A DETAILED ANALYSIS OF THE PREMIUM VARIATION IN THE MARKET FOR MEDICARE SUPPLEMENTAL INSURANCE

A Dissertation

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

by

Johan Mathis Schroeder

August 2006

A DETAILED ANALYSIS OF THE PREMIUM VARIATION
IN THE MARKET FOR MEDICARE SUPPLEMENTAL INSURANCE

Johan Mathis Schroeder, Ph. D.
Cornell University 2006

Medicare guarantees health insurance coverage for any person 65 or older. However, Medicare coverage is not complete and the additional costs are substantial: for example, the hospital deductible for part A is $956 and the part B deductible amounts to $123 in 2006. The elderly can insure against these financial risks by obtaining supplemental insurance from different sources. A private market designed to cover the “gaps” in Medicare is known as the “Medigap” market. This market is regulated since 1992 by the Omnibus Budget Reconciliation Act of 1990. The law created markets with homogenous goods mainly by standardizing the policies that could be offered. Economic theory predicts that in a market for homogenous goods, there should be little or no price variation. However, premiums of Medigap policies continue to vary even within narrowly defined markets.

This dissertation is concerned with finding economic explanations for this puzzle. Sources of premium variation in the Medigap market are empirically investigated as well as reasons for why premium variation is sustained. Chapter one provides a general overview of the Medigap market and points out specific peculiarities due to the Omnibus Budget Reconciliation Act of 1990. In the second chapter, which is joint work with Nicole Maestas and Dana Goldman, differences in the populations covered by insurance firms are investigated with respect to their impact on actuarially fair

premiums. The third chapter focuses on how firms set prices for specific components of Medigap premiums and how these change over time. Also, the degree to which firm and state specific variables explain premium variation is investigated. The fourth chapter (joint with Nicole Maestas and Dana Goldman) targets the consumer side of the Medigap market by estimating a structural model that allows for sustained price variation due to consumer search costs.

The findings in this dissertation suggest that premium variation is at least partially caused by firm specific differences The premium variation is sustained through consumer search costs and thus uninformed consumers. However, there are some indications that the market experienced an increase in competition that reduces premium variation.

BIOGRAPHICAL SKETCH

Mathis Schroeder was born in 1975 in Hamburg, Germany. He attended the Humboldt University in Berlin, Germany, from 1997 to 2001 and received a Diploma in Economics in March of 2001. During his time in Berlin he was a research assistant at the German Institute for Economics. He started his graduate studies at Cornell University in August of 2001, received his M.A. in May 2005, and his Ph.D. in August of 2006. He will stay at Cornell University in a post-doctoral position in the Department for Policy Analysis and Management, and then assume a position as a researcher in the Mannheim Research Institute for the Economics of Aging in Mannheim, Germany.

meinen Eltern, in Dankbarkeit

ACKNOWLEDGMENTS

Many people have contributed to this work in many different ways. It is impossible to name them all, but this is an acknowledgement to all who have supported me throughout the last five years.

First I want to express my gratitude towards Don Kenkel, my committee chair. He was always encouraging, helpful, and gave a lot of comments to improve my work, even after my dissertation topic changed. Richard Burkhauser provided guidance that not only improved this work but my academic skills in general. I am extremely fortunate to have been supported by Kosali Simon. Her advice on many issues regarding the dissertation and life as a graduate student has been invaluable. I am indebted to Nicole Maestas, who was one of the driving forces behind this project with many discussions essential to this work.

I would like to acknowledge financial support from the Department of Policy Analysis and Management at Cornell University, the Department of Economics at Cornell University as well as from the RAND Corporation, where this dissertation began.

I am very grateful for my family's support, especially from my parents. They gave everything I could ask for. A number of friends I would like to thank: Andreas, Gerrit, Jan, and Tina were there when I needed them. AJ, Ching-Mei, Debbie, José, and Luís made my everyday life special.

TABLE OF CONTENTS

Chapter One: Background To The Medigap Market **1**

1.1. Introduction 1

1.2. Private Supplemental Insurance To Medicare 1

1.3. The Omnibus Budget Reconciliation Act Of 1990 3
1.3.1. Insurance Policy Restrictions 3
1.3.2. The Open Enrollment Period 4
1.3.3. Rating Methods 6
1.3.4. Other Regulations Under OBRA-90 9

1.4. An Excerpt Of The Previous Literature On The Medigap Market 10

1.5. Weiss Data And Premium Variation 11
1.5.1. Defining Homogenous Products 12
1.5.2. Premium Variation 14

1.6. Summary 17

1.7. Appendix Tables 18

Chapter Two: Simulating Medigap Premiums **22**

2.1. Introduction 22
2.2. Rating Methods 22
2.3. Simulation Data 29
2.4. Simulations 31
2.4.1. Benchmarks 32
2.4.2. Different Ages At The Point Of Buying A Policy 35
2.4.3. Shocks To the Steady State Age Distribution 39
2.4.4. Continuous Changes To The Steady State Age Distribution 42
2.4.5. Influences Of Health On Attained Age Premiums 44
2.5. Conclusion 46
2.6. Appendix Tables And Figures 48

Chapter Three: Pricing Of Coverage Packages And Competition **53**

3.1. Introduction 53
3.2. Data Specifications 54
3.3. Sample Means 56
3.3.1. General Premium Differences 56
3.3.2. Distribution of Policy Characteristics 58
3.3.3. Premium Means for Policy Characteristics 62
3.3.4. Premium Means for State Characteristics 67
3.4. Econometric Methods 70
3.4.1. Marginal Impacts On Price 70
3.4.2. Firm Specific vs. State Specific Variation 72
3.5. Results 73
3.5.1. General Results 75
3.5.2. Comparisons by Gender and Age 81
3.5.3. Explained Variation 84
3.6. Conclusion 87
3.7. Appendix Tables 89

Chapter Four: Premium Variation And Consumer Search Costs **96**

4.1. Introduction 96
4.2. Theoretical Framework 97
4.2.1. An Overview of Theories of Price Variation 97
4.2.2. A Model of Search Costs and Price Dispersion 99
4.3. Data Specifications 105
4.4. Empirical Analyses 109
4.4.1. Analysis of Firm Costs 109
4.4.2. Analysis of Firm Price-Setting Behavior 112
4.4.3. Analysis of Demand 116
4.4.4. Discussion 122
4.5. Conclusion 125
4.6. Appendix 4.1.: Formulas 127
4.6.1. Demand Equation 127
4.6.2. Price Equation 129
4.6.3. Profit Maximization 131
4.7. Appendix 4.2.: Data 131
4.8. Appendix Tables 133

Bibliography **136**

LIST OF FIGURES

Figure 2.1.: Simulated Costs by Age For The Three Rating Schemes – Men 33

Figure 2.2.: Simulated Costs by Age For The Three Rating Schemes - Women 34

Figure 2.3.: Impact of Individuals Buying a Community Rated Plan After the Age of 65 37

Figure 2.4.: Shocks to the Steady State Age Distribution of a Community Rated Plan 40

Figure 2.5.: Development of Community Rated Premiums Based on Population Projections 2000-2100 43

Figure 2.6.: Attained Age Premiums for Plans Insuring Individuals of Different Health 45

Figure 4.1: Example of Search Cost and Information Distribution 101

Figure 4.2: Cumulative Distribution of W_1 and W_N over all Markets 124

Appendix Figure 2.1: Selected Age Distributions for Men 51

Appendix Figure 2.2: Selected Age Distributions for Women 52

LIST OF TABLES

Table 1.1.: Insurance Coverage of the Standardized Medigap Plans 5
Table 1.2.: Premium Variation In Ten States: 14
Table 1.3.: Premium Variation For Standard Plans In Illinois 1998 16
Table 2.1.: Average Premiums Split By Age And Rating Method In 2002 28
Table 3.1.: Sample Premium Means and Standard Deviations 57
Table 3.2.: Sample Means of Weiss Data Variables 59
Table 3.3.: Average Premiums by Plan Characteristics 63
Table 3.4.: Average Premiums by Area Resource File Variables 68
Table 3.5.: Regression Coefficients for Insurance Policy Offers
to 65 Year-Old Men 76
Table 3.6.: Predicted Base Premiums by Gender and Age 82
Table 3.7.: Mean Coefficient Differences Between Age Groups 83
Table 3.8.: Comparison of Firm vs. State Explanatory Power 85
Table 4.1.: Summary Statistics for Merged Sample and NAIC Universe 107
Table 4.2.: Estimation of Cost Equation (4.7') 111
Table 4.3.: Estimation of Price Equation (4.9') 114
Table 4.4.: Estimation of Demand Equation (4.4') 118
Table 4.5.: Implied Maximum Search Cost *S* by Plan and Rating Method 120

Appendix Table 1.1: Average Coefficient of Variation of Within Firm
Insurance Premiums 18
Appendix Table 1.2: Coefficients of Variation of Insurance Premiums 20
Appendix Table 2.1.: Medical Care Expenditures by Gender (1992 - 2002) 48
Appendix Table 2.2.: Results from Expenditure Regression: 49
Appendix Table 2.3.: Results from Regression On Death Rates: 49
Appendix Table 2.4: Fractions of Simulated Age Distribution 65-100+ 50
Appendix Table 3.1: State Variable Means 89
Appendix Table 3.2.: Regression Coefficients for Insurance Policy Offers
to 65 Year-Old Women 90
Appendix Table 3.3.: Regression Coefficients for Insurance Policy Offers
to 75 Year-Old Men 92
Appendix Table 3.4.: Regression Coefficients for Insurance Policy Offers
to 85 Year-Old Men 94
Appendix Table 4.1.: Statistics from Merging Weiss and NAIC Data 133
Appendix Table 4.2.: Fraction of NAIC Covered Lives Not Matched
in Weiss Data by State and Plan 134

CHAPTER ONE

BACKGROUND TO THE MEDIGAP MARKET

1.1. Introduction

This chapter provides the background about the private market for health insurance supplemental to Medicare, the Medigap market. It is designed to avoid redundancies in the successive chapters. Section 1.2. will give an overview of the history of the market. Section 1.3. provides a detailed investigation of a specific event, the Omnibus Reconciliation Act of 1990, and how it affected the Medigap market. In section 1.4. previous literature about the Medigap Market will be discussed. Section 1.5. is essential to this dissertation, as it introduces the main dataset used in the analysis, the Medigap premium data by Weiss Ratings, Inc. It will not only provide important information about the contents of the dataset but describe the data construction as well. Section 1.6. briefly summarizes the findings of this chapter.

1.2. Private Supplemental Insurance To Medicare

Health insurance coverage is crucial for the elderly. With increasing age, the need to insure against the financial burden of everyday illnesses as well as against catastrophic losses due to health shocks becomes more and more important. Medicare, enacted in 1965, guarantees health insurance coverage for any person 65 and older and for certain disabled individuals. Medicare coverage has two components: Part A, termed “hospital insurance” for inpatient and some nursing home care, and Part B, “medical insurance” for doctor’s services and outpatient procedures. As long as certain work requirements are fulfilled, Part A does not involve a premium and starts automatically at age 65. Part B requires a monthly premium of $88 in 2006 and active enrollment.

Medicare coverage is not complete and the additional costs are substantial: for example, the hospital deductible for part A is $956, any hospital stays beyond the 60th day require a coinsurance of $236 per day, and the part B deductible amounts to $123 (all in 2006). The elderly can insure against these considerable financial risks by obtaining supplemental insurance from four different sources: former employers, Medicaid, Medicare Managed Care (also called Medicare HMOs), and a private market designed to cover the "gaps" in Medicare known as the "Medigap" market.

While the employer provided insurance requires the individual to have an employer providing retirement coverage and Medicaid is restricted to individuals below a certain income threshold, Medicare Managed Care and the Medigap market are open to all elderly. About 30 percent of Medicare beneficiaries obtain supplemental insurance through the private Medigap market, another 30 percent obtain supplemental coverage through their former employer, about 15 percent eliminate the coverage gaps by enrolling in Medicare managed care, and 15 percent are eligible for and receive supplemental coverage through the Medicaid program. The remaining 10 percent relied on Medicare exclusively for their medical costs (MedPac, 2003). As the Medicare managed care market has contracted since its peak 1998 and employers continue to reduce coverage for new retirees (Kaiser Family Foundation, 2005), the Medigap market may become an even more important source of supplemental insurance in the future.

Since its inception, the Medigap market has attracted the concern of policymakers. Allegations of insurer fraud and concerns that the elderly were both uniformed about their coverage needs and unable to navigate the complexities of supplemental coverage offers led states to adopt minimum benefits standards in the late 70s and early 80s (Finkelstein, 2004). Nevertheless, concerns about insurer malpractice grew, as consumer protection agencies accused insurers of extracting large rents by intentionally misleading people into purchasing multiple plans with duplicate coverage (Select Committee on Aging, 1990). This led to drastic reform of the Medigap market with the passage of the Omnibus Budget Reconciliation Act (OBRA) in 1990. OBRA-90 imposed several regulations on the Medigap market, both to the company and the consumer side, to reduce consumer confusion and to increase consumer welfare. These regulations are discussed in detail in the next section.

1.3. The Omnibus Budget Reconciliation Act Of 1990

The Omnibus Budget Reconciliation Act (OBRA) of 1990 federally introduced several regulations intended to strengthen consumer rights in the Medigap market. Most importantly, ten standardized insurance policies labeled A through J were established, medical underwriting was greatly restricted, and the purchase and sale of multiple plans was prohibited. These regulations came into effect in 1992 in all states but Massachusetts, Minnesota, and Wisconsin, where similar regulative measures had previously been introduced. The following sections will look in detail at the specific regulations.

1.3.1. Insurance Policy Restrictions

Prior to OBRA-90, the coverage specified by insurance plans was subject only to the insurance companies. Although plans had to be approved by a state's insurance commissioner, the specific benefits covered varied considerably across insurance firms. For the elderly, this complicated the comparison to find the optimal insurance plan for their needs, sometimes leading to duplicate coverage (Short and Vistnes, 1992).

Standardization was intended to increase the comparability of plan offers across insurance companies, which would hopefully enhance competition, lead to price reductions, and generate welfare gains for consumers.

Table 1.1. shows the different coverage packages associated with each of the ten plan letters A through J.[1] All plans under OBRA-90 have to supply insurance for the following Medicare payments: Medicare part A coinsurance, part B coinsurance, and the costs of three pints of blood per year. The additional coverage packages include Medicare part A and B deductibles, skilled nursing facility (SNF) coinsurance, Medicare Part B excess charges, foreign travel emergency charges, at home recovery costs, prescription drugs, and preventive services that are covered by Medicare.

While the coverage packages are specified as shown in Table 1.1., insurance companies are allowed to further distinguish into different categories. They can offer plans specifically for smokers, as well as "select" plans, which, for full insurance benefits, limit the customers to specific hospitals and medical providers.

1.3.2. The Open Enrollment Period

An important restriction was the introduction of the "open enrollment" period. This period begins once a consumer turns 65 *and* enrolls in Medicare Part B and then lasts for six months. For example, a consumer who turned 65 on the 1st of January in 1998, but enrolled in Medicare part B on April 1st, the open enrollment ends on September 30th. During the open enrollment period an insurance company has to accept an individual's application regardless of his or her medical condition. Once the individual's open enrollment period ends, firms are allowed to medically underwrite. In a few situations the consumer may purchase policies with

[1] Table 1.1. reflects the plans as they were from 1992 to 2005, which embraces the period under investigation here. In 2005, two plans (K and L) were introduced that are similar to plan A but with catastrophic coverage. In addition, prescription drug coverage was moved into Medicare Part D.

Table 1.1.: Insurance Coverage of the Standardized Medigap Plans

	Plan									
	A	B	C	D	E	F	G	H	I	J
Basic Benefits										
Medicare Part A Coinsurance and Hospital Benefits										
Medicare Part B Coinsurance or Co-payment					*(all plans have to cover)*					
Blood (three pints per year)										
Extra Benefits										
Skilled Nursing Facility Coinsurance			X	X	X	X	X	X	X	X
Medicare Part A Deductible		X	X	X	X	X	X	X	X	X
Medicare Part B Deductible			X			X				X
Medicare Part B Excess Charges						X	X [1]		X	X
Foreign Travel Emergency			X	X	X	X	X	X	X	X
At-Home Recovery				X			X		X	X
Prescription Drugs (basic) [2]								X	X	
Prescription Drugs (extended) [2]										X
Medicare-Covered Preventive Services					X					X

Notes:
All benefits are not initially covered by Medicare Part A and B, hence represent "gaps" in the Medicare Coverage. "**X**" means that the specific plan provides the benefit.
1) With plan G, 20% of the Excess Charges need to be paid (plans F, I, and J do not have a co-payment).
2) Starting in 2006, prescription drug coverage was moved into Medicare Part D.
Source: US Department of Health and Human Services, 2005.

guaranteed coverage even though she is not in her open enrollment period. Specifically, this is the case when a Medigap insurer goes bankrupt. In this case other insurers have to offer plans A, B, C, and F, without being able to underwrite.[2]

States have the possibility to go beyond the federal regulations for open enrollment. Currently, Connecticut and New York have "continuous" open enrollment periods (i.e. no underwriting at all), while California, Maine, and Massachusetts have an annual open enrollment period of one month around a person's birthday (The Lewin Group, 2001).

For individuals in most states, however, the decision to buy a Medigap insurance policy is confined to their open enrollment period: the potentially large premium increases that insurers can impose with medical underwriting outside an individual's open enrollment period deters the individual from switching to a different Medigap policy. This limitation of the individual's choice set imposes an undue weight on the decision taken in the open enrollment period. Indeed, in a related study, Rice, Snyder, Kominski, and Pourat (2002) find that only six percent of Medigap policy holders switch into Medicare Managed Care, which may give an indication of the small amount of turnovers within Medigap policies.

1.3.3. Rating Methods

OBRA-90 also restricted the possibilities insurance companies have to set premiums in an individual's open enrollment period. With underwriting limited to age, gender, and smoking status, insurance companies were left with few ways of varying premiums to match their risk exposure. In addition to varying premiums by gender and smoking status, they adopted three different methods of varying premiums by age: Attained Age Rating, Community Rating, and Issued Age

[2] This was a provision added in the Balanced Budget Act of 1997 (BBA-97).

Rating. Each method represents a different degree of risk pooling within an insurance plan.

Attained Age plans vary premiums according to the consumer's current age, whereas Community Rated plans pool all risks and charge the same premium to all policyholders regardless of age (although some differentiate by gender). Issued Age plans are based on the consumer's buy-in age, not on her actual age, and therefore the same premium is charged to all individuals who bought at the same age, regardless of the year in which they first bought their policy. If an insurance company wishes to raise premiums, it must do so for all policyholders within the same rating class. For example, it is not possible for an insurer to increase the premium separately for the oldest people in a Community Rated or Issued Age plan – this would only be allowed in an Attained Age plan.

An important consideration is how the premiums differ depending on the rating methods. While a detailed discussion of the three rating methods is presented in Chapter Two, the following differences in premiums are immediate: for younger individuals buying a Medigap plan, the Attained Age policies will be the least expensive, since they charge by age group, and younger individuals have lower health expenditures. Community Rated policies on the other hand impose the highest premiums, since the young individuals in the plan subsidize the old. (Issued Age plans will be in between the two.) With increasing age, this difference decreases, and the relationship reverses eventually. Each rating method also implies a different age profile in premiums. Attained Age plans feature a relatively low premium at age 65 but a steeply rising premium profile with age, whereas Issued Age plans have higher age 65 premiums and less steeply rising premium profiles with age.[3] For Community

[3] For Plan A, the average annual increase in premiums is about 3 percent for Attained Age rating in the first ten years, compared to 2.2 percent for Issued Age plans.

Rated plans, the age profile is flat, i.e. as the individual ages, her premiums adjusted for inflation are not rising.

If one considers the different rating schemes, an obvious flaw seems to be present in the market – if Attained Age premiums are lowest when people are young, and the Community Rated premiums are lowest when old, why do older people not switch from an Attained Age plan to a Community Rated plan? If that were the case, the market for Community Rated plans would cease to exist, since the maintenance of lower premiums at older ages relies on the presence of younger (i.e., healthier) individuals in the plan population. This development is similar to the "adverse selection death spiral" mentioned for example by Buchmueller and DiNardo (2002) or Cutler and Reber (1998).

However, as discussed in the previous section, the mechanism that prevents the death spiral is the institution of the one-time open enrollment period. Only for plans purchased in open enrollment are insurers prohibited from further underwriting. For a plan bought in the open enrollment period, the premium can only change for the whole group. However, since medical underwriting or even rejection is allowed once the consumer is not in her open enrollment period when buying a plan, switching from one plan to another, or from one company to another, might lead to substantial additional costs for the consumer.[4] Consequently, the market resembles a one-shot market: individuals enter the market once they enroll in Medicare Part B at an age of at least 65, purchase a Medigap plan, and do not actively participate in the market once their open enrollment period ends. This not only reduces the incentives to switch,

[4] For example, in Arizona the Community Rated insurer United Health Care offers two rates per plan to people, who are out of their open enrollment period: A "preferred rate" and a "universal rate", where the universal rate is priced 36% higher than the preferred rate. For plans A through G, "answers to health questions on [the] enrollment application will be used" to determine the applicant's rate. For the high cost plans H, I, and J, the answers will determine eligibility as such. This pattern is found in several other states as well.
Source: AARP web site, http://www.aarphealthcare.com/quote/index.aspx, accessed October 2005.

but also eliminates the consumer's ability to learn and adjust in the market; purchasing "mistakes" cannot be fixed unless the consumer completely exits the Medigap market.[5]

1.3.4. Other Regulations Under OBRA-90

One restriction for companies in the Medigap market concerns the share of premiums collected from the insured that is used to cover the incurred medical costs, the so-called loss ratio. With OBRA-90 insurance companies were required to have loss ratios of at least 65 percent for policies issued to individuals and at least 75 percent for policies issued to groups.[6] Although insurance companies do not have to meet the loss ratio in the first years after the policy has been approved, the requirement reduces the firms' potential to overprice their insurance policies.

With the passage of OBRA-90, policies can no longer be canceled by the insurance company, as long as the customer pays the premiums. This guaranteed renewability of insurance policies provides stability to the insured, since the policy could not be discontinued on health grounds. Insurance companies were also prohibited to sell multiple insurance plans to one customer to avoid duplicate coverage. Fines of $5000 per policy are imposed if either of the above restrictions are violated.

Finally, OBRA-90 introduced the "select" policies, allowing for a managed care alternative to standard Medigap. Although the plans have to correspond with the coverage packages shown in Table 1.1., insurance companies are allowed to restrict full benefits to the use of specific network providers. Originally, select policies were

[5] Connecticut and New York, which both have a continuous open enrollment period, in addition implemented a mandatory Community Rating, such that there is no possibility to switch from Attained Age to Community Rated plans.
[6] Group policies are mainly those bought through an intermediate consumer agency, for example AARP.

introduced only in 15 states as an experiment, but in 1998, Congress extended the select option to all states. While the impact of this extension on the regular Medigap market is not clear (see for example Lee et al, 1997), insurance companies make little use of this low-cost option, with about six percent of policies offered being "select" in 2000.

1.4. An Excerpt Of The Previous Literature On The Medigap Market

Before OBRA-90 was implemented, Rice (1987) investigated efficiency and competition in the Medigap market. While a competitive price cannot be found easily because policies at that point were not comparable, his findings suggests that individuals do not purchase the coverage they need due to lack of information. He concludes that major changes to the (pre-OBRA-90) Medigap market are necessary to increase consumer welfare.

The evaluation of OBRA-90 is the focus of Fox, Snyder, and Rice (2003). They conclude that the legislation overall was successful, since consumer confusion was reduced as well as the number of complaints about insurance abuses. On the other hand, they do not find evidence that the price competition has increased in the period from 1990 to 2000. Lee, Garfinkel, Khandker, and Norton (1997) investigate the impact of introducing the "select" option to the Medigap market with a quasi experimental approach in those states that were implementing it first under OBRA-90. The results are somewhat unsatisfactory: in five states, the costs increase, whereas in the remaining six states under investigation they either remain constant or decline with the introduction of select policies.

A number of studies have concentrated on an adverse selection aspect of the Medigap market. As in any insurance market, the individuals in poorer health will buy more health insurance and have higher rates of utilization, thereby increasing premiums and driving healthier individuals out until the market collapses – the "adverse selection death spiral", see for example Buchmueller and DiNardo (2002) or Cutler and Reber (1998). The findings, however, are mixed. Wolfe and Goddeeris (1991) provide some evidence for adverse selection in the Medigap market, although the premium increases caused by adverse selection are rather small. They note that individuals with better health tend to have higher rates of Medigap insurance, which might be attributed to the Medicaid option that is available to the poor. Ettner (1997) uses the Medicare Current Beneficiary Survey (MCBS) and compares Medigap policy holders to those individuals with employer provided supplemental insurance. She finds that Medigap policy holders have significantly higher expenditures and interprets this (under the assumption of exogenous coverage choice) as evidence for adverse selection into the Medigap market. Opposite to these results, Fang, Keane, and Silverman (2006) use the MCBS in combination with the Health and Retirement Study (HRS) to conclude that there is advantageous selection into Medigap insurance: healthier individuals with lower health care expenditures risks are more likely to buy Medigap policies.

Tied closely to the problem of selection is that of moral hazard, see Wolfe and Goddeeris (1991), Ettner 1997, or Fang et al. (2006). Since Medigap is a supplement to Medicare, and Medicare still pays shares of the costs, the premiums are lower than the marginal costs of the utilization, thus leading to inefficient levels of use of medical care. All of the mentioned studies find utilization rates that are too high, causing an additional burden on the Medicare budget.

1.5. Weiss Data And Premium Variation

The main data source used in this dissertation is premium data provided by Weiss Ratings, Inc. The data span a time horizon of 5 years, from 1998 to 2002, and for each year contain the prices of Medigap policies as of January 1st of that year.[7] The Weiss data capture about 91 percent of all firms operating nationwide, and are voluntarily provided by insurance companies. Firms report their premiums for the Medigap plan letters they offer by gender, age, standard, smoking or select status, rating method, and zip code. The data also include the Weiss financial safety rating for each insurance firm (A+ to F).[8]

Medigap policies within a certain plan letter can be regarded as homogenous products, since to the consumer, they offer the same observable benefits. Economic theory suggests, that these homogenous products are priced identically in a competitive market. In the following section, I specifically define a homogenous product for the Medigap market, while section 1.5.2. will look at some examples of the premium variation within these homogenous products.

1.5.1. Defining Homogenous Products

As Table 1.1. shows, the ten standard Medigap plans provide different degrees of coverage. These coverage differences will lead to cost differences, which in turn will lead to premium differences; thus, premiums are expected to vary across plan letters. Premiums will also vary within plan letter on those dimensions permitted by law: gender, smoking status, select status, and age. For example, a smoker will pay more for Plan A than a non-smoker, and men will sometimes pay a different premium than women. As discussed in section 1.3.3., Attained Age premiums will

---

[7] For Chapter Four, only the premiums of 1998 are used.

[8] There are more types of plans, e.g. preferred or select-smoking plans. Since the cell sizes become small, they are omitted here. Weiss also reports whether the policy is a "guaranteed" issue plan. These are not plans sold in open enrollment periods but those where customers decide to forgo a waiting period to have coverage guaranteed. These plans also suffer from small sample sizes, and there also seem to be some measurement issues. Thus the sample is also restricted to non-guaranteed plans. The restrictions applied to the sample (non-guaranteed, standard, select or smoker plans) reduces the sample by about twelve percent.

generally be lower than Issued Age and Community Rated premiums at younger ages, but will be higher at older ages.

An important consideration is the geographic area relevant to insurance firms. Firms operating in the Medigap market report their premiums to Weiss on a zip code level. Although insurers are free to vary prices by zip code or county, the premium data show that most variation occurs across rather than within states. For example, of the 47 firms offering plan F to 65 year-old women in Illinois, 29 (62 percent) charge the same premium in every zip code.[9] The remaining 18 firms have a mean within-firm coefficient of variation of 6.1 percent, leading to an average within-firm coefficient of variation of 2.3 percent in Illinois. Most other states show a similar pattern (see Appendix Table 1.1.). This lack of variation within a firm and state is not altogether surprising: insurance companies are subject to regulations and reporting requirements that vary by state (e.g., open enrollment or loss ratio requirements), not by county or zip code. In addition, data on covered lives from the National Association of Insurance Commissioners (described in Chapter Four) suggest that for most firms the number of policyholders per zip code or county may be too small to adjust the premiums for risks that are specific to small geographic areas. In sum, the Weiss data suggest that states are the relevant "local" markets in most cases.

In all analyses that follow, policies of the same plan letter, gender, smoking status, select status, rating method, and age, which are offered in the same state, are considered to be homogenous goods and hence are perfect substitutes for one another. This consideration allows to aggregate the premium data to a state level, i.e. to reduce the data to one observation per firm and homogenous product.

---

[9] Note that all rating types are considered together here. Since firms that operate in more than one rating method (less than 2 percent of all firms) are not considered in the analysis, the variation in premiums within a firm is not caused by the rating method.

1.5.2. Premium Variation

As mentioned above, one main goal of OBRA-90 was to increase the competition among firms thereby decreasing the premium variation. Despite these efforts, considerable premium variation still exists among Medigap policies that are otherwise identical, i.e. homogenous as defined in the previous section.

Table 1.2.: Premium Variation In Ten States:
Attained Age Standard Plans F offered to 65 Year-Old Women 1998

State	Mean	CV	Min	Max	90/10	75/25	Offers
AZ	1185	0.14	869	1630	1.45	1.24	30
CA	1205	0.25	456	1911	1.68	1.43	24
IL	1069	0.15	774	1604	1.33	1.15	35
KS	1072	0.14	789	1466	1.50	1.16	29
NH	970	0.18	724	1323	1.70	1.26	14
NJ	1035	0.11	845	1134	1.34	1.07	5
PA	1071	0.11	977	1204	1.23	1.23	3
TN	1064	0.17	784	1623	1.35	1.15	31
TX	1142	0.14	874	1630	1.41	1.14	33
WY	1083	0.24	761	1826	1.71	1.10	23

Notes:
All values are for Attained Age standard plans F sold to 65 year-old women. "$90^{th}/10^{th}$ " and "$75th/25^{th}$ " show the ratio of the 90^{th} to the 10^{th} and the 75^{th} to the 25^{th} percentile, respectively. Means, Minimum, and Maximum in 1998 Dollars.

