The Role of Asymmetric Information in the U.S. Health Insurance Market

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THE ROLE OF ASYMMETRIC INFORMATION IN
THE U.S. HEALTH INSURANCE MARKET

By

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To my four amazing children - Kylie, Jackson, Ellie and Tycen.
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ABSTRACT

This dissertation examines several key aspects regarding health insurance policies in the United States. The development of the United States health insurance market began in the 1920s with life insurance companies selling traditional indemnity health insurance plans and hospitals offering hospital care plans on a pre-paid basis. This market has evolved over the last century into a heavily regulated market dominated by employer-sponsored, managed-care plans. Reviews in the introduction of this dissertation include the overall market, health insurer evolution, the history of managed care operations, the progression of employer-sponsored health insurance plans and regulation specific to health insurance. Analysis of health insurance market evolution can offer a better understanding of how past developments in U.S. health care can inform and shape future policy.

The second chapter of this dissertation provides an analysis of adverse selection in the U.S. health insurance market. Adverse selection is a phenomenon inherent in insurance contracting. Using a rich, unique dataset consisting of multiple insurers, across states for the years 2013-2015, I document a correlation between coverage and risk. Results show that adverse selection is present both in the individual and group markets. Additionally, I test for the presence of adverse selection by state and by insurer. I find that factors such as the health of the state population, regulatory environment, insurer competition and insurer size are not associated with the likelihood that a state or and insurer experiences the presence of adverse selection.

The third chapter of this dissertation relates adverse selection and consumer satisfaction in health insurance plans. I exploit a dataset rich with respondent demographics and health insurance plan information to evaluate the relationship between adverse selection and health insurance plan
satisfaction. I find that respondents who are more likely to have adversely selected into the health insurance plan are more satisfied with their plan. This is evidence that respondents may use private information on their risk level to choose plans to their advantage.
CHAPTER 1
INTRODUCTION

1.1 Introduction to Health Insurance in the U.S.

The health care industry in the United States represents a significant portion of the economy. In 2015, spending on health care represented nearly eighteen percent of GDP.¹ What began as Baylor University Hospital in Texas offering care on a prepaid basis has grown into a multi-trillion dollar sector of the economy (Batten and Hider 1979).² Traditional indemnity plans have given way to plans heavily managed by health insurers. Group health insurance plans now comprise nearly sixty percent of the market while individual purchases make up a mere eight percent of health insurance plans. Health insurance plays a key role in the health care industry. Of the $3.2 trillion, or $9,990 per person, spent on health care in 2015, $1.1 trillion was spent on private health insurance.³ Individuals in the U.S. spent another $338.1 billion out-of-pocket for health care. One-third of all expenditures were spent on hospital care with another twenty percent of expenditures on physician and clinical services. Prescription drug expenditures comprised ten percent of all health care spending. All developed nations have some form of universal healthcare. The U.S. is one of only two developed countries with a privatized health care market, where

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¹ Centers for Medicare and Medicaid Services (CMS). (2015). “National Health Expenditures 2015 Highlights.” Figure 1 offers an overview of expenditures in the U.S. from 1960-2015. See Figure 1 for development of health care spending over time in the United States.

² Prior to the pre-paid plans of the 1930s, “hospital associations” were developed in the late 1800s by railroad companies to serve sick or injured employees (Reed, 1965).

³ CMS (2015). Health insurance through the group or individual market, not government-subsidized plans such as Medicaid and Medicare.
payment of health care is outsourced to a third party.\(^4\) Despite this privatization of health care, health insurance is a heavily regulated sector.

Projections of future health care expenditures estimate that by 2022, health care spending will represent twenty percent of GDP, with an average private health insurance spending growth of 5.8 percent per year to 2022 (Cuckler et al., 2013). Indeed, in 2016, the U.S. spent more per capita on health care than any other developed nation. See Figure 2. Continually rising health care costs in the U.S. are attributed to a number of reasons including advances in technology, cost insulation due to third-party payers, employment-based health insurance, state-mandated benefits, increased spending on prescription drugs, cost shifting by government-sponsored plans such as Medicare and Medicaid, high administrative costs and defensive medicine (Rejda and McNamara, 2014). Ongoing regulatory changes, increased demand for services, and an overall unhealthy population are a few of the reasons to suspect that health care spending will remain an important part of the U.S. economy.

Health insurance contracts reflect competing incentives of insureds and insurers. From a supply-side perspective, insurers seek to contain health care costs despite strict state and federal regulation on health care markets (Cutler and Zeckhauser, 2000). Conversely, insureds seek to utilize benefits associated with the policy (Freeman et al., 2008). Further, insurance contracts are executed in an environment in which a variety of other stakeholder interests – e.g., those of employers, health care providers, and state and federal governments – are at play. The interrelated characteristics and differing incentives of these various participants create a complex market with

\(^4\) Switzerland also has a market where health care is outsourced to the private market (Chaufan, 2014) but since the mid-1990s, health insurance has been required in Switzerland and virtually everyone purchased it (Cutler and Zeckhauser, 2000).
significant economic obstacles (Cutler and Zeckhauser, 2000). Life and health insurers write business through employer-sponsored groups, through direct purchase and through government-sponsored plans. Insureds seek care through providers who are often contracted with insurers to provide care at discounted rates. Employers subsidize health insurance premiums as an employee benefit. Federal and state governments offer subsidized plans to insureds below certain income thresholds and to the elderly. The differences in incentives between the supply- and demand- sides create agency problems within the health insurance contract, which are controlled either by the discouragement of excess utilization on the demand side or rationing utilization from the supply side by offering financial incentives to providers who exercise moderation in care (Cutler and Zeckhauser, 2000).

The importance of research in health insurance is motivated by the fact that health care is a common need. Virtually every person will receive health care services at some point in their lifetime and seventy percent of those services are paid for by health insurance. The importance of the role of health insurance in the payment of health care expenditures, therefore, cannot and should not be ignored. The purpose of this essay is to provide a comprehensive overview of the historical developments in the health insurance industry in the U.S. Analysis of the health insurance market evolution can offer a better understanding of how past developments in U.S. health care – e.g., the consequences of regulatory intervention – can inform and shape future policy. The overview therefore provides links to many of the important research papers addressing these developments.

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This essay proceeds as follows. The next section provides a history of health insurance in the United States. The third section offers an overview of the evolution of health insurance plans from traditional indemnity-based coverage to managed care. The fourth section provides an overview of regulation pertinent to health insurance contracts. In the fifth section, a discussion of group health insurance markets is outlined. A final section concludes.

1.2 History of Health Insurance in the U.S.

Health insurers have evolved significantly since their advent in the early twentieth century. Prior to the first hospital prepaid plan, health insurance was generally issued in conjunction with disability policies (Murray, 1975). The first policy for prepaid hospital care was offered in the 1920s. These types of policies led to the formation of Blue Cross plans in 1929. Despite the growing prominence of health insurance and Blue Cross plans, physicians were wary of third party payers for physician services. Indeed, physicians doubted the need for a third party between the physician and the patient (Emanuel, 2014). To compete in the growing health insurance market but still keep some control between physician and patient, medical societies began offering coverage for physician services. The first offering of physician coverage offered by Blue Shield plans in 1939. Physicians served on the boards of Blue Shield plans to control the quality of care for patients. In 1982, the Blue Cross Association and the National Association of Blue Shield Plans merged to become Blue Cross Blue Shield (BCBS) Association, an organization that currently consists of thirty-six independent and locally operated health insurers.

6 Blue Cross and Blue Shield merged in 1982 to form the BlueCross BlueShield Association, licensing for-profit and government-sponsored plans.
7 https://www.bcbs.com/about-us/blue-cross-blue-shield-system Currently, Anthem BlueCross BlueShield (formerly WellPoint, Inc.) is the largest for-profit managed health care company within the BlueCross BlueShield Association.
Traditional life insurers began selling health policies in the 1930s (Batten and Hider, 1979). The plans offered by life insurers were initially indemnity plans where the insured was not restricted in the choice of provider and expenses were covered on a fee-for-service basis. The advent of managed care policies in the 1970s gave rise to managed care organizations and the formation of health insurers. The top five health insurers in 2015 were UnitedHealth Group, Anthem Blue Cross Blue Shield, Aetna, Cigna, and Humana. Three of these top five health insurers sell a portion of their health business as life insurers. These three are UnitedHealth Group, Aetna, and Cigna. These insurers report managed care business as health insurers but report the remainder of their business in, for example, preferred provider organizations (PPO) as life insurers.

Initially in health insurance, medical expense policies were offered as either “basic” or “major medical” coverages. Basic policies had little to no deductible and coverage began with the first day of hospital confinement and the first dollar spent. Conversely, major medical plans typically had higher deductibles and were meant to mitigate the low-frequency but high-severity risk of catastrophic illness. In major medical plans, a broad array of services was covered subject to the insured meeting the deductible requirements. The policies also had coinsurance clauses when expenditures exceeded the deductible requirement. These major medical policies, also known as traditional indemnity policies or fee-for-service plans, allowed for insured choice in

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8 The evolution of managed care plans is discussed below in the “Managed Care” section of the essay.
10 PPOs are discussed further below.
provider. The cost-sharing functions of health insurance plans of the twenty-first century are largely patterned after these major medical expense plans.

Health insurance plans offered today have elements of the traditional indemnity plans but are largely managed by the health insurer. In conjunction with providers, health insurers manage insured utilization of the policy in an effort to control costs. This utilization management has become a leading component of health care policies. Less than one percent of policies in force now are traditional indemnity plans (KFF, 2016). The cost-effectiveness of managed care plans allows insurers to offer plans at reduced overall costs, making managed care plans more appealing to both insureds and insurers, alike. However, the restricted choice in providers that often accompanies these plans can cause insureds to fear that their health plans will fail when most needed (Blendon et al., 1998).

1.3 Managed Care

Unlike the policies of the earlier twentieth century, which were largely indemnity plans, the majority of health insurance plans offered today have a managed care component (Kongstvedt, 2012). Managed care policies allow the insurer to offer policies at a lower price but at the cost of freedom of choice for the patients. The first recorded example of a managed care policy was sold in 1910 where a clinic in Washington offered a broad range of services for a premium (capitation payment) of $.50 per member per month (Fox and Kongstvedt, 2013). However, managed care policies did not truly emerge until the 1970s, stimulated by the Health Maintenance Organization Act of 1973, which required employers with 25 or more employees to offer HMO

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11 The health insurance market has evolved from traditional indemnity plans offered by hospitals or life insurers in the 1930s to the managed care plans that dominate the market today. These hospital policies were the start of Blue Cross organizations (Cutler and Zeckhauser, 2000).
options (Dorsey, 1975). HMOs were a stark difference to existing plans on the health insurance landscape. In contrast to traditional indemnity plans, HMOs restricted patients to a specific network of providers. Obtaining care outside of the HMO network often meant the patient had no coverage through the health insurance policy. A key component of the HMO plan is the requirement of a “gatekeeper” physician or primary care provider. This gatekeeper is the provider who refers the insured to any other providers, e.g., specialists. HMOs focused on preventative care, therefore coverage for services such as wellness check-ups and vaccinations were often offered free of deductible and coinsurance stipulations. In the early 1980s, ninety-two percent of health plans were traditional indemnity plans with the remaining eight percent of plans comprised of HMO plans. By the 1990s, ninety-six percent of plans included some form of managed care and the remaining four percent were traditional indemnity plans (Cutler and Zeckhauser, 2000). By the beginning of the twenty-first century, managed care plans dominated the health insurance market and most insureds faced at least some forms of restriction in both provider choice and services obtained.

In managed care plans, utilization management is the cornerstone of cost savings. The insurer has control over insured choice of provider and the insurer works closely with the provider to manage the care provided to the insured. Health insurers create “networks” by contracting with specific providers to obtain discounted services. Insureds have a financial incentive to seek care from in-network providers. If the insured obtains care out of the network, they often pay more out-of-pocket, or perhaps all of the expenses incurred. Many managed care organizations contract with providers through capitation agreements. These agreements stipulate that the provider adhere to a specific list of services for a fixed dollar amount per patient per unit of time, usually per month.
(Berwick, 1996). These fees are typically paid to the provider, in advance, for the delivery of health care services.

The evolution of managed care continued with the introduction of Preferred Provider Organizations (PPO). PPOs were created as a mechanism for reducing cost without sacrificing the insured’s freedom of provider choice or increasing insured’s cost sharing (Gabel and Errman, 1985). They provide elements of managed care with a less restrictive approach than HMOs (Smith and Bentley, 2000). Patients can obtain coverage outside of the PPO network for a higher shared cost. In contrast to the HMO plan, patients are not required to employ a gatekeeper physician in the PPO. Point of service (POS) health plans offer an intersection of the HMO and PPO plans. The POS patients are required to have a primary care physician, but patients with POS plans can obtain services out of network, albeit at a higher price.

By the close of the twentieth century, there was a backlash against managed care plans. Supply-side constraints of health care, or insurer utilization management, had insureds feeling too restricted in choices. Benefit denials and excessive utilization management of medically necessary services led to public dissatisfaction with managed care plans. States enacted laws to impose restrictions on managed care standards. In the 1990s, there were approximately nine hundred state laws enacted to govern the practices of managed care organizations (Cauchi, 1999). Quality of health care in the U.S. was questioned as health care costs were continuing to increase but insureds felt too restricted in access to care. More spending on health care seemed to have little effect on the quality of care provided. Indeed, a number of studies have examined the correlation between greater expenditures and increased quality of care. The findings are consistent among studies: higher spending does not equate to better quality of care (Fisher et al., 2009).
The Medicare Modernization Act of 2003 introduced a specific type of consumer-directed health plan, health savings accounts (HSA), where individuals could set aside wages subject to tax-preferred treatment for the use of approved health care expenditures. Offered through employer-sponsored plans, employers and employees can both contribute to the HSA on a pre-tax basis. In the mid-2000s, to meet consumer demand for lower cost policies with less managed care, health insurers began offering high deductible health plans (HDHPs) paired with HSAs.

HDHPs were primarily meant to cover catastrophic illness as the insured must meet the high deductible prior to receiving benefits on the policy. One could argue that HDHPs represent a return to the traditional indemnity plan of the early twentieth century but with one essential difference: whereas in an indemnity plan, the insured pays a higher premium for less managed care, in a HDHP, the insured pays a lower premium for less managed care but at the cost of higher potential out-of-pocket expenses (i.e. a higher deductible). Additionally, the key component of the HDHP is the HSA, which includes an employer contribution, and was not a feature contained in the traditional indemnity plans of the early 1900s. HDHPs require significantly more cost-sharing between insurer and insured. One main criticism of HDHPs is that greater cost-sharing exposes the insured to greater financial instability, thereby reducing consumer welfare (Lo Sasso, Helmchen and Kaestner, 2010).

In 2016, nearly all health insurance plans had managed care elements. The majority of health plans offered in the U.S. were PPO plans. Forty-eight percent of plans were PPOs while twenty-nine percent were high deductible health plans, fifteen percent were HMOs, nine percent

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12 IRS Guidance 2016 on HDHP minimum deductible limits and HSA Contribution limits are as follows. HDHPs: $1,300 for self-only coverage, $2,600 for family coverage; HSAs: $3,350 annual contribution limit for self-only coverage, $6,750 for family coverage.
were POSs and less than one percent were traditional indemnity plans.\textsuperscript{13} See Figure 3 for changes in health plan enrollment, by type for plans offered in the group market.

1.4 Regulation of Health Insurance

All insurers writing in health lines of business are regulated primarily at the state-level. This form of regulation dates back to the McCarran-Ferguson Act of 1945, a law passed by Congress which exempts insurers from most forms of federal regulation and assigns to individual states the task of regulating insurers that operate within its borders. There have, however, been several significant federal acts and regulations that have affected the operations of health insurers. These actions address the need for a safety net of insurance coverage for special populations, and other measures designed to ensure the availability of coverage.

The Social Security Act of 1935 created a welfare system, including a pension system whereby individuals in the U.S. were taxed through payroll taxes and distributions were paid to the elderly upon retirement. Although health insurance was not included in the Act in 1935, two key amendments to this Act, both of which were passed in 1965, had substantial influence on the health care market. In January 1965, President Johnson gave a special message to Congress titled, “Advancing the Nation’s Health,” wherein he stated, “Our first concern must be to assure that the advance of medical knowledge leaves none behind. We can - and we must – strive now to assure the availability of and accessibility to the best health care for all Americans, regardless of age or geography or economic status.” This message was the President’s promise to extend Social Security to include provisions for guaranteed health insurance coverage for the elderly and low-income families (Emanuel, 2014). Title XVIII, commonly known as Medicare, includes

\textsuperscript{13} KFF (2016). Plans are those in the group market. See Figure 3.
mandatory hospital and supplementary medical insurance for the elderly. Title XIX, or Medicaid, provides assistance to states for the finance of health care for low-income families. In 2015, Medicare spending totaled $646 billion or twenty percent of national health expenditures and Medicaid spending comprised seventeen percent of national health expenditures at $545 billion (CMS, 2015).

