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THE ELIMINATION OF GENDER AS A RATING FACTOR  
IN INSURANCE PRICING

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## ABSTRACT

With an increased focus on social equity in all aspects of daily life, insurance companies have recently been scrutinized for their use of gender as an identifying risk factor in the underwriting process. The general principles of insurance rely on an underwriter looking at a prospective insured's application and placing them into a risk category with others of similar risk. From there, the policyholder will be charged a rate for insurance based on the risk that the insurance company expects them to impose. Some examples of factors that are considered when creating these rates include age, relevant history pertaining to the type of insurance, and gender. A recent question has been focused around whether it is necessary to include gender as a factor in insurance pricing.

In 2012, the European Union implemented a law that no longer allows private insurance companies to consider gender when pricing insurance. As of January 2019, six states in the US have adopted this socially aware practice in their automobile insurance pricing methods.

This thesis serves to explore this social issue and how it pertains to the insurance industry. Through thorough investigation of the current adjustments to insurance pricing in the European Union, comparisons will be drawn to the automobile industry in the United States and extended to consider options as the industry continues to evolve its pricing rules with these new restrictions.

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## **Chapter 1**

### **Introduction**

The insurance industry exists to manage risks that come with the uncertainty of life. When an insurance product is purchased, an individual is looking to transfer their risk to an insurance company that will pay in the event of a loss. The intricacies of insurance rely on the ideas of predicting the uncertainty of future events occurring and translating this to an expected cost. Insurance has been around in many different forms through all of history. Given its long and thoroughly developed background, insurance companies have grown and created precise methods to price insurance products through the examination of factors that influence a consumer's risk. Certain factors have been found to create more or less risk depending on the line of business, and gender has been one of these such factors.

To ensure that an insurance company has enough money to pay for potentially incurred losses, companies will take on a large number of customers with similar characteristics and pool them in to a risk category via the underwriting process which will be discussed in further detail in Chapter 2. By the Law of Large Numbers, insurance companies are able to find a premium price that will fit the risk associated with this pool's characteristics and grant the company comfort that they will be able to cover the cost of filed claims.

As mentioned, risk categories are created by pooling together individuals with similar traits, one of which has historically been gender. Chapter 3 will further explore the roles that gender has played in both automobile insurance and life insurance.

This risk factor has recently been called in to question because of the possibility of discrimination based on this human characteristic that is out of an individual's control. The European Union has tackled this issue by outlawing the use of gender in insurance pricing. A law was passed in 2012 which laid out the terms that prohibit commercial insurance companies from pricing based on gender. The details of this will be outlined in Chapter 4.

Chapter 5 takes a look at how the United States has addressed this issue, as certain states in the US have also decided to create laws that prohibit gender to be used in pricing. As this legislation is new in the United States this year, this chapter will explore what one may expect to happen as time goes on.

Finally, as this gender neutral pricing continues to grow and expand to different locations as well as different lines of business, it is interesting to see how insurance companies and the insurance market will react to these changes. Chapter 6 will summarize all the ideas presented throughout this paper.



## Chapter 2

### Risk Pooling in Insurance Underwriting

Insurance aims to mitigate the financial implications that come with an accidental loss. An insurance company contractually agrees to pay for losses that are incurred on an insurable risk in exchange for a fee collected as premiums, usually throughout the term of the contract.

An insurable risk is anything that is susceptible to danger of loss. Traditionally, insurance products are intended to cover a loss that fits certain criteria. Something is an insurable risk if there is a large number of homogeneous exposures, the loss is out of control of the policyholder, and evaluations can be conducted by the insurance company to determine the true value of the loss. Also, insurance companies desire that all insureds are unable to be effected at the same time to the same degree by a catastrophic occurrence, and the premium must be within reason of the risk imposed on the insurance company. It is interesting to note that it is difficult to find insurable risks that perfectly meet all of these requirements, but insurance for automobiles, health, and life do closely fit these definitions.<sup>1</sup>

Insurance is attractive to consumers for many different reasons. For certain types of insurance, such as automobile insurance, it is required by law to possess. This is because a driver can incur a loss for themselves while operating an automobile, but one can also cause a loss to another driver on the road. For other types of insurance, such as life insurance, people want to plan for the future and provide financial comfort for their family in the case of an unexpected death. In health insurance, the cost of attending a doctor's visit or receiving a prescription could be more than a monthly premium so it makes sense to invest in the insurance policy that could

<sup>1</sup> Roth RJ. Insurable Risks, Regulation, and the Changing Insurance Environment.

subsidize these future costs. Also, the mandate in ObamaCare requires all individuals in the United States to have health insurance or be subject to a financial penalty. Uniting all these different lines of business is the idea of consumers being risk-averse. When insurance is at a reasonable price, a consumer who is risk-averse would prefer to forgo the payment of the total loss in the case that it does occur and would rather pay smaller amounts over time in exchange for the comfort of not having to pay the full cost of a loss.

Even with risk aversion and the idea that people would rather pay small amounts now than have the chance of paying a large amount if a loss occurs in the future, insurers must charge a reasonable price for this service. In the case where the insurance company charges actuarially fair premiums, it would make sense for a risk-averse person to purchase the insurance, as this is a fair price for the expected loss. If an insurance company were to charge a premium that is higher in absolute value than the expected loss, the policyholder would realize that in the case of a loss occurring, they would be better off paying the full amount than paying premiums that would accumulate to costing more than the amount of the loss. Since there is also the uncertainty as to whether the loss will even occur or not, a reasonable consumer would realize it would make sense to just hold the money themselves in the case of the loss rather than pay an insurance company more than the value of the loss and bet on the possibility that it may not happen. To attract customers and make sure that the insurance market is efficient, it is important that premiums are reasonably priced relative to the actual risk of the individual consumer.

To correctly capture the risk of an insured life, insurance companies use a tool known as underwriting. This is where an insurance company gathers information about the new policyholder and any characteristics that are correlated with the individual's risk. Each specific type of insurance may use different risk factors to determine an individual's risk. For example,

some of the top factors considered when assessing loss potential for automobile insurance are age, gender, marital status, and driving experience. An underwriter looks at these personal factors and determines the risk this policyholder imposes on the company and determines if the company will bear the risk. All of these factors help give the insurance company a better idea of an individual's risk profile, but recently the use of gender as a rating factor has been criticized for being a discriminatory factor. This paper will investigate the legitimacy of this argument and how countries are dealing with the removal of gender from insurance pricing.