While there is substantial variation nationwide, some of this variation is expected on account of differences in the costs of operating in different states. Table 1.2. shows how prices for Plan F vary *within* states, focusing on Attained Age plans in an arbitrary group of ten states. All of the within-state CV's are above 0.10, with two out of the ten above 0.20 (California and Wyoming), suggesting considerable within-state variation in premiums.[10] In some states, the range of premiums is quite large. For example, premiums for identical Plan F policies in California range from a low of \$456 to a high of \$1911, a fourfold difference. This spread is not merely due to outliers, as the ratio of the 90th over 10th percentiles is 1.7 and that of the 75th over 25th percentile is 1.4. The average premium differs substantially across states, indicating the presence of state-specific cost differences. Appendix Table 1.2. displays the complete listing of coefficients of variation all states and plan letters, confirming that significant price variation persists in all states and for all policies.

Table 1.3. illustrates the premium variation for the example of Illinois in 1998, restricted to standard plans under Attained Age rating offered to 65 year-old women. Depicted are yearly premium means, coefficients of variation (CV), minimum (Min), maximum (Max), the ratios of the 90th to the 10th and 75th to the 25th percentile, and the number of offers each plan letter has.

Although Table 1.3. only contains policies sold in Illinois in 1998, several observations from this specific state and year hold in general for the Medigap market. Plans A, C, and F, are offered the most. The average premium in general increases with the amount of coverage, i.e. the more comprehensive plans charge higher premiums (compare to coverage packages in Table 1.1.). Especially large differences exist between plans that cover prescription drugs (H, I, J) and those that do not, with an average difference of \$741. Those plans also experience more variation than plans A through G, although the variation in premiums is substantial in general. Coefficients of variation reach up to 37 percent (plan H) and ranges of premiums are more than

[10] The coefficients of variation reported here for the Medigap market are comparable to those noted in other studies of price dispersion in markets for homogeneous goods. For example, Sorensen (2000) reports an average CV of 0.22 in retail prescription drug markets, and Dahlby and West (1986) report examples of .0739 and .1796 for the automobile insurance industry.

$2000 for plan J. In addition, the percentiles ratios show that this spread is not due to outliers. Interestingly, the number of offers plays little role in the amount of variation.

Table 1.3.: Premium Variation For Standard Plans In Illinois 1998

Plan	Mean	CV	Min	Max	90/10	75/25	Offers
A	569	0.20	399	948	1.71	1.34	39
B	817	0.18	581	1312	1.53	1.24	29
C	970	0.18	677	1590	1.49	1.23	36
D	846	0.20	632	1410	1.40	1.23	18
E	911	0.25	650	1512	1.78	1.40	15
F	1069	0.15	774	1604	1.33	1.15	35
G	947	0.14	691	1181	1.44	1.18	13
H	1374	0.37	915	2440	2.67	1.47	7
I	1536	0.19	1174	2072	1.48	1.44	11
J	1942	0.35	1365	3555	2.60	1.42	9

Notes:
All values are for Attained Age standard plans sold to 65 year-old women in Illinois only. "$90^{th}/10^{th}$ " and "$75th/25^{th}$ " show the ratio of the 90^{th} to the 10^{th} and the 75^{th} to the 25^{th} percentile, respectively. Means, Minimum, and Maximum in 1998 Dollars.

This first look at the data suggests that despite the regulations of OBRA-90, prices continue to vary substantially between companies offering the same Medigap plans. Reports from Weiss (Weiss Ratings Inc., 1997-2006) indicate that this problem still persists in the Medigap market today. The existence of premium variation in a market with homogeneous goods is an indicator of imperfect information in the market (Stiglitz, 1989), and suggests that when consumers buy high-priced Medigap policies instead of identical lower-priced ones, welfare losses occur.

1.6. Summary

This chapter provides important background information about the market for supplemental Medicare insurance, specifically the Medigap market. The main changes introduced by the Omnibus Reconciliation Act of 1990 are discussed alongside a brief assessment of the economic changes this legislation has imposed on the market. In section 1.5. I introduce to the main data source of this dissertation, the premium data from Weiss Ratings, Inc. After defining homogenous products in the Medigap market, I show that significant premium variation exists.

The premium variation is the core of this dissertation: Chapter Two focuses on premium variation that is caused by differences in the population an insurance firm covers and relates the resulting simulated differences to the premium differentials that are actually observed. Chapter Three determines how specific coverage packages are priced and investigates the development of premium variation over time, especially with respect to implications for competition in the Market. In Chapter Four one reason for the sustained premium variation, search costs to consumers, is investigated and shown to be a major determinant.

1.7. Appendix Tables

Appendix Table 1.1: Average Coefficient of Variation of Within Firm Insurance Premiums

	PLAN									
STATE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
AK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AL	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
AR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AZ	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01
CA	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.04	0.04	0.03
CO	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
CT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FL	0.08	0.09	0.08	0.08	0.07	0.09	0.06	0.08	0.09	0.08
GA	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01
HI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IL	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.01
IN	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
KS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KY	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
LA	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.02
MD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MI	0.02	0.02	0.02	0.02	0.00	0.02	0.01	0.01	0.00	0.01
MO	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.01
MS	0.01	0.02	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01

Appendix Table 1.1: (continued)

	PLAN									
STATE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
MT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
NH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	
NM	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
NV	0.01	0.02	0.02	0.03	0.03	0.02	0.02	0.04	0.03	0.03
NY	0.05	0.04	0.03	0.04	0.04	0.05	0.04	0.04	0.03	0.02
OH	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
OK	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
OR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PA	0.02	0.02	0.02	0.02	0.03	0.01	0.01	0.01	0.04	0.01
RI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SC	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01
SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TN	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
TX	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.02
UT	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01
VA	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01
VT	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00
WA	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
WV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Within each firm, the state-plan coefficient of variation for premiums of plans offered to 65 year-old women are computed from all zip-codes the firm operates in in 1998. Each state-plan cell contains the average over these coefficients of variation in that cell. Firms that operate in more than one rating scheme (2% of all firms) were dropped from the analysis.
Source: Author's calculations using Weiss Ratings data, 1998.

Appendix Table 1.2: Coefficients of Variation of Insurance Premiums

	PLAN									
STATE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
AK	0.13	0.19	0.14	0.11	0.11	0.14	0.15	0.16	0.19	0.20
AL	0.20	0.17	0.19	0.18	0.20	0.15	0.16	0.29	0.18	0.28
AR	0.20	0.22	0.20	0.22	0.22	0.17	0.18	0.31	0.26	0.30
AZ	0.22	0.16	0.18	0.14	0.12	0.16	0.19	0.19	0.16	0.23
CA	0.26	0.22	0.28	0.14	0.14	0.19	0.17	0.10	0.14	0.28
CO	0.22	0.17	0.19	0.20	0.23	0.17	0.16	0.30	0.32	0.29
CT	0.27	0.07	0.16	0.12	0.08	0.13	0.09	0.51	0.55	0.22
DC	0.11	0.08	0.09	0.05	0.06	0.10	0.12	0.10	0.07	0.12
DE	0.16	0.15	0.09	0.15	0.16	0.10	0.00	0.00	0.13	0.12
FL	0.20	0.14	0.14	0.07	0.20	0.15	0.15	0.09	0.28	0.13
GA	0.16	0.15	0.16	0.16	0.16	0.15	0.14	0.31	0.23	0.31
HI	0.21	0.17	0.14	0.16	0.09	0.17	0.17	0.00	0.18	0.15
IA	0.23	0.23	0.20	0.15	0.18	0.20	0.22	0.11	0.19	0.26
ID	0.25	0.21	0.27	0.25	0.21	0.20	0.18	0.37	0.33	0.22
IL	0.20	0.17	0.19	0.17	0.22	0.16	0.14	0.29	0.19	0.32
IN	0.16	0.17	0.16	0.15	0.16	0.13	0.17	0.28	0.14	0.28
KS	0.20	0.16	0.18	0.15	0.14	0.15	0.14	0.20	0.15	0.20
KY	0.16	0.15	0.17	0.11	0.13	0.14	0.18	0.26	0.31	0.14
LA	0.18	0.15	0.15	0.14	0.10	0.11	0.13	0.15	0.13	0.18
MD	0.21	0.20	0.19	0.24	0.24	0.17	0.13	0.32	0.25	0.32
ME	0.19	0.20	0.19	0.17	0.15	0.19	0.18	0.86	0.69	0.19
MI	0.22	0.17	0.21	0.19	0.20	0.15	0.13	0.35	0.39	0.21
MO	0.16	0.13	0.15	0.12	0.17	0.12	0.14	0.25	0.13	0.19
MS	0.21	0.19	0.19	0.11	0.11	0.16	0.20	0.17	0.21	0.22

Appendix Table 1.2: (continued)

	PLAN									
STATE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
MT	0.16	0.13	0.14	0.15	0.11	0.14	0.14	0.11	0.15	0.27
NC	0.23	0.21	0.25	0.16	0.17	0.24	0.18	0.31	0.21	0.32
ND	0.16	0.12	0.13	0.15	0.12	0.15	0.16	0.13	0.17	0.21
NE	0.20	0.19	0.17	0.18	0.18	0.12	0.13	0.25	0.14	0.18
NH	0.14	0.11	0.13	0.11	0.08	0.13	0.11	0.08	0.18	0.24
NJ	0.18	0.14	0.13	0.08	0.00	0.10	0.09		0.04	
NM	0.19	0.14	0.14	0.14	0.06	0.11	0.16	0.12	0.14	0.19
NV	0.22	0.18	0.18	0.15	0.16	0.17	0.18	0.20	0.14	0.19
NY	0.12	0.13	0.11	0.06	0.14	0.14	0.12	0.21	0.02	0.18
OH	0.21	0.17	0.17	0.14	0.16	0.17	0.16	0.17	0.20	0.22
OK	0.24	0.18	0.19	0.19	0.20	0.20	0.18	0.25	0.16	0.29
OR	0.25	0.17	0.19	0.17	0.18	0.18	0.20	0.24	0.25	0.23
PA	0.19	0.16	0.13	0.11	0.19	0.08	0.00	0.14	0.00	0.29
RI	0.23	0.21	0.21	0.08	0.09	0.21	0.24	0.13	0.18	0.17
SC	0.17	0.19	0.21	0.16	0.18	0.15	0.15	0.22	0.17	0.22
SD	0.20	0.14	0.17	0.17	0.21	0.15	0.13	0.25	0.19	0.17
TN	0.20	0.21	0.21	0.19	0.20	0.17	0.16	0.33	0.23	0.27
TX	0.20	0.18	0.17	0.17	0.17	0.14	0.14	0.23	0.18	0.24
UT	0.18	0.16	0.18	0.16	0.18	0.15	0.17	0.19	0.15	0.23
VA	0.16	0.16	0.16	0.13	0.16	0.21	0.13	0.17	0.23	0.21
VT	0.13	0.11	0.07	0.11	0.03	0.00		0.03		0.04
WA	0.19	0.20	0.15	0.09	0.19	0.21	0.20	0.27	0.49	0.16
WV	0.22	0.22	0.18	0.19	0.22	0.18	0.16	0.32	0.20	0.21
WY	0.25	0.23	0.20	0.21	0.23	0.20	0.24	0.23	0.23	0.25

Notes:
The table shows the coefficients of variation for standard plans offered to 65 year-old women in 1998. The coefficients of variation are generated within each rating method. The cells depict the mean of these in the specific state-plan cell. Cells without entries do not have any offers.
Source: Author's calculations using Weiss Ratings data, 1998.

CHAPTER TWO

SIMULATING MEDIGAP PREMIUMS

2.1. Introduction

This chapter explains how actuarially fair premiums of otherwise identical insurance firms vary due to differences in the respective populations that are covered by the firms. The formation of premiums under the different rating methods is presented in detail, followed by premium simulations using different plan population scenarios. The comparison of variation created in these simulations and the actual variation in the market suggests, that at least for parts of the market, differences in consumers' age distributions could account for large parts of the premium differences between insurance companies.

The next section is concerned with the details of the rating methods and the implications that each has on the premium formation. Section 2.3 then introduces the data that is used as basis for the simulations presented in sections 2.4. The final section 2.5. concludes this chapter with a summary and discussion of the results.

2.2. Rating Methods

Theoretically, insurance policies can be distinguished by their degree of risk pooling or risk separation. If a separating contract is taken to the extreme, each consumer pays a premium according to his or her personal risk (see for example Arrow, 1963). On the other hand, in an extreme pooling contract all people covered by an insurer are paying the same premium, without consideration of their risk factors. As outlined in section 1.3.3., Attained Age, Issued Age and Community Rating are the rating methods used in the Medigap market. Of these three, Community Rating would be the most risk pooling, Attained Age Rating the most risk separating method. In general however, the risk specifications allowed by the regulations are relatively few, so that this market can be classified as having a large degree of risk pooling.

In what follows, the rating methods are compared based on actuarially fair premiums, i.e. the expected medical expenditures. The concentration here is on age differences causing differences in premiums, as basically the differences in gender, smoking, or select status affect all rating methods equally, whereas differences in the age distribution have different implications for each of them. (Note that the impact of regional risk diversification will be considered in the next chapter.)

Within each rating method, there is a group of individuals for which the premium is constant. For Attained Age plans, this will be an age group, for Issued Age plans, it is the group of people that bought into the plan at a specific age, and for Community Rated plans it is the whole plan population. The costs of each of these groups form the basis of the actuarially fair premiums considered in this analysis.

For any rating method, individual i in age group a files claims (or "produces" costs) C_{ai} with the insurance company. Let $E_a[C]$ denote the expected or average costs for an individual in age group a. As the individuals can buy into Medigap only when 65 or older, a ranges from 65 to the maximum age covered by the plan, denoted by A (the analysis has a maximum age of 100 years). n_a is the number of people in age group a covered by the insurer; N denotes the total number of people covered by the policy.

Premiums for Attained Age ratings (P^{AA}) will be based on the expected costs of each age group, i.e. all people of the same age covered by the same insurance company pay the same premium. The index a in the following formula labels an age group within an insurance company. Overall, the insurer covers (*A-64*) different age groups and thus can charge as many different premiums:

$$(2.1)\quad P_a^{AA} = \frac{1}{n_a}\sum_{i=1}^{n_a} C_{ai} = E_a\left[C\right],\quad \text{a} = 65, 66, \ldots, A.$$

Abstracting from inflation and real increases in medical costs, as long as average claims rise with age, the actuarially fair premium P^{AA} has to increase if an individual turns a year older. Thus a rational individual will expect to pay less now and more in the future in real terms, even if medical costs in each age group remain constant.

Actuarially fair premiums in Community Rated plans (P^{CR}) are based on the average claims of all individuals covered by the insurer:

$$(2.2)\quad P^{CR} = \frac{1}{N}\sum_{a=65}^{A}\ \sum_{i=1}^{n_a} C_{ai} = \frac{1}{N}\sum_{a=65}^{A}\ \frac{n_a}{n_a}\sum_{i=1}^{n_a} C_{ai} = \sum_{a=65}^{A}\frac{n_a}{N}E_a\left[C\right] = E\left[C\right]$$

The fraction n_a/N in equation (2.2) denotes the proportion of people covered by the insurer who are in age group a, and at the same time, it is the weight for the average claims this group imposes on the insurer in relation to the whole plan population. The last term in equation (2.2), $E[C]$, denotes the average or expected costs taken over the whole population covered by this plan. The premium for a Community Rated plan does not depend on the individual's age, and if expected costs and the age distribution remain constant (i.e. n_a/N is constant over time for all a), the premium is fixed over a person's life.

The Issued Age rating can be best described as Community Rating with greater risk separation. Actuarially fair premiums are based on the expected claims of all policyholders who bought in at the same age, regardless of their current age. For example, if person X bought a policy at age 66 in 1994 and person Y bought the same policy at age 66 in 2000, in 2003 they both pay the exact same premium, even though

X is six years older than Y. Let B denote the "buy-in" age for any group, and N_B the number of people who bought in at age B. (Note that all ages between buy-in age B and maximum age A are present in N_B.) Then the following formula applies for Issued Age premiums (P^{IA}) with a buy-in age of B[11]:

$$(2.3) \quad P_B^{IA} = \frac{1}{N_B} \sum_{a=B}^{A} \sum_{i=1}^{n_a} C_{ai} = \frac{1}{N_B} \sum_{a=B}^{A} \frac{n_a}{n_a} \sum_{i=1}^{n_a} C_{ai} = \sum_{a=B}^{A} \frac{n_a}{N_B} E_a[C], \quad \text{B=65, 66, \ldots A.}$$

Similar to Community Rated plans, without increases in health costs and with a constant age distribution within a buy-in group, there is no change in premiums for Issued Age plans. If in addition the buy-in age is fixed, i.e. every individual has to buy at the same age, say 65 years, N_B in equation (2.3) is identical to N in equation (2.2), and the Issued Age premium is identical to the Community Rated premium.

As costs to the insurer are increasing with age, and an increase in buy-in age results in higher premiums since younger people will not be present, a person buying an Issued Age plan will pay more, the later she buys in.[12] This also suggests that an Issued Age plan with a buy-in age greater than 65 can compete with a Community Rated plan only if it has a cost advantage in the individuals covered by the plan. This for example is the case if the Community Rated plan covers a larger number of older (thus unhealthy and more costly) people than the Issued Age plan.

Most of the following analysis is conducted comparing Community Rated and Attained Age plans. Unless otherwise noted, the results hold in a similar fashion for the comparison of Issued Age plans and Attained Age plans.

[11] We abstract here from the fact that insurance companies in general have a maximum buy-in age, which usually is around 80 years. Taking this into account would reduce the relevant number Issued Age plans, but not affect the premium calculation.
[12] Intuitively, an Issued Age plan with a buy-in age of 70 will not cover any person between 65 and 69, and since these age groups have lower costs on average, an Issued Age plan with a buy-in age of 70 has to charge higher premiums to cover its costs.

Equations (2.1), (2.2), and (2.3) confirm in detail findings from Chapter One: different rating schemes themselves cause some variation in Medigap premiums within an otherwise homogenous product. Specifically the buy-in age matters: consider for example a 65-year old comparing Attained Age and Community Rated premiums in her decision to buy a Medigap plan. Since, following equation (2.1), the Attained Age premium P_{65}^{AA} is only based on the expected costs of all 65 year-olds in this insurance company, this premium will be lower than the premium for a Community Rated plan, P^{CR}, assuming that this insurer has to average over multiple age cohorts.[13] There exists a buy-in age, at which the premium for Attained Age plans is higher than the premium for Community Rated plans. As will be shown in the simulation section in 2.4., with actuarially fair premiums based on the total medical costs, this buy-in age is at 75 for men and at 77 for women. Note that even between two Community Rated insurers there can be differentials in actuarially fair premiums, if the age distributions of their policyholders differ. Consider an example of two Community Rated plans, where the first covers relatively younger individuals, and the second covers relatively older people. The first insurer's premiums will be lower, since average costs will be lower. However, as the plan population ages, and thus the age distribution of the first policy shifts to the right, the insurer faces higher costs and hence has to raise its premium. The effects of different age distributions on costs are investigated in detail in section 2.4.

As discussed in section 1.3.3., there are barriers in the Medigap market that might deter individuals from switching Medigap policies after the open enrollment period. Thus, to the rational consumer an important consideration is not only the comparison of premiums at the buy-in age but also the expected total lifetime premium she has to pay. Again the different ratings yield differences in lifetime premiums, and depending

[13] Appendix table A2.1. shows how total medical costs increase with age from age 65-100.

on the life expectancy at buy-in age, any rating could be better than another. Holding constant changes in health care costs, inflation, and changes in the population distribution, in general a long-lived individual will be better off in a Community Rated plan than in an Attained Age plan. While the Attained Age premiums will be based on average costs in the age group, young people in Community Rated plans overpay when young, but underpay when old, and hence the older someone is, the larger will be the benefit of underpayment in a Community Rated plan. By the same reasoning, a short-lived individual will be better off in an Attained Age plan. The age at buy-in will influence the decision between ratings as well: only for the young is there a benefit of enrolling in an Attained Age plan, thus the older a person is when buying a Medigap plan, the better off she will be with a Community Rated plan.

From the insurer's perspective, an Attained Age insurer will be interested in covering healthy individuals – in any age group, they will yield positive profits, if the premium is based on expected costs. However, under certain circumstances a Community Rated insurer might be interested in insuring sick individuals. This would be the case if they buy in young and die young, and their lifetime costs remain below the lifetime costs of the average covered person. The incentives for insurers and consumers are opposite, since expected costs to consumers are expected revenues to insurers.

The decision to buy into a certain rating may not only depend on the present value of premium streams, however. Another aspect is how shocks to the risk pool are translated into shifts in premiums, depending on the rating's degree of risk pooling. Consider first the Attained Aged plans, where any shock to a specific age group will only affect that group. For example, if a group of healthy seventy year-olds decided to buy into an Attained Age plan, the premium would only change (decrease) within this group, and if the new group continued to be healthier, the whole present value of premiums would be shifted down, but only for the specific age group. In a Community Rated plan, all individuals enrolled are affected by a shock to a specific age group (in the example, all people benefit from the healthier individuals with lower premiums). However, since the premiums are averaged over all individuals, the impact on premiums is smaller than for Attained Age ratings. Since unexpected premium changes will be smaller in a Community Rated plan than in an Attained Age plan, a more risk averse an individual is better off with a Community Rated plan.

The above considerations are well reflected in the actual markets. Table 2.1. shows premiums differences split by the rating method and by age for standard premiums offered to women in 2002, without distinguishing by plan letter.

Table 2.1.: Average Premiums Split By Age And Rating Method In 2002

	Age At Which The Policy Is Bought		
	65	**75**	**85**
Attained Age	1206	1636	1942
	(421)	(561)	(677)
Issued Age	1419	1721	1955
	(519)	(647)	(749)
Community Rating	1544	1550	1553
	(607)	(612)	(616)

Notes:
Depicted are premiums for standard plans offered to women at the different age groups in 2002. Standard deviations are depicted in parenthesis.
Source: Author's calculations using Weiss data, 2002.

Within a rating method, the means increase with the buy-in age for Issued Age and Attained Age ratings, as expected from equations (2.1) and (2.3). Community

Rated plans should be the same across age following equation (2.2). There is some variation here, because not all insurance firms offer their plan to all buy-in groups. Across rating methods, the values are in line with the equations as well: at a buy-in age of 65, Attained Age plans are 15 percent less expensive than Issued Age and 22 percent less expensive than Community Rated plans. The Community Rated plans are on average 9 percent more expensive than the Issued Age plans for the 65 year-old buy-in group, which, as will be shown below, is likely due to the fact that not everybody buys into the Community Rated plan at age 65. As the buy-in age is increased, the differences are reversed: at a buy-in age of 75 (85), Community Rated plans on average cost only 95 percent (80 percent) of an Attained Age plan.

The standard deviation in premiums is one measure of the premium variation. Interestingly, while the premium variation remains almost constant for Community Rated plans, both Attained Age and Issued Age plans experience an increase in premium variation when the buy-in age is increased.

2.3. Simulation Data

To be able to accurately predict premiums and their development, this analysis firstly requires estimates of medical costs depending on age. The data source for these medical costs is the Medicare Current Beneficiary Survey (MCBS), a survey administered by the Research Data Assistance Center (ResDAC). The MCBS is a nationally representative panel survey of Medicare beneficiaries, providing demographic and socioeconomic measures as well as information on health status and health care utilization and expenditures. The sample is restricted to individuals 65 and older, where the group of 100 year-olds encompasses all individuals 100 years old and older. The years available are 1992-2002, for each of which the health care expenditures by age group and gender are reported – overall 792 cells.[14] Each of these cells contains a value for the mean medical expenditures (weighted by the MCBS population weights), which is then deflated to year 2000 dollars by a medical care consumer price index (Bureau of Labor Statistics, 2006). Then an expenditure function is obtained by regressing the logarithm of the real expenditures on age separately for men and women, taking into account that the samples become smaller with older individuals by using the number of people in each cell as a frequency weight.[15] (Results of this regression are shown in Appendix Table 2.2.)

Secondly, to be able to project how the premiums develop with age, it is important to know how likely it is that an individual that bought a Medigap policy actually survives until her next birthday. The Census' intercensal data (Census 2005a) are used to generate the survival rates for each age cohort (65-98) and gender for 1990-1999. This leads to a total of 612 survival probabilities for these years, which are used to estimate the probabilities of death (results are depicted in Appendix Table 2.3.).

In the simulations, the main interest is not on the actual number of people in a plan, but rather on what fraction of the age distribution these people contribute to the specific policy population.[16] These fractions are calculated using the estimated death probabilities estimated from the Census data. Appendix Table 2.4. shows the distribution of these fractions over the age groups from 65 to 100.

---

[14] Appendix Table A2.1. shows the distribution of expenditures by age averaged over 1992-2002.

[15] Since the costs used here are actual expenditures, the values presented here will be larger than the actual premiums found in the Medigap market. First, costs of all illnesses are considered, whereas any Medigap plan will only cover specific conditions, and second, Medigap policies do not cover all costs, but are only supplements to Medicare, which covers substantial parts of the costs as well. However, while the premiums then are not directly comparable, the trends shown in section 2.4. will still be valid for the plans, up to differences in coverage for age specific illnesses.

[16] To see this, consider any of the premium formulas (2.1) – (2.3). In each of them, the premium depends on the expected medical costs of different age groups, but not on the number of people itself.

2.4. Simulations

In this section actuarially fair premiums are simulated, where different premium paths are compared using the results from the regressions with the actual medical cost and life-table data.[17]

The discussion in section 2.2. indicates that an important factor for Community Rated and Issued Age plans is the age distribution of individuals. Hence first a steady state for both of these rating methods is defined:

Definition: *A steady state for a Community Rated or Issued Age plan is characterized by a fixed age distribution over time. That is, the fraction of the plan population in each age group remains constant over time.*

Appendix Table 2.4 shows the implied steady state distributions for men and women as specified in the previous section. This distribution will vary across the chapter to show the impact of changes and differences in the age distribution on actuarially fair premiums. First, however, the steady state distribution will be used to compare the Attained Age plans with the Community Rated and Issued Age plans as a benchmark.

The assumption is that insurers base their premiums on the same information on costs and survival probabilities as this analysis does, i.e. using the MCBS and the Census' population data from 1990 to 1999. The insurer collects premiums on a person's birthday and constructs the premium using the survival probability of the individual until her next birthday. Implicitly we assume, that the insurer will have to pay for the individual's health care costs only if she survives the whole year. The age dependent survival rates allow the insurer to calculate expected costs for each age

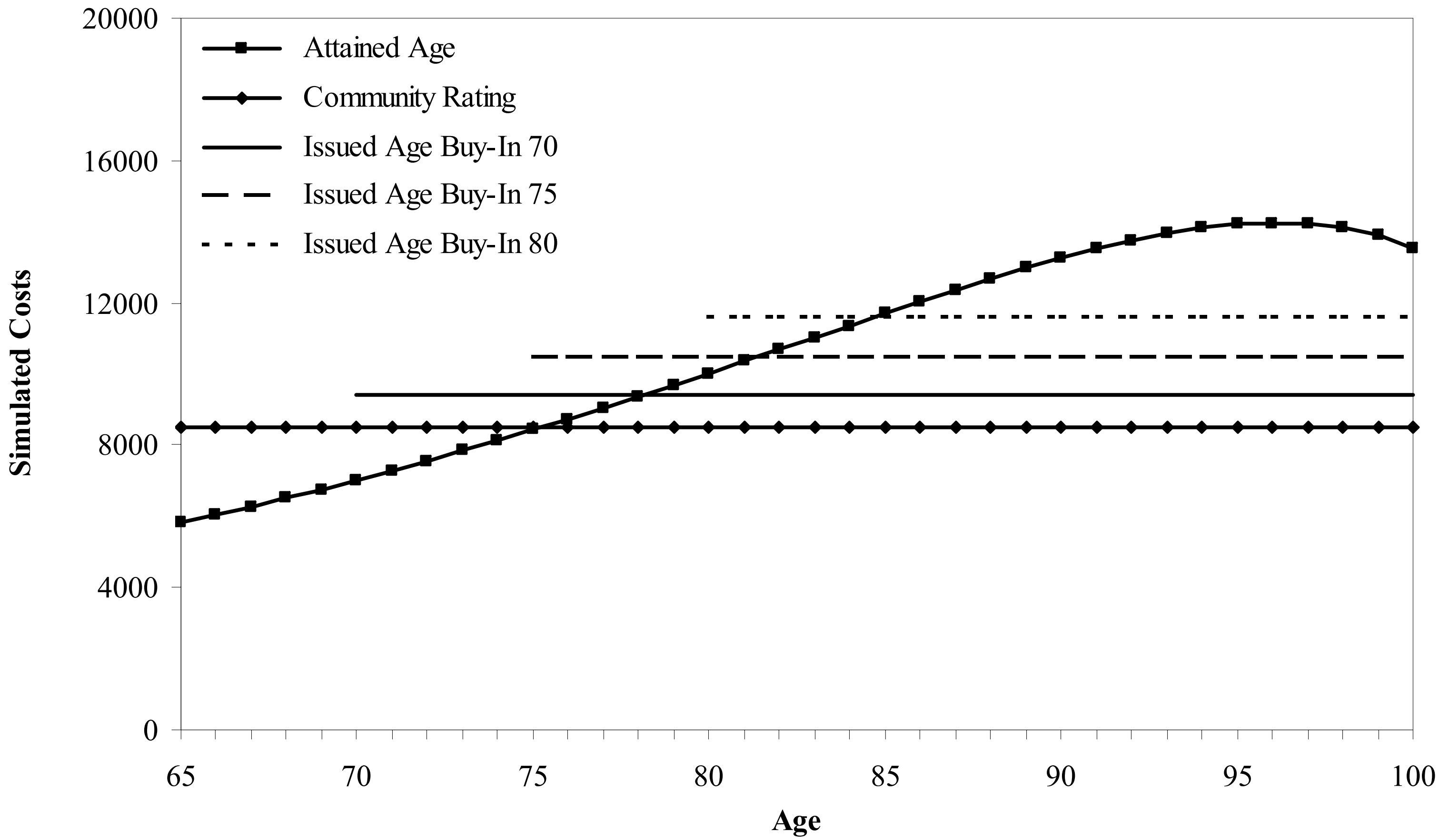
[17] The analysis is limited to a point in time, abstracting from dynamic effects like demand responsiveness and adverse selection. While those considerations might be important, they are beyond the scope of this analysis.

group and base the premiums on those accordingly. Note that with increasing age, the premiums are more and more influenced by the chances of death, i.e. even though the actual costs of a 95 year-old might be high, the *expected* costs will be discounted heavily due to the smaller chances of survival.

