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COMPETITION THROUGH INNOVATION IN PRICING VARIABLES:
A PROGRESSIVE APPROACH

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ABSTRACT

Insurers often compete through innovation in pricing variables and underwriting techniques. By continually developing new pricing variables, insurance companies are able to better match a customer's risk of loss to their insurance premium. When a company is able to do this, they will attract the less risky customers, by being able to charge them less. This leaves their competition with the higher risk, undesirable customers. This thesis will provide examples of risk classification and will provide a model of insurance competition using utility theory.

One company that has been particularly innovative over the years is Progressive. Often called the "Prince of Pricing," Progressive has databases full of customer information that they use to price policies. In their Auto Insurance business, Progressive, over the years, has developed a pay-as-you-go rating system called MyRate. MyRate is the innovative rating variable on which this thesis will focus.

MyRate uses telematics technology to record a customer's annual mileage, times of day driving, and hard braking and quick acceleration patterns. Through this information, Progressive has been able to create individualized insurance premiums that can save its safe drivers considerable money in premiums.

The Actuarial Standards Board has developed a list of standard and nonstandard (but desirable) characteristics of a rating variable. MyRate upholds most of those standards very well. One standard that the Actuarial Standards Board needs to add to their list is privacy. With the use of telematics technology, and possible GPS technology, there needs to be a standard of what is acceptable. The author of this thesis will explore what she deems as an acceptable standard of privacy.

Finally, this thesis will review Progressive's Company results over the past decade. Competitors, stock prices, returns on investment, loss ratios, and growth will be examined in depth.

TABLE OF CONTENTS

I. INTRODUCTION.....	1
1.1 INTRODUCTION TO INSURANCE.....	1
1.2 TYPES OF INSURANCE.....	2
1.3 AUTO INSURANCE AND THE PERSONAL AUTO POLICY.....	3
1.4 COMMON PRICING VARIABLES FOR AUTO INSURANCE.....	3
1.5 INSURANCE REGULATION	4
1.6 RATE REGULATION	6
1.7 AUTO INSURANCE MARKET DEMAND.....	7
1.8 THE PROGRESSIVE CORPORATION.....	9
II. MYRATE AND PREDECESSORS.....	12
2.1 AUTOGRAPH.....	12
2.2 TRIPSENSE	13
2.3 MYRATE.....	14
2.4 SYSTEMS COMPARED.....	17
III. RISK CLASSIFICATION	19
IV. MODEL OF INSURANCE COMPETITION USING UTILITY THEORY	25
V. RISK CLASSIFICATION STANDARDS.....	30
5.1 STANDARDS AND MYRATE COMPARED TO STANDARDS	30
5.2 NONSTANDARDS AND MYRATE COMPARED TO NONSTANDARDS.....	33
5.3 PRIVACY AS A RISK CLASSIFICATION STANDARD	36
5.4 REVIEW.....	38
VI. PROGRESSIVE’S RESULTS.....	39
6.1 COMPETITORS.....	39

6.2 STOCK PRICES.....	40
6.3 RETURN ON EQUITY.....	40
6.4 LOSS RATIOS.....	41
6.5 GROWTH.....	43
VII. CONCLUSION	45
APPENDIX 1- PERSONAL AUTO POLICY.....	47
APPENDIX 2- PROGRESSIVE’S STOCK PRICE OVER THE LAST DECADE	49
APPENDIX 3- PROGRESSIVE VERSUS THE S&P INDEX OVER THE LAST 10 YEARS	49
APPENDIX 4- PROGRESSIVE VERSUS ALLSTATE OVER THE LAST 10 YEARS.....	49
APPENDIX 5- PROGRESSIVE VERSUS NATIONWIDE OVER THE LAST 10 YEARS.....	50
APPENDIX 6- PROGRESSIVE VERSUS TRAVELERS OVER THE LAST 10 YEARS.....	50
APPENDIX 7- PROGRESSIVE VERSUS GEICO OVER THE LAST 10 YEARS.....	50
APPENDIX 8- PROGRESSIVE VERSUS FARMERS OVER THE LAST 10 YEARS	51
BIBLIOGRAPHY.....	52

LIST OF FIGURES

FIGURE 1- PROPERTY AND LIABILITY INSURANCE PREMIUM VOLUME 2006.....7

FIGURE 2- AUTO INSURANCE MARKET 2006.....8

FIGURE 3- AUTO INSURANCE MARKET 2006.....8

FIGURE 4- CHART OUTLINING PROGRESSIVE’S INNOVATION BY YEAR11

FIGURE 5- DRIVING ACCIDENT RISK BY TIME OF DAY.....15

FIGURE 6- COMPARISON OF TRADITIONAL INSURANCE TO OTHER REPORTING SYSTEMS.....17

FIGURE 7- LOSS DISTRIBUTION FOR COLLEGE STUDENT AGE 22.....22

FIGURE 8- LOSS DISTRIBUTION FOR MALE AND FEMALE COLLEGE STUDENTS AGE 22.....23

FIGURE 9- UTILITY GRAPH FOR INSURED VERSUS UNINSURED.....29

FIGURE 10- PROGRESSIVE’S TOP COMPETITORS IN PRIVATE PASSENGER AUTO.....39

FIGURE 11- PROGRESSIVE’S ROE OVER THE LAST 10 YEARS.....40

FIGURE 12- LOSS RATIOS FROM 2001 TO 2007- PROGRESSIVE AND TOP AUTO COMPETITORS.....42

FIGURE 13- LOSS RATIOS FROM 2001 TO 2007- PROGRESSIVE AND TOP AUTO COMPETITORS.....43

FIGURE 14- PROGRESSIVE’S GROWTH IN NET WRITTEN PREMIUM 1950-2008.....43

FIGURE 15- PROGRESSIVE’S GROWTH IN NET WRITTEN PREMIUM 1950-2008.....44

I. INTRODUCTION

1.1 INTRODUCTION TO INSURANCE

Insurance is defined as the transferring of pure risk by means of a two party contract. Risk is the uncertainty concerning the occurrence of an event. A pure risk is an event with only downside potential and no possibility for a gain. If there is possibility for a gain, the risk is classified as a speculative risk. An example of a speculative risk is the stock market, which has both upside and downside potential. An example of a pure risk is an auto accident, which has only a possibility for loss (Denenberg, 1974).

The two parties who enter into the insurance contract include those who transfer the risk, and those who take on the risk. The risk transferring party is known as the insured. The risk bearing party is known as the insurer (Denenberg, 1974). By transferring risk, the insured is opting to pay a fixed premium, in exchange for the insurer taking on the financial risk of suffering a large loss. Insurance is a part of many of our everyday lives. Therefore, we often do not question the reason why people choose to pass on pure risk to an insurer. In fact, many insureds will never suffer a loss, but will pay premiums their whole life. This can be explained by risk aversion. The theory of risk aversion states that given two events with approximately the same financial outcome, a person prefers the less risky event. Therefore, people are willing to pay a premium in exchange for knowing that they will not suffer an immobilizing loss.

In this paper, automobile insurance will be discussed at length. In this type of contract, the insured is an individual who purchases auto insurance for their car. The insurer is a corporation who sells auto insurance. For a fixed premium amount, an individual is transferring the financial risk of having a large, costly auto accident onto the insurer.

When examining the contractual relationship between policyholder and insurer, it is appropriate to ask why the insurer is able to take on this risk that the insured could not. One answer is that insurers have an important technique available to them that the individual insured may not. This technique is pooling. Pooling refers to the gathering of many similar risks and splitting the losses evenly among them

(Denenberg, 1974). Therefore, the average loss of the group is substituted for the actual loss of the individual (Rejda, 2003). Pooling will be discussed at length in the following chapters.

1.2 TYPES OF INSURANCE

There are two broad types of insurance offered by private insurance companies; Life and Health Insurance and Property and Liability Insurance.

Life insurance pays death benefits to family members or beneficiaries of the insured when the insured dies. The money received in death benefits can help pay for burial expenses, and other expenses that the insured may have left behind upon death. Health insurance pays for medical expenses that occur due to sickness or injury.

Property and liability insurance insures many different risks in the hope of making the insured financially whole after a loss or a liability lawsuit. The types of insurance sold by property and liability insurers are as follows:

- Fire - to cover the loss to real estate or personal property due to fires, or lightning. Other causes of loss can be specified such as windstorms, hail, and vandalism.
- Marine - to cover the transport of goods.
- Auto - covers the physical damage, legal liability, medical payments arising from a car accident. It also protects against losses caused by uninsured motorists.
- General Liability- covers any legal liability the insured has due to property damage or physical bodily injury to others.
- Burglary and Theft- covers the loss of property, money, and securities due to a robbery.
- Workers Compensation- covers a worker for job related injury or illness. Workers compensation pays for medical bills and income loss.
- Glass – covers glass breakage in a building.

- Boiler and Machinery- covers boilers, turbines, generators, and other power producing machinery.
- Nuclear- covers losses due to nuclear accidents.
- Crop-Hail- covers farmers' crops due to storms.

(Rejda, 2003).

1.3 AUTO INSURANCE AND THE PERSONAL AUTO POLICY

This paper will focus on property and liability insurance, specifically auto insurance. Therefore, it is important to go over what is covered in an auto insurance policy. The personal auto policy was introduced in 1977. It has been revised a few times, and the latest version in the 1998 personal auto policy. Under a personal auto policy (PAP), a vehicle is eligible for coverage if it is a four wheel motor vehicle owned or leased by the insured for at least six continuous months. Falling into this category can be private passenger cars, station wagons, and sports utility vehicles. Vans and pickup trucks can also fall into this category if they are less than 10,000 pounds, and are not used for the delivery of goods (Rejda, 2003). To see an example of a Personal Auto Policy, please see Appendix I.

1.4 COMMON PRICING VARIABLES FOR AUTO INSURANCE

Auto insurance premiums are commonly set for individual drivers based on the following factors:

- Territory- based on the state, large city, and part of a city, suburb, or rural area in which the insured lives. Due to increased litigation, higher claim costs, large number of vehicles, and traffic congestion, auto insurance premiums are significantly higher in some states such as New Jersey and New York.
- Age, Gender, Marital Status- these are factored in because all have a relationship with propensity for loss.

- Use of Auto- insurers classify vehicles based on why the car is driven: for pleasure, for driving to work, for business, for farming.
- Driver Education- if a young driver completes driver education, their premiums will be reduced.
- Good Student Discount- if a young driver demonstrates that they are a good student, they may receive a discount in many states.
- Number and Type of Cars- insureds may qualify for a multicar discount if they own two or more cars. Also, the year, make and model of car all affect premiums.
- Individual Driving Record-if an insured is a safe driver; they may qualify for safe driver plans. Being a safe driver means not being in any accident where they are at fault and not being convicted of a serious traffic violation in the last 3 years. If a person is not a safe driver or does not have a clean record, they will be charged higher premiums.
- Credit Score- many auto insurers are now using credit scores to determine premium. Credit scores are derived from credit history and is combined with other factors to set an insurance score. An insurance applicant's insurance score corresponds to whether and at what price they are able to receive insurance.