After the underwriting process occurs, the insurer places this policyholder in to a risk category. This risk pool will ideally group together individuals with homogenous traits and base a premium off their predicted risk, which can be estimated based on historical data, given their characteristics. This idea for pricing insurance relies on the Law of Large Numbers which states that if you can create a large group of people with assumedly homogenous risk, their average cost will tend towards the expected value. Therefore, the insurance company can plan on saving an expected amount for that group of members. As more members are added to the pool, the less likely it becomes that the reserved funds will fail to cover the cost that these members impose on the company. Although this principle relies heavily on the number of members in the pool, there is also a need for all members to have similar risks, so that their expected cost can be accurately accounted for.<sup>2</sup>

Each company has its own underwriting guidelines, but the use of risk pooling, which provides the basis for the Law of Large Numbers, is a fundamental principle overall. Author of *General Insurance*, David Bickelhaupt (1983) provided this insight on the Law of Large Numbers in relation to insurance: "This is the 'magic' of insurance, increasing predictability and

<sup>2</sup> "On Risk Classification"

reducing risk through the use of the principle of large numbers. Insurers have learned the wisdom of insuring the largest number of similar risks possible." The predictability of risk comes with more insight on factors that help determine what the insurance company believes a certain member will cost the company. The more factors that can be used in matching alike policyholders, the more similar these groups will be and therefore their expected loss can be more closely approximated.<sup>3</sup>

Without the underwriting process, the insurance market would face issues with asymmetric information. When one party has more information than the other, it allows for that group to take advantage of the system and ultimately hurt the overall market. This issue can be illustrated through an idea presented by an economist, Akerlof, pertaining to the market for cars, more commonly known as "The Market for Lemons". In this example, there are good and bad cars but it is difficult to know which you are buying. Only the car dealer knows whether a car is actually good or bad, so they price their cars somewhere in between the value of the good cars and the bad cars. A car dealer will only sell cars that they know are lemons because he or she will profit from these sales. The better cars will not be sold because there will be a loss to the seller, as the value of the car is worth more than the price at which it is purchased. Ultimately, the market for cars will only consist of these "lemons" and people will not want to purchase cars anymore. This same phenomenon can occur in the insurance market as well, if there is the assumption that policyholders possess information about their risk type that is unobservable to the insurance company. If underwriting did not exist, insurers would not know if people were of high or low risk so they would price insurance somewhere in between the value of the two. After a while, only the individuals that are high risk, and therefore paying less than their expected loss,

<sup>3</sup> Smith M.L., Kane S.A.

would continue buying insurance. This would cause a great loss to the insurance companies that no longer have the lower risk members to subsidize those higher risk policyholders.

Underwriting exists to prevent asymmetric information from causing a detriment to the insurance industry through adverse selection.<sup>4</sup>

Additionally, the issues that come with adverse selection can be addressed through offering options that allow individuals to self-select themselves, giving a better indication of the individual's true risk. Self-selection and underwriting together can help insurance companies to truly tailor an insurance contract to a individual. In theory, this self-selection process works when an insurance company offers different contracts that would attract people of certain risks. The insurance company could very simply design two products, one in which they sell an insurance contract that would meet the needs of low risk consumers and another that is crafted to meet the needs of a high risk consumer. Thus, when consumers chooses one of these contracts, they are giving the insurance company an indication of the risk that they believe they will impose on the company, without ever having to give away personal information.<sup>5</sup> Implementing both the self-selection contracts and underwriting together allow insurance companies to accurately identify the risk of a particular individual.<sup>6</sup> Given these examples presented, successful insurance pricing relies on best fitting the price for the policy to the risk that an individual imposes. If this is not done accurately, it can deter individuals from purchasing insurance or could cause a large loss to the insurer.

<sup>4</sup> Akerlof, George A.

<sup>5</sup> Rothschild, Michael, and Joseph Stiglitz.

<sup>6</sup> Crocker, K. J. and Snow, A.

## **Chapter 3**

### **Role of Gender in Insurance Pricing**

Any well-functioning insurance market exists by the principles of risk classification in order to create a pool of individuals with homogenous risks. The legal criteria for a risk factor requires that an insurance company cannot use unfairly discriminatory client characteristics to price insurance policies. Therefore, the use of gender in insurance pricing has been called in to question. The National Women's Law Center (2019) believes, "For decades, insurance companies discriminated against women. They charged women more or denied coverage altogether."<sup>7</sup> Although this organization was speaking about issues in the health insurance industry, there have been criticisms in all lines of insurance. This paper will explore the role of gender in both life and automobile insurance.

#### **Life Insurance**

Life insurance is seen as a tool for financial planning. There are various uses for this type of insurance that are made to fit different needs of consumers. Most life insurance plans pay out whenever the life of the policyholder ends, but special types of life insurance may provide compensation while the policyholder is alive, like annuities. The two most prominent types of life insurance are whole life and term life policies.<sup>8</sup>

<sup>7</sup> "Discrimination in Health Care."

<sup>8</sup> "Life Insurance Basics."

When it comes to pricing life insurance policies, a premium is charged to the policyholder so that when the policy ends, either at the time of death or at the end of an established term, the insurance company is able to pay out the agreed amount. To determine the cost of premiums, life expectancies are factored in to the calculations. For women, life expectancies are longer and therefore their premiums will be less than premiums for men, as the insurance company does not expect to pay out this amount until later. Women live longer than men in almost every country, including the United States. The graph below shows the difference in life expectancies between men and women in a variety of different countries, where the United States is highlighted in red. The x-axis states the country for which the data comes from and the y-axis details average life expectancy in years for men, women, and the overall life expectancy for people of that country.<sup>9</sup>