2.4.1. Benchmarks

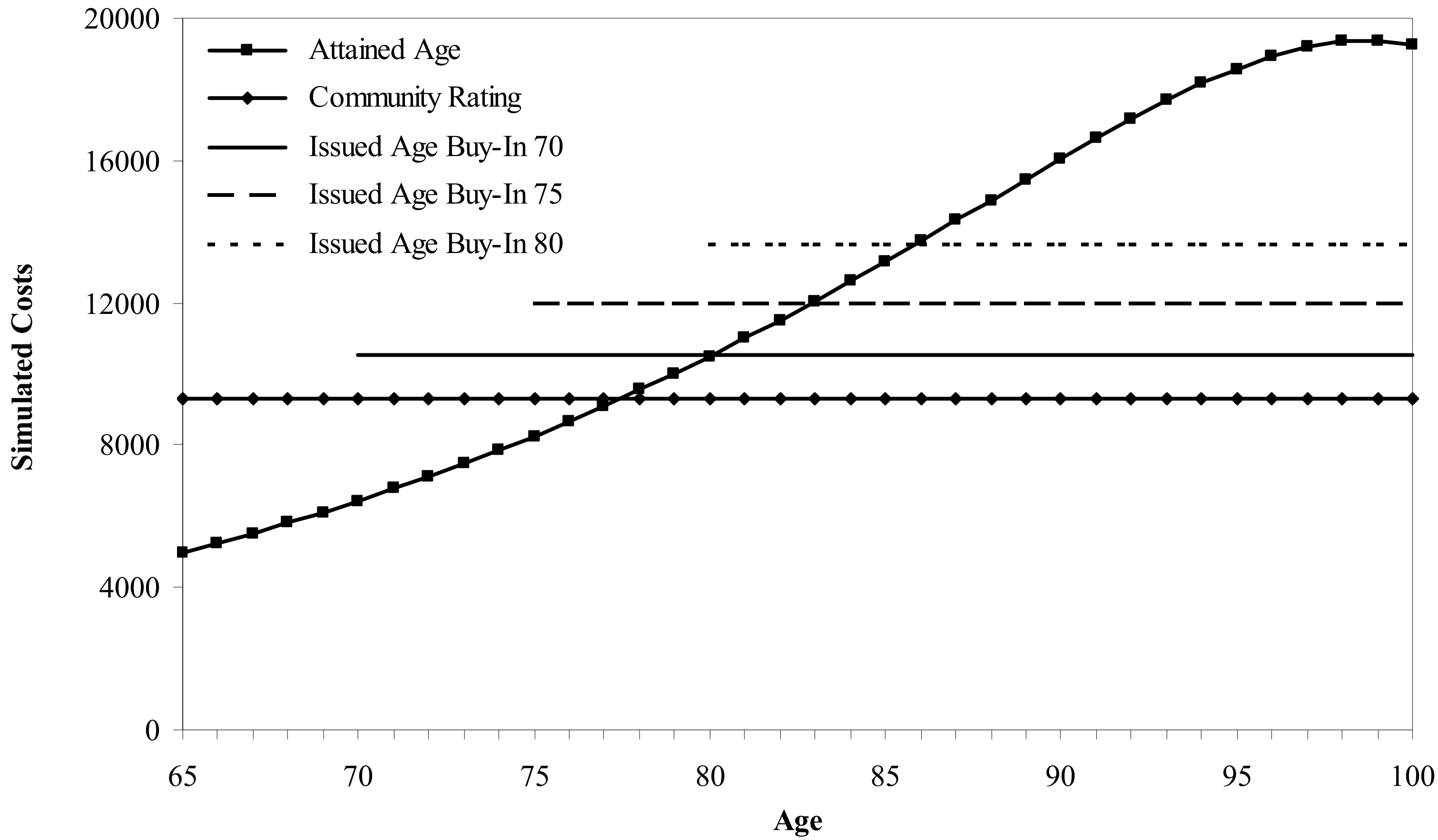
Figures 2.1. and 2.2. show the benchmark cases for the three different rating methods, where the implicit assumption is made that any buying individual is in his/her open enrollment period and cannot be subject to underwriting. The benchmark case for men is shown in Figure 2.1. The Attained Age plan experiences lower costs (and thus can charge lower premiums) for younger people, but as covered people get older, the costs outgrow the premiums for Community Rated plans. The switching point where a Community Rated premium is lower than an Attained Age premium is at 75 years. An individual (without discounting future payments) is better off with an Attained Age plan only if he dies before the age of 85 – at this point the overall sum of premiums is lower in a Community Rated plan. Introducing a 5 percent discount rate, an Attained Age plan is worth it as long as the individual dies before the age of 90.

For Issued Age plans, three different buy-in ages are shown (note that since in the Community Rated plan everybody buys in at age 65, there is no need to show an Issued Age plan of this buy-in age). With every increase in buy-in age by five years, the Issued Age premium increases buy roughly 11 percent. Again, the point can be calculated at which the Issued Age plans with these buy-in ages have lower sums of premiums than an Attained Age plan bought at that respective age. Compared to the Community Rated plans, they are later: for the buy-in ages of 70, 75, and 80, these turning points are at 87, 88, and 90 years respectively.



Source: Author's calculations using MCBS cost data (1992-2002) and Census population data (1990-1999).

Figure 2.1.: Simulated Costs by Age For The Three Rating Schemes – Men



Source: Author’s calculations using MCBS cost data (1992-2002) and Census population data (1990-1999).

Figure 2.2.: Simulated Costs by Age For The Three Rating Schemes - Women

Figure 2.2. shows the benchmark for women. While there slight differences compared to men in the rate of increase (women face higher expected costs with increasing age and have a higher chance of survival), the graph of premium development by age looks almost the same. The switching point is at age 77, two years later than for men. When comparing lifetime payment without discounting, a woman will be better off with a Community Rated plan after age 89, with 5 percent discounting, this threshold increases to age 95. Similar to the series for men, the later the buy-in age in an Issued Age plan, the higher the premium and the longer an individual has to survive to make the purchase of that plan worth it compared to the Attained Age plan.

Since the Medigap Market as it is now exists only since 1992, it is worth looking at differences in premiums depending on the time the plan is already in business. For Attained Age plans, there will be no changes in the premiums, if we assume that the premiums are set according to the expected costs in an age group. However, for Community Rated and Issued Age plans, the premiums will change over time, especially if the age at which people buy into a plan is at 65 (or younger ages in general). This will mean that the Community Rater that just entered the market is not in the steady state yet, and will approach the steady state premium from below, as the age distribution builds up. This leads to a price advantage for the "younger" plan.

2.4.2. Different Ages At The Point Of Buying A Policy

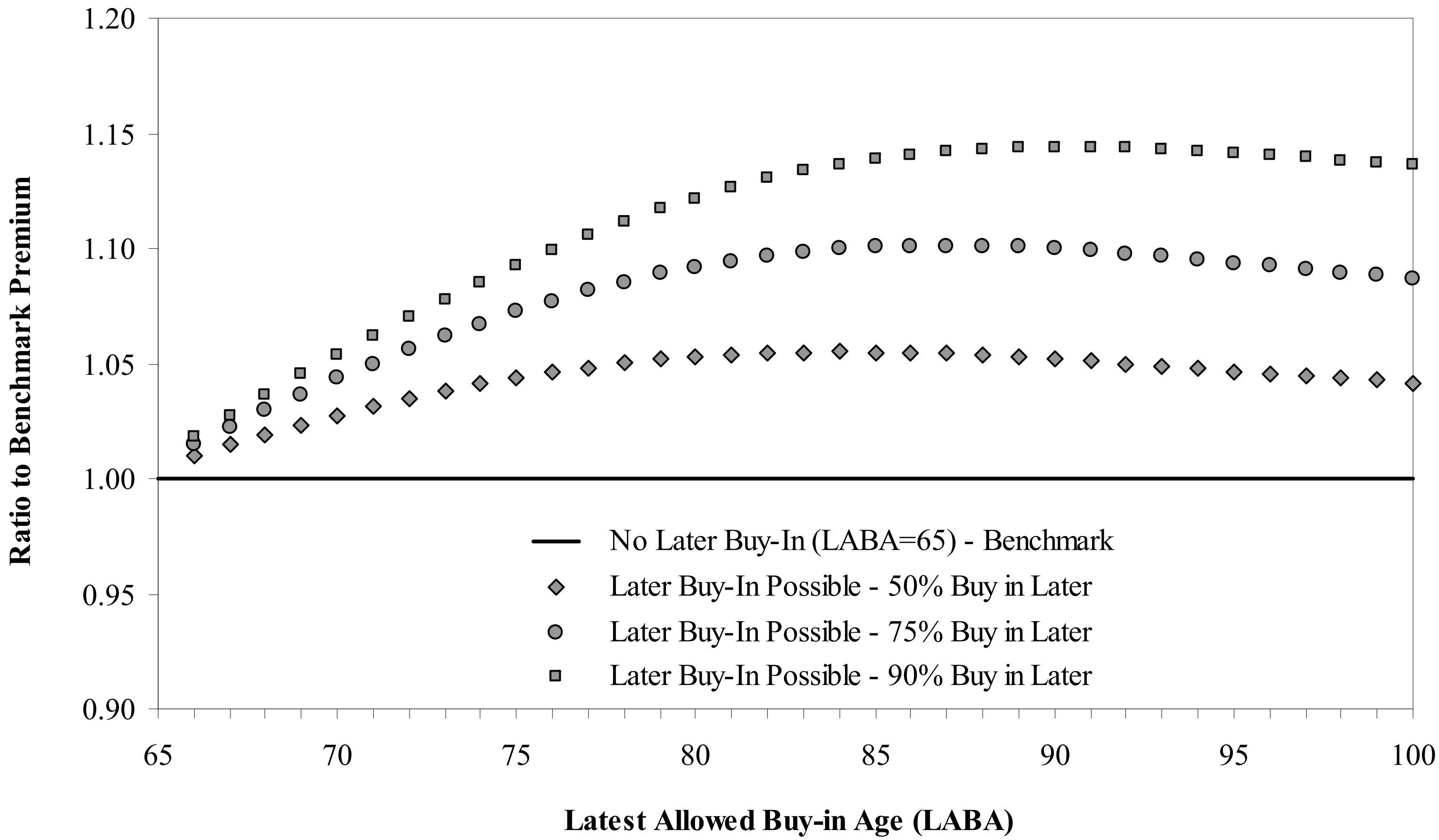
For the Community Rated plans, it was so far assumed, that the age at which people buy the plan, is restricted to 65. However, as mentioned before, the longer an individual expects to live the better off she would be buying a Community Rated plan. In addition, the later in her life she decides to buy Medicare Part B, and thus enters the open enrollment period, the better off she would be with a

Community Rated plan compared to an Attained Age plan with respect to total lifetime premiums paid. As figure 2.1. shows for men, buying into Attained Age plans being 75 and older does not make any sense, as lifetime premiums will be lower in Community Rated plans without uncertainty.

It is interesting to investigate what influence the fact that people are allowed to buy in later than 65 has on the premiums. To an Attained Age plan, these people do not matter in terms of their premium, as long as the expected costs do not change. However, adding extra people to the Community Rated plan will distort the plan's initial age distribution, and compared to a plan where everybody has to buy in at age 65, more older people will be in the plan and the age distribution shifts left. As older people have higher costs, this situation leads to higher premiums for the entire plan population.

Figure 2.3. investigates the usual Community Rated plans with the addition that people do not necessarily buy in at the age of 65. However, the assumption of a constant age distribution is maintained, i.e. the plan is in a steady state, where the same number of people enter and leave each age group in each year, such that each age group's fraction in the total plan population remains constant. All premiums are depicted as a fraction of a benchmark premium, which is when everybody buys in at age 65. This is useful, since the calculated dollar amounts will not relate directly to the actual premiums in the Medigap market, whereas the ratios provide a good indication of how premiums change relatively due to a change in the buy-in behavior.

The benchmark is depicted by the solid line in figure 2.3., showing the mean expenses when everybody buys the plan being 65 years old (and then remain in the plan until they die). Then the premiums depending on a "latest allowed buy-in age" (LABA) are simulated. The LABA is a measure of the age groups that buy into the



Source: Author's calculations using MCBS cost data (1992-2002) and Census population data (1990-1999).

Figure 2.3.: Impact of Individuals Buying a Community Rated Plan After the Age of 65

plan. For example, with a LABA of 75, the buy-in age is distributed between 65 and 75.

Figure 2.3. shows three specific scenarios, where a fictional population of 65 year-olds is split into a fraction that buys into the plan at age 65, and other fractions that buy in when they are older. Each fraction is always adjusted by their corresponding probability of survival until their next birthday. In scenario 1 (diamonds), 50 percent of the population buy in at age 65, and the remaining 50 percent are distributed evenly over the remaining buy-in years (which are determined by the LABA). For scenario 2 (circles), 25 percent buy in at age 65, and hence a remainder of 75 percent of the population is distributed over the remaining years, and for scenario 3 (squares), the ratio is 10 percent at 65 vs. 90 percent when older. Each dot represents a premium for the whole plan – and thus stands for a line parallel to the benchmark line – given the scenario and the LABA.

To give an example for scenario 1 at age 66, 50 percent buy into a plan at age 65, and the survivors of the remaining 50 percent buy in at age 66. Similarly for scenario 2 at age 75, 25 percent buy a policy at age 65, and for each age from 66 to 75, the survivors of 7.5 percent up to 75 years of age are added. For the first example, the actuarially fair premium for the whole plan population associated with this age distribution would be 1 percent higher than the benchmark premium. For the second example, the premium is around 7.2 percent higher than in the benchmark.

The figure shows several important points with regard to the concern that premiums are distorted by people who do not buy in at age 65. First, note that with any shift of the age distribution to the right, i.e. with more older people in the plan population, the premium increases compared to the benchmark. Looking back at the formula for Community Rated plans in equation (2.2) in section 2.2., this can be shown as well, as with an increase of people in age group *a*, the weight n_a/N is increased for the higher age groups, which have larger expected costs, $E_a[C]$.

Second, even for the extreme case of only 10 percent buying in at age 65, the maximum premium is not even 15 percent larger than the benchmark premium. Also, this maximum is at a LABY of 90 years, which is unlikely high, as insurance companies place restrictions on the buy-in age.

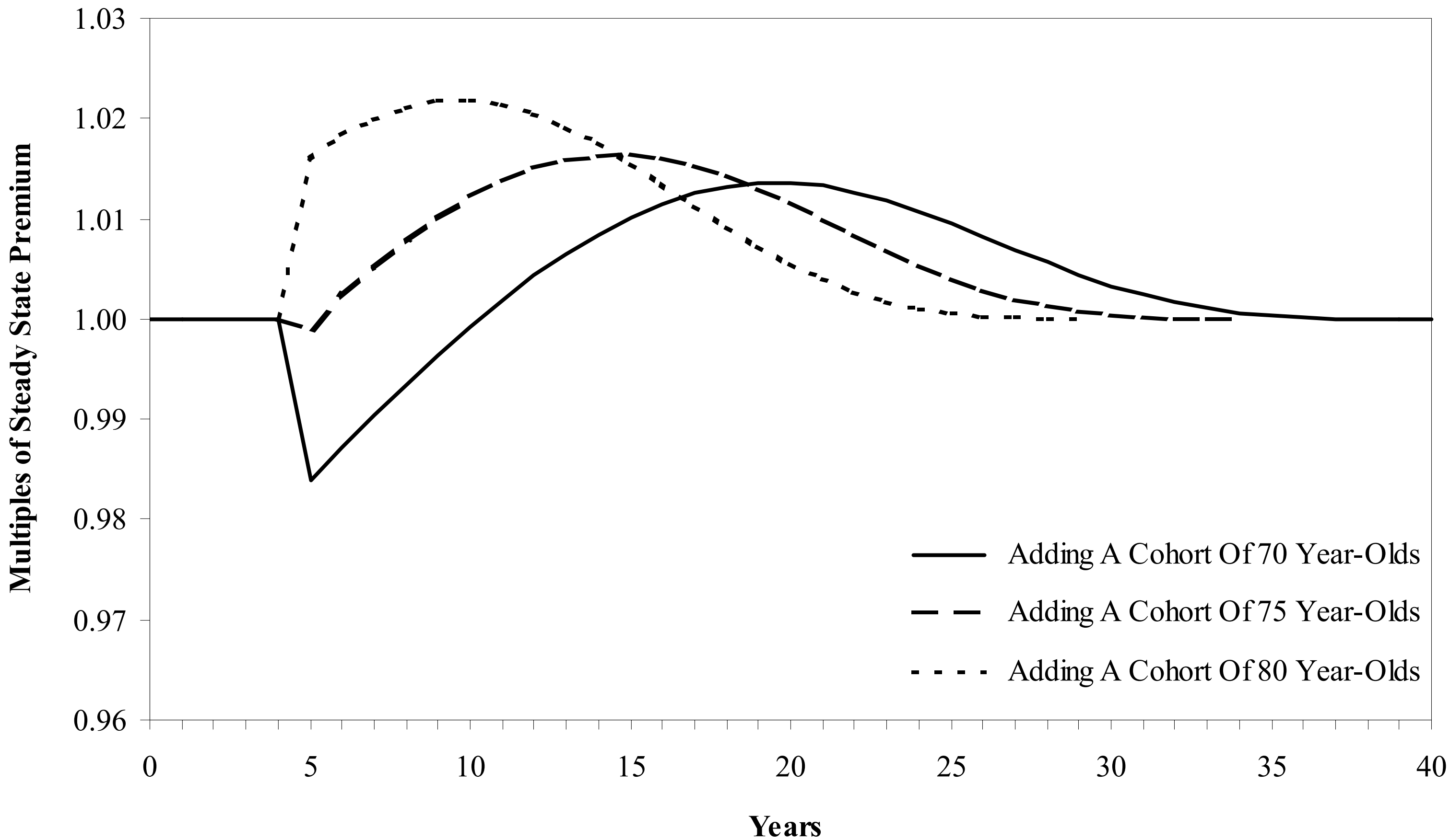
Third, the scenarios presented here are somewhat unrealistic in the sense that the people buying are always distributed evenly over all age groups. One would expect more people to buy in at younger ages, i.e. rather between 65 and 75 than at 85 or 90 years. Considering as well the fact that the costs for younger people are lower, the simulations show premiums that are likely to be an upper bound in the analysis of the impact of people buying plans at later ages. Thus the conclusion is that the premium distortion will not be large, if people are allowed to buy in when they are older than 65, and premium variation larger than 15 percent is unlikely caused by differences in the buy-in age distribution.[18]

2.4.3. Shocks To the Steady State Age Distribution

So far, the focus was only on premiums for Community Rated plans when the age distribution remained in the steady state. However, in general shocks to the age distribution have to be considered as well – different reasons could lead to sudden increases in certain plan population fractions, for example through a competitor's bankruptcy.[19] Again, an artificial scenario is created to consider an initial steady state population based on the predicted survival probabilities. Then this age

[18] A different interpretation of this scenario would be to think of the older of people simply of less healthy people buying in at age 65. The conclusions would be the same – the people buying in extra are just in worse health and thus cause the premium increases.

[19] As mentioned in section 1.3.4., when Medigap coverage is lost not due to a covered person's fault, she has the right to buy plan A, B, C, or F.



Source: Author's calculations using MCBS cost data (1992-2002) and Census population data (1990-1999).

Figure 2.4.: Shocks to the Steady State Age Distribution of a Community Rated Plan

distribution is shocked by adding to the plan populations of a specific age group (or health group) sized at ten percent of the original population.

Figure 2.4 shows three different populations that are added as a one-time event to a Community Rated plan after five years in the steady state. The solid line shows how the premium develops if a cohort (ten percent of the entire plan population) aged 70 enters the plan. Again premiums are depicted relative to the initial (steady state) premium. At first the Community Rated premium drops, i.e. the entire plan population actually benefits from the entry, since the entering group is relatively young. When the entering cohort is relatively old (e.g. 80 years old, short-dashed line), there is an immediate increase in the premium, as the entrants have higher expected costs due to their age. Common to all scenarios is that at some point, the premium will be larger than the previous steady state premium, because at some point, the added population imposes extra cost on all individuals covered. However, the effect is dampened and disappears entirely after some time, depending on the age at entry.

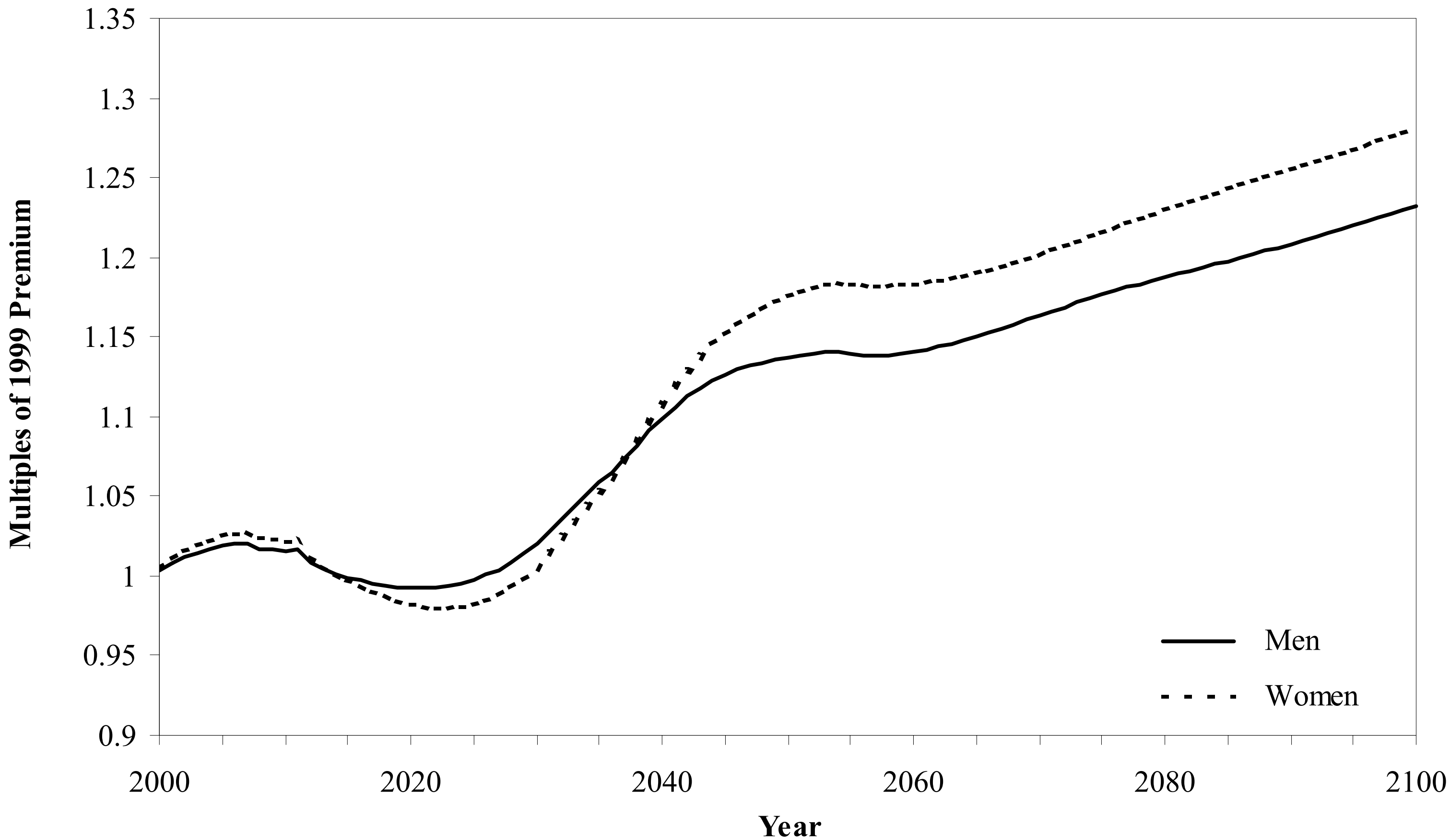
The increase in premium compared to the steady state at any point in time is not larger than 2.2 percent, for an entering group aged 80, and over those years in which an effect of the entry is observable, the sum of premiums (i.e. the area under the curve) increases by less than 1 percent compared to the steady state values. Allowing larger populations to enter increases these effects, but not dramatically: if the entering population is as large as 50 percent of the initial population, the maximum increase is about 9 percent, and the overall sum of premiums increases by 3.8 percent. This leads to the conclusion, that even large shocks to the age distribution of Community Rated plans should not lead to large distortions of premiums.

2.4.4. Continuous Changes To The Steady State Age Distribution

The next analysis reverts to the assumption that everybody is buying their policy at age 65, while the assumption of a steady state is relaxed. Instead, the actuarially fair premiums are simulated when the insurer's age distribution mirrors the actual population distribution. For this the population projections from 2000-2100 are used, taken from the Census (Census Bureau, 2005b). Figure 2.5. shows the cost development for Community Rated plans for the years 2000 to 2100 in terms of the 1999 premiums for men and women, using the predicted population distributions. (Appendix figures 2.1. and 2.2. show the respective age distributions for 2000, 2020, 2050, and 2100.)

The costs for both men and women move very characteristically relative to the 1999 premium: they first rise from 2000 to 2006, and then start to decline, as the Baby Boomers start to enter the distribution, which causes a left shift in the age distribution. The costs are at a low for both genders at around 2022, where the mix of Baby Boomers and older people is at its optimum. Soon afterwards, however, as the Baby Boomers age, their costs push overall costs higher and higher, with an annual growth rate as high as 1.1 percent for women and 0.8 percent for men in 2038. Around 2050, the cohort of Baby Boomers perishes, which leads to a period of almost steady costs for almost 10 years, followed by a constant increase in (real) expenses of about 0.2 percent from 2065 onward, as the population becomes old and older every year.

A look at the corresponding age distributions in the respective years shows that the distribution in 2020 indeed has a large mass of younger ages, whereas towards 2050 and 2100, the distributions are more skewed towards older ages. This is best seen when looking at the fraction of people being 100 or older, which grows to be as large as the fraction of 65 year-olds. Figure 2.5. not only shows how costs (and premiums) could develop over the next 100 years, but again sheds light on



Source: Author's calculations using Census population projections (2000-2100) and MCBS cost data (1992-2002).

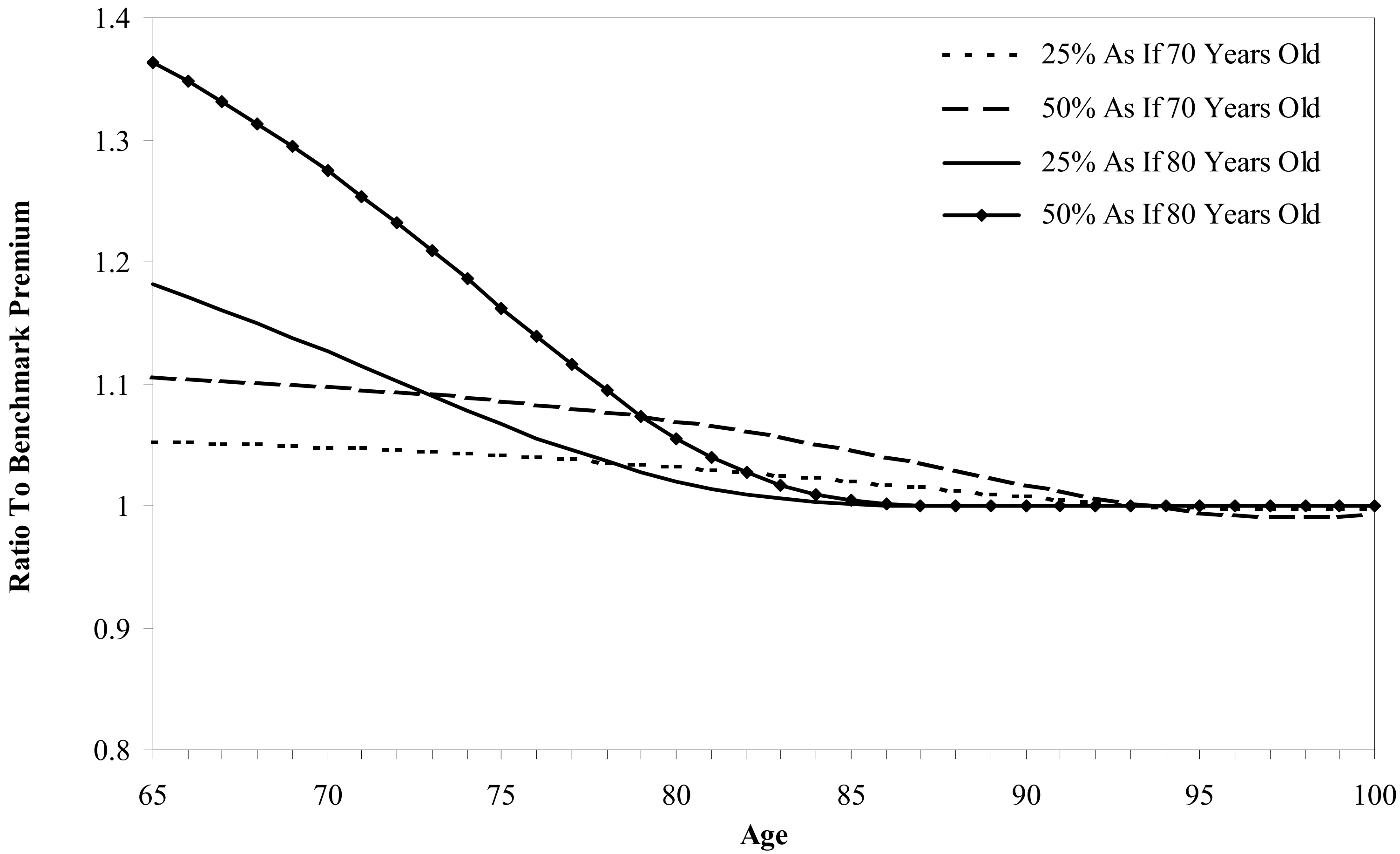
Figure 2.5.: Development of Community Rated Premiums Based on Population Projections 2000-2100

the differences in costs that insurance companies can experience due to differences in the age distribution.

