalaureate Degree
- ○ Master's Degree
- ○ Doctoral Degree

53. Please indicate which additional degrees you have received since your initial RN licensure. **Mark all that apply.**
- ○ No additional degrees earned
- ○ Associate Degree (nursing major)
- ○ Associate Degree (other)
- ○ Baccalaureate Degree (nursing major)
- ○ Baccalaureate Degree (other)
- ○ Master's Degree (nursing major)
- ○ Master's Degree (other)
- ○ Doctoral Degree (nursing major)
- ○ Doctoral Degree (other)

## California Certificates

54. Which of the following certifications have you received from the California Board of Registered Nursing since your initial licensure as a registered nurse? **Mark all that apply.**
- ○ Nurse Anesthetist
- ○ Nurse Midwife
- ○ Nurse Midwife with Furnishing Number
- ○ Nurse Practitioner
- ○ Nurse Practitioner with Furnishing Number
- ○ Public Health Nurse
- ○ Psychiatric/Mental Health Nurse
- ○ Clinical Nurse Specialist
- ○ None

55. Are you planning to obtain a California Board of Registered Nursing certification within the next three years in one of the areas of nursing listed in question 54?
- ○ No
- ○ Yes - Indicate Specialty/Certification: _____

## SECTION V: LICENSURE AND PERSONAL INFORMATION

**The following questions ask for information that will remain confidential and only be used to group survey responses. You will not be identified individually.**

56. In what year and in which state or country were you first licensed as a registered nurse?

_____ Year

_____ State/Country

57. In what year were you first licensed as a registered nurse in California?

_____ Year

58. Do you currently hold an active registered nurse license in a state other than California?
- ○ No
- ○ Yes How many? _____

59. Gender:
- ◯ Male
- ◯ Female

60. Year of birth: _____

61. Mark your racial/ethnic background. If more than one, indicate the category with which **you most strongly identify. Mark only one.**
- ◯ Hispanic or Latino of Mexican Descent
- ◯ Other Hispanic or Latino, e.g., Guatemalan
- ◯ White, not Hispanic origin
- ◯ Black or African American
- ◯ Asian Indian
- ◯ Other Asian (describe)_____
- ◯ Filipino
- ◯ Native Hawaiian or Other Pacific Islander
- ◯ American Indian or Alaska Native
- ◯ Mixed
- ◯ Some other race (describe)_____

62. Current marital status:
- ◯ Never Married
- ◯ Married
- ◯ Separated or Divorced
- ◯ Widowed

63. Do you have children living at home?
- ◯ No (go to question 64)
- ◯ Yes (go to question 63a)

63a. If YES, how many?
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4 or more

63b. What are their ages? **Mark all that apply.**
- ◯ Birth to 2
- ◯ 3-5
- ◯ 6-12
- ◯ 13-18
- ◯ over 18

64. Are there other people (spouse, parents, grandchildren, friends) dependent on you for care?
- ◯ No (go to question 65)
- ◯ Yes (go to question 64a)

64a. If yes, how many?
- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4 or more

64b. What are their age(s)?:_____

65. Home Zip Code: _____

66. Please mark the eategory that includes your gross income from **nursing** in 2002. This is the before-tax income that you received from **nursing work**.
- ◯ $10,000 or less
- ◯ $10,001 to $15,000
- ◯ $15,001 to $20,000
- ◯ $20,001 to $30,000
- ◯ $30,001 to $40,000
- ◯ $40,001 to $50,000
- ◯ $50,001 to $60,000
- ◯ $60,001 to $70,000
- ◯ $70,001 to $80,000
- ◯ $80,001 to $90,000
- ◯ $90,001 to $100,000
- ◯ $100,001 to $110,000
- ◯ $110,001 to $125,000
- ◯ More than $125,000
- ◯ Did not work in nursing

67. Indicate the categ[illegible] best describes your total **household** income for 2002. This is the total before-tax income of **ALL** related persons living in your household.