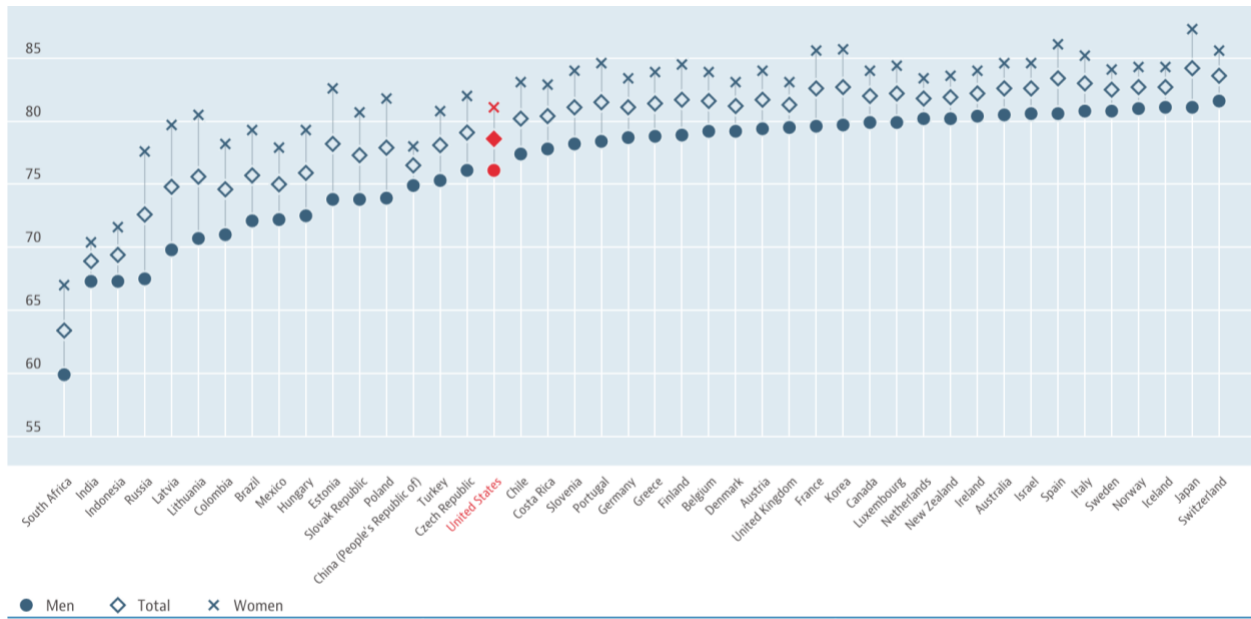


Figure 1. Life Expectancy at Birth

As this figure shows, women, on average, live about five years longer than men in the United States. Therefore, this would further explain why men pay more for life insurance. Since there is an expectation for males to die sooner, the insurance company will have to pay the death benefit on a whole life insurance policy earlier. In essence, if a male and female both purchase a certain life insurance policy for the same death benefit amount, the insurance company estimates that the woman will be alive longer and will therefore be able to pay premiums for a longer period of time given the life expectancy differences between males and females. Therefore, the woman will pay less for premiums than the man. Below is a figure of differences in women's and men's annual premiums for a \$250,000 term life insurance product from data gathered by an insurance price comparison website.<sup>10</sup>

**Table 1. Annual Premiums for Term Life Insurance Products**

Health Profile and Policy Term	Age 30	Age 40	Age 50
Female Non-Smoker 10-Year Term	\$232	\$318	\$598
Male Non-Smoker 10-Year Term	\$274	\$377	\$769
Female Non-Smoker 20-Year Term	\$303	\$466	\$948
Male Non-Smoker 20-Year Term	\$357	\$578	\$1,202
Female Non-Smoker 30-Year Term	\$426	\$693	\$1,573
Male Non-Smoker 30-Year Term	\$523	\$866	\$2,065

<sup>10</sup> *Compulife Quotation System as of Jan. 2019.*



As shown by this figure, males can end up paying a large difference in premiums because of this difference in life expectancy.

### **Auto Insurance**

Automobile insurance is required before one can legally drive a car in the United States. There are a many different components to automobile insurance contracts, but the most important and the only one that is required is the auto liability insurance. This part pays for medical costs and repairs when the policyholder is at fault for an accident. In a traditional auto insurance policy there are 6 components, all priced separately. These include bodily injury liability, personal injury protection, property damage liability, collision, comprehensive, and uninsured motorist coverage. Although these other components to an automobile insurance policy are not required by state law, they provide financial relief for the insured in the case that the individual is involved in an accident.<sup>11</sup>

The required liability insurance is very dependent on the driver's ability and estimated risk to the insurance company. Gender in automobile insurance pricing determines that males are typically riskier drivers. Certainly, there are many different factors that are considered risky in terms of driving, but a particularly measurable behavior is speeding. As this figure highlights, of fatal crashes, males display higher percentages of speeding than females.<sup>12</sup>

<sup>11</sup> "Auto Insurance Basics."

<sup>12</sup> National Center for Statistics and Analysis.