2.4.5. Influences Of Health On Attained Age Premiums

One further potential cause of differences in costs and thus premiums could be the type of people an insurer covers – one could imagine an insurer trying to advertise specifically in health clubs for the elderly, to attract a potentially healthier group. If successful, this insurer will be able to set lower actuarially fair premiums. While this will hold for all rating schemes, health differentials within an age group are the only way for Attained Age premiums to differ between two insurers that charge actuarially fair premiums. Any simulation in this case is somewhat arbitrary; however, in Figure 2.6. provides some insights by considering the possible effects of insuring individuals with different health.

This figure shows the premiums for four different scenarios in relation to the original Attained Age premium depicted in Figure 2.1. Still the assumption holds that all individuals buy in at age 65, but now for individuals at age 65 are allowed to be of worse health, i.e. health that causes medical expenditures identical to the average costs of an older cohort. Variation in health status as well as variation in the fraction of people who are of worse health causes moderate effects: Even when half of the plan's population has medical expenditures similar to a population of 80 year olds, the plan's premium is not more than 37 percent larger than the original premium. (The effects decrease with age, because not only are the expenditures those of older cohorts, but also the health status is worse and thus these individuals die earlier.)



Source: Author’s calculations using MCBS cost data (1992-2002) and Census population data (1990-1999).

Figure 2.6.: Attained Age Premiums for Plans Insuring Individuals of Different Health

2.5. Conclusion

This chapter investigates why actuarially fair premiums could vary in the Medigap market. The analysis is based on actual medical costs and abstracts from profit considerations of insurance companies. The impacts on premiums are investigated in several scenarios with respect to the rating methods used as well as to changes in the age distribution. The main finding is that substantial cost variation and thus premium variation can exist even when insurers charge actuarially fair premiums.

The three different rating schemes – Attained Age, Issued Age, and Community Rating – can account for some of the premium variation an individual faces when buying a Medigap plan at a certain age. For example, for 65 year-old men, the costs of a Community Rated plan are simulated to be 47 percent higher than for an Attained Age plan. This is even assuming that all people buy into the Community Rated plan at age 65, hence it is somewhat surprising that this difference is larger than the mean ratio observed in the actual market, which is 28 percent (table 2.1.). One possible reason for this finding could be the dependency of coverage on age – the Community Rated premium presented here might be unnecessarily high due to coverage that is only affecting older buy-in ages and would not be included in the real plans. At a buy in age of 85, simulated Community Rated premiums are 20 percent less expensive than Attained Age plans; in the actual market, this differential is 27 percent. Since the rating methods are considered to be part of the definition of the homogenous good, variation in premiums due to rating methods is generally not considered to be a problem.

However, the market also experiences price variation within the same rating scheme. Differences in age distributions between insurance companies can lead to substantial differences in costs and thus premiums. This variation in age distribution can realistically account for premium differentials of up to 40 percent (see Figure 2.5).

Of course other explanations (or a combination of them) are possible, especially since we observe larger variation in the Medigap market for Issued Age plans. These other explanation for cost and/or premium variation could include cost effectiveness, product differentiation, and the exertion of market power. The only reason why actuarially fair premiums could vary between Attained Age plans is that consumers' health (and thus expected costs) differ by insurer.

2.6. Appendix Tables And Figures

Appendix Table 2.1.: Medical Care Expenditures by Gender (1992 - 2002)

Age	Male	Female	Age	Male	Female
65	3735.41	2508.78	86	11454.60	12756.69
66	4802.73	4840.19	87	10657.04	13180.77
67	5672.66	4979.07	88	12286.35	14619.33
68	5424.04	5538.68	89	13425.01	15718.84
69	5950.73	5680.89	90	12434.04	15750.63
70	6978.38	6462.05	91	16035.47	16193.22
71	6658.55	6206.37	92	13673.42	17610.81
72	7715.60	6647.82	93	13578.39	17467.20
73	7710.38	6889.65	94	15281.84	19837.04
74	7381.41	7018.21	95	18332.33	19289.13
75	7606.55	7081.85	96	14523.58	21654.45
76	8056.81	7423.00	97	15480.58	19978.91
77	8458.76	7928.53	98	20480.19	20811.45
78	8681.60	8792.67	99	16968.24	22039.24
79	8800.88	8559.21	100	17198.50	20690.43
80	10008.90	8782.60			
81	9942.89	9271.74			
82	9953.88	9976.08			
83	10304.19	10990.34			
84	10325.54	11402.92			
85	11707.65	11817.87			

Notes:
All values in year 2000 dollars using the medical care Consumer Price Index, Bureau of Labor Statistics, 2005. Figures are weighted means of total medical expenditures.
Source: Authors' calculations using MCBS 1992-2002.

Appendix Table 2.2.: Results from Expenditure Regression:

ln(real expenses)= $\beta_0 + \beta_1$*age

	Male	**Female**
Constant	0.0403 (0.0001)	0.0522 (0.0001)
Age	6.0665 (0.009)	5.131 (0.006)
Observations	47014	68692
R^2	0.7245	0.8642

Notes:
Weighted Regression with real expenses. Standard errors in parentheses.
Source: Author's calculations using MCBS 1992-2002.

Appendix Table 2.3.: Results from Regression On Death Rates:

ln(probability of death)= $\gamma_0 + \gamma_1$*age

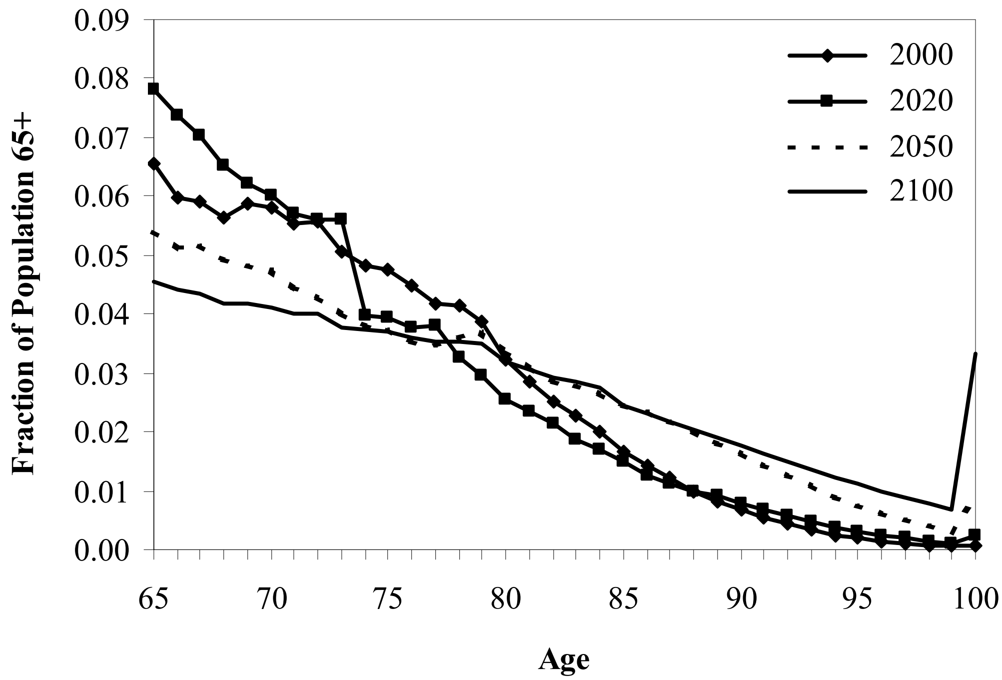
	Male	**Female**
Constant	0.0881 (0.0015)	0.1028 (0.0026)
Age	-9.6242 (0.126)	-11.231 (0.218)
Observations	306	301
R^2	0.9154	0.8340

Notes:
Standard errors in parentheses.
Source: Author's calculations using Census' intercensal estimates 1990-1999

Appendix Table 2.4: Fractions of Simulated Age Distribution 65-100+

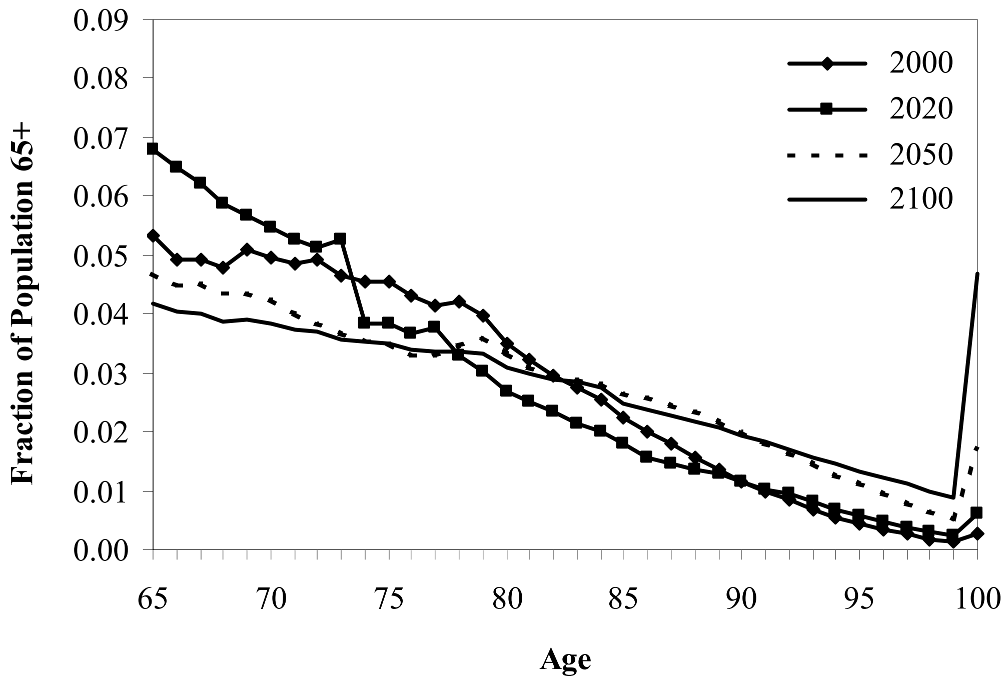
Age	Male	Female	Age	Male	Female
65	0.0609	0.0500	86	0.0179	0.0232
66	0.0597	0.0495	87	0.0156	0.0210
67	0.0584	0.0489	88	0.0134	0.0189
68	0.0570	0.0483	89	0.0114	0.0168
69	0.0555	0.0476	90	0.0095	0.0147
70	0.0539	0.0468	91	0.0077	0.0126
71	0.0522	0.0460	92	0.0062	0.0107
72	0.0504	0.0451	93	0.0048	0.0089
73	0.0485	0.0441	94	0.0037	0.0072
74	0.0465	0.0431	95	0.0027	0.0057
75	0.0444	0.0419	96	0.0019	0.0044
76	0.0422	0.0407	97	0.0013	0.0032
77	0.0400	0.0393	98	0.0009	0.0023
78	0.0377	0.0379	99	0.0006	0.0016
79	0.0353	0.0364	100+	0.0007	0.0024
80	0.0328	0.0347			
81	0.0303	0.0330			
82	0.0278	0.0312			
83	0.0253	0.0293			
84	0.0228	0.0273			
85	0.0203	0.0253			

Notes:
Source: Author's calculations using Census' intercensal estimates 1990-1999.



Source: Census Projections “Middle Series”, 2000-2100. “100” refers to “100 years or older”.

Appendix Figure 2.1: Selected Age Distributions for Men



Source: Census Projections "Middle Series", 2000-2100. "100" refers to "100 years or older".

Appendix Figure 2.2: Selected Age Distributions for Women

CHAPTER THREE

PRICING OF COVERAGE PACKAGES AND COMPETITION

3.1. Introduction

This chapter is concerned with important aspects of the premium variation in the Medigap market. Using pricing regressions, I determine the marginal impact of different coverage packages on insurance premiums. While this approach provides key insights about how different degrees of coverage are priced by the insurance firms, it does not address the issue of variation within each plan. This aspect is the focus of the second part of the analysis, where I determine the influence of state and firm specific variables on homogenous products. I argue that this may also serve as a measurement for the degree of competition in the market.

This analysis has some relevance for policy makers. For example, the pricing model allows to price specific parts of insurance policies for the elderly. As mentioned before, insurance companies could offer prescription drug coverage in three Medigap plans until in January of 2006, when Medicare part D for prescription drug coverage was introduced. Although this is not part of this analysis, the results from the pricing regressions presented here may serve as a benchmark to evaluate the price setting decisions of firms offering the new plans for Medicare part D. In addition, the dynamic development of the market is important to evaluate the impacts of OBRA90 – did the price variation decrease and did competition increase over time? This also sheds some light on how the market might develop in the future.

The analyses lead to the conclusion, that the Medigap market experienced a slight expansion from 1998 to 2000, but contracted dramatically towards 2002. There are indications that this led to an increase in the competition in the market, as over time, firm specific effects lose influence, mark-ups for specific coverage packages decrease and state specific influences increase.

The next section briefly illustrates how the Weiss data are used in this chapter, and what data are used to augment the analysis. Section 3.3. will show detailed sample means to provide a thorough description of the market and its developments. In section 3.4., I present the econometric setup, whereas section 3.5. will show the results. Section 3.6. summarizes the findings and concludes.

3.2. Data Specifications

The main data source used in this chapter is the premium data provided by Weiss Ratings, Inc. Here, data from 1998 to 2002 are used. From the plan letters A through J (see Table 1.1.) I code indicators of what specific benefit is covered to elicit the influence of that benefit on the price. Since all plans have to cover Medicare part A and B coinsurance as well as the costs for three pints of blood per year, these cannot be part of the indicators; instead these costs will be reflected in the regression constant. Then there remain the following indicators for the coverage of: i) Medicare part A deductible, ii) Medicare part B deductible, iii) Medicare part B excess charges, iv) at home recovery costs, v) prescription drugs (basic), vi) prescription drugs (extended), and vii) preventive services that are covered by Medicare. Note that the latter six indicators all include the coverage of skilled nursing facilities (SNF) as well as foreign travel coverage, such that these effects cannot be separated out in the price regression.

The Weiss data are augmented by data from the Area Resource File (ARF) of 2004. This dataset contains various variables of interest on a county level. I will use this information mainly to account for state differences that might lead to differences in pricing the Medigap policy. The Medicare Adjusted Average per Capita Cost (administered by the CMS for each county) are used by Medicare HMOs to estimate the costs for an average Medicare beneficiary. While these costs are averages for the whole county, they can be further adjusted by age, gender, and Medicare status (employed, institutionalized, Medicaid, non-Medicaid). In this analysis, they serve as a proxy for county health in the specific age-gender subgroup of the non-Medicaid Medicare beneficiaries.[20] Medicare inpatient days per Medicare recipient are another way to measure the health of the Medicare population. An important factor is the degree of Medicare Managed Care penetration in the county, as this poses a significant competition to the Medigap policies. Robst (2001) argues that a higher level of Medicare Managed Care should lead to increases in price, since the healthier individuals would rather go into HMOs than into regular plans. Another important aspect of competition is how many firms operate with the same policy in one state.[21] While the assumption of a fully competitive market may not hold because of lack of information on the buyers' side (see also Chapter Four), still an increase in the number of firms in a market should increase competition between firms and thus should lower prices. The per capita income are added since it has been shown that individuals with more income are more likely to buy into Medigap (e.g. Wolfe and Goddeeris, 1991, or Fang et al., 2006). Finally the unemployment rate is used to control for general economic developments specific to the county.[22]

As section 1.5. showed, premium variation within a firm across counties is rather small. Hence I aggregate both data sources to a state level, where, similar to Robst

[20] The main advantage of this variable is its target on the specific age group under investigation here, i.e. the Medicare population. Other cost indicators, e.g. the state's physician and hospital wage expenditure, had less explanatory power in test regressions and thus are not used in the analyses.

[21] The "same policy" is defined as in section 1.5.1.: an identical policy in terms of plan letter, plan type, gender, age group, and rating method.

[22] The unemployment rate may also be interpreted as a proxy for how much competition the Medigap market faces through employer provided supplemental insurance. In counties with low unemployment, more individuals should be covered by their former employers. Since there is no assumption as to whether these people would be healthier or not, the direction of this effect is not clear.

(2001), the county observations are weighted by the number of Medicare beneficiaries (taken from the ARF files) in the respective county.[23]

3.3. Sample Means

3.3.1. General Premium Differences

Table 3.1. shows the mean premiums over the years in the complete sample as well as split by gender and age group.[24] The premiums are inflation-adjusted to year 2000 dollars by the medical care consumer price index (Bureau of Labor Statistics, 2006). From the first category ("Totals"), three stylized facts can be observed, that remain true for all categories in the table. First, the mean premiums increase over the years, on average by three percent. However, the growth is not steady over increases from 1998 to 1999, slightly drops towards 2000, only to then dramatically drop in 2001 (by about twenty percent). From 2001 to 2002, the number of offers remains almost constant. These three facts suggest, that the Medigap market underwent some structural changes between 1998 and 2002. While fewer firms were operating in the market from 2001 on and the variation in policy premiums declined at that time, only in 2002 was this reflected in a smaller increase in premium levels.

The differences between offers for men and women are relatively small: on average, men pay $18 (or 1.2 percent) more than women.[25] The premiums for men rose about one percentage point more in the five-year period than that for women, leading to a slightly larger spread in 2002. The number of offers for men and women

[23] To compare the impact of the level of aggregation, I also conducted the analysis in section 3.4. using county level information from Weiss and ARF data. There are few differences of statistical significance between the specifications, but none of them is leading to qualitatively different results.
[24] Note that I am only considering age 65, 75, and 85, although all age groups from 65 to 100 years are included in the Weiss data.
[25] Almost all differences in premiums between any two groups in Table 3.1. and in the following tables are significant at a ten percent level at least, in most cases at a one percent level.

Table 3.1.: Sample Premium Means and Standard Deviations

	1998	1999	2000	2001	2002
Totals	1435	1480	1530	1577	1614
	(707)	(724)	(921)	(732)	(627)
Sample Size	57516	63460	61020	48522	48872
Male	1441	1489	1536	1587	1627
	(710)	(726)	(920)	(732)	(629)
Sample Size	28758	31730	30510	24261	24436
Female	1429	1470	1524	1567	1601
	(705)	(722)	(921)	(732)	(626)
Sample Size	28758	31730	30510	24261	24436
Age 65	1122	1147	1189	1237	1278
	(510)	(517)	(657)	(537)	(451)
Sample Size	19462	21316	20500	16210	16378
Age 75	1486	1530	1569	1609	1648
	(679)	(700)	(883)	(670)	(562)
Sample Size	19462	21316	20500	16212	16378
Age 85	1710	1769	1839	1888	1921
	(782)	(790)	(1062)	(812)	(675)
Sample Size	18592	20828	20020	16100	16116

Notes:
Standard deviations are in parentheses. All values are inflation-adjusted by the medical care Consumer Price Index, reflecting year 2000 dollars. See text for further details.
Source: Author's calculations using Weiss Data 1998-2002.

time: While in the first three years the increase in premiums is larger than three percent, from 2001 to 2002 it is only 2.3 percent. Second, the variation in premiums as measured by the standard deviation peaks in 2000, then drops towards 2002 to levels below those of 1998. Third, the number of policy offers first is identical, whereas the standard deviation for women is in general slightly lower. Similar to observations in chapter two, there are large premium differences between the age groups: 65 year-olds pay on average $374 less than 75 year-olds and $631 less than 85 year-olds, which reflects the increasing medial costs with age. The variation in premiums for 75 (85) year-olds is 30 percent (54 percent) higher than that of 65 year-olds. This shows, that the older groups not only face higher premium levels but also a larger spread in these premiums, even though the number of offers is not very different between the age groups. All age groups experience a reduction in spread from 2000 onwards, but it is more pronounced in the higher age groups, which may be a first indication, that competition increased over time in those market segments.

3.3.2. Distribution of Policy Characteristics

Table 3.2. restricts the sample to offers made to 65 year-old men. The table gives an overview of how the different plan characteristics are distributed across these offers and how their fractions develop over time. Most offers are standard plans, although in the course from 1998 to 2002, their fraction is reduced by almost 20 percentage points. At the same time, the fraction of plans offered to smokers dramatically increased from seven to over twenty percent. The fraction of select plans, which reduce the flexibility of medical service, is small and relatively constant at between four and seven percent. From the number of observations in the bottom row it is apparent that the market contracted by more than twenty percent from 1999 to 2001. Mainly this is due a reduction in the number of standard plans, whereas the number of smoking plans remains almost constant over time.

Table 3.2.: Sample Means of Weiss Data Variables

	1998	1999	2000	2001	2002
Plan Type					
Standard	0.889	0.833	0.770	0.688	0.690
	(0.315)	(0.373)	(0.421)	(0.463)	(0.462)
Smoker	0.070	0.117	0.171	0.261	0.245
	(0.255)	(0.321)	(0.377)	(0.439)	(0.430)
Select	0.041	0.050	0.059	0.051	0.065
	(0.199)	(0.218)	(0.236)	(0.220)	(0.246)
Weiss Rating A	0.126	0.135	0.116	0.175	0.175
	(0.332)	(0.342)	(0.320)	(0.380)	(0.380)
Weiss Rating B	0.366	0.333	0.269	0.266	0.260
	(0.482)	(0.471)	(0.443)	(0.442)	(0.439)
Weiss Rating C	0.165	0.186	0.238	0.294	0.295
	(0.371)	(0.389)	(0.426)	(0.456)	(0.456)
Weiss Rating D	0.246	0.255	0.303	0.262	0.253
	(0.431)	(0.436)	(0.459)	(0.440)	(0.435)
Not Rated	0.097	0.091	0.075	0.002	0.017
	(0.296)	(0.287)	(0.263)	(0.040)	(0.130)
Rating Method					
Attained Age	0.634	0.690	0.686	0.683	0.669
	(0.482)	(0.462)	(0.464)	(0.465)	(0.470)
Issued Age	0.289	0.236	0.241	0.246	0.259
	(0.453)	(0.425)	(0.428)	(0.430)	(0.438)
Community Rating	0.077	0.073	0.074	0.071	0.071
	(0.266)	(0.260)	(0.261)	(0.257)	(0.258)
Observations	9731	10658	10250	8105	8189

Table 3.2.: (continued)

	1998	1999	2000	2001	2002
Plans covering:					
Basic Coverage only	0.188 (0.390)	0.184 (0.387)	0.187 (0.390)	0.194 (0.396)	0.191 (0.393)
Medicare part A deductible	0.812 (0.390)	0.816 (0.387)	0.813 (0.390)	0.806 (0.396)	0.809 (0.393)
Medicare part B deductible	0.385 (0.487)	0.384 (0.486)	0.389 (0.488)	0.410 (0.492)	0.397 (0.489)
at home recovery costs	0.259 (0.438)	0.264 (0.441)	0.249 (0.432)	0.242 (0.428)	0.250 (0.433)
preventive services	0.081 (0.273)	0.072 (0.259)	0.061 (0.240)	0.053 (0.224)	0.041 (0.199)
Medicare part B excess charges	0.346 (0.476)	0.338 (0.473)	0.326 (0.469)	0.323 (0.468)	0.322 (0.467)
prescription drugs (basic)	0.088 (0.283)	0.079 (0.269)	0.069 (0.254)	0.043 (0.204)	0.038 (0.192)
prescription drugs (extended)	0.039 (0.194)	0.032 (0.176)	0.025 (0.156)	0.026 (0.159)	0.015 (0.123)
Observations	9731	10658	10250	8105	8189

Notes:
Sample is restricted to offers made to 65 year-old males. An observation is a plan offer made by any firm within a state to this group.
Source: Author's calculations using Weiss Data 1998-2002.

The Weiss Rating measures the financial stability of firms in the Medigap market, where "A" is "excellent", "B" is "good", "C" is "fair", "D" is "weak", and "E" and "F" are "very weak" and "failed", respectively. A number of firms do not receive any rating, because they are too small or Weiss does not have enough information.[26] The ratings do not vary by firm over the years, i.e. there are no firms that receive a certain rating in one year and a different rating in another. Hence shifts in the fractions for the rating groups in Table 3.2. can be interpreted as shifts in the number of offers put forward by each rating group. The percentage of offers by firms receiving a “B” rating decreases by ten percent, whereas firms rated A or C increased their share over the years by five and thirteen percent, respectively. Firms with D ratings or lower have a surprisingly large share overall, peaking at 30 percent in 2000 and then dropping by to 25 percent in 2002. In light of the previous observations that indicated a contraction of the market, this can be expected: competition will drive the weakest firms out of the market first. A similar explanation may hold for the large decline from 2000 to 2001 in the fraction of those firms that are not rated by Weiss, since these are the small firms in particular.

The three rating methods show little dynamics with respect to their market share over the years, with two thirds of all offers to 65 year-old men being of Attained Age rating, 25 percent of Issued Age, and only 7.3 percent with Community Rating.

The fractions of the different coverage packages in the next eight rows are not mutually exclusive, i.e. these are not the plans from Table 1.1., but rather their different policy benefits and how common they are among the offers. About nineteen percent of all plans do not offer any benefits other than the mandatory coverage specified by plan A. Roughly 81 percent of all plans offer the Medicare Part A deductible, between 38-41 percent offer the part B deductible as well. Also relatively common coverage is at home recovery (25 percent) as well as part B excess charges

[26] Weiss Ratings Inc., 2005: “The company is unrated for one or more of the following reasons: 1) total assets are less than $1 million; 2) premium income for the current year is less than $100,000; 3) the company functions almost exclusively as a holding company rather than as an underwriter; or 4) we do not have enough information to reliably issue a rating.”

(32-35 percent). Few plans offer preventive services or prescription drug coverage, and both categories experience a decline in prevalence over the years: while the fraction of plans with preventive services drops from eight to less than four percent, offers for prescription drugs coverage (basic and extended) decline from thirteen to five percent from 1998 to 2002. These declines do not follow the pattern observed earlier (i.e. peaking in 2000), but instead are spread out relatively even across the years. Parts of this decrease in offers may be explained by the general increase in the prescription drug expenditures over time, where the out of pocket expenditures have almost doubled from 2000 to 2005 (Kaiser Family Foundation, 2005). Increasing per person expenditures combined with a fixed deductible of $250 make these plans a financial liability to insurance companies. They have to charge higher prices to cover the increasing financial risks, which then leads to a reduction in demand, and successively, in supply.

3.3.3. Premium Means for Policy Characteristics

While Table 3.2. shows the fractions of plans in different categories, it is also interesting to look at the premiums associated with these categories. Table 3.3. allows to investigate whether the first two stylized facts from Table 3.1., i.e. the increase in premium levels over the years and the decrease in premium variation from 2000 onwards, are present in different categories as well. (The third fact, the pattern of the reduction in the number of offers, is presented in the last row of Table 3.3.) Again, the focus is on policy offers to 65 year-old men.

The first three rows focus on the three different plan types, “standard”, “smoker” and “select”. The first stylized fact of increasing premiums is also reflected by the three plan types, although to different degrees: while the standard plans experience a premium increase of 3.2 percent per year and thus follow similar trends as found in

Table 3.3.: Average Premiums by Plan Characteristics

	1998	1999	2000	2001	2002
Plan Type					
Standard	1154	1189	1231	1263	1309
	(526)	(544)	(704)	(573)	(481)
Smoker	813	848	868	979	1023
	(222)	(237)	(240)	(298)	(292)
Select	964	1038	1141	1249	1295
	(306)	(299)	(468)	(449)	(366)
Weiss Rating A	1086	1123	1168	1289	1263
	(549)	(559)	(650)	(658)	(311)
Weiss Rating B	1175	1208	1174	1252	1303
	(521)	(549)	(490)	(478)	(467)
Weiss Rating C	1020	1095	1169	1244	1283
	(354)	(409)	(536)	(581)	(483)
Weiss Rating D	1162	1140	1248	1206	1290
	(558)	(507)	(861)	(435)	(474)
Not Rated	1085	1164	1170	1569	1338
	(487)	(535)	(556)	(421)	(441)
Rating Method					
Attained Age	1045	1080	1116	1157	1217
	(441)	(457)	(632)	(440)	(393)
Issued Age	1227	1266	1317	1402	1415
	(542)	(537)	(599)	(671)	(501)
Community Rating	1422	1486	1523	1543	1486
	(709)	(738)	(857)	(611)	(575)
Observations	9731	10658	10250	8105	8189

Table 3.3.: (continued)

	1998	1999	2000	2001	2002
Plans covering:					
Basic Coverage only	658 (155)	697 (173)	729 (185)	810 (205)	892 (228)
Medicare part A deductible	1235 (503)	1257 (513)	1301 (678)	1349 (538)	1381 (439)
Medicare part B deductible	1321 (527)	1338 (518)	1349 (538)	1457 (594)	1478 (416)
at home recovery costs	1432 (709)	1422 (713)	1464 (921)	1478 (790)	1398 (537)
preventive services	1739 (922)	1746 (934)	1782 (1088)	2077 (1284)	1661 (818)
Medicare part B excess charges	1453 (600)	1464 (616)	1502 (793)	1535 (679)	1512 (488)
prescription drugs (basic)	1814 (559)	1928 (652)	2399 (1376)	2060 (665)	2070 (768)
prescription drugs (extended)	2524 (711)	2622 (703)	2885 (885)	3153 (1035)	2521 (718)
Observations	9731	10658	10250	8105	8189

Notes:
Sample is restricted to offers made to 65 year-old males. An observation is a plan offer made by any firm within a state to this group. All values are inflation-adjusted by the medical care Consumer Price Index, reflecting year 2000 dollars.
Source: Author's calculations using Weiss Data 1998-2002.

Table 3.1., plans for smokers and select plans incur much larger average increases in premiums of 5.9 and 7.7 percent per year, respectively. Moreover, the smoker plans experience a one-time increase in 2000 of almost thirteen percent. Due to the faster premium growth of select plans, the gap in premiums between select and

standard plans closes over time, such that in 2002, the differential is only $14 on average. The somewhat surprisingly negative (but decreasing) difference in premiums between standard and smoker plans (about $323 less on average) can be explained by the fact that there are virtually no prescription drug plans for smokers. Since the averages are taken over all offers of a certain plan type, these systematic difference are not taken into account here. The second stylized fact of a reduction in variation from 2000 to 2002 is more pronounced for the standard and select plans, whereas the variation in smoker plans actually increases. This might be due to the fact that the previously mentioned decrease in plans mainly affected select and standard plans, while the number of smoker plans remained almost constant.