- ◯ $10,000 or less
- ◯ $10,001 to $15,000
- ◯ $15,001 to $20,000
- ◯ $20,001 to $30,000
- ◯ $30,001 to $40,000
- ◯ $40,001 to $50,000
- ◯ $50,001 to $60,000
- ◯ $60,001 to $70,000
- ◯ $70,001 to $80,000
- ◯ $80,001 to $90,000
- ◯ $90,001 to $100,000
- ◯ $100,001 to $110,000
- ◯ $110,001 to $125,000
- ◯ More than $125,000

68. Approximately what percentage of your total **household** income comes from your nursing job(s)?

- ◯ Less than 25%
- ◯ 25 to 50%
- ◯ 51 to 75%
- ◯ 76 to 99%
- ◯ 100%

***Thank you very much for your cooperation in completing this questionnaire. If you have additional thoughts or ideas about the nursing profession in California, please write them below.***

**Comments**

# Appendix C - Committee on Human Subjects

UCSF COMMITTEE ON HUMAN RESEARCH **Please date form:** 10/20/06
**REVISED EXEMPT CERTIFICATION**
**(CATEGORY 4:** Biological Specimens, Records Review and/or Data Analysis)

General Instructions | Submission Requirements

**Street Address:**
Committee on Human Research (CHR)
Office of Research
3333 California Street, Suite 315
University of California
San Francisco, CA 94118

**Campus Mailbox:**
CHR
Box 0962

**Office Contact for questions:**
Office: (415) 476-1814
Facsimile: (415) 502-1347
e-mail: chr@ucsf.edu

**PART 1: ADMINISTRATIVE REQUIREMENTS**

- Eligibility requirements for Principal Investigator, Co-Principal Investigator and Contact Person
- Training requirements

| **A. Principal Investigator:** | | |
|---|---|---|
| Name and degree<br>Jean Ann Seago, PhD, RN. | University Title<br>Associate Professor | Department<br>Community Health Systems |
| Campus Mailing Address (Box No.)<br>0608 | Phone Number<br>(415) 502-6340 | E-mail Address<br>Jean.ann.seago@nursing.edu |
| Co-Principal Investigator: | | |
| Name and degree<br>Michelle S. Tellez, RN, MS, PhD(c) | University Title<br>Doctoral Student | Department<br>Community Health Systems |
| Campus Mailing Address (Box No.)<br>0608 | Phone Number<br>(510) 654-7104 | E-mail Address<br>michelle.tellez@ucsf.edu |
| Additional Contact Person (if any): | | |
| Name | University Title | Department |
| Campus Mailing Address (Box No.) | Phone Number | E-mail Address |

| Study Title: | Application Type: |
|---|---|
| Do wages matter?: Econometric analysis of the effect of wages on nurses' labor participation in California. | [X] New<br>Category 4<br>[ ] Modification / Update<br>[ ] Re-certification |

Sites (Check all that apply):

[X]UCSF [ ]SFGH [ ]VAMC [ ]Fresno [ ]Cancer Center [ ]UC Berkeley

[ ]GCRC (Moffitt/Mt. Zion) [ ]GCRC (SFGH) [ ]PCRC [ ]Foreign Country
[ ]Other(s):

**B. Funding:** If this study is eligible for "Just in Time" NIH review, do not submit your application to the CHR until you have received notification from the federal granting agency that your study appears to be in a fundable range. If this study is federally funded please complete section B.6.
Check all that apply:

| **1. Type of funding:** | **2. Source of funding:** | **3. Funds will be awarded to/through:** |
|---|---|---|
| [ ]Contract/Grant<br>[ ]Subcontract<br>[ ]Drug/device donation<br>[ ]Departmental<br>[ ]Gift<br>[X]Student project | [ ]Federal Government*<br>[ ]Other Gov. (e.g., State, local)<br>[ ]Industry**<br>[ ]Other Private<br>[ ]Campus/UC-Wide program<br>[ ]Departmental Funds | Dept./ORU:<br>*Institution* — *Federal Wide Assurance (FWA) No.*<br>[ ]UCSF ..... 00000068<br>[ ]Blood Centers of the Pacific ..... 00002111<br>[ ]Blood Systems Research Institute ..... 00006454<br>[ ]Gallo Institute ..... 00000304<br>[ ]Gladstone Institute ..... 00000087 |