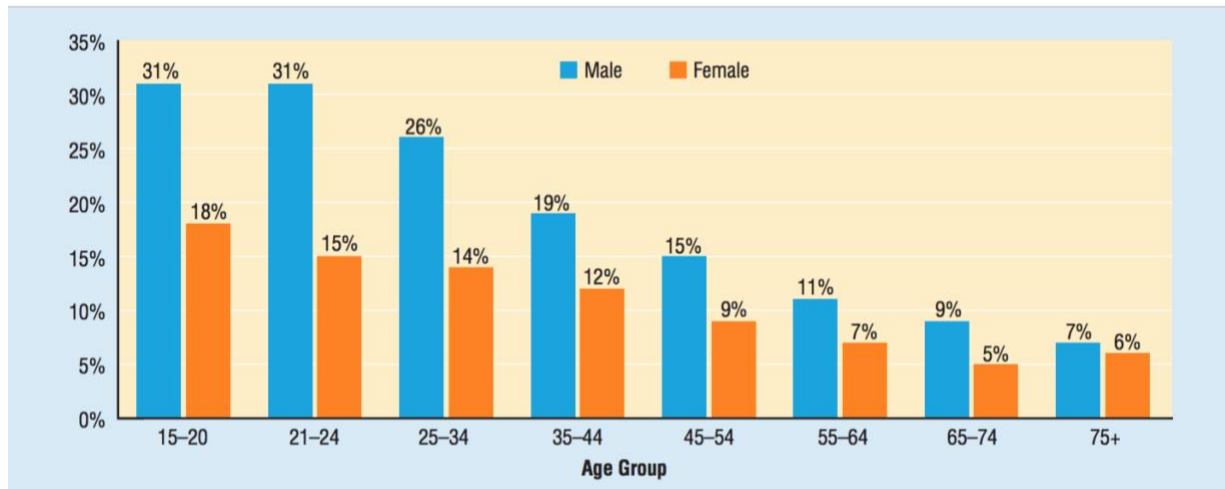


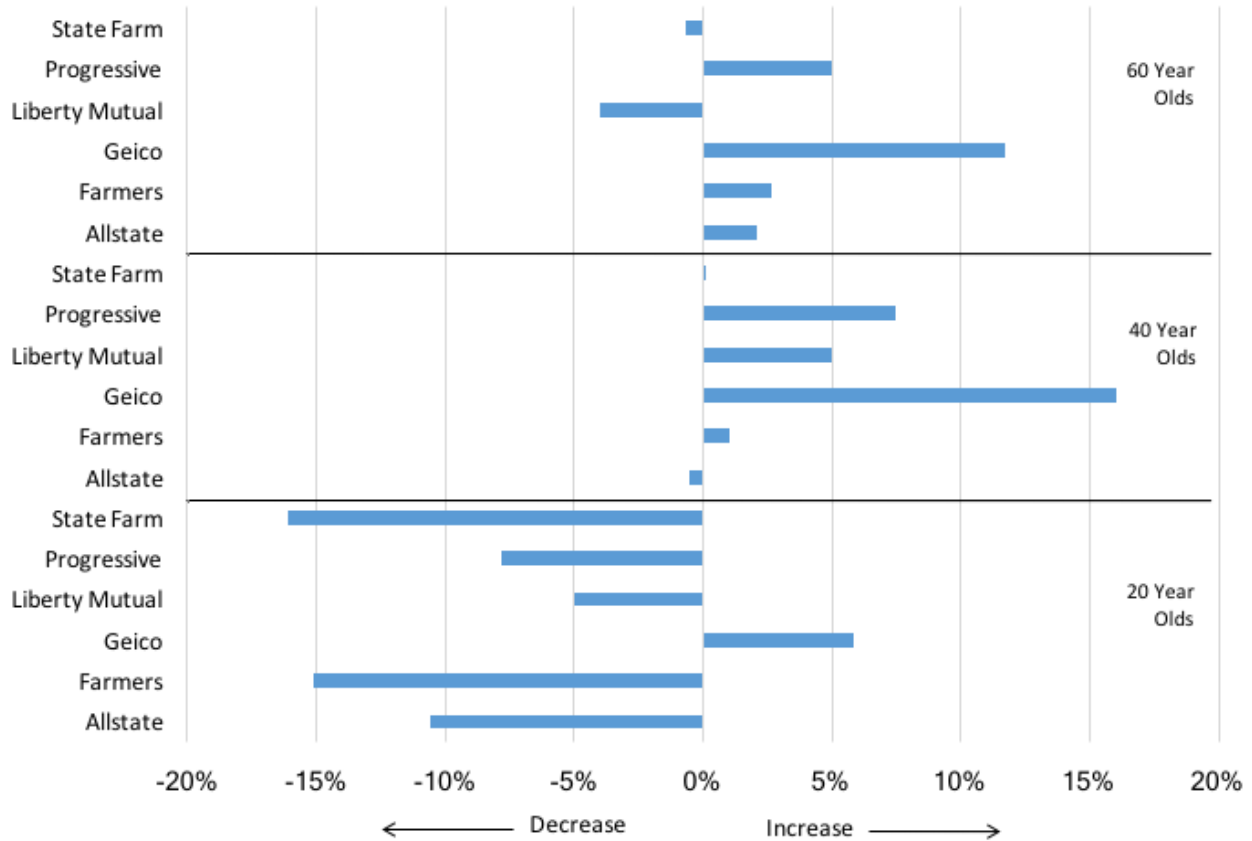
Figure 2. Percentage of Speeding Drivers in Fatal Crashes, by Age and Gender, 2017

Particularly for males younger than 35 years old, there is a much larger difference in risky driving behaviors than females, but after about 20 years of driving experience the difference in risk for males and females is much more negligible. Additionally, regarding young drivers, the U.S. Department of Transportation (2017) found, “The rate of drivers involved in fatal crashes per 100,000 licensed drivers for young female drivers was 21.99 in 2017. For young male drivers the involvement rate was 49.62, about 2.3 times that of young female drivers.”<sup>13</sup>

Since males are statistically found to be riskier drivers that are more likely to speed or be involved in crashes, this would lead one to believe that male auto insurance premiums would be higher. Since males are more likely to have a claim, it would make sense that they would pay more for insurance. Even if this is only true for newer drivers, as males and females become older, they have similar risk in terms of driving and therefore should pay similar premiums. This is not exactly the case in the United States though. The figure below shows the difference in premiums between men and women for several different auto insurers in the US. For women

<sup>13</sup> Summary of motor vehicle crashes: 2017 data.

aged forty years old and above, they almost always pay more than men and sometimes very significant differences occur.<sup>14</sup>



**Figure 3. Auto Insurance Premium Differences Between Males and Females**

As shown by the figure above, women end up paying much higher rates than men from these well-known insurers as they become older. Also, it is interesting to note that Geico charges 20-year old females more than 20-year old males even though there are great disparities in the expected losses for these two age and gender groups. In studies conducted by the Consumer Federation of America, these inconsistencies in rates have been deemed very concerning. This information is a basis for the argument against using gender in auto insurance pricing. The CFA

<sup>14</sup> “Most Large Auto Insurers Charge 40 and 60-year old Women Higher Rates than Men.”

(2017) has expressed “[its] concern that tying auto insurance rates to factors that a customer cannot control and have nothing to do with their driving safety record – such as one’s biological sex – leads to unfair discrimination and indefensible claims of actuarial soundness.”<sup>15</sup> Therefore, the use of gender in automobile insurance pricing has brought much concern around the fairness of its use.

It is very interesting to note how the use of gender in life insurance and automobile insurance is different. In life insurance, this risk factor is a biological factor that directly changes how likely or how often an insurance company will have to pay a claim. Life insurance benefits are directly controlled by the length of an individual’s life. In contrast, gender is less of a direct factor that determines when a claim will be made in automobile insurance. Pricing an auto insurance policy by factoring in the individual’s gender uses the given information as an indication of the driver’s behavior on the road. This type of insurance uses gender as more of a correlation factor to driving habits rather than using it for actual, direct impacts on frequency of claims. Both insurance types use gender in pricing but in rather different ways.

<sup>15</sup> “Most Large Auto Insurers Charge 40 and 60-year old Women Higher Rates than Men.”

## Chapter 4

### European Union Eliminating Gender Discrimination

#### Background

In March of 2011, the council of the EU adopted the Directive 2004/113/EC, also known as the gender directive, as a way to combat discrimination based on sex in the business of goods and services. As defined in article 1 of the directive, the definition of goods and services would now extend to include insurance, among other things. The European Court of Justice declared that the use of gender as a risk factor in pricing insurance premiums and benefits is unlawful, and beginning in December of 2012, would not be permitted to be used in pricing private insurance. Section 18 of the Council Directive (2004) states: “The use of actuarial factors related to sex is widespread in the provision of insurance and other related financial services. In order to ensure equal treatment between men and women, the use of sex as an actuarial factor should not result in differences in individuals' premiums and benefits.” The directive and these new sanctions apply in the case of private and voluntary insurance and pensions which are separate from insurance resulting from employment, as this sector has separate rules regarding pricing.<sup>16</sup>

The insurance industry in the European nations differs from insurance in the United States, but the gender directive set a precedent for insurance companies banning gender as a pricing factor in order to promote gender equality. The European Union decided that this course of action promotes insurance pricing based on factors that can be controlled by the policyholder. There is argument that pricing factors should be things that one has influence over, such as