Over all years, the premiums associated with the different financial ratings experience increases between eleven percent (B and D rating) and twenty-six percent (C rating). This is not a constant growth, however, but all five rating categories (except for the C rating) experience a decline in premium means at some point over the five years. There is no consistent pattern for the premium variation, although all five categories have a smaller variation in 2002 compared to 2000. The differences in premium averages between the categories are not consistently different from one another.

The Attained Age offers to 65 year-old men are the lowest among the different rating methods for all years, on average $203 and $369 less than Issued Age and Community Rated plans, respectively. Both Issued Age and Attained Age offers follow a similar premium and variation pattern as the premiums found in Table 3.1. However, Community Rated plans experience less growth, and even a drop of 3.7 percent in average premiums from 2001 to 2002.

The premium means for the different coverage packages show some interesting patterns that are diverging from the stylized facts in Table 3.1. The premiums for basic plans have a much larger increase (almost eight percent per year) than any other category when averaging over all years. This is matched by a general increase in variation of plan A premiums over this period. The basic plan covers part A coinsurance, part A hospital benefits, the part B coinsurance, and the costs for three pints of blood (see Table 1.1.). As the rates for the first three parts are fixed federally, their development can be related to the premiums here. From 1998 to 2002, the federal rates have decreased in real terms by almost nine percent (own calculations using Kaiser Family Foundation, 2005). Hence the finding of increasing premiums for basic coverage, although unconditional, is surprising and suggests that premiums are not based solely on the federal costs.[27]

Those plans covering the Medicare part A deductible follow the general pattern in Table 3.1., i.e. an increase in the average of twelve percent from 1998 to 2002, with a larger growth before 2001. Also the variation pattern looks similar, i.e. the standard deviation is reduced towards 2002. While premiums for coverage packages covering the part B deductible grow at about twelve percent over all years, they experience an unusual growth of eight percent in 2000. For at home recovery and part B excess charge coverage, the premiums remain almost constant and even drop from 2001 to 2002. The most dramatic changes occur for the coverage of preventive services and prescription drugs, which both experience premium drops of twenty percent from 2001 to 2002. In addition, those plans offering basic drug coverage decrease their premiums from 2000 to 2001 by about fourteen percent. It is interesting that these dramatic reductions are occurring only once over the five year period, and are

[27] The costs of three pints of blood is unlikely to have offset the decrease in costs of part A coinsurance, part A hospital benefits, and the part B coinsurance.

seemingly not related to the constant decline in offers for these plans seen in Table 3.2. However, the decrease in premium spread over time present in most categories can be interpreted as an increase in competition.

3.3.4. Premium Means for State Characteristics

Table 3.4. depicts average premiums split by some of the buyer's characteristics, i.e. the ARF variables. The premiums are for 65 year-old men buying standard plan A, which is the plan offering only the basic coverage (see Table 1.1.). For each of the ARF variables, I calculate the 25th and 75th percentile (in a year-plan-gender-age group), and then report the premium averages for the states in the lower and upper quartile as well as in the interquartile range of this variable.

While Table 3.4. contains a wide range of information, I focus only on the premium differences between the quartiles to show that the state variation might contribute to premium variation. Several variables show variation in the premiums based on the quartile: States in the lower quartile of the Medicare adjusted per capita cost have premiums that are on average sixteen percent lower than those states in the upper quartile. For Medicare inpatient days, it is somewhat strange that the premiums in the interquartile range are lower than both the upper and lower quartile, especially since there is no consistent relationship between the lower and upper quartile. States with a high degree of Managed Medicare penetration have larger average premiums (on average fifteen percent), concurring with Robst's (2001) assessment. Markets with fewer firms have higher premiums, which could indicate that in those markets the lack of competition allows the firms to charge higher prices. The difference peaks at $60 in 2000, and declines to $26 in 2002 (both significant) thus this finding strengthens the notion of a general contraction in the Medigap market towards 2002. States in the upper quartile of per capita income have slightly higher (4.3 percent on average)

Table 3.4.: Average Premiums by Area Resource File Variables

	1998	1999	2000	2001	2002
Medicare Pay Rate, Male, 65					
below 25th Percentile	622	655	682	754	841
	(138)	(151)	(166)	(183)	(222)
25th to 75th Percentile	652	679	709	769	856
	(147)	(156)	(165)	(166)	(196)
above 75th Percentile	728	763	802	881	958
	(181)	(196)	(215)	(228)	(233)
Medicare Inpatient Days per Beneficiary					
below 25th Percentile	689	723	743	786	888
	(181)	(191)	(203)	(196)	(236)
25th to 75th Percentile	646	675	706	785	858
	(148)	(163)	(177)	(198)	(211)
above 75th Percentile	669	701	738	807	898
	(146)	(159)	(168)	(179)	(206)
Managed Medicare Penetration					
below 25th Percentile	650	648	660	719	810
	(148)	(141)	(144)	(164)	(197)
25th to 75th Percentile	647	691	738	798	887
	(148)	(166)	(179)	(179)	(220)
above 75th Percentile	706	744	771	855	927
	(179)	(193)	(213)	(221)	(214)
Observations	1621	1629	1486	1107	1107

Table 3.4.: (continued)

	1998	1999	2000	2001	2002
Number of Firms Offering the Same Policy					
below 25th Percentile	685	716	762	822	884
	(157)	(183)	(182)	(191)	(225)
25th to 75th Percentile	660	694	723	790	885
	(161)	(174)	(191)	(203)	(223)
above 75th Percentile	649	678	702	773	858
	(150)	(151)	(164)	(179)	(202)
Per Capita Income					
below 25th Percentile	658	695	722	794	891
	(151)	(159)	(173)	(189)	(225)
25th to 75th Percentile	645	672	704	767	861
	(145)	(158)	(168)	(177)	(215)
above 75th Percentile	700	732	760	831	889
	(182)	(197)	(213)	(217)	(212)
Unemployment Rate					
below 25th Percentile	609	635	672	716	815
	(129)	(147)	(167)	(178)	(201)
25th to 75th Percentile	682	715	744	820	891
	(167)	(174)	(186)	(191)	(222)
above 75th Percentile	676	713	740	811	917
	(153)	(173)	(184)	(192)	(210)
Observations	1621	1629	1486	1107	1107

Notes:
Sample restricted to standard plan A offers made to 65 year-old males. An observation is a plan offer made by any firm within a state to this group. All values are inflation-adjusted by the medical care Consumer Price Index, reflecting year 2000 dollars.
Source: Author's calculations using Weiss data 1998-2002 and ARF 2004.

premiums than those in the lower quartile, and states with unemployment rates in the upper quartile have premiums that are on average twelve percent higher.

Tables 3.2., 3.3., and 3.4. show some interesting differences in premium averages, although it is important to note that they are all unconditional, and the "true" influence might change in the following multivariate analysis. Especially interesting is whether the contraction of the market in 2002 can be shown to have effects on premiums.

3.4. Econometric Methods

3.4.1. Marginal Impacts On Price

The variation in prices over firms and states will help to specify the influence of different variable groups on price, i.e. plan characteristics (coverage of different conditions), firm characteristics (Weiss financial ratings), buyer characteristics (state level variables), and market characteristics (rating methods, number of competitors).[28] The analysis will also investigate whether time trends are present in the variables, which might indicate future developments of the market.

Specifically, an insurance policy i in year t is any firm j's insurance offer in a state s; distinguished by the plan letter, the rating method, and the age group; whether it is offered to men or women; and whether it is a standard, select or a smoker plan. Each of the policies is associated with a number of firm specific characteristics, X_j, which are fixed across the policies a firm offers in different states and in different years. Each of the policies has certain coverage characteristics, P_i, which are identical across firms, states, and years. Within each state, all policies face the same buyer characteristics, B_s, and hence the state specific variables do not vary by policy or firm

[28] To some extent, this method is similar to that of a hedonic price regression, see for example Rosen (1974) or Lucas (1977). However, since demand for the Medigap policies is not a part of this analysis, the coefficients do not reflect the consumers' average marginal willingness to pay for specific product characteristics, but rather the firms' "marginal willingness to charge".

within a state, but by year only. Then the basic equation to determine the influence on a premium y_{ijst} (charged for policy i by firm j in state s and year t) is:

$$(3.1)\quad \ln(y_{ijst}) = \beta_0 + X_j\beta_X + P_i\beta_P + B_{st}\beta_P + \eta_j + \varepsilon_{ijst}$$

Variables used in P_i are the coverage and rating indicators as well as the indicators for standard, select and smoker plans. B_{st} contains the Medicare adjusted costs, the percent of Managed Medicare penetration, the per capita income, and the unemployment rate.[29] As a measure for competitive influence on prices, I include in B_{st} the number of firms offering the same policy in a state as a variable as well. X_j and η_j are firm specific effects, where the X_j are the Weiss financial ratings and η_j depict unobserved heterogeneity in firms.

An OLS estimation of the different β's is consistent, as long as the unobserved effects are not correlated with any of the observed variables. While this seems to be a reasonable assumption for the state specific variables B_{st}, there is some concern about X_j and especially P_i: the offers of specific coverage packages observed in the market are based on a firm's perception of how to perform best in the market. Since these perceptions remain unobserved, they could influence P_i in a non-random way, hence introducing omitted variable bias. Since a Hausman test for random vs. fixed effects leads to a rejection of the random effects model, the β's are estimated by age groups and gender separately for each year (1998-2002) with regressions employing a fixed effects procedure. The firm specific variables in X_j (which are the Weiss Ratings) drop out of the equation.[30] The error terms ε_{ijst} are allowed to be correlated for any number

[29] I am not using the number of Medicare inpatient days, since they can be assumed to measure the health of individuals in the states, similar to the Medicare adjusted costs. Indeed the variables are correlated and results run with Medicare inpatient days or the hospital expenditures do not change qualitatively.
[30] The fixed effects could also be specified with state-firm interactions. This however does not lead to different results, but leads to losing the state specific variables in the regression as well.

of offers by a firm within a state, i.e. on a state-firm level. Identification of the β's is obtained through variation of firms across states and across policies offered.

One important aspect of the analysis is the measure of competition. A measure of concentration like the Herfindahl-Index is in general preferred in the literature, but since there are no demand data specific enough to capture the populations within a homogenous product group (i.e. a state, plan letter, plan type, gender, age, and rating method cell), this variable cannot be created. Tests with Herfindahl-Indexes defined on a state – plan letter or a state basis only did not yield significant results, which is likely due to the lack of precision in defining the index. Thus the rather crude measure of firms per market is used here, and the development in the coefficients over time is specifically interpreted in their relation to market competition.

3.4.2. Firm Specific vs. State Specific Variation

General economic theory suggests, that a market for homogenous goods that experiences variation in prices cannot be fully competitive (see for example Stiglitz, 1989). In the Medigap market, after controlling for plan letter, plan type, rating method, gender, and age, one would expect the remaining variation to be explained by state specific effects, if the market was competitive. That is, including controls for states (e.g. state fixed effects) should eliminate most of the variation, the remainder would be due to omitted non-linear effects. If there is a lack of competition, at least part of the variation will be explained by firm specific variables.

In the following two-step procedure, I use this relationship. First, I restrict the analysis to specific age and gender groups and construct a set of interacted indicators for any plan letter, plan type, and rating method combination. This creates at most 90 indicators within any age-gender group. The residuals from a regression of the premiums on these indicators are then regressed separately in a second stage on both state (at most 48) and firm fixed effects (at most 147). The degree of residual variation that is explained by state and firm effects, respectively, will serve as a measure of competition in the market.[31] As an alternative method of this analysis, I will fully interact state indicators with each plan letter, plan type, and rating method, creating overall 1852 dummy variables.[32] Then again, the residuals of a regression on these indicators are regressed on the firm effects, where the degree of variation can be interpreted similarly as before.

This approach, while not a standard to measure competition, seems particularly attractive in this setting, where data that are usually used to measure competition, i.e. demand variables, are not available. The comparison of the explanatory power of state vs. firm fixed effects allows to determine the importance of each type of indicator. In addition, the dynamics of the explained variation over time show market developments, i.e. an increase in the explanatory power of firm effects can be interpreted as a decrease in the degree of competition.

3.5. Results

The discussion of the regression results form the price regressions is organized as follows: first the results for insurance policies offered to 65 year-old men are discussed. With these results as a benchmark, I will compare them with the results for women as well as for 75 and 85 year-old men. In those discussions I will refer to the relevant results only.

[31] Note that since the interest is solely on the degree of variation that is explained by the effects, no "real" variables are included. While the coefficients do not have any interpretation except for being a mean shifter for the specific state or firm, this approach provides maximum flexibility.

[32] Note that the maximum possible number here would be 3 (rating method) times 3 (plan types) times 10 (plan letters) times 48 (states) equaling 4320 indicators. However, not all combinations of plans exist in all states, hence this number is smaller than the maximum.

Since the dependent variable is the natural logarithm of premiums, the estimated coefficients (β's from equation 3.1) can be interpreted as percentage shifts in premiums caused by an increase in the corresponding independent variable. Accordingly, the difference between any two coefficients translates into a percentage difference in the dollar amount of premiums.

Comparing the coefficients over the years allows some conclusions about the market structure: In a competitive market, one would expect little changes in the influence of variables, unless exogenous shocks change the structure of the market. For example, in a competitive market for health insurance, the influence of average health in a state should not affect the premiums differently across years. (If there are changes in health, these should be reflected in changes in premiums, not in the influence of health on premiums.) I am not aware of any exogenous changes to the Medigap market (either state or policy specific) that occurred during the period under investigation here, and hence I interpret significant changes over time in the coefficients as evidence for a lack of competition. The direction of the change is also important, and the interpretation depends on the type of variable: if the influence for a state variable decreases over time, this is interpreted as a decline in competition, as the exogenous influence on the firms' premium setting decision is reduced. On the other hand, if the impact of a coverage variable decreases, this points to an increase in competition, since firms were able to reduce the premium on the specific coverage package, implying that it was not priced competitively before. (Note that another interpretation would be a decrease in costs for the specific coverage, for which I found no evidence.) The interpretation does not allow to specify the actual "degree of competition", it only allows to detect shifts towards a more or less competitive market structure.

3.5.1. General Results

Table 3.5. shows the regression coefficients for plan offers to 65 year-old men. To increase readability, Table 3.5. is split by the type of variables, i.e. by plan and state characteristics. The top of panel a) includes a "predicted base premium", which is calculated from the estimated coefficients on the state variables at their means and the estimation constant, and thus depicts the estimated rate for (i) a standard plan, with (ii) no additional coverage, sold (iii) under Attained Age rating in the average state (see Appendix Table 3.1. for the state means).[33] All coefficients in Table 3.5. will be related to these base premiums and since most variables are indicator variables, their coefficients serve as a percentage shift of (or a "mark-up" to) the base premium when the indicator is "switched on". The ratio of predicted base premiums in 2002 and 1998 is 1.36, implying an 8 percent increase per year, identical to the unconditional premium increase mentioned in the earlier discussion of Table 3.3. for the basic coverage. Also a similar pattern of smaller increases in 1999 and 2000 and larger ones towards 2002 is present.

In the remainder of panel a) the coefficients of the state characteristics and the estimation constant are depicted. The constant, which captures the base premium without the influence of the state variables, actually declines over time by 35 percent (as measured by the difference in coefficients). Offsetting this decline and leading to the enormous increase in the predicted base premium is the increasing influence of the Medicare adjusted costs (as the mean for the adjusted costs does not change a lot over time). The unit of the adjusted costs is \$100, thus a one unit increase in the adjusted costs increases the base premium by 11 percent (\$61) in1998 and 30 percent (\$232) in 2002. Since this variable captures state differences in health, over time these

[33] The calculation is as follows: $\hat{y} = \exp(\beta_0 + B_{st}\beta_B)$, where the calculation of the standard error assumes a covariance of zero between the B_{st} variables. While this assumptions may not be correct, the correlations are mainly positive, and thus the estimate of the standard error is likely too large.

Table 3.5.: Regression Coefficients for Insurance Policy Offers to 65 Year-Old Men

a) State Characteristics

	1998	1999	2000	2001	2002
Predicted Base Premium	579***	618***	654***	703***	786***
	(39)	(45)	(57)	(105)	(120)
Constant	6.1103***	6.1227***	6.0657***	5.6778***	5.7645***
	(0.040)	(0.046)	(0.054)	(0.084)	(0.084)
Medicare Pay Rate, Male, 65	0.1056***	0.1288***	0.1570***	0.2672***	0.2955***
	(0.010)	(0.010)	(0.013)	(0.029)	(0.031)
Managed Medicare Penetration	0.2124***	0.1899***	0.1734***	0.1634***	0.1479***
	(0.032)	(0.034)	(0.039)	(0.048)	(0.048)
Per Capita Income	-0.0613***	-0.0598***	-0.0588***	-0.0648***	-0.0869***
	(0.014)	(0.014)	(0.017)	(0.020)	(0.018)
Unemployment Rate	0.0013	-0.0038	0.0025	0.0062	0.0030
	(0.003)	(0.003)	(0.005)	(0.006)	(0.006)
Number of Firms In The Market	0.0011	0.0014	0.0003	0.0064***	0.0053**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Square of Number of Firms	1.0E-05	1.6E-06	3.0E-06	-1.2E-04**	-9.0E-05
	(3E-05)	(3E-05)	(3E-05)	(6E-05)	(6E-05)

Table 3.5.: (continued 1)

b) Policy Characteristics

	1998	**1999**	**2000**	**2001**	**2002**
Plans Covering					
Medicare Part A Deductible	0.3594***	0.3428***	0.3232***	0.3253***	0.2987***
	(0.006)	(0.005)	(0.005)	(0.007)	(0.007)
Medicare Part B Deductible	0.1893***	0.1878***	0.1891***	0.1655***	0.1803***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
At Home Recovery Costs	0.0700***	0.0640***	0.0397***	0.0383***	0.0217***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Preventive Services	0.1350***	0.1348***	0.0831***	0.0874***	0.0709***
	(0.008)	(0.008)	(0.009)	(0.013)	(0.016)
Medicare Part B Excess Charges	0.0958***	0.0767***	0.0602***	0.0509***	0.0311***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Prescription Drugs (basic)	0.6010***	0.6286***	0.8030***	0.7673***	0.7135***
	(0.011)	(0.012)	(0.021)	(0.021)	(0.024)
Prescription Drugs (extended)	0.5363***	0.5856***	0.7833***	0.8561***	0.7229***
	(0.012)	(0.012)	(0.020)	(0.022)	(0.021)

Table 3.5.: (continued 2)

b) Policy Characteristics

	1998	**1999**	**2000**	**2001**	**2002**
Smoker Policy	0.0269	0.0701***	0.0773***	0.1117***	0.1006***
	(0.017)	(0.013)	(0.011)	(0.010)	(0.012)
Select Policy	-0.2180***	-0.2164***	-0.2511***	-0.1606***	-0.1717***
	(0.017)	(0.016)	(0.017)	(0.021)	(0.020)
Issued Age Rating	0.2259***	0.2242***	0.1911***	0.1768***	0.1651***
	(0.014)	(0.014)	(0.013)	(0.016)	(0.016)
Community Rating	0.2627***	0.2807***	0.2739***	0.2655***	0.2208***
	(0.020)	(0.018)	(0.016)	(0.026)	(0.029)
Observations	9731	10658	10250	8105	8189
Number of Firm Fixed Effects	147	146	140	104	106
Adjusted R2	0.745	0.713	0.689	0.65	0.534

Notes:
Panels a) and b) show different estimated coefficients from the same estimation of equation (3.1). The sample is restricted to policy offers to 65 year-old men. Omitted categories are “Basic Coverage Only”, “Standard Policy”, and “Attained Age Rating”.
The estimation is performed with a firm-fixed effects procedure. The standard errors (in parentheses) are allowing for clustered errors on State-Firm groups.
*, **, ***: significant on a 10, 5, and 1% level, respectively.
Source: author’s calculations using Weiss data 1998-2002 and ARF 2004.

differences have become more important in the price setting decision of firms, indicating an increase in competition.

While the impact of managed Medicare competition on premiums decreases from about 2.1 to 1.5 percent for a ten percent increase in the penetration rate, the dollar impact on premiums remains almost the same, decreasing from $12.2 in 1998 to $11.6 in 2002. Since the Medicare adjusted costs are taking into account state specific differences, there is some correlation between the costs and the other state variables, most important between the costs and the per capita income. In regressions (not reported) run separately for income and costs, the influence of costs was slightly lower than presented in Table 3.5., while the per capita income had a small positive effect. The correlation between the two explains why states have a 0.6 to 0.9 percent lower premium with a $1000 increase of per capita income. The effect of unemployment is never significant and very small, and thus it probably is not suited very well to capture competition with employer provided supplemental insurance. The influence of the number of firms in the market and its square is rather small, but turns significant after 2000. If there is any inference to be drawn from these effects, it is that towards the end of the period, the rate at which the premiums increase decreases with the number of firms, as given by the negative estimates on the square term.

In panel b) of Table 3.5., the influence of the insurance policy characteristics are depicted. In 1998, compared to having a basic policy without any additional coverage (plan A), a plan with Medicare Part A deductible increased the premium by almost 36 percent ($208 in terms of the predicted base premium). Coverage for the Part B deductible added 19 percent ($110), the coverage of at home recovery costs meant a 7 percent ($41) higher premium, and preventive services and Medicare Part B excess charges increased premiums by 14 and 10 percent ($78 and $55), respectively. The highest mark-up came through prescription drug coverage: for the basic coverage, the base premium increased by 60 percent ($348), whereas 54 percent ($311) were added for the extended coverage.

To compare the development over time, it is important to relate the coverage indicators to the development of the predicted base premium. For example, the mark-up for the part A deductible decreased significantly from 1998 to 2002 by about 6 percent, with the biggest drop in 2002. Since at the same time, the base premium increased by 35 percent, premiums for plans covering the part A deductible have still increased, but at a slightly lower rate than the base premium, as over time, the mark-up has decreased. Similarly, the influences of coverage for at home recovery, preventive care and part B excess charges have declined by 5, 6, and 6 percent, respectively, from 1998 to 2002. The mark-up for the part B deductible remained relatively constant over the years, while the premium for prescription drug coverage (both basic and extended) first increased by more than 20 percent, to then drop to mark-ups levels of about 70 percent of the base premium in 2002.

1998 is the only year in which the policies for smokers are not significantly different from standard policies, in the all other years, they are priced between 7 and 11 percent higher. On the other hand, insurers charged between 16 and 25 percent less for select policies in all years, where once again, the difference is smallest in 2001 and 2002. The Attained Age policies have premiums below those with Issued Age rating and Community Rating plans, but both differences are declining over time from 23 to 17 percent (Issued Age) and 26 to 22 percent (Community Rating), thus the relative increase for these rating methods is less than for the Attained Age premiums.

Overall Table 3.5. suggests that state variables matter in the determination of premiums, and that over time, their influence increased, indicating that competition increased over time as well. In this regard, the decreasing influence of the policy specific characteristics point in the same direction – as competition increases, the mark-ups for certain coverage packages decrease.

3.5.2. Comparisons by Gender and Age

Table 3.6. shows the predicted base premiums based on gender and age. The first four rows in panel a) show the log base premium calculated in the same way as in Table 3.5., thus reflecting the predicted premiums in the average state for a standard plan without additional coverage under Attained Age rating. The only difference in these premiums is in the gender or the age group, such that the four rows are for men and women at 65, and for men at 75 and 85 years of age, respectively. Panel b) then shows the predicted premiums, i.e. the exponentiated log premiums.

All premiums follow a similar pattern, and increase by roughly 30 percent over the period of observation. For all estimates, the variation increases as the precision of the estimated coefficients declines towards 2002. The premiums charged to women are only slightly lower than those charged to men – on average about 1.3 percent or $9. None of these differences is significant, which is also true for all differences in coefficients from Table 3.5. between premiums for men and women.[34] Men that are 75 years old pay on average 30 percent more than their 65 year old counterparts. This differences is relatively constant over time, and due to the general increase in premiums, the absolute difference then increases from $212 in 1998 to $256 in 2002. Similarly, the differential between premiums for 65 year-old men and those for 85 year-old men is about 45 percent, implying an increase in the gap from $345 to $424. Both of these differences are significant throughout, although with less precision towards 2002.

[34] For completeness, the coefficients from the estimations for offers to women as well as those from the regressions for offers to 75 and 85 year-old men are reported in appendix tables A3.2., A3.3., and A3.4.

Table 3.6.: Predicted Base Premiums by Gender and Age

a) Log of Base Premium

	1998	1999	2000	2001	2002
65 Year-Old Men	6.3621	6.4264	6.4827	6.5554	6.6667
	(0.068)	(0.073)	(0.088)	(0.149)	(0.152)
65 Year-Old Women	6.3513	6.4127	6.4731	6.5421	6.6490
	(0.067)	(0.072)	(0.088)	(0.151)	(0.155)
75 Year-Old Men	6.6745	6.7380	6.7805	6.8404	6.9491
	(0.042)	(0.049)	(0.057)	(0.086)	(0.087)
85 Year-Old Men	6.8301	6.8891	6.9432	7.0009	7.0985
	(0.072)	(0.079)	(0.097)	(0.150)	(0.153)

b) Predicted Base Premium

	1998	1999	2000	2001	2002
65 Year-Old Men	579	618	654	703	786
	(39)	(45)	(57)	(105)	(120)
65 Year-Old Women	573	610	648	694	772
	(38)	(44)	(57)	(105)	(120)
75 Year-Old Men	792	844	880	935	1042
	(33)	(42)	(50)	(80)	(90)
85 Year-Old Men	925	982	1036	1098	1210
	(67)	(78)	(101)	(165)	(186)

Notes
The log of base premiums are estimated from the estimated coefficients at the state means (Appendix Table 3.1.) for a standard plan without additional coverage, sold at Attained Age rating. Standard errors are estimated assuming no correlation between the variables. The predicted base premiums are the exponentiated log premiums, standard errors are obtained with the delta method.
Source: Author’s calculations using Weiss data 1998-2002 and ARF 2004.

As mentioned, there are no differences in coefficients between men and women (comparing Table 3.5. and Appendix Table 3.2.). Table 3.7. shows the mean

Table 3.7.: Mean Coefficient Differences Between Age Groups

	to 75 Year-Olds	**to 85 Year-Olds**
Plans covering		
Medicare part A Deductible	0.0199 **	0.0296 ***
	(0.009)	(0.009)
Medicare part B Deductible	0.0032	0.0166 **
	(0.006)	(0.007)
At Home Recovery Costs	0.0218 ***	0.0455 ***
	(0.005)	(0.005)
Preventive Services	0.0094	0.0169
	(0.016)	(0.016)
Medicare part B Excess Charges	-0.0015	-0.0037
	(0.004)	(0.004)
Prescription Drugs (basic)	-0.0211	-0.0269
	(0.026)	(0.027)
Prescription Drugs (extended)	-0.0584 **	-0.1136 ***
	(0.026)	(0.027)
Smoker Policy	0.0267	0.0332 *
	(0.018)	(0.018)
Select Policy	-0.0081	-0.0145
	(0.026)	(0.026)
Issued Age Rating	-0.1021 ***	-0.1562 ***
	(0.020)	(0.020)
Community Rating	-0.3266 ***	-0.4750 ***
	(0.033)	(0.033)
Medicare Adjusted Per Capita Costs	-0.0651 ***	-0.0839 ***
	(0.025)	(0.024)

Notes:
Mean differences from the differences in coefficients for men, from estimates in Table 3.5. and Appendix Tables 3.3. (for age 75) and 3.4. (for age 85). Standard errors in parenthesis.
*, **, ***: significant on a 10, 5, and 1% level, respectively.
Source: Author’s calculations using Weiss data 1998-2002 and ARF 2004.

differences in coefficients between the age groups for men (from Table 3.5. and Appendix Tables 3.3. and 3.4.). Certain changes in the impact are expected when moving from the group of 65 year-olds to 75 or 85 year-olds. For example, covering the inpatient deductible costs about 2 percent more for 75 year-olds than for 65 year-olds, and the difference increases to 3 percent for the 85 year-olds (first row). The increase is due to the fact that the likelihood of a hospital stay increases with age and insurance companies face higher expected costs. Similar considerations explain the increases in the home health care mark-up, and that for the part B deductible. Interestingly, the coverage mark-up for extended prescription drug coverage declines with age, by 6 and 11 percent for age groups 75 and 85, respectively. Clearly older beneficiaries should not buy into Attained Age plans when first buying a Medigap plan: Issued Age plans are 10 and 16 percent less expensive, at age 75 and 85, respectively, whereas the differential amounts to 33 and 48 percent for Community Rated plans. Of the state variables, only the difference for the Medicare adjusted costs are reported, as all other ones are very close to zero and not significant. While the coefficient differential is negative between age 65 and the older groups, it is almost completely offset by the increase in means for this variable (compare to Appendix Table 3.1.), such that the dollar increase due to differences in Medicare adjusted costs is the same for all groups.

3.5.3. Explained Variation

Table 3.8. now depicts the degree of explanatory power that is provided by state and firm fixed effects. Panel a) contains the results of the two stage procedure outlined in section 3.4.2., where first the log premiums are regressed on fully interacted indicators of plan letter, plan type and rating method. The first row

Table 3.8.: Comparison of Firm vs. State Explanatory Power

a) Regression on Plan Letter-Plan Type-Rating Interactions

	1998	**1999**	**2000**	**2001**	**2002**
Number of First Stage Effects	78	80	81	80	81
Residual Variation Explained By State Effects	0.105	0.102	0.110	0.183	0.156
Number of State effects	47	47	47	47	47
Residual Variation Explained By Firm Effects	0.370	0.365	0.331	0.292	0.275
Number of Firm Effects	146	145	139	103	105
Observations	9731	10658	10250	8105	8189

b) Regression on State-Plan Letter-Plan Type-Rating Interactions

	1998	**1999**	**2000**	**2001**	**2002**
Number of First Stage Effects	1526	1565	1644	1572	1528
Residual Variation Explained By Firm Effects	0.401	0.398	0.350	0.337	0.315
Number of Firm Effects	146	145	139	103	105
Observations	9731	10658	10250	8105	8189

Notes:
The sample is restricted to policy offers for 65 year-old men. The "residual variation" depicts the R^2 from a fixed effects regression of the residual from the first stage on the state or firm effects. The number of first stage effects refers to mutually exclusive cells, depending on the definition. See text for details.
Source: Author’s calculations using Weiss data 1998-2002.

shows how many indicators are used in each year, where the sample is once again restricted to premiums offered to 65 year-old men. (The results are similar for the other samples.) The adjusted R^2 for a regression of the residuals from the first stage on state fixed effects is given in the second row, whereas the number of fixed effects follows in the row below. The degree of variation explained by the firm fixed effects and the number of firm effects used are presented in the fourth and fifth row, respectively.

