THE IMPACT OF FIRM, INDIVIDUAL, AND GOVERNMENT CHOICE ON HEALTH OUTCOMES

BY JOHN R. BOWBLIS

A dissertation submitted to the

Graduate School–New Brunswick

Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Graduate Program in Economics

Written under the direction of

Roger W. Klein

and approved by

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New Brunswick, New Jersey

May, 2008

ABSTRACT OF THE DISSERTATION

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By John R. Bowblis

Dissertation Director: Roger W. Klein

This dissertation is comprised of three essays that consider how choices made by firms, individuals, and governments have impacts on health outcomes. In the first essay, a legislative policy shock is used to determine why nursing home facilities converted to a new ownership type and how these conversions subsequently lead to changes in the quality of care provided between 1999 and 2004. As a result of a legislative change in reimbursement policy, nearly five percent of nursing homes converted. Conversions from a not-for-profit to for-profit was found to be associated with a decrease in the use of physical restraints while the proportion of residents with pressure ulcers in facilities that converted from for-profit to not-for-profit increased.

The second essay analyzes how promotion of sickness insurance by the government contributed to the reduction in the infant mortality rate in six European countries between the Franco-Prussian War and the Great War. The results suggest that for every additional percentage point of the adult population that is covered by sickness insurance infant death rates declined by additional 0.39 to 1.11 deaths per 1000 live births in this period.

The final essay studies how individual choice to purchase insurance affects out-of-pocket expenditures on antidepressant medications by elderly Medicare recipients. This essay discusses the econometric problems faced in the estimation of medical expenditures and finds that the average out-of-pocket expenditure on antidepressants decreases with supplemental insurance.

ACKNOWLEDGEMENTS

I appreciate the help and support of my advisor, Roger Klein. He has helped me develop an understanding of econometric theory and its application to applied microeconomics. I further owe thanks to my committee members for helpful comments and support in writing this dissertation: Carolyn Moehling, Martin Perry, and Andrew Abere. Carolyn is own consideration for her guidance in improving the chapters.

I am appreciative of useful comments from Ayse Akincigil, Stephen Crystal, Carrie Levin, Judith Lucas, and Alan Monheit. Special thanks must be given to Dorothy Rinaldi for all her support. Further, I thank Stephen Crystal for providing the OSCAR dataset and financial support throughout these years.

In additional, I am thankful to my friends I have met that have helped to make my time at Rutgers enjoyable: Andy, Arnisa, Ayse, Chetan, Costie, Geetesh, Kaveh, Levent, Lorenzo, Ramu, Ying, and Yoko. Special consideration must be given to Andy and Marty…

Finally I would like to thank my family for their past, present, and future support in all the things I do.

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Chapter 1

Introduction

This dissertation considers how choices made by firms, individuals, and governments have impacts on health outcomes. In the second chapter, a legislative policy shock caused by a change in Medicare reimbursement for skilled nursing home care is used to determine why nursing home facilities converted to a new ownership type and how these conversions subsequently lead to changes in the quality of care provided between 1999 and 2004. As a result of the legislative change, nearly five percent of nursing homes converted from not-for-profit (NFP) to for-profit (FP) or from FP to NFP. The effect of these conversions on quality is estimated using a generalized least squares version of instrumental variables. The probability of conversion is estimated by a semiparametric method that avoids parametric assumptions about the error component and allows for an unknown form of heteroscedasticity. Conversions significantly affected quality in the period. Conversion from NFP to FP conversion is associated with a decrease in the use of physical restraints while conversion from FP to NFP is associated with an increase in the proportion of residents with pressure ulcers. Further, the quality of care has significantly declined since the implementation of the reimbursement change. From 1999 to 2004 there was a 6.4% increase the proportion of residents who obtain pressure ulcers and over a 40% increase in the proportion of residents who are prescribed antipsychotic medications. Although nursing homes are highly regulated, quality can significantly change because of ownership conversion.

The third chapter analyzes the choice of governments to provide sickness insurance. In 1883, Germany passed the first social insurance legislation in Europe that required firms in the mining and manufacturing industries to provide sickness insurance to employees. Sickness insurance expanded throughout Europe in the next thirty years. This chapter analyzes the role of

sickness insurance in the reduction of infant mortality in six European countries between the Franco-Prussian War and the Great War. In the spirit of Winegarden and Murray (1998, 2004), the proportion of the adult population enrolled in sickness insurance schemes determine the extent of coverage. However, unlike Winegarden and Murray (1998, 2004) this chapter looks at how sickness insurance affected infant death rates and accounts for temperature changes that may affect infant death rates. The results suggest that for every additional percentage point of the adult population is covered by sickness insurance the infant death rate declined 0.39 to 1.11 deaths per 1000 live births.

The main objective of the final chapter is to understand the effect of individual choice to purchase insurance on out-of-pocket expenditures on antidepressant medications. Prior to 2006, Medicare recipients did not have insurance for prescription drug unless they purchased supplemental insurance that provided prescription drug coverage. Further, this chapter discusses econometric problems in the estimation of medical costs. The main finding is that elderly with supplemental insurance spent $4.37 to $7.29 less out-of-pocket on antidepressants in 2000.

Chapter 2

Ownership Conversion by Nursing Homes and the Quality of Care

2.1 Introduction

In the provision of health care, asymmetric information between patients and providers can cause health care organizations to use their informational advantage to increase profits at the cost of quality of care. The perception that providers organized as not-for-profits (NFP) are reluctant to use this informational advantage is one reason NFPs are considered to deliver higher quality services than for-profit (FP) firms (Arrow, 1963). Legal regulations require that the net cash flows of NFPs be used only for the advancement of the organization's mission. This provides NFPs with a disincentive to use their informational advantage for financial gain since any excess profits cannot be passed on to shareholders (Hansmann, 1980). In contrast, FP firms can distribute net cash flows to their shareholders. These differences in objectives and constraints can lead to NFP firms providing higher quality services than FPs. As a result, ownership status is often considered a signal of quality (Hirth, 1999; Steinberg, 2006).

In contrast, FPs are viewed as one solution for lowering health care costs because they would employ resources more efficiently through market discipline. Further, FPs are more flexible in their ability to raise capital and expand facilities (Jensen and Ruback, 1983). This permits FPs to provide services at a more competitive price and may explain why a large number of FPs entered the health care industry during the last few decades. One method FPs utilize to enter the market was through ownership conversion. A conversion is a change in ownership due to the reorganization of corporate structure or through acquisition of the facilities that results in new ownership status. If there are differences between FP and NFP firms in their quality and costs, these conversions can have an impact on aggregate quality. Therefore, it is important when evaluating future policies that would promote one ownership type over the other to consider the quality-cost trade-off.

Although there is a large empirical literature on the differences in quality between FP and NFP firms, there are few papers that address the effect of ownership conversion on quality. In an analysis of hospitals, Shen (2002) and Picone et al. (2002) found a significant increase in severity-adjusted mortality associated with facilities that converted from NFP to FP, but no statistically significant difference from the conversion of FP to NFP. Farsi (2004) analyzed the quality indicators of mortality and re-admission rates following hospitalization for heart attacks and congestive heart failure. He found that there is a higher mortality rate for heart attack patients admitted to hospitals that converted from a NFP to FP while the mortality rate is higher in congestive heart failure patients admitted to a hospital that converted from FP to NFP.

In the nursing home sector, quality is defined by measures that capture the care processes employed by the facility and the resulting health outcomes on residents. Common examples include regulatory deficiencies, nursing staff composition, labor saving devices that may lead to physical or mental harm, and preventable medical conditions. Recent work claims to find little difference in quality indicators following conversion of nursing homes from 1993 to 2004 (Grabowski and Stevenson, 2007).[1]

Health-care facilities that are in financial trouble or take advantage of changes in the market are more likely to adapt new business strategies, which can include conversions. If the empirical model does not account for endogeniety of conversion, there is uncertainty if the effect of conversion on quality is directly attributed to the ownership change. None of the four studies that analyze the affect of ownership conversion on quality of care account for the endogeniety of conversion. Therefore, policy makers need to understand the reasons for conversion and how these reasons can result in subsequent changes in quality. Policies that promote conversions of one type have long run consequences on quality and costs. This is especially relevant since competitive spillovers in quality and price exist when FP and NFP nursing homes compete with each other (Grabowski and Hirth, 2003; Keller et al, 1999).

[1] At the time of the writing of this paper, only an abstract is available that describes this preliminary work.

This paper extends the literature on nursing home ownership conversions and their effect on various measures of the quality of care. These measures include the proportion of residents with pressure ulcers, the proportion of residents physically restrained, and the proportion of residents prescribed antipsychotic medications. The method exploits the legislative change introduced by the Balanced Budget Act of 1997 (BBA) which altered the manner in which nursing homes were reimbursed for expenses. The BBA provides an exogenous shock to nursing homes that required each facility to assess its strategy of conversion and subsequent choice of the level of quality. The choice to convert is estimated by a semiparametric estimation technique that allows for heteroscedasticity and is used as an instrument in the estimation of the impact of conversion on quality of care. The results suggest that low cost NFPs and high cost FPs had a higher probability of conversion and these conversions had a subsequent impact on quality.

The rest of the chapter is organized as follows. The next section discusses the literature on quality differences between FP and NFP organizations. Section 2.3 discusses the BBA and how it affected the choice to convert by private nursing home facilities. Section 2.4 describes the estimation technique that determines the effect of conversions on quality and the instrument used to account for endogeneity. Section 2.5 describes the data and variables. Section 2.6 contains the results and the subsequent discussion. Section 2.7 concludes.

2.2 Nursing Home Quality

The theoretical literature does not provide an unambiguous prediction for which ownership status delivers higher quality. In most models, quality enters the firm's utility, revenue, and cost functions and is treated as a one-dimensional parameter to be chosen by the firm. One approach is to included profits, quality, reputation, and/or social welfare in the NFP's objective function (Vitaliano, 2003). This approach predicts that NFPs have higher quality. However, any model that defines an objective function as a combination of quality and profits will find NFPs provide higher quality when the weight on quality is greater than zero. A second

approach is to treat the NFP's objective as welfare maximization. In this class of models, Spence (1976) suggests that the outcome is determined by functional form. He observed that the manner in which quality enters the demand function will affect the relative value of quality to the marginal and average consumer. Without strong assumptions on how quality enters demand, it is hard to determine which ownership status results in higher quality. The final approach is to treat NFPs as if they had similar objective functions to FPs. This would suggest there is no quality difference between FPs and NFPs since NFPs may operate as "for-profits in disguise" (Weisbrod, 1988).

An important dimension in empirical work is the choice of quality measures. Quality is multi-dimensional and the fact that a facility performs well in one measure does not mean that it performs well in all others (Zhang and Wan, 2005). Health care quality measures are chosen to incorporate outcomes and care processes that can directly be attributable to the facility. Therefore, empirical models must adjust for the patient's severity of illness. In the hospital sector, these often include severity-adjusted mortality and re-admission rates after hospital discharge. In the nursing home literature, the most commonly used quality measures include the number of regulatory deficiencies, the proportion of residents with pressure ulcers, and the proportion of residents that are physically restrained. Other common measures include the use of catheters, the use of feeding tubes, the use of certain medications, the composition of nursing staff, and the mortality of patients. Therefore, empirical work generally focuses on several quality measures and draws conclusions about quality across the measures.

Empirical evidence for the support of the hypothesis that NFPs have higher quality than FPs in the health care industry is weak. Many studies have found statistically significant differences in quality in both directions. The largest number of studies conclude there is no difference between FPs and NFPs (Rosenau and Linder, 2003; Schlesinger and Gray. 2006a, 2006b). In the nursing home industry, there is some empirical support that NFPs provide at least

the same or higher quality of care as FPs.[2] However, many of these studies use cross-sectional data and do not fully address the endogeniety of selection in ownership structure. Therefore, it is still an open question whether FP and NFP firms differ in quality.

2.3 The Balanced Budget Act of 1997

Conversion is a response to a new equilibrium caused by a change in the legal and market environment (Mark, 1999; Marsteller et al, 1998). For example, price pressure from managed care and the implementation of the prospective payment system by Medicare caused many hospitals in the 1990's to convert from NFP to FP in order to access new capital (Hollis, 1997; Cutler and Horwitz, 2000; Sloan et al, 2003). The nursing home industry was faced with similar pressures that increase the likelihood of conversion. The improvement in the health of senior citizens and competition from assisted living facilities and home health agencies have contributed to a steady decline in the proportion of the population using long-term nursing home care (Bishop 1999). One response has been for nursing homes to increase the number of nursing home beds certified to provide skilled nursing to Medicare patients after hospitalization.

Prior to 1998, Medicare reimbursed nursing facilities on a fee-for-service (FFS) basis for skilled nursing care after hospitalization. Under the FFS reimbursement mechanism, facilities were paid under a rate-of-return regime with different rates for routine services and ancillary services. The routine services of general nursing, room and board, and administrative overhead were subject to reimbursement limits. However, the facility could increase payments from Medicare through the use of more ancillary services, such as rehabilitation. Since facilities were paid more than the costs of ancillary services, facilities could increase the payments received from Medicare by provision of more therapy minutes without regard for clinical effectiveness. Further, Medicare reimbursed separately for capital costs (Dummit, 2000).

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[2] See Davis (1991), Schlesinger and Gray (2006a, 2006b), and Hillmer et al. (2005) for reviews of the literature on nursing home quality comparisons by ownership status.

Facilities engaged in strategic business practices that were optimal for the FFS system. This included outsourcing nursing staff, selling the physical plant and re-leasing it from a real estate company, and promoting the use of ancillary services. Each of these activities allowed facilities to increase profits in the short term. For example, facilities that sold the physical nursing facility to a real estate company could recognize a profit from the sale of the building and then lease the property. This lease-back arrangements converted capital costs into operating costs. In the long run, any increases in rental expenses would partially be reimbursed by Medicare. The use of contracted staff enabled firms to reduce the fixed cost of training staff. Any increase in variable cost through use of contracted staff could be passed on to Medicare. In effect, the FFS system created an incentive for facilities to engage in business practices that would maximize short run profits without regard to the cost.

The generous reimbursement of FFS resulted in an increase in the number of facilities certified for Medicare skilled nursing care. In 1987, just under half of all facilities were certified for Medicare. In 1996 the number rose to 78% of all nursing facilities (Rhoades and Krauss, 1999). By 1999, the number of beds certified for Medicare increased to 90% of all nursing home beds (Harrington et al., 2006). This growth in the supply of skilled nursing beds and the incentives of the FFS system caused skilled nursing to be the fastest growing expenditure by Medicare in the 1990's (US GAO, 1999).

The rise in Medicare spending on skilled nursing prompted Congress to include a provision as part of the Balanced Budget Act of 1997 that changed how nursing homes were reimbursed. The legislation changed the reimbursement mechanism Medicare used for skilled nursing from FFS to a prospective payment system (PPS). The new PPS system paid a fixed per-diem rate that included the costs of routine services, ancillary services, and capital costs in the payment. The fixed payment was adjusted for severity by classifying each patient in a resource utilization group (RUG) and regional adjustments were made to account for differences in nursing wages. The system first affected facilities in the start of their new fiscal year on or after

July 1, 1998. In the first year, facilities were reimbursed 25% of the PPS payment and 75% of the payment they received under FFS. Each subsequent year, the proportion of the PPS payment increased by 25% until 100% was reached in 2002 (Konetzka et al., 2004). A later amendment to the legislation allowed facilities that were advantaged by the system to receive 100% PPS payment after January 1, 2000 (US GOA, 2002a).

The PPS system reduced the average reimbursement for skilled nursing care to 1995 levels and transferred financial risk to the nursing home. The legislation cut Medicare's average per-diem reimbursement for all services and capital costs by 9% (Dummit, 2000) and reduced the revenue that skilled nursing facilities received from Medicare by two billion dollars in fiscal year 1999 (Medicare Payment Advisory Commission, 2003). The financial burden on facilities became evident when the five largest nursing home chains – which accounted for about 12% of all nursing facilities – filed for bankruptcy protection by the middle of 2000 (Dummit, 2000). Although the reimbursement change only affected payment for Medicare patients, a number of studies have shown that the BBA affected all nursing home residents (Konetzka et al., 2004; Konetzka et al., 2006; and Unruh et al., 2006). This is primarily because most facilities provide care to both short and long stay residents. Furthermore, facilities used Medicare "profits" to subsidize Medicaid residents since Medicaid reimbursed at rates below the cost of care (US GAO, 2003; Troyer, 2002). This shortfall in reimbursement by Medicaid grew by 39% from 1999 to 2002, and reached $12.58 per Medicaid patient day in 2002 (BDO Seidman, 2005).

Under political pressure from industry representatives, Congress made temporary modifications to the BBA in the Medicare Balanced Budget Refinement Act of 1999 (BBRA) and the Benefits Improvement and Protection Act of 2000 (BIPA). The BBRA included a 4% across the board increase in Medicare payments and additional 16.66% increase in the nursing home component of all Medicare RUGs. These payment increases were set to expire on October 1, 2002 and amounted to 1.4 billion dollars annually. The BIPA temporarily increased payments

from 6.7% to 20% for select RUGS and provided one billion dollars in revenue for nursing homes annually (US GOA, 2002a).

The BBA and subsequent legislation placed a disproportionate amount of burden on nursing facilities with higher average cost and greater reliance on Medicare FFS skilled nursing for revenue. Since PPS bundled routine services, ancillary services, and capital costs into one fixed payment, facilities with high labor costs and capital expenditures needed to make operational changes to account for the difference in average revenue and average cost per patient. PPS also equalized the payments between hospital-based and free-standing facilities (Konetzka et al., 2004). This caused significant financial pressure on hospital-based facilities since they generally had higher cost structures than free-standing facilities and provided care primarily to patients in need of skilled nursing. In fact, the median Medicare margin – the difference between Medicare payments and Medicare costs expressed as a percentage – for hospital-based facilities was -53% in 1999 compared to 8% for free-standing facilities (US GAO, 2002a). Further, in the early 1990's, Medicare managed care and private health insurance had implemented utilization review mechanisms to reduce payment for ancillary services (Angelelli et al. 2000). Therefore, facilities in counties with higher penetration of managed care could be more impacted from PPS since they had prior experience with cost containment mechanisms.

The strategies that high cost facilities employed to reduce costs varied with the price-cost gap the facility experienced under PPS. Facilities that were reliant on ancillary services for revenues attempted to reduce the number of ancillary services provided to Medicare patients. Since ancillary services were bundled into the per diem rate, a reduction in these services lowered the marginal cost of care provided to each patient. A United States General Accounting Office (2002b) report found that nursing homes had cut the number of therapy minutes for medium to high need patients by 22% and by 4% for low need patients in 2001 compared to 1999. Further, the report found that facilities adapted new patient assessment practices for how patients were

classified into RUGs. This implies facilities changed how they accounted for the severity of nursing home residents to maximize revenue potential and align treatment with costs.