<sup>16</sup> “COUNCIL DIRECTIVE 2004/113/EC.”

lifestyle habits like smoking and nutrition, occupation, and marital status. The counterargument is that gender is a good indication of these factors as well as factors such as disability likelihood and driving tendencies, based on historical evidence. Even though the European Union has created this rule over insurance pricing, actuaries still see a downfall to what is perceived as a morally correct decision.<sup>17</sup>

### **Market Implications**

#### **Adverse Selection**

By removing a risk factor that insurance pricing is usually based on, the market has asymmetric information, and issues occur regarding the determination of fair rates for all policyholders. The issue that arises given this new standard of rate setting is with adverse selection.<sup>18</sup>

Adverse selection occurs when buyers and sellers of insurance do not have the same available information. An example of this in health insurance is when someone purchases health insurance only once he or she is diagnosed as sick and in need of healthcare.<sup>19</sup> This issue arises in the case of the elimination of gender as a pricing factor as well. The reason that gender is even considered a rating factor in insurance pricing is because one group (male or female) poses a greater risk to the company than the other. For automobile insurance, men are more likely to file claims than women and therefore should potentially pay more for their automobile insurance.

<sup>17</sup> The draft EU Directive on Equal Insurance Premiums for Men and Women.”

<sup>18</sup> “Adverse Selection.”

<sup>19</sup> Institute of Medicine (US) Committee on Employment-Based Health Benefits.

The opposite being true with health insurance, as women are more likely to cost the insurance company and therefore usually end up paying more for insurance. So, it follows that when mandating insurance companies to exclude gender from the pricing of contracts, the cost of insurance will find itself somewhere in between the price that males and females currently pay. Therefore, one group will end up paying less than they previously did, while the other group's cost for insurance will increase.<sup>20</sup>

The main concern is that those who are higher risk for a particular type of insurance will purchase large amounts of the lower cost insurance, while those who saw a premium increase will no longer buy insurance. This would cause the insurance company to lose money, if they do not have the lower-risk individuals in their pool to subsidize the higher-risk members. The one idea about insurance though is that the demand for this product is inelastic because there is no replacement. In the European Union you are required to purchase insurance in order to drive (similar to the laws in the United States). Thus, there is no choice but to purchase at the new higher price. The only other issue that could occur is if people have a choice between insurance companies. With the option to purchase either this insurance that is priced independently of gender or this hypothetical option that can price based on gender risk factors, there would be a divide. This gender-neutrally priced insurance will attract higher-risk members because the cost has gone down for this group. The lower-risk members would choose to go to the other insurers because this price will be closer to what their real risk imposes, which is less than the gender-neutral price. If only the high-risk members are purchasing insurance at the gender-neutral price, the insurance company will find itself in a deficit.

<sup>20</sup> Schmeiser, Hato, Tina Störmer, and Joël Wagner.

Since insurance is theoretically an inelastic good, there is not a true replacement for insurance products. There is the possibility of remaining uninsured, but in some cases like with automobile insurance, this is illegal. Otherwise, a person can assume the risk of potentially suffering a loss and plan to pay for this on their own. However, based on certain assumptions, people are generally risk-averse and would rather pay a higher premium, within reason, than assume the risk of potential catastrophic loss.

### **Insurance Adjustments**

Looking at this situation from the perspective of an insurance company, insurers have to figure out how to deal with this loss of rating factor. There are several ways to address this but when presented with this change, it is hard to know what course of action would find the best results.

There are most likely rating factors already being used to price insurance that are somewhat related to gender, and this is one way to make up for the loss of pricing factor. If a company can increase the weight of a certain risk factor that may imply a policyholder's gender, they can almost simulate the loss of this rating factor.

Additionally, companies can look to find new rating factors that have not been previously used in insurance pricing. This method may not accurately depict a persons' gender or may be more intrusive than gender, but this is yet another option for insurance companies to make up for the weight that is lost due to eliminating gender from insurance pricing.

Other options for insurance companies include charging higher premiums to make up for the lost information in insurance pricing, therefore having a much greater chance of being able to



cover the entire loss that may be incurred. This may be a sound method immediately after gender pricing bans are set in place until further information is found to suggest how these changes will impact the insurance market.

From a marketing standpoint, the insurance company could attempt to target customers that are part of the lower-risk gender. Revisiting another concept, insurance companies could design insurance contracts that work with the idea of self-selection. If an insurance company can develop products that are designed to target males and females differently, each gender would likely choose the contract designed to better fit their needs and would give the insurance company a decent indication as to the individual's gender without ever having to directly disclose that information.

This change in insurance pricing will affect all companies in very different way depending on their market segment (automobile, life, health, etc.), their size, their policyholder demographics, and many other factors. At the time of the law enactment, there was much uncertainty as to what would occur on an individual company level as well as for the entire insurance market.

### **Expected Changes in the EU**

For each type of insurance, the different genders would expect changes to their insurance costs. For health insurance and pension annuities, females were expected to gain from the redistribution of risk between genders, while with automobile insurance and life insurance, males would likely see premiums decrease. The figure below illustrates a simple example of how

females and males were expected to see premiums change in regards to automobile insurance given this new change in pricing in the European Union.<sup>21</sup>

	Unisex premium				
	Current premium	Gender mix	Weighted average	Including risk margin	% change
Female	1,000	40%	1,600	1,600–2,000	60–100% increase
Male	2,000	60%	1,600	1,600–2,000	0–20% reduction

**Figure 4. Stylized Illustration of Premium Changes in EU**

As displayed from the figure, women could end up paying almost double what they currently pay for automobile insurance, while males could see a decrease of up to 20%. The reason for the difference in the first place is that given historical data, males are more likely to incur a loss when it comes to automobile insurance. Particularly regarding this example, males at age 20, compared to females at age 20 display a large difference in expected loss given risky driving behavior in young males and therefore end up paying higher premiums from their automobile insurance.<sup>22</sup>

This is a very explicit and theoretical example of how eliminating gender from pricing would increase premiums for a lower-risk population even though their risk has not changed. The argument that just because someone is born male means they are predisposed to be a riskier driver is what has prompted this call to action on gender pricing, as this is not always true. On the other hand though, the immense amount of data that insurance companies have gathered over

<sup>21</sup> “Gender and Insurance: Unintended Consequences of Unisex Insurance Pricing.”

<sup>22</sup> “The Use of Gender in Insurance Pricing.”

many years determines that it is the actuarially fair premium and taking this away increases premiums for the less-risky group.