Pricing variables are also often referred to as rating variables and will be discussed at length later in the paper.

(Rejda, 2003).

1.5 INSURANCE REGULATION

Insurance is very unique in that it is regulated by the states, not the federal government. In fact, there are three main ways insurance is regulated: by state insurance departments, by legislation, and by courts.

Each state, including the District of Columbia and United States territories, has separate insurance departments. The head of each department is the insurance commissioner, who is either appointed by the governor, or elected. The commissioner, through administrative rulings, has a great affect on insurers; including the power to suspend or revoke an insurer's license. All of the state commissioners belong to the National Association of Insurance Commissioners (NAIC). This organization meets periodically to discuss industry problems and draft model laws. Model laws are laws that are recommended for adoption by the states. The states are not forced to adopt these laws, but in most cases they adopt all of or part of the proposed law.

Each state also has legislation to regulate the operation of insurers. Laws regulate the following areas; formation of insurance companies, licensing of agents and brokers, financial requirements for maintaining solvency, insurance rates, sales and claim practices, taxation, and rehabilitation of liquidation of insurers.

Finally, courts are used to regulate insurance. Here, both state and federal courts have made decisions about the constitutionality of state insurance laws, the interpretation of insurance policies, and the legality of administrative actions by state insurance departments (Rejda, 2003).

There are several reasons why insurance needs to be regulated. The first reason is to maintain insurer solvency. Solvency is very important in insurance primarily because premiums are paid in advance for future security. If an insurer goes bankrupt, the insured has paid for nothing. Also, insurer solvency is important because people are facing potentially devastating losses.

Another reason why insurance needs to be regulated is because consumers need adequate insurer knowledge. Insurance contracts and products are often too complex for the average consumer. Without insurer information, the insured will not be able to choose the best insurance product for their needs.

Also, regulation must insure that people are being charged reasonable rates. A reasonable rate is one that is not excessive but also high enough so that the insurer does not become insolvent. In most lines of insurance, rates are kept regulated by competition.

Finally, insurance must be regulated in order to make insurance available to all people that need it. For example, public interest groups may ask regulators to take actions that expand the private insurance market (Rejda, 2003).

1.6 RATE REGULATION

As mentioned earlier, one of the areas of insurer regulation is rate regulation. In property and casualty insurance, rates must meet certain state standards. Rates (a synonym for premium) must be considered adequate, reasonable, and unfairly discriminatory by each state's department of insurance. Therefore, if an insurer is selling insurance in all 50 states, they will have to file for and get approval of the rates they charge in all 50 of these states. Rate regulation is very different across states. There are two principal rating laws used by states.

The first is prior approval law. Under prior approval law, rates must be filed and approved by the state insurance department before they can be used. In most states, if the rate is not disapproved within 30 or 60 days, it can be considered approved. A majority of states have some type of prior approval law.

The second is file and use law. Under file and use law, insurers are required only to file the rates with the state insurance department and the rates can be used immediately. The state insurance department can later disapprove the rate if they violate the state laws. This type of law is much more liberal than prior approval (Rejda, 2003).

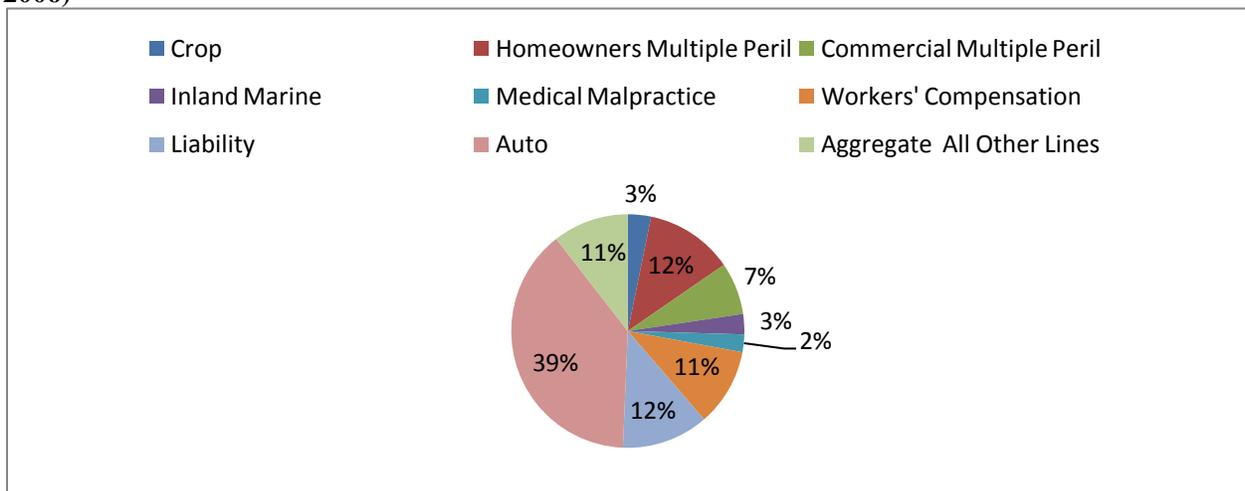
When presenting these rates, insurers must give an explanation for why these rates are considered fair. They must include an explanation of the rating variables, trends affecting the frequency of severity of losses, loss development factors, expense loadings and profit provisions used in calculating the rate.

Because public interest groups often encourage the state insurance commissioner for lower rates while insurers often file for higher rates, debate over the acceptance of a rate can go on for some time. The length of this time does vary state by state and can be affected by things such as the state’s public policy, and whether the commissioner is appointed or elected (Feldblum). Therefore, it can take time for a new insurance rate to be accepted by all states. Sometimes, insurers even test a rate filing in a state where it is usually easier to get a rate passed before moving onto filing the rate in a more strict state.

1.7 THE AUTO INSURANCE MARKET AND DEMAND

According to the National Association of Insurance Commissioners, auto insurance, including both commercial and personal insurance, accounted for \$195.3 billion in written premiums in 2006. The total property and liability insurance market accounted for \$503 billion in written premiums in 2006. Therefore, auto insurance made up approximately 38.82% of all premiums written by property and liability insurers. The following graph shows the breakdown of written premiums within the property and liability market.

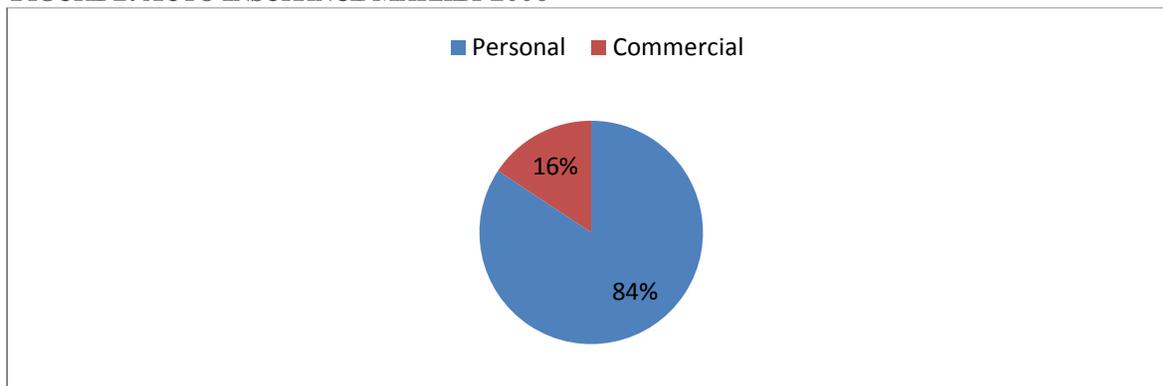
FIGURE 1: PROPERTY AND LIABILITY INSURANCE PREMIUM VOLUME (AS A PERCENT OF TOTAL 2006)



SOURCE: ATKISSON, 2007

Within the auto insurance market, personal auto insurance accounts for most of the written premium in 2006, approximately \$164.6 billion or 84.3%. Commercial auto had written premiums of \$30.6 billion or 15.7%, as shown in the following figure.

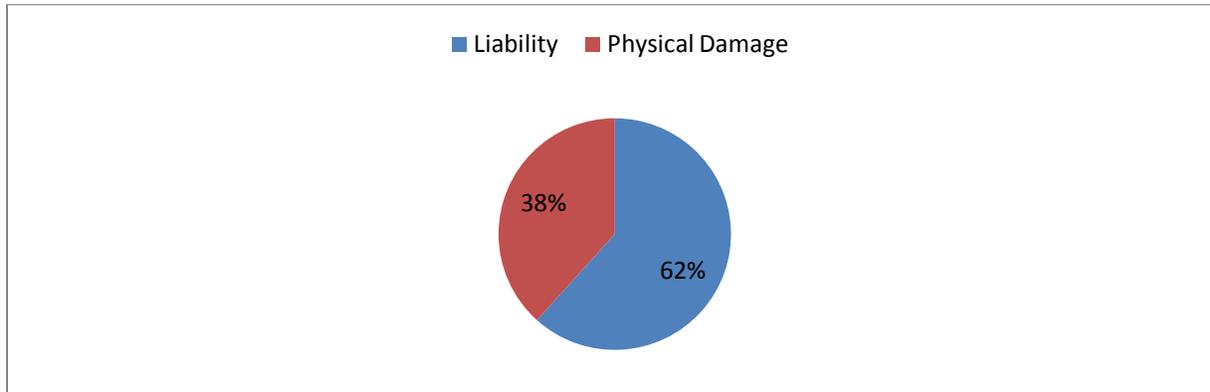
FIGURE 2: AUTO INSURANCE MARKET 2006



SOURCE: ATKISSON, 2007

Additionally, in 2006, auto liability had written premiums of \$120.5 billion or 61.7% of the auto insurance market. Physical damage had written premiums of \$74.8 billion or 38.3% of the auto insurance market, shown in the following figure.

FIGURE 3: AUTO INSURANCE MARKET 2006



SOURCE: ATKISSON, 2007

As can be seen, auto insurance makes up the largest portion of the property and casualty insurance market. Also, liability insurance makes up the largest portion of the auto insurance market. There is one main reason for this; almost all states have insurance laws that require drivers to carry some minimum amount of liability insurance or post a bond at the time of an accident. Therefore, since auto

insurance in almost every state is required by all drivers, the demand for auto insurance is greatly increased (Rejda, 2003). This requirement is very different from other types of insurance sold by property and liability companies. Many other insurance lines are voluntary. Because auto insurance is compulsory and is in high demand, it is crucial for property and liability companies to compete heavily for control of this market.

1.8 THE PROGRESSIVE CORPORATION

One company has stood out throughout their history as being innovative while competing for auto insurance market control. The Progressive Corporation has had a long, successful, colorful, and controversial history. On March 10, 1937, Progressive Mutual Insurance Company was formed by Jack Green and Joseph Lewis (Progressive Autobiography).