Health care reform at the federal level continued well in the 1970s with the passage of two more regulations that affected the business of health insurers, namely the Health Maintenance Organization (HMO) Act of 1973 and the Employee Retirement Income Security Act (ERISA) of 1974. The HMO Act of 1973 required firms that offered traditional health insurance to also offer federally certified HMOs. This act was designed to encourage the development and growth of managed care plans as a way to contain costs. Firms with more than twenty-five employees were required to offer HMOs as an option in employer-sponsored health insurance. ERISA placed further pressure on employers by establishing minimum pension standards for employer-sponsored retirement and health plans. Two major amendments to ERISA - the Consolidated Omnibus Budget Reconciliation Act (COBRA) and the Health Insurance Portability and Accountability Act (HIPAA) - expanded the protections required of employers offering health insurance plans. COBRA gave employees the right to extend employer-sponsored health plans following termination of employment, while HIPAA mitigated growing discrimination against employees with pre-existing conditions and established practices for the protection of personal medical information.

Following the substantial growth of managed care plans through the 1980s, the first major health care reform was proposed by President Clinton in the early 1990s. Although it was not passed, the Health Security Act bill proposed guaranteed coverage including pre-existing
conditions, subsidies for individuals and families who could not previously afford health insurance, and mandated coverage for certain benefits. Following a decade of little action on the federal front, the Medicare Prescription Drug, Improvement, and Modernization Act or Medicare Modernization Act (MMA) of 2003 updated Title XVIII Medicare. The MMA included the establishment of the Health Savings Accounts (HSA), accounts with which an individual or family with a HDHP can save for future health expenditures and receive tax benefits. HDHPs comprised approximately thirty percent of all plans chosen by employees in 2016.

The most recent legislation regarding health care reform was the passage of the Patient Protection and Affordable Care Act (PPACA) in March 2010. This federal regulation included major provisions, almost all of which had an impact on health insurers. Key provisions included: (1) the required coverage of ten essential health benefits, (2) guaranteed coverage for all applicants despite pre-existing conditions, and (3) the establishment of state health insurance exchanges where those individuals and families who are not offered employer-sponsored coverage and do not qualify for government-sponsored health insurance can purchase an affordable health insurance plan. The exchanges were mandated to be in operation by January 1, 2014. Since the enactment of the exchanges, the uninsured rate of the U.S. population has fallen to a historic low of just below ten percent. See Figure 4 for a timeline of key regulations.

1.5 Group and Individual Markets

There are three main channels through which individuals obtain insurance coverage in the U.S. health care market: employer-sponsored coverage on the group market, direct-purchase on the individual market, and government-sponsored plans such as Medicaid and Medicare. Employer-sponsored plans with managed care elements now dominate the health insurance
market. In 2015, fifty-six percent population obtained coverage on the group market, twenty-six percent obtained coverage through Medicaid or other government plans and eight percent purchased on the individual market.\textsuperscript{14} See Figure 5.

The group market emerged along with the individual market in the early twentieth century when commercial insurers began offering medical expense coverage to employer-sponsored groups in the 1920s and 1930s (Batten and Hider, 1979). In the 1920s, General Motors contracted with Metropolitan life to offer health insurance to 180,000 employees. Prepaid group health care, seen as radical in its inception, became mainstream during World War II. The wage and price controls imposed during this time period did not apply to the employer contributions to benefit plans. Payments to group insurance and pension plans became acceptable methods of compensation to both employers and union leaders. By the 1960s, group coverage was the most common form of health insurance in the United States (Akerlof, 1970).

Drawing on the theory of local public goods, Goldstein and Pauly (1976) remark on the importance of the group market as both a “fringe” benefit and an efficient delivery mechanism for health care. Employer-sponsored coverage is considered a fringe benefit since it is typically less expensive for the employee to purchase health insurance through the group than on the individual market and the employer often contributes to the cost. Currently, under the PPACA, firms with fifty or more full-time employees must offer group health insurance coverage or incur a tax penalty.\textsuperscript{15} One possible negative externality of employees receiving employer-sponsored health insurance is that the employee is sheltered from the true cost of health care. Employers negotiate

\textsuperscript{14} Information regarding coverage for the non-elderly obtained from Kaiser Family Foundation (2015).

\textsuperscript{15} The penalty is $2000 annually per employee if at least one employee is receiving a tax credit and coverage through the Health Insurance Marketplace.
discounted rates with insurers to offer health insurance and employees “pay” a portion of their premium in the form of reduced wages. In 2015, the average annual premium for health insurance family coverage was $17,545 with $12,591 attributable to employer contributions. The subsidy received from the employer may incentivize the employee to purchase more and/or better insurance than they would without employer subsidization (Gorman, 2009).

Group health insurance differs from individual health insurance in several ways. In group market coverage, many employees are covered under one contract, thereby allowing coverage to cost less than comparable coverage purchased by the individual. Additionally, individual evidence of insurability is not usually required in a group policy. While there has been an increase in employer-sponsored coverage over time, there has also been an increase in purchases on the individual market recently. The high costs of purchasing health insurance on the individual market are often cited as one reason for the existence of an uninsured population. Individuals seeking health insurance through direct-purchase are typically those who are not offered health insurance through an employer or those who do not qualify for government-sponsored health insurance such as Medicaid. Prior to the passage of the Patient Protection and Affordable Care Act (PPACA), sixty percent of candidates for the individual market were viewed as income-constrained and therefore could not afford health insurance through direct purchase. Additionally, there was often disagreement about the functionality and usefulness of the individual market, leading to impediments to policy consensus (Pauly and Nichols, 2002). The main policy disagreement in

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17 These non-elderly individuals are typically employed part-time and are not offered employer-sponsored health insurance since that benefit is often reserved for full-time employees. Additionally, these individuals do not qualify for Medicaid based on income. “Full-time, full-year employment offers families the best chances of acquiring and keeping health insurance, as does annual income of at least a moderate level (greater than 200 percent of the federal poverty level. Insured status correlates highly with many aspects of employment, including work status, income level, educational attainment, occupation and employer characteristics such as firm size and employment sector,” (Institute of Medicine, pg. 58).
this area pertains to the balance between the value of high risks obtaining insurance at lower rates (i.e. adverse selection) and the value of attracting low risks in a voluntary market. The reduction of the number of individuals without insurance was a main reason for the passage of the PPACA, and offering more affordable health insurance in the individual market was a primary goal of this legislation.

1.6 Conclusion

The purpose of this chapter is to compile an extensive overview on various topics regarding the evolution of the U.S. health insurance market. This chapter seeks to establish where the market began, how it evolved and report on its current state. At the same time, the chapter provides links to important health insurance research papers that have focused on evaluation of these developments over time. Health insurers have experienced significant change since the birth of health insurance in the early twentieth century. Continued increases in health care expenditures, stricter government regulation, the advent of managed care plans, and the increasingly popular usage of employer-sponsored plans has brought the market to a point where complexity and competing stakeholder interests fuel a continued political debate over the future of health care in the U.S. Because the majority of health care expenses are paid through health insurers, the impact of reforms on the U.S. insurance market should not be ignored. Research in this area will continue to evaluate the impact of various legislation on health insurers and offer policy implications.18

18 While this chapter has focused on an overview of the health insurance market in the United States and the dimensions on which it has evolved in the last century, Chapter 2 of this dissertation focuses on a phenomenon inherent in all insurance contracting, including health insurance: adverse selection. The study of adverse selection is the tendency of high risk insureds to purchase insurance. Adverse selection is of particular concern to insurers and regulators given that, in the least, it can lead to an undersupply of products and increases in healthcare costs and at most it can lead to the financial unraveling of the market. Chapter 3 of this dissertation relates adverse selection with consumer satisfaction of health insurance plans. This evaluation offers a discussion on whether adverse selection leads to greater consumer satisfaction.
Figure 1.1: National Health Expenditures in the United States, 1960-2015

Source: Centers for Medicare and Medicaid Services, 2015. Dollar amounts shown are in current dollars.
Figure 1.2: OECD Countries Health Care Expenditures, 2016

Figure 1.3: Group Market Health Plan Enrollment, by Plan Type

**Figure 1.4:** Timeline of Key Regulatory Acts in the United States

- **Title XVIII 1965**  
  - Creates Medicare
- **Title XIX 1965**  
  - Creates Medicaid
- **HMO Act of 1973**  
  - Encourages development of HMO plans
- **MMA of 2003**  
  - Modernizes Titles XVIII and XIX
  - Creation of CDHPs
- **PPACA of 2010**  
  - Mandates health insurance coverage

**Figure 1.5:** Health Insurance of the Non-Elderly Population by Coverage Type

CHAPTER 2

TESTING FOR ADVERSE SELECTION IN THE U.S. HEALTH INSURANCE MARKET

2.1 Introduction

It is a widely accepted phenomenon that, in theory, high risk, less healthy insureds tend to differentially prefer more generous and expensive health insurance plans than low risk, healthier insureds (Cutler and Zeckhauser, 1998). Adverse selection theory suggests that in markets characterized by asymmetric information, a positive correlation exists between coverage and risk (Cohen and Siegelman, 2010).\(^{19}\) Adverse selection affects both the supply and demand of health insurance. Health insurers may undersupply in response to the consumer use of private information (Lieberthal, 2016) and low risk insureds consume less health insurance than they would in a market free of adverse selection (Browne, 1992; Browne and Doerpinghaus, 1993). However, evidence of adverse selection in the U.S. health insurance market is mixed (Cutler and Zeckhauser, 2000).\(^{20}\) Prior studies have focused on samples of one insurer (e.g. Van de Ven and Van Vliet, 1995), of one employer (e.g. Ellis, 1985; Cutler and Reber, 1998) or of one state (e.g. Luft, Trauner and Maerki, 1985; Buchmueller and Feldstein, 1997). Using detailed information on policy characteristics, most of these studies either focus on one market (e.g. Browne, 1992; Browne and Doerpinghaus, 1993; Hofmann and Browne, 2013) or one age group (e.g. Cardon and Hendel, 2001; Fang, Keane and Silverman, 2008). Due to limitations in the data, these prior studies are unable to evaluate adverse selection in a cross-section representative of the current

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\(^{19}\) The authors provide a review of studies that measure adverse selection in insurance markets.

\(^{20}\) The authors provide a review of studies regarding the health insurance market in the United States.
overall health insurance market. Thus, the ability to generalize the results of these studies to the conditions in other markets or other insurers may be limited.

In this study, I investigate the presence of adverse selection in the U.S. health insurance market using a dataset containing insured demographics and health plan characteristics for fifty-five individual health insurers operating in forty-three states over three years.\(^{21}\) With this novel dataset, I contribute to the existing literature by testing for adverse selection across insurers in different state markets and across states with different market characteristics. First, consistent with prior literature, I document a statistically significant correlation between coverage and risk. Next, I test for, and find evidence of, adverse selection in the health insurance market using the seminal correlation test proposed by Chiappori and Salanie (2000) and extended by Dardanoni, Forcina and Donni (2016). I test for the presence of adverse selection in the individual and group markets separately. Unique to this study is the ability to use the correlation test results to analyze the variations in the presence of adverse selection across insurers and across states. First, I analyze the relationship between adverse selection and the health of a state population and the state regulatory environment. Then, I examine how insurer characteristics, such as the insurer’s market share, might explain why some health insurers experience the presence of adverse selection and others do not.

The results of this analysis complement the findings of prior studies and extend the existing literature in several ways. Cohen and Siegelman (2010) note that future work in this area should focus not on the documentation of a coverage-risk correlation but rather the identification of the

\(^{21}\) The data consists of health insurance survey data from JD Power and Associates (JDPA) merged with insurer financial data from the National Association of Insurance Commissioners (NAIC). For more information on the data, see section three.
circumstances where the presence of adverse selection is more likely to exist. This unique and extensive dataset allows me to account for state-level and insurer-level heterogeneity that prior studies have not been able to evaluate due to data constraints.

The dataset used in this study spans three years, 2013-2015. Earlier studies assume less adverse selection in the group market than in the individual market due to the differences in underwriting criteria that may be applied in each market (Browne, 1992). The Patient Protection and Affordable Care Act (PPACA) was significant legislation that further restrained the underwriting and pricing structures of health insurers and could potentially affect the presence of adverse selection in health insurance. Underwriting in the individual market is now more similar to underwriting in the group market. Post-PPACA, insurers operating in the individual market are prohibited from underwriting based on characteristics other than age, tobacco usage, geography and family size. Insurers must also accept all applicants and can no longer deny coverage based on pre-existing conditions. Beyond the changes in underwriting flexibility, the individual mandate also affected the individual health insurance market. A key mandate within the PPACA, the enactment of the health insurance marketplaces in 2014, required individuals to either purchase a health insurance plan or face a tax penalty.\(^\text{22}\) This mandate has two potential consequences for adverse selection. On the one hand, the mandate enables large numbers of previously uninsured, but healthy, low risk individuals to join the pool thus potentially reducing the presence of adverse selection. On the other hand, the mandate could potentially force those who were previously uninsured, but high risk, to join the pool at standard rates, which may increase the potential for adverse selection (Harrington, 2010a; Rosenbaum, 2011). Finally, the PPACA standardized the

\(^{22}\) Health insurance marketplaces, operated at the state level and in effect to help those on the individual and small group market purchase health insurance plans, were required to be in operation by 2014.
benefits that insurers must provide, thereby reducing opportunities for insurer competition which could further affect the presence of adverse selection in the market. Ultimately, responses by these stakeholders in the health insurance market following the passage of the PPACA may profoundly impact the potential for adverse selection in the U.S. health insurance market.

This research, and the implications therein, are of interest to insurers and regulators alike. Adverse selection is of particular concern to insurers and regulators given that, unchecked, adverse selection may lead to the financial unraveling of the health insurance market at worst (Browne, 1992; NAIC, 2011) or to the continued increase in the cost of health care at least (Harrington, 2010a). Given that the PPACA was a major reform that affected the entirety of the health care sector, the analysis of adverse selection in the health insurance market following its passage can inform on whether the enactment of the legislation served its purpose of simultaneously expanding health insurance coverage in the U.S. and decreasing overall health care costs (Harrington, 2010b).

The rest of the paper proceeds as follows. In the second and third sections, I provide a discussion of prior literature related to health insurance markets and adverse selection and present the testable hypotheses. The fourth section presents the data and variables constructed for the analyses. The fifth section reviews methodology and the sixth section presents the empirical results. A final section concludes.

2.2 Background Research

Asymmetric information is inherent in insurance contracts. An insured has private information about his or her risk level (low risk or high risk) that is not evident to the insurer at the inception of the policy. While low-risk insureds and high-risk insureds share the same underlying utility function, they differ in their loss probabilities, which affects the insurer’s ability
to appropriately price premiums based on risk class. Two possible consequences of asymmetric information in insurance contracts are adverse selection and moral hazard.

In health insurance policies, adverse selection occurs when insureds have more information about their risk (probability) of illness than the insurer (Neudeck and Podczeck, 1996). More generally, adverse selection is the tendency for high risks to purchase insurance or to purchase larger amounts of insurance than low risks (Cummins, Smith, Vance and VanDerhei, 1983). Prior to the contract, the insurer does not observe the risk type of the insured, which can lead to adverse selection. Moral hazard is the impact of the existence of the insurance contract on the insured’s incentives to manage risk. Moral hazard involves the existence of hidden information which can lead to hidden action ex post. Even though adverse selection and moral hazard occur together, they differ in their implications for contracting. For instance, while both imply that partial coverage for at least some individuals is optimal, adverse selection particularly implies the self-selection of lower risk individuals into contracts of less than complete coverage (Winter, 2000).

This section provides a review of the literature related to adverse selection in health insurance that falls into three main areas: (1) theoretical research linking asymmetric information and risk perceptions to insurance purchases, (2) empirical approaches to identifying adverse selection, and (3) empirical research identifying the drivers of adverse selection.

2.2.1 Asymmetric Information and the Presence of Adverse Selection

Theoretical analysis of contracts under asymmetric information began with seminal work by Akerlof (1970) in which the author relates the quality of goods to uncertainty through a discussion of the market for used automobiles. In this paper, the author provides reasons for a widespread lack of health insurance among the elderly population prior to Medicare. The
subsequent analysis shows that some markets fail in the presence of asymmetric information. Given that insurers are unable to distinguish between high and low risk applicants, if it prices its health policies for the elderly at an average price for all elderly individuals, only high-risk individuals will purchase health insurance despite the fact that the insurer anticipates building a pool of low and high risks. The insurer then experiences losses that are greater than expected resulting in increased prices. Over time, price increases force more low-risk insureds out until only the highest risk individuals purchase health insurance at extremely high rates or the market collapses. Thus, there can be a need for government intervention in markets characterized by adverse selection.

