Developments in the Pricing of Auto Insurance Based Upon Driving Behavior

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The idea of insurance pricing based on mileage or driving behavior is far from new. In fact, a paper presented at a 1930 Casualty Actuary Society meeting noted that the following should be incorporated into ratings: “1. The car- age, condition, etc.; 2. Highways-road beds, curves, visibility, etc.; 3. Traffic density; 4. Laws, regulations, and their enforcements; 5. Efficiency of driver-age, experience, habits, impairments, etc.; 6. Mileage; 7. Speed; 8. Weather conditions; 9. Seasonal use of car; and 10. Day and/or night use of car” (Greenberg, 2008). While at the time, it was practically impossible to imagine incorporating real-time vehicle usage data into premium calculations, it is amazing that over 80 years ago actuaries noted the same factors that many insurance companies today are trying to work into new products.

Lump sum pricing is a method of setting insurance rates in which consumers pay a flat rate for an unlimited amount of mileage (Litman). In 1968, William Vickrey criticize the inefficiency of lump-sum auto insurance and proposed a number of ideas for implementing insurance pricing based on the number of miles driven (Vickrey, 1968). He first noted odometer checks as the easiest way of verifying mileage, but at the time odometer tampering was common practice (Vickrey, 1968). He then proposed the use of pay-at-the-pump insurance, where drivers would purchase their coverage when they purchase fuel, or tacking the cost of insurance onto tires based on the estimated mileage of tire wear (Vickrey, 1968). Vickrey also noted the varying degrees of crash risk on different types of roadways (Vickrey, 1968). He further argued drivers should drive not only non-negligently, but defensively (Vickrey, 1968). One of his arguments for pay-at-the-pump insurance was that because speeding results in more gas use, drivers would be priced according to driving behavior to at least some extent (Vickrey, 1968).

Thus, Vickrey's hope was for an insurance product that could base premiums on verifiable data about mileage, route choice, and driving behavior. His propositions, while faulted for their inability to measure actual mileage, were what he believed to be practical ways at the time to improve the lump-sum pricing strategy.

The lump-sum pricing scheme is criticized for a number of reasons. One problem is the inefficiency it creates. Research from Massachusetts that combines vehicle mileage and loss cost data shows a compelling relationship; 72% of the variability in loss costs is explained when it is combined with vehicle mileage whereas only 15% of the variability is explained before the loss cost data is combined with vehicle mileage. The relationship is pretty straightforward. Consider an insured has an accident about every 35,000 miles. Currently the insured drives about 15,000 miles a year and therefore has an accident every 2.33 years. If this insured reduced their yearly mileage to 12,000 miles per year then they could expect an accident every 2.92 years. Then as mileage decreases, so does crash risk. Yet, drivers who are the same in other aspects pay nearly the same premiums despite wide variations in mileage (Bordoff & Noel). As a result, low-mileage drivers subsidize the accident costs of high-mileage drivers (Bordoff & Noel). Another problem is that lump-sum pricing does nothing to encourage people to drive less. This excessive driving results in significant societal cost resulting from more accidents, congestion, carbon emissions, local pollution, and oil dependence (Bordoff & Noel).

The advances in technology over the last twenty years have made the near-century old ideas about insurance pricing a real possibility. Per-mile auto insurance, or pay-as-you-drive (PAYD), provides an avenue to address not only the above issues, but

also allows a means for insurers to price insurance based on real-time data rather than past realized losses. Today, monitoring devices can provide data about mileage, total driving time, location, safe driving, seat belt use, turn signal use, vehicle speed, sudden braking, and sudden acceleration or deceleration (McMillan, Craig, & Heinen, 1996). However, a vast amount of data does little if one does not know how to properly incorporate the data into a pricing structure. Basic PAYD premiums are calculated by dividing existing premiums by a vehicle's rate class average annual miles (Litman). However, it would not be actuarially correct to convert an entire premium to per mile pricing. For instance, other than collision coverage, such as theft, explosion, vandalism, contact with an animal, or breakage of glass, does not vary with mileage (American Institute for Chartered Property Casualty Underwriters, 2008). Furthermore, insurance companies also have to determine which risk factors are important enough to be tracked and how to incorporate these factors into a pricing scheme.

An ongoing naturalistic study by the Strategic Highway Research Program, with over 2000 participants as of September 2012, and over 3000 by its end, stands to provide tremendous insight as to how driving behavior impacts crash risk (Strategic Highway Research Program 2, 2012). A naturalistic study is a study in which researchers carefully observe and record some behavior in its natural environment with as little interference as possible (Webster's New World, 2008)This is the largest naturalistic study of its kind with basic questions examining how driving behavior is affected by driver, vehicle, roadway and environmental factors and how changes in driver behaviors are related to crash risk under different vehicle, roadway, and environmental conditions (Strategic Highway Research Program 2, 2012). While this

study's goal is actually to find a solution to current road safety issues, insurance companies should find the results of this study to be particularly useful in determining the factors most directly related to crash risk. This data may strengthen actuarial views of current models or suggest other areas of exploration.