| | | |
|---|---|---|
| [ ]Other: __<br>Have funds been awarded?<br>[ ]Yes [ ]Pending [ ]No<br>Award No.: __<br>**Proposal Express** number(s): __ | [ ]Other:<br>**Specify name of source designated above:** __ | [ ]Institute on Aging.....00002525<br>[ ]NCIRE.....00000256<br>[ ]S.F. Dept. of Public Health .....00000162<br>[ ]SFVAMC Research Office .....00000280 |

| | |
|---|---|
| 4. **UCSF (or affiliate) financial contact person for IRB review recharge: | N/A |
| 5. Grant Title and PI (if different from above): | N/A |

**6. *CHR Protocol/Federal Grant or Contract Comparison (New CHR Studies Only)**
If this study is federally funded, please submit one copy of one of the following documents (unless there is more than one grant or contract involved; in that case, submit one copy for each associated grant or contract). Please indicate which document you have attached:

[ ] The human subjects section of your NIH grant, or
[ ] For other federal proposals (contracts or grants), the section of the proposal describing human subjects work, or
[ ] The section of your progress report if it provides the most current information about your human subjects work.
**Note:** If there are any significant discrepancies between the grant or contract and this CHR application please explain here:

7. Secondary sponsors: If there are multiple sources of funding for this study, please describe the additional funding:

**C. Key Personnel:** All key personnel including the PI and Co-PI must be listed below along with a brief statement of their qualifications. *If the SF VAMC is a study site*, please identify the principal VAMC investigator, unless already listed as PI or CoPI above. For questions regarding the VAMC application process, please contact the VA Clinical Research Office at 221-4810 ext.4655. Please note: All Key Personnel at UCSF or affiliated sites must complete the online UCSF Human Subject Protections Training program (https://www.researchonline.ucsf.edu/).

| Investigator (and institution): | Qualifications: |
|---|---|
| PI: Jean Ann Seago RN, PhD, UCSF | Dr. Seago is a registered nurse and holds a PhD in Nursing from UCSF. She has published numerous articles on hospital demand for registered nurses (RNs) as well as the RN supply. She has done extensive research on the factors that predict positive nurse workforce outcomes such as turnover, absenteeism, job satisfaction, and increased ethnic diversity. |
| Co-PI: Michelle Tellez, RN, MS, PhD(c) | Mrs. Tellez is a registered nurse and she holds a Masters in Nursing Administration from UCSF. The focus of her research is the nurse workforce, using econometric analysis. This research is her doctoral dissertation project |

| | |
|---|---|
| **D. Statement of Financial Interest:** Does the PI or any investigator have any financial interests related to this clinical study?<br>**If Yes, Attach Disclosure Of Investigators' Financial Interests Supplement** | [ ]Yes [X]No |

**E. Principal Investigator's Certification:**

- I certify that the information provided in this application is complete and correct.
- I accept ultimate responsibility for the conduct of this study, the ethical performance of the project, and the protection of the rights and welfare of the human subjects who are directly or indirectly involved in this project.
- I will comply with all UCSF policies and procedures, as well as with all applicable federal, state and local laws regarding the protection of human subjects in research.

- I will ensure that the personnel performing this study are qualified and adhere to the provisions of this CHR-certified protocol.
- I will not modify this CHR-certified protocol or any attached materials without first submitting an amendment to the previously approved protocol.

Jean Hsiao — 10/25/04

Principal Investigator's Signature — Date

PI completed training [X] Yes [ ] No

CoPI completed training [X] Yes [ ] No

**PART 2: STUDY SPECIFIC INFORMATION**

**Complete section A and/or B below for research eligible under Exempt Category #4:**

**Category #4** The research involves the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

**IMPORTANT NOTE: The Exempt application is not allowed for Category 4 if any of the following are true:**

1. There is contact with subjects
2. The human biologic specimens are from the Pathology Department
3. The research involves derivation and use of human embryonic stem cells, human embryonic germ cells, or human adult stem cells from any source, including somatic cell nuclear transplantation.
4. Medical Records are used.