When these strategies could not be successfully implemented, the facility could legally change ownership types or be sold to another firm that would be able to execute these strategies.[3] However, for a few years after the implementation of the BBA, the set of possible acquirers of a high cost facility was small. The largest FP nursing home chains went bankrupt in 2000 and other FPs were hesitant to enter an uncertain market. This left NFPs as the only potential sponsor of high cost facilities since NFPs had lower cost structures provided by their exemption from corporate, property, and sales taxes (Reinhardt, 2000). Further, NFPs typically had foundations or religious organizations that could provide alternative support for the financial operations of the nursing facility. The tax-exempt status of NFPs and outside sponsorship would allow NFPs to finance losses until the facility could achieve a sustainable cost structure. In the case of high cost NFPs, FPs would not purchase a high cost NFP for the same reason they would not purchase a high cost FP. Also, any potential NFP purchaser could not reduce costs through reduced taxes since the facility already operated under a tax exemption. Therefore, high cost FPs sold the facility to a NFP if a sponsor could be found, but high cost NFPs were unlikely to convert.

Although high cost facilities were adversely affected by the PPS, facilities with costs below the PPS reimbursement benefited from the implementation of PPS. Low cost facilities were able to make profits and attempted to increase market share. Consequently, low cost FPs had little incentive to convert. However, low cost NFPs generated profits and could use their relative market position for financial gain. If the profits of a NFP were large enough, the facility could have the incentive to convert to FP status either through an asset sale or formal ownership conversion. The conversion would permit shareholders to extract these increased rents. But, conversions were expensive because resources were needed to transform the mission of the

[3] The dataset does not include information to identify if a change in ownership type is due to a sale or change in corporate structure. However, most ownership changes from FP to NFP may only involve asset transfers since shareholders in the FP would prefer liquidation.

organization and obtain regulatory approval.[4] The need for regulatory approval reduced the ability of a NFP firm to convert.[5] Therefore, variations in the conversion rate were determined by the preference of local regulatory authorities for FP enterprise in health care production and the level of competition in the market.

2.4 Empirical Method

The primary focus of this paper is to determine the effect of conversion on nursing home quality. The production function for nursing home quality is given by

$$Q_{it} = \alpha_1 NFP_{it} + \alpha_2 FP_{it} + \alpha_3 X_{it} + t*(\delta_0 + \delta_1 NFP99_i + \delta_2 W99_i) + c_i + u_{it}$$

where Q_{it} is a quality measure for nursing home i in period t, NFP_{it} and FP_{it} are dummy variables that indicate ownership type and act as an intercept, and X_{it} is a vector of time varying exogenous variables. The variable $NFP99_i$ is an indicator for NFP ownership type in 1999 and $W99_i$ is vector of observable facility and market characteristics in 1999. Both $NFP99_i$ and $W99_i$ are interacted with a time trend and capture how facility characteristics in 1999 affected the trend in quality after the implementation of PPS. Finally, the variable c_i includes observable and unobservable time-constant factors while u_{it} is an error term.

To handle the unobserved individual specific effects, the model is estimated as the first difference of the years 2004 and 1999. The first differenced quality production function becomes

$$\Delta Q_i = \alpha_1 \Delta NFP_i + \alpha_2 \Delta FP_i + \alpha_3 \Delta X_i + (\delta_0 + \delta_1 NFP99_i + \delta_2 W99_i) + \Delta u_i .$$

By way of interpretation, this model defines the change in quality as a function of time varying inputs, ΔX, and fixed factors that were determined in 1999, $W99$. The ΔNFP, ΔFP, and $NFP99$ variables combine to identify NFP converters, FP converters, and NFP non-converters,

[4] Brody (2006) provides a review of legal issues related to not-for-profit changes in purpose, sale, merger, and conversion.

[5] Regulatory delay is evident in some highly publicized cases. They include the decision by Horizon Blue Cross and Blue Shield of New Jersey to end their attempts to convert to a FP firm because of the long regulatory delay and various cases of states' authorities that delayed conversions in the hospital industry due to inadequate sale prices.

respectively, with a reference of non-converted FPs. Therefore, in comparison to FP non-converters, the coefficient δ_1 is the change in quality of NFP that does not convert, $\alpha_1 + \delta_1$ is the change in quality of NFP that converts, and α_2 is the change in quality of FP that converts.

In the estimation of this "quality" equation, several issues need to be addressed. First, as conversions are likely to be endogenous, the estimation employs an instrumental variable procedure that uses the probability of conversion as an instrument. Only the choice to convert is endogenous among the ownership variables since the BBA provides an exogenous shock that makes the initial ownership type in 1999 exogenous to the equilibrium under PPS. Second, a White (1980) test reveals the presence of heteroscedasticity in the quality model.[6] Therefore, the estimation utilizes a weighted form of instrumental variables with a flexible estimator for the variance function to construct the weights.[7]

The instrument used for each conversion type in the quality model is the probability of conversion between 1999 and 2004. In both FPs and NFPs, managers made an initial assessment of the market and financial positions of each facility after the implementation of PPS and decided if conversion is a potential strategy. The specific year of conversion was largely out of the control of managers as there was a need to find a purchaser or establish a new organizational structure. Since the process of conversion took time, facilities initially made assessments in 1999 and made a choice to attempt to convert. This decision, which is only observed for facilities that convert, can be written as a binary choice model:

$$D = \begin{cases} 1: & Z\beta_0 + c_0 > e \\ 0: & \text{Otherwise} \end{cases}, \quad e = \left[1 + s\left(Z\pi_0\right)\right]\varepsilon .$$

The variable D is equal to one if a facility converted by the end of 2004 and zero otherwise, Z is a vector of exogenous variables in 1999 that includes at least one variable that significantly predicts

[6] A White (1980) test for heteroscedasticity for each specification and quality measure rejected the null hypothesis that the error term has a constant variance at the 5% level.

[7] The conditional variance is estimated as an unknown function of an index with the squared residual as the dependent variable. The estimator is Semiparametric Least Squares developed by Ichimura (1993).

the probability of conversion but not the quality outcome, β_0 and π_0 are parameter vectors, and ε is a random disturbance that is distributed independent of Z. The function s allows for the possibility of heteroscedasticity, which is found in the data by a score test.[8] It should be noted that heteroscedasticity in the conversion model provides an additional source of identification from any exclusion restrictions.[9] Economic theory provides little, if any, guidance as to the distribution of the error component or the form of the heteroscedasticity. Therefore, the above model is estimated without parametric assumptions.[10] Further, the factors that determine conversion for FPs and NFPs are similar although the way in which these factors enter into the decision to convert is different for each ownership type. Therefore, separate models for FPs and NFPs are estimated to determine which facilities convert.

2.5 Data

The empirical model uses the Online Survey Certification and Reporting (OSCAR) system to examine the effect of the BBA on nursing home conversions and quality in the United States. OSCAR is extensively used to analyze nursing home quality and is a uniform database of state nursing home surveys. The over 16,000 nursing homes that provide care to Medicare or Medicaid residents are required to complete these surveys as part of the yearly re-certification processes to determine if nursing homes are compliant with federal regulations (Harrington et al. 2006). The surveys contain self-reported information on facility, quality, and aggregate resident characteristics for the 96% of certified facilities in the United States (Strahan, 1997). The surveys

[8] A score test for heteroscedasticity in parametric discrete choice models (Pagan and Vella, 1989) rejected the null hypothesis that there was no heteroscedasticity at the 5% level.

[9] There are several variables in Z that are excluded from the quality equation. In addition, note that the conversion model can be written as:

$$D = \begin{cases} 1: & Z^*\beta_0 + c_0^* > \varepsilon \\ 0: & Otherwise \end{cases}, \quad Z^* = Z/\left[1 + s\left(Z\pi_0\right)\right] \cdot$$

Effectively, all the Z^* variables are excluded from the quality model.

[10] This model is termed a double index model because the probability of conversions is dependent on Z through the "aggregators" or indices $Z\beta_0$ and $Z\pi_0$. See Ichimera and Lee (1991) for a general discussion of multiple index models. Klein and Spady (1993) provide a likelihood-based estimator for this model when there is no heteroscedasticity. Klein and Vella (2006) provide the extension for the current model.

are completed with oversight by state agents and validation studies have found that the information in OSCAR is reliable (Intrator et al 2005; Harrington et al. 2006; Feng et al 2005).

The OSCAR system was supplemented with data on policy, economic, and demographic characteristics of each facility's location. Addresses provided in OSCAR contain the zip code, county, and state of each facility. The urbanicity of each facility was identified at the zip code level by the second version of the Rural-Urban Commuting Area Codes (RUCA) available through the WWAMI Rural Health Research Center (2007). Annual county level demographic data was from the Bureau of Health Profession's Area Resource File (ARF). Annual state level data was obtained from several different sources. The Hospital Statistics data book was the source of information on hospital ownership (American Hospital Association, 2002) while state minimum wage rates was from the Tax Policy Center (2007). The Tax Foundation (2007a, 2007b) provided corporate tax rates and property tax per-capita. Finally, average Medicaid reimbursement rates came from Grabowski, Feng, et al (2004) and Grabowski, Angelelli, and Mor (2004).

2.5.1 Study Sample

The study analyzes the determinants of conversion after the implementation of the BBA and the subsequent change in quality for nursing homes that were privately owned during the period.[11] The 14,316 non-governmental facilities that completed a survey in 1999 were matched with their corresponding survey for the year 2004. Since a facility can complete a survey every nine to fifteen months, with an average time between surveys of twelve months, a nursing home may not have completed a survey or may have completed multiple surveys during a calendar year. A facility was determined to have a survey in calendar year 2004 if a survey was completed between December 1, 2003 and January 30, 2005. The December 2003 surveys were included

[11] Government owned facilities have different characteristics and provide services to very different populations than privately owned nursing homes. Further, the choice of a facility to convert to or convert from a government facility is driven by political rather than economic factors.

only if the facility was surveyed earlier in 2003. This method permitted facilities to have gaps between surveys of longer than twelve months but still be used in the analysis. However, facilities that had gaps of more than two years between surveys were not included.[12] Further, facilities were restricted to the contiguous forty-eight states and an additional eight facilities were excluded because the year of conversion could not be identified. The resulting sample with surveys for both 1999 and 2004 includes 12,894 facilities.[13]

Similar to other researchers that used OSCAR to analyze quality, nursing homes with erroneous staffing levels were excluded (Banaszak-Holl et al, 2002; Harrington et al, 2006; Wan et al 2006). In particular, some nursing homes report no nursing staff or numbers of nursing staff that are implausibly high. A two step process is used to limit the sample to facilities with consistent staffing levels. First, the 178 facilities with no reported nursing staff and the 115 facilities with staff levels of greater than 24 hours per resident day were identified and deleted from the sample. Of the remaining facilities, those with staff levels that were three standard deviations outside the sample mean were excluded. The final sample for analysis includes 12,111 facilities.

2.5.2 Measuring Ownership and Conversions

OSCAR did not record conversions in ownership type. However, OSCAR contained information that can be used to identify conversions. Each survey contained information on twelve different nursing home ownership structures which can be broadly classified as FP (corporation, individual, and partnership), NFP (church-related, corporation, and other), and government entities (city, city/county, county, federal, hospital district, and state). A conversion was defined as a nursing home that switched broad ownership designations within a two year

[12] Surveys between the years of 1999 and 2004 were used to verify that facilities converted once during the period.

[13] Eighty-one percent of those facilities that did not have a matched 2004 survey were determined to have closed by 2004. The remainder had a survey after January 2005 or could not be verified if the facility closed.

period. For example, if a nursing home was reported as one of the categories identified as FP in year 2000 and as one of the categories reported as NFP in 2001, then the nursing home would be designated as a facility that converted from FP to NFP in the year 2001.[14]

Five percent of nursing homes converted between 1999 and 2004 (Table 2.1). Of the 8,698 FP facilities in 1999, 4.2% of the FPs converted to a NFP within five years of the implementation of PPS while 7% of NFPs converted to a FP. The highest number of conversions occurred in 2002. This corresponded with the full implementation of PPS and the end of the temporary increases in Medicare reimbursement provided by the BBRA and the BIPA.

2.5.3 Quality Measures

Since nursing home quality is multidimensional, separate models were estimated for one substantive measure and two procedural measures. The substantive quality measure used in this analysis is the proportion of residents with pressure ulcers, sometimes referred to as bedsores. Pressure ulcers are erosions in the skin caused by a lack of blood supply to the skin or friction with the bed. Pressure ulcers are preventable and treatable so they represent a substantive quality measure. The first procedural measure is the proportion of residents that are physically restrained. Physical restraint is a procedure of nursing care that can have substantial effects on the patient. For example, restraints are associated with lower dignity and the medical consequences of increased risk of physical harm and mental illness. In many causes, nursing homes may use restrains as a labor-saving mechanism. Dementia is often associated with wandering and agitated behavior toward self or others. With over 45% of nursing home residents diagnosed with dementia, physical restraint of such residents can reduce the burden to nursing

[14] This methodology is used except in two situations. The first was for nursing homes that converted in the year 2000. Although validation studies found OSCAR to be reliable, there was a possibility for coding errors in the initial ownership designations reported in 1999. The second case was when nursing homes reported a different ownership type in multiple subsequent years. In both cases, it is assumed all nursing home conversions are legitimate conversions when one of three criteria was met: 1) the name of the facility changed, 2) the name of the corporate owner changed, or 3) the provider certification number changed.

staff. The second procedural measure is the proportion of residents that are prescribed antipsychotic medication. Antipsychotics (APs) are medications used to treat psychosis (e.g. schizophrenia, mania, and delusions). APs have the effect of sedating or "tranquilizing" the residents. Again, the use of APs is a procedure or policy of the nursing home that is associated with lower quality, especially in light of the recent black box warning and pre-mature death caused by antipsychotic use in nursing home residents (Schneider et al, 2006). For all these measures, a higher number is associated with lower quality.

Table 2.2 contains the summary statistics for NFPs, FPs, and the combined sample for years 1999 and 2004. NFPs had higher quality in 1999 and 2004 although both ownership types have the same direction in the change in quality over the period. For the combined sample, an additional half percent of residents had a pressure ulcer while the proportion of residents physically restrained decreased by about three and half percentage points. Interestingly, the number of residents that use antipsychotics medications increased drastically during the period. An additional six percentage points of residents were prescribed antipsychotics drugs in NFP nursing homes compared to an additional nine percentage points of residents in FP nursing homes.

2.5.4 Explanatory Variables

Quality of nursing home care is a function of organizational structure, revenue sources, market conditions, resident case-mix, and nursing staff levels. A facility's physical and corporate structure can influence quality of care after the passage of the BBA. For example, facilities that were part of a corporate structure that operated multiple nursing homes may standardize care across their facilities. This could result in lower average quality than if care was tailored to the individual resident. Other characteristics that affect the quality of care provided are the size of the facility, whether or not it was hospital-based, the presence of an Alzheimer's special care unit, and occupancy rate.

The facility's revenue sources and market conditions determine the financial resources available to provide quality after the BBA. The revenue level of a facility can vary with primary payer of nursing home care for each resident. For example, the Medicaid program consistently paid low reimbursement rates and previous studies have found that facilities more dependent on Medicaid provided lower quality of care (Cohen and Spector, 1996; Grabowski, 2004). Resources available to the facility were further determined by the level of market competition, urbanicity,[15] Medicaid reimbursement rate, [16] and demand for nursing care. The level of market competition was measured by a Hirschmann-Herfindahl index for the number of beds in the county.[17]

The physical dependence of the typical nursing home resident has steadily increased as the number of assisted living facilities expanded bed capacity. Therefore, holding other things equal, facilities with residents that were less dependent on nursing staff could have higher measured quality. To account for this difference in physical case-mix, the ACUINDEX is included in the model. It is a measure that incorporates the activities of daily living index (proportion of residents: dependent in eating, toileting, transferring, ambulation) and the proportion of residents that require special treatments (Cowles, 2002). The case-mix of cognitively impaired residents was measured using the proportion of residents with dementia and the proportion of residents with psychiatric conditions other than dementia and depression.

The final component that enters into a facility's quality decision was nursing staff. Staffing is a mechanism that can directly affect the health outcomes of nursing home residents.

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[15] Urbanicity is captured using the WWAMI Rural Health Research Center's categorization C for RUCA codes. Categorization C divided zip codes into urban and rural based on population dispersion and commuting patterns.

[16] The use of a facility specific reimbursement rate would suffer from endogeneity. The average Medicaid reimbursement rate does not suffer from endogeniety problems because any given facility does not have a significant impact on the average state per diem rate. Further, the average Medicaid rate is only available for years 1998 to 2002. The change in Medicaid reimbursement rate used in the quality model is defined as the 2002 level minus the 1999 level.

[17] The county is the most commonly used market definition in nursing home studies since exact origins of residents are unknown (Nyamn, 1985; Zinn, 1994).

Facilities are required to maintain a minimum level of nursing staff by law and most facilities have staff levels close to this legal requirement. Further, nursing facilities had some discretion over the composition of nursing staff. This discretion results in different cost structures as registered nurses (RNs) are the most expensive type of nursing staff while certified nurse aides (CNAs) are paid minimum wage. Facilities could adjust staff composition to alter quality and reduce costs. Since facilities that convert could change staff levels more than non-converted facilities, the inclusion of staff variables could underestimate the effect of ownership conversion on the quality of care. Therefore, the quality models were estimated as reduced form equations without staff variables and robustness checks were preformed that included staffing variables in the regression models. All staffing levels were measured in terms of hours per resident day (HPRD) to standardize across facilities of various sizes.

The factors that determined the probability of conversion after the implementation of the BBA can be broadly classified as the cost structure of the facility, the exposure to the PPS, and especially in the case of NFPs, the regulatory environment. Since the process of conversion required time for facilities to determine the impact of PPS on operations and assess the need to convert, these factors are measured as of 1999 when the facilities first confronted the impact of the BBA.

The variables that determine the probability of conversion but do not determine quality are taxes, median gross rent, growth in proportion of FP hospitals, and Medicare managed care penetration rates. Property taxes and median gross rent represent fixed costs while corporate taxes are only charged on firm profits. Corporate taxes and fixed costs affect the decision to convert but are not expected to influence the profit maximizing quality and quantity decisions. Regulators have some ability to restrict entry and exit from the local health care market. Regulator preference for FPs in the health care production is reflected by the growth in proportion of FP hospitals in the state. Since hospitals and nursing homes do not directly compete, the increase in FP hospitals should be uncorrelated with changes in quality of nursing home care but

correlated with regulator willingness to allow FPs to enter the market. The final instrumental variable is the Medicare managed care penetration rate. Managed care entities use cost containment mechanisms to reduce costs. In counties with higher Medicare managed care penetration rates, facilities are more likely to be under financial pressure from cost containment mechanisms and may be disproportionately impacted by PPS. Since managed care was well established prior to the passage of the BBA, any correlation with quality and the managed care penetration rate would have occurred prior to 1999.