The seminal work of Rothschild and Stiglitz (1976) shows that, in a competitive market with two types of individuals – low and high risk - and asymmetric information, high risk insureds cause an externality. In their model, profit-maximizing insurers have no way of distinguishing low-risks and high-risks. The low risks are worse off with the presence of high risk insureds since they purchase less insurance than they would in a market free of information asymmetries. Adverse selection in health insurance leads to three types of inefficiencies (Cutler and Zeckhauser, 1998; Cutler and Zeckhauser, 2000). First, to avoid subsidizing the cost of high risks (sicker people), low risks will choose to be in less generous plans. Therefore, desirable risk spreading in plans is lost. Second, insurers will have incentives to manipulate plans to attract low risks and avoid high risks. Insurers may avoid innovations that could improve plans if those innovations will attract the high risks. Third, and ultimately, competition may be stifled since adverse selection induces low risks to enroll in less generous plans and insurers may distort offerings to be less generous with high risks insureds.
2.2.2 Approaches to Testing for Adverse Selection

Empirical testing for adverse selection in health insurance markets typically involves analysis of plan characteristics and claims. Evidence on the existence of information asymmetries, specifically adverse selection in health markets is inconclusive. Browne (1992) examines the role of adverse selection in the individual health insurance market. By comparing observed expenses in the individual market with predicted expenses in the group market, he finds evidence that low-risk insureds purchase less in the individual market than they would in the group market, consistent with adverse selection theory. Conversely, Cardon and Hendel (2001) find no evidence of information asymmetry when they test a sample from the National Medical Expenditure Survey (NMES). Instead, they find that the link between health insurance demand and consumption is based on observable characteristics. Fang, Keane, and Silverman (2008) find evidence of information asymmetries in a sample of individuals with Medigap insurance. However, they do not find evidence of adverse selection. Rather, they find evidence of advantageous or favorable selection, where low risks are more risk averse and buy more coverage. Cutler and Reber (1998) find evidence of information asymmetry in health markets using claims and enrollment data. They find that welfare losses from adverse selection are about two to four percent of total spending.

A common prediction of adverse selection models is the correlation between coverage and risk.\textsuperscript{23} When presented with a menu of options, high risk insureds will tend to choose greater coverage. In prior literature, coverage is measured by deductible choice (see e.g. Puelz and Snow, 1994; Chiappori and Salanie, 2000; Cohen, 2005, Cohen and Einav, 2007). Insureds seeking more

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\textsuperscript{23} The coverage-risk correlation is also a prediction of moral hazard theory. For adverse selection to be present, there must be an existence of such a correlation (Cohen and Siegelman, 2010). However, following Doiron, Jones and Savage (2008), I am using the insured’s \textit{ex ante} risk. Most studies use measures of \textit{ex post} risk. The use of an \textit{ex ante} risk measure reflects adverse selection but not moral hazard.
insurance coverage choose plans with lower deductibles. In a health insurance policy, insureds often must meet an aggregate deductible before services are rendered by the insurer. An insured who knows his risk level is high, and who expects losses ex-post, is more likely to choose a lower deductible.

In existing studies, proxies for risk vary between ex-ante and ex-post measures. Most studies of adverse selection use measures of ex-post risk, such as occurrence of a claim or other measures related to utilization. In these studies, the correlation between coverage and risk captures the effects of both adverse selection and moral hazard. The use of ex-ante measures, such as self-assessed health (Browne and Doerphinghaus, 1993), indicators for long-term conditions (Doiron, Jones and Savage, 2008) or other measures where the insured is privy to more information than the insurer, should reflect adverse selection but not moral hazard since the proxy for risk is measured prior to the implementation of the policy (Doiron et al., 2008).

Chiappori and Salanie (2000) propose a test of adverse selection which rejects the null of the absence of asymmetric information when individuals with more coverage are higher risk. Using binaries to proxy both insurance coverage (deductible level) and risk (occurrence of a claim), the authors run a bivariate probit model, with one equation estimating choice of coverage and one equation estimating risk, to test for evidence of adverse selection in the automobile insurance market. The authors estimate the two probit equations simultaneously and observe the correlation between the residuals of each of the regressions. A positive correlation between the residuals is consistent with a coverage-risk correlation. This positive correlation test has since been used in studies across different types of insurance markets including health, automobile, annuities and life insurance. This model is robust and arises in a variety of situations, thus making it useful in testing for the presence of adverse selection (Cohen and Siegelman, 2010). In addition to the
correlation test, the authors employ a nonparametric test based on chi-square tests for independence between coverage and risk.

Cohen (2005), using panel automobile data from one insurer, tests the coverage-risk correlation by addressing whether policyholders with lower deductibles have more claims. Testing differences between new policyholders choosing a low deductible and new policyholders choosing a regular deductible, the author finds that the probability of having at least one accident was higher by four percent for low-deductible policyholders.

Dardanoni, Forcina and Donni (2016) extend the work of Chiappori and Salanie (2000) by considering a multivariate logit model as opposed to the bivariate probit model. Claiming that the nature of private information is not fully captured in the bivariate probit model, which relies on the analysis of the correlation coefficients derived from two jointly tested probits, Dardanoni et al., (2016) theorize and test an ordered logit model designed to test the correlation coefficients of models where multiple, ordered and categorical measures of insurance and loss are available. The authors study asymmetric information in the Medigap health insurance market in the U.S. Using data from the Health and Retirement Study of 2002, the dependent variable used to measure coverage is categorical and equal to 0, 1, or 2 to represent the plan chosen. The dependent variable used to measure risk (occurrence of a claim) is categorical and equal to 0, 1 or 2 to represent doctor visits or hospital stays. The authors find a positive and statistically significant correlation between coverage and risk using their updated model of the Chiappori and Salanie (2000) positive correlation test.

Browne (1992), tests for adverse selection in the individual health insurance market by comparing expected expenses in the group market with actual expenses in the individual market.
The findings suggest that individuals purchase more insurance in the group market than they would in the individual market indicating the presence of adverse selection. Browne and Doerpinghaus (1993) use a measure of self-reported risk status to directly test whether there is reduced consumption of insurance (i.e., less complete medical coverage) by low risks and find further evidence of adverse selection. The findings support pooling and suggest evidence of adverse selection and cross-subsidization. These works use a sample from the National Medical Care Expenditure Survey conducted in 1977 and 1978. Given the changes in the health insurance market since these works were published, such as the movement away from traditional indemnity plans toward managed care plans and the major reform of the health insurance market through the PPACA, this essay seeks to extend this literature and test for the presence of adverse selection in the current health insurance market.

2.2.3 Factors That Increase or Decrease the Potential for Adverse Selection

Common belief is that there exists less adverse selection in the group market than in the individual market for health insurance (Mayers and Smith, 1981; Browne, 1992). Because of the employer-sponsored nature of the group health insurance contract, low risks can only exit the pool by foregoing the employer subsidy or by leaving employment (Browne, 1992) and high risks only gain access if employed. The group market has less adverse selection because underwriting of group coverage is based on the average experience of the group, effectively pooling low risks and high risks (Hall, 2000). However, if employees are insulated from plan costs because the plan is heavily subsidized by the employer, they may choose the generous plan too often leading to adverse selection in the group market (Cutler and Zeckhauser, 2000) or if individual choice is excluded altogether from a group insurance scenario, then group insurance still experiences the presence of adverse selection (Eling, Jia and Yao, 2017).
2.3 Development of Hypotheses

The existing literature provides a number of testable hypotheses. In the ensuing analysis, I attempt to add to the literature using a unique dataset surrounding the years of the enactment of the PPACA to test for the presence of adverse selection and explore the factors associated with the potential for adverse selection.

To begin, theory suggests that adverse selection is less present in the group market than in the individual market (Browne, 1992). Group health insurance is often offered as an employer-subsidized benefit. Because the low risks can only leave the pool by foregoing that subsidized benefit or by terminating employment, adverse selection should be comparatively less (Browne, 1992). However, Cutler and Zeckhauser (1998) find evidence that adverse selection in the group market does exist and leads to a withdrawal of plans (or an undersupply) of health insurance in the group market. The authors illustrate an adverse selection “death spiral” where employees at Harvard University were initially offered a generous Preferred Provider Organization (PPO) plan and a number of Health Maintenance Organization (HMO) plans. Several years later, the University changed its subsidy structure which led to the lower risk insureds leaving the most expensive plan. Employees who chose the more generous plan at that point were higher risk insureds. Due to the presence of adverse selection, the more generous plan became unsustainable and the PPO was discontinued as a result. Thus, the first and second testable null hypotheses are stated as follows:

\[ H1: \text{Adverse selection is not present in the individual market for health insurance.} \]
\[ H2: \text{Adverse selection is not present in the group market for health insurance.} \]
A key contribution of this paper is the analysis of the presence of adverse selection not just in the overall market, but by state and by insurer. This has not been tested in prior literature due to data constraints. There are reasons to expect that the presence of adverse selection may vary across states including differences in the health of the state population and the state regulatory environment. For example, states with unhealthier populations may experience the presence of adverse selection more than states with healthier populations since unhealthier persons are more likely to purchase plans with greater coverage and utilize more services. Regulatory environments also differ across states. A “competitive” state is one where the market, rather than the insurance commissioner, controls the pricing of insurance (Meier, 1988). There is substantial variation in rating laws across states. For instance, prior to the passage of the PPACA, in twenty-eight states, regulators had authority to review the rates of health insurers. In that regard, those states are considered more stringently regulated. The passage of the PPACA did not change the variation in state regulation nor did it take away authority of state regulators to regulate the pricing of health insurers. Therefore, given that regulation may exacerbate the presence of adverse selection (Finkelstein, 2004), I expect the regulatory environment will be related to the presence of adverse selection across states. Thus, the third and fourth testable hypotheses are stated as follows:

H3: The health of the state population is not related to the presence of adverse selection in a state.

H4: The regulatory environment in a state is not related to the presence of adverse selection.

There are several factors that may contribute to whether an insurer experiences the presence of adverse selection. Differences in the presence of adverse selection may be related to the types

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of plans (i.e. HMO, PPO, etc.) written by different insurers. HMO plans typically restrict access to a network of providers. If the insured seeks care out of the given network, often the HMO plan does not provide coverage. In contrast, the PPO plan provides a less restrictive form of managed care. Insureds can seek care out of network albeit at a higher out-of-pocket cost (i.e. less coverage is provided out of network). A large body of literature finds mixed evidence of adverse selection in managed care plans, specifically HMOs (Eggers, 1980; Rodgers and Smith, 1996; Altman, Cutler and Zeckhauser, 1998). Some of the major health insurers write traditional indemnity and PPO business as a life insurer. These (life) insurers may be more likely to experience the presence of adverse selection if the traditional indemnity and PPO plans are more apt to attract the sick relative to the HMO (Hellinger, 1995). Conversely, these insurers writing indemnity and PPO business as life insurers may be less likely to experience the presence of adverse selection if the HMO plans are more likely to be adversely selected against (Jackson-Beeck and Kleinman, 1983). Thus, I do not suggest an expectation, a priori, between type of plan and adverse selection. The number of competitors that a firm has may affect the presence of adverse selection. Competition in insurance markets can be problematic given that competition can induce adverse selection (Cutler and Reber, 1998). High risk insureds prefer more generous plans and low risk insureds will purchase less insurance due to the expense of the more generous plans so as to not be pooled with the high risks (Rothschild and Stiglitz, 1976; Browne, 1992). Conversely, insurers with fewer competitors may attract more high risks or may be forced to service more high risks if that firm has a large part of the market. Additionally, increased competition may lead to decreased pricing (i.e. more competitive pricing) which could induce low risks to purchase insurance. In this instance, low risks joining the pool may decrease the presence of adverse selection. Competition and adverse selection may also be related through the menu of choices presented to an insured.
An increase in the number of insurers may increase the number of choices presented and more choices could lessen the presence of adverse selection because consumers could more easily sort themselves into the appropriate plan. Formally, the fifth and sixth testable hypotheses are stated as follows:

\[ H5: \text{There is no relationship between type of coverage written and the presence of adverse selection within insurers.} \]

\[ H6: \text{Competition is not related to the presence of adverse selection within insurers.} \]

The first phase of testing these hypotheses involves: (1) confirming the correlation of low deductible choice and high risk and (2) detecting the presence of adverse selection in the overall market and in the group and individual markets (H1 and H2). Then, hypotheses H3 through H6 are evaluated in a regression framework. The methodology is described in detail further below.

### 2.4 Data

#### 2.4.1 Respondent and Plan-level Characteristics

To evaluate the hypotheses, I utilize a dataset consisting of survey data from JD Power and Associates (JDPA). The JDPA survey, conducted in 2014, 2015, and 2016, asked respondents about their health insurance coverage for the prior year. Therefore, responses are related to coverage in years 2013, 2014, and 2015. The sample respondents reside in forty-three states.\(^{25}\) The data contain individual policy-level information regarding the insured’s health insurance plan including the name of the insurer, type of plan (e.g., HMO, PPO) and whether the plan is employer-sponsored or purchased in the individual market. The survey includes only plans that were offered

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\(^{25}\) This is not a panel. Since there is no individual identifying data, it is impossible to determine if a person in the sample was interviewed in more than one year.
by employers (i.e. on the group market) or purchased on the individual market excluding plans that were purchased in the individual market on the state exchanges mandated by the PPACA. Also excluded from the JDPA data are government-sponsored plans such as Medicare and Medicaid. The data also include information on insured deductibles, premiums, and whether the deductible was met for the year. Additionally, there is insured-level demographic information including age, gender, education level, employment status, income, race/ethnicity, state of residence, and respondent self-assessment of health. The data include the largest health insurers (i.e. Aetna, Cigna, UnitedHealthcare, Humana and Anthem BlueCross BlueShield), which operate in many states as well as many smaller insurers and some that operate in only one state. The insurers included in the sample represent eighty-eight percent of the premiums earned in health lines of business in 2016.\footnote{This calculation is based on a comparison of health premiums earned by all insurers in the sample to health premiums earned by line for all health and life insurers writing health insurance.} The data initially contain 92,725 respondent-year observations. The following screens are used to ensure a reasonable sample. First, to limit the sample to non-elderly insureds, respondents aged 65 and older are dropped from the sample. Second, because I am interested in using a respondent’s deductible to proxy coverage choice, I drop from the sample both respondents who pay no deductible and respondents where deductible is missing. The coverage choice made by these respondent may be strongly driven by the fact that they pay no deductible. Finally, to control for outliers, I drop from the sample those respondents with deductible amounts below $100. Additionally, for inclusion in the sample, all necessary demographic characteristics must not be missing. The filtered sample contains 38,330 respondent-year observations.
2.4.2 Insurer Financials

I merge the JDPA data with insurer statutory filings compiled by the National Association of Insurance Commissioners (NAIC). The NAIC data contain firm financial information as reported on statutory annual insurer statements. These financials include premiums, assets, surplus, liabilities, medical losses, and utilization by-line and by-state. This information is collected both for insurers that report as health insurers and insurers that report as life insurers writing business in health lines. I match plan-level information in the JDPA dataset with firm-level NAIC data. While the JDPA data offers plan names (e.g. Aetna, Cigna, UnitedHealthcare, etc.) and states of operation, there is no plan identifier common to both datasets. Therefore, utilizing information from the health supplement of the statutory financial statements, I identify the set of insurers that earn health premiums each state by year. Insurers in the JDPA data are then matched with the firms in the NAIC dataset by NAIC company code. Those insurers that cannot be uniquely identified (i.e. Humana operates under multiple names in one state) are dropped from the sample. The remaining sample contains 29,013 respondent-year observations.

2.4.3 Variable Creation and Summary Statistics

Many of the variables in the JDPA data are categorical based on the survey answers. It is necessary to create a number of binary variables to use as proxies in this analysis. I start by assessing overall characteristics of the JDPA sample. The sample size is 29,013 respondent-year observations. See Table 1 for variable definitions and Table 2 for summary statistics. The mean age of respondents is 46 years, with a minimum of 18 years and a maximum of 64 years. The mean

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27 See Appendix A for a correlation coefficient matrix of all control variables.
annual pre-tax household income is between $70,000 and $80,000.\textsuperscript{28} The mean annual deductible amount is $2,192 per year and the mean monthly premium is $295 per month. Seventy percent of the respondents are in PPO plans, twenty-two percent are in HMOs and the remaining eight percent are in POS plans. Eighty-nine percent of respondents receive their insurance through the group market and eleven percent are on the individual market.