Early on, the pair realized that they were interested in selling automobile insurance not just to affluent risks, but to everyone, including the blue-collar worker. The blue-collar worker at this time usually could not afford insurance, and also was classified as high risk. Innovation started early at Progressive. Up until its formation, car insurance customers were expected to pay their premiums all at once. Progressive targeted these blue-collar workers by allowing them to pay monthly premiums with no extra charge. In addition, Progressive offered a drive-in claims service that allowed customers to get their car damage assessed and their car fixed all in one stop at a local garage (Progressive Autobiography).

In 1956, Progressive defined its role in the auto insurance industry. In the 1950's, more insurers were emerging; there were more cars, more highways, and ultimately more accidents. During this time, Progressive realized a niche market, the substandard, high risk drivers that other insurers refused. The company was able to be profitable due to stringent underwriting and statistical analysis of its drivers. Progressive introduced the Safe Driver Merit Rating Plan, which gave lower rates to those drivers did not have accidents. Due to its role in insuring the substandard market, Progressive was able to greatly expand (Progressive Autobiography).

The Progressive Company continued its growth and innovation during the 1970's and 1980's. In 1990, Progressive introduced Immediate Response, a 24-hour claim service that sends representatives immediately to the scene to provide cost estimates, on-the-spot towing, and rental cars (Progressive Autobiography). The claims adjuster sent to the accident had the capability of writing a check immediately. This ultimately reduced costs to Progressive by reducing rental car and storage expenses. Also, fraud and lawyer involvement, which adds at least 10-15% to the cost of losses, was minimized (Siggelkow, 1998).

Although Progressive used many techniques to compete for market control, their most fascinating and innovative has been pricing. In 1992, Fortune magazine called Progressive "The Prince of Smart Pricing." Since 1950, it has developed databases that kept track of such things as personalities, lifestyles, and driving habits of high risk groups. Due to this extensive data, Progressive was able to price policies to match the underlying risk. It was able to offer lower premiums than competitors to substandard risks, and therefore draw the better risks out the market (Siggelkow, 1998). As of 1992, "Progressive had more than 14,000 different premiums based on driving record, vehicle year, make and model, driver age, sex, marital status, residence, and other factors" (Siggelkow, 1998, page 8).

1993 was full of customer focused innovation. Progressive became the first insurer to offer a free apples-to-apples rate comparison to its customers. Customers could obtain Progressive's rates as well as competitors by calling 1-800-AUTO-PRO. Also, Progressive began its new product, Universal Auto. Universal Auto gave a rate to every risk that inquired and rejected no risks. This product ended Progressive's run as a substandard market insurer (Progressive Autobiography).

Progressive's innovation in insurance pricing using unique customer characteristics was met with controversy in 1995. Progressive began using customers' credit scores as rating variables and in underwriting decisions. This caused the Arkansas and Vermont insurance regulators to question this new variable. They argued that this would be discriminating to those who did not have credit cards and

therefore to less wealthy races. Regulators in Alaska, Maryland, and Texas also followed suit in questioning the use of credit scores as fair indicators of risk (Progressive Corporation, 2010).

As of 2008, Progressive has reached all 50 states after finally breaking into the Massachusetts auto market. It has a net written premium volume of \$13.6 billion. The company employs 25,920 people. It is the 3rd largest insurer in the auto market (Progressive Autobiography). Most importantly, innovation at Progressive has not halted. As stated by Adam Klauber, director of research for Cochran Caronia,

"Progressive, clearly, is the leader in several senses, In the traditional sense, they've been the most forward in the auto insurance business as far as having a good integrity system between pricing and acquiring customers. The real key has been their ability to segment, to slice and dice and price the risk better than their competitors. That's what they are known for (Earning Its Name, 2005, p.1)."

FIGURE 4: CHART OUTLINING PROGRESSIVE’S INNOVATION BY YEAR

Year	Landmark
1937	Progressive Mutual Insurance Company Formed
1956	Realized Niche Market of Substandard Drivers
1990	24 Hour Claims Service
1992	“The Prince of Smart Pricing”- More than 14,000 Different Premiums Based on Collected Customer Data
1993	Free Apples-to Apples Rate Comparison at 1-800-AUTO-PRO
1995	Began Use of Credit Scores as Rating Variables
1998	Progressive Reaches all 50 States for Auto

SOURCE: PROGRESSIVE AUTOBIOGRAPHY

II. MYRATE AND PREDECESSORS

The unique company started by Joe Lewis and Jack Green continues. While it is uncertain what possibilities lay ahead for Progressive, a promising new innovation is for the company is their pay-as-you-go rating systems. These systems were first developed in 1998; and a new system, MyRate, is in place today. Pay-as-you-go rating systems are systems that use either GPS technology or telematics technology to gather customer driving data. Based on such data, insurers, like Progressive, are able to set unique premiums for each customer based on driving experience and number of miles driven. MyRate and its predecessors are examples of how insurers are able to compete in a large market through underwriting innovation.

2.1 AUTOGRAPH

Progressive began its first development of a pay-as-you-go rating system in 1998. Autograph was a pioneering way of setting premium by using cellular and global positioning technologies installed into customers' cars. Autograph was piloted in Texas and used volunteers to examine the new program. Customers electing to try Autograph got billed on a monthly basis based on the number of miles driven and driving behavior in the previous month. Autograph collected data from almost every aspect of the vehicle. According to its patent, Autograph collected driving information including: RPM, transmission setting, throttle position, engine coolant temperature, intake air temperature, barometric pressure, brake lights, turn signals, hazard lights, wipers, door locks, ignition, horn, airbag deployment, ABS application, level of fuel in tank, radio station, seat belt, odometer reading, cruise control, anti-theft disable, vehicle speed, location, data, time, and direction (Frei, 2004).

It is important to recognize the use of a GPS system in Autograph. Progressive's patents say that they would share knowledge of driver's whereabouts with other companies. For example, they can alert travel companies at a vacation location you are visiting (Frei, 2004). The use of a GPS system may also be viewed as problematic or invasive to customers if information is used for real time or retrospective

surveillance of a person, or if it is used to create personality profiles based on the locations visited (Usman, 2006). For example, if a car using Autograph was located at a scene of a crime, this information could be subpoenaed and used against the customer. Also, if a customer's car is stopped at a bar for a long period of time, this information could be used to alert police of a possible drunk driver. Although consumers were seeing premium cuts on average of 25%, Autograph did not catch on with the public and was not rolled out to other states (Frei, 2004).

2.2 TRIPSENSE

Although Autograph was put on halt, Progressive did not abandon the pay-as-you-go insurance concept. In 2005, Progressive developed TripSense. TripSense was a telematics device that did not use a GPS system; therefore it did not know where a customer was driving. Using a black box device that plugged into a car's On-Board Diagnostic, it simply measured mileage, times of day the car was driven, and hard braking and quick accelerations measured by speed per second. Each month, the customer (who was also voluntary) could view their driving data online by loading TripSense data onto their PC. This was done by taking the small black box and plugging into the customer's computer's USB drive (David, 2004). It was then up to them whether they wanted to submit this information to Progressive. Therefore, if a customer had poor driving experience during the month, they can see this online and opt not to give this information to the insurer.

Progressive has a very unique view on privacy. In fact, their view on privacy is based primarily on their ability to sell their insurance products. They feel that if you cannot make an insurance product priced by a variable that people are accepting of, then they [Progressive] will not have a competitive advantage with that product. They want customers of other companies to willingly switch from their current company to Progressive without worry. When David Huber of Progressive was asked about privacy and security issues related to TripSense he replied, "Within our industry, carriers, agents, and brokers and other technology players must agree and make it very clear that the customer 'owns' his or her data and

then provide a system that allows customers to choose whether to share that data with their insurer or agency” (Bresnick Kendler, 2005).

TripSense, like Autograph was discontinued. This was most likely due to the fact that Progressive had no upside potential due to the fact that customers elected whether to be charged regularly or based on their previous month’s data. Obviously, if a customer is facing a higher premium, they will elect not to turn in their information.

2.3 MYRATE

Although Progressive had two prior failures, the development of telematics and pay-as-you-drive insurance never ceased at Progressive. In 2008, after ten years of research and development, MyRate was introduced.

MyRate is a voluntary program that uses obtained driving data to price an auto insurance premium. Because the program is voluntary, Progressive is enticing only low risk drivers to leave their current insurers who do not offer pay-as-you-drive insurance options. This creates a win-win situation. Progressive is capturing low risk, low cost drivers, ultimately making them money, while customers are paying smaller car insurance premiums. By being innovative and by being a first mover, Progressive has the chance to highly profit from their development of MyRate.

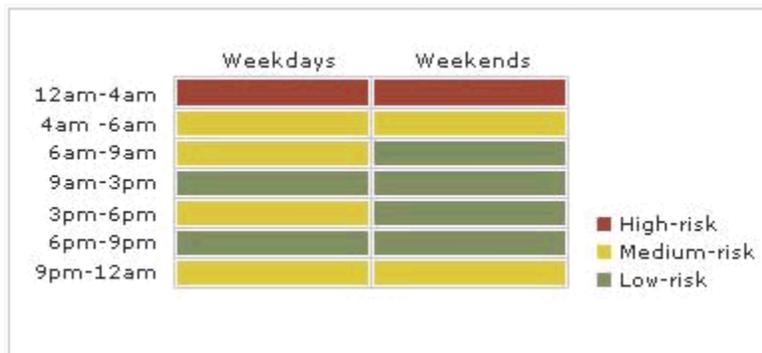
Progressive customers are charged an auto insurance premium based on three factors; annual mileage, times of day driving, and hard breaking and quick accelerations.

In order to measure these variables, Progressive ships a small blue box to their customer, who inserts it into their car’s diagnostic port (the car must be a 1996 model or newer). Then, the customer drives as usual and driving information is sent wirelessly to Progressive. The customer has the ability to go to Progressive’s online website to view personal driving information collected including: mileage, times of day driving (and how safe these times are), how safely he or she drives, and the expected next

insurance premium. MyRate, therefore, is a customized auto insurance premium based exactly on how a customer drives (MyRate Program).

As might be expected, as annual mileage increases, so does the possibility for an accident. Therefore, with increased mileage comes a higher premium. Also, the frequency of accidents increases during nighttime. This could be due to tired drivers, less road visibility, or a number of other different reasons. Therefore, the more a person drives during these high risk times, the higher their premium will be. Progressive’s website offers the following chart to summarize the driving risk by time of day.

FIGURE 5: DRIVING ACCIDENT RISK BY TIME OF DAY



SOURCE: MYRATE PROGRAM

Finally, if a customer shows signs of being an aggressive driver by having patterns of hard braking and quick accelerations measured in speed per second, both the frequency and the severity of accidents may increase. Therefore, if a driver is showing these undesired patterns, they too will have higher premiums.

There are many advantages for those who choose to use MyRate. By using MyRate, Progressive customers can save up to 25 percent or more on their insurance. However, the average discount has been 10 to 15 percent (Levick, 2009). The system not only gives a customer a premium based on driving experience, but also encourages safe driving through discounts and an interactive website. Also, if a customer feels that MyRate is not right for them, they can cancel the use for ratemaking purposes since MyRate is, after all, voluntary.