2.6 Results

2.6.1 Probability of Conversion

Separate models for facilities that were NFP and FP in 1999 are estimated. This is permissible because the BBA provides an exogenous shock with initial ownership in 1999 determined under the previous regime. Further, the estimation technique employed only identifies normalizations of the parameter estimates in the probability of conversion equation. In this structure, β and π are unknown and it is not possible to identify how a change in the explanatory variable affects the probability of conversion solely due to β or π. However, the overall impact of the exogenous variables on the choice of conversion can be determined through calculation of the marginal effect.[18] Marginal effects for the probability of conversion along with their standard errors and t-statistics are reported in Table 2.3.

NFP facilities that were hospital-based and in high tax states were less likely to convert, although only the hospital-based marginal effect was statistically significant. These marginal effects are consistent with the hypothesis that low cost NFPs convert to take advantage of market

[18] With $P[Y=1 \mid Z] = F\left[\frac{Z\beta_0 + c_0}{1+s(Z\pi_0)}\right]$, the marginal effect represents the impact on the $P[Y=1 \mid Z]$ when Z is evaluated at its mean and one variable is changed. The amount of the change in the explanatory variables is a one standard deviation increase if the variable is continuous or a discrete change from 0 to 1 if a dummy variable.

opportunities and reflect management's use of conversion to extract profit from the nursing home. Facilities that had greater exposure to the public revenue sources of Medicare and Medicaid had higher probabilities of conversion. As expected, the less competitive the market and lower growth in the proportion of FPs hospitals in the state were associated with a lower probability of conversion. This reflects the regulatory burden of NFPs in their ability to convert.

The marginal effects are also consistent with FP divestiture of the highest cost facilities. First, the positive marginal effects for tax rates indicate conversion to the tax-exempt NFP status was more attractive in higher tax jurisdictions. Second, facilities in states with higher minimum wage and higher rental expenses were more likely to convert to NFP. Third, staff levels had an effect on the probability of conversion. Higher RN and therapy staff HPRD were associated with an increase in the probability of conversion to a NFP while higher licensed practical nurse (LPN) reduced the probability. Since most FPs already had staffing levels close to the legal limits, the results for the RN and LPN staff is consistent with high cost facilities under greater financial pressure as RNs cost more than LPNs. Further, facilities with higher therapy staff capture the use of therapy minutes to increase profits. Finally, a one standard deviation increase in the growth of FP hospitals translated into a 7.5 percentage point higher probability of conversion and may reflect later entry by FP nursing homes. These later entrants could have had higher cost structures than earlier entrants.

The variables of median gross rent, taxes, growth in FP hospitals, and Medicare managed care penetration rate were the exclusion restrictions that identified the quality model. Tests found that these exclusion restrictions significantly explained the probability of conversion through tests on the normalized parameters. Tests for joint significance of the normalized parameter estimates reveal that the exclusion restrictions are significantly different from zero for the FP sample (F-statistic = 32.9, p-value < 0.001) and for the NFP sample (F-statistic = 104.18, p-value < 0.001). Further, individual t-tests on the normalized parameter estimates that represent β or π were preformed. For both the FP and the NFP sample, the coefficient estimates were

statistically significant for at least the one of the normalized parameters that corresponded to each exclusion restriction (data not shown).

2.6.2 Effects of Conversions on Quality of Care

The second part of the analysis was to determine the effect of conversion on quality of care. Summary statistics (Table 2.2) show significant variation between NFP and FP facilities in staffing levels, organizational characteristics, payer-mix, and case-mix. Hausmann tests find the coefficients in the quality production function were different for facilities that were initially a NFP and FP in 1999. Therefore, separate models for NFPs and FPs are estimated and are the primary focus of the discussion, but regression results that use all facilities are presented in the tables.

The prevalence of pressure ulcers increased from 6.7% of residents in 1999 to 7.3% in 2004 (Table 2.2). NFPs started with higher quality in 1999 although quality decreased in 2004 for both NFP and FP facilities. The regressions suggest that the baseline comparison group of non-converted FPs reduced quality although the coefficient is not statistically significant (Table 2.4). The substantive finding that emerges from Table 2.4 is that non-converting NFP facilities experienced a reduction in quality compared to non-converting FP facilities. The regression on the sample of NFP facilities in 1999 suggests that the decrease in quality for non-converting facilities translates into an approximately 1.5 percentage point increase in the proportion of residents with a pressure ulcer. Given that there were over 315,000 residents in NFP nursing homes, this constitutes an additional 4,725 residents with a pressure ulcer in 2004 compared to 1999. The result is robust to treatment of conversions as exogenous and endogenous. The decrease in quality associated with non-converted NFP facilities also appears in the estimation of the sample of all facilities but the effect was only a 0.41 percentage point increase in the proportion of residents with a pressure ulcer. The significant increases in the proportion of

residents with pressure ulcers in NFP facilities suggest that there was a convergence in quality between NFP and FP facilities between 1999 and 2004.

In all the estimated models, NFP to FP conversion has no statistically significant effect on the percentage of residents with pressure ulcers. In the case of the FP sample, there was no effect of conversion in the exogenous model, but the instrumental variable (IV) model found a 1.75 percentage point increase in pressure ulcers in FP to NFP converted facilities. This result is marginally significant and not statistically significant in the regression of all facilities. The finding that facilities that convert from FP to NFP reduce quality can be attributed to a similar resource story that affected non-converted NFPs. These facilities were more likely to have costs that were higher than the new PPS reimbursement rate, and through cost cutting measures and the tax advantages of NFP ownership, were able minimize losses. Thus, high cost FPs were more likely to have admitted residents that required special needs to fill beds and improve the attractiveness of the facility to a NFP sponsor. This made facilities that convert from FP to NFP initially have a higher proportion of residents with pressure ulcers in 1999 and is one reason that failure to account for the endogeneity of conversion leads to underestimate of the effect of conversion on quality.

The other control variables had effects similar to those found in other papers that study nursing home quality measures. Further, the IV model did not significantly change the effects of these control variables. Facilities that were members of multi-facility organizations had lower proportions of residents with pressure ulcers. This suggests that chains employed standardized care processes that could better identify and treat potential pressure ulcers. However, the effect was only significant for FP chains. As expected, facilities with more physically dependent residents had higher incidence of pressure ulcers. Competition forced facilities to provide higher quality to attract new residents to the facility although competition was only significant for FPs. This may suggest that FPs had optimally chosen quality that was unique to their perceived market and the number of alternative nursing homes available to potential consumers. Further, quality

was responsive to Medicaid reimbursement, though the effect was only significant for NFPs and small. A $10 increase in Medicaid reimbursement per day was associated with a 0.20 percentage point reduction in the proportion of residents with pressure ulcers in NFP facilities.

The use of physical restraints declined by 3.6 percentage points for the entire sample (Table 2.2), but after adjustments for changes in other variables, the proportion of residents that were physically restrained declined by five to six percentage points between 1999 and 2004 (Table 2.5). The overall decrease in restraint use by all ownership types was consistent with the effort by Center for Medicare and Medicaid Services to reduce the use of physical restraints. Across all samples there was a significant difference between the results from the exogenous and IV models.

The exogenous model for the NFP facility sample suggests non-converting NFPs reduced restraint use by 6.7 percentage point reduction while those facilities that converted to a FP reduced restraints by 6.4 percentage points. The IV model suggested a different effect. Non-converted NFPs reduced the use of restraints by 6.3 percentage points while NFP to FP conversions were associated with an additional 3.6 percentage point reduction in physical restraints compared to non-converting NFPs. For the 273 converted NFP facilities this additional reduction corresponds to about 1,200 residents or 4.34 residents per facility. One explanation for this result is that low cost NFPs could have case-mixes that were associated with lower use of restraints in 1999 and why they were attractive to convert to a FP enterprise. In contrast, the effect of FP to NFP conversions was a 1.87 percentage points increase in the use of restraints compared to non-converted FPs but the result is not statistically significant.

Unlike the pressure ulcer quality measure, there was a significant increase in the use of restraints associated with nursing homes in multi-facility organizations with the effect found in both FPs and NFPs. The higher the proportion of residents with dementia or psychiatric disorder the more physical restraints were used. This is due to persons with mental disorders in nursing homes are often less physically dependent and their mental health conditions could be associated

with wandering and aggression toward staff, other residents, or themselves. The state's average Medicaid reimbursement rate and minimum wage rates were associated with reduced use of physical restraints. Similar to the pressure ulcers measure, the effect the Medicaid reimbursement rate was small. The effect of minimum wage could capture two separate effects. Since CNAs were often paid the minimum wage, a higher minimum wage could be associated with staff that was more motivated to provide care. But more likely, states that raised the minimum wage also had well-developed health advocacy networks that pressured state regulators to reduce the use of restraints.

There are several reasons why all facilities reduced the use of restraints over the period. First, regulators and public advocacy groups had pressured nursing homes to use fewer physical restraints. Second, the use of restraints was an observable quality that consumers could use to verify quality. A lower use of restraints provided facilities with a strategy to try to attract higher revenues that were associated with private pay patients. Third, residents that are physically restrained cost more in staff time (Phillips and Fries, 1993) and a reduction in restraints could allow facilities to reduce staff levels to save on costs. Fourth, FP nursing homes may have been more effective in provision of care to mentally needy residents without the use of restraints and implemented strategies to admit residents with lower cognitive ability (Table 2.2). The final reason for the trend was substitution of physical restraints with chemical restraints due to the perceived efficacy of the second generation of antipsychotic medication.

Physical restraints decreased by a rate nearly equivalent to the increase in antipsychotic drug use adjusted for psychiatric illness. The increase in use of antipsychotic medication among nursing home residents was 7.8 percentage points. This coincided with a 3.6 percentage decrease in use of physical restraints and 5.5 percentage point increase in residents with psychiatric conditions. Nursing homes may have substituted the use of some physical restraints for the "chemical restraints" provided by the second generation of antipsychotic medications that became available in this period. Facilities would have the incentive to reduce the use of physical

restraints since they were easily verifiable by potential consumers. In contrast, the use of antipsychotic medications act as restraints by sedating the resident, is not easily verifiable without use of medical records, and may be a costless input to the nursing home if the resident's medical insurance covered the cost of the drugs. Further, the use of antipsychotic medication was not reported in public reports of quality, such as Nursing Home Compare.

The potential substitution of physical with chemical restraints is plausible given the estimated coefficient values for the time trend in regressions that used antipsychotic medication as a quality measure (Table 2.6). In both the FP and NFP samples, the subsequent increase in the proportion of residents prescribed antipsychotic medications was approximately eight percentage points. This corresponds to a 38% increase in FP facilities and a 50% increase in NFP facilities. This is suggestive of approximately 110,000 more nursing home residents receiving an antipsychotic in 2004 than in 1999. For those facilities that were NFP in 1999, the regressions for the sample of all facilities found the proportion of residents prescribed antipsychotic medications was about 1.06 percentage points lower than facilities that were FP in 1999. In all models, both types of conversions were not associated with a statistically significant change in antipsychotic use compared to non-converted facilities. Further, there existed some variation in the models when the endogeniety of conversion was accounted for in the estimation but it did not substantially change the findings.

As found in the other quality measures, multi-facility organizations were significantly associated with quality. There was a positive and statistically significant association between the use of antipsychotic drugs and multi-facility organization if the facility was a FP. NFPs had a similar magnitude associated with multi-facility organizations but the result was not statistically significant. As expected, facilities with more cognitively impaired residents had higher utilization of antipsychotics. The effect of the proportion of residents with psychiatric conditions was not one-for-one. A 10 percentage point increase in the proportion of residents with a psychiatric condition resulted in a 1.18 percentage point increase in the proportion of residents

that were prescribed antipsychotics. This reflects that not all psychiatric conditions require the use of antipsychotics and needs to be further investigated with resident level data. Rural NFP nursing homes were found to have a greater proportion of residents prescribed antipsychotics and may suggest the existence of an urban-rural disparity in the quality of nursing home care. Similar to the pressure ulcer quality measure, an increase in the rate of Medicaid reimbursement reduced the use of AP drug although NFPs were more responsive to reimbursement changes.

2.6.3 Robustness

In the previous regressions, the quality models were estimated without staff controls since staff levels are a mechanism that facilities could use after conversion to change the level of quality. This was done because the inclusion of staff levels could underestimate the effect of ownership conversion on the quality of care. Ownership conversions may lead to changes in staff levels. In fact, this is one way in which facilities could change the quality of care provided. Therefore, staffing levels are endogenous.

To determine if the results were robust to changes in staff level, the quality models were estimated with staffing variables as controls. Direct care staff was divided into four types: RNs, LPNs, CNAs, and occupational/rehabilitative therapy staff. The average amount of contact time with each resident was measured in terms of hours per resident day to standardize across facilities of different sizes. Additionally, the proportion of hours of licensed nursing (RNs and LPNs) that was provided by contracted staff was included in the regressions.

Table 2.7 reports the instrumental variable results for the ownership variables when staff levels are and are not included as a control for the three quality measures. The inclusion of staffing controls does not change the direction or the significance of the ownership variables except in one case. For pressure ulcers, the effect of conversion from a FP to NFP becomes insignificant. The fact that inclusion of staff controls does not significantly impact the effect of conversion suggests that there are other mechanisms that cause conversions to affect quality other

than staff levels, such as staff turnover rates. Further, the impact of staffing on the quality of care provided had mixed results with many staffing variables having no significant effect. This may suggest that more staff do not directly translate into higher quality of care.

A second concern is that nursing homes may select patients. Since many nursing home residents were admitted to the nursing home through hospitals, many of these residents could have had pre-existing pressure ulcers or orders for restraints. Therefore, there is a possibility that the effect of ownership conversion on quality was caused by systematic difference in the admission of patients with pre-existing conditions. As a robustness check the quality measures for pressure ulcers and physical restraints were redefined as the proportion of residents with facility acquired pressure ulcers and facility acquired physical restraints.[19] The signs and significance of the coefficients for these quality models were consistent with the previous results (Table 2.8).

2.7 Concluding Remarks

Medical facilities are dependent on government reimbursement for a large share of revenues. Significant changes to reimbursement rules that try to increase efficiency, such as those instituted by the BBA, can change incentives for firms and influence the relative mix of FPs and NFPs. Approximately five percent of nursing homes underwent an ownership conversion within five years of the introduction of the PPS. Further, the facilities that converted were consistent with low cost NFPs converted to FP to extract financial benefits provided by the reimbursement changes while high cost FPs divested facilities to NFPs to limit losses. This and other reimbursement changes can effectively force NFPs and FPs to face similar incentives (Nelson, 1997) and is a reason the distinction between the two ownership types has diminished (Frank and Salkever, 2000; Sloan, 1998). Facilities that converted from FP to NFP and NFP to

[19] Facility acquired was defined as the proportion of residents with the condition minus the proportion of residents with the condition at admission.

FP significantly changed quality from 1999 to 2004. NFP to FP conversion were found to be associated with a decrease in use of physical restraints while the proportion of residents with pressure ulcers in facilities that converted from FP to NFP increased.

The substantive finding that comes out of this study is that quality has significantly changed since 1999. Since the implementation of the BBA certain nursing facilities increased the use of antipsychotic medications and changed practices that result in a greater proportion of residents with pressure ulcers. Nursing facilities that change ownership status have the incentive to change quality as residents and family members have limited ability to monitor quality on a daily basis. There are multiple mechanisms in place to reduce this problem of asymmetric information. First, regulators require facilities to fill out assessments on each individual resident on a continuous basis and facilities are re-certified for Medicare and Medicaid yearly. Second, the Center for Medicare and Medicaid Services launched a website that publicly posted quality measures. Even with these mechanisms in place, the change in quality since 1999 is quite large. As shown above, from 1999 to 2004 there was a 6.4% increase the proportion of residents with pressure ulcers and over a 40% increase in the proportion of residents prescribed antipsychotics.

The large change in quality since the implementation of the PPS could be due to the nature of the oversight mechanisms used in nursing homes. Many mechanisms focus on yearly changes or the comparison of facilities in a short time horizon. If current quality is not compared to historical levels, regulators and consumers could be unaware of long-run changes in quality, especially after a nursing home conversion. The results suggest that the quality change is quite large over the five year period but the current model cannot address if the change in quality on a yearly basis is small. An extension of the quality production function that allows the effect of conversion to vary by year can be used to test how quality changes after conversion. If the change in quality due to conversion is found to diminish as conversions occur closer to 2004, then quality changes occurred slowly and may not have been detected. It further implies that

regulators need to be aware of historical quality levels in their oversight inspections and the re-certification process.

In sum, there still exist differences between NFPs and FPs even if they have similar responses to policies and there is a convergence in operational strategies. Each ownership type has distinct economic advantages and disadvantages. Consequently, new regulations will have a varied affect the nursing home strategies for each ownership type. The relative size of the quality change in facilities that can convert can be substantially large. Regulators need to be aware of long-run changes in quality in all nursing homes and oversight mechanisms need to incorporate historical quality levels. Further, this paper does not address how facilities respond in the dimension of private pay prices or access. Therefore, there is a need for further research and vigilance of regulators to provide oversight of nursing homes conversion. This is particularly important as the baby-boomers age and it is predicted that close to 46% of them will use a nursing home once in their lifetimes (Spillman and Lubitz, 2002).