## Chapter 5

### United States Eliminating Gender Based Insurance Pricing

#### New Auto Insurance Requirements

As of January 1<sup>st</sup>, 2019, the state of California enacted the Gender Non-Discrimination in Automobile Insurance Rating Regulation. This regulation requires that all automobile insurers create a newly revised class plan that does not use gender as a rating factor for pricing.

California's Insurance Commissioner, Dave Jones (2019) is quoted saying, "My priority as Insurance Commissioner is to protect all California consumers, and these regulations ensure that auto insurance rates are based on factors within a driver's control, rather than personal characteristics over which drivers have no control." Therefore, eliminating gender in insurance pricing was necessary for Jones' agenda of social fairness and equality in insurance pricing.<sup>23</sup>

This is not the only state to have implemented this automobile insurance plan for pricing without basis on gender. Hawaii, Massachusetts, Montana, North Carolina, and Pennsylvania are other states that have followed suit and banned the use of gender for insurance pricing. In the United States, young females are expected to feel the highest impacts of this new legislation. Younger female's premiums are likely to rise 4-6% whereas older females with more experience would expect to see premiums rise only slightly.

<sup>23</sup> "Commissioner Issues Regulations Prohibiting Gender Discrimination in Automobile Insurance."

The biggest disparity between genders when it comes to insurance pricing is for new drivers. Young male drivers pay abundantly more than younger female drivers as their risk to an insurance company is much greater than a female of this age. The figure below shows the differences between younger drivers based on gender.<sup>24</sup> Although there are inconsistencies among some insurers in the United States as to whether males or females should have higher premiums, prices for policyholders under the age of 25 remain consistent, with males paying significantly more.

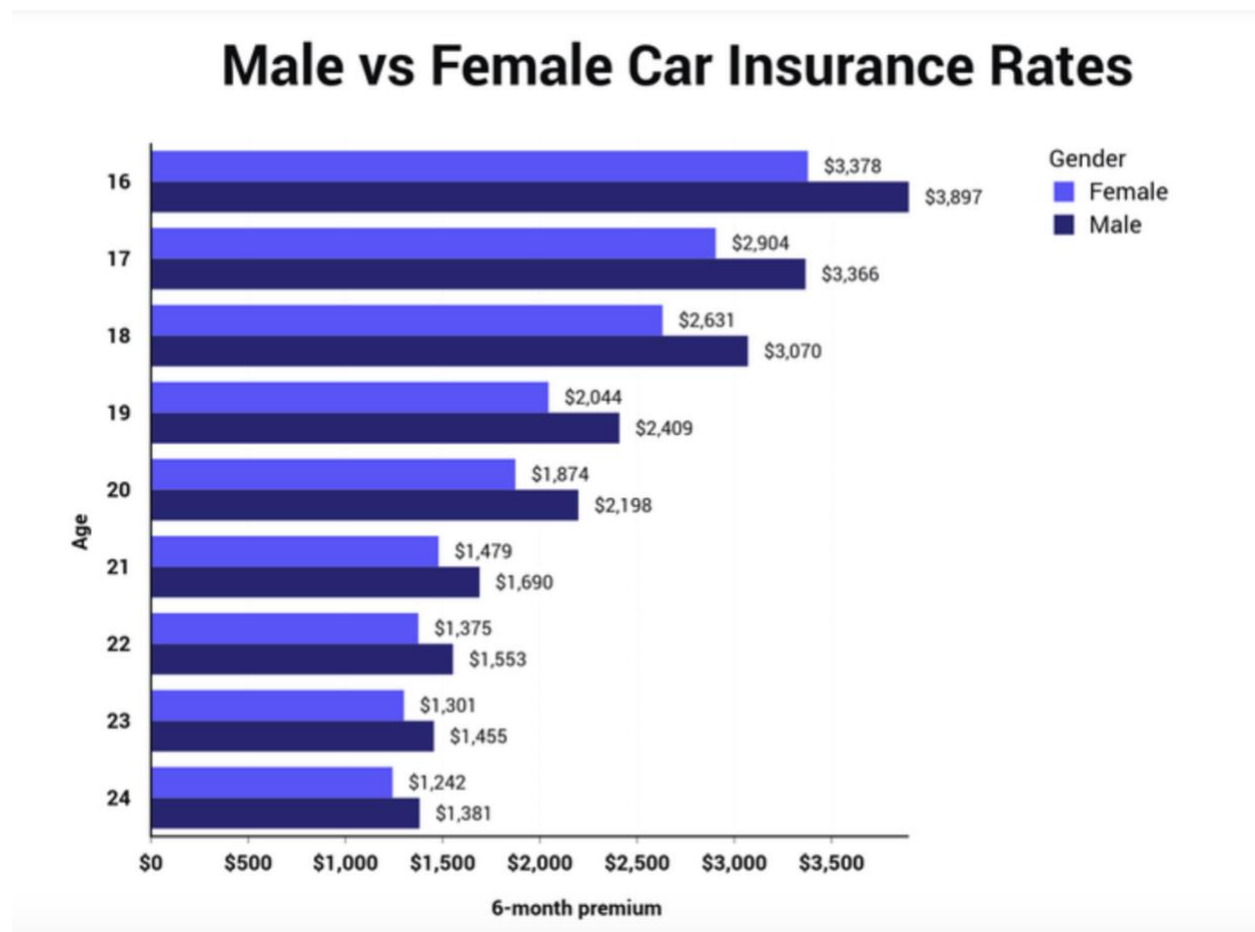


Figure 5. Young Male vs Female Car Insurance Rates

<sup>24</sup> “Male vs. Female Car Insurance Rates.”

A study done in Michigan in 1983 showed that drivers over the age of 25 were barely impacted by laws that no longer allowed pricing based on gender, while younger drivers were negatively impacted. This older age group, that felt little to no impact in the study, makes up for about 80% of the insurance market. Thus, this study's findings help to promote the idea of unisex pricing for automobile insurance.<sup>25</sup> The other argument that supports the push for unisex pricing are the inconsistencies between which gender pays more for auto insurance. This may be partially due to the fact that insurance in the United States is dealt with at the state level, and so each state separately sees different trends, but this also may reveal that gender is not as telling of a risk factor as expected.

Recently, insurance price differences between men and women have been negligible, as the gender that pays more for insurance on average continues to fluctuate between men and women through the years.<sup>26</sup> This is why some people think that removing gender from insurance pricing would be beneficial, that it is not actually indicative of risk that a gender imposes but rather just a way to unfairly change a policyholder's rate.<sup>27</sup> Factors like location and years of experience seemingly carry much more value in determining a consumer's risk, so the use of gender is more of an outdated and obsolete factor.<sup>28</sup>

In this new era where more data can be gathered and shared and risk can be more accurately determined, there are other factors that insurance companies can use to base their prices on. The growing technology industry allows driving habits to be monitored in new, innovative ways. As more data is gathered, it will become easier to set prices based on more

<sup>25</sup> "Law Bans All Policy Rates Based on Gender : Montana Begins Unisex Insurance."