The degree of variation explained by the state fixed effects is not large, but it increases over time, most notably from 11 to 18 percent from 2000 to 2001. At the same time, the degree of variation explained by firm specific effects decreases gradually over time – from 37 to 27 percent. Both effects suggest, that state variables affected premiums stronger after 2000, while firm effects lose their influence on premiums, which is complementary to the discussion of Table 3.5. in section 3.5.1.

Panel b) shows the results with the alternative first stage regressions, where the log premiums are regressed on the indicators of full interactions of state, plan letter, plan type and rating method. Again the first row depicts the number of these indicators, while the second shows the residual variation that is explained by the firm effect. The results are in line with the previous findings as well: the degree to which firm specific effects explain the variation in premiums decreases, suggesting that the degree of competition has increased in the Medigap market over time. Note that the finding of firm effects explaining price variation in any year does not lead to the above conclusion – indeed it could be that the individuals buying policies from the different firms are inherently different from one firm to another and thus the firms have to charge different premiums. It is the change in the degree of variation explained that allows this interpretation.

3.6. Conclusion

In this chapter, I analyze the variation in premiums for insurance policies offered in the Medigap market. The analysis focuses on a year by year comparison from 1998 to 2002, and allows conclusions about the impact of coverage packages and state characteristics on Medigap premiums. Changes in these impacts are related to the competitive structure of the market. In addition, the degree to which state and firm specific variation explain premium variation is investigated and interpreted as a measure of competitiveness in the Medigap market.

In particular, differences in insurance coverage account for large amounts of the price variation present in the market. In 2002, the yearly premium for a basic plan with coverage only for Medicare part A and B coinsurance as well as three pints of blood is estimated to be $786. When adding coverage for other gaps in Medicare, this base premium is increased significantly. For example, the mark-up for extended prescription drug coverage amounts to $47 a month. Select plans are an alternative that is significantly less expensive than standard plans, the differential in 2002 is at $135 a year. While young individuals profit from buying Attained Age policies ($130 and $174 less than Issued Age and Community Rated plans, respectively), this relationship is reversed with age. In addition, state variables have some influence, most notably decreases in the health of the Medicare population (as measured by increases in the Medicare adjusted costs) and increases in the degree of managed Medicare penetration increase premiums.

The analysis also shows that the market changed significantly from 1998 to 2002. The number of active firms declined from 146 to 105, which also led to a reduction in plan offers by 15 percent, as measured by offers to 65 year-old men. Almost all coverage mark-ups decline over this period, which is an indication that they were (or still are) not priced competitively. This finding is strengthened by an unconditional reduction in real premium growth towards 2002 and by a decrease in firm specific variation in insurance premiums. Taken together, this leads to the conclusion that while variation in premiums for Medigap insurance policies still exists, the competition has increased over time and the firm specific influence on premiums has decreased.

3.7. Appendix Tables

Appendix Table 3.1: State Variable Means

	1998	1999	2000	2001	2002
Medicare Adjusted Costs:					
Male, 65	3.399	3.382	3.422	3.583	3.580
	(0.503)	(0.460)	(0.425)	(0.287)	(0.256)
Male, 75	5.101	5.075	5.129	5.375	5.349
	(0.755)	(0.690)	(0.637)	(0.430)	(0.382)
Male, 85	6.023	5.992	6.046	6.342	6.279
	(0.892)	(0.814)	(0.751)	(0.508)	(0.448)
Female, 65	2.923	2.909	2.943	3.081	3.081
	(0.433)	(0.395)	(0.366)	(0.247)	(0.220)
Female, 75	4.250	4.229	4.275	4.479	4.464
	(0.629)	(0.575)	(0.531)	(0.358)	(0.319)
Female, 85	5.309	5.281	5.328	5.589	5.531
	(0.786)	(0.717)	(0.662)	(0.447)	(0.395)
Managed Medicare Penetration	0.112	0.123	0.122	0.119	0.106
	(0.108)	(0.116)	(0.116)	(0.114)	(0.109)
Per Capita Income	2.498	2.629	2.664	2.649	2.714
	(0.423)	(0.414)	(0.434)	(0.431)	(0.435)
Unemployment Rate	5.045	4.733	4.441	4.200	4.830
	(1.226)	(1.181)	(1.061)	(1.041)	(0.975)
Number of Firms In The Market	13.13	14.02	12.52	8.52	11.90
	(10.27)	(9.72)	(10.36)	(6.93)	(8.15)
Observations	48	48	48	48	48

Notes:
All means (except the number of firms) are generated from county level information weighted by the number of Medicare beneficiaries in the respective county. Standard deviations depicted in parentheses.
Medicare Adjusted costs in \$100, per capita income in \$10000, in year 2000 levels.
Source: Author's calculations using ARF 2004 and Weiss data, 1998-2002.

Appendix Table 3.2.: Regression Coefficients for Insurance Policy Offers to 65 Year-Old Women

	1998	1999	2000	2001	2002
Part A Deductible	0.359 ***	0.340 ***	0.321 ***	0.322 ***	0.295 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Part B Deductible	0.189 ***	0.190 ***	0.191 ***	0.168 ***	0.184 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
At Home Recovery	0.070 ***	0.064 ***	0.040 ***	0.039 ***	0.022 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Preventive Services	0.136 ***	0.134 ***	0.083 ***	0.086 ***	0.070 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Part B Excess Charges	0.096 ***	0.077 ***	0.061 ***	0.051 ***	0.031 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Rx Coverage (basic)	0.602 ***	0.629 ***	0.803 ***	0.768 ***	0.716 ***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Rx Coverage (ext.)	0.536 ***	0.584 ***	0.781 ***	0.854 ***	0.723 ***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Smoker Policy	0.027	0.063 ***	0.072 ***	0.109 ***	0.097 ***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Select Policy	-0.218 ***	-0.222 ***	-0.255 ***	-0.171 ***	-0.179 ***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Issued Age Rating	0.228 ***	0.232 ***	0.197 ***	0.181 ***	0.171 ***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Community Rating	0.273 ***	0.296 ***	0.282 ***	0.278 ***	0.238 ***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)

Appendix Table 2.2.: (continued)

	1998	**1999**	**2000**	**2001**	**2002**
Costs, Female, 65	0.122 ***	0.148 ***	0.182 ***	0.311 ***	0.341 ***
	(0.01)	(0.01)	(0.02)	(0.03)	(0.04)
HMO Penetration	0.213 ***	0.189 ***	0.176 ***	0.166 ***	0.155 ***
	(0.03)	(0.03)	(0.04)	(0.05)	(0.05)
Per Capita Income	-0.063 ***	-0.061 ***	-0.060 ***	-0.069 ***	-0.089 ***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Unemployment Rate	0.002	-0.003	0.002	0.005	0.002
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Number of Firms	0.001	0.001	0.000	0.006 ***	0.005 **
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Square of Above	1.E-05	8.E-07	4.E-06	-1.E-04 **	-9.E-05
	(3E-05)	(2E-05)	(3E-05)	(6E-05)	(6E-05)
Constant	6.106 ***	6.119 ***	6.066 ***	5.680 ***	5.767 ***
	(0.04)	(0.05)	(0.05)	(0.09)	(0.09)
Observations	9731	10658	10250	8105	8189
Number of Firms	147	146	140	104	106
Adjusted R2	0.736	0.703	0.688	0.651	0.533

Notes:
The sample is restricted to policy offers to 65 year-old women. Omitted categories are “Basic Coverage Only”, “Standard Policy”, and “Attained Age Rating”. The estimation is performed with a firm-fixed effects procedure. The standard errors (in parentheses) are allowing for clustered errors on State-Firm groups.
*, **, ***: significant on a 10, 5, and 1% level, respectively.
Source: Author’s calculations using Weiss data 1998-2002 and ARF 2004.

Appendix Table 3.3.: Regression Coefficients for Insurance Policy Offers to 75 Year-Old Men

	1998	1999	2000	2001	2002
Part A Deductible	0.381 ***	0.363 ***	0.343 ***	0.345 ***	0.317 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Part B Deductible	0.190 ***	0.189 ***	0.194 ***	0.173 ***	0.182 ***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
At Home Recovery	0.088 ***	0.083 ***	0.063 ***	0.066 ***	0.043 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Preventive Services	0.145 ***	0.146 ***	0.093 ***	0.092 ***	0.081 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Part B Excess Charges	0.095 ***	0.076 ***	0.058 ***	0.048 ***	0.030 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Rx Coverage (basic)	0.590 ***	0.621 ***	0.794 ***	0.731 ***	0.672 ***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Rx Coverage (ext.)	0.493 ***	0.543 ***	0.731 ***	0.779 ***	0.646 ***
	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
Smoker Policy	0.057 ***	0.107 ***	0.110 ***	0.132 ***	0.114 ***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Select Policy	-0.217 ***	-0.215 ***	-0.251 ***	-0.186 ***	-0.189 ***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Issued Age Rating	0.111 ***	0.114 ***	0.091 ***	0.083 ***	0.074 ***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Community Rating	-0.082 ***	-0.071 ***	-0.061 ***	-0.039	-0.076 ***
	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)

Appendix Table 2.3.: (continued)

	1998	1999	2000	2001	2002
Costs, Female, 65	0.068 ***	0.086 ***	0.103 ***	0.177 ***	0.194 ***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
HMO Penetration	0.192 ***	0.173 ***	0.158 ***	0.160 ***	0.143 ***
	(0.03)	(0.03)	(0.04)	(0.05)	(0.05)
Per Capita Income	-0.061 ***	-0.060 ***	-0.054 ***	-0.062 ***	-0.082 ***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Unemployment Rate	0.002	-0.003	0.004	0.006	0.003
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Number of Firms	0.001	0.002 *	0.001	0.007 ***	0.006 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Square of Above	2.E-05	-1.E-05	-1.E-05	-1.E-04 **	-1.E-04 *
	(3E-05)	(3E-05)	(3E-05)	(6E-05)	(6E-05)
Constant	6.433 ***	6.420 ***	6.342 ***	5.962 ***	6.051 ***
	(0.04)	(0.05)	(0.06)	(0.08)	(0.09)
Observations	9731	10658	10250	8106	8189
Number of Firms	147	146	140	104	106
Adjusted R2	0.709	0.680	0.659	0.628	0.508

Notes:
The sample is restricted to policy offers to 75 year-old men. Omitted categories are "Basic Coverage Only", "Standard Policy", and "Attained Age Rating". The estimation is performed with a firm-fixed effects procedure. The standard errors (in parentheses) are allowing for clustered errors on State-Firm groups.
*, **, ***: significant on a 10, 5, and 1% level, respectively.
Source: Author's calculations using Weiss data 1998-2002 and ARF 2004.

Appendix Table 3.4.: Regression Coefficients for Insurance Policy Offers to 85 Year-Old Men

	1998	1999	2000	2001	2002
Part A Deductible	0.390 ***	0.374 ***	0.352 ***	0.354 ***	0.328 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Part B Deductible	0.204 ***	0.203 ***	0.207 ***	0.186 ***	0.196 ***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
At Home Recovery	0.107 ***	0.106 ***	0.085 ***	0.091 ***	0.071 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Preventive Services	0.156 ***	0.159 ***	0.105 ***	0.091 ***	0.084 ***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Part B Excess Charges	0.093 ***	0.073 ***	0.056 ***	0.046 ***	0.028 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Rx Coverage (basic)	0.598 ***	0.621 ***	0.799 ***	0.711 ***	0.650 ***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Rx Coverage (ext.)	0.457 ***	0.494 ***	0.680 ***	0.715 ***	0.571 ***
	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
Smoker Policy	0.063 ***	0.115 ***	0.122 ***	0.136 ***	0.117 ***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Select Policy	-0.222 ***	-0.221 ***	-0.254 ***	-0.197 ***	-0.196 ***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Issued Age Rating	0.053 ***	0.055 ***	0.033 **	0.034 **	0.027 *
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Community Rating	-0.225 ***	-0.214 ***	-0.218 ***	-0.194 ***	-0.221 ***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)

Appendix Table 2.4.: (continued)

	1998	**1999**	**2000**	**2001**	**2002**
Costs, Female, 65	0.059 ***	0.075 ***	0.087 ***	0.148 ***	0.166 ***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
HMO Penetration	0.196 ***	0.168 ***	0.158 ***	0.168 ***	0.143 ***
	(0.03)	(0.03)	(0.04)	(0.05)	(0.05)
Per Capita Income	-0.064 ***	-0.061 ***	-0.052 ***	-0.061 ***	-0.081 ***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Unemployment Rate	0.002	-0.005	0.004	0.006	0.000
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Number of Firms	0.001	0.003 *	0.002	0.006 **	0.004 *
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Square of Above	2.E-05	-2.E-05	-2.E-05	-1.E-04 *	-5.E-05
	(3E-05)	(3E-05)	(4E-05)	(6E-05)	(6E-05)
Constant	6.582 ***	6.569 ***	6.498 ***	6.137 ***	6.217 ***
	(0.04)	(0.05)	(0.06)	(0.09)	(0.09)
Observations	9296	10414	10010	8050	8058
Number of Firms	146	145	139	104	106
Adjusted R2	0.703	0.665	0.637	0.620	0.520

Notes:
The sample is restricted to policy offers to 85 year-old men. Omitted categories are "Basic Coverage Only", "Standard Policy", and "Attained Age Rating". The estimation is performed with a firm-fixed effects procedure. The standard errors (in parentheses) are allowing for clustered errors on State-Firm groups.
*, **, ***: significant on a 10, 5, and 1% level, respectively.
Source: Author's calculations using Weiss data 1998-2002 and ARF 2004.

CHAPTER FOUR

Premium Variation and Consumer Search Costs

4.1. Introduction

In this chapter we investigate why price variation is sustained in the Medigap market. As discussed in the first chapter, because of the standardization imposed by OBRA 1990, the Medigap market is in essence a market with homogeneous goods. The existence of price variation in a market with homogeneous goods is an indicator of imperfect information in the market (e.g., see Stiglitz, 1989), and suggests that when consumers buy high-priced Medigap policies instead of identical lower-priced ones, welfare losses occur. To guide our analysis, we apply a theoretical model by Carlson and McAfee (1983) that explains the existence of a discrete price distribution in a market for homogenous goods with differences in cost structures among firms and search costs to consumers. The Carlson-McAfee model has been used to study price variation in a variety of settings. For example, Dahlby and West (1986) found support for the model's main predictions in the market for auto insurance. In a study of local pharmacy markets in upstate New York, Sorensen (2000) found more variation in prices for acute-care medications than for medications used to treat long-term chronic conditions, where the expected gains from searching were larger. Horteçsu and Syverson (2004) applied the Carlson-McAfee model to the market for S&P 500 index funds, finding that increased market participation by novice investors moved the search cost distribution rightward, supporting the existence of more expensive funds.

Applying the Carlson-McAfee model to the Medigap market, we estimate a maximum search cost of $430, leading to an average search cost of $215. By way of comparison, average search costs ranged from \$28 to \$125 in the market for auto insurance (Dahlby and West, 1986), and between \$5 and \$30 for every \$10,000 of assets invested in the mutual fund market (Horteçsu and Syverson, 2004). Our findings suggests that many elderly consumers do not know where to find the lowest prices in the market, and face costs of search that are high enough to prevent most of them from searching until they find the lowest price. Our results imply that in two-thirds of all markets nationwide, only about eleven percent of individuals find the lowest priced policy.

We begin by discussing theories of price variation and then present an augmented version of the Carlson-McAfee search cost model. We describe our data in section 4.3., and estimate the search cost model's main equations in section 4.4. We conclude with a summary of our findings and a brief discussion.

4.2. Theoretical Framework

4.2.1. An Overview of Theories of Price Variation

In general, there are three potential explanations for sustained price dispersion in a homogenous goods market. The first is cross subsidization within a firm. In this scenario, a firm sells products in more than one market, allows for losses in one (or more) of them, and subsidizes the losses with profits made in other markets. In the Medigap context, firms could offer Plan A very cheaply (i.e. below costs) in order to attract people to the company. Then the firm could present the other plans it offers, which (by definition) are better plans in terms of coverage and thus are more expensive. The premiums for these plans would be above costs, and thus the firm could offset losses on Plan A (and perhaps make profits) if enough consumers decide to buy the more expensive plan. If only some firms engaged in this kind of pricing, or if all did but to different extents, prices could vary. It is unlikely that firms engage in this kind of cross-subsidization, however, because federal Medigap regulations require insurers to maintain loss ratios (the ratio of claims to premiums) of at least 65 percent for individual plans, and 75 percent for group plans. If that ratio is not met, the insurer has to pay transfers to his policyholders. If, as is usually assumed, the administrative costs for Medigap policies are about 10-15 percent of total costs (Centers for Medicare and Medicaid Services, 2006b), there remains a maximum profit margin of 25 percent for collected premiums.

Firms could also cross subsidize *across* insurance markets by operating in the Medigap market with losses, but subsidizing these losses with profits from an entirely different insurance market, say long term care or life insurance. In other words, Medigap policies could be thought of as "loss leaders." Only about 11 percent of Medigap plans in data from the National Association of Insurance Commissioners (NAIC, see next section) operate with losses, however, indicating that this type of cross subsidization, if it even exists, is relatively uncommon.

Price variation could also persist if ostensibly homogeneous products are in fact differentiated on some dimension that is observable to consumers, but not to the researcher. Examples of product differentiation might include special discounts for spouses, financial stability of the insurance firm, or a reputation for efficient claims processing. Furthermore, advertising is a form of product differentiation, which in general does not alter the product, but increases knowledge and name recognition. While it is likely that some unobserved product differentiation exists in the Medigap market, it cannot plausibly explain price ranges where the maximum price is more than double the minimum price in some states and for some plan letters (see Tables 1.2. and 1.3.).

A third reason for equilibrium price dispersion is that firms differ in their costs of production, and these differences are sustained by the existence of consumer search costs. Several theoretical papers have investigated the implications of incompletely informed consumers who have to gather information before they buy a product. Even with a large number of consumers and sellers, and no heterogeneity in production costs, Diamond (1971) concludes that the monopoly price prevails if there are search costs. Stiglitz (1989) shows how price dispersion arises through cost differentials in the presence of search costs, assuming that consumers are either fully informed or not at all informed (i.e., no learning about the market through sequential search) and a continuous distribution of prices. Carlson and McAfee (1983) relax these particular assumptions. They allow consumers to learn about the market through sequential search, and they assume a discrete price distribution, the latter feature being particularly relevant in the Medigap setting where there are relatively few firms operating in a given market. Perhaps most importantly, their model yields testable predictions. We explain their model and our augmentations in detail in the next section.

4.2.2. A Model of Search Costs and Price Dispersion

Carlson and McAfee (1983) explain sustained price variation in a homogeneous goods market with consumer search costs and variation in production costs. The intuition behind their model is to assume incomplete information in the sense that consumers are not fully informed: while they know the price distribution they do not know which firm offers which price.[35] However, consumers can obtain information about firm-price pairs at a certain cost that is specific to the consumer. Heterogeneity in search costs lead to differences in the amount of information obtained, which allows for a non-degenerate price distribution to exist in the market.

[35] Virtually all papers in the search cost literature assume a commonly known price distribution. This is necessary to evaluate any consumer's expected (monetary) gain from searching. Otherwise it is not possible for a consumer to assess when to stop searching (in dynamic programming models).

Suppose all consumers gain utility u_j if they buy a Medigap policy from firm j:

$$(4.1) \qquad u_j = \lambda X_j - p_j \ ,$$

where X_j is a vector of firm j's characteristics other than price, p_j. Utility is linear, and it is normalized in terms of prices (i.e. there is no coefficient on p_j). Although the consumer does not know which firms yield which level of utility, she can rank all possible utilities from highest to lowest, $u_1 \geq u_2 \geq \ldots \geq u_N$. If only prices mattered ($\lambda = 0$) this would correspond to an ordering from lowest to highest price as in Carlson and MacAfee (1983). Here we allow factors other than price to also affect a firm's ranking. Upon entering the market, the consumer searches once, drawing an offer from firm k, which she learns yields utility u_k. Because she knows the ranking of all u_j, the consumer can calculate the expected gain, w_k, from searching again. The expected gain also depends on the probability of a firm being found, where we assume here that all firms N in a market are found with equal probability $1/N$. Then, for any utility u_k, the expected gain is:

$$(4.2) \qquad w_k = \sum_{i=1}^{k-1} \frac{1}{N}\left(u_i - u_k\right) = \frac{1}{N}\sum_{i=1}^{k-1} u_i - \frac{k-1}{N} u_k$$

The consumer then compares the expected gain to her search cost to determine whether to buy this policy or to search for another one.[36] Each consumer has a search cost draw s from a cumulative distribution function $G(s)$, with $g(s) = G'(s)$. The problem of search then becomes an optimal stopping problem: as long as s is lower than (or equal to) the expected gain, w_k, the individual will continue to search and stop if and only if $w_k \leq s \leq w_{k+1}$. Since the distribution of expected gains

[36] Search in Carlson and McAfee's model occurs with replacement, i.e. the utility distribution does not change with the number of searches conducted. While this may seem unrealistic, note that consumers are not limited in the number of times they search, but only by their cost of searching again as it compares to their expected gain. They can discard any draw from the utility distribution with lower utility than a previous draw at no cost.

is the same for all consumers, the search cost distribution, *G(s)*, maps the searching individuals into groups of people that are associated with each firm's utility rank.

Figure 4.1 (slightly altered from Carlson/McAfee) depicts how the expected gains are distributed in an arbitrary example with five firms and gains from searching $w_1 < w_2 < w_3 < w_4 < w_5$, where $w_1 = 0$. Search costs are distributed uniformly on $[0,S]$, and

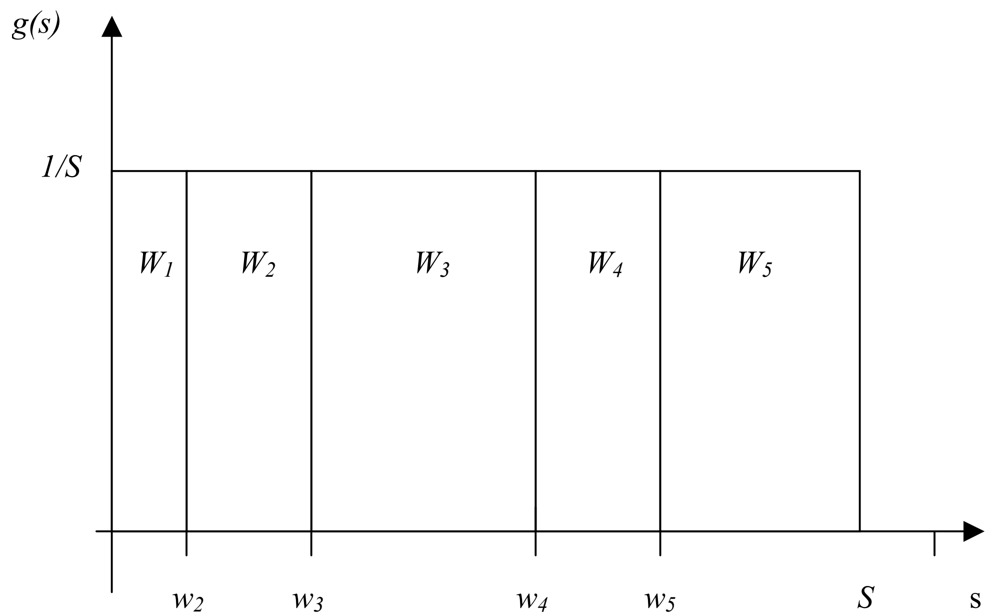


Figure 4.1: Example of Search Cost and Information Distribution

in this example, the maximum search cost is larger than the maximum possible gain, w_5. W_5 (or $[S-w_5]/S$) then depicts the fraction of people in the market that buys the first plan they find. (This does not have to be the plan with the lowest utility, but recall that only people with a search cost draw of $s > w_5$ will end up buying this plan.) W_5 is also equivalent to the fraction of people that remains uninformed about all other firm-price combinations in the market, except for the one they acquire initially. Similar considerations apply to the other parts of the market, where W_1 depicts the fraction of people who will always buy at the lowest price, since their search costs are lower than the smallest gain, w_2.

To determine the relative demand for each firm's plan in the case of a general price distribution, we start by considering q_N, the number of individuals that buys at the firm giving the lowest utility, u_N. These are all people with search cost $s \geq w_N$, who are unlucky enough to draw this firm when entering the market:

$$q_N = \frac{1}{N} G(s \geq w_N) = \frac{1}{N}\left[G(\infty) - G(w_N)\right], \tag{4.3$_N$}$$

where $G(\infty)$ represents the total number of individuals in the market, Q. Similarly, we can find the number of individuals that buys at the firm yielding the second lowest utility, firm $N\text{-}1$:

$$\begin{aligned} q_{N-1} &= \frac{1}{N} G(s \geq w_N) + \frac{1}{N-1} G(w_N \geq s \geq w_{N-1}) \\ &= \frac{1}{N}\left[G(\infty) - G(w_N)\right] + \frac{1}{N-1}\left[G(w_N) - G(w_{N-1})\right] \end{aligned} \tag{4.3$_{N-1}$}$$

Intuitively, firm $N\text{-}1$ attracts $1/N$ of the consumers with the highest search costs and $1/(N\text{-}1)$ of those with the second highest search costs. In general, we can obtain each firm j's demand as:

$$q_j = \sum_{k=j}^{N} \frac{1}{k}\left[G(w_{k+1}) - G(w_k)\right] = \frac{Q}{N} - \frac{G(w_j)}{j} + \sum_{k=j+1}^{N} \frac{G(w_k)}{k(k-1)} \ , \tag{4.3}$$

with $G(w_{N+1})=Q$. Equations (4.2) and (4.3) can then be used to calculate the number of all consumers in any firm j based on the expected utility gain w_j of further search associated with the firm, where we assume in line with

Carlson/McAfee that the search cost distribution is uniform on an interval [*0,S*]. This leads to

$$(4.3') \qquad q_j = \frac{Q}{N} - \frac{Q}{j}\frac{w_j}{S} + \sum_{k=j+1}^{N}\left[\frac{Q}{k(k-1)}\frac{w_k}{S}\right]$$

Substituting equation (4.2) into (4.3') yields a demand equation in terms of the utilities associated with each firm *j* (see section 4.6.1. in Appendix 4.1. for the derivation):

$$(4.4) \qquad q_j = \frac{Q}{N}\left[1 - \frac{1}{S}\left(\overline{u} - u_j\right)\right],$$

where, as before, q_j depicts the number of consumers in firm *j*. The demand thus depends on the difference in utility derived from firm *j*'s offer and the market average utility derived from this plan. When the utility gained from firm *j*'s plan offer increases, firm *j*'s market demand rises, as

$$(4.5) \qquad \frac{\partial q_j}{\partial u_j} = \frac{Q}{N}\frac{1}{S}$$

Similarly, firm *j*'s demand also depends on the maximum search cost:

$$(4.6) \qquad \frac{\partial q_j}{\partial S} = \frac{Q}{N}\frac{1}{S^2}\left(\overline{u} - u_j\right)$$

Thus an increase in search cost leads to a loss in demand for firms with above average plan utility, and demand gains for firms with below average utility. Hence an upward shift in search costs will lead to a reduction in the variance in market shares, and as *S* approaches infinity each firm's market demand approaches the average market demand, *Q/N*. (In a situation where the maximum search cost approaches zero, the search cost distribution is degenerate and every consumer will buy at the firm(s) providing the largest utility, leading to the full information market outcome.) Note also that a reduction in firm *j*'s demand can be brought about by an increase in firms N as well as by an increase in the utility provided by any other firm, as this increases the average market utility.

We next turn to firm price setting decisions. Carlson and McAfee assume that firms differ in their (quadratic) cost functions:

$$c_j(q_j) = \alpha_j q_j + \beta q_j^2 = \alpha_j \left\{ \frac{1}{N}\left[1 - \frac{1}{S}(\bar{u} - u_j)\right]\right\} + \beta \left\{ \frac{1}{N}\left[1 - \frac{1}{S}(\bar{u} - u_j)\right]\right\}^2, \tag{4.7}$$

where they assume $\alpha_j \geq 0$ and $\beta \geq 0$ as conditions for profit maximization, and which are testable hypotheses in our model.[37] The profit function is

$$\Pi_j = p_j q_j - c_j(q_j) \tag{4.8}$$

and maximizing it with respect to price yields a system of N equations in N unknowns, which can be solved for each price p_j (see section 4.6.2. in Appendix 4.1. for the derivation).

$$p_j = \alpha_j + \frac{(1+\gamma)N}{N-1} S + \frac{(1+\gamma)N}{2N - 1 + \gamma N}(\bar{\alpha} - \alpha_j) - \frac{(1+\gamma)N}{2N - 1 + \gamma N} \lambda (\bar{X} - X_j), \tag{4.9}$$

where

$$\gamma = \frac{2\beta(N-1)}{SN^2}.$$

Since only α_j, and X_j vary across firms, variation in p_j is determined by firm-specific costs and other characteristics of the firm from which consumers derive utility.

---

[37] Note that the derivation in appendix A4.1. (section 4.6.3) shows that β is bounded from below by a values that could be less than zero. However, if β is estimated to be positive, firms will meet the profit maximization condition.

4.3. Data Specifications

We draw on two sources of data in the analyses. Once again, the main dataset is the data distributed by Weiss Ratings, Inc., where now only data from 1998 is considered. Our second dataset, from the National Association of Insurance Commissioners (NAIC), reports total premiums, claims, and covered lives for each plan letter offered by an insurance company in every state. In each year of NAIC data, the data are aggregated across policies issued during the previous three years. For example, the data for 1998 contain covered lives for policies issued by a particular firm in a given state in 1996, 1997 and 1998 combined. In order to match the NAIC data to the Weiss price data for 1998, we simply divide the three-year totals by three to obtain an estimate of the figures for 1998. This implicitly assumes that plans had the same influx of new policyholders in each of the three years.