Table 2.1: Sample Size by Ownership Type		
	Sample Size	**%**
Non-converters:	11,506	95.0%
For-profit	8,330	68.8%
Not-for-profit	3,176	26.2%
Not-for-profit to for-profit	237	2.0%
Year 2000	30	0.2%
Year 2001	36	0.3%
Year 2002	76	0.6%
Year 2003	44	0.4%
Year 2004	51	0.4%
For-profit to not-for-profit:	368	3.0%
Year 2000	63	0.5%
Year 2001	72	0.6%
Year 2002	111	0.9%
Year 2003	69	0.6%
Year 2004	53	0.4%
Overall	12,111	100.0%

Table 2.2: Summary Statistics

	Not-For-Profits		For-profits		All facilities	
	1999	2004	1999	2004	1999	2004
Quality Measures						
% residents with pressure ulcers	6.43	7.24	6.82	7.32	6.71	7.30
	5.86	*6.11*	*4.82*	*5.23*	*5.14*	*5.49*
% residents physically restrained	10.02	5.88	11.83	8.37	11.32	7.67
	12.71	*8.97*	*12.84*	*9.09*	*12.83*	*9.13*
% residents using antipsychotics	15.31	21.66	20.68	29.12	19.17	27.01
	9.49	*11.48*	*13.38*	*14.96*	*12.64*	*14.46*
Facility Characteristics						
Number of beds (10's)	11.24	--	11.24	--	11.24	--
	8.60		*5.46*		*6.50*	
Part of a multi-facility organization	0.39	--	0.67	--	0.59	--
	0.49		*0.47*		*0.49*	
Hospital-based	0.19	--	0.01	--	0.06	--
	0.40		*0.09*		*0.24*	
Alzheimer's special care unit	0.21	--	0.16	--	0.17	--
	0.41		*0.36*		*0.38*	
Occupancy rate	85.09	84.51	83.99	83.27	84.30	83.62
	17.64	*17.97*	*15.05*	*14.87*	*15.83*	*15.82*
Care Staffing						
Registered nurse staff HPRD	0.57	0.53	0.32	0.27	0.39	0.34
	0.66	*0.66*	*0.29*	*0.25*	*0.44*	*0.43*
Licensed practical nurse staff HPRD	0.71	0.76	0.65	0.71	0.67	0.72
	0.47	*0.47*	*0.35*	*0.33*	*0.39*	*0.38*
Certified nurse aide staff HPRD	2.12	2.26	1.84	2.00	1.92	2.07
	0.67	*0.71*	*0.61*	*0.65*	*0.64*	*0.68*
% of licensed nursing staff contracted	2.10	2.63	1.32	1.86	1.54	2.07
	6.69	*7.13*	*5.79*	*6.69*	*6.07*	*6.83*
Therapy staff HPRD	0.17	0.19	0.10	0.13	0.12	0.15
	0.29	*0.29*	*0.17*	*0.15*	*0.21*	*0.20*
Resident Mix						
% residents paying with Medicaid	53.28	53.35	69.14	68.06	64.67	63.92
	27.22	*25.87*	*20.04*	*17.96*	*23.41*	*21.54*
% residents paying with Medicare	12.39	15.16	8.29	12.29	9.45	13.10
	21.94	*21.47*	*10.41*	*10.96*	*14.73*	*14.76*
Acuity index	10.05	10.06	10.13	10.17	10.10	10.14
	1.68	*1.62*	*1.55*	*1.48*	*1.58*	*1.53*
% residents with dementia	43.10	45.55	43.32	45.34	43.26	45.40
	19.60	*20.47*	*17.86*	*17.84*	*18.37*	*18.62*
% resident with psychiatric disorder	10.82	14.88	15.67	21.92	14.30	19.94
	12.28	*13.85*	*16.03*	*17.65*	*15.22*	*16.96*

Standard errors are in italics. Missing statistics are for variables that use 1999 level only in estimating the model. All dollar values are measured in 2004 dollars.

Table 2.2: Summary Statistics Continued

	Not-For-Profits		For-profits		All facilities	
	1999	2004	1999	2004	1999	2004
Community, Competition, and Policy						
Rural facility	0.37	--	0.35	--	0.35	--
	0.48		*0.48*		*0.48*	
Hirschmann-Herfindahl index	0.20	--	0.19	--	0.20	--
	0.23		*0.23*		*0.23*	
Five year change in % for-profit hospitals	0.47	--	0.68	--	0.62	--
	3.46		*4.45*		*4.19*	
Medicaid reimbursement rate	99.48	121.08	93.48	115.69	95.18	117.21
	26.31	*23.91*	*24.59*	*22.10*	*25.23*	*22.75*
State minimum wage	5.58	5.26	5.55	5.37	5.56	5.34
	0.78	*0.77*	*0.87*	*0.80*	*0.85*	*0.79*
Population aged 65+ (10,000's)	7.36	7.38	8.77	8.88	8.38	8.46
	14.59	*14.51*	*18.38*	*18.34*	*17.40*	*17.36*
Five year change in population aged 65+	2.44	--	3.65	--	3.31	--
	7.31		*7.71*		*7.62*	
Per capita income (1,000's)	27.62	30.85	26.78	29.76	27.01	30.07
	7.27	*9.19*	*6.67*	*8.15*	*6.86*	*8.47*
Five year change in per capita income	14.67	--	14.79	--	14.76	--
	7.48		*7.02*		*7.16*	
Medicare managed care penetration rate	13.59	--	14.48	--	14.23	--
	14.44		*15.37*		*15.12*	
Median gross rent (100's)	5.33	--	5.40	--	5.38	--
	1.43		*1.45*		*1.45*	
Taxes						
Corporate tax rate	7.63	--	6.66	--	6.93	--
	2.78		*2.93*		*2.92*	
Per capita property taxes levied (100's)	10.40	--	9.72	--	9.92	--
	3.14		*3.35*		*3.31*	
Region Variables						
Middle Atlantic	0.21	--	0.10	--	0.13	--
	0.41		*0.29*		*0.33*	
New England	0.06	--	0.07	--	0.07	--
	0.25		*0.26*		*0.25*	
Midwest	0.41	--	0.31	--	0.33	--
	0.49		*0.46*		*0.47*	
Rocky Mountain	0.04	--	0.04	--	0.04	--
	0.19		*0.18*		*0.19*	
Pacific	0.07	--	0.11	--	0.10	--
	0.25		*0.31*		*0.30*	

Standard errors are in italics. Missing statistics are for variables that use 1999 level only in estimating the model. All dollar values are measured in 2004 dollars.

Table 2.3: Conversion Model - Marginal Effects

	Not-for-profit			For-profit		
	Marginal Effect	Standard Error	T Statistic	Marginal Effect	Standard Error	T Statistic
Sample size	3,413			8,698		
Baseline Conversion Rate	0.0694			0.0423		
Facility Characteristics						
Number of beds (10's)	-0.0021	0.027	-0.381	-0.0057	0.005	-1.213
Part of a multi-facility organization	-0.0118	0.011	-1.113	0.0187	0.012	1.594
Hospital-based	-0.0304	0.016	-1.894*	0.0205	0.045	0.046
Alzheimer's special care unit	-0.0147	0.015	-0.953	0.0315	0.013	2.507**
Occupancy rate	-0.0304	0.013	-2.259**	0.0158	0.009	1.716*
Care Staffing						
Registered nurse staff HPRD	0.0026	0.008	0.3012	0.0160	0.006	2.656***
Licensed practical nurse staff HPRD	-0.0118	0.012	-1.016	-0.0057	0.003	-2.012**
Certified nurse aide staff HPRD	-0.0198	0.009	-2.118**	-0.0048	0.004	-1.226
% of licensed nursing staff contracted	0.1077	0.004	2.486**	-0.0028	0.002	-1.548
Therapy staff HPRD	0.0304	0.012	2.630***	0.0095	0.003	2.740***
Resident Mix						
% residents paying with Medicaid	0.0476	0.027	1.736*	0.0004	0.000	2.614***
% residents paying with Medicare	0.0263	0.016	1.693*	0.0004	0.004	0.113
Acuity index	0.0295	0.010	2.814***	-0.0030	0.001	-2.146**
% residents with dementia	-0.0052	0.002	-2.233***	0.0042	0.002	1.947**
% resident with psychiatric disorder	0.0072	0.002	2.596***	0.0001	0.001	0.006
Community, Competition, and Policy						
Rural facility	0.0153	0.011	1.431	0.0184	0.006	2.909***
Hirschmann-Herfindahl index	-0.0141	0.006	-2.557**	0.0082	0.004	0.1913
Five year change in % for-profit hospitals	0.0248	0.009	2.696***	0.0747	0.017	4.302***
Medicaid reimbursement rate	-0.0357	0.012	-2.875***	0.0374	0.011	3.515***
State minimum wage	0.0011	0.001	1.732*	0.0183	0.008	2.215**
Five year change in population aged 65+	-0.0075	0.006	-1.223	-0.0041	0.004	-0.991
Five year change in per capita income	-0.0083	0.004	-2.113**	0.0190	0.006	3.394***
Medicare managed care penetration rate	-0.0034	0.009	-0.377	0.0156	0.005	2.842***
Median gross rent (100's)	0.0029	0.008	0.355	0.0169	0.007	2.468**
Taxes						
Corporate tax rate	-0.0149	0.012	-1.222	0.0188	0.009	2.157**
Per capita property taxes levied (100's)	-0.0114	0.009	-1.223	0.0057	0.006	1.025
Region Variables						
Middle Atlantic	-0.0102	0.006	-1.643*	-0.0153	0.011	-1.415
New England	-0.0282	0.014	-2.006**	0.0037	0.013	0.278
Midwest	-0.0218	0.009	-2.516**	-0.0519	0.013	-3.848***
Rocky Mountain	-0.0458	0.015	-3.018***	-0.0187	0.041	-0.455
Pacific	-0.0162	0.012	-1.322	0.0006	0.019	0.033

Marginal effects reflect a standard deviation increase in the explanatory variable if continuous or a discrete change from 0 to 1 if a dummy variable. All marginal effects are evaluated at the means of the variables.

* P-value < 10%

** P-value < 5%

*** P-value < 1%

Table 2.4: Quality Model Results: Pressure Ulcers

	Not-for-profits		For-profits		All facilities	
	Exogenous	IV	Exogenous	IV	Exogenous	IV
Time Trend Constant	1.078*	1.491***	0.293	0.194	0.345	0.164
	1.666	*2.524*	*0.663*	*0.449*	*0.942*	*0.511*
Ownership Variables						
Not-for-profit in 1999					0.299**	0.248*
					2.297	*1.711*
Not-for-profit to for-profit conversion	0.258	-0.753			0.376	0.066
	0.568	*-0.886*			*0.832*	*0.082*
For-profit to not-for-profit conversion			0.033	1.745*	-0.081	0.926
			0.076	*1.939*	*-0.183*	*1.001*
Facility Characteristics						
Number of beds (10's)	0.025	0.015	0.003	0.006	0.019*	0.019***
	1.631	*1.277*	*0.246*	*0.465*	*1.937*	*2.713*
Part of a multi-facility organization	0.211	0.303	-0.252*	-0.321**	-0.132	-0.202*
	0.928	*1.473*	*-1.819*	*-2.422*	*-1.120*	*-1.854*
Hospital-based	0.349	0.384	-2.668*	-3.101***	-0.105	0.239
	0.848	*1.161*	*-1.821*	*-3.854*	*-0.265*	*0.731*
Alzheimer's special care unit	0.121	0.098	-0.246	-0.325*	-0.142	-0.132
	0.547	*0.414*	*-1.475*	*-1.818*	*-1.059*	*-0.968*
Occupancy rate	-0.014	-0.011	-0.015**	-0.012**	-0.014***	-0.015***
	-1.32	*-1.603*	*-2.371*	*-2.754*	*-2.639*	*-4.167*
Resident Mix						
% residents paying with Medicaid	-0.005	0.001	0.000	0.001	-0.002	0.001
	-0.545	*0.130*	*-0.004*	*0.139*	*-0.331*	*0.196*
% residents paying with Medicare	0.043***	0.059***	0.057***	0.059***	0.051***	0.056***
	2.582	*5.583*	*5.916*	*7.847*	*5.795*	*9.238*
Acuity index	0.663***	0.550***	0.581***	0.524***	0.606***	0.535***
	6.032	*7.239*	*10.575*	*10.979*	*11.944*	*13.168*
% residents with dementia	-0.009	-0.009	-0.013***	-0.013***	-0.012***	-0.012***
	-1.506	*-1.774*	*-3.758*	*-4.056*	*-4.016*	*-4.547*
% resident with psychiatric disorder	-0.006	-0.006	-0.005	-0.003	-0.005	-0.004
	-0.870	*-1.024*	*-1.103*	*-0.934*	*-1.322*	*-1.291*
Community, Competition, and Policy						
Rural facility	0.208	0.101	-0.054	-0.019	0.018	0.027
	0.658	*0.369*	*-0.284*	*-0.111*	*0.111*	*0.191*
Hirschmann-Herfindahl index	0.157	-0.082	0.913**	0.903**	0.664**	0.623**
	0.271	*-0.152*	*2.431*	*2.566*	*2.101*	*2.120*
Medicaid reimbursement rate	-0.024***	-0.019***	-0.003	-0.003	-0.009*	-0.006
	-2.119	*-2.120*	*-0.488*	*-0.432*	*-1.728*	*-1.298*
State minimum wage	0.222	0.313	-0.468***	-0.496***	-0.343***	-0.335***
	0.935	*1.621*	*-4.377*	*-5.004*	*-3.518*	*-3.954*
Population aged 65+ (10,000's)	0.0147	0.011	-0.007	-0.003	-0.002	-0.004
	1.143	*0.991*	*-1.335*	*-0.755*	*-0.515*	*-0.848*
Per capita income (1,000's)	-0.013	-0.019	-0.005	-0.007	-0.010	-0.007
	-0.763	*-1.135*	*-0.416*	*-0.582*	*-0.959*	*-0.760*
Region Variables						
Middle Atlantic	-0.240	-0.223	0.529**	0.513**	0.268	0.256
	-0.621	*-0.697*	*2.169*	*2.111*	*1.292*	*1.344*
New England	-0.508	-0.357	0.704**	0.828**	0.466*	0.659***
	-0.856	*-0.709*	*2.374*	*2.530*	*1.748*	*2.618*
Midwest	0.083	-0.028	0.032	0.081	0.081	0.101
	0.249	*-0.097*	*0.170*	*0.484*	*0.498*	*0.714*
Rocky Mountain	-0.655	-0.760	0.105	0.492	-0.083	0.249
	-1.041	*-1.376*	*0.264*	*1.461*	*-0.249*	*0.945*
Pacific	-0.357	-0.946*	0.969***	1.076***	0.755***	0.822***
	-0.572	*-1.770*	*3.626*	*4.242*	*3.023*	*3.517*

Statistics in italics are t-statistics.
* P-value < 10%
** P-value < 5%
*** P-value < 1%

Table 2.5: Quality Model Results: Physical Restraints						
	Not-for-profits		For-profits		All facilities	
	Exogenous	IV	Exogenous	IV	Exogenous	IV
Time Trend Constant	-6.663***	-6.313***	-4.953***	-4.528***	-5.23***	-4.932***
	-4.012	*-4.661*	*-5.046*	*-4.841*	*-6.160*	*-6.681*
Ownership Variables						
Not-for-profit in 1999					-0.898***	-0.286
					-2.971	*-0.922*
Not-for-profit to for-profit conversion	0.224	-3.624**			0.126	-4.576**
	0.228	*-2.056*			*0.129*	*-2.508*
For-profit to not-for-profit conversion			-0.427	1.869	-0.439	0.278
			-0.628	*0.993*	*-0.650*	*0.153*
Facility Characteristics						
Number of beds (10's)	-0.002	0.013	-0.027	-0.019	-0.007	0.012
	-0.114	*0.517*	*-1.026*	*-0.717*	*-0.400*	*0.880*
Part of a multi-facility organization	1.324***	1.879***	1.796***	1.679***	1.678***	1.623***
	0.870	*4.280*	*5.732*	*5.710*	*6.530*	*6.826*
Hospital-based	1.602	1.043*	0.730	-0.926	0.708	0.375
	1.178	*1.950*	*0.575*	*-0.665*	*1.406*	*0.790*
Alzheimer's special care unit	0.424	0.436	-0.076	-0.110	0.085	0.004
	0.871	*0.812*	*-0.196*	*-0.295*	*0.277*	*0.014*
Occupancy rate	0.004	0.003	-0.020*	-0.023*	-0.013	-0.017**
	0.278	*0.200*	*-1.704*	*-2.445*	*-1.425*	*-2.261*
Resident Mix						
% residents paying with Medicaid	0.023	0.020	0.004	0.008	0.008	0.003
	1.097	*1.288*	*0.307*	*0.811*	*0.783*	*0.382*
% residents paying with Medicare	-0.031	-0.013	-0.032*	-0.027*	-0.032**	-0.015
	-1.255	*-0.662*	*-1.660*	*-1.740*	*-2.128*	*-1.241*
Acuity index	0.831***	0.779***	0.665***	0.710***	0.728***	0.658***
	4.632	*5.023*	*5.831*	*6.883*	*7.620*	*7.746*
% residents with dementia	0.002	-0.002	0.018**	0.017**	0.014**	0.013**
	0.149	*-0.200*	*2.316*	*2.527*	*2.078*	*2.260*
% resident with psychiatric disorder	0.023	0.030**	-0.003	-0.003	0.003	0.004
	1.530	*2.188*	*-0.305*	*-0.379*	*0.436*	*0.665*
Community, Competition, and Policy						
Rural facility	-0.276	-0.389	-0.694*	-0.508	-0.571*	-0.293
	-0.443	*-0.650*	*-1.777*	*-1.381*	*-1.722*	*-0.952*
Hirschmann-Herfindahl index	0.789	1.102	1.198	0.677	1.038	0.102
	0.592	*0.945*	*1.540*	*0.932*	*1.538*	*0.162*
Medicaid reimbursement rate	-0.045**	-0.030	-0.030**	-0.033**	-0.034***	-0.026**
	-2.059	*-1.506*	*-2.263*	*-2.634*	*-3.018*	*-2.504*
State minimum wage	-1.403***	-1.502***	-2.627***	-2.478***	-2.374***	-2.101***
	-2.656	*-3.544*	*-10.337*	*-10.684*	*-10.379*	*-9.702*
Population aged 65+ (10,000's)	0.039*	0.043**	0.014	0.020	0.018*	0.020**
	1.947	*2.386*	*1.303*	*1.973*	*1.893*	*2.369*
Per capita income (1,000's)	0.051	0.025	0.035	0.024	0.038	0.021
	0.957	*0.653*	*1.282*	*0.870*	*1.486*	*1.003*
Region Variables						
Middle Atlantic	1.120	0.949	0.009	-0.298	0.368	-0.085
	1.585	*1.394*	*0.017*	*-0.586*	*0.900*	*-0.215*
New England	0.494	0.111	0.741	0.446	0.700	0.268
	0.365	*0.098*	*0.964*	*0.623*	*1.044*	*0.449*
Midwest	1.356**	0.945	0.172	0.049	0.438	0.224
	2.179	*1.558*	*0.476*	*0.138*	*1.404*	*0.751*
Rocky Mountain	-5.533***	-5.607***	-2.736***	-2.778***	-3.615***	-3.217***
	-3.418	*-4.730*	*-3.470*	*-3.810*	*-4.966*	*-4.962*
Pacific	-1.451	-1.475	-1.480**	-1.379**	-1.448***	-1.751***
	-0.857	*-1.235*	*-2.352*	*-2.360*	*-2.407*	*-3.014*