Consistent with prior literature, I first consider using a variable related to the deductible choice as a proxy for insurance coverage.\textsuperscript{29} Insureds who are known to themselves to be high risk tend to choose greater insurance coverage through lower deductibles (Cohen and Siegelman, 2010). The variable, \textit{DeductibleLow}, is equal to one if the insured’s deductible is lower than $1250 for self or $2500 for family for the years 2013 and 2014 and $1300 for self or $2600 for family for 2015 and zero otherwise.\textsuperscript{30} In the sample, insureds who chose low deductibles have differing characteristics from those who do not choose low deductibles. As expected, the differences between the means of those in the low deductible group and those not in the low deductible group are statistically significant at the one percent significance level for all variables, with the exception of \textit{Employed} and \textit{HighRisk}. The employment status is not significantly different between these two groups even though one may expect differences given that employment is a precursor to group coverage. Surprisingly, there is no difference between the two groups of deductible choice in self-
assessed health, *HighRisk*. This is a further indication of the inherent subjective bias in self-assessed risk level as noted above. See Table 3 for results of these univariate tests.

Second, I consider using a continuous variable as a proxy for insurance coverage choice. This variable, *DeductibleAmount*, ranges from $33 to $9,999 annually. The mean is $2018 per year. In prior studies, instead of estimating the model using the pair of probits in Chiappori and Salanie (2000), I estimate the model using Ordinary Least Squares (OLS) because of the continuous nature of this deductible dollar amount in the data. Therefore, when testing for adverse selection, I use *DeductibleAmount* to proxy coverage.\(^{31}\)

To measure risk, I consider three variables, *HighRisk*, *SumHealth* and *RiskCost*. Consistent with prior literature, I consider the use of self-reported health status as a proxy for riskiness of the insured (Browne and Doerpinghaus, 1993; Doiron et al., 2008). Insureds are classified as high risk if the self-reported health status is “Poor” or “Fair” and low risk if the self-reported health status is “Good” or “Excellent.” Because self-reported health status has an inherent bias where an insured’s optimism bias may cause him to overestimate his own health, I also consider the use of a relatively more objective indicator to measure risk status (Doiron et al., 2008). Consistent with Lange, Schiller and Steinorth (2017), Bolhaar, Lindeboom and van der Kaauw (2012), and Doiron et al., 2008), I use a categorical variable to estimate the insured’s health status using physician-diagnosed ailments: diabetes, allergies, arthritis, back condition, cancer, chronic pain, heart condition, and epilepsy. This variable, *SumHealth*, has a minimum value of 0 and a maximum value of 8 to indicate the number of physician-diagnosed diseases. Insureds with chronic diseases

\(^{31}\) In addition to estimating the model using OLS, I estimate the model using a probit model similar to Chiappori and Salanie (2000). Risk is proxied with *Risky* and coverage is proxied with *DeductibleLow*. Results are qualitatively the same in each model and are reported in Appendix B. I also estimate the model according to Puelz and Snow (1994) and Dardanoni et al. (2016) by using an ordered logit approach. In this approach, risk is proxied with *SumHealth* and coverage is proxied with categories of *DeductibleAmount*. Results are qualitatively the same and are reported in Appendix C. See, also, Appendix C for information on the categorization of *DeductibleAmount.*
may be more likely to obtain greater coverage. These insureds may also know more about their expected utilization. Therefore, their choice in deductible may be a signal that they plan to use their coverage and, therefore, they may be more likely to purchase greater coverage. To determine the correlation between HighRisk and SumHealth, I perform a t test. The results show that there is a difference between the low risk insureds and high risk insureds in the mean of SumHealth. Those insureds who self-reported “Poor” or “Fair” health had a mean of 1.40 chronic physician-diagnosed diseases while those who self-reported “Good” or “Excellent” health had a mean of 0.64 chronic physician-diagnosed diseases. The difference is statistically significant at the one percent significance level. Because of the potential subjective bias in HighRisk, I consider testing for the presence of adverse selection using the relatively more objective measure, SumHealth. I construct a variable, Risky, which is equal to one if the respondent has two or more physician diagnosed diseases and zero if the respondent has zero or one physician diagnosed diseases. Sixteen percent of the sample has two or more physician diagnosed diseases.

The SumHealth measure does not account for the fact that the eight diseases identified in the survey are not equal in severity. That is, some of the diseases pose a greater health cost than others. Therefore, I create a third variable, RiskCost, to measure risk. This variable is a continuous variable that proxies the average annual cost of treating the respondent’s specific set of diseases as identified in the survey. I gather average annual cost of treating diabetes ($6,320) cancer ($11,140), heart condition ($8,582), arthritis ($2,690) and allergies ($360) from the Centers for Disease Control Chronic Disease Calculator. From the National Center for Biotechnology Information, I report the average cost to treat epilepsy ($9,744). The average cost of treating chronic back pain ($6,096) comes from the American Medical Association. Finally, I gather the average cost of treating chronic pain ($4,475) from the Journal of Pain. I use these average costs
to construct $RiskCost$ as follows: A respondent with no specified diseases is assigned a $0$ value for $RiskCost$. A respondent with one of the specified diseases is assigned the value of that disease. Finally, if a respondent has more than one disease, I take the sum of these average costs to arrive at the $RiskCost$ for that respondent. For instance, if a respondent has both allergies and a heart condition, his total $RiskCost$ is $8,942$, which is the sum of treating allergies and a heart condition. The average $RiskCost$ in the sample is $2,584$.

The variable, $Female$, is a binary variable equal to one if the respondent is female and zero if the respondent is male. The sample is fifty-nine percent female. The variable, $CollegeEducated$, is a binary variable equal to one if the respondent has a four-year college degree or an advanced college degree and zero otherwise. Sixty-four percent of the sample is college educated. $Employed$ is a binary variable equal to one if the respondent is employed full-time, part-time or self-employed and zero if the respondent is retired or unemployed. Eighty-five percent of the sample is employed. $EmployerSponsored$ is a binary variable equal to one if the insured has an employer-sponsored health plan and zero if the insured purchased the plan on the individual market. Eighty-nine percent of the sample have an employer-sponsored plan. $PPO$ is a binary variable equal to one if the plan is a PPO plan and zero if the plan is a HMO plan. Seventy percent of the sample have PPO plans. The variable $SelfCoverage$ is a binary variable equal to one if the annual deductible covers self and zero if the annual deductible covers self and family. Forty-seven percent of the sample is self-coverage.

The $RiskCost$ measure could be overstated due to comorbidities, or the presence of more than one chronic condition at a time. A person who has comorbidities (i.e. arthritis and a heart condition) may be less expensive to treat than what is reflected in the $RiskCost$ variable. Additionally, the average cost of treating diabetes, cancer, heart conditions, arthritis, and allergies, which were reported from the Centers for Disease Control Chronic Disease Calculator are available on a by-state basis. Results are similar whether using the by-state averages or the national average. Therefore, the national average is what is used in the calculation of $RiskCost$.

Ideally, household size would serve as a better proxy for whether a plan covers self or self and family. However, household size is unavailable for 2013. Thus, $SelfCoverage$ serves as a proxy for household size.
2.4.4 Respondents on the Group Market versus the Individual Market

Because I am interested in testing adverse selection in the group market and the individual market, I assess the differences between these two groups. Recall that the variable, EmployerSponsored is an indicator equal to one if the plan is employer-sponsored (purchased on the group market) and zero if the plan is purchased in the individual market. Eighty-nine percent of the sample obtained insurance on the group market and eleven percent obtained insurance on the individual market. As discussed previously, it is assumed that there are differences between those insured in the group market and those insured in the individual market. I conduct univariate tests to analyze the differences between these two groups. As expected, the differences between the means of those in the group market and those in the individual market (across all three years) are statistically significant (at the one percent significance level) for all variables, with the exception of Female, CollegeEducated and PPO. See Table 4 for the results of these univariate tests.

2.5 Methodology

I start by confirming that there exists a negative correlation between coverage and risk in this sample. While other authors document a positive correlation between coverage and risk, I am using continuous variables to measure coverage (deductible amount) and risk (dollar amount of disease treatment), therefore I expect a negative and significant relation between my measures of coverage and risk. I expect lower deductible amounts to be correlated with higher risk as evidence of the presence of adverse selection. I follow Cohen (2005) and begin by assessing whether low

34 The survey excludes insureds who purchased plans on the individual health exchange marketplaces mandated by the PPACA. The individual market in this sample represents those who purchased a health insurance plan directly from the health insurer.
Deductible choice is correlated with high risk. I analyze the correlation between *DeductibleAmount* and *RiskCost* using OLS, controlling for other respondent characteristics. Specifically, I estimate the following model (1):

\[
\text{RiskCost}_{r,t} = X'_{r,t} \beta + \mu_i + \delta_t + \gamma_s + \epsilon_{r,t} \quad (1)
\]

Where \( X'_{r,t} \) is a vector of controls: *DeductibleAmount*, *Age*, *Female*, *CollegeEducated*, *Employed*, *PPO*, *Income and EmployerSponsored*, and *MonthlyPremium* for respondent \( r \) in year \( t \). The terms \( \mu_i \), \( \delta_t \) and \( \gamma_s \) account for time invariant insurer, year and state specific effects, respectively, that control for unobserved heterogeneity.

The second test is a correlation test where I estimate two equations, one for coverage and one for risk, and analyze the correlation, \( \rho \), between the error terms of the two equations. To test the hypothesis (H1 and H2) regarding a coverage-risk correlation, I estimate the following equations:

\[
\text{DeductibleAmount}_{r,t} = X'_{r,t} \beta + \mu_i + \delta_t + \gamma_s + \epsilon_{r,t}, \quad (2)
\]

\[
\text{RiskCost}_{r,t} = X'_{r,t} \beta + \mu_i + \delta_t + \gamma_s + \epsilon_{r,t},
\]

where coverage is proxied using *DeductibleAmount* of respondent \( r \) in year \( t \), and risk is proxied using *RiskCost* of respondent \( r \) in year \( t \). The vector \( X_{r,t} \) contains controls for insured characteristics and the terms, \( \mu_i \), \( \delta_t \) and \( \gamma_s \), account for time invariant insurer, year and state fixed effects, respectively, that control for unobserved heterogeneity.

One of the key contributions of this analysis is the testing of the presence of adverse selection across states and insurers. I now consider that the presence of adverse selection may vary differentially across states. Insurance is primarily regulated at the state level and states have
relatively different operational environments for insurers, e.g. whether a state formed its own exchange under the PPACA, whether a state opted to expand Medicaid, differences in state populations. I estimate the OLS model discussed previously, but I estimate it at the state level. Thus, I estimate the coverage-risk OLS model (equation 2) by state-year to obtain estimates of adverse selection in state $s$ in year $t$. The JDPA dataset contains information on respondents in forty-three states.\footnote{Information on respondents in Alaska, Delaware, Hawaii, North Dakota and South Dakota is not available in the initial JDPA data. West Virginia, and District of Columbia are excluded due to lack of observations in the filtered sample.}

I estimate the coverage and risk equations by state-year and analyze the correlation $\rho$ for each state-year to evaluate the presence of adverse selection in each state by year.\footnote{The results of this analysis are reported in Appendix D.} From the results of this analysis, I create a state-year adverse selection variable, $\text{AdverseSelectionState}$, equal to one if the state experienced the presence of adverse selection in a given year and zero otherwise. For a state to have experienced the presence of adverse selection, the state is assigned a one if $\rho$ is negative and significant (at the one percent, five percent, or ten percent level) for a given year and zero otherwise. Using this $\text{AdverseSelectionState}$ variable, I construct a state-year panel to test H3 and H4. Key controls include state-level variables related to the regulatory environment in a state and health of the state population. To proxy state regulatory environment, I compiled information from the Center for Consumer Information and Oversight (CCIIO) Health Insurance Marketplaces. I consider a state to be “strictly” regulated, $\text{StrictRegulation}$, if the state chose to operate a state-level exchange on the PPACA mandated health insurance marketplace exchanges and zero if the state chose to operate a federally-facilitated exchange. Therefore, this variable is defined as one if the state opted to operate its own state-level exchange and zero
otherwise. While other forms of state intervention (e.g., review of rates) may capture other dimensions of the regulatory environment, for the period of study, the decision to operate a state-level exchange at least suggests interest of the state legislature in having a degree of control over the health insurance market.\footnote{Given that defining \textit{StrictRegulation} in terms of the exchange operations may reflect the political environment (i.e. Republican or Democrat) of the state, I consider an alternative measure for \textit{StrictRegulation} in the health insurance market, specifically around the time of the enactment of the PPACA. I construct a variable equal to 1 if the state is ME, MA, NJ, NY or VT and zero otherwise. Prior to 2014 in all states other than ME, MA, NJ, NY and VT, health insurance sold in the individual market, was underwritten based on health status, health history and other risk factors (Kaiser, 2016). Therefore, the five states that had strict underwriting regulation prior to 2014, could be considered more “strictly” regulated. Results with this variable are qualitatively the same.} To proxy health of the population in a state, information is collected from the Centers for Disease Control (CDC) regarding state average percentage of self-reported health status, \textit{PoorHealth}, percentage of smokers in a state population, \textit{SmokingAdults}, and percentage of overweight and obese adults in a state, \textit{AdultObesity}. Other control variables include state median income, \textit{MedianIncome} and \textit{NumInsMktShare}, a variable from the Center for Consumer Information and Oversight (CCIIO) and the Centers for Medicare and Medicaid Services (CMS) that measures the number of insurers with greater than five percent market share in the individual market in a state year. From the Current Population Survey (CPS), information is collected on health insurance coverage of the state population (e.g. employer-sponsored, Medicaid, individual market, etc.). \textit{GroupCoverage}, and \textit{NonGroupCoverage} are proxies for percentage of the state population with employer-sponsored coverage and individual market coverage, respectively. To test H2 and H3 I estimate the following model:

$$\Pr(AdverseSelectionState_{s,t} = 1) = f(X'_{s,t} \beta + \epsilon_{s,t})$$  \hspace{1cm} (3)$$

where \textit{AdverseSelectionState}_{s,t} is a binary equal to one if state \(s\) experiences adverse selection in year \(t\) and zero otherwise. \(X_{s,t}\) is a vector of controls related to state \(s\) in year \(t\).
I now turn to the analysis of the presence of adverse selection among health insurers. Whether an insurer experiences adverse selection could be due to the state environment in which it operates, but could also be due to variations among insurers. To do this, I estimate the OLS model discussed previously, this time at the insurer level. The sample contains respondents with health insurance plans from the top five health insurers - UnitedHealthcare, Anthem BlueCross BlueShield, Aetna, Cigna and Humana - as well as smaller health insurers. As noted previously, factors that could influence whether an insurer experiences the presence of adverse selection include size, leverage, number of competitors, number of states in which an insurer writes health business, age, whether the firm is in a group and whether the firm operates as a life insurer. Therefore, I create controls to measures each of these factors. *Size* is the natural log of an insurer’s assets. Larger insurers may be more likely to experience the presence of adverse selection because of the larger pool of insurers or larger insurers may be at a comparative advantage since they may have more opportunities to manage the pool of insureds. *Leverage* is net premiums earned to surplus. *NumCompetitors* is a variable used in Born (2001) where the author calculates an effective number of competitors to control for the state economic climate in which the insurer writes business. Insurers operating in states where they have more competitors may face more pressure to control costs and premiums. *NumStates* is the number of states in which an insurer writes health business. *FirmAge* is 2016 minus the year established. *FirmGroup* is a binary equal to one if the insurer is a member of a group and zero otherwise. *LifeInsurer* is a binary equal to one if the insurer writes health business as a life insurer and zero otherwise. Using the same methodology in the by-state regressions, I use the correlation coefficients analyzed by-insurer to create an insurer-

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38 First, a measure of concentration in every state for every line of business is calculated using the share of premiums written by each insurer in every state in every line for each year. Then a weighted sum of the number of competitors is calculated for each company across all lines of business and states by summing up the inverse of the concentration measures, using the shares of the total premiums written in each line-state as weights (Born, 2001).
year variable indicating the presence of adverse selection within a firm, \( \text{AdverseSelectionInsurer} \), a variable equal to one if insurer \( i \) in year \( t \) experiences adverse selection and zero otherwise. If \( \rho \) is negative and statistically significant (at the one percent, five percent, or ten percent level), the insurer is assigned a one indicating adverse selection and zero otherwise.\(^{39}\) I then construct an insurer-year panel to test H5 and H6.

\[
\Pr(\text{AdverseSelectionInsurer}_{i,t} = 1) = f(\mathbf{X}'_{i,t} \beta + \epsilon_{i,t})
\] \hspace{1cm} (4)

where \( \text{AdverseSelectionInsurer}_{s,t} \) is a binary equal to one if insurer \( i \) experiences adverse selection in year \( t \) and zero otherwise. \( \mathbf{X}_{i,t} \) is a vector of controls related to insurer \( i \) in year \( t \).