Contrary to previous pay-as-you-go ratemaking systems developed by Progressive, such as Autograph, MyRate is as non-evasive as possible. MyRate does not use a global positioning system in order to set rates. Therefore, Progressive cannot tell where you are driving. This eases customers concerns about privacy issues and about the possibilities of location data being used to convict the user of a crime. For example, MyRate will collect data that tells Progressive that you are going 50 miles per hour. However, Progressive will not be able to tell if you are going 50 miles per hour in a 35 mile per hour zone. Also, Progressive

“will not share MyRate data with any third parties unless it's necessary or appropriate to service the insurance policy, prevent fraud, perform research, or comply with the law. If a customer has a claim, Progressive will not use MyRate data to resolve the claim without first obtaining permission from the customer and, if not the customer, the registered vehicle owner”
(MyRate Program).

With all the positives that this system does present, there are of course some negatives. First of all, if a potential customer thinks MyRate would be a great fit for them, they do not always have the option of implementing it. As January 9th 2010, MyRate is only approved for use in the 19 states.¹
(MyRate Program).

In addition, there can be certain costs associated with MyRate. Depending on your state, you could pay a \$30 technology expense per policy term to cover the MyRate device and for the cost to transmit your data wirelessly to Progressive. Furthermore, if a person shows poor driving experience, his or her premiums may actually increase (MyRate Program).

¹ Alabama, Colorado, Connecticut, Georgia, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, New Jersey, Nevada, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Texas

Finally, some people do have privacy issues with the MyRate system. Although it is not a GPS system, personal driving information is still being submitted to a company. Also, Progressive keeps driving data on record for extensive periods of time. As stated on the ‘Frequently Asked Questions’ page on Progressive’s website:

“To meet our legal obligations to state departments of insurance, we keep information collected or derived from the MyRate device for the time we determine is required by law. After this time, we will remove personally identifiable information so that the data cannot be associated with a particular driver or policyholder and keep it indefinitely.”

2.4 SYSTEMS COMPARED

To compare and contrast automobile insurance priced by traditional methods, odometer audits (where a car garage reports mileage information to insurer), incentive based reporting (systems like MyRate which do not include GPS technology), and GPS based reporting (like Autograph), the International Global Navigation Satellite Systems Society (IGNSS) created the following chart.

FIGURE 6: COMPARISON OF TRADITIONAL INSURANCE TO OTHER REPORTING SYSTEMS

	Traditional Insurance	Odometer Audits	Incentive Based Approach	GPS Based PAYD
Mobility Based Premiums	Not possible	Possible	Possible	Possible
Infrastructure Costs	None	Low	Medium	High
Privacy Invasion	Low	Low	Medium	High
Time of Day Risk Assessment	Not Possible	Not Possible	Possible	Possible
Road Based Risk Assessment	Not Possible	Not Possible	Not Possible	Possible
Conditions Based Risk Assessment	Not Possible	Not Possible	Not Possible	Not Possible
Actuarially Accurate	Inaccurate	Slightly better than Traditional	Slightly better than Odometer Audits	Slightly better than Incentive Based

SOURCE: USMAN, 2006

As can be seen by the chart, traditional insurance cannot provide mobility based premiums. Although it has a no infrastructure cost, it is considered actuarially inaccurate because it cannot take into

account different driving risks. Traditional insurance has the lowest privacy invasion of all the reporting systems. Odometer audits can provide mobility based premiums, but cannot take into account other driving risks. Although it also has a low cost, it is only slightly more actuarially accurate than traditional methods. Odometer audits also have a low level of privacy invasion. Incentive based approaches such as MyRate are able to provide mobility based premiums, and information regarding the time of day a customer is driving. It has a medium infrastructure cost, but is more actuarially accurate than both traditional insurance and odometer audits. With this, comes slightly higher privacy invasion. Finally, GPS based pay-as-you-drive systems allow for mobility based premiums, as well as information about time of day customer is driving, and road risk assessment. Although it is actuarially the most accurate of the systems, it comes at the expense of high infrastructure cost, and also high privacy invasion. Therefore, it appears that incentive based approaches such as MyRate give the best of both worlds. It is more actuarially accurate, with only medium infrastructure costs and privacy invasion.

III. RISK CLASSIFICATION

When deciding to whom to offer car insurance and at what price, an insurer gathers applicant information including but not limited to: age, gender, marital status, geography, previous driving violations, vehicle make and model, occupation and credit score. The insurer then uses this information to organize or classify that individual into a group of people who have similar risk characteristics and expected loss. This process is called risk classification. The characteristics used to classify are called pricing or rating variables. This expected loss amount is the cost-based price of premium, also known as the pure premium. For some individuals, this premium is significantly higher than for others due to being placed in a group by a risk characteristic that signifies a greater probability for loss. For example, a young, inexperienced driver will be placed in a group that has a higher probability for loss when compared to a middle aged, experienced driver. The young driver will therefore pay a higher premium that reflects this greater probability of loss. When an individual has a high probability of loss and therefore must pay a higher premium, they are known as high risk. When an individual has a low probability of loss and therefore must pay a lower premium, they are known as low risks (Harrington, 2003).

There are a few distinct assumptions of risk classification that need to be more closely examined. The first is the insurer's desire for the groups into which individuals are classified to be homogeneous. This means that each buyer has the same loss characteristics and therefore the same expected loss. In this group, it is also assumed that an individual's losses are independent of all other individuals falling into the same category. This refers to the fact that the loss of one policyholder does not cause or affect the loss of another policyholder. If these assumptions hold true, the insurer will then be able to pool this group of insureds and charge them a pure premium equal to the expected claim cost. The expected loss for an individual is equal to the probability of loss multiplied by the loss amount.

$$\text{Expected Loss} = E[X] = \sum \text{Probability of Loss} \times \text{Loss Amount}$$

The expected loss for a pooled group is equal to the sum of all of the expected losses.

$$\text{Expected Loss} = n * E[X]$$

Notice, this is the same expected loss per person, since you simple would divide the above equation by n to get E[X].

By pooling, the insurance company is able to use the Law of Large Numbers. The Law of Large Numbers says that as the number of independent people with the same probability of loss goes to infinity, the actual loss converges to the expected loss. Therefore, the variance of the expected losses goes to zero. The variance for an individual is equal to the loss amount squared times the probability of loss minus the expected loss squared.

$$\text{Variance of Loss} = \sigma^2 = \sum \text{Loss}^2 * \text{Probability of Loss} - E[x]^2$$

$$\text{Standard Deviation} = \sigma = \sqrt{\sigma^2}$$

The variance for a group is equal to the sum of the variances.

$$\text{Variance of Loss} = n * \sigma^2$$

$$\text{Standard Deviation} = \sigma = \sqrt{n * \sigma^2}$$

Notice, that the standard deviation for the group will be significantly less than the sum of the standard deviations for the individuals.

This means that by insuring a large number of people, the insurer can almost guarantee that the losses they will pay out will be equal to the expected loss, and that their risk will virtually be zero. An insurer's risk is often measured by a ratio called the coefficient of variation. For individuals, the coefficient of variation is the standard deviation divided by the expected value.

$$\text{Coefficient of Variation} = \frac{\sigma}{E[X]}$$

For a group of n people, the coefficient of variation is as follows:

$$\text{Coefficient of Variation} = \frac{\sqrt{n}\sigma}{nE[X]} = \frac{\sigma}{\sqrt{n}E[x]}$$

Therefore, it can be seen, as n gets large, the risk of the insurer will go to zero (Anderson, 2005).

A NUMERICAL EXAMPLE:

Loss	Probability of Loss	Loss ²
0	.95	0
1,000	.05	1,000,000

For an individual:

$$E[X] = (0 \cdot .95) + (1,000 \cdot .05) = 50$$

$$E[X^2] = (0 \cdot .95) + (1,000,000 \cdot .05) = 50,000$$

$$\sigma^2 = 50,000 - 50^2 = 47,500$$

$$\sigma = 217.95$$

$$\text{Coefficient of Variation} = 217.95/50 = 4.36$$

For 1,000 people:

$$E[X] = 1,000 \cdot 50 = 50,000$$

$$\sigma^2 = 1,000 \cdot 47,500 = 47,500,000$$

$$\sigma = 6,892.02 \text{ (which is less than } 1000 \cdot 217.95 = 21,795 \text{).}$$

$$\text{Coefficient of Variation} = 6,892.02/50,000 = .14$$

(Anderson, 2005).

Of course, if insurers only charge insureds a premium equal to their expected losses, they will have zero profit. Therefore, the insurer adds loading expenses onto the pure premium. Loading expenses cover administration expenses and overhead expenses and also include a profit contingency. Basically, the loading expense gives the insurer the ability and the incentive to run their business.

The following is another simple example of how an insurer would determine the pure premium. The insurer is only looking at one group of policyholders, college students age 22. They are only taking into account two risk characteristics, age and education. The student has a 15% probability of having a \$1000 loss. Therefore, they would be charged a pure premium of $.15 * \$1000 = \150 (Harrington, 2003).

FIGURE 7: LOSS DISTRIBUTION FOR COLLEGE STUDENT AGE 22

Group	Probability of Loss	Probability of No Loss	Expected Loss if Loss Size=\$1000
College Student Age 22	.15	.85	\$150

Now it is important and interesting to look at what would happen if two distinct groups of policyholders are classified in the same group. Using the above example, suppose that a male college student age twenty-two has a higher risk of loss than a female college student age twenty-two. The group in the above example that was once thought to be homogeneous is actually now viewed as heterogeneous. Risk classification can be used to split these groups not only by age and education, but also by gender. Each of these two groups can now be charged a pure premium that better reflects their expected loss.

The following example shows that male students have a 20% probability for loss, while female college students have only a 10% probability for loss. Therefore, males would be charged $.2 * \$1000 = \200 , and females would be charged $.1 * \$1000 = \100 (Harrington, 2003).

FIGURE 8: LOSS DISTRIBUTION FOR MALE AND FEMALE COLLEGE STUDENTS AGE 22 (IT IS ASSUMED THAT THE NUMBER OF MALES AND FEMALES FROM THE PREVIOUS EXAMPLE ARE EQUAL)

Group	Probability of Loss	Probability of No Loss	Expected Loss if Loss Size= \$1000
Male College Student Age 22	.2	.8	\$200
Female College Student Age 22	.1	.9	\$100

Adequate and appropriate risk classification is crucial when faced with competition. Suppose Insurer A does not recognize a difference in expected loss between male and female students. Insurer A will therefore charge all college students the same cost-based price of \$150. On the other hand, suppose Insurer B realizes there is difference in expected loss between males and females. Insurer B could then offer females a price lower than \$150 and either not offer males policies or offer males policies with a cost-based premium of \$200 or greater. This would allow insurer B to make a very large profit because they would be making money on both males and females; while Insurer A would only be making money on females and losing money males. Stated otherwise, the females would be subsidizing the males (Harrington, 2003).