T-statistics in italics.
* P-value < 10%
** P-value < 5%
*** P-value < 1%

Table 2.6: Quality Model Results: Antipsychotic Medication						
	Not-for-profits		For-profits		All facilities	
	Exogenous	IV	Exogenous	IV	Exogenous	IV
Time Trend Constant	7.391***	7.715***	7.890***	7.818***	8.228***	8.523***
	6.324	*7.438*	*9.861*	*9.684*	*12.559*	*13.630*
Ownership Variables						
Not-for-profit in 1999					-1.146***	-1.059***
					-4.879	*-3.941*
Not-for-profit to for-profit conversion	0.332	0.943			0.228	0.026
	0.473	*0.691*			*0.331*	*0.018*
For-profit to not-for-profit conversion			0.390	1.295	0.404	1.272
			0.693	*0.760*	*0.721*	*0.804*
Facility Characteristics						
Number of beds (10's)	0.022	0.019	0.041*	0.046**	0.031*	0.029**
	1.175	*1.056*	*1.661*	*2.005*	*1.954*	*2.542*
Part of a multi-facility organization	0.407	0.468	0.460*	0.620**	0.455**	0.499**
	1.196	*1.401*	*1.797*	*2.506*	*2.201*	*2.506*
Hospital-based	-2.594***	-2.694***	-4.456***	-3.154**	-2.687***	-2.646***
	-6.023	*-6.512*	*-2.601*	*-2.021*	*-6.339*	*-6.462*
Alzheimer's special care unit	0.019	-0.047	0.443	0.526	0.300	0.314
	0.049	*-0.118*	*1.291*	*1.598*	*1.133*	*1.249*
Occupancy rate	-0.016	-0.017	-0.006	-0.012	-0.007	-0.013*
	-1.217	*-1.613*	*-0.505*	*-1.449*	*-0.817*	*-1.945*
Resident Mix						
% residents paying with Medicaid	0.018	0.008	0.028***	0.028***	0.026***	0.020***
	1.334	*0.667*	*2.856*	*3.177*	*3.295*	*2.905*
% residents paying with Medicare	-0.029	-0.036	-0.025*	-0.030*	-0.026**	-0.028***
	-1.549	*-2.352*	*-1.693*	*-2.379*	*-2.239*	*-2.591*
Acuity index	-0.113	-0.119	-0.652***	-0.568***	-0.502***	-0.468***
	-0.858	*-1.013*	*-5.714*	*-6.309*	*-5.559*	*-6.474*
% residents with dementia	0.032***	0.037***	0.032***	0.039***	0.032***	0.037***
	2.862	*4.230*	*4.964*	*6.505*	*5.712*	*7.360*
% resident with psychiatric disorder	0.099***	0.096***	0.138***	0.121***	0.129***	0.117***
	8.615	*9.203*	*14.733*	*17.006*	*16.864*	*19.524*
Community, Competition, and Policy						
Rural facility	1.646***	1.600***	0.126	0.109	0.515*	0.439*
	3.294	*3.524*	*0.385*	*0.344*	*1.887*	*1.666*
Hirschmann-Herfindahl index	-2.346**	-2.25**	-0.240	-0.229	-0.810	-0.732
	-2.482	*-2.416*	*-0.361*	*-0.349*	*-1.480*	*-1.381*
Medicaid reimbursement rate	-0.025	-0.709**	-0.045***	-0.045***	-0.040***	-0.041***
	-1.417	*-2.119*	*-4.106*	*-4.198*	*-4.249*	*-4.678*
State minimum wage	-0.656*	-0.027*	-0.111	-0.113	-0.230	-0.228
	-1.867	*-1.711*	*-0.562*	*-0.606*	*-1.328*	*-1.329*
Population aged 65+ (10,000's)	0.033***	0.031***	0.024***	0.021***	0.026***	0.026***
	2.620	*2.566*	*2.872*	*2.738*	*3.695*	*4.039*
Per capita income (1,000's)	-0.017	-0.027	0.022	0.018	0.007	-0.003
	-0.486	*-0.918*	*0.916*	*0.757*	*0.372*	*-0.172*
Region Variables						
Middle Atlantic	-1.322**	-1.160**	-1.352***	-1.299***	-1.322***	-1.222***
	-2.386	*-2.196*	*-3.010*	*-2.826*	*-3.849*	*-3.639*
New England	-0.908	-1.115	-2.336***	-2.310***	-1.923***	-1.864***
	-0.976	*-1.265*	*-3.872*	*-3.913*	*-3.796*	*-3.790*
Midwest	-1.391***	-1.367***	-1.074***	-1.139***	-1.124***	-1.148***
	-2.901	*-2.952*	*-3.324*	*-3.680*	*-4.206*	*-4.463*
Rocky Mountain	1.042	0.506	-0.361	-0.867	0.056	-0.458
	1.066	*0.557*	*-0.519*	*-1.226*	*0.098*	*-0.795*
Pacific	-1.494*	-1.511	-2.064***	-1.791***	-1.952***	-1.864***
	-1.831	*-1.999*	*-4.681*	*-3.924*	*-5.046*	*-4.875*

T-statistics in italics.
* P-value < 10%
** P-value < 5%
*** P-value < 1%

Table 2.7a: Staffing Robustness Checks: Pressure Ulcers						
	Not-for-profits		For-profits		All facilities	
Time Trend Constant	1.491***	1.471***	0.194	0.140	0.164	0.431
	2.524	*2.365*	*0.449*	*0.323*	*0.511*	*1.216*
Ownership Variables						
Not-for-profit in 1999					0.248*	0.300**
					1.711	*2.006*
Not-for-profit to for-profit conversion	-0.75	-1.041			0.066	-0.266
	-0.886	*-1.275*			*0.082*	*-0.322*
For-profit to not-for-profit conversion			1.745*	0.957	0.926	0.263
			1.939	*1.021*	*1.001*	*0.285*
Care Staffing						
Registered nurse staff HPRD		1.612***		-0.174		0.358*
		5.148		*-0.658*		*1.780*
Licensed practical nurse staff HPRD		0.512**		0.135		0.231
		1.830		*0.784*		*1.520*
Certified nurse aide staff HPRD		0.040		-0.162*		-0.138*
		0.311		*-1.932*		*-1.894*
% of licensed nursing staff contracted		0.009		0.014*		0.015**
		0.791		*1.816*		*2.427*
Therapy staff HPRD		-1.306***		0.707*		-0.063
		-2.196		*1.939*		*-0.194*

Table 2.7b: Staffing Robustness Checks: Physical Restraints						
	Not-for-profits		For-profits		All facilities	
Time Trend Constant	-6.313***	-6.670***	-4.528***	-4.271***	-4.932***	-4.831***
	-4.661	*-4.974*	*-4.841*	*-4.537*	*-6.681*	-6.439
Ownership Variables						
Not-for-profit in 1999					-0.286	-0.284
					-0.922	*-0.917*
Not-for-profit to for-profit conversion	-3.624**	-4.011**			-4.576**	-4.782***
	-2.056	*-2.293*			*-2.508*	*-2.654*
For-profit to not-for-profit conversion			1.869	1.355	0.278	-0.013
			0.993	*0.712*	*0.153*	*-0.007*
Care Staffing						
Registered nurse staff HPRD		-0.027		-0.558		-0.389
		-0.052		*-1.003*		*-1.039*
Licensed practical nurse staff HPRD		-0.574		-0.496		-0.410
		-1.098		*-1.291*		*-1.335*
Certified nurse aide staff HPRD		0.249		0.246		0.170
		0.912		*1.328*		*1.126*
% of licensed nursing staff contracted		-0.004		-0.961		-0.005
		-0.191		*-1.293*		*-0.357*
Therapy staff HPRD		-0.642		-0.001		-0.425
		-0.629		*-0.072*		*-0.662*

Table 2.7c: Staffing Robustness Checks: Antipsychotic Medication						
	Not-for-profits		For-profits		All facilities	
Time Trend Constant	7.715***	7.608***	7.818***	7.862***	8.523***	8.227***
	7.438	*7.468*	*9.684*	*9.685*	*13.630*	*13.074*
Ownership Variables						
Not-for-profit in 1999					-1.059***	-1.066***
					-3.941	*-3.963*
Not-for-profit to for-profit conversion	0.943	0.571			0.026	-0.585
	0.691	*0.424*			*0.018*	*-0.396*
For-profit to not-for-profit conversion			1.295	1.729	1.272	1.291
			0.760	*1.006*	*0.804*	*0.803*
Care Staffing						
Registered nurse staff HPRD		-1.057**		-0.358		-0.645**
		-2.395		*-0.735*		*-1.911*
Licensed practical nurse staff HPRD		-0.124		0.201		0.217
		-0.309		*0.623*		*0.829*
Certified nurse aide staff HPRD		0.354*		-0.178		-0.029
		1.742		*-1.140*		*-0.226*
% of licensed nursing staff contracted		-0.033*		-0.020		-0.021*
		-1.914		*-1.412*		*-1.887*
Therapy staff HPRD		-0.415		-1.542**		-1.222**
		-0.520		*-2.034*		*-2.075*

T-statistics in italics. All regressions are estimated with instrumental variables and include facility characteristics, resident mix, community, competition, policy, and region variables. Including staffing does not significantly change the coefficients

* P-value < 10%

** P-value < 5%

*** P-value < 1%

Table 2.8a: Facility Acquired Robustness Checks: Pressure Ulcers

	Not-for-profits		For-profits		All facilities	
	All	Facility acquired	All	Facility acquired	All	Facility acquired
Time Trend Constant	1.491***	0.618	0.293	0.363	0.345	0.439
	2.524	*1.503*	*0.663*	*1.064*	*0.942*	*1.487*
Ownership Variables						
Not-for-profit in 1999					0.299**	0.241**
					2.297	*1.938*
Not-for-profit to for-profit conversion	-0.753	-0.777			0.376	-0.551
	-0.886	*-1.188*			*0.832*	*-0.845*
For-profit to not-for-profit conversion			0.033	1.352*	-0.081	0.363
			0.076	*1.913*	*-0.183*	*0.495*

Table 2.8b: Facility Acquired Robustness Checks: Physical Restraints

	Not-for-profits		For-profits		All facilities	
	All	Facility acquired	All	Facility acquired	All	Facility acquired
Time Trend Constant	-6.313***	-3.608***	-4.953***	-1.838**	-4.932***	-2.569***
	-4.661	*-3.198*	*-5.046*	*-2.344*	*-6.681*	*-4.199*
Ownership Variables						
Not-for-profit in 1999					-0.286	-0.295
					-0.922	*-1.109*
Not-for-profit to for-profit conversion	-3.624**	-2.996**			-4.576**	-2.149
	-2.056	*-2.027*			*-2.508*	*-1.377*
For-profit to not-for-profit conversion			-0.427	0.115	0.278	0.051
			-0.628	*0.077*	*0.153*	*0.032*

T-statistics in italics. All regressions are estimated with instrumental variables and include facility characteristics, resident mix, community, competition, policy, and region variables.

* P-value < 10%

** P-value < 5%

*** P-value < 1%

Chapter 3

The Decline in Infant Mortality, 1878 -1913: Effects of Early Sickness Insurance Programs

3.1 Introduction

In 1883, Germany passed the first social insurance legislation in Europe that required firms in the mining and manufacturing industries to provide sickness insurance to employees. Sickness insurance expanded throughout Europe in the next thirty years. Insurance design varied as some countries issued coverage mandates and others included coverage for dependants of workers. Sickness insurance often paid up to 100% of the cost of physician visits, cash payments for lost wages for episodes of illness, and a lump-sum cash payment in case of death. In some cases, cash payments were also made to support female workers or workers' wives after childbirth. The study of the health consequences of early sickness insurance can provide insight into how modern social insurance schemes, such as Medicare or Social Security in the United States, impacted the health of a country's population. For example, the implementation of European sickness insurance in the nineteenth century coincides with the start of a persistent increase in life expectancy that continued into the twenty-first century.

This paper analyzes the role of sickness insurance in the reduction of infant mortality in six European countries between the Franco-Prussian War and the Great War. In the spirit of Winegarden and Murray (1998, 2004), the proportion of the adult population enrolled in sickness insurance schemes determine the extent of coverage. However, unlike Winegarden and Murray (1998, 2004) this paper looks at the effect of sickness insurance on infant outcomes, includes the country of Austria in the analysis, and accounts for temperature changes that may affect infant death rates. The study of the role of sickness insurance on infant mortality has largely been ignored and thought of as second-order effect of these insurance schemes. However, the proportion of deaths that were of persons in the first year of life reached 28.5% in 1900 and

22.1% in 1913 for the countries of Austria, Belgium, Denmark, France, Germany, and Sweden.[20] Since infant deaths accounted for a significant proportion of all deaths in the 19th century and small improvements in infant mortality could have large impacts on average life expectancy, it is important to understand if the improvements in mortality rates associated with sickness insurance affected only adults or the broader population, such as infants.

Western European countries experienced a decline in the infant mortality rate in second half of the 19th century with an acceleration of the decline around 1890 (Woods et al, 1998). Trends in the infant death rate suggest Germany had significant improvements in the infant mortality rate that started in the middle of the 1880's while these improvements started in the 1890's for Belgium, Denmark, and France (Figure 3.1). Subsequently, during this period, many European countries enacted sickness insurance legislation that could provide maternity and medical benefits. Initial coverage rates increased rapidly. For example, in Austria, after passage of national sickness insurance legislation the rate of adult coverage increased from zero percent to twelve percent within five years and increased to eighteen percent by 1913.

The paper looks at the role that sickness insurance in the decline in infant mortality between 1878 and 1913. The results suggest that the annual infant death rates declined by 1.11 infant deaths per 1000 live births for each one percentage point increase in the proportion of the adult population is covered by sickness insurance. When this result is compared to the change in the crude death rate caused by sickness insurance, it suggest that eight to thirty three percent of the decline found by Winegarden and Murray (1998) can be contributed to a reduction in infant mortality. The rest of the paper is organized as follows. Section 3.2 discusses the design of

[20] The percentage of deaths that were of persons in the first year of life is calculated as the total number of infant deaths in the six countries divided by the total number of deaths in the six countries. To obtain the number of infant deaths, for each country, the infant mortality rate is converted to the proportion of live births that result in infant death in the first year of live. This proportion is multiplied by the number of live birth to obtain. The infant mortality rates, number of live births, and number of death are from (Flora 1983b, pp. 38, 44, 46, 54, 58, and 73). Rates significantly varied by countries. In 1900, France experienced the lowest proportion of deaths that were for infants at 15.6% while Germany had the highest at 36%.

sickness insurance in Europe while Section 3.3 discusses the role of sickness insurance in the improvement of health. The data are explained in Section 3.4. Section 3.5 contains discussion of the analyses and results. The final section includes concluding remarks and implications for future research.

3.2 Sickness Insurance Schemes[21]

At the turn of the twentieth century, Europe underwent a large socio-demographic transition. Workers moved to cities and found work in factories. This transition from farm to city led to many social problems related to income maintenance as factory workers were often wage dependent. Minor injuries or illness resulted in an inability to earn an income and could lead to poverty. To combat this problem, unregulated mutual aid societies were formed to provide financial support in the time of need to members that paid dues. These mutual aid societies instituted various insurance schemes including sickness insurance. The primary purpose of sickness insurance was to provide monetary assistance and medical care to restore the capacity of the worker to return to work. By the late 19th century, European countries started to regulate these organizations either through establishment of compulsory insurance mandates or through subsidization of voluntary sickness insurance provided by mutual aid societies (Lindert, 1994).

3.2.1 Sickness Insurance in Germany

In 1883, Germany was the first European country to pass legislation on sickness insurance. After the Franco-Prussia War, socialism gained momentum in the working class through unionized labor. Workers demanded aid in the form of income maintenance as industrialization lead to increased urbanization, wage dependency, and an inability to save income (Zollner, 1982). Many historians argue that the 1883 legislation on sickness insurance and subsequent passage of other social insurances were an attempt of the "political coterie to

[21] This section is largely derived from United States Commissioner of Labor (1911) and (Rubinow, 1916).

stifle the labor movement and preserve an authoritarian social order" (Eghigan, 2000). The government's passage of social insurance was backed by industrialists to undermine socialism and labor unions, with the industries of steel and coal the largest advocates of compulsory insurance.

The German sickness insurance legislation commissioned the establishment of compulsory insurance in the form of various types of funds for workers in manufacturing and mining. Subsequent legislation expanded the industries and persons eligible to enroll in these funds. The initial legislation required all workers and some administrators of the firms to pay two thirds of sickness insurance premiums while the employer paid the other third. In 1892, sickness insurance benefits were expanded to families.[22] In return, the insured would receive a sick pay benefit of 50% of ordinary wages after the third day of illness. Further, the insured had access to free medical treatment and medicine. In some cases, hospitalizations would be covered with reductions in the sick pay benefit. Benefits could last for thirteen weeks.

For women who were enrolled for at least six months prior to giving birth, the insured would receive at least four weeks of maternity pay after childbirth. This was later expanded to six weeks in 1903, and eight weeks with possible extensions to twelve weeks in the case of breast feeding in 1911. Female enrollment grew rapidly. In 1885, nearly 16.8% of all insured members were female, but this rose to 24.2% in 1906. By 1911, nearly 11.1% of all females in Germany had coverage. In 1909/1910, nearly 5% to 6.4% of female members received maternity benefits for the largest seven urban sickness funds (Dawson, 1913). The impact of these plans was evident as female participation more than doubled, while expenditures for childbirth grew almost 800% from 1882 to 1908 (Table 3.1).

[22] Dependents were allowed to enroll in the funds as part of a statutory resolution. Dues for dependents were paid for by either all members of the scheme or by supplementary payments from the worker's family without contribution from the employer. By 1900, nearly 4 million dependents were covered by sickness insurance (Zollner, 1982; Sulzbach, 1947).

3.2.2 Sickness Insurance in Austria

Austria enacted sickness insurance legislation for similar reasons to Germany. Around 1880, the economic situation in Austria put great pressure on the working class as food prices rose and wages dropped as much as 80% in extreme cases (Hofmeister, 1982). These circumstances led to the establishment of compulsory sickness insurance in 1888 with many benefits similar to Germany. Sickness insurance provided free medical treatment, medicine, and therapeutic applications for persons in manufacturing, building, transport, and most commercial establishments. Also like Germany, workers were to pay two thirds the cost of the insurance while the employer paid the final third. The maximum statutory rate of premium was to be no more than 3% of the worker's wage. In return, workers were given 60% of ordinary income if ill for more than three days, free medicine and medical treatment through fund contracted physicians,[23] a death benefit at least twenty times the rate of wage, and a maternity benefits of at least four months of sick-pay benefits for normal childbirth.