2.6 Results

2.6.1 Coverage-Risk Correlation

To address the question of whether lower deductible are correlated with higher risk in this sample, I estimate equation (1).\(^{40,41}\) The primary variable of interest, \( \text{DeductibleAmount} \), represents the deductible amount chosen by the respondent and is a proxy for coverage choice. I expect the coefficient on the variable \( \text{DeductibleAmount} \) to be negative and statistically significant, indicating a negative correlation between deductible amount and high risk. The results of this analysis, shown in Table 5, confirm this correlation. The coefficient on the variable \( \text{DeductibleAmount} \) is negative and statistically significant at the one percent significance level. This result is consistent with prior literature, which finds that there is a correlation between lower deductibles and higher risk.

\(^{39}\) The results from this analysis are available in Appendix E.

\(^{40}\) For robustness, in addition to estimating equation (1) for the aggregate sample, I estimate this equation for the individual and group markets separately. Results are qualitatively similar and are reported in Appendix F.

\(^{41}\) For robustness, I estimate the equation only for those respondents employed full-time since it is often the case that part-time employees are not offered coverage through their employer. Results are qualitatively similar. The sample is reduced to 26,848 respondent-year observations.
levels, specifically that individuals with higher risk choose lower deductibles. The variable Age is positively correlated with RiskCost and the coefficient is statistically significant (at the one percent significance level). Older persons are more likely to be higher risk. Conversely Female, CollegeEducated, Employed, PPO and Income are each negatively related to RiskCost and the coefficients on each of these variables are statistically significant at the one percent significance level. Female insureds, college educated insureds, employed insureds, insureds with a PPO plan and insureds with higher income are less likely to be higher risk. Interestingly, insureds in employer sponsored plans have a greater cost of risk, as seen by the positive and statistically significant coefficient on EmployerSponsored. The coefficient on MonthlyPremium is positive and significant, indicating a positive correlation between premium and risk. Finally, the coefficient on SelfCoverage is positive and significant indicating that individuals with coverage for themselves and not self and family are likely to be higher risk. Controlling for various demographic and plan characteristics and consistent with prior literature, there is an overall negative and significant relationship between coverage choice and risk level.

2.6.2 Adverse Selection in the Individual versus Group Markets

Next, to test H1 and H2, I estimate equation (2) to analyze the presence of adverse selection in the individual and group markets, respectively, using the separate samples of respondents reporting that they have either individual or group coverage. The results of this analysis are presented in Table 6. The estimates for $\rho$ are negative and statistically significant (at the one percent significance level), indicating the presence of adverse selection in both the individual and group markets, as seen by the negative relationship between deductible amount and risk cost. Therefore, the null hypotheses, stated in H1 and H2, are rejected. Theory suggests that adverse selection is less present in the group market. The results indicate the presence of adverse selection
in the group market, as well. The control variables show signs, as expected. For instance, in Panel A of Table 6, Age is positively correlated with DeductibleAmount in the individual market but not in the group market. Age is one of the few factors on which a health insurer can underwrite a health insurance policy in the individual market. Age may be less of a factor in group market underwriting due to community rating. Therefore, older respondents in the individual market may choose a higher deductible to lower the overall cost of the policy. Female and DeductibleAmount are positively related. This result is not surprising given that women tend to be more risk averse, therefore, they may choose the higher deductible, accordingly. Interestingly, this result is less magnified in the group market, perhaps indicating the choice of women is less when coverage is subsidized by the employer. CollegeEducated and DeductibleAmount are positively related. Respondents with a college education may be more aware of the benefits of choosing a plan with a higher deductible. Surprisingly, the coefficient on MonthlyPremium is positive and significantly related to DeductibleAmount. Typically, we expect that when one chooses a higher deductible, the premium decreases. In Panel B of Table 6, Age is positively related to RiskCost in both markets. This is unsurprising as the cost of treating illnesses is a function of age. The coefficient on Female is negative and significant, as expected since females tend to be less risky than males. College education and employment are factors in lower risk levels.

2.6.3 Adverse Selection Within States

Third, to test H3 and H4, I evaluate factors that may contribute to the presence of adverse selection in a state. I estimate equation (3). Table 7 reports the number of respondents by state. Summary statistics of the state-year panel and the variables used in this model are reported in Table 8. Results of this analysis are reported in Table 9. The results, consistent with H3 and H4, indicate that characteristics of the health of the state population do not impact the presence of adverse
selection in a state. Recall that several proxies are used to represent the health of the state population – PoorHealth, SmokingAdults and AdultObesity, none of which seem to be factors in variation in the presence of adverse selection among state. Likewise, the regulatory conditions in a state do not have an impact on the variation in the presence of adverse selection across states. StrictRegulation and controls used to proxy insurance coverage in a state population, GroupCoverage and NonGroupCoverage do not appear to be associated with the presence of adverse selection in a state.\textsuperscript{42} The results of this analysis suggest that health care market factors do not explain whether a state experiences the presence of adverse selection. Indeed, the presence of adverse selection may be due to institutional characteristics such as rate regulation within the state, the legal structure of the environment for the insurer, demographics of the insurance market within a state, etc. While the study of these possible characteristics is beyond the scope of this chapter, I suggest that these may be important factors for future research in understanding why certain states experience the presence of adverse selection.

2.6.4 Adverse Selection Within Insurers

Finally, I test H5 and H6 to evaluate variation in whether an insurer experiences adverse selection. Summary statistics regarding the variables used in this model are reported in Table 10. Table 11 reports the results from the model tested in equation 4. The coefficient on LifeInsurer is marginally significant at the five percent level, indicating that whether an insurer writes health business as a life insurer impacts whether the insurer experiences the presence of adverse selection.

\textsuperscript{42} The use of state fixed effects was explored in an attempt to control for additional differences among states. The results were not qualitatively the same. In fact, the results from the state fixed effects model were consistent with H3 and H4. However, according to Greene (2002), one of the shortcomings of the nonlinear fixed effects model is that the fixed effects estimator shows large finite sample bias in discrete choice models. Additionally, the marginal effects in these models are overestimated. Therefore, the results using state fixed effects are not reported in the main body of the paper. Results of this analysis are reported in Appendix G.
Life insurers writing health business typically write PPO and indemnity business as a life insurer and HMO business as a health insurer. This result indicates that there may be more adverse selection among the plans such as PPOs and indemnity plans. The results, overall, indicate that the variation in adverse selection among insurers is not explained by the number of competitors it faces or the number of states in which it writes health insurance business nor is it affected by size, leverage, age or group status.43

2.7 Conclusion

Cohen and Siegelman (2010) suggest that future work testing for the presence of adverse selection should focus not on the documentation of the adverse selection itself but in the identification of circumstances where the presence of adverse selection is more (less) likely to appear. This article presents a study of the presence of adverse selection in the U.S. health insurance market by-state and by-insurer. Using unique data of health insurer plans among various insurers operating in different states, I test for the presence of adverse selection in the U.S. health insurance market. Using an extension of the positive correlation test first introduced by Chiappori and Salanie (2000) and extended by Dardanoni, et al., (2016), I estimate OLS models for coverage and risk to find the correlation between the residuals of the equations. This is evidence of the presence of adverse selection. First, I document a negative relationship between deductible amount and risk. I find evidence of the presence of adverse selection in the individual and group markets. The key contribution of this paper is the testing of the presence of adverse selection across

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43 The use of insurer fixed effects was explored in an attempt to control for additional differences among insurers. The results were not qualitatively the same. The results from the model using insurer fixed effects were consistent with H5 and H6. However, according to Greene (2002), one of the shortcomings of the nonlinear fixed effects model is that the fixed effects estimator shows large finite sample bias in discrete choice models. Additionally, the marginal effects in these models are overestimated. Therefore, the results using insurer fixed effects are not reported in the main body of the paper. Results of this analysis are reported in Appendix H.
states and among insurers. First, I find there is variation in whether a state experiences the presence of adverse selection and whether an insurer experiences the presence of adverse selection. However, I find that state regulatory environment does not explain the variation in whether a state experiences the presence of adverse selection in its health insurance market. Additionally, I find that while the smoking status of adults in the state is marginally related to the presence of adverse selection, other measures of health of a state population are not associated with the presence of adverse selection. Among insurers, I find that the number of states in which an insurer writes health business does impact whether a firm experiences the presence of adverse selection. However, other firm characteristics do not explain the variation in the presence of adverse selection among insurers.
<table>
<thead>
<tr>
<th>Respondent Variables:</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Policyholder Age in years</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1 for female, 0 male</td>
</tr>
<tr>
<td><strong>CollegeEducated</strong></td>
<td>1 for Bachelor's Degree or higher, 0 otherwise</td>
</tr>
<tr>
<td><strong>Employed</strong></td>
<td>1 for full time, part time or self-employed, 0 retired or unemployed</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>Household income in $</td>
</tr>
<tr>
<td><strong>HighRisk</strong></td>
<td>1 if self-reported overall health is &quot;Poor&quot; or &quot;Fair&quot;, 0 if &quot;Good&quot; or &quot;Excellent&quot;</td>
</tr>
<tr>
<td><strong>SumHealth</strong></td>
<td>Sum of indicator variables for 9 different physician diagnosed diseases</td>
</tr>
<tr>
<td><strong>Risky</strong></td>
<td>1 if $SumHealth$ is greater than or equal to 2, 0 if $SumHealth$ is 0 or 1</td>
</tr>
<tr>
<td><strong>RiskCost</strong></td>
<td>Sum of cost of treating specific illnesses, ($)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health Insurance Plan Variables:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DeductibleLow</strong></td>
<td>1 if annual deductible is less than $1350 for self or less than $2650 for family</td>
</tr>
<tr>
<td><strong>DeductibleAmount</strong></td>
<td>Annual Deductible Amount ($)</td>
</tr>
<tr>
<td><strong>EmployerSponsored</strong></td>
<td>1 if plan is employer sponsored, 0 if plan is purchased on individual market</td>
</tr>
<tr>
<td><strong>PPO</strong></td>
<td>1 if plan is PPO, 0 if HMO</td>
</tr>
<tr>
<td><strong>SelfCoverage</strong></td>
<td>1 if plan covers self, 0 if plan covers family</td>
</tr>
<tr>
<td><strong>MonthlyPremium</strong></td>
<td>Monthly Premium Amount ($)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State Variables:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>AdverseSelectionState</strong></td>
<td>1 if state experiences presence of adverse selection by year, 0 otherwise</td>
</tr>
<tr>
<td><strong>StrictRegulation</strong></td>
<td>1 if state operates its own exchange, 0 otherwise</td>
</tr>
<tr>
<td><strong>PoorHealth</strong></td>
<td>Percentage of state population with self-reported poor health status</td>
</tr>
<tr>
<td><strong>SmokingAdults</strong></td>
<td>Percentage of adults in the state population who smoke</td>
</tr>
<tr>
<td><strong>AdultObesity</strong></td>
<td>Percentage of adults in the state population who are obese</td>
</tr>
<tr>
<td><strong>MedianIncome</strong></td>
<td>Median Income, by state year ($ 000s)</td>
</tr>
<tr>
<td><strong>NumInsMktShare</strong></td>
<td>Number of insurers with greater than 5% market share, individual market</td>
</tr>
<tr>
<td><strong>GroupCoverage</strong></td>
<td>Percentage of state population with coverage in group market</td>
</tr>
<tr>
<td><strong>NonGroupCoverage</strong></td>
<td>Percentage of state population with coverage in individual market</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Firm Variables:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AdverseSelectionIns</strong></td>
<td>1 if insurer experiences presence of adverse selection by year, 0 otherwise</td>
</tr>
<tr>
<td><strong>NumCompetitors</strong></td>
<td>Weighted sum of the number of competitors in a state</td>
</tr>
<tr>
<td><strong>NumStates</strong></td>
<td>Number of states in which an insurer writes health business</td>
</tr>
<tr>
<td><strong>FirmAge</strong></td>
<td>2016-year established</td>
</tr>
<tr>
<td><strong>FirmGroup</strong></td>
<td>1 if insurer is a group member, 0 otherwise</td>
</tr>
<tr>
<td><strong>LifeInsurer</strong></td>
<td>1 if insurer writes health business as a life insurer, 0 otherwise</td>
</tr>
</tbody>
</table>
Table 2.2: Chapter Two Summary Statistics

<table>
<thead>
<tr>
<th>Respondent Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>46</td>
<td>12</td>
<td>18</td>
<td>64</td>
</tr>
<tr>
<td>Female</td>
<td>0.59</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
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N=29,013
### Table 2.3: Differences between DeductibleLow

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<td>0.0005</td>
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N=29,013

### Table 2.4: Differences between Group and Individual Market

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<th>Individual Market</th>
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N=29,013
Table 2.5: Deductible Amount and Risk Cost
Dependent Variable: RiskCost

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<tr>
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<tr>
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Standard errors in brackets
State fixed effects, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Table 2.6: Adverse Selection in the Individual and Group Markets
Panel A Dependent Variable: *DeductibleAmount*

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<td>[0.9995]</td>
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<td>39.3697*</td>
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<td>[23.4126]</td>
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<td>[34.0895]</td>
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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Table 2.6 continued
Panel B Dependent Variable: *RiskCost*

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<td>-0.016***</td>
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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Table 2.7: Number of Respondents, by State

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<th>State</th>
<th>N</th>
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N=29,013
Table 2.8: Summary Statistics State-Year Panel

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Table 2.9: State-level Adverse Selection
Dependent Variable: \textit{AdverseSelectionState}

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</tr>
<tr>
<td>Obs.</td>
<td>58</td>
</tr>
</tbody>
</table>

Standard errors in brackets
* p<0.10, ** p<0.05, *** p<0.01
Table 2.10: Summary Statistics, Insurer Year Panel

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>AdverseSelectionInsurer</td>
<td>164</td>
<td>0.14</td>
<td>0.35</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Size</td>
<td>168</td>
<td>14.00</td>
<td>1.20</td>
<td>11.76</td>
<td>16.94</td>
</tr>
<tr>
<td>Leverage</td>
<td>167</td>
<td>5.20</td>
<td>3.35</td>
<td>0.10</td>
<td>20.28</td>
</tr>
<tr>
<td>NumCompetitors</td>
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<td>2.29</td>
<td>3.08</td>
<td>0</td>
<td>22.04</td>
</tr>
<tr>
<td>NumStates</td>
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<td>7.41</td>
<td>13.42</td>
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<tr>
<td>Age</td>
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<td>51.66</td>
<td>30.11</td>
<td>16</td>
<td>166</td>
</tr>
<tr>
<td>Group</td>
<td>168</td>
<td>0.93</td>
<td>0.26</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LifeInsurer</td>
<td>168</td>
<td>0.09</td>
<td>0.29</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2.11: Insurer-level Adverse Selection
Dependent Variable: AdverseSelectionIns

<table>
<thead>
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<tbody>
<tr>
<td></td>
<td>Probit</td>
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<tr>
<td>Size</td>
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<td></td>
<td>[0.2038]</td>
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<tr>
<td>Leverage</td>
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<td></td>
<td>[0.0457]</td>
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<tr>
<td>NumCompetitors</td>
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<td></td>
<td>[0.0649]</td>
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<tr>
<td>NumStates</td>
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<td>FirmAge</td>
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<td>Group</td>
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<td></td>
<td>[0.4988]</td>
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<tr>
<td>LifeIns</td>
<td>1.4510**</td>
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<td></td>
<td>[0.6713]</td>
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<td>_cons</td>
<td>2.0673</td>
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<td></td>
<td>[2.5904]</td>
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</table>

Pseudo R^2 0.108
Obs. 163

Standard errors in brackets
Year fixed effects included but not shown; * p<0.10, ** p<0.05, *** p<0.01
CHAPTER 3
ASYMMETRIC INFORMATION AND CONSUMER SATISFACTION IN HEALTH INSURANCE PLANS

3.1 Introduction

In a health insurance market free of information asymmetry, insurers could offer a competitive menu of insurance plans to attract a variety of risk-levels and insureds would sort themselves into plans accordingly. In a market characterized by private information, insurers do not observe ex-ante risk levels and a pooling equilibrium can result with a wealth transfer from low risks to high risks (Wilson, 1977; Miyazaki, 1977, Browne, 1992). This adverse selection can stifle competition among health insurance plans and lead to an under supply of health insurance products (Frank, Glazer and McGuire, 2000), imposing costs on the low risks through a cross-subsidization of high risks (Browne, 1992; Lieberthal, 2016). The costs to both the insurer and the insured are affected by the placement within the pool. The insurer attempts to determine ways to attract the low risks and deter the high risks or price plans according to risk level of the insured. However, when health insurers are severely restricted in individual underwriting criteria (Day, 2016), the resulting distortion of plans can lead to market failure (Cutler and Zeckhauser, 1998; Lustig, 2010).