It may be difficult for an individual firm to justify costs on a private basis. It might be the case that the monitoring costs exceed the benefits to private firms (Bordoff & Noel, 2008). This combined with the above issue that insurers aren't entirely sure how to weigh in monitored factors into premium formulas, leaves many companies with a level of uncertainty that they simply are not willing to take. However, this may be less of an issue as technology advances. The devices used by Progressive are thought to cost $100 or less per unit (Greenberg, 2008). Furthermore, some methods of PAYD do not require any sort of technology.

In 2008 in Dalllas, Texas, MileMeter became the first company to dedicate itself exclusively to selling low cost car insurance by the mile (Auto Insurance Monitor, 2014). Coverage extends for six months at a time (Auto Insurance Monitor, 2014). When customers purchase the policy, customers purchase between 1,000 and 6,000 miles of coverage (Auto Insurance Monitor, 2014). If a customer goes over their purchase mileage they must simply purchase more miles (Auto Insurance Monitor, 2014). Mileage is tracked by having customers upload digital photos of their odometers (Auto Insurance Monitor, 2014). Customers who drive farther than their purchased mileage they do so without coverage (Tingwall, 2008). In Australia, the Hollard Insurance Company already offers such a product (Greenberg, 2008).Hollard's product even won an Australian Business Award for product innovation (citation). In October of 2013, Australian

telematics provided announced they were supplying technology to Insurance Box, a subsidiary of QBE which is one of top four Australian insurers, to enable the first telematics-based personal car insurance in Australia. Insurance Box tracks customer driving behavior and assigns a scored based on how well the customer is driving (Insurance Box, 2013). This score drop if the car is driven in a dangerous or reckless manner and customers may experience a premium increase if there is no improvement (Insurance Box, 2013). Since 2008, Plymouth Rock Assurance Company has used mileage data from mandatory state inspections in rate setting (Greenberg, 2008). Other PAYD programs use preexisting technology in the vehicle. For example, GMAC Insurance uses OnStar to communicate mileage data and provides enrolled customer with low-mileage discounts (Greenberg, 2008). The monitoring costs of these techniques should be very minimal.

In 2003, a survey of the U.S. found that current insurance regulations prohibit PAYD in over a third of the 43 responding jurisdictions (Guensler, Amekudzi, Williams, Mergelsberg, & Ogle, 2003). While it is true that insurance regulations were once a huge concern for PAYD, this is no longer the case today. As of March 2013, 46 states have four or more PAYD products offered to its citizens (Arquette, 2013). A large majority, at least 8, of the top 10 auto insurers in the U.S. have implemented PAYD products to at least one insured in at least one state (Arquette, 2013).

In 1998, Progressive filed a patent for a “motor vehicle monitoring device” and initiated the “Autograph” pilot study in Texas (Greenberg, 2008). This pilot test primarily focused on the technical capability to install telematics, which in this case were about the size of a stereo and had to be professionally installed (Progressive, 2012). In 2004,

the company began the TripSense program in Minnesota, Michigan, and Oregon, where participants could view data on their home computer and, at their discretion, share the data with Progressive for appropriate discounts (Greenberg, 2008). TripSense® was the first device customers plugged directly into their onboard diagnostic port (ODP) and had to be unplugged at regular intervals to upload data to the Internet (Progressive, 2012). Progressive's next product, MyRate®, was launched in 2008 and was available in 18 states. This product used a device like that of TripSense® but data was automatically uploaded via cellular network.

Progressive's most recent product, SnapShot®, is available in the District of Columbia and all states but Arkansas, California, Hawaii, Indiana, and North Carolina (Progressive, 95-2014). SnapShot® uses a device similar to that of its predecessor which tracks how often you make hard brakes, how many miles you drive each day, and how often you drive between midnight and four a.m. (Progressive, 95-2014). Some SnapShot® devices beep when drivers hard break in an effort to help improve driving behavior (Progressive, 95-2014). Progressive can tell if the device is disconnected but does not track location or speed and does not use any GPS technology (Progressive, 95-2014). Users can view all the information Progressive tracks by logging in online (Progressive, 95-2014). The driving discount provided to SnapShot® is calculated over two time periods. After the first 30 days the device is installed, any discount earned is applied to the remainder of the policy period (Progressive, 2012). Then, Progressive continues to collect data until they have been provided with six months of information (Progressive, 2012). This information is used to calculate a second discount that is to be

applied to future policies until policy expiration, until Progressive elects to re-monitor the vehicle, or until Progressive revises its PAYD discount factors (Progressive, 2012)

Progressive has currently tracked over 5 million miles of driving data from customer (Progressive, 2012). Their analysis led to the following results: driving behavior is more than twice as predictive of claims costs as any other factor; the highest risk driving behavior has loss costs about 2.5 times higher than the lowest risk behavior; 7 out of 10 drivers who try SnapShot® receive a discount; and the range of rates could be much wider and more personalized than they are today (Progressive, 2012).