The maternity benefits in Austria were not as generous as Germany, but women were large participants in sickness insurance. From 1891 to 1895, females accounted for 1.95 million of the 8.2 million enrollees. A significant number of childbirths were covered under sickness insurance in Austria. The number of cases of childbirth for insured women increased from 26,780 cases in 1890 to 55,046 cases by 1907. An analysis of crude birth rates and cases of birth covered by sickness insurance suggest that by the turn of the twentieth century sickness insurance covered greater than 5% of all the births (Table 3.2). More importantly, the total number of days sickness insurance paid out benefits for childbirth more than doubled.

3.2.3 Sickness Insurance in Other European Countries

While Austria and Germany implemented systems of compulsory insurance, the majority of other European countries implemented subsidized voluntary insurance. Sickness insurance

[23] Some funds allowed enrollees free choice of physicians.

was often provided by mutual aid societies, subsidized by the state and usually covered a smaller percentage of the population than compulsory insurance. Many of these voluntary plans did not mandate maternity benefits although most funds provided some form of aid for childbirth. For example, Italy had mutual aid societies that only provided benefits for childbirth (United States Commissioner of Labor, 1911, pp. 1852-5).

Denmark enacted legislation to subsidize voluntary sickness insurance in 1892. The government would pay one fifth of the dues up to 2 Krones per member if the government recognized the mutual aid society. In order to be recognized, a mutual aid society had to admit all persons between the age of 15 and 45 that were free of chronic or incurable disease and were within the trade boundaries of Denmark. Further, members, their wives, and children under the age of fifteen needed to be entitled to free medical treatment and cash sickness benefits. Although the system was not compulsory, 31% of females and 30% of males in the country had sickness insurance by 1907.

In contrast, the 1894 subsidized system established by Belgium was not able to obtain as high a rate of participation. Although many of the details were similar to Denmark, Belgium did not require funds to provide sickness insurance or medical benefits. In 1908, only 36.3% of all mutual aid societies in Belgium provided sickness insurance. Even with limited sickness insurance coverage, the number of mutual aid societies recognized by the government increased from 759 to 7,945 with sickness insurance accounting for 21.7 to 29% of a total mutual aid society expenses between 1895 and 1908. At the turn of the twentieth century, there were 196,487 persons covered by sickness insurance although only 10,794 were female.

Sweden implemented legislation to subsidize sickness insurance in 1891 and France followed in 1898. Similar to Denmark and Belgium, Sweden subsidized mutual aid societies if cash benefits were paid (Rosenthal, 1967) while France provided subsidies to mutual aid societies and public assistance programs that covered physician fees, medicines, and cash-benefits. In the

case of France, the scope of the legislation was limited as most of these societies were only in cities (Smith, 2003).

3.3 The Role of Sickness Insurance on Health Outcomes

The role of insurance on health outcomes since World War II is well studied.[24] However, there are fewer studies that analyze the effect of social insurance on health between the Franco-Prussian War and the Great War. It is expected that a greater proportion of the population had access to medical care when coverage rates of sickness insurance were higher. This would have accelerated the diffusion of medical knowledge and its impact (Mokyr and Stein, 1997; Deaton, 2005) since physicians were early promoters of promoters of sanitation, lifestyle behavioral changes, and medicalized childbirth (Kunitz, 1991; Mackenbach, 1996). Besides increased access to care, many mutual aid societies provided education on public health issues. As stated in a United States commission report that studied the European sickness insurance programs in 1911, "in addition to the granting of aid and medical attendance, many of the societies and federations of societies are engaging, by education and otherwise, in combating tuberculosis and infant mortality, and are encouraging the building of sanitary homes, disinfection, and other protective measures against disease" (United States Commissioner of Labor, 1911, pp. 809-10).

Winegarden and Murray (1998, 2004) found that a ten-percentage point increase in the population enrolled in sickness insurance resulted in a decline of 0.9 to 1.6 per 1000 in the crude death rate for all ages and would have accounted for one-seventh to one-sixth of the reduction in the crude death rate for previously uninsured persons. They argue that part of the reduction in crude death rate could be attributed to changes in birth patterns but argue that the effect of sickness insurance on infant mortality would be a second order effect. Although Winegarden and Murray (1998, 2004) have looked at the crude death and marital fertility rates, infant deaths

[24] With recent United States data, Currie and Gruber (1996) found that a thirty percent increase in expansion of coverage of woman between the ages of 15 to 44 by Medicaid resulted in a decline in infant mortality rates by 8.5%.

accounted for sixteen to thirty six percent of all deaths in 1900. They don't address if the improvement in mortality is only for adult or if these sickness insurance schemes benefited other segments of the population, specifically infants.

It has been shown that changes in birth patterns caused by higher female labor participation could have led to decreased fertility rates and increased intervals between births (Galloway et al, 1994). These longer birth intervals could lower the risk to a new mother's health, allowed mothers to invest more time on the health of newborn children (Hedenborg, 2000), and lower probability of infant death. Sickness insurance could have worked through similar mechanisms since the maternity benefits would decrease the cost of missed work. These maternity benefits provided free medical care and cash payments equal to a proportion of wages for a length of time after childbirth. This would allow the mother to rest and reduced the cost of childbirth since the mother did not need to return to work immediately. Further, these benefits would facilitate breast-feeding which has been shown to improve infant health and survival chances through development of immunity to disease (American Academy of Pediatrics, 2005). Therefore, sickness insurance through maternity and other benefits could have been a large factor in the decline of the infant death rate. This fact was best stated by the United States Commission of Labor report on sickness insurance programs in 1911, "The purpose of maternity insurance is not only that of assistance to the mother, but also the reduction of infant mortality" (United States Commission of Labor, 1911, pp.12).

3.4 Data

To determine the role of sickness insurance in the decline of infant mortality in the late 19th century, a balanced panel of six European countries is constructed for the period of 1878 to 1913. Annual data is collected on the countries of Austria, Belgium, Denmark, France, Germany, and Sweden. These countries represent six of the seven countries that passed national legislation

prior to 1900.[25] The only country excluded is Italy since annual data on the extent of sickness insurance coverage is unavailable. Further, this period represents one of the longest periods of European peace and starts long enough after the Franco-Prussian War to eliminate the any distorting effects caused by the war.

3.4.1 Infant Mortality and Sickness Insurance

The two main variables of interest are the infant mortality rate and the coverage of the population by sickness insurance. The annual infant mortality rate is obtained from Mitchell's *International Historical Statistics: Europe 1750-2000, 5th Edition* (2003, pp. 121-24). The three year moving average of the infant mortality rate for each country is presented in Figure 3.1. The infant mortality rate improved for all countries over the period. For example, Austria had the highest infant mortality rate at 252 deaths in the first year of life per 1000 live births in 1879, but the rate declined by 24.6% to 190 deaths per 1000 live births in 1913 (Table 3.3). Similarly, for Sweden the decline in the infant mortality rate went from 134 to 70 deaths per 1000 live births or a 47.8% decline for the same period.

The other variable of interest is sickness insurance. The measure of sickness insurance needs to be uniform across countries as programs differed by structural form, types of benefits, and whom they covered. The measure used in the analysis is the percentage of the population participating in sickness insurance schemes in each year. This measure captures the diffusion of the schemes and their monotonic increase in coverage rate up until the Great War. Data on the percentage of the population over fifteen years of age enrolled in the sickness schemes is available in *State, Economy, and Society in Western European: 1815-1975 Volume 1* (Flora, 1983a, pp. 467, 474, 481, 495, 502, 537). Table 3.4 reports the proportion of the adult population

[25] Although other European countries passed national sickness insurance legislation after 1900, most of these countries do not have annual data on participation rates.

covered by sickness insurance for the six countries in 1913. It is expected that sickness insurance is associated with a reduction in the infant mortality rate.

3.4.2 Other Observable Factors

There are factors other than sickness insurance that are associated with this decline in infant mortality. One set of factors that may affect the infant mortality rate are birth patterns. First, a higher birth rate decreases the interval between childbirth (Hedenborg, 2000). These shorter intervals between births could lead to more maternal mortality and less time to invest in each child after birth. Therefore, it is expected that higher birth rates are associated with higher rates of infant mortality. Similarly, illegitimate births lead to higher infant mortality as mothers may be unable or unwilling to invest in newborn health (Kinter, 1988). The birth rate and illegitimacy ratio[26] are used in the regression models to account for birth patterns. The source of these variables is Flora (1982b, pp. 38, 42-3, 46, 54-5, 58-9, 73, 164, 167-8, 171-2, 183-4, 199-200).

Another factor that could affect the infant mortality rate in the period is temperature. Many infant deaths were caused by digestive diseases, such as diarrhea. Although highly treatable, the consequences of dehydration were not well understood in this period. Higher temperatures increased the risk of dehydration of infants and subsequently raised the infant mortality rate. Mean temperatures in Celsius for July are used to account for climatic effect on infant mortality. The source of the temperature data is Vose et al (1992). The climatic stations used were Wien/Hohe Warte for Austria, Uccle for Belgium, Copenhagen for Denmark, Paris/Le Bourget for France, Berlin-Tempelhof for Germany, and Stockholm for Sweden.

Income is an important correlate of infant mortality (Woods et al., 1988; 1989). Higher income can lead to more resources available for the provision of necessities, such as food and shelter, to infants. However, the economic structure of Europe was in transition as the economic

[26] The illegitimacy ratio is the number of illegitimate births per 100 legitimate births.

base of the countries moved from farming to manufacturing. As discussed in Winegarden and Murray (1998), income growth that accompanies structural changes in the economy could make certain social classes worse off and result in higher mortality. Therefore there is no prediction about the effect of income on infant mortality. *The World Economy: Historical Statistics* (Maddison, 2003) is the source of the income variable. Income is measured in terms of GDP per capita in 1990 international Geary-Khamis dollars.

Further, the urbanization rate of the country could influence the infant mortality rate. Cities could provide better access to medical resources and it might be expected that as more persons move to cities then infant mortality would improve. However, the crowded living conditions of cities could decrease public health through disease. It is unknown if the negative effect of poor public health associated with crowding living conditions during the period would outweigh the gains of access to medical care. The urbanization rate is the percentage of the population living in localities with more than 100,000 inhabitants. Data on urbanization is available on a five or ten year interval in Flora (1983b, pp. 249, 253, 255, 259, 262, 274) and required the estimation of the annual urbanization rate. The intermediary values between years in which data are available are imputed by use of an exponential growth model. The growth rate used to calculate the intermediary values is determined for each period between the two years data is available.

3.5 Empirical Model and Results

Three separate analyses are conducted to determine the effect of sickness insurance on infant mortality. The first of the analyses calculates and compares the percentage change in the unadjusted infant mortality rates in all six countries. The percentage change in infant mortality rates is calculated for 1878 to 1913 and two shorter periods between 1878 to 1913: from 1878 until passage of national legislation on sickness insurance and passage of national legislation until

1913. If infant mortality rates are found to decline faster after legislation is passed, it suggests that sickness insurance is correlated with the decline in infant mortality.

The results of the first analysis find that sickness insurance is correlated with the decline in the infant mortality rate (Table 3.3). For all countries besides Sweden, the decline in the infant mortality rate between 1878 and the passage of national sickness insurance legislation ranged from an increase of 8% to a decline of 6%. However, after the passage of sickness insurance legislation, these countries experienced a large decline in the infant mortality rate by 1913. The infant mortality rate declined the least in Belgium (14.5%) while Denmark improved the most (38.3%). The poor performance by Belgium is probably due to its lower coverage rate of sickness insurance and lower female participation rate compared to other countries. In contrast, Denmark provided higher rates of coverage and even insured wives and the dependants of workers. The experience of Sweden was slightly different from other countries. Besides having one of the lowest infant mortality rates throughout the period, Sweden experienced an almost similar decline in infant mortality before and after passing sickness insurance legislation.

Comparison of the infant mortality rate before and after passage of national legislation suggests that infant mortality rates declined faster after the government passed legislation, but this analysis does not account for differences in coverage rates. The second analysis is to compare the proportion of the adult population covered by sickness insurance and the infant mortality rate. This is done graphically for the period after passage of national sickness insurance legislation. Trend lines are drawn to determine if the infant mortality rate declined as coverage rates increased.

The impact of sickness insurance is further evident by analysis of percentage of the adult population covered by sickness insurance and the infant mortality rate after the passage of national legislation on sickness insurance (Figure 3.2). For each country, the trend line is negative and suggests that as a greater proportion of the population was covered by sickness insurance the lower the infant mortality rate. Comparison of the slopes of the trend lines point to

Austria and Germany experiencing the largest decrease per percentage point of the population covered by sickness insurance. This may be due to Austria and Germany's institution of compulsory insurance, more generous maternity benefits, and longer experience with sickness insurance. On the other hand, Denmark had the smallest decline in infant mortality per percentage of the adult population covered.

Although the Table 3.3 and Figure 3.2 suggest that implementation of national sickness insurance legislation and higher coverage rates of the population reduce infant mortality, these analyses do not account for other factors that could influence the infant mortality rate. The third analysis accounts for other factors through estimation of an empirical model that can be written for country i in year t as

$$IMR_{it} = \beta_0 + \beta_1 IMR_{it-1} + \beta_2 S_{it-1} + \theta X_{it} + \delta_i + \varepsilon_{it} \quad (1)$$

where the variable *IMR* is the infant mortality rate, S is a measure for sickness insurance coverage, X is a vector of observable factors that affect the infant mortality rate, δ is unobservable heterogeneity, and ε is an error term.

The lag of the dependent variable is included to capture the persistence in the infant mortality rate. The lag of the sickness insurance measure is used since impact of sickness insurance on infant mortality may not occur contemporaneously. This is due to sickness insurance schemes requiring woman to be enrolled for at least six months before being eligible for maternity benefits. The inclusion of the unobserved heterogeneity allows for time-constant factors that could affect infant mortality that may not be directly observable and include lifestyle differences attributed to religion (Poppel, 1992; Poppel et al, 2002), diet, breast feeding habits, and institutional traditions.

There are three issues that need to be addressed in estimation of equation (1). First, it has been shown that inclusion of the lag dependent variable can lead to biased estimates in panel data that have few cross-sections but a long time series dimension. Therefore, the above equation is

estimated by the method proposed by Arellano and Bond (1991) for dynamic linear panel models. This method accounts for the endogeneity of the lag dependent variable and allows for unobserved time invariant heterogeneity that can be correlated with the explanatory variables. Second, the proportion of the adult population covered by sickness insurance could be endogenous since countries with higher infant mortality rates could be more aggressive in the promotion of sickness insurance. A Durbin-Wu-Hausmann test for endogeneity could not reject the null hypothesis that the sickness insurance coverage rate is exogenous (p-value = 0.164). However, as a robustness check, equation (1) is estimated with the sickness insurance coverage rate treated as endogenous in the Arellano and Bond estimation. Third, the comparison of the rates of infant mortality suggests the distribution of the infant mortality rate is highly skewed across countries. As a second robustness check, equation (1) is estimated with the dependent variable as the logarithm of the infant mortality rate.[27]

The summary statistics used in the regression models are reported in Table 3.4. The average infant mortality rate was 161.8 infant deaths per 1000 live births between 1878 and 1913 while the average proportion of adults over the age of fifteen covered by sickness insurance was 9.5%. Only 11.8% of the population lived in cities with the average per capita income in the period of 2,809 international Geary-Khamis dollars. The average birth rate was 32 births per 1000 persons and there were 11.6 illegitimate births per every 100 legitimate births. Finally, the average temperature was 17.8 degrees Celsius while the hottest year was in 1901.

The implementation and growth of sickness insurance contributed to the decline in infant mortality rates after controlling for income, illegitimacy ratio, birth rate, urbanization, and temperature (Table 3.5). The first two columns present the results when the dependent variable is the infant mortality rate while the last column used a dependent variable of the logarithm of the

[27] The Arellano and Bond (1991) method uses first differences of the variables to solve the problem of the unobserved heterogeneity. Therefore, when the infant mortality rate is used as the dependent variable, the interpretation of the coefficients is the change in infant mortality rate. If the dependent variable is the logarithm of the infant mortality rate, the interpretation is a percentage point change in the infant mortality rate.

infant mortality rate. The rate of coverage significantly reduced infant mortality. An additional percentage point of the adult population covered by sickness insurance resulted in a decline in the infant mortality rate of 1.11 infant deaths per 1000 live births when the coverage rate is treated as exogenous. When sickness insurance is treated as endogenous, the extent of sickness insurance still reduces the infant mortality rate, but at the rate of 0.39 infant deaths per 1000 live births. These coefficients imply that a country that improved coverage rates by ten percentage points would reduce infant mortality by 3.9 to 11.1 deaths per 1000 live births. The model that used the logarithm of the infant mortality rate found a one percentage point increase in the proportion of the population covered by sickness insurance reduced infant mortality by 1.01 percent points. Evaluated at the mean infant mortality rate, this corresponds to a decline in the infant mortality rate of 1.62 infant deaths per 1000 live births and is comparable to the results of the untransformed dependent variable. Therefore, the results are robust to use of the logarithm of infant mortality.

Winegarden and Murray (1998) found that a ten percentage point increase in the proportion of the population covered by sickness insurance could reduce the death rate by as much as 0.9 to 1.6 per 1000 total population. The coefficient for the coverage rate suggests a similar policy change would result in a decline in the infant death rate of 3.9 to 11.1 deaths per 1000 live births. For the five countries used in their analysis and given demographic conditions in 1900, the decline in infant mortality translates into a 0.12 to 0.33 decline in the crude death.[28] This suggests that 8 to 33% of the decline in the crude death found by Winegarden and Murray (1998) can be contributed to the improvement in infant mortality.

[28] The total number of infant deaths and number of live births for Belgium, Denmark, France, Germany, and Sweden is used to find the average infant mortality rate for the five countries. The improvement in the infant mortality rate for a ten percentage point increase in the coverage rate by sickness insurance is applied to the average infant mortality to obtain a new infant mortality rate. This new infant mortality rate is multiplied by the number of live births to find the new number of infant deaths. The total number of deaths is then reduced by the reduction in infant deaths caused by the change in coverage and divided by the mid-year population (in 1000's) to obtain the new crude death rate.

Other variables affected infant mortality as expected. The average July temperature is an important determinant of infant mortality. Higher temperatures lead to diseases of the digestive system and increased the infant mortality rate. Interestingly, the illegitimacy ratio had a significant effect on the infant mortality rate while the birth rate had no effect. The infant mortality rate increased by 0.345 infant deaths per 1000 live births for every additional illegitimate per 100 legitimate births. It is possible to simulate the effect of a one percentage point change in the proportion births that are illegitimate and determine the effect on infant mortality. For example, there were 967,939 live births in Austria in 1900, of which, 13.5% were illegitimate (Flora, 1983b, pp.38, 164). If the proportion of births that were illegitimate increased to 14.5%, the number of illegitimate births would increase by 9,679. Of these 9,679 illegitimate births, nearly 4.7% or 451 would die in the first year of life because they were now an illegitimate birth. This clearly shows that illegitimacy rates could have large impacts on the survival of infants between 1878 and 1913.