Models of insurance supply and demand assume a certain amount of asymmetric information (Chiappori, 2000). This information, which is private to the insured, regarding both risk level and expected utilization leads to either adverse selection, moral hazard or both (De Donder and Hindriks, 2009). Indeed, insurance contracts are traded in a market where adverse selection is present. An insurer may make inferences regarding consumer accident probabilities
but ex-ante the consumer has more information regarding risk level than the insurer can observe (Rothschild and Stiglitz, 1976). The indication of adverse selection, measured by a correlation between coverage and risk (Chiappori and Salanie, 2000), can result in a separating equilibrium where higher risk insureds purchase more complete coverage (Rothschild and Stiglitz, 1976).\footnote{The positive correlation between coverage and risk indicates the presence of adverse selection (Cohen and Sielgelman, 2010).} Conversely, advantageous selection (Fang, Keane and Silverman, 2008; Chiappori and Salanie, 2000; Hemenway, 1992; Cutler and Zeckhauser, 2000), occurs when low risk individuals purchase more insurance coverage and do not use the insurance as purchased.\footnote{Advantageous selection is also referred to in the literature as cherry-picking (Chiappori and Salanie, 2000), propitious selection (Hemenway, 1992), and favorable selection (Cutler and Zeckhauser, 2000).} This implies a negative correlation between coverage and risk. Either case suggests an outcome that is not Pareto optimal (Rothschild and Stiglitz, 1976).

The purpose of this paper is to analyze the impact of the use of private information on consumer satisfaction with health insurance plans. Specifically, if an individual uses his private information to purchase insurance such that the purchase results in paying too much or too little according to his risk level, is the individual likely to be more or less satisfied with his plan? I use a unique dataset in this study to evaluate the role of private information and consumer satisfaction with health insurance plans, and focus specifically on whether an individual capitalizes on the benefit of his private information.

This study contributes to literature in several ways. I build on prior work regarding both the existence of adverse selection in health insurance markets and the consequences of the use of consumer private information in the selection of health insurance plans. This study exploits a rich dataset containing survey responses from a large sample of respondents with health insurance plans.
from a variety of insurers across the United States. The analysis provides evidence of the respective roles of consumer choice, market features and insurer characteristics in explaining consumer satisfaction with health insurance.

The rest of the paper proceeds as follows. The next section offers a review of the literature related to health insurance demand and satisfaction. The third section presents the hypotheses and the fourth section provides an overview of the data. The fifth section includes a description of the methodology and the sixth section presents the results. A final section concludes.

3.2 Background

It is important to understand how individuals make decisions, specifically those regarding health care and health insurance given that the use of private information can result in sub-optimal consumer choices and distort insurer plan offerings (Rothschild and Stiglitz, 1976; Cutler and Zeckhauser, 2000). Health insurance contracts, by design, are often confusing to consumers (Loewenstein, et al., 2013). Uncertainty surrounding healthcare reform further exacerbates this problem. Thus, it is not surprising that, compared to different types of insurance, consumers derive the least satisfaction from their health insurance plan (JDPA, 2016). George Loewenstein, a renowned health economist says, “I have a Ph.D. in economics…and I still find [health] insurance policies confusing.” He assumes that the general public has an even lower understanding of such policies. Limited understanding of insurance policies has several consequences including that if consumers are aware of their own misunderstanding, they may have overall discontent with current policies.

46 As of August 2017 there is uncertainty as to whether the Patient Protection and Affordable Care Act (PPACA) will be repealed and replaced with the American Healthcare Act.
insurance options (Heiss et al., 2006). A combination of theoretical and empirical research tackles the concerns regarding health insurance plan choice, the resulting welfare implications, and the potential relationship with satisfaction. These are described further below.

3.2.1 Relevant Theoretical Research

In a market characterized by asymmetric information, the assumption is made that consumers use private information regarding individual risk level when purchasing insurance (Donder and Hindricks, 2009). Adverse selection is the tendency for insureds with higher-than-average risk levels to seek insurance at standard (average) rates (Rejda and McNamara, 2014). If adverse selection is not controlled through the underwriting process, the result is higher-than-expected loss levels. Indeed, if the insureds with high-than-average change of loss succeed in obtaining the coverage at standard rates, the insurer is considered to be adversely selected against. Within health insurance policies, adverse selection is defined as the behavior that higher risk individuals, who expect high health care costs, differentially prefer more generous (i.e. expensive) health insurance plans while low risks choose more moderate plans (Cutler and Zeckhauser, 1998).

Assuming a competitive market model (Rothschild and Stiglitz, 1976) with two types of insurance consumers – high risk and low risk – and information that is known to the insured but not to the insurer, each individual uses his private information, ex-ante, in the decision to purchase health insurance and, specifically, in the decision of which plan to purchase. If the individual is high risk, and expects greater usage of the policy ex-post, it is expected that he will choose the more generous plan with greater coverage. If the individual is low risk, it is expected that he will choose the less generous plan. If an insurer is unable to sort based on risk-level, the high-risk individual is more likely to be able to purchase greater coverage at standard rates similar to that of
the low-risk individual. Therefore, the high-risk individual may obtain greater coverage at standard rates despite the greater expected usage. If this happens, is the high risk individual more satisfied with his plan? Conversely, assume the low risk individual knows his risk type and the insurer does not and despite this knowledge, purchases greater insurance coverage, or pays too much for coverage. Does this propensity toward advantageous selection lead to an outcome where this individual is less satisfied with their plan?

While standard utility theory assumes consumer rationality and perfect information in decision-making, there is a body of literature dedicated to evaluating sub-optimal consumer choices, and resulting welfare losses, in health insurance plans that cannot be explained by standard utility models.\(^{47}\) Adverse selection, consumer misunderstanding of insurance plans, and consumer perception and inherent biases has each been examined as possible explanations for these inefficient choices. In an ideal health insurance market, greater choice enables consumers to choose plans appropriate for their needs and provider competition leads to decreased prices and increased quality. However, research provides evidence that increased choices made by uninformed consumers leads to welfare losses, as measured by unnecessary spending (Bhargava and Loewenstein, 2015). In this study, I will not attempt to comment on the optimal number or types of choices in health insurance plans. Rather, I am interested in relating the optimality of choices to consumer satisfaction with health insurance plans, specifically the evaluation of whether

\(^{47}\) A sub-optimal health insurance choice is defined here as one where the coverage chosen does not match the consumer needs. One major source of sub-optimality in choices among insurance plans is the tendency for insureds to choose plans with lower optimal deductibles (Sydnor, 2010). The coverage can either be too much to too little. An “internality” is produced when an individual fails to consider the full impact of a behavior on his present/future utility (Herrnstein, Lowenstein, Prelec and Vaughan, 1993). Thus, a sub-optimal choice in this setting is one where an individual, who has greater knowledge of both risk level and expected usage, fails to consider how the choice will impact his future satisfaction with the choice.
a consumer who may have adversely selected into a plan, from the insurer’s perspective, is
ultimately more satisfied with their health insurance plan.

3.2.2 Findings from Empirical Research

Prior work in insurance choice models evaluating the consequences of private information,
specifically adverse selection, in health insurance markets present mixed empirical evidence of
welfare losses due to adverse selection. For instance, using data from the 1987 National Medical
Expenditure Survey on individuals, Cardon and Hendel (2001) estimate a structural model of
health insurance and health care choices. The model predicts that there is positive correlation
between coverage and risk and that, on average, higher risk types utilize coverage more when
compared to lower risk types. However, they find that health care demand is linked to observable
characteristics, thus rejecting the assertion of asymmetric information. Carlin and Town (2009),
assess the welfare impact of adverse selection in health insurance using data from a large, self-
insured employer for 2002-2004. Their specific focus is on the role of adverse selection in
distorting premiums which is a welfare consequence identified initially by Akerlof (1970). In
estimating the welfare impact of adverse selection, the authors find that adverse selection is present
in a statistically and economically significant fashion. However, this presence of adverse selection
does not translate into significant welfare loss. Indeed, welfare loss is low because premium
elasticities are low. Bundorf, Levin and Mahoney (2012) analyze the efficiency of health insurance
markets, specifically the effect of plan pricing on the effective allocation of consumers into plans.
In simulations, the authors find that observed pricing are less efficient than potential prices if plans
were rated based on risk. The results of the simulations show inefficiencies equal to between $60
to $325 annually per enrollee less than what could be priced in a risk-related pricing scheme.
However, in their particular setting of 11 employers who purchased coverage in a single metropolitan area, the authors find that welfare losses from observed pricing are relatively small.

Conversely, Handel (2013) identifies substantial inertia in health insurance markets. Even when policy changes nudge consumers toward optimal individual decisions, the author finds that when aggregated, the improvements at the individual level substantially exacerbate adverse selection. Ultimately, higher risk individuals choose more comprehensive coverage leading to increased welfare losses overall. This is consistent with the idea that adverse selection can lead to inefficient market outcomes where a distortion in prices leads lower-risk individuals to choose plans with less comprehensive coverage than they would otherwise choose in an efficient health insurance market.

A recent survey study provides strong evidence that indicates consumers do not understand traditional health insurance policies (Loewenstein et al., 2013). This lack of understanding is correlated with insurance choices, indicating that consumers may make sub-optimal health insurance choices due to a misunderstanding of the options or of health insurance, in general. It is costly for consumers to learn about either the overall health insurance market or to gather enough information about their individual choices to make informed decisions. Whether the information is misunderstood at the market level or the individual plan level, these information frictions are suggested as a possible reason for consumer sub-optimal choices in health insurance plans. Indeed, may only lead to reduced prices and overall improvements of quality in markets where consumers make informed decisions. Insurance consumers who misunderstand options, or are faced with too many options, are likely to make suboptimal decisions regarding health insurance plans (Frank and Zeckhauser, 2009).
3.2.3 Related Findings from Research in Other Disciplines

Also relevant to this research is a body of literature that ties consumer purchase decisions to satisfaction, more generally. Specifically, studies in marketing and psychology suggest a relationship between satisfaction and certain aspects of the purchase. Lichtenstein et al. (1997) report findings that suggest individuals have varying degrees of “sales proneness” which reflect propensity to respond to purchasing deals. Alford and Biswas (2002) tie this concept directly to satisfaction, by showing that individuals who are highly sale-prone reported both higher perceptions of value and higher intent to purchase. Similarly, Hunt et al. (1995) report that individuals are more likely to experience satisfaction with a shopping experience involving a rebate. These individual are also more likely to repurchase the product and share their satisfaction with others. While the health insurance product has unique and complex features that may complicate finding a strong relationship between “getting a deal” and satisfaction, this body of literature lends support for this possibility.

3.3 Hypotheses

In this study, I relate adverse selection and consumer satisfaction with health insurance plans. Adverse selection can lead to higher costs in health insurance and when unchecked can additionally lead to distortions in plan offerings and ultimately an unraveling of the market, if unchecked. From the insurer’s perspective, consumers that adversely select into a health plan are problematic, but these consumers, who would be predicted low risk based on a number of characteristics but are actually high risk, may feel as though they have gotten “a better deal” on their health insurance and, in addition, may be more likely to use the policy once it is in force. Ultimately, high-risk individuals who obtain insurance at standard rates (i.e. more coverage at
standard rates despite a higher risk level) may be more satisfied with their policy. Therefore, the
testable hypothesis for this study is stated formally as follows:

*Hypothesis: Those consumers who have adversely selected into a health insurance plan will be more satisfied with the health plan than those consumers who did not adversely select into the plan.*

Based on prior literature and the arguments presented above, I expect that consumers who
inefficiently sorted into health insurance plans will be more satisfied when the inefficient sorting
is to their advantage, meaning they paid less than they should have paid according to their
individual ex-ante risk level.

### 3.4 Data

The data used in this study are described previously in Chapter 2. The JDPA data contain
unique data on respondent information, and risk preferences, as well as health insurance policy
information, respondent demographics as described in Chapter 2. In addition to the variables
described previously, the JDPA data contain information on quality of care and consumer
satisfaction. I consider four variables to measure quality of care provided. The variable,
*WaitTimeAppt*, refers to the amount of time (in days) the respondent waits to obtain an appointment
with a primary care physician. When this variable has a value of “1” the respondent has waited 0-
15 days to have an appointment with the primary care physician, “2” the respondent has waited
16-30 days to have an appointment with the primary care physician, “3” the respondent has waited
over 30 days to have an appointment with the primary care physician. The variable,
*YrsCurrentDr*, refers to the number of years (1-5) the respondent has been a patient of the current
primary care physician. The variable, *TooLittleTime*, refers to whether the respondent believes he
has too little (value of “1”), too much (value of “3”) or just the right amount of time (value of “2”)

69
with the physician during visits. The variable TimeWithDr, refers to the time (in minutes) the respondent spends with the primary care physician during visits. This variable ranges from 1 to 300 minutes. In prior studies, quality of care measures obtained from surveys are often used to proxy satisfaction (see e.g. Rubin, Pronovost and Diette, 2001; Mainz, 2003; Aiken et al., 2012). The quality of care variables in the JDPA data and can be compared to, or used to complement, the aforementioned satisfaction data. Because the JDPA data contain proxies that measure actual satisfaction through survey answers, I employ those variables instead of these more traditional quality of care measures.  

There are four measures I consider to assess consumer satisfaction, OverallSatisfaction, LikelihoodToRecommend, LikelihoodToRenew, and EaseOfUnderstanding. Each of these measures allows for the study of different dimensions of consumer satisfaction. The variable OverallSatisfaction is a categorical variable, ranging from one to ten. When the variable has a value of one, unacceptable, this represents the insured’s least degree of satisfaction. When the variable has a value of 10, outstanding, this represents the respondent’s greatest degree of satisfaction. Because OverallSatisfaction may be too broad a categorization of how satisfied the respondent is with their plan, I consider the variable LikelihoodToRecommend, which is a categorical variable with a minimum value of one, “definitely will not” recommend and a maximum of four, “definitely will” recommend. Whether a patient is willing to recommend a product or service (such as a particular physician or hospital) to a family member or friend is accepted as a measure of satisfaction in the patient outcomes literature within medical care

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48 I evaluate correlations between the quality of care and consumer satisfaction variables. The correlation coefficient matrix is reported in Appendix I.
disciplines (Senti and LeMire, 2011; Johnson et al., 2012; Loughman et al., 2009). Similarly, LikelihoodToRenew is a categorical variable equal to one for “definitely will not” renew and four for “definitely will” renew. The variable, EaseOfUnderstanding, reflects a more specific dimension of a consumers’ perception of their health insurance plan and refers to the respondents’ ease of understanding plan benefits. When this variable has a value of “1” the respondent rates the information and communication from the health plan provider as “Unacceptable” and when the variable has a value of “10” the respondent rates the information and communication from the health plan provider as “Outstanding.”

Additional variables used in the analysis are described previously in Chapter 2 and include Age, Female, CollegeEducated, Employed, Income, PPO, SumHealth, HighRisk, RiskCost, RiskyDeductibleLow, DeductibleAmount, MonthlyPremium, and EmployerSponsored.. EmployerPrivate and NoPremium are two additional controls used in this chapter that were not used in Chapter 2. EmployerPrivate is a variable equal to one if the employer is a privately-owned company. This is a proxy for generosity of employer sponsored plans. Those employed by private employers may have less subsidy or fewer complete choices in coverage than those employed by federal and state government. Additionally, the variable NoPremium is used as a control to capture whether the respondent shares any of the monthly cost of the policy. Those who pay no premiums may be inherently more satisfied with their plan. This variable controls for that possibility. In this

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49 This is in reference to the likelihood to recommend a particular physician. Little has been documented, to my knowledge, on the likelihood to recommend an insurer. This variable may be more important in the individual market than in the group market. Group market members’ choices are typically reduced to the choices made for them by their employer. That is, the menu of options presented to a group market participant is expected to be fewer than the menu of choices presented to a participant on the individual market. Therefore, the likelihood to renew may depend on the market in which the insured has purchased the policy. A similar argument can be made for likelihood to renew. LikelihoodToRenew may be different in the individual and group markets given that a respondent in the group market may not have many choices in the renewal of the policy, specifically in the choices of insurance companies. Several measures of satisfaction are explored in this study to account for differences within the group and individual market.
chapter, the sample is restricted to those whose health insurance is only for themselves (i.e. individuals) who either purchased on the individual or group markets. Because I am interested in categorizing respondents based on coverage choices and risk cost, I analyze only those respondents that report the coverage choice for themselves and therefore, I can calculate the cost of risk for the individual. The initial sample includes 13,597 respondent-year observations. I keep only those observations with respondent answers correlating to each of the four measures of satisfaction. Therefore, the final sample contains 11,218 respondent-year observations. See Table 1 for variable definitions and Table 2 for summary statistics.