We merge the NAIC and Weiss data with the goal of creating a dataset that contains price, quantity sold (covered lives), and production costs (claims) for each Medigap plan offered by a firm in every market. However, the two datasets are not strictly comparable and three issues arise when attempting to merge them. We give an overview of the major issues here, while section 4.7. in Appendix 4.2. describes the merge procedures in detail. First, as the NAIC data are available at the state level, we must aggregate up the Weiss data. As discussed earlier, we do not lose much information since insurers predominantly vary premiums across states, rather than within states.

Second, while the Weiss data list premiums by age, the NAIC data report covered lives for all ages combined. Because health status varies with age, we wish to avoid attributing prices offered to a relatively healthy group to the quantity purchased by a less healthy group (or vice versa). This concern is mitigated by the fact that most people who buy Medigap policies buy them when they turn 65 years old. Since those who bought policies at age 65 dominate total covered lives, age 65 premiums should be well matched to the market share averaged over all ages. One way of testing this assertion is to assess whether a firm's market share is likely to vary substantially by the policyholder's age. In our model, a firm's market share is uniquely determined by the utility it offers relative to the average utility offered by other firms in the market. If the relative utility offered does not vary with age, then the firm's market share for each age will equal its average market share over all ages. We can readily test whether this is the case when $\lambda = 0$ by computing relative premiums by policyholder age for each firm (using the Weiss data) in every market, and then computing a measure of the age-related variation in relative premiums for each firm (in every market). We find that relative premiums do not vary much by age: the average within-firm standard deviation of relative premiums as a percent of the market average premium is just 3.3 percent; in 75 percent of state-firm-plan letter-rating method observations the standard deviation over age groups is 4.6 percent or less, and in 90 percent the standard deviation over age groups is 7.1 percent or less. We conclude that since relative premiums do not vary much by age within firms, market shares are unlikely to vary much by age, and thus age 65 premiums are well matched to market shares that are averaged over all ages.

Finally, the NAIC data are comprehensive whereas the Weiss data are not. In merging the Weiss and NAIC data, we retain 91 percent of total covered lives represented in the NAIC data, consistent with the market coverage rate reported by Weiss for that time period. Table 4.1. compares firms in our merged subsample with the NAIC "universe." We retain 133 out of 186 firms found in the NAIC file (72 percent). The excluded firms are disproportionately inactive participants in the market or sell very few policies (and hence do not appear in the Weiss data). For example, the

Table 4.1.: Summary Statistics for Merged Sample and NAIC Universe

	Merged Weiss-NAIC Sample	**NAIC Universe**
Firms		
Number of Firms	133	186
Median Total Covered Lives	3,934	1,435
Median Total Premiums (in 1000)	$3,734	$1,753
Median Total Claims (in 1000)	$2,605	$1,236
Operates in Less Than 19 States	0.729	0.715
Operates in 19 to 44 States	0.24	0.199
Operates in More Than States	0.03	0.086
Loss Ratio > 1	0.038	0.108
Weiss Rating A	0.12	--
Weiss Rating B	0.436	--
Weiss Rating C	0.165	--
Weiss Rating D or Worse	0.157	--
No Weiss Rating	0.12	--
Policies		
Agent Solicited Policy	0.662	0.608
Direct Solicited Policy	0.346	0.328
Average Months Policy on Market	66.6	66.7
Fraction Of Covered Lives		
in Plan A	0.048	0.049
in Plan C	0.255	0.255
in Plan F	0.423	0.422
in All Other Plans	0.274	0.274
in Attained Age Plans	0.44	--
in Issue Age Plans	0.303	--
in Community Rated Plans	0.257	--

Table 4.1.: (continued)

Markets	Merged Weiss-NAIC Sample	NAIC Universe
Number of Markets	1216	--
Number of Firms per Market: Mean (Max)	5.5 (31.0)	--
Fraction of Markets with One Firm	0.385	--
Mean Number Plan Letters Offered by Firms in Market	6.6	--

Notes:
See Appendix 4.2. for merge details. Covered lives, premiums and claims are shown here as three-year totals over the period 1996-1998, as reported by NAIC.
Source: Authors' calculations using Weiss data, 1998, and NAIC data, 1998.

median firm in our subsample issued 3,934 new policies between 1996 and 1998, compared to 1,435 new policies in the NAIC file. The median firm in our subsample earned more than twice the premiums of the median firm in the NAIC file between 1996 and 1998 ($3.7 versus $1.8 million), and incurred more than twice the claims ($2.6 versus $1.2 million).

The Medigap market is populated by a few large firms that operate in almost every state, and a large number of small firms that operate in select states. For example, just three percent of firms operate in more than 44 states, but this three percent accounts for one third of all covered lives nationwide. Another one-third of covered lives are accounted for by the 24 percent of firms who operate in 19 to 44 states, and the last one-third of covered lives is accounted for by the 73 percent of firms that operate in fewer than 19 states. These distributions are similar in the NAIC file and our merged sample, although our merged sample does contain significantly fewer of the largest firms operating in more than 44 states (3 percent v. 8.6 percent). The data reveal substantial heterogeneity in the financial stability of firms selling Medigap policies. Only 12 percent of firms enjoy a Weiss financial safety rating of A- or better, about 44 percent receive a B+, B or B-, and 32 percent receive a C+ or lower. About 12 percent of firms in our sample are not rated by Weiss.

Turning to characteristics of the policies themselves, about 62 percent of all Medigap policies are agent solicited in our merged sample, which compares to about 61 percent in the NAIC file. About one-third are sold directly by the insurance company in both our merged sample and the NAIC file. The average policy has been on the market for about 67 months in both files. The distribution of policyholders over plan letters is similar in both our merged sample and the NAIC file, with the average firm enrolling approximately five percent of policyholders in Plan A, about 25 percent in Plan C, and 42 percent in Plan F. The remaining seven standardized plan letters enroll just 27 percent of policyholders. About 44 percent of policyholders are in Attained Age plans, 30 percent are in Issued Age plans, and 26 percent are in Community Rated plans.

Finally, our merged sample contains 1,216 markets nationwide, where markets are defined by state-plan letter-rating method combinations. The average number of firms per market is 5.5 and the largest market has 31 firms. In 38.5 percent of markets only one firm operates; these tend to be Community Rated markets for less popular plan letters.

4.4. Empirical Analyses

4.4.1. Analysis of Firm Costs

Before attempting to directly estimate search costs in the Medigap market, we begin by assessing whether our data support the main empirical predictions of the

Carlson-MacAfee model. In this section, we estimate the cost equation presented in (4.7), and test whether the profit-maximizing conditions, $\alpha_j \geq 0$ and $\beta \geq 0,$ hold. Our measure of firm costs is the dollar amount of claims incurred by the insurance firm. While claims are just one component of costs, they are the major variable cost that firms face, and they vary across markets. We exclude from our estimation sample firms with fewer than 30 policyholders in any market because these firms could be subject to extreme values in their claims. For firms with more policyholders, these extreme claims will average out as the number of covered lives increases. We use covered lives as our measure of quantity.

Ideally, we would like to estimate the cost equation separately for each market, but this is not possible given the relatively small number of firms operating in each of our markets. Instead, we estimate the cost equation using 2,357 firm-state-plan-rating observations, where we control for market characteristics by including state-plan letter-rating method effects:

$$(4.7') \qquad c_{jspr} = \alpha_j q_{jspr} + \beta q_{jspr}^2 + \sigma_{spr} + \nu_{jspr} \quad ,$$

where the *jspr* subscript refers to firm *j* in state *s* selling plan letter *p* under rating method *r.* Identification of the firm-specific first order effects (α_j) comes from variation within a firm over the different *spr* markets it operates in. We allow the stochastic error term, υ_{jspr}, to be clustered by firm.

Table 4.2. shows our estimation results for two specifications, the first without market fixed effects (column 1) and the second with market fixed effects (column 2). The first row of Table 4.2. gives the average of the 114 estimated firm-specific first order effects (α_j,), which is \$712 in the model without market fixed effects, and \$663 in the model with market effects. There is substantial variation in the estimated firm effects; for example, the implied coefficient of variation in column 2 is 0.63.

Table 4.2.: Estimation of Cost Equation (4.7')

	(1)	(2)
Mean(α_j)	\$712	\$663
Standard Deviation (α_j)	\$245	\$420
Percent of $\alpha_j > 0$	100	98.8
β	0.005	0.006
	(0.007)	(0.005)
Market FE (σ_m)	no	yes
Observations	2357	2357
R-squared	0.963	0.987

Notes:
Dependent variable is claims incurred by firm *j* operating in market *m*. Estimation sample excludes firm-market pairs with fewer than 30 covered lives. Robust standard errors (clustered by firm) in parentheses. The α_j are the coefficients on covered lives and β is the coefficient on the square of covered lives.
Source: Authors' calculations using Weiss Ratings data, 1998, and NAIC data, 1998.

Consistent with our theoretical model, virtually all of the α_j's are positive, and for each with a point estimate less than zero, the hypothesis that $\alpha_j \geq 0$ cannot be rejected. In both specifications, the second order effect β is not statistically different from zero, which implies constant returns to scale. Under constant returns to scale, our estimates of α_j can be interpreted as marginal costs (and average costs); thus each new policyholder costs the average firm an additional \$663 per year in claims. Not surprisingly, the model explains almost all the variation in claims within markets. Consistent with the Carlson-McAfee model, the firms in our data appear to be profit maximizers.

4.4.2. Analysis of Firm Price-Setting Behavior

Having established that that there is significant variation in marginal costs across firms, we next turn to the second key prediction of the Carlson-McAfee model: that variation in firm marginal costs, α_j, leads to variation in prices, p_j, as described in equation (4.9). We implement equation (4.9) as follows:

$$(4.9') \qquad p_{jspr} = b + \kappa \left(\frac{c}{q} \right)_{jspr} + \phi \left(\overline{\frac{c}{q}} \right)_{spr} + \varphi \left(X_{jspr} - \overline{X}_{spr} \right) + \mu_{jspr}$$

The first difference between our implementation and the original equation (4.9) is that we use firm j's average claims (c/q) as a proxy for α_j. In the previous section, we obtained estimates of α_j , but because these parameters were identified using within-firm variation over markets, they do not themselves vary across markets. Since firms price differently in different markets, the best measure of firm j's marginal costs should also vary across markets. Moreover, we found in the previous section that average costs are approximately equal to marginal costs since $\beta \approx 0$. In equation (4.9), firm marginal costs enter twice; once in levels and again in deviations from the market mean. In (4.9'), we combine the two terms in levels, which from equation (4.9) implies that $\kappa = 1 - \phi$, where $\kappa > 0$ and $\phi > 0$. We do not impose this restriction, but test whether it holds.

Equation (4.9) also lets other firm characteristics $\left(X_{jspr} - \overline{X}_{spr} \right)$ affect prices in mean-deviated form—characteristics that may in fact differentiate seemingly homogeneous products. In (4.9'), we let X_{jspr} be a vector containing the following variables: a set of indicator variables measuring firm j's Weiss financial safety rating, (a measure of financial stability); indicators for whether firm j sells Medigap policies in fewer than 19 or more than 44 states, respectively (to capture name recognition and national presence); the total number of plan letters firm j offers in the market (a measure of both market presence and the availability of close substitutes); an indicator for whether the firm has a loss ratio greater than one for plan letter p (to control for loss leader pricing); indicators for whether plan letter p is sold by insurance agents or directly by the insurance company (a measure of firm advertising methods); and the number of months the policy has been on the market (a measure of market exposure).

Equation (4.9') includes a constant term, b, such that $b = [N/(N-1)](1+\gamma)S$ in equation (4.9), where $\gamma = 2\beta(N-1)/SN^2$. From our estimation of the cost equation, we found $\beta \approx 0$, which implies $\gamma \approx 0$, and thus that $b \approx [N/N-1]S$; in other words, our estimate of b should be slightly greater than the maximum search cost estimated over all markets nationwide. The last term, μ_{jspr}, is a stochastic error term, which is clustered by firm.

Table 4.3. presents estimation results for equation (4.9'). In the first column, we show results for our base specification which includes just the cost terms and omits the product differentiation terms $\left(X_{jspr} - \overline{X}_{spr}\right)$. We estimate κ=0.139 and ϕ=0.484, both of which are statistically significant. Our estimate of ϕ implies that prices are higher in markets with higher average costs—for each dollar increase in market average costs, premiums rise by 48 cents. Holding constant market average costs, our estimate of κ suggests that firm premiums rise by about 14 cents for every one-dollar increase in firm costs that is above the market average. Although these results are generally consistent with the Carlson-McAfee model, our data reject the specific hypothesis that $\kappa = 1 - \phi$. The constant in our model gives an estimate of b=\$588, which as noted above should be slightly (i.e. by *N/[N-1]*) higher than our estimated maximum search cost. As we will show in Table 4.4., the maximum search cost estimated over all markets is quite a bit lower (\$430), but because the maximum search cost varies by market, \$588 is not so large as to be completely implausible.

Table 4.3.: Estimation of Price Equation (4.9')

	Price in Levels		Price Mean Deviated	
	(1)	(2)	(3)	(4)
Firm Claims ***(κ)***	0.139	0.138	0.139	0.137
	(0.053)	(0.056)	(0.008)	(0.008)
Market Average Claims ***(ϕ)***	0.484	0.488		
	(0.075)	(0.074)		
Weiss Rating A		28.3		26.2
		(73.2)		(13.1)
Weiss Rating B		31.9		30.4
		(64.2)		(10.3)
Weiss Rating C		20.6		20.0
		(64.1)		(12.1)
No Weiss Rating		-56.2		-58.2
		(71.7)		(12.7)
Operates in Less Than 19 States		-31.8		-29.7
		(37.6)		(9.5)
Operates in More Than 44 States		78.5		78.5
		(56.7)		(9.9)
Number Plan Letters Offered		1.9		1.7
		(7.9)		(1.7)
Loss Ratio >1		-61.5		-61.9
		(54.4)		(16.1)
Agent Solicited Policy		21.2		16.3
		(40.4)		(10.4)
Direct Solicited Policy		-13.5		-17.4
		(49.9)		(12.7)
Months Policy on Market		0.738		0.745
		(0.424)		(0.141)

Table 4.3.: (continued)

	Price in Levels		Price Mean Deviated	
	(1)	(2)	(3)	(4)
Constant ***(b)***	588 (45)	586 (41)		
Observations	2357	2327	2357	2327
R-squared	0.392	0.414	0.106	0.207

Notes:
Specifications based on equation (4.9') in the text. Dependent variable is the premium charged to 65-year-old female nonsmokers, entered in levels in columns (1) and (2) , and in deviations from the market mean premium in columns (3) and (4). All *X* variables entered as deviations from market mean. Sample includes firms that insure at least 30 individuals in any given market. Reference group for financial ratings is "Weiss Rating D or Worse", and for states of operation, "Operates in 9 to 44 States". Robust standard errors (clustered on a firm level) are in parentheses.
Source: Authors' calculations using Weiss Ratings data, 1998, and NAIC data, 1998.

Column 2 adds the mean-deviated product differentiation terms to our base specification. Our estimates of κ, ϕ, and b are largely unchanged. None of the product differentiation terms are estimated precisely enough as to be statistically significant, and judging by the very small increase in the R-squared, they contribute little additional explanatory power.

In column 3, we estimate a slightly different version of (4.9') where we fully mean the dependent variable as well as the independent variables. Although it can be shown that this equation is theoretically equivalent to (4.9'), it confers an econometric advantage of controlling for market fixed effects. A disadvantage is that we cannot recover estimates of ϕ and b. Our estimate of κ is unchanged in this fully mean-deviated specification. The point estimates on the product differentiation terms do not change much, but they are now much more precisely estimated. Firms with A, B, or C financial safety ratings charge \$20-30 more than firms rated D or below, and unrated firms charge about $58 less than these firms. Prices are also higher at firms with greater national presence and name recognition. For example, firms operating in more than 44 states charge $79 more than firms operating in 19 to 44 states and about $110 more than firms operating in fewer than 19 states. The number of plan letters sold by a given firm does not affect prices. Firms operating in a given market with losses charge about $61 less. Although this does not confirm the existence of loss leader pricing, it is consistent with its use by some firms. Solicitation method, whether by agents or direct from the firm, is largely unrelated to price, and policies that have been on the market longer are more expensive. Overall, the product differentiation terms contribute as much explanatory power in the fully mean deviated model as do marginal costs themselves, underscoring the importance of controlling for product differentiation when estimating search costs based on observed price variation.

In sum, our analyses of the cost and price-setting equations establish that the firms in the Medigap market largely behave as predicted by our augmented Carlson-McAfee model. Insurance firms are profit maximizers with varying marginal costs, which contribute to variation in prices. We next turn to the question of why price variation is sustained in the market.

4.4.3. Analysis of Demand

The starting point for our demand analysis is equation (4.4). Dividing both sides of (4.4) by Q_{spr}/N_{spr}, where Q_{spr} is total covered lives in market *spr*, and adding a stochastic error term μ_{jspr}, yields our empirical specification of the demand equation:

$$\text{(4.4')} \quad \frac{q_{jspr}}{Q_{spr}/N_{spr}} = 1 - \frac{1}{S}\left(p_{jspr} - \overline{p}_{spr}\right) + \frac{\lambda}{S}\left(X_{jspr} - \overline{X}_{spr}\right) + \mu_{jspr}$$

Once again, X_{jspr} is a vector containing our measures of product differentiation. We estimate (4.4') using a tobit procedure, since approximately 24 percent of firms in our data report zero covered lives. We exclude markets in which only one firm operates (since there is no price variation), and once again we allow μ_{jspr} to be clustered by firm. Because all regressors are mean-deviated, identification comes from variation within markets. Note that because the mean of our dependent variable is 1, this specification is equivalent to a fully mean-deviated model.

Table 4.4. presents our estimation results. The first column shows the estimated coefficients and column 2 gives the implied estimates of the maximum search cost S (row 1) and of the elements in the λ vector (all other rows). In the first row of column 1, we see that firms with above-average prices experience lower demand. Firms with a financial safety rating of A experience notably higher demand, but, surprisingly, so do firms unrated firms. Demand is greatest at firms operating with the most national presence, i.e., those operating in more than 44 states. Firms selling plans with a loss ratio>1 experience notably higher demand, even controlling for price. Demand is slightly statistically higher with agent solicitation, whereas direct solicitation and the number of months a policy has been on the market does not appreciably affect demand.

Column 2 in Table 4.4. shows our implied estimates of the parameters S and λ. Standard errors are obtained using a bootstrap procedure on the model in column1.[38] The first row depicts the estimated maximum search cost, S, which is the inverse of the coefficient in column 1 multiplied by -1. The implied maximum search cost in the Medigap market is substantial, estimated to be \$430. Under the assumption that search

[38] The standard error for the first row is obtained by the delta method. For the bootstrap, we apply Andrews and Buchinsky's (2000) method to find an optimal number of repetitions. We require the standard errors to be at most 5 percent different from a bootstrap with infinite replications with a probability of at least 99 percent. This requires 1943 repetitions.

Table 4.4.: Estimation of Demand Equation (4.4')

	(1)	(2)[1)]
Price	-0.0023***	430***
	(0.0004)	(70)
Weiss Rating A	2.1484***	925***
	(0.5150)	(277)
Weiss Rating B	0.3632	156
	(0.3391)	(171)
Weiss Rating C	0.8215**	353*
	(0.3482)	(184)
No Weiss Rating	1.3038**	561*
	(0.5525)	(320)
Operates in Less Than 19 States	-1.7223***	-741**
	(0.6390)	(346)
Operates in At Least 19 But Less Than 45 States	-2.5284***	-1088***
	(0.5403)	(340)
Number Plan Letters Offered	-0.1207*	-52
	(0.0629)	(33)
Loss Ratio >1	1.9675***	847***
	(0.4258)	(255)
Agent Solicited Policy	0.9872*	425
	(0.5066)	(285)
Direct Solicited Policy	0.6535	281
	(0.5867)	(302)
Months Policy on Market	0.0092	3.95
	(0.0056)	(2.66)

Table 4.4.: (continued)

	(1)	**(2)**[1)]
χ^2 (added)	78.64	
P(added)=0	0.00	
LL Ratio	0.930	

Notes:

Econometric model is a tobit model. All regressors enter ed in mean-deviated form. The χ^2 statistic refers to the addition of all variables other than price. "LL Ratio" is the ratio of the log-likelihood of this tobit model and a model without any independent variables. Reference group for financial rating is "Weiss Rating D or Worse", and for states of operation is "Operates in More Than 44 States."

1) Column (2) shows the implied estimates of S (row 1) and λ (all other rows) in equation (4.4'). The entry in row 1 is obtained by inverting the coefficient in column (1) and multiplying by –1. In all other rows, the entry is obtained by dividing the corresponding coefficient in column (1) by the coefficient on price in column (1) ($-1/S$). The standard errors in column 2 (except for the first value) are obtained using bootstrapping with 1943 replications on the full sample. The standard error for the first value is obtained by the delta method.

Robust standard errors (clustered by firm) are in parentheses.

*, **, ***: significant on a 10, 5, and 1% level, respectively.

Source: Authors' calculations using Weiss Ratings data, 1998, and NAIC data, 1998.

costs are uniformly distributed, dividing by 2 yields an average search cost of \$215. The remaining quantities in column 2 represent the λ-coefficients from the original utility specification in equation (1). They may be interpreted as the marginal utility (in monetary terms) of other firm characteristics. For example, the estimates imply that a financial safety rating of A is worth \$925 to consumers, and a loss ratio >1 is worth \$847. It is not clear what this latter value actually measures, since it is unlikely that many consumers undertake to compute loss ratios for insurance firms.

Table 4.5.: Implied Maximum Search Cost *S* by Plan and Rating Method

	Estimated Coefficient on Price	Implied Maximum Search Cost	N	LL Ratio
Plan A	-0.0016	636	1085	0.900
	(0.0011)	(436)		
Plan B	-0.0023**	430**	723	0.882
	(0.0010)	(189)		
Plan C	-0.0029***	341***	1066	0.949
	(0.0008)	(88)		
Plan D	-0.0037***	271***	432	0.820
	(0.0013)	(92)		
Plan E	-0.0034**	295**	201	0.810
	(0.0015)	(133)		
Plan F	-0.0024***	409***	1118	0.946
	(0.0006)	(99)		
Plan G	-0.0053***	187***	509	0.812
	(0.0009)	(32)		
Plan H	-0.0015**	680**	112	0.819
	(0.0006)	(297)		
Plan I	-0.0017***	583***	303	0.848
	(0.0003)	(115)		
Plans J	-0.0008	1210	175	0.831
	(0.0005)	(773)		

Table 4.5.: (continued)

	Estimated Coefficient on Price	Implied Maximum Search Cost	N	LL Ratio
Attained Age	-0.0028***	360***	3468	0.932
	(0.0005)	(69)		
Issued Age	-0.0020***	502***	1852	0.899
	(0.0005)	(113)		
Community Rating	-0.0010***	972***	404	0.881
	(0.0004)	(335)		
All	-0.0023***	430***	5724	0.922
	(0.0004)	(70)		

Notes:

Each row gives the price coefficient from a tobit model estimated on the indicated subsample, using the same specification as in Table 7. The implied maximum search cost figures are obtained by multiplying the inverse price coefficient by (-1), following equation (4'). The standard errors follow by the delta method. "LL Ratio" is the ratio of the log-likelihood of this tobit model and a model without any independent variables. Regressions include Weiss Rating indicators, whether the firm operates in less then nine or more than 44 markets, respectively, whether the plan is agent solicited, and which plans this firm offers in this state other than the one in the current state-plan-rating cell.

Robust standard errors (on a firm level) are in parentheses.

*, **, ***: significant on a 10, 5, and 1percent level, respectively.

Source: Authors' calculations using Weiss Ratings data, 1998, and NAIC data, 1998.

Using the same specification in Table 4.4., we next estimate equation (4.4') separately by plan and by rating method to see whether and how search costs might vary across different parts of the market. Shown in Table 4.5. are the estimated price coefficients (column 1) and the implied maximum search costs (column 2). The (statistically significant) estimates range from $187 (Plan G) to $680 (plan H). There are significant differences in search costs across the plans, although they occur without any discernable pattern. There are also differences in maximum search costs across the three rating methods with the highest estimated maximum search costs arising in the markets for Community Rated policies. As noted before, over all markets we obtain a maximum search cost of $430, and an average search cost of $215.

4.4.4. Discussion

Compared to studies of other markets, our estimated search costs are high. For example, using a similarly specified model, Dahlby and West (1986) found average search costs to be between $28 to $125 in the market for auto insurance. Horceçsu and Syverson (2004) found that search costs ranged between $5 and $30 for every $10,000 of assets invested in the mutual fund market. It is less straightforward to compare our results to the results in Hortaçsu and Syverson since they assume firms are found by consumers with unequal probabilities, whereas we assume that each firm is found with the same probability, *1/N*. On the other hand, Hortaçsu and Syverson do not have product differentiation variables in their data, whereas we are able to take into account terms like the market presence and the financial rating of the firm. These will at least to some extent account for differences in the probabilities of finding a given firm, and also appear to have a significant influence on demand.

To further judge the plausibility of our estimates, we use our model to quantify the fraction of consumers in the market who buy at the highest price and the fraction who search until they find the lowest price. Using the estimated parameters of equation (4.4'), we can estimate the set of expected utility gains from searching in each market (the w_j's in equation (4.2)), and then quantify the fractions of insured individuals that are associated with each expected utility gain. In other words, we can specify the W_j's in Figure 4.1 for each of the 830 markets and consider their distribution (taking into account the covariates specified above).

To understand our presentation of these results in Figure 4.2, it is useful to first consider what we would expect in the extreme. First, imagine a setting in which 99 percent of the individuals in each market search until they find the plan yielding the highest utility. Thus the fraction buying from Firm 1 (W_1) is 0.99 in each market, and a cumulative density of W_1 will be zero until the 99th percentile and then one afterwards. In the opposite scenario, where 99 percent face search costs such that they buy from the firm yielding the lowest utility (firm N), the cumulative density of W_N will take the same shape. Figure 4.2 graphs the cumulative densities for W_1 and W_N, as calculated over all markets we observe. The y-axis gives the cumulative density and the x-axis is the fraction in the market buying the plan with the highest utility (W_1) or lowest utility (W_N), as the case may be. Comparing the extremes discussed before to the lines plotted in Figure 4.2 gives some insight about the information deficits and the extent of search in the Medigap market. The cumulative distribution function for W_N indicates that in two thirds of all markets, the fraction of people potentially buying the worst plan is 11 percent or less. However, as the distribution for W_1 shows, in two thirds of all markets only 11 percent or less search until they find the plan yielding the highest utility. So while some information flow seems to be present and most individuals search somewhat, very few search until they find the lowest price in the market; large parts of the Medigap population face search costs that are high enough to prevent them from searching until they find the plan with the lowest price.

That search costs would be higher in the Medigap market than in other markets is not implausible, especially given the relatively advanced age of the consumer population buying Medigap plans, and the potential for age-related cognitive decline

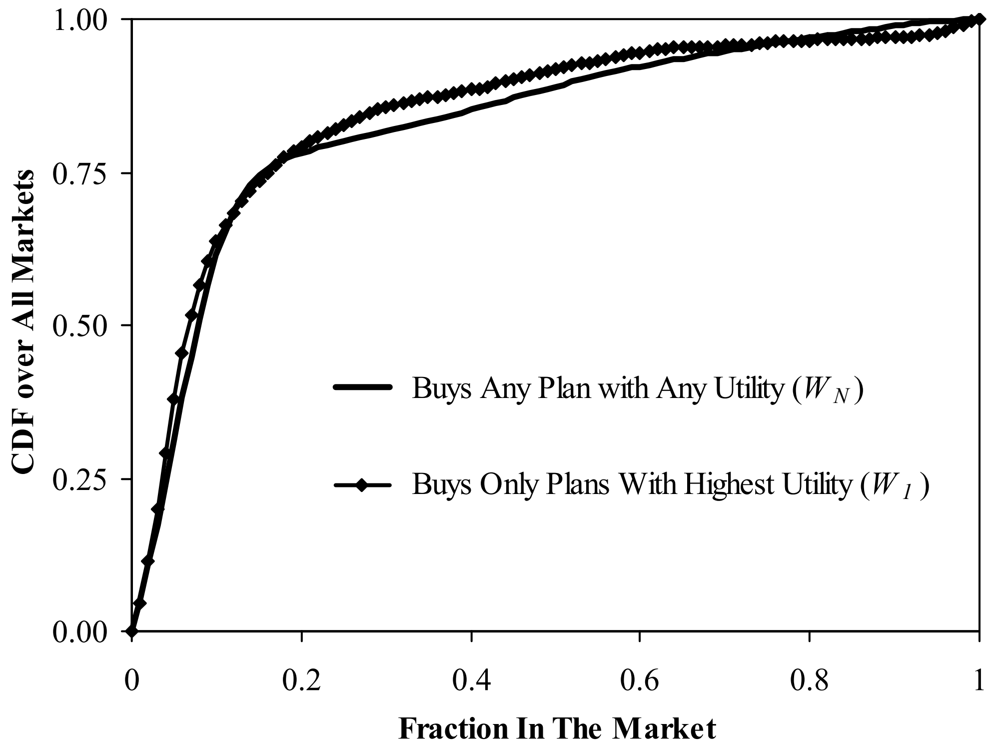


Figure 4.2: Cumulative Distribution of W_1 and W_N over all Markets

among many of them. Even in the absence of cognitive decline, the Medigap market is quite complicated, and its relationship with the equally complicated Medicare program could be challenging for some to understand. It could also be difficult to understand one's specific needs for supplemental insurance coverage without having had much practical experience with Medicare's coinsurance requirements. Furthermore, no individual has any familiarity with the Medigap market prior to turning age 65, and neither do one's adult children, should their assistance be sought. Individuals have a relatively short window of time during which to search for and select a Medigap policy, and the one-shot nature of the market means that learning does not occur with successive purchases, and mistakes are not easily reversible. Our results seem plausible given the complex nature of the market and its elderly consumer population.

4.5. Conclusion

In this chapter we investigate why substantial price variation is sustained in the market for supplemental health insurance for the elderly. We show that a model allowing for information deficiencies on the consumer side cannot be rejected. This can be taken as evidence that a key assumption of a competitive market is violated in this market: consumers are not fully informed when entering the market.