3.6 Concluding Remarks

This paper addresses the role of sickness insurance in the decline in the infant mortality rate in the late 19th and early 20th centuries. The results suggest that government-sponsored sickness insurance played a role in reduction of death rates among infants. Between 1878 and 1913, the infant mortality rate declined by 0.39 to 1.11 infant deaths per 1000 live births for each additional percentage point the adult population was covered by sickness insurance. This decline in infant mortality accounts for eight to thirty three percent of the decline in mortality found by Winegarden and Murray (1998). Sickness insurance increased the access to medical care by through reduction in the price of medical care. Access allowed physicians to use and diffuse new medical knowledge that would reduce the risk of death both to the mother and child in childbirth and the first year of infancy. Also, sick-pay benefits lowered the opportunity cost of not working after childbirth. The supplemental income provided to mothers allowed for longer periods of

breast feeding and for infants to benefits from the gains of breast feeding. These factors improved infant survival in the period.

There is a need for further research on the role of sickness insurance in the decline of infant mortality. Macro-level data is necessary to see if there is an overall effect of the growth of sickness insurance coverage in Europe, but there are many local variations within a country that might lead to different results. For example, analysis of infant mortality at the local level has been done for Germany (Kintner, 1988), but they do not directly consider the role of sickness insurance. Of particular interest is how Denmark, with such a high rate of coverage for the entire population faired only marginally better then France in reducing their infant mortality rates.[29] Further, it has been suggested that most of the reduction in mortality is due to caloric intake (Fogel, 1997; 2004) although improvements in sanitation and piped water have also been suggested as a catalyst for the decline in mortality rates (Vogele, 1993; Brown, 1990; Cutler and Miller, 2005). The methodology employed in this work does not allow direct testing of these hypotheses and work by van Poppel and van der Heijden (1997) suggest it is hard to determine the effect of sanitation and piped water improvements on infant deaths.

Although there are other factors that may affect the decline infant mortality rates, the model employed accounts for these factors through the unobserved heterogeneity or lag dependent variable. The results suggest that sickness insurance contributed to a decline in the infant mortality rate and provides insight into why the United States, a country without universal social insurance, has higher infant mortality rates that other industrialized countries that have universal health insurance. Study of this period could bring further understanding to these differences through comparisons of health outcomes in countries with compulsory sickness insurance and subsidized sickness insurance schemes. For example, though Germany and Austria started with higher initial levels of the infant death rates these programs of compulsory insurance may improve health outcome more effectively than subsidized plans. This may explain why

[29] Both countries reduce infant mortality by approximately one third over the 1878 to 1913 period.

compulsory insurance eventually became the standard across Europe as France (1928-30), Denmark (1933), and other European countries moved from voluntary to compulsory insurance.

Table 3.1: Sickness Insurance Aid for Childbirth in Germany

Year	Average # of female members in all funds	Total childbirth benefits in all funds (US$)	Average benefit for childbirth per female member
1892	1,109,110	$ 288,909	$ 0.260
1893	1,184,370	392,012	0.331
1894	1,232,780	423,172	0.343
1895	1,295,949	433,641	0.335
1896	1,378,427	480,188	0.348
1897	1,461,260	516,633	0.354
1898	1,546,388	558,413	0.361
1899	1,629,995	581,637	0.357
1900	1,739,483	607,967	0.350
1901	1,805,202	622,518	0.345
1902	1,917,515	645,590	0.337
1903	2,041,501	678,622	0.332
1904	2,174,758	1,019,955	0.469
1905	2,315,406	1,089,777	0.471
1906	2,464,906	1,204,693	0.489
1907	2,625,103	1,307,406	0.498
1908	2,742,914	1,410,799	0.514

Source: Data for the average number of female members and total childbirth benefits come from pages 1232 and 1249 of the United States Commissioner of Labor (1911). Average benefit for childbirth per female member is defined as the total childbirth benefits divided by the average number of female members.

Table 3.2: Sickness Insurance and Childbirth in Austria

Year	# of childbirth benefit claims	# of sick days paid for childbirth	# of childbirth claims per 100 enrolled females	# of live births	# of childbirth benefit claims to 100 live births
1890	26,780	689,889	7.90	868,935	3.08
1891	30,757	814,814	8.50	919,503	3.34
1892	32,394	858,435	8.49	871,278	3.72
1893	36,220	943,121	8.81	923,470	3.92
1894	39,021	1,019,277	9.08	901,398	4.33
1895	41,846	1,124,522	9.13	941,184	4.45
1896	45,558	1,234,465	9.29	948,619	4.80
1897	46,999	1,278,980	9.19	944,764	4.97
1898	48,076	1,311,794	9.54	923,241	5.21
1899	49,319	1,349,566	9.36	960,205	5.14
1900	51,053	1,399,474	9.44	967,939	5.27
1901	50,842	1,390,371	9.18	961,501	5.29
1902	52,113	1,430,103	9.10	984,240	5.29
1903	51,735	1,422,459	8.70	943,953	5.48
1904	53,265	1,468,544	8.67	961,430	5.54
1905	50,696	1,434,982	7.91	921,764	5.50
1906	54,020	1,502,120	8.10	961,258	5.62
1907	55,046	1,541,076	7.98	942,169	5.84

Sources: The number of childbirth benefit claims, the number of sick days paid for childbirth, and number of childbirth claims per 100 enrolled females come from the United States Commissioner of Labor (1911, pp 274). The number of live births come from Flora (1989b, pp. 38). The number of childbirth benefit claims to 100 live births were calculated as the number of claims divided by number of live births multiplied by 100.

Table 3.3: Change in Infant Mortality Rates

	Infant Mortality Rate in Year			Change in Infant Mortality Rate		
Country	1878	1st Year of Sickness Insurance	1913	1878 to 1913	1878 to 1st Year of Sickness Insurance	1st Year of Sickness Insurance to 1913
Austria	252	236	190	-24.6%	-6.3%	-19.5%
Belgium	161	152	130	-19.3%	-5.6%	-14.5%
Denmark	138	149	92	-33.3%	8.0%	-38.3%
France	169	168	112	-33.7%	-0.6%	-33.3%
Germany	226	235	151	-33.2%	4.0%	-35.7%
Sweden	134	101	70	-47.8%	-24.6%	-30.7%

Sources: Mitchell (2003, pp. 120-124). The first year of sickness insurance refers to the first year sickness insurance was covered under the nation legislation.

Table 3.4: Summary Statistics

	Mean	Std. Dev.
Infant Mortality Rate	161.838	49.054
Sickness Insurance Legislation	0.616	0.488
Sickness Insurance Coverage Rate	9.537	10.571
GDP per capita (1,000's of GK$)	28.089	5.804
Urbanization Rate	11.415	3.811
Illegitimate Birth Ratio	11.673	6.426
Birth Rate	32.717	30.432
July Temperature (Celsius)	17.840	1.699
Sickness Insurance Coverage Rate in 1913		
Austria	18%	
Belgium	10%	
Denmark	42%	
France	14%	
Germany	31%	
Sweden	16%	

Notes: The sickness insurance coverage rate is the proportion of the population over the age of 15 with sickness insurance. GK$ stands for 1990 international Geary-Khamis dollars.

Sources: Infant mortality - Mitchell (2003); GDP per capita - Maddison (2003); sickness insurance coverage - Flora (1983a); illegitamcy ratio, urbanization rate, and birth rate - Flora (1983b); Temperature - Vose et al (1992).

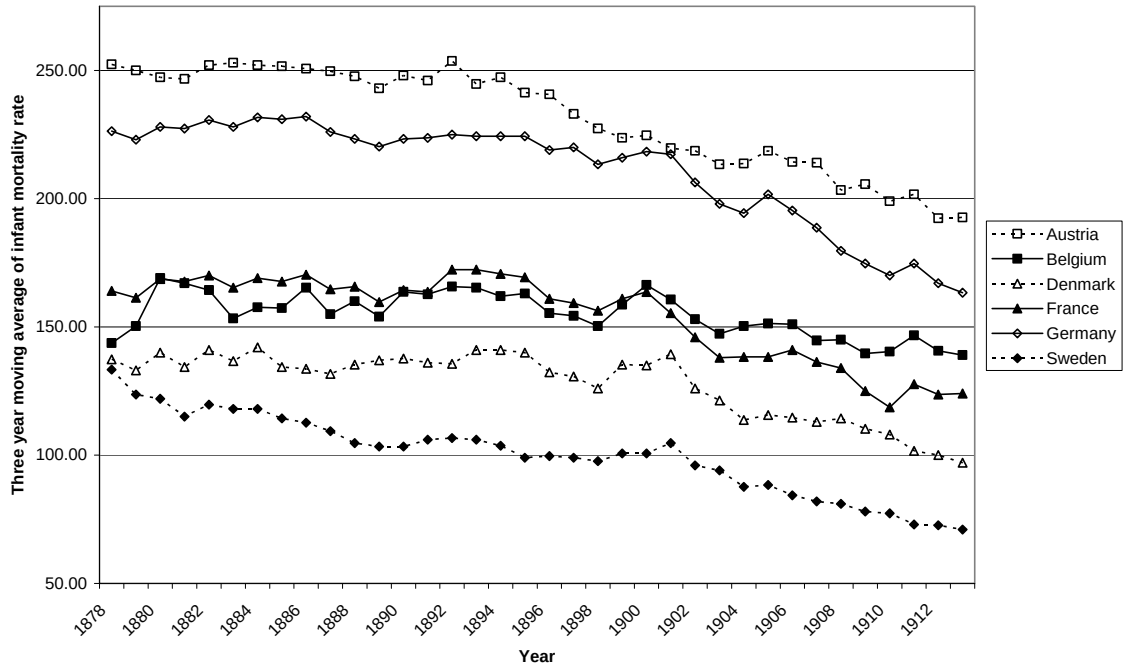
Table 3.5: Multivariate Regression Results

	Dependent Variable		
	Infant Mortality		Logarithm Infant Mortality
	Exogenous	Endogenous	Exogenous
Lag Dependent Variable	-0.187***	0.057	-0.180***
	0.070	*0.072*	*0.067*
Lag of Sickness Insurance Coverage Rate	-1.112***	-0.389*	-1.011***
	0.345	*0.211*	*0.211*
GDP per capita (1,000's of GK$)	21.759***	3.214	13.878***
	3.310	*2.049*	*2.124*
GDP per capita squared (1,000's of GK$)	-0.369***	-0.079**	-0.237***
	0.051	*0.032*	*0.033*
Urbanization Rate	-6.358***	-2.914***	-3.093***
	1.528	*0.750*	*0.953*
Illegitimate Birth Ratio	0.345***	0.205	0.244***
	0.120	*0.132*	*0.077*
Birth Rate	0.018	-0.009	0.015
	0.024	*0.027*	*0.015*
July Temperature (Celsius)	2.098***	2.255***	1.471***
	0.483	*0.558*	*0.305*

Standard errors are in italics.
* P-value < 10%
** P-value < 5%
*** P-value < 1%

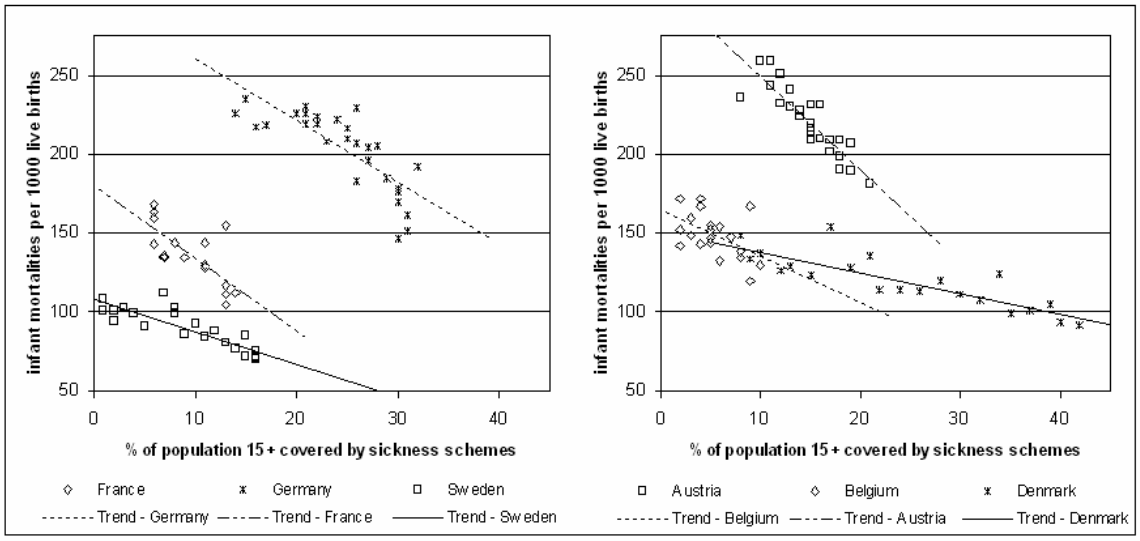
Notes: The dependent variable for each regression is the infant mortality rate or the logarithm of the infant mortality rate times 100. The models are estimated by the method proposed by Arellano and Bond (1991) for dynamic linear panel models that allows the unobserved heterogeneity to be correlated with the explanatory variables. The columns marked endogenous use the Arellano and Bond (1991) method to correction for the potential endogeneity of sickness insurance. Each model uses data from 1878 to 1913 for the countries of Austria, Belgium, Denmark, France, Germany, and Sweden. GK$ stands for 1990 international Geary-Khamis dollars.

Figure 3.1: Infant Mortality Rates In Europe: 1878 to 1913



Source: Mitchell (2003, pp. 121-4).

Figure 3.2: Infant Mortality Rates and Coverage Rates of Sickness Insurance Schemes After Passage of National Legislation



Source: Infant mortality rates are from Mitchell (2003, pp 120-4) while the percentage of the population over the age of fifteen are from Flora et al. (1983a, pp 467, 474, 481, 495, 502, 537).

Chapter 4

Demand for Antidepressants by the Elderly: Parametric and Semiparametric Approaches

4.1 Introduction

Medicare is a public health insurance program that covers most Americans aged 65 and older with basic inpatient and outpatient services, inpatient drug consumption, and other services. Prescription drugs were not covered by Medicare until Medicare Part D became effective in 2006. Medicare Part D provided drug coverage to millions of elderly Americans that did not have coverage prior to 2006. However, those Medicare recipients that did have coverage had it through non-Medicare means, such as, Medicaid, state low-income prescription plans, employer retirement health plans, or self-purchased supplemental insurance. It was important for policy makers to know how the choice to purchase supplemental drug coverage affected the amount spent on pharmaceuticals when they designed Medicare Part D. However, the estimation techniques employed to estimate demand for medical care suffer from a number of econometric issues.

The first econometric problem is censoring. The latent demand for medical care is unobservable for these people that do not have expenditures. A common solution to this problem is to set demand for those people with no expenditures to zero, but this censors the latent demand. If ordinary least squares is used to estimate demand when the latent demand is censored at zero the parameter estimates will be biased. The Tobit model is a method proposed by Tobin (1958) to solve the censoring problem if the error term is normally distributed. The normality of the error term is not a common feature in models that estimate medical expenditures. Therefore, use of the Tobit model could also lead to biased parameter estimates.

A second approach to the censoring problem is the two-stage model (Heckman, 1979). In this approach, the amount of medical care is estimated in two stages. In the first stage, the

probability an individual purchases a positive amount of medical care is estimated by a binary discrete choice model. In the second stage, the demand for medical care is estimated for those persons with positive demand. Since the estimation of the second stage for only individuals with positive demand leads to a selection bias problem, estimates from the first stage are used to correct for the bias. This correction is referred to as a Heckman correction. Although the two-stage model corrects for censoring it still has drawbacks. The first drawback to the two-stage model is that the first stage requires distributional assumptions. The second drawback is the identification of the parameter estimates in the second stage requires an exclusion restriction. That is, there must be a variable available in the data that significantly explains the probability of positive expenditures but not the level of expenditures. In medical data, an exclusion restriction is often not available.

Besides censoring, another problem that occurs in the estimation of medical expenditures is the skewness of the data. When linear regression is used and the dependent variable has a skewed distribution, the parameter estimates can be biased due to misspecification. The most common method employed to handle the skewness in medical expenditures data is to transform the dependent variable. The most common transformation in medical expenditure studies is the natural logarithm of medical expenditures (Buntin and Zaslavsky, 2004).[30] However, the transformation of the dependent variable can still give biased parameter estimates if the transformation does not closely approximate the true distribution of the data. Further, the estimated parameters of interest in empirical work on medical demand are from the untransformed model. If the natural logarithm transformation is used, a common method to convert the parameter estimate back into untransformed estimates is to use the smearing method developed by Duan (1983). The smearing method takes the averaged exponential of the transformed residuals to create a smearing factor. This factor is used to adjust the transformed

[30] One of the first papers to use this method to estimate medical expenditure data was Manning et al (1987). They recognized that the skewness in the medical expenditures failed to result in approximately normal errors and used the logarithm of the dependent variable to approximate normal errors.

parameter estimates to obtain untransformed parameter estimates. The challenge with the smearing method is the untransformed parameter estimates are only unbiased if the error term is independent of the explanatory variables and has constant variance (Buntin and Zaslavsky, 2004).

Although there are multiple solutions to the problem of censoring and the skewness of the dependent variable most parametric methods require strict distributional assumptions that are not common in medical data. Semiparametric estimators are a solution to these problems that does not make strong distributional assumptions. Semiparametric least squares (SLS) developed by Ichimura (1993) is an estimator that allows for an unknown distribution of the dependent variable.[31] This paper compares the differences in parametric and semiparametric approaches to the estimation of medical expenditures. The application is the estimation of demand for antidepressant drugs in the elderly Medicare population with an emphasis on the effect of supplemental insurance on out-of-pocket (OOP) expenditures.

4.2 Data

The data used comes from the 1995 and 2000 Medicare Current Beneficiaries Survey (MCBS) Cost and Use files. The Centers for Medicaid and Medicare Services (CMS) created MCBS with the purpose of providing a national representative sample of the Medicare population to estimate health use and expenditures. Information on health care utilization and cost, health insurance coverage, health status, demographic characteristics, and economic characteristics are collected from claims data of Medicare reimbursements or interviews with Medicare beneficiaries.[32]

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[31] SLS original was originally proposed to estimate the model $Y = f(X\beta) + \varepsilon$ where f is an unknown function. The model can be rewritten as $g(Y) = X\beta + \varepsilon$ to allow for skewness and censoring of the dependent variable.