3.5 Methodology

I begin the analysis by categorizing respondents into four types based on the ability to correctly predict their coverage choice and categorizing respondents into four types based on the ability to correctly predict their risk. I estimate the following equation using Ordinary Least Squares (OLS) regression:

\[
DeducibleAmount_{r,t} = X'_{r,t} \beta + \mu_i + \delta_t + \gamma_s + \epsilon_{r,t},
\]

where \(DeducibleAmount_{r,t}\) is equal to the dollar amount of the respondent’s annual deductible and the controls are respondent characteristics \(\text{Age, Female, CollegeEducated, PPO, EmployerSponsored, SumHealth, Income, EmpPriv, and NoPremium}\). The terms \(\mu_i + \delta_t + \gamma_s\) control for state, firm and year fixed effects, respectively. Results of this regression are shown in Table 3. Recall that \(DeducibleAmount\) is used as a proxy for coverage. Following the regression, I predict the probability of correctly predicting a positive outcome. Because I am interested in sorting the respondents based on coverage choice and risk cost of self (and not self and family), I keep only observations that correspond to respondents where deductible applies to self only and
not self and family. Respondents are then categorized based on the residuals. Type1 respondents are those where a high deductible is predicted and low deductible is chosen. Type2 respondents are those where a high deductible is predicted and a high deductible is chosen. Type3 respondents are those where a low deductible is predicted and a low deductible is chosen. Type4 respondents are those where a low deductible is predicted and a high deductible is chosen.

I am specifically interested in the respondents categorized as Type1 and Type4. Type1 respondents, those who are predicted a high deductible and chose a low deductible, are categorized as having chosen a “more-than-suitable” policy. These are the respondents where, holding all else constant, their characteristics predict the high deductible choice but they chose the low deductible. These respondents may be less satisfied with their plan since they have chosen a plan that is more coverage than necessary. Type4 respondents, are those who are predicted a low deductible but chose a high deductible. These are the respondents where, holding all else constant, their characteristics predicted the low deductible choice but they chose the high deductible. These respondents may be more satisfied with their plans because they may feel they “got a good deal” on their coverage given that they paid less in premiums. Premiums for higher deductible plans are generally lower, all else equal. Types2 and 3 respondents are those that were predicted accurately.

I repeat this analysis with the risk equation. I estimate the following equation using OLS regression:

$$RiskCost_{r,t} = X'_{r,t}\beta + \mu_i + \delta_t + \gamma_s + \epsilon_{r,t},$$

where $RiskCost_{r,t}$ is the dollar amount associated with treating one or more of the eight physician-diagnosed diseases and the controls are respondent characteristics, $Age$, $Female$, $CollegeEducated$, $PPO$, $EmployerSponsored$, $Income$, $EmpPriv$, and $NoPremium$. The terms $\mu_i + \delta_t + \gamma_s$ control
for state, firm and year fixed effects, respectively. Results for this regression are shown in Table 4. Following the regression, I calculate the residuals and categorize the respondents accordingly into four types, A-D, based on how close the predicted is to the actual risk cost of the respondent. TypeA respondents are those who are predicted to be high risk but are actually low risk. Similarly, TypeD respondents, are those who are predicted to be low risk but are actually high risk. The risk cost is lower for TypeA (or higher for TypeD) than what was predicted based on their characteristics so they may be effectively sorting into a plan that is more (less) expensive than is necessary based on cost of risk. The insurer may be charging TypeA more than necessary for coverage based on the estimated risk of TypeA. Therefore, TypeA may be less satisfied with the plan. Conversely, TypeD may be paying less than necessary based on risk level, and therefore, may be more satisfied with the plan.

To categorize respondents by coverage choice and risk cost, I first observe the distributions of the residuals from the coverage and risk equations, respectively, as shown in Tables 7 and 8. To categorize respondents, I set thresholds of 25 percent and 75 percent of the distribution.\(^{50}\) For categorizing Types 1-4, those observations at or above the 75\(^{th}\) percentile are considered Type1 and those at or below the 25\(^{th}\) percentile are considered Type4. The residual is calculated as the predicted minus the actual, therefore those with positive residuals are Type1 and those with negative residuals are Type4. Similarly, according to the distribution of residuals for the risk equation, to categorize Types A-D, those observations at or above the 75\(^{th}\) percentile are

\(^{50}\) Although this is an arbitrary threshold, this is a starting point that allows me to categorize the respondents while retaining fifty percent of the sample. For robustness, I employ greater thresholds as discussed later.
considered TypeA and those with negative residuals at or below the 25th percentile are considered TypeD. See Figures 3 and 4.\textsuperscript{51}

With respondents categorized, I now consider how the categories relate to consumer satisfaction. To test the hypothesis stated above, I estimate the following equation using an ordered logit regression:

\[
\Pr(\text{OverallSatisfaction}_{r,t} = k) = f(X'_{s,t}\beta + \epsilon_{s,t}), \quad k = 1, ..., 10.
\]

where the dependent variable is \(\text{OverallSatisfaction}_{r,t}\) corresponds to the overall satisfaction of respondent \(r\) at time \(t\) and include controls for Type1, Type4, TypeA and TypeD. In addition, I control for respondent demographics and plan characteristics, \(Age, Female, CollegeEducated, PPO, EmployerSponsored, SumHealth, HighRisk, DeductibleLow, Income,\) and \(MonthlyPremium.\)

In addition to using the measure \(\text{OverallSatisfaction}\) as a proxy for respondent satisfaction, I analyze the way in which suitability of coverage choice and mis-estimation of risk are related to consumer satisfaction using \(\text{LikelihoodToRecommend}, \text{LikelihoodToRenew}\) and \(\text{EaseOfUnderstanding}\) as robustness to capture the different dimensions on which each of these variables measures satisfaction. Results of this analysis are reported in Table 5.

### 3.6 Results

Recall that Type1 respondents are those that are likely to have a “more-than-suitable” policy. As expected, in all four specifications, the coefficient on \(Type1\) is negative and statistically significant (at the one percent significance level) indicating that Type1 respondents are less

\textsuperscript{51} For robustness, I employ a greater threshold in categorizing Types 1-4 and Types A-D. In addition to the threshold at the 25th and 75th percentiles, I also use the threshold of 5th and 95th percentiles. Results are qualitatively similar and are reported in Appendix J for the overall market and Appendix K for the individual market.
satisfied with their health insurance plans. These respondents may be more likely to have sorted into plans that are more than suitable, perhaps making them a more “favorable” selection in terms of the insurer because the respondent has more coverage than necessary, i.e. is paying for coverage they do not need. Type4 respondents are those who are likely to feel like they “got a good deal” on the policy. These are the respondents that ended up choosing less coverage than necessary, therefore getting a better deal and paying less for coverage than they otherwise would have. In all four specifications, the coefficient on Type4 is positive and statistically significant (at the one percent significance level), indicating that these respondents are more satisfied with their plans, as expected.

In all four specifications, there are the same controls for demographics and plan characteristics. In all four specifications, education is negatively and significantly (at the one percent significance level) related to consumer satisfaction, meaning that those with education are less likely to be satisfied with their health insurance plans. Surprisingly, respondents with PPO plans are less likely to be satisfied, regardless of specification. PPO plans are known for being more flexible than HMO or POS plans. I would expect that the freedom in those plans (i.e. not having to choose a primary care physician or get prior approval to see specialists) would lead a respondent to be happier with the plan but that freedom comes at a greater expense. The coefficient on EmployerSponsored is consistently positive and statistically significant (at the one percent significance level) in all but one specification, indicating those respondents in plans within the group market are more satisfied. Those in the group market take advantage of group ratings and thus may be more satisfied with plans because they do not bear as much of the overall cost.

The coefficient on SumHealth is positive and marginally significant when related to OverallSatisfaction, indicating that respondents with more physician diagnosed diseases are more
satisfied with their health plan. This is consistent with the idea that respondents who expect to utilize the policy ex-post sort themselves into plans with adequate coverage. The coefficient on HighRisk is negative and statistically significant in all specifications. Those respondents who are high risk based on self-assessment of risk are less likely to be satisfied with their health insurance plan. This could be that these respondents do not feel they have adequate coverage compared to their expected usage. Those respondents with low deductibles are more likely to be happier with their health insurance plan given that the coefficient on DeductibleLow is positive and statistically significant (at the one percent significance level) in two of the four specifications. This is consistent with the fact that cost may be a factor in the satisfaction of consumers. The less they pay for the coverage, the more satisfied they may be with the plan.

Consumer satisfaction of individuals in the group market may be related to the restriction in choice of health insurer. Generally, group market participants are limited to options chosen by their employer. Therefore, for robustness, I analyze the satisfaction of only those participants in the individual market. The results are reported in Table 6. Type1, those respondents likely to be favorably selected are less satisfied with their plans, regardless of the satisfaction measure. The coefficient on Type1 is negative and statistically significant (at the one percent significance level) across all four specifications. Type4 respondents, or those that are more likely to have adversely selected into the plan are likely to be more satisfied in three of the four specifications. The coefficient on Type4 is positive and significant when the measures, OverallSatisfaction, LikelihoodToRecommend and LikelihoodToRenew are employed.
3.7 Conclusion

The existence of adverse selection and the impact of adverse selection on health insurance policies is a widely studied phenomenon. In this study, I add to the literature by relating adverse selection with consumer satisfaction. I exploit a dataset rich with respondent demographic demographics and health insurance plan information to evaluate whether respondents that adversely select into the health insurance plan are then more likely to be satisfied with their health insurance plan. Indeed, using several proxies for consumer satisfaction, I find that respondents that are more likely to have adversely selected into the health insurance plan are more satisfied with their plan, thus indicating that they may feel as though they got a “better deal” on their health insurance.

The results of this research have important implications for the marketing and pricing of health insurance coverage. Given consumers’ private information about their health status, and the fact that health insurers are severely restricted in their ability to use individual characteristics to price policies, the potential for adverse selection may be difficult for insurers to manage. A variety of policy tools to address this problem have been implemented or proposed, including standardizing coverage across plans and mandating purchase. If underwriting restrictions on health insurers are lifted, insurers may be able to price policies more accurately and policyholders may be less likely to be able to adversely select into the plan. However, to the extent that health insurer financial viability relies on maintaining a stable pool of enrollees plans (i.e., high renewal rate), insurers may wish to consider additional ways to communicate health plan value.
Table 3.1: Chapter Three Variable Definitions

<table>
<thead>
<tr>
<th>Respondent Variables:</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Policyholder Age in years</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1 for female, 0 male</td>
</tr>
<tr>
<td><strong>CollegeEducated</strong></td>
<td>1 for Bachelor's Degree or higher, 0 otherwise</td>
</tr>
<tr>
<td><strong>Employed</strong></td>
<td>1 for full time, part time or self-employed, 0 retired or unemployed</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>household income in $ categories 1-16(^{52})</td>
</tr>
<tr>
<td><strong>HighRisk</strong></td>
<td>1 if self-reported overall health is &quot;Poor&quot; or &quot;Fair&quot;, 0 if &quot;Good&quot; or &quot;Excellent&quot;</td>
</tr>
<tr>
<td><strong>SumHealth</strong></td>
<td>Sum of indicator variables for 9 different physician diagnosed diseases</td>
</tr>
<tr>
<td><strong>Risky</strong></td>
<td>1 if (\text{SumHealth}) is greater than or equal to 2, 0 if (\text{SumHealth}) is 0 or 1</td>
</tr>
<tr>
<td><strong>RiskCost</strong></td>
<td>Sum of cost of treating specific illnesses, $</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plan Variables:</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DeductibleLow</strong></td>
<td>1 if annual deductible is less than $1350 for self or less than $2650 for family</td>
</tr>
<tr>
<td><strong>DeductibleAmount</strong></td>
<td>Annual Deductible Amount ($)</td>
</tr>
<tr>
<td><strong>EmployerSponsored</strong></td>
<td>1 if plan is employer sponsored, 0 if plan is purchased on individual market</td>
</tr>
<tr>
<td><strong>PPO</strong></td>
<td>1 if plan is PPO, 0 if HMO</td>
</tr>
<tr>
<td><strong>MonthlyPremium</strong></td>
<td>Monthly Premium Amount ($)</td>
</tr>
<tr>
<td><strong>EmpPriv</strong></td>
<td>1 if employer is private, 0 otherwise</td>
</tr>
<tr>
<td><strong>NoPremium</strong></td>
<td>1 if respondent pays no monthly premium, 0 otherwise</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfaction Variables</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OverallSatisfaction</strong></td>
<td>categorical 1 to 10, 1 is &quot;unacceptable&quot;</td>
</tr>
<tr>
<td><strong>LikelihoodToRecommend</strong></td>
<td>categorical 1 to 4, 1 is &quot;definitely will not&quot; recommend</td>
</tr>
<tr>
<td><strong>LikelihoodToRenew</strong></td>
<td>categorical 1 to 4, 1 is &quot;definitely will not&quot; renew</td>
</tr>
<tr>
<td><strong>EaseOfUnderstanding</strong></td>
<td>categorical 1 to 10, 1 is &quot;unacceptable&quot;</td>
</tr>
</tbody>
</table>

\(^{52}\) Categories for income range from 1-16. The breakdown is as follows: 1 is household annual income (pre-tax) under $25,000; 2 is between $25,000-29,999; 3-9 correspond to $10,000 increments (for example 3 is $30,000-$39,999 and so on); 10-14 correspond to $25,000 increments (for example 10 is $100,000-$124,999 and so on); 15 is $250,000-$499,999 and 16 is $500,000 or more. The mean for this sample is 6.73 which corresponds to an average annual household income (pre-tax) between $60,000-$69,999. Standard deviation is 3.38. Min is 1 and Max is 16. (n=32,173)
Table 3.2: Chapter Three Summary Statistics

<table>
<thead>
<tr>
<th>Respondent Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
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<td>13</td>
<td>18</td>
<td>64</td>
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<tr>
<td>Female</td>
<td>0.63</td>
<td>0.48</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CollegeEducated</td>
<td>0.65</td>
<td>0.48</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Employed</td>
<td>0.85</td>
<td>0.36</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Income</td>
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<td>3.35</td>
<td>1</td>
<td>16</td>
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<tr>
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<td>0.35</td>
<td>0</td>
<td>1</td>
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<tr>
<td>SumHealth</td>
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<td>0.97</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>RiskCost</td>
<td>2696</td>
<td>4689</td>
<td>0</td>
<td>49407</td>
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<tr>
<td>Risky</td>
<td>0.17</td>
<td>0.38</td>
<td>0</td>
<td>1</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Plan Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeductibleLow</td>
<td>0.51</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
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<td>DeductibleAmount</td>
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<td>1758</td>
<td>100</td>
<td>10000</td>
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<tr>
<td>EmployerSponsored</td>
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<td>0.37</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>PPO</td>
<td>0.69</td>
<td>0.46</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>MonthlyPremium</td>
<td>212</td>
<td>303</td>
<td>0</td>
<td>5000</td>
</tr>
<tr>
<td>EmpPriv</td>
<td>0.43</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfaction Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OverallSatisfaction</td>
<td>7.05</td>
<td>2.00</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>LikelihoodToRecommend</td>
<td>3.02</td>
<td>0.84</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>LikelihoodToRenew</td>
<td>3.16</td>
<td>0.82</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>EaseOfUnderstanding</td>
<td>6.50</td>
<td>2.14</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

N=11,218
### Table 3.3: Estimation of Deductible Equation
Dependent Variable *DeductibleAmount*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>p-value</th>
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<tbody>
<tr>
<td><strong>Coverage Equation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Age</em></td>
<td>11.8388***</td>
<td>[1.2391]</td>
<td></td>
</tr>
<tr>
<td><em>Female</em></td>
<td>43.2156</td>
<td>[31.7977]</td>
<td></td>
</tr>
<tr>
<td><em>CollegeEducated</em></td>
<td>139.4817***</td>
<td>[33.6682]</td>
<td></td>
</tr>
<tr>
<td><em>PPO</em></td>
<td>109.3508***</td>
<td>[34.4182]</td>
<td></td>
</tr>
<tr>
<td><em>EmployerSponsored</em></td>
<td>-1723.7858***</td>
<td>[42.3810]</td>
<td></td>
</tr>
<tr>
<td><em>SumHealth</em></td>
<td>-82.1130***</td>
<td>[15.9267]</td>
<td></td>
</tr>
<tr>
<td><em>Income</em></td>
<td>-14.6980***</td>
<td>[4.8629]</td>
<td></td>
</tr>
<tr>
<td><em>EmpPriv</em></td>
<td>354.0123***</td>
<td>[31.4216]</td>
<td></td>
</tr>
<tr>
<td><em>NoPremium</em></td>
<td>-8.8613</td>
<td>[52.8660]</td>
<td></td>
</tr>
<tr>
<td>_cons</td>
<td>3028.3679***</td>
<td>[477.4242]</td>
<td></td>
</tr>
<tr>
<td><strong>R^2</strong></td>
<td>0.185</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Obs.</strong></td>
<td>11218</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Table 3.4: Estimation of Risk Equation OLS
Dependent Variable *RiskCost*