After word gets out that Insurer B is charging females less than Insurer A, all females will eventually leave Insurer A for Insurer B. This will leave Insurer A with the high risk, high cost, and undesirable males. This is referred to as adverse selection from Insurer A's perspective and cherry picking from Insurer B's perspective. Because Insurer A is now left with only males whose expected cost is \$200 but only charging \$150, they are losing money. Insurer B, however, is still making large amounts of money. In order to stay in business, Insurer A will need to increase premiums, or start also using gender as a risk characteristic. However, Insurer A will be very reluctant to raise prices because increasing prices will cause more insureds to leave their company, and the vicious cycle continues. This cycle is often referred to as an insurer death spiral because it often leads to the insurer being forced out of the market (Harrington, 2003).

This discussion exemplifies a fundamental principle of insurance pricing: In a competitive market, differences in expected claim costs will produce differences in premiums across consumers as long as three conditions hold; insurance companies want to be profitable, policyholders search for policies with the lowest premium amount given a certain amount of coverage, one or more insurers can predict differences in expected claim costs at a reasonably low price (Harrington, 2003).

It also highlights the importance of continuous innovation in risk classification. Insurers must always be searching for new characteristics to use to classify people, also known as rating variables. If insurers are first movers with new rating variables, like Progressive, they have the potential to earn large amounts of profit. If, however, they are behind the curve with new rating variables, they will experience adverse selection. If the adverse selection continues, they will eventually be forced out of the market. The next section will further look at and provide an economic model for competition within insurance underwriting.

IV. MODEL OF INSURANCE COMPETITION USING UTILITY THEORY

In order to further analyze the effects of competition within the insurance industry and failure of insurers to properly categorize people based on their expected loss, a utility model will be used. Utility refers to a measure of one's overall satisfaction from the consumption of goods and services. In this utility model, people will be consuming (or not consuming) insurance. Utility will be measured by the square root of a person's wealth (Doherty, 1985).

$$U = \sqrt{\textit{Wealth}}$$

Utility will be defined using a function that is consistent with the assumption that most consumers exhibit diminishing marginal utility with respect to wealth. This utility formula is based on two assumptions. The first assumption is that more wealth is preferred to less wealth. Secondly, as wealth accumulates, each additional unit of wealth gives a person less and less satisfaction. For example; a college student who has \$20 in their bank account will appreciate finding a \$20 bill on the street far more than a wealthy person who has \$300,000 in their bank account. That \$20 doubles the college student's bank account, but will add only a tiny fraction to the wealthy person's account. Therefore, there is diminishing marginal returns with respect to wealth (Doherty, 1985).

The assumption that consumers exhibit diminishing marginal utility with respect to wealth results in a model in which all individuals are risk averse. As previously stated in the introduction, risk averse refers to one's desire to avoid risk. An example of this is a person's desire to avoid financially harmful situations that would leave them economically unstable.

In the following example, it will be demonstrated how risk aversion and heterogeneous risk classification (as discussed in the previous chapter) can lead to adverse selection in the auto insurance market. In order to show this, it is assumed that there are two groups of people, one being high-risk male college drivers age 22 and one being low-risk female college drivers age 22. We will assume that each group has the same amount of drivers and each driver has an initial wealth of \$100. However:

- Female drivers have a 1/3 probability of having a loss of \$99
- Male drivers have a 2/3 probability of having a loss of \$99

Therefore, the pure premium for each group is as follows:

$$\text{Female drivers: } 1/3(\$99) = \$33 \quad \text{(EQUATION 1)}$$

$$\text{Male drivers: } 2/3(\$99) = \$66 \quad \text{(EQUATION 2)}$$

If the insurer could differentiate between low-risk female and high-risk male drivers and charge each group their respective pure premium, each group's utility with and without insurance is as follows:

Utility with Insurance:

$$U_{\text{Female}} = \sqrt{100 - 33} = 8.185 \quad \text{(EQUATION 3)}$$

$$U_{\text{Male}} = \sqrt{100 - 66} = 5.831 \quad \text{(EQUATION 4)}$$

Utility without Insurance:

$$U_{\text{Female}} = 2/3\sqrt{100} + 1/3\sqrt{1} = 7.0 \quad \text{(EQUATION 5)}$$

$$U_{\text{Male}} = 1/3\sqrt{100} + 2/3\sqrt{1} = 4.0 \quad \text{(EQUATION 6)}$$

It can be seen that both female and male drivers would have a higher utility if they chose to buy insurance. Therefore, both groups prefer to be insured rather than run the risk of a large financial loss, making them risk averse.

It will now be assumed that the insurer offering the auto insurance cannot differentiate between the female and male drivers. Since the group consists of an equal number of females and males, the insurer will charge one price, the average of the two pure premiums.

$$\text{All drivers: } \frac{\$33 + \$66}{2} = \$49.5 \quad \text{(EQUATION 7)}$$

Because the average premium is different from the premiums that were calculated in equations 1 and 2, we must recalculate the drivers' utility of insurance in this pooled arrangement and compare it to the value of their expected utility without insurance to see if both parties are still willing to buy insurance under this circumstance.

Utility with Insurance:

$$U_{\text{Female}} = \sqrt{100 - 49.5} = 7.106 \quad \text{(EQUATION 8)}$$

$$U_{\text{Male}} = \sqrt{100 - 49.5} = 7.106 \quad \text{(EQUATION 9)}$$

Notice that these two utilities are now the same because both groups have the same initial wealth and pay the same premium.

Remember: Utility without Insurance **(EQUATIONS 5 AND 6):**

$$U_{\text{Female}} = 2/3\sqrt{100} + 1/3\sqrt{1} = 7.0$$

$$U_{\text{Male}} = 1/3\sqrt{100} + 2/3\sqrt{1} = 4.0$$

From this example, it can be seen that when a high financial loss is at stake, both female drivers and male drivers, even when charged the same premium, again will both choose to buy insurance because buying insurance yields higher utility. When the two groups are charged the same amount and choose to buy insurance, the female customers are providing a subsidy for the male drivers. The females are over paying for their insurance while the males are under paying.

Low-risk drivers may be willing to provide a subsidy to the high-risk drivers for several reasons. First of all, it is often very hard or impossible for a driver to know whether they are low-risk or high-risk. In fact, if both groups are paying the same pure premium, usually the insurer cannot tell if a particular driver is a low-risk or a high-risk. While insurance consumers have the capability to compare competitors' prices, many drivers fail to do so. Another reason that low-risk drivers may be willing to

subsidize the high-risks is the concept of a sticky consumer. A sticky consumer is a person who stays with their original insurer for numerous reasons which may include a sense of loyalty to the insurer or to avoid the hassle of trying to find a new insurer.

Now, it will be assumed that another insurer (Insurer B) has a way of identifying and distinguishing between females and males. For example, suppose they send out a questionnaire to their college students age 22 asking them to state their gender. Insurer B could then price each group according to its true expected loss. It will be assumed that there are 1000 males and 1000 females. Eventually, since Insurer B is charging the female drivers a considerably lower premium, females will switch from Insurer A to Insurer B. To illustrate how adverse selection occurs, suppose that Insurer B is able to attract 500 of Insurer A's 1000 female customers. Insurer A is now left with 1000 high-risk drivers, but only 500 low-risk drivers to provide the subsidy.

Insurer A would now charge a pooled premium of:

$$(1000 * 66) + (500 * 33) = \$82,500$$

$$\frac{82,500}{1500 \text{ customers}} = \$55$$

(EQUATION 10)

$$U_{\text{Female}} = \sqrt{100 - 55} = 6.708$$

(EQUATION 11)

$$U_{\text{Male}} = \sqrt{100 - 55} = 6.708$$

(EQUATION 12)

Remember: Utility without Insurance **(EQUATIONS 5 AND 6)**:

$$U_{\text{Female}} = 2/3\sqrt{100} + 1/3\sqrt{1} = 7.0$$

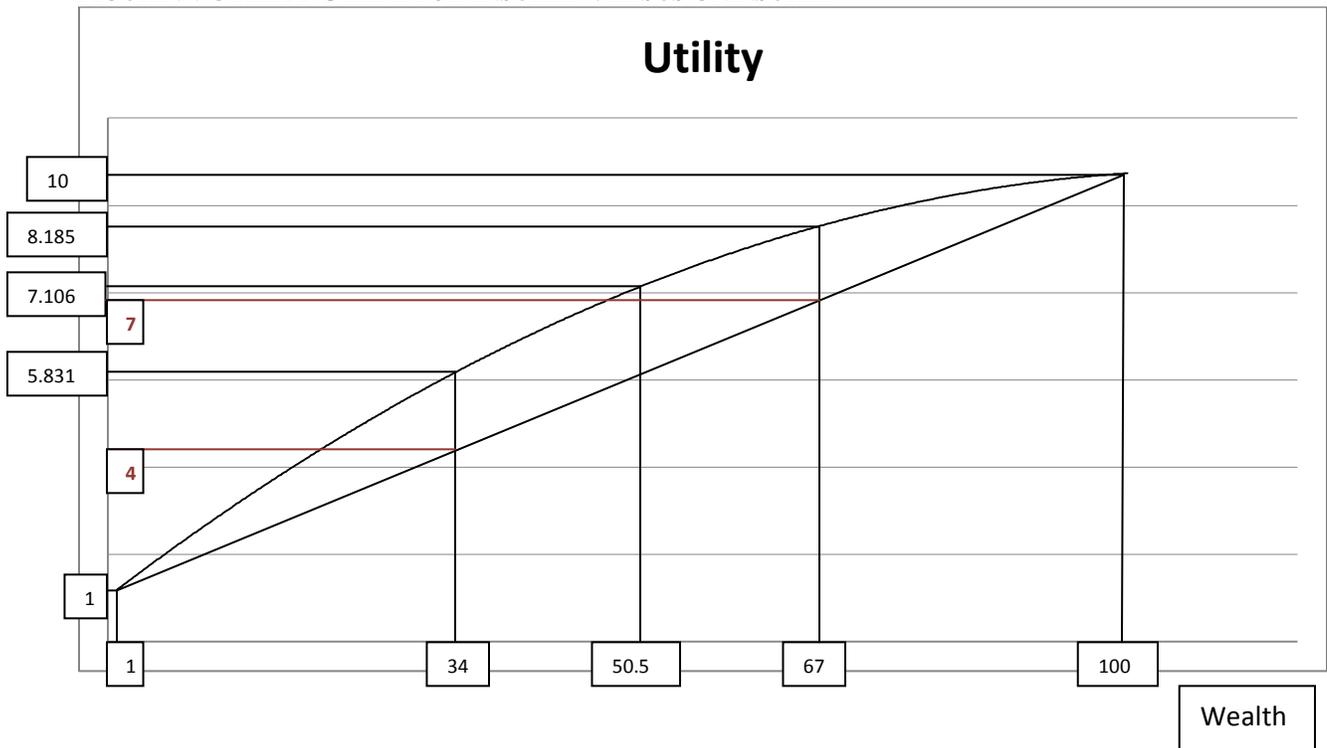
$$U_{\text{Male}} = 1/3\sqrt{100} + 2/3\sqrt{1} = 4.0$$

From this example it can be seen that females would have a higher utility by not buying insurance rather than buying insurance at the higher pooled premium price. If this was a real life example, Insurer B

would continue to attract the female customers from Insurer A and the insurance death spiral discussed in the previous chapter would begin for Insurer A (Doherty, 1985).