[32] Further details on the MCBS are available from Centers for Medicare and Medicaid Services (2003) and Adler (1994).

To examine OOP expenditures on antidepressants, individuals that dwelled in the community for the full-year, were age sixty-five or older, and enrolled in Medicare for the full year were identified. Further, only non-Hispanic white and black individuals that lived in the fifty states were included in the sample. Data on individuals that were not enrolled in Medicare for the full year or spent time in a nursing home were not included because full year data on their costs and utilization were not available. The final sample size was 15,343 persons of which 7,460 and 7,883 persons were from years 1995 and 2000.

The prescribed medical events file of MCBS is used to identify all persons that were prescribed antidepressants. The file contains a record for each prescription and contains information on the generic or brand name of each drug, dosage, number of pills, payment sources, and expenditures on the prescription by various payment sources. Antidepressant prescriptions were identified by brand and generic names.[33] To find the total OOP expenditures on antidepressants for each individual, the OOP expenditures for all antidepressant prescriptions in the year are summed.

Explanatory variables include the demographic characteristics of gender, race, education, and marital status. Economic variables include income, insurance premiums, and different types of insurance coverage. Health characteristic variables are used in the estimation to determine the presence of chronic diseases and capture the general health condition of the individual. Binary variables are created to represent if a physician ever told a person they had the following medical conditions: hypertension, heart disease including acute myocardial infarction, cancer, diabetes, and mental disorder. As a predictor of morbidity, a scale from 0 to 6 is constructed to represent the number of limitations a person has in activities of daily living (ADLs) and instrumental ADLs (IADLs). The measure for ADLs is comprised of the total number of "yes" responses to having

[33] The specific drugs that were classified as antidepressants in 1995 and 2000 were identified in the 2002 *Physician's Desk Reference*: Amitriptyline, Amoxapine, Desipramine, Doxepin, Imipramine, Maprotiline, Nortriptyline, Protriptyline, Trimipramine, Clomipramine, Buprpoion, Trazodone, Venlafaxine, Nefazodone, Mirtazapine, Phenelzine, Isocarboxazid, Tranylcypromine, Fluoxetine, Citalopram, Fluvoxamine, Sertraline and Paroxetine.

difficulty in the personal care tasks of bathing or showering, dressing, eating, getting in and out of chairs, walking, and using the toilet. Difficulties in day-to-day tasks are used for the measure of IADLs. These include difficulty in using a phone, doing light or heavy housework, making meals, shopping, and managing money.

All prices and incomes for 1995 are adjusted to 2000 price levels. Various components of the consumer price index are used to make these adjustments. OOP expenditures are inflated by the "prescription drug and medical supplies" subcategory of "medical care," corresponding to a 21.4% increase in price over the period. An 18.6% increase is applied to the total amount of insurance premium reflected in the "medical care services" subcategory of "medical care," while income is increased by 13% to reflect the overall consumer price index.

The average total OOP expenditures on antidepressants rose by 27% from 1995 to 2000 for those people who were prescribed at least one antidepressant medication (Table 4.1). For the entire sample, OOP expenditures on antidepressants rose from $8.89 in 1995 to $17.53 in 2000. Further, the proportion of the sample that filled at least one antidepressant prescription increased from 8.4% to 13%. Medical researchers have attributed this rise in use of antidepressants to the reduced social stigma associated with depression and the introduction of new antidepressants with more tolerable side-effects (Delgado 2000). This may also account for the increase in the prevalence of the number of persons told by a doctor they had or have a mental illness (Table 4.2).

4.3 Econometric Method

The estimation of OOP expenditure on antidepressants suffers from the skewness and censoring problems discussed in the previous section. Therefore, the OOP expenditures for person that did not purchase antidepressant medications were replaced with zeros. That is,

$$Y_i = \max\left\{0, Y_i^*\right\}$$

where Y_i^* is latent OOP expenditures that are generated by the model

$$Y_i^* = f(X_i;\beta) + \varepsilon_i \quad (1)$$

for individual *i*. The vector *X* represents the set of explanatory variables described in Table 4.2 and β is a parameter to be estimated. This setup can be estimated by a two-stage or Tobit model. Since a variable that explains why physician prescribe antidepressants but does not explain the amount of OOP expenditures on antidepressants is not available the Tobit model is employed. The Tobit model assumes that the error term is normal and the function *f* is linear.

Since the functional form of *f* is unknown and the error term is not normally distributed, a semiparametric estimator that empirically estimates the function *f* and does not require normality of the error term is estimated. The semiparametric estimation technique employed is semiparametric least squares (SLS) developed by Ichimura (1993).[34] SLS makes no parametric assumptions on the distribution of the error term and weaker assumptions on the functional form of equation (1). The SLS model is defined as

$$Y_i = f(v_i) + \varepsilon_i$$

where *f* is unknown and the exogenous covariates enter as a single index, v_i. The single index v_i is defined as $Z_i\beta = \beta_1(Z_{1i} + Z_{2i}(\beta_2/\beta_1)) \equiv \beta_1(Z_{1i} + Z_{2i}\delta) \equiv \beta_1 v_i$ where Z_{1i} is a continuous variable with associated non-zero parameter value β_1, and Z_{2i} is a row vector of variable with parameter vector β_2 that does not include a constant. Estimates of δ can be identified (i.e. β up to location and scale) as a consequence of not imposing a known functional form to *f*. The estimates of δ are found by maximizing a likelihood function similar to non-linear least squares but uses kernel density estimation to estimate the condition expectation of *Y*.

[34] There are three different semiparametric censored regression estimators that could have been used (*censored least absolute deviation, symmetrically censored least squares,* or *identically censored least squares*) however, there is no literature comparing the efficiency of SLS to these methods. A review of these three estimators is given by Chay and Powell (2001).

Since the model does not identify β, the marginal effects are used to determine the difference in effects of variables between the Tobit and SLS models. For binary variables the average marginal effect is defined as the averaged difference in the expected value of those in the group verses those not in the group. Average marginal effects will be taken for the entire sample and across quartiles of explanatory variables to capture differences along the distribution of continuous variables.

4.4 Results

Table 4.3 reports the estimates of β, standard errors, and p-values associated with the maximum likelihood estimation of the parametric Tobit model of OOP expenditures for the year 1995 and 2000 samples. The choice of an individual to have supplemental medical insurance that does not include drug coverage increases OOP expenditures while supplemental insurance that covered prescription drugs lowers OOP expenditures. This is expected since supplemental medical insurance increases access to physicians and increases the probability of prescription antidepressant medication. In contrast, supplemental drug coverage reduces the cost of OOP expenditures if the antidepressant is purchased.

The variable for insurance premium is positive for both years suggesting that those who seek insurance with higher premiums are doing so because they have higher medical expenses, although the result is only significant for the 1995 data. The demographic characteristics of being male, black, older, and living in the northeast United States reduce the amount of OOP expenditures on antidepressants for both years. In contrast, individuals with any type of comorbid condition, including difficulties in daily living, have increased OOP expenses. Those persons with a history of mental illness were found to spend $384 more OOP for antidepressant than those without a history of mental illness. Cancer is of particular interest among the health status variables. Both in 1995 and 2000, the presence of cancer increased OOP costs. This may

suggest that antidepressants are used as supplemental treatment for cancer due to the psychological burden of the disease.

The SLS model is dependent on having a continuous variable with non-zero parameter to use as Z_{1i}. The single index model is estimated with age as this continuous variable since the variable is significant at the 10% in the Tobit estimation for both years. The estimates, standard errors, and p-values of the SLS estimation are reported in Table 4.4. Since the exact functional form of the model is unknown and the estimates are ratios of parameters. This implies interpretation of the parameters requires the estimation of marginal effects.

Table 4.5 reports the average marginal effects for select variables associated with the OOP expenditures models for the year 2000 sample. The directions of the marginal effects are the same for both the Tobit and SLS modeling approaches except for the urban variable. Tobit predicts elderly individuals living in an urban environment can expect to spend $1.31 less on OOP antidepressant costs compared to individuals living in a rural setting. The SLS model finds the opposite situation, with an urban dwelling individual expected to spend $2.51 more on antidepressants.

Both approaches predict that elderly individuals enrolled in Medicare HMOs have higher OOP expenditures on antidepressants although the effect is larger in the Tobit model. In contrast, the SLS model finds a larger reduction in OOP costs from supplemental drug coverage. The effect of insurance premiums on expenditures does not vary between the two models when the marginal effect is averaged over the entire sample. However, when marginal effects are calculated for the quartiles of the premium variable there are some differences between the approaches. In the parametric model, there is an estimated increase in OOP expenditures as the annual premiums increase. For example, the individuals in the lowest quartile of insurance premiums increased OOP expenditures by 10 cents but those in the highest quartile increased but 12.5 cents for every $100 increase in the insurance premium. The semiparametric method has no significant pattern.

College education results in an almost negligible effect on expected expenditures in the parametric model compared to an increase of $4.60 in the semiparametric model. Similarly, the SLS model finds larger impact on OOP expenditures for the age and race of the individual than the Tobit model.

4.5 Concluding Remarks

Most of empirical studies that analyze medical expenditures employ parametric estimation techniques that require distributional assumptions to handle the skewness and censoring of medical expenditures data. Censoring can be handled either through implementation of the Tobit or two-stage approaches while skewness is handled by transformation of the dependent variable. In both these cases, incorrect distributional assumptions can result in biased parameter estimates. Further, transformations change the interpretation of parameters often in a manner that is not of interest to policy makers.

Since SLS does not make strong distributional assumptions and provides unbiased parameter estimates if the data is censored and skewed, it is a solution to both problems. This paper compares the choice to have supplemental drug coverage on elderly OOP expenditures for antidepressants if the model is estimate parametrically by Tobit and semiparametrically by SLS. Both approaches found supplemental drug coverage reduced OOP expenditures, but the magnitude of the change differed. Specifically, the semiparametric model finds that the effect of supplement drug coverage is larger than if the model was estimated by Tobit. Further, the Tobit model incorrectly suggested that individuals in rural areas spend more OOP on antidepressants than individuals in urban areas. Failure to fully address the econometric problems associated with medical data could result in biased parameter estimates and policy decisions made on incorrect models.

Although SLS solves the censoring and skewness problem a topic of further research is a third problem that exists in modeling medical expenditures. In most contexts, the choice to enroll

in supplemental insurance by an individual is not exogenous (Ettner, 1997; Mello et al., 2002; Zweifel and Manning, 2000).[35] Estimation techniques have been developed to handle endogenous dummy variables in a parametric context. For example, Coulson et al. (1995) employed a two-stage procedure to account for the endogeneity of insurance although the technique required strict distributional assumptions. One possible extension of this paper is to develop an estimation technique that corrects for an endogenous dummy variable and solves the problem of censoring and skewness without use of strict parametric assumptions. At this moment, it is unknown to the author if such a method exists.

[35] One reason insurance choice is endogenous in estimation of medical expenditure is persons with higher expected medical expenditures may decide to enroll in insurance plans that have lower OOP costs. Another is when demand for medical care is not perfectly inelastic. Since insurance reduces the price of medical care individuals with insurance may increase demand than if they were uninsured.

Table 4.1 - Mean Out-of-Pocket Expenditures by Antidepressant Users			
	1995	2000	1995 and 2000
Sample Size	630	1022	1652
OOP Expenditures	$ 106.28	$ 135.24	$ 124.19
(2000 $)	(181.558)	(217.322)	(204.850)
Note: Standard deviations are in parentheses.			

Table 4.2 - Summary Statistics of Dependent and Independent Variables

	1995	2000	1995 and 2000
Sample Size	7460	7883	15343
Dependent Variables			
Antidepressant User	8.44%	12.96%	10.77%
	(.2781)	(.3359)	(.3099)
OOP Expenditures	$ 8.98	$ 17.53	$ 13.3724
	(60.4417)	(90.4540)	(77.4462)
General Exogenous Variables			
Age	76.88	76.54	76.70
	(7.1826)	(6.9530)	(7.0674)
Male	41.57%	41.99%	41.78%
	(.4929)	(.4936)	(.4932)
Black	9.50%	9.72%	9.61%
	(.2933)	(.2962)	(.2947)
Married	50.79%	52.39%	51.61%
	(.5000)	(.4995)	(.4997)
Urban	71.31%	71.13%	71.22%
	(.4523)	(.4532)	(.4527)
Northeast	19.97%	19.94%	19.96%
	(.3998)	(.3996)	(.3997)
College or Higher Education	12.63%	15.11%	13.90%
	(.3322)	(.3582)	(.3459)
Income (1000's $)	$ 25.17	$ 28.65	$ 26.96
	(34.3790)	(41.3040)	(38.1330)
Health Insurance Variables			
Medicaid	11.62%	9.32%	9.815%
	(.3044)	(.2908)	(.2975)
Medicare HMO	11.62%	20.84%	16.359%
	(.3205)	(.4062)	(.3699)
Supplemental Medical Coverage	71.81%	66.47%	70.07%
	(.4500)	(.4721)	(.4622)
Supplemental Drug Coverage	50.74%	62.50%	56.78%
	(.5000)	(.4841)	(.4954)
Health Insurance Premiums (100's $)	$ 7.60	$ 8.26	$ 7.94
	(9.7403)	(9.8461)	(9.8001)
Health Status Variables			
ADLs	.6958	.5766	.6346
	(1.3267)	(1.1827)	(1.2561)
IADLs	.5676	.5291	.5478
	(1.1227)	(1.0928)	(1.1075)
Hypertension	55.97%	59.85%	57.96%
	(.4965)	(.4902)	(.4936)
Heart Disease	40.60%	25.07%	32.62%
	(.4911)	(.4334)	(.4688)
Cancer	20.21%	19.03%	19.60%
	(.4016)	(.3925)	(.3970)
Diabetes	16.66%	16.72%	16.69%
	(.3727)	(.3732)	(.3729)
Mental Disorder	3.20%	6.96%	5.135%
	(.1761)	(.2546)	(.2207)

Note: Standard deviations are in parentheses. All dollar values are in year 2000 dollar terms.

Table 4.3 - Tobit Model of Out-of-Pocket Expenditures on Antidepressants for 1995 and 2000

	1995			2000		
	Coefficient	Std Error	P-Value	Coefficient	Std Error	P-Value
Age	-1.922	0.964	0.046	-1.636	0.924	0.077
Male	-92.149	14.797	0.000	-66.784	13.498	0.000
Black	-103.764	27.404	0.000	-65.043	23.011	0.005
Married	24.553	14.537	0.091	-12.994	13.564	0.338
Urban	-20.269	14.257	0.155	-11.180	13.820	0.419
Northeast	-38.728	16.991	0.023	-30.900	15.803	0.051
College or Higher Education	4.374	20.247	0.829	-0.985	20.799	0.962
Income (1000's $)	0.117	0.188	0.535	-0.017	0.138	0.901
Medicaid	-29.192	25.314	0.249	-48.768	23.996	0.042
Medicare HMO	-12.956	24.654	0.599	22.179	19.256	0.249
Sup. Medical Coverage	17.516	19.018	0.357	48.877	18.146	0.007
Supplemental Drug Coverage	-17.935	14.055	0.202	-36.845	13.883	0.008
Sup. Insurance Premium	1.686	0.558	0.003	0.958	0.679	0.159
ADLs	23.953	4.920	0.000	16.539	5.209	0.002
IADLs	7.138	5.786	0.217	18.492	5.647	0.001
Hypertension	27.587	13.290	0.038	24.073	12.712	0.058
Heart Disease	41.309	13.018	0.002	42.569	13.566	0.002
Cancer	12.492	15.106	0.408	47.203	14.266	0.001
Diabetes	60.016	15.840	0.000	39.913	15.488	0.010
Mental Disorder	297.812	24.914	0.000	384.418	18.189	0.000
Constant	-321.486	78.551	0.000	-330.352	74.798	0.000
σ	287.083	9.587	0.000	315.971	8.054	0.000

Table 4.4 - SLS Model of Out-of-Pocket Expenditures on Antidepressants for 2000

	2000		
	Coefficient	Std Error	P-Value
Male	13.663	6.295	0.030
Black	32.799	11.985	0.006
Married	6.424	4.979	0.197
Urban	-8.104	3.749	0.031
Northeast	5.213	4.996	0.297
College or Higher Education	-13.074	6.713	0.051
Income (1000's $)	0.030	0.133	0.819
Medicaid	12.886	6.153	0.036
Medicare HMO	-1.276	4.401	0.772
Supplemental Medical Coverage	-9.986	2.488	0.000
Supplemental Drug Coverage	21.081	7.178	0.003
Supplemental Insurance Premium (100's $)	-0.458	0.209	0.028
ADLs	-0.641	0.756	0.397
IADLs	-13.779	3.402	0.000
Hypertension	-4.923	3.276	0.133
Heart Disease	-13.496	4.907	0.006
Cancer	-5.827	1.969	0.003
Diabetes	-9.418	4.992	0.059
Mental Disorder	-83.901	27.056	0.002

Note: Each estimate is of the ratio, delta, with respect to continuous variable age.

Table 4.5 - Average Marginal Effects for Select Variables (Year 2000)

	2000			
	Tobit		SLS	
Age	-0.189		-0.318	
1st Quartile		-0.188		-0.338
2nd Quartile		-0.178		-0.306
3rd Quartile		-0.195		-0.324
4th Quartile		-0.197		-0.304
Male	-7.500		-4.314	
Black	-6.665		-9.141	
Urban	-1.314		2.514	
College or Higher Education	-0.114		4.602	
Northeast	-3.433		-1.633	
Medicaid	-5.172		-4.033	
Medicare HMO	2.666		0.410	
Supplemental Medical Coverage	5.457		3.248	
Supplemental Drug Coverage	-4.375		-7.285	
Supplemental Insurance Premium (100's $)	0.108		0.147	
1st Quartile		0.103		0.154
2nd Quartile		0.102		0.138
3rd Quartile		0.117		0.147
4th Quartile		0.125		0.150
Hypertension	2.759		1.550	
Heart Disease	5.182		4.409	
Cancer	5.858		1.945	
Diabetes	4.930		3.118	
Mental Disorder	92.533		74.388	

Note: The average marginal effect of a continuous variable is defined as the increase in one unit of the variable.

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Vita

John R. Bowblis

2004 -2008 Ph.D in Economics, Rutgers University, New Brunswick, New Jersey

2002-2004 M.A. in Economics, Rutgers University, New Brunswick, New Jersey

1999-2002 B.S. in Economics, King's College, Wilkes-Barre, Pennsylvania

2007-2008 Research Economist, Princeton Economics Group

2003-2008 Graduate Assistant, Institute for Health, Health Care Policy and Aging Research, Rutgers University

2003-2008 Instructor, Department of Economics, Rutgers University

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