<table>
<thead>
<tr>
<th>Risk Equation</th>
<th>(1)</th>
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<tbody>
<tr>
<td>Age</td>
<td>58.8954***</td>
</tr>
<tr>
<td></td>
<td>[3.5305]</td>
</tr>
<tr>
<td>Female</td>
<td>-314.7182***</td>
</tr>
<tr>
<td></td>
<td>[91.3817]</td>
</tr>
<tr>
<td>CollegeEducation</td>
<td>-554.0095***</td>
</tr>
<tr>
<td></td>
<td>[96.6558]</td>
</tr>
<tr>
<td>PPO</td>
<td>-263.0282***</td>
</tr>
<tr>
<td></td>
<td>[98.9309]</td>
</tr>
<tr>
<td>EmployerSponsored</td>
<td>501.8173***</td>
</tr>
<tr>
<td></td>
<td>[121.7026]</td>
</tr>
<tr>
<td>Income</td>
<td>-65.6814***</td>
</tr>
<tr>
<td></td>
<td>[13.9603]</td>
</tr>
<tr>
<td>EmpPriv</td>
<td>-343.4616***</td>
</tr>
<tr>
<td></td>
<td>[90.2733]</td>
</tr>
<tr>
<td>NoPremium</td>
<td>-363.2647**</td>
</tr>
<tr>
<td></td>
<td>[151.9493]</td>
</tr>
<tr>
<td>_cons</td>
<td>1754.0567</td>
</tr>
<tr>
<td></td>
<td>[1372.3340]</td>
</tr>
<tr>
<td>R^2</td>
<td>0.054</td>
</tr>
<tr>
<td>Obs.</td>
<td>11218</td>
</tr>
</tbody>
</table>

Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Table 3.5: Ordered Probit
Dependent Variable 4 measures of Consumer Satisfaction

<table>
<thead>
<tr>
<th></th>
<th>OverallSat</th>
<th>LikelihoodToRec</th>
<th>LikelihoodToRen</th>
<th>EaseOfUnderstand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type1</strong></td>
<td>-0.1250***</td>
<td>-0.1064***</td>
<td>-0.1199***</td>
<td>-0.1197***</td>
</tr>
<tr>
<td></td>
<td>[0.0277]</td>
<td>[0.0295]</td>
<td>[0.0298]</td>
<td>[0.0277]</td>
</tr>
<tr>
<td><strong>Type4</strong></td>
<td>0.1850***</td>
<td>0.2328***</td>
<td>0.2058***</td>
<td>0.1728***</td>
</tr>
<tr>
<td></td>
<td>[0.0282]</td>
<td>[0.0305]</td>
<td>[0.0311]</td>
<td>[0.0282]</td>
</tr>
<tr>
<td><strong>TypeA</strong></td>
<td>0.0468</td>
<td>0.0132</td>
<td>0.0372</td>
<td>0.0587*</td>
</tr>
<tr>
<td></td>
<td>[0.0315]</td>
<td>[0.0339]</td>
<td>[0.0344]</td>
<td>[0.0315]</td>
</tr>
<tr>
<td><strong>TypeD</strong></td>
<td>0.0188</td>
<td>0.0030</td>
<td>0.0208</td>
<td>0.0388</td>
</tr>
<tr>
<td></td>
<td>[0.0302]</td>
<td>[0.0325]</td>
<td>[0.0330]</td>
<td>[0.0302]</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>0.0009</td>
<td>-0.0003</td>
<td>0.0001</td>
<td>-0.0066***</td>
</tr>
<tr>
<td></td>
<td>[0.0009]</td>
<td>[0.0010]</td>
<td>[0.0010]</td>
<td>[0.0009]</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>0.0265</td>
<td>0.0219</td>
<td>0.0117</td>
<td>-0.0314</td>
</tr>
<tr>
<td></td>
<td>[0.0205]</td>
<td>[0.0221]</td>
<td>[0.0224]</td>
<td>[0.0205]</td>
</tr>
<tr>
<td><strong>CollegeEducated</strong></td>
<td>-0.1519***</td>
<td>-0.1460***</td>
<td>-0.0956***</td>
<td>-0.1386***</td>
</tr>
<tr>
<td></td>
<td>[0.0219]</td>
<td>[0.0236]</td>
<td>[0.0240]</td>
<td>[0.0219]</td>
</tr>
<tr>
<td><strong>PPO</strong></td>
<td>-0.1140***</td>
<td>-0.0913***</td>
<td>-0.0615**</td>
<td>-0.1285***</td>
</tr>
<tr>
<td></td>
<td>[0.0222]</td>
<td>[0.0238]</td>
<td>[0.0242]</td>
<td>[0.0222]</td>
</tr>
<tr>
<td><strong>EmployerSponsored</strong></td>
<td>0.0986***</td>
<td>0.1085***</td>
<td>0.1552***</td>
<td>0.0402</td>
</tr>
<tr>
<td></td>
<td>[0.0294]</td>
<td>[0.0316]</td>
<td>[0.0320]</td>
<td>[0.0294]</td>
</tr>
<tr>
<td><strong>SumHealth</strong></td>
<td>0.0222</td>
<td>0.0154</td>
<td>0.0108</td>
<td>0.0286*</td>
</tr>
<tr>
<td></td>
<td>[0.0147]</td>
<td>[0.0158]</td>
<td>[0.0160]</td>
<td>[0.0147]</td>
</tr>
<tr>
<td><strong>HighRisk</strong></td>
<td>-0.3340***</td>
<td>-0.2683***</td>
<td>-0.2339***</td>
<td>-0.2900***</td>
</tr>
<tr>
<td></td>
<td>[0.0290]</td>
<td>[0.0309]</td>
<td>[0.0313]</td>
<td>[0.0289]</td>
</tr>
<tr>
<td><strong>DeductibleLow</strong></td>
<td>0.1991***</td>
<td>0.1861***</td>
<td>0.2171***</td>
<td>0.1349***</td>
</tr>
<tr>
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<td>[0.0276]</td>
<td>[0.0296]</td>
<td>[0.0300]</td>
<td>[0.0276]</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td>0.0022</td>
<td>0.0068**</td>
<td>0.0054</td>
<td>0.0014</td>
</tr>
<tr>
<td></td>
<td>[0.0032]</td>
<td>[0.0034]</td>
<td>[0.0035]</td>
<td>[0.0032]</td>
</tr>
<tr>
<td><strong>MonthlyPremium</strong></td>
<td>-0.0002***</td>
<td>-0.0002***</td>
<td>-0.0002***</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>[0.0000]</td>
<td>[0.0000]</td>
<td>[0.0000]</td>
<td>[0.0000]</td>
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</tbody>
</table>
Table 3.5 continued

<table>
<thead>
<tr>
<th></th>
<th>(1) Overall Sati</th>
<th>(2) LikelihoodToRec</th>
<th>(3) LikelihoodToRen</th>
<th>(4) EaseOfUnderstan</th>
</tr>
</thead>
<tbody>
<tr>
<td>cut2</td>
<td>-1.6405***</td>
<td>-0.9736***</td>
<td>-1.3389***</td>
<td>-2.1361***</td>
</tr>
<tr>
<td></td>
<td>[0.3067]</td>
<td>[0.3454]</td>
<td>[0.3835]</td>
<td>[0.3050]</td>
</tr>
<tr>
<td>cut3</td>
<td>-1.3149***</td>
<td>0.3737</td>
<td>0.0001</td>
<td>-1.7498***</td>
</tr>
<tr>
<td></td>
<td>[0.3063]</td>
<td>[0.3453]</td>
<td>[0.3834]</td>
<td>[0.3048]</td>
</tr>
<tr>
<td>cut4</td>
<td>-1.0294***</td>
<td></td>
<td></td>
<td>-1.4148***</td>
</tr>
<tr>
<td></td>
<td>[0.3061]</td>
<td></td>
<td></td>
<td>[0.3046]</td>
</tr>
<tr>
<td>cut5</td>
<td>-0.4232</td>
<td></td>
<td>-0.5823*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.3060]</td>
<td></td>
<td>[0.3044]</td>
<td></td>
</tr>
<tr>
<td>cut6</td>
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<td>-0.3303</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.3060]</td>
<td></td>
<td>[0.3044]</td>
<td></td>
</tr>
<tr>
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<td>0.0645</td>
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</tr>
<tr>
<td></td>
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Standard errors in brackets

State, firm and year fixed effects included but not shown
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Table 3.6: Ordered Probit Individual Market
Dependent Variable: 4 measures of Satisfaction

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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Figure 3.1: Distribution of Residuals, Coverage Equation
Figure 3.2: Distribution of Residuals, Risk Equation
### Table 3.7: Predicting Coverage Choice

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<td>Type 2 – correctly sorted</td>
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N=11,310

### Table 3.8: Predicting Risk Level

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## APPENDIX A

### CORRELATION COEFFICIENT MATRICES

Correlation Coefficient Matrices

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Table B Panel B Dependent Variable: Risk Level

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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01

For robustness, I run the analysis using a bivariate probit in addition to the OLS model results reported in the main body of the paper. The results of the bivariate probit are listed here in Appendix B. Table B1 can be compared with Table 6 in the main body of the paper, confirming the presence of adverse selection in both the individual and group markets. Recall that
DeductibleLow is equal to one if the respondent has a low deductible and zero otherwise. Risky is equal to one if the respondent has two or more physician diagnosed diseases and zero otherwise. A positive relationship between these two variables indicates the presence of adverse selection since the lower deductible is associated with higher risk. Therefore, I expect that ρ will be positive and significant in both the individual and group markets.
## APPENDIX C

### ORDERED LOGIT

Table C Results from Ordered Logit

Panel A Dependent Variable: **DeductibleAmount**

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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
### Table C continued

Panel B Dependent Variable: Risk Level

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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
For robustness, I employ the use of categorical variables in the data. Recall that respondents were asked to self-assess their health into either “Poor,” “Fair,” “Good,” or “Excellent.” Therefore, I created a categorical variable $\text{SelfRisk}$ equal to 1 for “Poor,” 2 for “Fair,” 3 for “Good,” and 4 for “Excellent.” There are 282 respondents with poor health, 3,911 with fair health, 19,222 with good health and 5,411 with excellent health. To check that $\text{DeductibleAmount}$ is the appropriate variable to use to proxy coverage, I likewise categorize $\text{DeductibleAmount}$. According to the distribution, I divide the deductible amounts into 8 categories as follows. The variable, $\text{DeductibleCategory}$ is equal to 1 if the deductible amount is $0-250, 2 if the deductible amount is $251-$500, 3 if the deductible amount is $501-$1000, 4 if the deductible amount is $1001-$1500, 5 if the deductible amount is $1501-2000, 6 if the deductible amount is $2001-$3500, 7 if the deductible amount is $3501-5000 and 8 if the deductible amount is above $5000. I expect a positive correlation between $\text{SelfRisk}$ and $\text{DeductibleCategory}$ to indicate the presence of adverse selection as those with greater health (i.e. lower risk) choose higher deductibles. The results are reported in Appendix C.
## APPENDIX D

### BY-STATE REGRESSIONS

Table D: Results Estimates of rho from by-state regressions

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# APPENDIX E

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Table F: Results from Equation 1 Group and Individual Deductible Amount and Risk Cost Dependent Variable: RiskCost

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Standard errors in brackets
State fixed effects, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
Equation (1) is estimated to confirm a negative correlation between deductible amount and the cost of risk. Results in Table 5 are reported for the aggregate sample. For robustness, I also estimated equation (1) separately for the individual and group markets. Results of this analysis are reported here in Table F1.
## APPENDIX G

### STATE-LEVEL PROBIT WITH FIXED EFFECTS

Table G: Results of State-Level Probit with Fixed Effects

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Standard errors in brackets. Year fixed effects included but not shown

* p<0.10, ** p<0.05, *** p<0.01

Results with state fixed effects do show differences in factors that may affect the presence of adverse selection in a state. In the sample without state fixed effects, there are forty-three states. In the sample with state fixed effects, twenty-four states are dropped due to collinearity thus the sample is reduced from 129 state-year observations to 59 state-year observations. Of the remaining states in the sample, ten of the state dummies are significant indicating that there is significant variation among states that experience adverse selection suggesting omitted variable bias.
# APPENDIX H

## INSURER-LEVEL PROBIT WITH FIXED EFFECTS

Table H: Results of Insurer-Level Probit with Fixed Effects  
**Insurer-Level Adverse Selection Dependent Variable: AdverseSelectionIns**

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Standard errors in brackets  
Year fixed effects included but not shown  
* p<0.10, ** p<0.05, *** p<0.01  
Results with insurer fixed effects do show differences in factors that may affect the presence of adverse selection within an insurer. In the sample without insurer fixed effects, there are fifty-five insurers. In the sample with insurer fixed effects, forty-two insurers are dropped due to collinearity thus the sample if reduced from 163 insurer-year observations to 53 insurer-year observations. Of the remaining insurers in the sample, thirteen of the insurer dummies are significant indicating that there is significant variation among insurers that experience adverse selection suggesting omitted variable bias.
APPENDIX I

QUALITY OF CARE AND CONSUMER SATISFACTION

Table I: Correlations between Quality Of Care And Consumer Satisfaction Variables

<table>
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<tr>
<th></th>
<th>WaitTimeAppt</th>
<th>YrsCurrentDr</th>
<th>TooLittleTime</th>
<th>TimeWithDr</th>
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<tr>
<td>LikelihoodToRenew</td>
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<td>0.131***</td>
<td>0.016*</td>
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<td>-0.0002</td>
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<td>0.044***</td>
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* p<0.10, ** p<0.05, *** p<0.01

Reported above are the correlations between the quality of care variables and the consumer satisfaction variables. With the exception of the correlation between EaseOfUnderstanding and YrsCurrentDr, the variables are significantly correlated.
## APPENDIX J

### ORDERED PROBIT WITH GREATER THRESHOLDS

Table J: Ordered Probit with Greater Thresholds
Ordered Probit with Types categorized at the 5th and 95th percentiles

<table>
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<tr>
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<th>LikelihoodToRen</th>
<th>EaseOfUnderstan</th>
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Table J Continued

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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
## APPENDIX K

### ORDERED PROBIT INDIVIDUAL MARKET

Table K: Ordered Probit with Greater Thresholds – Individual Market

Ordered Probit with threshold at 5th and 95th percentile Individual Market

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Standard errors in brackets
State, firm and year fixed effects included but not shown
* p<0.10, ** p<0.05, *** p<0.01
## APPENDIX L

### UNIVARIATE TESTS BY TYPES

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APPENDIX M

IRB APPROVAL

Office of the Vice President for Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-3673  FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 08/19/2017
To: Eleanor Simmons
Address: 221 Academic Way Tallahassee, FL 32306
Dept.: COLLEGE OF BUSINESS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
   Essays on Adverse Selection, Subsidization and Policyholder Satisfaction in the U.S. Health Insurance Market

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Expedited per 45 CFR § 46.110(c) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 06/18/2018, you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00060446.

Cc: Patricia Bom, Advisor
HSC No. 2017.0075
REFERENCES


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Lieberthal, R., (2016). What is health insurance (good) for? (Springer).


The Internal Revenue Service (2016) “Publication 969, Health Savings Accounts and Other Tax-Favored Health Plans.”


E. Tice Sirmans was born in Athens, Georgia. She lived in Watkinsville, GA, Baton Rouge, LA, and Storrs, CT, where she graduated from E.O. Smith High School in 1996. Upon graduation, she moved to Salt Lake City, UT to attend the University of Utah, where she earned Bachelor of Science degrees in economics and sociology in 2001. After spending several years raising young children, Tice began her graduate education in the online Master’s program in Risk Management and Insurance at Florida State University in the summer of 2013. One year later, she transferred into the Risk Management and Insurance doctoral program at Florida State University. During Tice’s tenure in the doctoral program, she taught the introductory risk and insurance course numerous times, served as Assistant Editor of Risk Management and Insurance Review, and received several scholarships. She is scheduled to graduate from the doctoral program in December 2017. She currently holds the position of Visiting Instructor in the Healthcare Management and Insurance Studies program in the Finance Department at the University of Connecticut.