This example proved numerically the importance of the development of new, innovative rating variables that charge people a pure premium based on their true expected cost in order to remain competitive in the auto insurance market. Below is a graph of the utility function used.

FIGURE 9: UTILITY GRAPH FOR INSURED VERSUS UNINSURED



V. RISK CLASSIFICATION STANDARDS

There are three basic methods that insurers use to quantify the expected loss of an insured. The first method is the use of underwriters' informed judgment about the nature of the insured and his or her exposure to loss. It is the underwriters' decisions whether to accept or decline a candidate for insurance.

The second method is the method of deducing an individual's expected loss is through experience rating. This method observes the individuals actual losses in the past to predict future losses. This method is sometimes controversial, however, because collected data maybe greatly outdated.

The first two methods are often better for large commercial accounts, where risks are very individualized. When dealing with smaller, personal risks, risks must be grouped or pooled together in order to form a predicted loss. In order to group these risks into categories that have similar expected losses and to avoid heterogeneous groups as discussed in the previous two chapters, risk classification must be used (Walters, 1981).

5.1 STANDARDS AND MYRATE COMPARED TO STANDARDS

Now, we will explore what variables are appropriate to use in risk classification. In the introduction, we have already discussed the most common variables for auto insurance. These common variables were developed by insurers and accepted by state regulation. In order to develop these variables and to have them be accepted for use, actuaries use guidelines outlined a paper written by Michael A. Walters in May of 1981 entitled "Risk Classification Standards." In this paper, seven risk classification standards as well as seven nonstandard (but often desired) qualities of rating variables are developed. These rating variables are in line with the three basic rules of insurance rates; rates should be adequate, rates should not be excessive, rates should not be unfairly discriminatory.

In this section, these standard and nonstandard qualities will be presented, followed by an interpretation of how well the use of Progressive's MyRate as a variable fits these standards.

As noted by Walters, The first seven classification standards can be broken into three distinct categories; Homogeneous Category, Well-Defined Category, Practical Category.

Homogeneous Category

Standard 1: Similar risks should be assigned to the same class with respect to each variable while dissimilar risks should be assigned to different classes. This first standard is the true meaning of homogeneous. If classes are homogeneous, it will help the insurer avoid adverse selection as discussed in chapters three and four of this paper.

MyRate compared to Standard 1: MyRate would only increase homogeneity within classes. MyRate allows Progressive to more narrowly define rating classes. In actuality, practically everyone has a personalized insurance premium based on their individual driving experience.

Standard 2: The characteristic used to group insureds should reasonably relate to the potential for loss. This is often referred to as the “reasonable relationship” standard. This means that there should be a correlation between the characteristic and the loss, but not necessarily causation.

MyRate compared to Standard 2: MyRate certainly reasonably relates to the potential for loss. MyRate specifically measures variables that cause an increase in losses such as driving at night, quick accelerations and decelerations, and high mileage.

It is important to note that while it is desirable to have homogeneous classes, it is impossible for individuals to have identical expected losses. Therefore, although a group is supposed to be as similar as possible, there must be enough individuals in a group for the data from the group to be credible and to be able to use the law of large numbers in approximating expected loss.

Well-Defined Category

Standard 3: The classes should be exhaustive and mutually exclusive. This means that an individual should always fall into one, but only one category. Therefore, this individual can be assigned a rate, but only one rate.

MyRate compared to Standard 3: As long as Progressive defines classes very specifically, MyRate should allow for classes to be exhaustive and mutually exclusive. For example, one class may be: Drives between the hours of 2 a.m. and 4 a.m. once a month, has accelerations and decelerations of greater than 10 miles per second 5 percent of time, and drives between 300 and 500 miles per month. In addition, to allow for the most accurate placement of customers, MyRate would allow Progressive to adjust insureds into new classes based on most recent received data.

Standard 4: Class definitions should not be ambiguous. This means that classes should be clear and objective. For example, an ambiguous class would be ‘bad drivers.’ A clear and objective definition would be ‘a driver who has had three or more accidents in the past year.’

MyRate compared to Standard 4: As stated in the comparison to Standard 3, as long as Progressive clearly and objectively defines classes based on the data they are collecting, this standard will be met.

Standard 5: The insured should not be able to misrepresent his or her classification. This is pretty self explanatory. The person applying for insurance should not be able to lie about or to manipulate data used in classification.

MyRate compared to Standard 5: Because MyRate wirelessly transmits data to Progressive based solely on driving habits; the insured will not be able to manipulate his or her classification.

Practical Category

Standard 6: The cost of administering a rating variable should not outweigh the benefits. Being cost efficient is a must to any insurance company. If a company is losing money by using a particular classification method, it should abandon this method.

MyRate compared to Standard 6: The cost to administer MyRate or similar systems may prove to be too costly for smaller companies. However, Standard 6 does not say that a variable must be cost effective for all insurers, but cost efficient for the insurer that is using it. There are many technology and data storage costs associated with such systems. When Progressive was questioned by the author or this thesis through email about the cost per person to administer MyRate, they declined to comment due to competition reasons. However, a representative did mention that the \$30 technology fee per billing cycle does go towards covering these costs (Everett, 2009).

Standard 7: The class rating variables should be subject to measurement by experience data. This refers to the fact that experience data should be used to supplement any other rating variable.

MyRate compared to Standard 7: MyRate can be verified by comparing the data to actual experience data (previously collected data on accidents and losses). Moreover, MyRate data is the most current, accurate experience data that can be collected on an insured in addition to accidents turned into Progressive.

5.2 NONSTANDARDS AND MYRATE COMPARED TO NONSTANDARDS

The seven nonstandard, but often desired qualities will now be presented. These qualities were judged by Walters to be not as important and in fact unnecessary in the classification system. However, they are often held as highly important by both regulators and the public.

Nonstandard 1: Controllability. Controllability refers to the ability of the insured to determine by his or her behavior the class to which he or she is assigned. This nonstandard would allow the insured to alter behavior to reduce both individual and overall losses. Although this is ideal, some variables which are

necessary in ratemaking simply cannot be controllable. For example, an insured cannot control his or her age, a major determinant in the price of auto insurance.

MyRate compared to Nonstandard 1: MyRate allows customers to control their behaviors that will determine to which class he or she is defined. By driving fewer miles, driving at safe times, and driving cautiously, a driver can allow his or her self to be placed into a lower risk group. In addition, MyRate enables customers to continually monitor and improve their class status by viewing online information related to their personal behaviors.

Nonstandard 2: Incentive Value. This ties in closely with controllability. Incentive value refers to a rating variable persuading people to change their behavior in order to incur a smaller premium. In order for a rating variable to have this quality, it must also be controllable.

MyRate compared to Nonstandard 2: MyRate gives people incentive to alter their behavior. By driving safely, a customer can lower his or her auto insurance premium by 25 percent or more, a significant amount that would prompt changes.

Nonstandard 3: Causality. It is desired that the behavior being measured ultimately causes the loss. This makes both the public and regulators feel that the variable has merit. As previously noted, there is only a need for correlation. Therefore, insurers do use variables that only have a correlation such as credit scores in car insurance. Having poor credit does not cause car accidents. However, having poor credit does indicate lack of financial responsibility, which could lead to an indifference towards having a car accident.

Regulators often disagree with this quality that pricing variables only need to show correlation to potential for loss. For example, many regulators felt that credit scores have no direct relationship to safe driving. Additionally, they felt that credit scores were a way to redline unwanted groups of people. In January 2010, Washington state senator Sharon Nelson argued against the use of credit scores stating,

“This method of rating policy holders has disproportionately impacted communities of color, especially Latino and African-American communities, which has resulted in higher policy premiums that they can’t afford,” said the bill’s sponsor. “Even those with good credit histories may be just one financial crisis or one late payment away from a significant change in their credit score, which could considerably increase their insurance rates even if they’ve never filed a claim or had a driving infraction (Nelson, 2010, p.1).”

MyRate compared to Nonstandard 3: MyRate is a rating variable that does measure causality. If an insured is a poor driver, this is directly related to their expected loss.

Nonstandard 4: Separation. This refers to whether classes are different enough in their expected losses to merit the setting of different premiums. If an insured is placed in one class but has loss experience closer to another class, these classes are not well separated.

MyRate compared to Nonstandard 4: There are some separation problems foreseen with MyRate.

Although the system would allow for homogeneity within classes, there is potential for a person in one class to have actual loss experience that would more closely fit with another class. For example, if a person drives only during safe hours, but has patterns of hard accelerations and decelerations they would be placed into the appropriate corresponding category. However, the ultimate cause of their accident may not be related to this unsafe driving, but may be during safe driving hours. Therefore, Progressive must decide the most appropriate ways to weight each of the three variables it measures.

Nonstandard 5: Reliability. Reliability simply means that a rating variable be objective, well defined, and easy to verify.

MyRate compared to Nonstandard 5: MyRate is a reliable standard in definition. It is objective, clearly defined, and easy to verify (once installed). However, MyRate may have technological reliability issues if the system malfunctions or if an insured receives a faulty MyRate.

Nonstandard 6: Social Acceptability. This quality references whether a rating variable is popular with the public. Unfortunately, many rating variables that are statistically great for ratemaking are also very unpopular with the public. The public does have an influence on what regulators deem as unfairly discriminatory rating variables.

MyRate compared to Nonstandard 6: Social acceptability can pose a definite problem for MyRate. Although the system does not include a GPS component, possible customers still fear the ‘big brother’ affect. Privacy as a consideration for a rating variable will be discussed in more detail at the end of this chapter.

Nonstandard 7: Admissibility. This ties in closely with social acceptability. For a rating variable to be admissible, it must be accepted on all levels, both regulatory and with the public.

MyRate compared to Nonstandard 7: MyRate may be having a tough time getting accepted by insurance regulators. As of January 2010, MyRate is only accepted in 19 states. However, this may also be due to the fact that Progressive wants to slowly release their product, state by state, in order to monitor factors such as public acceptance and administration costs (Walters, 1981).

5.3 PRIVACY AS A RISK CLASSIFICATION STANDARD

The Walters paper was published in 1981, and needless to say, much has changed since then. In particular, technology has developed at exponential speeds. With this development comes new ways to become connected to those in the world around us. Cellular phones allow people to communicate to anyone in the world at any time. The internet’s social networking sites such as Facebook and Twitter allow users to access others’ personal information at a blink of the eye. Much the same, computer rating systems such as MyRate, allow insurers to gather the most up to date driving data about a customer.

As of now, some states are slow to adopt MyRate as an appropriate and acceptable rating variable. All evidence for why points towards privacy concerns. For example, consumer advocacy groups

such as Consumer Watchdog in California strongly protest against the use of location data in setting insurance premiums (Carr, 2009). Groups such as these have a major influence on whether or not insurance commissioners from each state allow a rating variable to be used.