<sup>26</sup> Kunkle, Frederick.

<sup>27</sup> Albright, Brian.

<sup>28</sup> "Gender Non-Discrimination in Automobile Insurance Rating."

direct links to driving behavior. In the past, gender gave a good indication of how much a person would be driving because of their occupation, the types of cars they may own, or the speeds at which they may drive, but these ideals are rather outdated at this point in time.<sup>29</sup>

As established, gender is a rating factor that is potentially indicative of risk, but it is not a very direct factor on whether an insurance company will have to pay a claim or not.

Additionally, automobile insurance premiums can change, as these policies must be renewed and premiums can be reevaluated based on previous accident history. Therefore, it makes sense that gender could be easily removed and other factors can be used to make this pricing more fair. To illustrate this idea, a toy model can be developed.

In general, one could imagine that there is a situation with no asymmetric information, and therefore those who are high-risk will pay a higher price and those who are low-risk will pay a lower price. For each group, the premium would be the expected value which factors in the expected loss and the probability of that loss. In this model, the probability of loss for a high-risk individual is  $P_H$  and for a low-risk policyholder, the probability of loss is  $P_L$ . For this example, it is assumed that a loss will cost a fixed value which will be denoted,  $D$ .

Risk Types:	H – high risk	L – low risk
Probability of Loss:	$P_H$	$P_L$
Premium:	$P_H \times D$	$P_L \times D$

Continuing with this model, the current market conditions can be simulated, in which gender is allowed to be used in insurance pricing. For simplicity one can assume that there are

<sup>29</sup> Carrns, Ann.

just two categories that the insurance company separates policyholders into, males and females. Within each group, there are high risk and low risk drivers, but this is unknown to the insurance company. Based on the given assumptions, it is predicted that there are less high-risk female drivers than high-risk male drivers. First, it may be beneficial to examine the idea behind the current insurance pricing conditions where gender is considered.

Females:	$\lambda^w$	(H-type)
	$1 - \lambda^w$	(L-type)
Males:	$\lambda^M$	(H-type)
	$1 - \lambda^M$	(L-type)

The proportions of high-risk males and high-risk females are denoted  $\lambda^M$  and  $\lambda^w$  respectively. Another necessary assumption is that  $\lambda^w < \lambda^M$  based on male and female driving habits. From this information the insurance company could create two prices, one for males and one for females. The premium calculation follows below, and given that the proportion of high-risk females is lower than high-risk males, the female premium will consequently be less.

Male Premium:

$$[\lambda^M P_H + (1 - \lambda^M) P_L] \times D$$

Female Premium:

$$[\lambda^w P_H + (1 - \lambda^w) P_L] \times D$$

Looking at this calculation, the most unfairly charged group is the low-risk males. Moving forward, the goal of the model will be to find a way to help the most negatively impacted group pay a more fair premium.



By removing gender from insurance calculations, it is possible to lower the premium for the low-risk males, as will be shown. In the case that gender is removed from insurance pricing, premiums will fall somewhere in between the previous male and female differentiated premiums. Assuming that the insurance company has an equal number of males and females, the simple premium for all members, independent of gender would look like the following:

$$\frac{1}{2}[\lambda^M P_H + (1 - \lambda^M)P_L] \times D + \frac{1}{2}[\lambda^w P_H + (1 - \lambda^w)P_L] \times D$$

Given this simple calculation, the goal of reducing the burden on the low-risk males was accomplished, as this combination will produce a price that is less than what males previously paid. The question remains unanswered as to whether this is the best solution or if pricing based on previous driving experience could create more fair premiums. The unique ability of auto insurers to adjust premiums based on driving history allows for the removal of gender in pricing to be more feasible. The idea behind this experience rated insurance is that for the first year that an individual is insured, he or she pays a set premium. If gender is not used in pricing, it would be the simple general premium calculated above. From there, the premium is reevaluated each year based on whether that individual has an accident or not between policy renewals. If an accident did occur, they will now be responsible for paying a higher premium than before, while if an accident has not occurred, their premium could decrease. This ability to base pricing on previous driving behavior that is indicative of risk is a unique characteristic of automobile insurance. This model shows that it may make sense for gender to be eliminated from insurance pricing, as there are still ways to charge individuals based on what appears to be their inherent risk.

Given these conclusions above, it may seem shocking that eliminating gender from pricing benefits males of low risk the most, as many believe that women are being taken advantage of in gender differentiated insurance pricing. As shown throughout the paper, women are not always the disadvantaged group. So, the arguments put forward speak of equality for both genders, and removing gender from pricing accomplishes this, no matter which group ends up paying more. Additionally, examining the idea of using experience rating to price insurance can be expanded to multiple periods. As the insurer continues to evaluate premiums for a policyholder based on their driving and accident history, the individual's true risk profile will become clearer. This multi-period experience rating concept allows the insurer to approach fair premiums in the long run for people of both high and low risk. With this idea in mind, the insurance company can approach an equilibrium, even without the use of gender as a rating factor.

### **Life Insurance in the United States**

Life insurance policies are typically long-term contracts with a fixed premium determined at the beginning of the term. Therefore, once an insurance contract is established along with a premium, there is no ability to reevaluate based on experience as is the case with auto insurance. Once a premium is set at the beginning of the policy, even if there is useful information about an individual's life expectancy revealed at some point in time during the term of the policy, it is not able to be reflected in future premiums.

It would appear that life insurance has very few factors to contribute to the determination of a fair price. Some factors that may give good indication to predicted future lifetime may be even more invasive than gender, such as DNA test results that could show anticipated medical issues for an individual. Therefore, it becomes slightly more difficult to determine a fair way to price life insurance without gender as a rating factor.

Theoretically, if states begin eliminating the use of gender in pricing, women will generally end up paying less for their policies under the new legislation. Taking a look at life annuities, women currently pay a higher price than men for the same policy because women have a greater life expectancy, and therefore the insurance company would expect to make more payments to a female policyholder. Once gender is eliminated from pricing, the price for life insurance would fall somewhere in between the higher female-specific rate and the lower rate that males pay. This looks similar to the auto insurance argument presented previously. Two resulting outcomes could occur given this premium change. Depending on the change in price, males could continue to buy insurance if the difference in premium is not too large, assuming males remain risk-averse. This is the most ideal result for insurers. The other outcome will occur if the difference in price is too high. In this case, it would make sense that males would be less likely to purchase life insurance policies and therefore, women would see premiums rise, as the males would no longer subsidize the expected value of the women's annuities. This would continue to drive males away from purchasing life annuities, until finally the premium would settle back at the female specific price. This is quite obviously not the goal of any legislation put in place, so it becomes the responsibility of the insurance company to determine a fair premium that will keep both males and females interested in purchasing these life annuities.