**If any of the above is not applicable you must submit an application for Expedited Review.**

**A. Biological Specimens- complete the following if you are requesting permission to study biological specimens.**

1. **In non-technical language briefly describe the study purpose and activities:**
2. 
3. **Will there be any contact with the subjects? [ ] Yes [ ] No**

   If "Yes", this research does not qualify as exempt. Please fill out and submit an expedited review or full committee application.

4. **Are the human biological specimens pre-existing? [ ] Yes [ ] No**

   ***Pre-existing*** means the specimens are collected prior to this research use for a purpose other than the proposed research The materials must be "on the shelf" (or in the freezer at the time the protocol in initiated).

   If no, this study does not qualify for Exempt. Submit an application for Expedited Review.

5. **What is (are) the types of human biological specimens?**
6. 
7. **What is the source of the human biological specimens? Check all that apply. Identify the contact person and location of the repository/bank.**

   [ ] Nationally recognized or an established UCSF Tissue Bank
   - Contact Person/Location:

   [ ] On-site (UCSF) repository/bank

- Contact Person/Location:

[ ] Off-site repository/bank
- Contact Person/Location:

[ ] Historical samples with none of the 18 Protected Health Identifiers associated with the human biological specimen.
- Contact Person/Location:

8. **Does the human biological specimen repository/bank have IRB approval to obtain, receive, possess, private information that is individually identifiable for research purposes?**
   [ ] **Yes**
   [ ] **No, please explain:**

9. **How will identities of the specimens be protected?**
   [ ] **Neither** the researcher nor the human biological specimen repository/bank possess identifiers.
   [ ] The identifiers are maintained at the human biological specimen repository/bank only. There is a firewall between the source and the researcher so that the protected health identifiers are never given to the researcher.

10. **In order to work with biological samples in your lab you must have or apply for Biosafety Committee (BSC) approval through the Biological Use Authorization (BUA) process.**
    **Please provide your BUA number:** (Please note exempt certification cannot be given if this number is not provided.)

11. **Will the human biological samples be used in animal research?**
    [ ] **No**
    [ ] **Yes, please provide the IACUC approval number:**

**Protected Health Identifiers:**

| | | |
|---|---|---|
| 1) Names | 7) Social Security Numbers | 13) Device identifiers |
| 2) Dates | 8) Medical record number | 14) Web URLs |
| 3) Postal address | **9)** Health plan numbers | 15) IP address numbers |
| 4) Phone numbers | 10) Account numbers | 16) Biometric identifiers |
| 5) Fax numbers | 11) License/Certificate numbers | 17) Photos and comparable images |
| 6) Email address | 12) Vehicle id numbers | 18) Any other unique identifier |

**B. Records Review and/or Data Analysis- complete the following if you are requesting permission to review records or do data analysis.**

1. **In non-technical language briefly describe the study purpose and activities: The purpose of the study is to measure the effect of wages on the number of hours nurse worked in acute care settings in California. In order to measure this effect, researchers will conduct an econometric (statistical) analysis of an anonymous survey conducted in 2004 for the California Board of Registered Nursing.**

2. **Will there be any contact with the subjects?** [ ] **Yes** [x] **No**

   If "Yes", this research does not qualify as exempt. Please fill out and submit an expedited review or full committee application.

1. **What types of records will be reviewed? (Check all that apply)**
   [ ] Aggregate data from STOR, Cancer Center, or other established data bank or repository.
   [ ] Publicly available (i.e. DMV, library, newspapers)
   [ ] NCI SEER (Surveillance Epidemiology and End Results)
   [X] Data Sets not including any of the 18 Protected Health Identifiers
   [ ] Other:

Publishing Agreement

It is the policy of the University to encourage the distribution of all theses and dissertations. Copies of all UCSF theses and dissertations will be routed to the library via the Graduate Division. The library will make all theses and dissertations accessible to the public and will preserve these to the best of their abilities, in perpetuity.

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Michelle Tellez
Author Signature

08/23/07
Date