Although MyRate does not use a GPS component, many still feel that it gives insurers a glimpse into their private lives. Others, however, think that it is a great way to reduce insurance premiums. Others, still, think it is a great way to help the environment by reducing mileage driven. It seems that many insurance commissioners are beginning to agree with this third group. At an NAIC meeting held in summer 2009, The Climate Change and Global Warming Task Force met and discussed pay-as-you-go insurance as a green insurance option. They highlighted some advantages of pay-as-you-go insurance.

The Climate Change and Global Warming Task Force stated that pay-as-you-go insurance increases road safety by providing incentives for drivers to drive more cautiously. In addition, it keeps people off of the road at unsafe hours when more accidents occur. They also argued that pay-as-you-go insurance saves energy and reduces emissions (including greenhouse gases). This is achieved because premiums are based on mileage, therefore, customers will drive less. This also leads to reduced road congestion. Finally, they argued that because people will be driving less and driving more safely, this will ultimately lead to reduced road and parking facility costs. They cited MyRate as a system that could achieve all of these things (Climate Change, 2009).

Therefore, it looks as though commissioners may be leaning towards the acceptance of pay-as-you-go systems for ratemaking (although it may only be for the reason of satisfying consumer groups focused on the environment). With the popularity of MyRate and pay-as-you-go insurance increasing, there is sure to be an intense debate about its acceptability. The question remains: should privacy be taken into account for a rating variable? The answer is yes. If the author of this thesis was to set up guidelines for privacy as a rating variable, she would state the following:

A rating variable that raises privacy concerns should be allowed if the variable or system is voluntary and all information is properly explained to the customer.

However, if such a system would become non voluntary, then the following should apply:

The general public, who is being subject to this rating variable, should not feel a threat of any kind from this variable or the information gathered, whether the threat is of safety, legal, social, or ethical concern. If the public does feel a threat from the variable, the variable must be made voluntary.

5.4 REVIEW

MyRate seems to be an excellent rating variable. It meets all of the standards required for a variable. It may, however, prove to be too costly for small insurers. As for the desired but unnecessary non standards, MyRate also fares well. In particular, MyRate is great at allowing insureds to alter their behavior in order to be placed into a desired class. MyRate does run into some problems with social and regulator acceptability that Progressive is actively trying to work on.

As of now, MyRate is a voluntary program. However, in the future, as MyRate becomes more popular, and regulators start encouraging the use, Progressive may start charging a higher premium to those customers who choose not to use the system. This is based on the concept that those who choose not to use MyRate might do so because they know they have poor driving habits and are unwilling to change them. Therefore, in effect, MyRate will no longer be a voluntary program. When this occurs, that is when the debate between insurers, regulators, and the public about whether MyRate (and similar systems that raise privacy concerns) are appropriate rating variables.

VI. PROGRESSIVE'S RESULTS

We have gone through the theory of insurance competition and have shown that through innovation in the underwriting process, specifically through developing new ratemaking variables, an insurance company can beat out its competitors. We have also looked at Progressive's history of being an innovator in pricing and their new rating variable, MyRate. Finally, we examined the Actuarial Standards Board's standards for a rating variable and saw how MyRate compared. Now, this chapter will step away from theory and focus on actual results at Progressive. These results will hopefully show that Progressive, through innovation, is taking its spot as a leading insurer.

6.1 COMPETITORS

When looking at Progressive's results, it is first important to identify its competitors. The following is a list of Progressive's top nine competitors. These companies are considered Progressive's top competitors because they have the highest net written premiums in private passenger auto insurance. Keep in mind that some of these companies are stock insurers, while others are mutual insurers. When Progressive's stocks are later compared with competitors, the mutual insurers will not have stock performance information.

FIGURE 10: PROGRESSIVE'S TOP COMPETITORS IN PRIVATE PASSENGER AUTO BASED ON PREMIUM

STATE FARM GROUP	NATIONWIDE GROUP
ALLSTATE INSURANCE GROUP	USAA GROUP
BERKSHIRE HATHAWAY GROUP (GEICO)	AMERICAN INTERNATIONAL GROUP
FARMERS INSURANCE GROUP	LIBERTY MUTUAL INSURANCE COMPANIES
TRAVELERS INSURANCE COMPANIES	

SOURCE: BEST'S AGGREGATES AND AVERAGES, 2008.

6.2 STOCK PRICES

Next, Progressive's stock price will be examined and compared to its major stock insurer competitors. The chart found in **APPENDIX II** shows Progressive's stock price over the last decade. The stock price climbed very quickly from 2000 to its peak in late 2005. This was followed by a decreasing trend into the financial crisis, when Progressive's stock reached an all time low in early 2009. Since then, the stock price is recovering and closed on February 14, 2010 at \$16.71 (Progressive Corp., 2010).

In order to attach value to these stock prices, Progressive's stock was compared to the S&P 500 index, as well as to its major competitors. The major competitors used were: Allstate (ALL), GEICO (BRKA), Farmers (ZFSVY), Nationwide (NHP), and Travelers (TRV). From the graphs found in **APPENDICES III- VIII**, it can be seen that the Progressive Corporation has consistently well outperformed the S&P index as well as all its major competitors since 2000. Nationwide was the only competitor with stock prices very close to Progressive's from 2008 on (Progressive Corp., 2010).

6.3 RETURN ON EQUITY

Return on equity shows a company's efficiency at generating profits. Therefore, it is important to look at Progressive's return on equity ratios over the last ten years.

$$\text{Return on Equity} = \frac{\text{Net Income After Tax}}{\text{Shareholder Equity}}$$

FIGURE 11: PROGRESSIVE'S ROE OVER THE LAST 10 YEARS

2000	1.7%	2005	25.0%
2001	13.5%	2006	25.3%
2002	19.3%	2007	19.5%
2003	29.1%	2008	(1.5%)
2004	30.0%	2009	21.4%

SOURCE: THE PROGRESSIVE CORPORATION AND SUBSIDIARIES TEN YEAR SUMMARY, 2009.

As can be seen in the above chart, Progressive's return on equity was very good in most years. One year that noticeably stands out is 2008 at a -1.5%. This low number is due to the financial crisis. Progressive bounced back in 2009 with a return on investment of 21.4%.

6.4 LOSS RATIOS

Next, Progressive's loss ratios for the years 2001 to 2007 will be compared to its competitors. Loss ratios are the company's incurred losses divided by their earned premiums. If a company incurs fewer losses, and brings in more premium, the loss ratio will be smaller, and therefore better (Insurance Glossary).

$$\text{Loss Ratio} = \frac{\text{Incurred Losses}}{\text{Earned Premiums}}$$

The combined ratio is the sum of two ratios. One is the incurred losses plus loss adjustment expenses divided by the earned premium. The other is all other expenses divided by written premiums. If the combined ratio is under 100 percent, that indicates an underwriting profit (Insurance Glossary).

$$\text{Combined Ratio} = \frac{\text{Incurred Loss} + \text{LAE}}{\text{Earned Premium}} + \frac{\text{All Other Expenses}}{\text{Written Premium}}$$

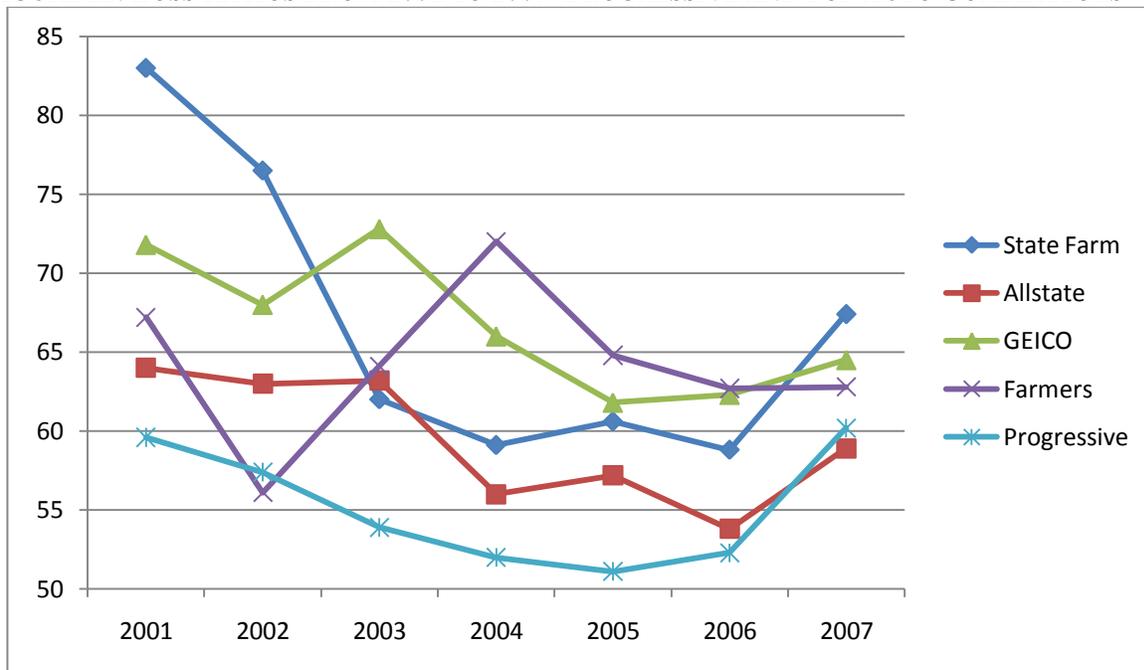
To define a few more terms: an incurred loss is a loss that actually happened and was reported. Loss adjustment expense (LAE) is the cost of investigating or adjusting losses. Earned premium is the portion of a policy's premium that has expired. Written premium is the full premium written for the policy term (Insurance Glossary).

It is also worth noting that insurers make a profit in two ways. The first way is through underwriting, and is measured, as stated before, by having a combined ratio less than 100 percent. A low combined ratio is therefore desired. However, many insurers are lax when it comes to underwriting profit,

because they figure they can make an investment profit. Investment profit is the profit earned on a premium while it is being held by the insurer before claims are paid out (Insurance Glossary). Firms who can achieve profit in both areas have a clear competitive advantage. Therefore, it is important to focus on underwriting profit as well as investments.

As discussed earlier, Progressive achieves underwriting profits by being innovative in their underwriting process. Noting that loss ratios are a large component of the combined ratio, Progressive's loss ratios for the years 2001 to 2007 will now be compared to its competitors. The loss ratio is a better metric to use here because Progressive's combined ratio would appear much higher than competitors like GEICO, who do not have initial expenses agents. Looking at the loss ratio information below, it can be seen that Progressive consistently has lower loss ratios than competitors over the last seven years. In fact, of the top five competitors, Progressive has the lowest seven year average loss ratio of 55.21.

FIGURE 12: LOSS RATIOS FROM 2001 TO 2007- PROGRESSIVE AND TOP AUTO COMPETITORS



SOURCE: BEST'S AGGREGATES AND AVERAGES, 2008.