Montana is the only state in the US that does not factor gender in to any insurance pricing, including life insurance, but this state only makes up for about 0.3% of the insurance market. Even so, this has opened up the conversation surrounding sectors of the insurance realm outside of automobile insurance to look in to how gender could be eliminated from life insurance pricing.<sup>30</sup>

<sup>30</sup> Heen, Mary L.

## **Chapter 6**

### **Conclusion**

The European Union has already started the initiative to fight the apparent gender discrimination in insurance rate setting by restricting insurance companies from using gender as a pricing factor. Although this brings up the potential for problems involving adverse selection or different moral hazards, overwhelmingly the EU found it most important to fix the gender discrimination issues.

In the United States, the automobile industry has been the most progressive in terms of unisex pricing. Many states have already adjusted their pricing practices to reflect this and only about 20% of policyholders will experience any large impact on their insurance pricing. Gender in automobile insurance has seemingly proved to be used inconsistently and is less deterministic of true risk after a few years of driving experience, so it makes removing this factor from the pricing equation reasonable. The other insurance sectors have faced more adversity in terms of eliminating gender in pricing.

For life insurance, there is solid evidence proving that women typically live longer than men and therefore should have higher premiums on life annuity contracts. This is similar in health insurance, as women often have more expenses regarding healthcare and should subsequently pay more. For health insurance it is concretely evident that child-bearing expenses come with a specific gender and add to the overall cost for insuring this gender as opposed to males. These specific insurance industries may take longer to change their pricing ways, but there is still a great amount of conversation surrounding the balance between social equality and fair pricing based on inherent gender risk.

Given all of the empirical evidence that has been collected over the years that the insurance industry has existed, it is difficult to ignore the fact that pricing insurance based on gender can give a true identification of a policyholder's potential loss risk. On the other hand, insurance companies can use this information in discriminatory ways and cause certain genders to pay greater amounts solely based on an uncontrollable factor. This desire for balance between actuarially fair pricing methods and social fairness will always bring up questions, but as seen in the United States now, gender may no longer be considered among rating factors in insurance pricing.

## BIBLIOGRAPHY

“Adverse Selection.” HealthInsurance.Org.

Akerlof, George A. "The Market for "Lemons": Quality Uncertainty and the Market Mechanism." *The Quarterly Journal of Economics* 84, no. 3 (1970): 488-500.

Albright, Brian. 2019. “Studies Show Women May Pay More for Auto Insurance than Male Counterparts.” *Automotive Body Repair Network* 58, (4) (04): 10

“Auto Insurance Basics.” Insurance Information Institute.

Carns, Ann. “In California, Gender Can No Longer Be Considered in Setting Car Insurance Rates.” *The New York Times*, January 18, 2019.

“Commissioner Issues Regulations Prohibiting Gender Discrimination in Automobile Insurance Rates.” CDI, 3 Jan. 2019.

“COUNCIL DIRECTIVE 2004/113/EC.” *Official Journal of the European Union*, December 13, 2004.

Crocker, K. J. and Snow, A. (2011), Multidimensional Screening in Insurance Markets with Adverse Selection. *Journal of Risk and Insurance*, 78: 287-307.

“Discrimination in Health Care.” National Women's Law Center.

“Gender and Insurance: Unintended Consequences of Unisex Insurance Pricing,” March 2011.

“Gender Non-Discrimination in Automobile Insurance Rating.”

“Health Status: Life Expectancy.” OECD.Stat. Organisation for Economic Co-Operation and Development, 2019.

Heen, Mary L. “Federal Advisory Committee on Insurance.” Federal Advisory Committee on Insurance.

Institute of Medicine (US) Committee on Employment-Based Health Benefits; Field MJ, Shapiro HT, editors. *Employment and Health Benefits: A Connection at Risk*. Washington (DC): National Academies Press (US); 1993. 5, Risk Selection, Risk Sharing, and Policy.

Kunkle, Frederick. “Auto Insurance Rates Have Skyrocketed — and in Ways That Are Wildly Unfair.” *The Washington Post*, February 7, 2018.

“Law Bans All Policy Rates Based on Gender : Montana Begins Unisex Insurance.” Los Angeles Times, 3 Oct. 1985.

“Life Insurance Basics.” Insurance Information Institute.

“Male vs. Female Car Insurance Rates.” Insurance Zebra.

“Most Large Auto Insurers Charge 40 and 60-year old Women Higher Rates than Men.” Consumer Federation of America, October 12, 2017.

National Center for Statistics and Analysis. (2019, May) Speeding: 2017 data (Traffic Safety Facts. DOT HS 812 687). Washington, DC: National Highway Traffic Safety Administration.

National Center for Statistics and Analysis. (2019, September). Summary of motor vehicle crashes: 2017 data. (Traffic Safety Facts. Report No. DOT HS 812 794). Washington, DC: National Highway Traffic Safety Administration.

OECD (2019), Life expectancy at birth (indicator). doi: 10.1787/27e0fc9d-en (Accessed on 20 October 2019)

“On Risk Classification.” Risk Classification Work Group of the American Academy of Actuaries. American Academy of Actuaries, November 2011.

Oxera. “The Use of Gender in Insurance Pricing.” The Use of Gender in Insurance Pricing. Association of British Insurers, 2010.

Roth RJ. Insurable risks, regulation, and the changing insurance environment. In: Diaz HF, Pulwarthy RS, editors. Hurricanes: climates and socioeconomic impacts. Berlin, Germany: Springer; 1997. p. 261–72.

Rothschild, Michael, and Joseph Stiglitz. "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information." *The Quarterly Journal of Economics* 90, no. 4 (1976): 629-49.

Schmeiser, Hato, Tina Störmer, and Joël Wagner. “Possible Market Implications of Unisex Insurance Pricing,” *Insurance Economics*, The Geneva Association, July 2014.

Smith M.L., Kane S.A. (1994) The Law of Large Numbers and the Strength of Insurance. In: Gustavson S.G., Harrington S.E. (eds) *Insurance, Risk Management, and Public Policy*. Huebner International Series on Risk, Insurance and Economic Security, vol 18. Springer, Dordrecht

“The draft EU Directive on on Equal Insurance Premiums for Men and Women.” Society of Actuaries in Ireland. April 04, 2004.



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