Using price data from Weiss Ratings and demand data from the National Association of Insurance Commissioners, we analyze the Medigap market in 1998. As a framework for understanding the price variation, we consider a theoretical model by Carlson and McAfee (1983), which we augment to account for product differentiation. We conclude that firms in this market behave according to the assumptions of the C-M model. They are profit maximizers who have different cost structures; their different cost structures contribute to price differences that are sustained by the presence of significant consumer search costs. We estimate average search costs to be about $215. Our estimates imply that while relatively few individuals buy the highest priced policy, equally few find the policy with the lowest price (i.e. yielding the highest utility).

Even in 2006, it can be a relatively time-intensive activity to collect price information from different Medigap insurers. Certainly more information is available over the internet than ever before, however, insurers do not usually post their rates online, and while some state insurance websites list Medigap insurers, they do not also list prices. Finding the lowest price requires calls to many different insurers.

Moreover, it is uncertain whether the elderly experience large information gains from technology improvements like the internet.

Our results suggest that consumer welfare could be substantially improved if individuals had complete knowledge of the price distribution in the market. An important step in this direction is the "Weiss Ratings Shopper's Guide to Medicare Supplemental Insurance," which is a customized report listing prices for all Medigap policies offered in a consumer's zip code (given age and gender) by rating method and Weiss' financial safety rating. The report is available for $49 and can be ordered by telephone or via the internet.[39] Compared to the average cost of search in the market, the Weiss report is a bargain. Increasing consumer's knowledge of this resource or developing a similar free resource would go a long way toward enhancing information in the market and improving welfare. As policymakers move toward granting the elderly greater choice in insurer selection and benefit provision in other areas of the Medicare program, such as the new Medicare prescription drug benefit, the issue of information availability and search costs become very salient in assessing consumer welfare under the new policies.

[39] Weiss Ratings Inc distributes information regarding the Medigap market on the Internet. Specifically, based on their age and the state they live in, consumers can obtain premiums, rating method, and Weiss' financial rating for each company and all plans offered in the state and age group. As of March, 2006, this information costs $49, see http://www.weissratings.com/Products/sen_rep.asp.

4.6. Appendix 4.1.: Formulas

4.6.1. Demand Equation

$$(4) \qquad q_j = \frac{Q}{N}\left[1 - \frac{1}{S}\left(\overline{u} - u_j\right)\right]$$

First, we use equation (2),

$$(2) \qquad w_k = \sum_{i=1}^{k-1} \frac{1}{N}\left(u_i - u_k\right) = \frac{1}{N}\sum_{i=1}^{k-1} u_i - \frac{k-1}{N} u_k$$

and substitute the w_k's in equation (3'):

$$(3') \qquad q_j = \frac{Q}{N} - \frac{Q}{j}\frac{w_j}{S} + \sum_{k=j+1}^{N}\left[\frac{Q}{k(k-1)}\frac{w_k}{S}\right]$$

Then the following terms within this equation are obtained:

$$(10) \qquad \begin{aligned} \frac{Q}{j}\frac{w_j}{S} &= \frac{Q}{jS}\left[\frac{1}{N}\sum_{i=1}^{j-1} u_i - \frac{j-1}{N} u_j\right] \\ &= \frac{1}{S}\frac{Q}{N}\left[\frac{1}{j}\sum_{i=1}^{j-1} u_i - \frac{j-1}{j} u_j\right] \end{aligned}$$

and

$$(11) \qquad \begin{aligned} \sum_{k=j+1}^{N}\left[\frac{Q}{k(k-1)}\frac{w_k}{S}\right] &= \frac{1}{S}\sum_{k=j+1}^{N}\left[\frac{Q}{k(k-1)}\left(\frac{1}{N}\sum_{i=1}^{k-1} u_i - \frac{k-1}{N} u_k\right)\right] \\ &= \frac{1}{S}\frac{Q}{N}\sum_{k=j+1}^{N}\left[\frac{1}{k(k-1)}\left(\sum_{i=1}^{k-1} u_i - (k-1) u_k\right)\right] \end{aligned}$$

To obtain equation (4), we use (10) and (11) and evaluate for each q_j, starting with q_N:

$$q_N = \frac{Q}{N}\frac{1}{S}\left[S - \left(\frac{1}{N}\left(u_1 + u_2 + \ldots + u_{N-1}\right) - \frac{(N-1)}{N}u_N\right) + 0\right]$$

(12) $$= \frac{Q}{N}\frac{1}{S}\left[S - \left(\frac{1}{N}\left(\sum_{i=1}^{N} u_i - u_N\right) - \frac{(N-1)}{N}u_N\right)\right]$$

$$= \frac{Q}{N}\frac{1}{S}\left[S - \left(\overline{u}_N - u_N\right)\right] = \frac{Q}{N}\left[1 - \frac{1}{S}\left(\overline{u} - u_N\right)\right]$$

For q_{N-1} we get:

$$q_{N-1} = \frac{Q}{N}\frac{1}{S}\left[S - \left(\frac{1}{N-1}\left(u_1 + \ldots + u_{N-2}\right) - \frac{N-2}{N-1}u_{N-1}\right)\right.$$

$$\left. + \left(\frac{1}{N(N-1)}\right)\left[\left(u_1 + \ldots + u_{N-1}\right) - (N-1)u_N\right]\right]$$

$$= \frac{Q}{N}\frac{1}{S}\left[S - \left(\frac{1}{N-1}\left(\sum_{i=1}^{N} u_i - u_{N-1} - u_N\right) - \frac{N-2}{N-1}u_{N-1}\right)\right.$$

$$\left. + \left(\frac{1}{N(N-1)}\right)\left[\sum_{i=1}^{N} u_i - u_N - (N-1)u_N\right]\right]$$

$$= \frac{Q}{N}\frac{1}{S}\left[S - \frac{1}{N-1}\left(\sum_{i=1}^{N} u_i - u_{N-1} - u_N - (N-2)u_{N-1} - \frac{1}{N}\sum_{i=1}^{N} u_i + \frac{1}{N}u_N + \frac{N-1}{N}u_N\right)\right]$$

$$= \frac{Q}{N}\frac{1}{S}\left[S - \frac{1}{N-1}\left(N\overline{u} - \overline{u} - (N-1)u_{N-1} - u_N + u_N\right)\right]$$

$$= \frac{Q}{N}\frac{1}{S}\left[S - \left(\overline{u} - u_{N-1}\right)\right] = \frac{Q}{N}\left[1 - \frac{1}{S}\left(\overline{u} - u_{N-1}\right)\right]$$

Repeating this process for each firm j leads to the demand equation (4).

4.6.2. Price Equation

The price equation (9) follows from maximizing equation (8)

(8) $\Pi_j = p_j q_j - c_j(q_j)$

with respect to price, after substituting in the cost equation, (7):

(7) $c_j(q_j) = \alpha_j q_j + \beta q_j^2 = \alpha_j \left\{ \frac{1}{N}\left[1 - \frac{1}{S}(\overline{u} - u_j)\right]\right\} + \beta \left\{ \frac{1}{N}\left[1 - \frac{1}{S}(\overline{u} - u_j)\right]\right\}^2$

Note that from equation (4) and equation (1),

(13) $\frac{\partial q_j}{\partial p_j} = -\frac{N-1}{SN^2}$

Then we obtain the following derivative with respect to (the firm's own) price:

$$\frac{\partial \Pi_j}{\partial p_j} : q_j + p_j \frac{\partial q_j}{\partial p_j} - \alpha_j \frac{\partial q_j}{\partial p_j} - 2\beta q_j \frac{\partial q_j}{\partial p_j}$$

(14)
$$= \frac{1}{N} + \frac{2\beta}{N}\frac{N-1}{SN^2} + \alpha_j \frac{N-1}{SN^2} + \frac{1}{SN^2}\sum_{i \neq j} p_i + \frac{2\beta}{SN^2}\frac{N-1}{SN^2}\sum_{i \neq j} p_i$$

$$-\frac{1}{SN}\lambda(X_j - \overline{X}) - \frac{2\beta}{SN}\frac{N-1}{SN^2}\lambda(X_j - \overline{X})$$

$$-\frac{1}{SN}p_j + \frac{1}{SN^2}p_j - \frac{N-1}{SN^2}p_j - \frac{2\beta}{SN}\frac{N-1}{SN^2}p_j + \frac{2\beta}{SN^2}\frac{N-1}{SN^2}p_j \equiv 0$$

This can be simplified into the following expression:

(15) $p_j[(2+\gamma)(N-1)] = (1+\gamma)N[S - \lambda(X_j - \overline{X})] + \alpha_j(N-1) + (1+\gamma)\sum_{i \neq j} p_i$ or

(16) $p_j = \frac{1+\gamma}{2+\gamma}\frac{1}{N-1}\sum_{i \neq j} p_i + \frac{1}{2+\gamma}\alpha_j + \frac{1+\gamma}{2+\gamma}\frac{N}{N-1}S - \frac{1+\gamma}{2+\gamma}\frac{N}{N-1}\lambda(\overline{X} - X_j)$, where

$\gamma = \frac{2\beta(N-1)}{SN^2}$

Since the solution is algebraically complicated, we now show with an example of three firms, that the solution presented in equation (9) is correct. For $N=3$, there are three equations (16) in three unknowns, which can be solved by substituting in.

$$(16_1)\quad p_1 = \frac{1+\gamma}{2+\gamma}\frac{1}{N-1}(p_2+p_3)+\frac{1}{2+\gamma}\alpha_1+\frac{1+\gamma}{2+\gamma}\frac{N}{N-1}S-\frac{1+\gamma}{2+\gamma}\frac{N}{N-1}\lambda(\bar{X}-X_1)$$

$$(16_2)\quad p_2 = \frac{1+\gamma}{2+\gamma}\frac{1}{N-1}(p_1+p_3)+\frac{1}{2+\gamma}\alpha_2+\frac{1+\gamma}{2+\gamma}\frac{N}{N-1}S-\frac{1+\gamma}{2+\gamma}\frac{N}{N-1}\lambda(\bar{X}-X_2)$$

$$(16_3)\quad p_3 = \frac{1+\gamma}{2+\gamma}\frac{1}{N-1}(p_1+p_2)+\frac{1}{2+\gamma}\alpha_3+\frac{1+\gamma}{2+\gamma}\frac{N}{N-1}S-\frac{1+\gamma}{2+\gamma}\frac{N}{N-1}\lambda(\bar{X}-X_3)$$

Substituting (16_3) into (16_2) and solving for p_2 yields a function in terms of p_1:

$$(16_2')\quad p_2 = \frac{(1+\gamma)}{(3+\gamma)}p_1+\frac{(1+\gamma)}{(3+\gamma)}3S-\frac{(1+\gamma)(2+\gamma)}{(5+3\gamma)(3+\gamma)}6(\bar{X}-X_2)-\frac{(1+\gamma)^2}{(5+3\gamma)(3+\gamma)}3(\bar{X}-X_3)$$
$$+\frac{4\alpha_2(2+\gamma)}{(5+3\gamma)(3+\gamma)}+\frac{2\alpha_3(1+\gamma)}{(5+3\gamma)(3+\gamma)}$$

Plugging (16_2') back into (16_3) yields a similar formula for p_3:

$$(16_3')\quad p_3 = \frac{(1+\gamma)}{(3+\gamma)}p_1+\frac{(1+\gamma)}{(3+\gamma)}3S-\frac{(1+\gamma)(2+\gamma)}{(5+3\gamma)(3+\gamma)}6(\bar{X}-X_3)-\frac{(1+\gamma)^2}{(5+3\gamma)(3+\gamma)}3(\bar{X}-X_2)$$
$$+\frac{4\alpha_3(2+\gamma)}{(5+3\gamma)(3+\gamma)}+\frac{2\alpha_2(1+\gamma)}{(5+3\gamma)(3+\gamma)}$$

Then, using (16_2') and (16_3') in (16_1), we obtain the formula for p_1:

$$(16_1')\quad p_1 = \frac{3}{2}\frac{(1+\gamma)(5+3\gamma)}{(5+3\gamma)}S+\frac{1}{2}\frac{(2+2\gamma)}{(5+3\gamma)}(\alpha_1+\alpha_2+\alpha_3)+\frac{1}{2}\frac{2\alpha_1}{(5+3\gamma)}$$
$$-\frac{1}{2}\frac{3(1+\gamma)^2}{(5+3\gamma)}\left[\lambda(3\bar{X}-X_1-X_2-X_3)\right]-\frac{1}{2}\frac{6(1+\gamma)}{(5+3\gamma)}\lambda(\bar{X}-X_1)$$

Note that $(3\bar{X}-X_1-X_2-X_3)=0$; then after some rearranging of the a_1 terms, (16_1') simplifies to:

$$(16_1'') \quad p_1 = \alpha_1 + \frac{3}{2}(1+\gamma)S + \frac{(1+\gamma)}{(5+3\gamma)}3(\overline{\alpha} - \alpha_1) - \frac{(1+\gamma)}{(5+3\gamma)}3\lambda(\overline{X} - X_1) \quad ,$$

which is exactly what was proposed in equation (9) if *N=3*.

4.6.3. Profit Maximization

For firms to be profit maximizing, the second derivative has to be negative:

$$(17) \quad \begin{aligned} \frac{\partial^2 \Pi_j}{\partial p_j^2} &= -\frac{1}{SN} + \frac{1}{SN^2} - \frac{N-1}{SN^2} - \frac{2\beta}{SN}\frac{(N-1)}{SN^2} + \frac{2\beta}{SN^2}\frac{(N-1)}{SN^2} \\ &= -\frac{2(N-1)}{SN^2}\left[1 + \frac{\beta(N-1)}{SN^2}\right] \end{aligned}$$

Note that (17) is only less than zero if

$$1 + \frac{\beta(N-1)}{SN^2} > 0 \Rightarrow \beta > -\frac{SN^2}{(N-1)}$$

Hence β is bounded from below, where $\beta \geq 0$ will lead to the profit maximizing condition in any case.

4.7. Appendix 4.2.: Data

As mentioned in the first chapter (section 1.5.1), the Weiss data are aggregated to a state level dataset by averaging over a firm's offers in all zip-codes in any state the firm operates in. The Medigap policies are restricted to standard plans (i.e. no select or smoker plans) offered to 65 year-old women.

Our second dataset, from NAIC, contains data for all Medigap policies issued by insurance companies in a given state during the years 1996-1998. We only keep observations on individual standard Medigap policies offered after OBRA-90 within the continental United States (except Massachusetts, Minnesota, and Wisconsin which have different standardization schemes). Some plan letters are offered more than once by the same firm in the same state. These are likely to be plans that differ across counties, as observed in the Weiss data. Since we have no means of identifying these local differences, we combine these plans (about 22 percent), summing up covered lives, premiums and claims, such that each firm only offers one policy in each state-plan letter cell. To the extent we are combining policies with different rating methods, these cases will not be present in our merged sample since we exclude the two percent of policies in the Weiss data where firms use more than one rating method in a given market.

Both the Weiss data and the NAIC data have the company name of the firms offering a Medigap policy. After some minor adjustments, we can merge the two datasets based on the company name, the US state of operation and the plan letter. (Note that the NAIC data do not have any information on the age of the people covered under the policy.) To analyze how well the two datasets merge, we focus on the number of covered lives represented by firms in the NAIC data that we successfully merge to firms in the Weiss data. For example, the NAIC data contain firms representing 1,814,515 covered lives between 1996 and 1998. Firms representing 151,053 of these covered lives are not found in the Weiss data; thus our merged sample captures 91.6 percent of the Medigap market nationwide. Column 1 of Appendix Table A4.1. shows the total number of covered lives accounted for by firms in the NAIC data, by plan letter, and Column 2 shows the number of covered lives not matched to the Weiss data. Appendix Table A4.2. shows the fraction of NAIC covered lives not matched by state and plan letter. In most state-plan letter combinations, the fraction not matched is very low; however in order to guarantee that we observe "most" of any given market, we drop those state-plan letter cells where the fraction not matched exceeds 50 percent. Overall, we drop cells representing just 5,618 covered lives, or 0.3 percent of total covered lives (App. Table 2, col. 3). Column 4 of Appendix Table A4.1. reports the fraction of total covered lives either not matched or omitted to be just 8.6 percent.

4.8. Appendix Tables

Appendix Table 4.1.: Statistics from Merging Weiss and NAIC Data

Plan Letter	(1) Total NAIC Covered Lives	(2) Covered Lives Not Matched to Weiss Data	(3) Covered Lives Dropped[1)]	(4) Fraction Dropped or Not Matched[2)]
A	88151	7780	467	0.09
B	129499	6786	0	0.05
C	468767	40683	82	0.09
D	143838	10208	826	0.08
E	29298	104	0	0.00
F	762457	64531	0	0.08
G	54672	3437	46	0.06
H	31044	15664	3851	0.63
I	44274	1258	323	0.04
J	62515	602	23	0.01
Total	1814515	151053	5618	0.09

Notes:
A "matched" record refers to a successful merge of a firm-state-plan letter combination in the Weiss and NAIC data.
1) Number of covered lives in state-plan letter cells that were dropped because fewer than 50 percent of covered lives were matched. See Appendix Table 4.2. for match rates by state and plan letter.
2) (4) = [(2) + (3)] / (1)
Source: Authors' calculations using Weiss Ratings data, 1998, and NAIC data, 1998.

Appendix Table 4.2.: Fraction of NAIC Covered Lives Not Matched in Weiss Data by State and Plan

	PLAN									
STATE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
AK	0.02	0.03	0.01	0.08	0.00	0.05	0.01	0.00	0.00	
AL	0.33	0.27	0.34	0.13	0.00	0.35	0.43	0.00	0.00	
AR	0.03	0.07	0.04	0.02	0.00	0.08	0.01	0.02	0.00	0.00
AZ	0.19	0.06	0.14	0.00	0.11	0.10	0.05	0.00	0.05	0.00
CA	0.02	0.03	0.02	0.00	0.06	0.02	0.00	0.00	0.14	
CO	0.05	0.26	0.01	0.00	0.25	0.01	0.20	0.08	0.02	0.06
CT	0.01	0.04	0.02	0.08	0.00	0.01	0.08	0.01	0.94	0.00
DC	0.04	0.00	0.02	0.08	0.00	0.05	0.01	0.00	0.00	
DE	0.01	0.00	0.57	0.18	0.00	0.03			0.00	
FL	0.04	0.02	0.01	0.09	0.00	0.09	0.06	0.15	0.01	0.00
GA	0.07	0.04	0.02	0.04	0.00	0.05	0.06	0.00	0.00	
HI	0.06	0.00	0.00	0.00		0.00	1.00			
IA	0.18	0.13	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00
ID	0.00	0.00	0.00	0.00	0.40	0.00	0.00		0.00	
IL	0.07	0.04	0.02	0.02	0.00	0.04	0.10	0.00	0.01	0.00
IN	0.04	0.01	0.05	0.00	0.00	0.04	0.08	0.05	0.19	0.56
KS	0.03	0.03	0.01	0.02	0.00	0.01	0.04	0.05	0.14	0.00
KY	0.15	0.18	0.15	0.01	0.01	0.08	0.01	0.90	0.00	0.00
LA	0.04	0.03	0.04	0.07	0.00	0.13	0.05	0.00	0.00	
MD	0.02	0.00	0.01	0.08	0.00	0.03	0.04		0.00	0.00
ME	0.03	0.00	0.00	0.01	0.00	0.03	0.02	0.02	0.00	0.00
MI	0.11	0.18	0.20	0.05	0.00	0.32	0.00		0.01	
MO	0.00	0.01	0.02	0.02	0.05	0.03	0.08	0.48	0.57	0.00
MS	0.14	0.31	0.21	0.83	0.01	0.44	0.14	0.00	0.22	0.01

Appendix Table 4.2.: (continued)

	PLAN									
STATE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
MT	0.08	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.12	0.00
NC	0.09	0.03	0.15	0.08	0.01	0.06	0.02	0.02	0.01	0.00
ND	0.03	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.04	0.13
NE	0.12	0.07	0.05	0.04	0.00	0.09	0.10	0.01	0.01	0.07
NH	0.05	0.00	0.01	0.00	0.00	0.05	0.00	0.50	0.00	
NJ	0.10	0.47	0.12	0.29	0.33	0.05	0.78	1.00	0.04	1.00
NM	0.19	0.11	0.07	0.00		0.08	0.04		0.00	0.00
NV	0.08	0.02	0.05	0.05	0.00	0.08	0.03	0.00	0.00	0.01
NY	0.00	0.00	0.00	0.03		0.01	0.00	0.07	0.65	
OH	0.09	0.08	0.14	0.00	0.00	0.18	0.00	0.02	0.43	0.40
OK	0.19	0.09	0.05	0.03	0.00	0.18	0.00	0.00	0.00	
OR	0.06	0.00	0.00	0.01	0.04	0.06	0.02	0.01	0.00	
PA	0.00	0.00	0.29	0.01	0.02	0.02	0.00	0.78	1.00	0.00
RI	0.06	0.03	0.01	0.16		0.07	0.05	0.05	0.00	
SC	0.05	0.03	0.04	0.02	0.00	0.02	0.00	0.00	0.01	
SD	0.08	0.02	0.02	0.00	0.00	0.08	0.01	0.00	0.00	0.00
TN	0.39	0.10	0.10	0.00	0.00	0.16	0.17	0.00	0.02	
TX	0.47	0.28	0.25	0.38	0.00	0.28	0.11	0.00	0.02	0.18
UT	0.78	0.00	0.02	0.00		0.03	0.01	0.00	0.01	
VA	0.01	0.02	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.00
VT	0.03	0.00	0.00	0.00	0.00	1.00		0.63	1.00	0.00
WA	0.03	0.15	0.12	0.15	0.01	0.06	0.16	0.00	0.01	0.01
WV	0.02	0.03	0.02	0.01	0.00	0.01	0.01	0.02	0.00	0.00
WY	0.07	0.00	0.01	0.05	0.00	0.05	0.06	0.00	0.00	0.00

Notes:
Cell entries give the fraction of total NAIC covered lives not matched to the Weiss data. State-plan letter cells with a fraction larger than 0.50 are dropped from the analysis.
Source: Authors' calculations using Weiss Ratings data, 1998, and NAIC data, 1998.

BIBLIOGRAPHY

Andrews, Donald W. K. and Moshe Buchinsky. 2000. “A Three-Step Method for Choosing the Number of Bootstrap Repetitions.” *Econometrica*, Vol. 68, No 1, pp 23-51.

Arrow, Kenneth J. 1963. “Uncertainty and the Welfare Economics of Medical Care.” *The American Economic Review*, vol. 53, No 5, pp 941-973.

Buchmueller, Thomas, and John DiNardo. 2002. “Did Community Rating Induce an Adverse Selection Death Spiral? Evidence from New York, Pennsylvania, and Connecticut.” *The American Economic Review*, vol. 92, No 1, pp 280-294.

Burdett, Kenneth, and Kenneth L. Judd. 1983. “Equilibrium Price Dispersion.” *Econometrica*, Vol. 51, No 4, pp 955-970.

Bureau of Labor Statistics. 2006. “Consumer Price Index – All Urban Consumers (Current Series).” Downloaded at: http://data.bls.gov/PDQ/outside.jsp?survey=cu, accessed May 2006.

Bundorf, M. Kate and Kosali I. Simon. 2006. “The Effects of Rate Regulation on Demand for Supplemental Health Insurance.” *The American Economic Review*, Vol. 96, No 2, pp. 67-71.

Card, David, Carlos Dobkin and Nicole Maestas. 2004. “The Impact of Nearly Universal Insurance Coverage on Health Care Utilization and Health: Evidence from Medicare.” NBER Working Paper 10365.

Carlson, John A., and R. Preston McAfee. 1983. “Discrete Equilibrium Price Dispersion.” *The Journal of Political Economy*, Vol. 91, No 3, pp 480-493.

Census Bureau. 2005a. “National Intercensal Estimates (1990-2000).” Downloaded at: http://www.census.gov/popest/archives/EST90INTERCENSAL/US-EST90INT-datasets.html, accessed October 2005.

Census Bureau. 2005b. “National Population Projections. II. Detailed Files, Middle Series Data.” Downloaded at: http://www.census.gov/population/www/projections/ natdet-D1A.html, accessed October 2005.

Centers for Medicare and Medicaid Services (CMS). 2006a. Data Tables for "The Characteristics and Perceptions of the Medicare Population" 1996-2003, tables 1.6. Downloaded April 2006 at http://www.cms.hhs.gov/apps/mcbs/PublDT.asp.

Centers for Medicare and Medicaid Services (CMS). 2006b. "National Health Expenditure Web Tables, Table 12." Downloaded May 2006 at http://www.cms.hhs.gov/NationalHealthExpendData/downloads/tables.pdf.

Cutler, David M. and Sarah J. Reber. 1998. "Paying for Health Insurance: The Trade-Off between Competition and Adverse Selection." *The Quarterly Journal of Economics*, vol. 113, No 2, pp 443-266.

Carlson, John A., and R. Preston McAfee. 1983. "Discrete Equilibrium Price Dispersion." *The Journal of Political Economy*, Vol. 91, No 3, pp 480-493.

Dahlby, Bev, and Douglas S. West. 1986. "Price Dispersion in an Automobile Insurance Market." *The Journal of Political Economy*, Vol. 94, No 2, pp 418-438.

Diamond, Peter A. 1971. "A Model of Price Adjustment." *Journal of Economic Theory*, Vol. 3, No 2, pp 156-168.

Ettner, Susan L. 1997. "Adverse Selection and the Purchase of Medigap Insurance by the Elderly." *Journal of Health Economics*, vol. 16, No 5, pp. 543-562.

Finkelstein, Amy. 2004. "Minimum Standards, Insurance Regulation and Adverse Selection: Evidence from the Medigap Market." *Journal of Public Economics*, Vol. 88, No 12, pp. 2515-2547.

Follmann, J.F. Jr. 1962. "Experience Rating vs. Community Rating." *The Journal of Insurance*, vol. 29, No 3, pp 403-415.

Fox, Peter D., Rani E. Snyder, and Thomas Rice. 2003. "Medigap Reform Legislation of 1990: A 10-Year Review." *Health Care Financing Review*, Vol. 24, No 3, pp. 121-137.

Hortaçsu, Ali, and Chad Syverson. 2004. "Product Differentiation, Search Costs, and Competition in the Mutual Fund Industry: A Case Study of S&P 500 Index Funds." *The Quarterly Journal of Economics*, Vol. 119, No 2, pp 403-456.

Lee, A.James, Steven A. Garfinkel, Rezaul K. Khandker, and Edward C Norton. 1997. "Impact of Medicare SELECT on Cost and Utilization in 11 States." *Health Care Financing Review*, Vol.19, No 1, pp. 19-40.

Lucas, R. 1977. Hedonic Wage Equations and Psychic Wages in the Returns to Schooling. American Economic Review, 67, 549-58.

Medicare Payment Advisory Commission (MedPac). 2003. "Report to Congress: Variation and Innovation in Medicare." Chapter 2, pp 19-38. Washington, D.C.

Medicare Payment Advisory Commission (MedPac). 2004. "Report to Congress: Market variation and Medicare Supplementation: Looking Ahead." Washington, D.C.

Pauly, Mark V. 1970. "The Welfare Economics of Community Rating." *The Journal of Risk and Insurance*, vol. 37, No 3, pp 407-418.

Poi, Brian P. 2004. "From the Help Desk: Some Bootstrapping Techniques." *The Stata Journal*, Vol. 4, No 3, pp. 312-328.

Rice, Thomas. 1987. "An Economic Assessment of Health Care Coverage for the Elderly." The Milbank Quarterly, Vol. 65, No 4, pp. 488-520.

Rice, Thomas, Rani E. Snyder, Gerald Kominski, and Nadereh Pourat. 2002. "Who Switches From Medigap To Medicare HMOs?" *Health Services Research*, Vol. 32, No 2, pp. 273-290.

Robst, John. 2001. "Estimation of a Hedonic Pricing Model for Medigap Insurance." Unpublished working paper, Centers for Medicare & Medicaid Services.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy*, No. 82, pp. 34-55.

Short, Pamela F., and Jessica P. Vistnes. 1992. "Multiple Sources of Medicare Supplementary Insurance." *Inquiry*, Vol. 29, pp 33-43.

Sorensen, Alan T. 2000. "Equilibrium Price Dispersion in Retail Markets for Prescription Drugs." *The Journal of Political Economy*, Vol. 108, No 4, pp 833-850.

Stiglitz, Joseph E. 1989. “Imperfect Information in the Product Market.” In *Handbook of Industrial Organization*, Vol. 1, Schmalensee, R. and R.D. Willig, editors.

The Henry J. Kaiser Family Foundation. 2005. “Medicare Chartbook.” Third Edition, Summer 2005. Prepared by Juliette Cubanski, Molly Voris, Michelle Kitchman, Tricia Neuman, and Lisa Potetz.

The Lewin Group. 2001. “Restricting Underwriting and Premium Rating Practices in the Medigap Market: The Experience of Three States.” The Public Policy Institute, report No 2001-01. AARP, Washington, DC.

US Congress, Select Committee on Aging, Subcommittee on Human Services. 1990. “Medigap Fraud and Abuse: How Can Communities Stop These Problems?” Briefing by the Subcommittee on Human Services. Washington, DC, US Government Printing Office.

US Department of Health and Human Services. 1995. “The Impact of OBRA 1990 on State Regulation of Medigap Insurance.” OEI-09-93-00230.

US Department of Health and Human Services. 2005. “Choosing A Medigap Policy: A Guide To Health Insurance For People With Medicare.” Accessed October 2005 at http://www.medicare.gov.

US Department of Health and Human Services. 2006. “Choosing A Medigap Policy: A Guide To Health Insurance For People With Medicare.” Accessed May 2006 at http://www.medicare.gov.

US General Accounting Office. 1994. “Health Insurance for the Elderly. Owning Duplicate Policies is Costly and Unnecessary”. GAO/HEHS-94-185.

Weiss Ratings Inc. 1997-2006. “Medigap Insurance News Releases.” Accessed May 2006 at http://www.weissratings.com/News/Ins_Medigap/ .

Weiss Ratings Inc. 2005. “Weiss Ratings’ Shopper's Guide to Medicare Supplement Insurance.” Accessed August 2005 at http://www.weissratings.com/ .

Wolfe, John R and John H. Goddeeris. 1991. "Adverse Selection, Moral Hazard, and Wealth Effects in the Medigap Insurance Market." *Journal of Health Economics*, vol. 10, No 4, pp. 433-459.