FIGURE 13: LOSS RATIOS FROM 2001 TO 2007- PROGRESSIVE AND TOP AUTO COMPETITORS

	State Farm	Allstate	GEICO	Farmers	Progressive
2001	83	64	71.8	67.2	59.6
2002	76.5	63	68	56.1	57.4
2003	62	63.2	72.8	64.1	53.9
2004	59.1	56	66	72	52
2005	60.6	57.2	61.8	64.8	51.1
2006	58.8	53.8	62.3	62.7	52.3
2007	67.4	58.9	64.5	62.8	60.2
7 Yr Av.	66.77	59.44	66.74	64.24	55.21

SOURCE: BEST'S AGGREGATES AND AVERAGES, 2008.

6.5 GROWTH

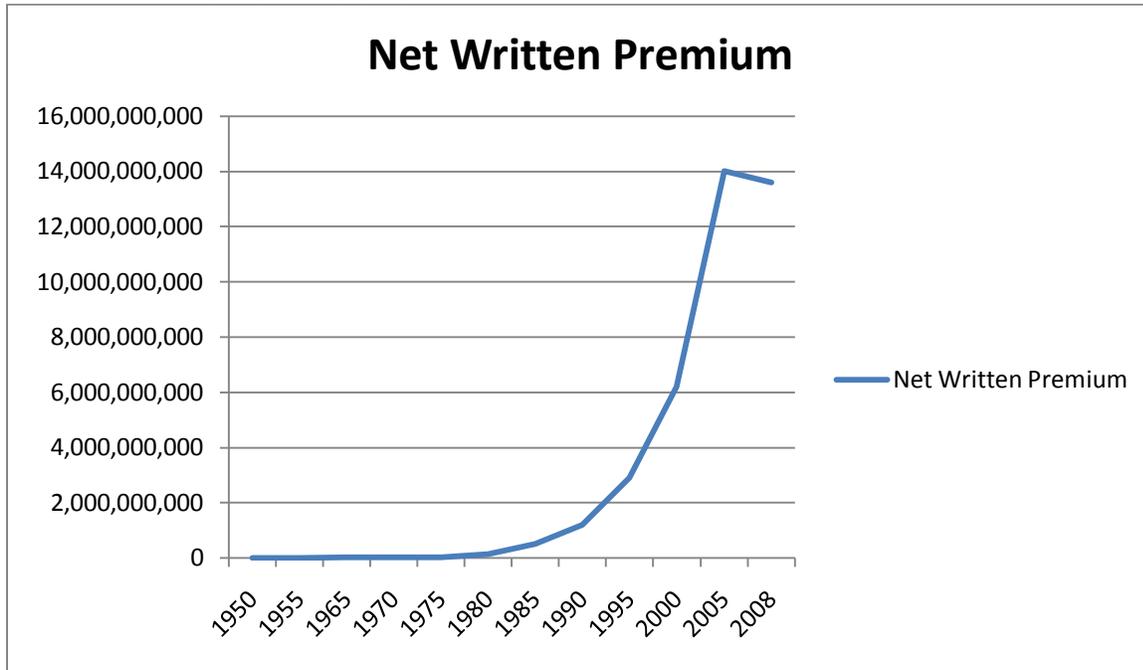
From its inception, Progressive has grown at astronomical rates. The following chart shows the net written premium by Progressive from 1950 to 2008.

FIGURE 14: PROGRESSIVE'S GROWTH IN NET WRITTEN PREMIUM 1950-2008

YEAR	NET WRITTEN PREMIUM
1950	1.5 million
1955	3.2 million
1965	19.3 million
1970	23.4 million
1975	37 million
1980	156 million
1985	522.9 million
1990	1.196 billion
1995	2.9 billion
2000	6.196 billion
2005	14.008 billion
2008	13.6 billion

SOURCE: PROGRESSIVE AUTOBIOGRAPHY

FIGURE 15: PROGRESSIVE'S GROWTH IN NET WRITTEN PREMIUM 1950-2008



SOURCE: PROGRESSIVE AUTOBIOGRAPHY

From the previous discussions on stock prices, loss ratios, and growth rate, it can be seen that Progressive's results are nothing short of amazing. They generally have high stock prices and low loss ratios when compared to competitors. Also their growth rate has been exponential. Therefore, it seems as though the results match the theory. If an insurer is innovative in underwriting, they will be very competitive in a large market such as auto insurance.

VII. CONCLUSION

This thesis has shown that in order to remain competitive in a large insurance market, an insurer must be innovative in its underwriting and ratemaking process. Many times this is achieved by using new rating variables for risk classification. If an insurer is able to be a first mover in improvement of risk classification, they will have the opportunity to be very profitable. This theory was demonstrated in chapter four using a utility model.

This thesis also looked at the specific example of The Progressive Corporation. Progressive is very well known as an innovator in insurance underwriting and ratemaking. Over their history, they have developed databases full of customer information that they use to set a customer specific premium. They were a pioneer in the very successful yet controversial use of credit scores for ratemaking. Finally, they are leaders in developing pay-as-you-go rating systems such as MyRate.

Because of these developments in underwriting and ratemaking, Progressive has had very successful results. We have seen that Progressive beats out its competitors in stock price and in loss ratios. We have also seen that Progressive has grown at outstanding rates. Therefore, we can conclude that the theory of innovation in risk classification does lead to desirable company results.

Finally, an underlying theme within this thesis was consumer privacy. As technology increases, insurers, like Progressive, will find more and more ways to be able to gather information about its customers. As this technology develops, insurance commissioners will be pushed by insurers to accept these new methods as appropriate rating variables. The Actuarial Standards Board has developed risk classification standards that insurers should follow when developing or considering a rating variable. These standards, however, are very outdated, and do not take into account technological advances. With technological advances often come questions about consumer privacy.

Privacy concern should therefore be considered as a standard for risk classification. Once again, if the author of this thesis was to set up guidelines for privacy as a rating variable, she would state the following:

A rating variable that raises privacy concerns should be allowed if the variable or system is voluntary and all information is properly explained to the customer.

However, if such a system would become non voluntary, then the following should apply:

The general public, who is being subject to this rating variable, should not feel a threat of any kind from this variable or the information gathered, whether the threat is of safety, legal, social, or ethical concern. If the public does feel a threat from the variable, the variable must be made voluntary.

Also, in the future, in order to be successful at using variables that question privacy, insurers should look to Progressive's pay-as-you-go systems as an example. Progressive has put a great deal of time in the development and tweaking of these systems. They have made their latest system, MyRate, as least invasive as possible while still collecting relevant data. Progressive has also been smart about making the program completely voluntary with the option to terminate use if customer is dissatisfied. Finally, they have also introduced the product slowly on a state by state basis in order to view and understand consumer reactions.

All of these steps taken by Progressive were crucial in making MyRate a success. The ultimate goal of MyRate is to attract low risk customers, not scare them away. Therefore, when initiating the use of a rating variable that raises privacy concerns, an insurer must take the necessary steps to insure a positive public reaction, as Progressive has done.

APPENDICES

APPENDIX I- PERSONAL AUTO POLICY

The PAP consists of a declarations page, a definitions page, and the following six parts:

Part A: Liability Coverage

Part B: Medical Payments Coverage

Part C: Uninsured Motorists Coverage

Part D: Coverage for Damage to Your Auto

Part E: Duties after an Accident or Loss

Part F: General Provisions

The declarations page is a page that provides information about the car to be insured. Information in the declarations is used to set premiums, and to identify the insured auto. The definitions page is a page of key words or phrases used throughout the policy. For example, words like “we” and “your.”

Part A: Liability Coverage covers the insured against a law suit or claim that comes about due to an auto accident. This claim alleges that the vehicle operator was negligent in the ownership and operation of their vehicle. Usually, the liability coverage is written as split limits. This is where the amounts of insurance for bodily injury and property damage are listed separately. For example: \$250,000/\$500,000/\$100,000 means that the policy allows for coverage of up to \$250,000 per person with bodily injury in an accident, \$500,000 for the total bodily injury amount, and \$100,000 for property damage. Liability coverage is often considered the most important part of the insurance policy due to the potential for high loss amounts. All states have insurance laws that require drivers to carry some

minimum amount of liability insurance or post a bond at the time of an accident. Therefore, auto insurance in almost every state is required by all drivers.

Part B: Medical Payments Coverage are benefits covering all medical and funeral expenses incurred to the insured or those in the insured's car, regardless of fault. Therefore, if you are in an accident, and are found at fault, medical payments may still be made to you. Medical payments coverage is not required in a PAP.

Part C: Uninsured Motorists Coverage covers bodily injury and property damage that arises due to accidents caused by uninsured drivers, hit and run drivers, drivers who have inadequate insurance, and drivers whose insurance company is insolvent. Uninsured motorist coverage is not required in a PAP.

Part D: Coverage for Damage to Your Auto provides coverage for damage or theft of a car. It covers collision damage where you are at fault, missiles or falling objects, fire, theft, explosion or earthquake, windstorm, hail, water, flood, vandalism, riot, contact with a bird or animal, and glass breakage. Coverage for damage to you auto is not required in a PAP.

Part E: Duties After an Accident or Loss states the insured's obligations after an accident occurs. These include determining if anyone is hurt, notifying the police, giving the other driver your information, getting the information of the other driver and witnesses, not admitting fault, notifying insurance agent promptly, and cooperating with the insurer in the investigation and settlement of the claim.

Part F: General Provisions can contain a number of general provisions such as information about your policy period and out of country coverage, and policy termination information.

(Rejda, 2003).

APPENDIX II- PROGRESSIVE'S STOCK PRICE OVER THE LAST DECADE



SOURCE: PROGRESSIVE CORP., 2010.

APPENDIX III- PROGRESSIVE VERSUS THE S&P INDEX OVER THE LAST 10 YEARS



SOURCE: PROGRESSIVE CORP., 2010.

APPENDIX IV- PROGRESSIVE VERSUS ALLSTATE OVER THE LAST 10 YEARS



APPENDIX V- PROGRESSIVE VERSUS NATIONWIDE OVER THE LAST 10 YEARS



SOURCE: PROGRESSIVE CORP., 2010.

APPENDIX VI- PROGRESSIVE VERSUS TRAVELERS OVER THE LAST 10 YEARS



SOURCE: PROGRESSIVE CORP., 2010.

APPENDIX VII- PROGRESSIVE VERSUS GEICO OVER THE LAST 10 YEARS



APPENDIX VIII- PROGRESSIVE VERSUS FARMERS OVER THE LAST 10 YEARS



SOURCE: PROGRESSIVE CORP., 2010.

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- Inspected both internal data and industry data from ISO
- Calculated loss ratios for new specialty segments and trended them to effect launch dates in order to demonstrate that segments still profitable going into future
- Produced an excel program that generates the amount of new business OneBeacon would need to write given desired market share and percent growth
- Collected and organized new segment industry data from Hoovers online database
- Performed extensive data collection for an upgraded worker's compensation pricing tool

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THE PRESIDENT SPARKS AWARD
For maintaining a 4.0 grade point average during sophomore year
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