StateFarm also offers several PAYD products. Customers can receive a discount of up to 50% using a product that tracks mileage, braking, acceleration, turns, time of day, and speed (Arquette, 2013). A discount up to 40% is offered for using a device that tracks only mileage (Arquette, 2013). Furthermore, StateFarm's products display the ability of insurers to further diversify their insurance products. StateFarm provides a wide range of additional features to customers including emergency response, stolen vehicle location assistance, vehicle diagnostic and maintenance reminders, speed alerts, website and a smart phone application to monitor driving behavior (Arquette, 2013). StateFarm also has the capability to track data through OnStar, Ford Sync, or a customer installed device (Arquette, 2013).

An innovative product offered by American Family Insurance, DriveCam, though not a PAYD product, gives insight to the potential of monitoring driving behavior. DriveCam monitors the vehicle use of new teenage drivers for triggers, behavior correlated with crashing, and videotapes drivers and the road (Greenberg, 2008). None

of the data is shared with the insurance company; instead, teen drivers are expected to monitor their own behavior along with coaching from their parents (Greenberg, 2008). DriveCam reduces teen trigger events by 60% in three weeks and reduces crashes by over 50% (Greenberg, 2008). mySafetyValet™ is another product offered by American Family Insurance. The company promotes this as a “safety-focused program” rather than as PAYD (American Family Insurance). Customers receive a 5% discount for signing up and then the insurance company collects six months of data (American Family Insurance). When it is time to renew the policy a discount of up to 30% is applied based on individual data. mySafetyValet™ tracks braking, acceleration, and cornering and allows customers to set and monitor goals (American Family Insurance).

One Dutch experiment used GPS devices to track location, speed, time of day, and mileage of drivers under 30 (Bolderijk, Knockaert, Steg, & Verhoef, 2011). The results of this experiment suggest PAYD reduces overall speeding by an estimated 14% in affected drivers (Bolderijk, Knockaert, Steg, & Verhoef, 2011). This is a significant increase in safety gains when one considers the limitations of more conventional speed enforcement tools. Speed cameras and mobile radars can only monitor a part of the road. The reduced speeding resulting from PAYD reflects reduced speeds over *all* roads driven, rather than just the roads conventional tools can monitor. It is also important to recognize that small differences in driving speed are associated with large differences in crash risk (Elvik, 2006). A 5% reduction in speeding can reduce fatalities in road accidents by as much as 20% (OCED/ECMT, 2006). This study could not, however, conclude their PAYD product resulted in reduction of mileage or driving during ‘peak hours’ (Bolderijk, Knockaert, Steg, & Verhoef, 2011). “When a small sample of

participants was interviewed about their experiences with the experiment, most indicated that reducing mileage and avoiding nighttime driving was very difficult. Reduction of driver speed contrarily, does not require planning. So it may be easier for drivers to change driving style rather than driving volume" (Bolderijk, Knockaert, Steg, & Verhoef, 2011).

Clearly, in situations where behavior is tracked, actuarial accuracy increases as insurance companies begin to rely on real-time data rather than past-realized losses. However, evidence suggests tracking driving behavior can stand to do much more than reduce premium inequities. The DriveCam system reduced teen trigger events by an astounding amount. Because driving behavior is much easier to manage and change than mileage and the time of day one drives, consumers will likely be more accepting of PAYD products that provide discounts for driving safely. Thus, insurance companies can create a way to actually encourage and facilitate safe driving behavior.

PAYD also stands to increase affordability. Lower income motorists generally drive less and tend to place a high value on anything that allows them to save money (Litman). Furthermore, increased affordability might result in a reduction in the number of uninsured drivers reducing uninsured motorist claims. One survey found that, "A majority of those currently uninsured and those purchasing a minimum limits policy had a high level of interest in a lower cost alternative to the current minimum limits policy and stated that they would probably purchase such a policy even if it was offered at only a 10% reduction from the current minimum level" (Hundstad, Bernstein, & Turem, 1994).Therefore, PAYD products will greatly benefit low-income drivers willing to forfeit unnecessary vehicle travel for a reduced premium.

PAYD allows companies a level of competition which is especially important in a market regulated as highly as insurance. One study tested which factors were most important to customer acceptance of usage-based insurance found there was insufficient evidence to suggest that perceived privacy risk was not important in determining customer acceptance (Rejikumar, 2012). However, people have varying degrees of privacy risk and each individual will be accepting of only a certain level of risk. Some will only want to have miles tracked while others will be comfortable having behavior tracked and others still will allow for both to be tracked. Some individuals will not allow GPS tracking while others embrace the new technology. The differences in opinions allow for a variety of products that increase competition and promote creativity and innovation in the insurance industry.

Tracking driving behavior stands to not only provide personalized insurance premiums but also to actually influence drivers to improve their driving behaviors. Rejikumar found that customer acceptance of PAYD depends on perceived individual benefits, perceived ease of understanding the policy and device, and the perceived value, which is the degree to which a person believes to gain in comparison to what they sacrifice (Rejikumar, 2012). PAYD products offering discounts for good driving behavior have a huge advantage because it allows customers an avenue of savings that requires relatively little effort on their part, making the product more appealing to consumers. A night employee cannot avoid driving during dangerous hours, but he or she can certainly drive safely. The actuarial soundness of pricing based on driving behavior is further validated by Progressive's findings that driving behavior is more than twice as predictive of claims costs as any other factor (Progressive, 2012). In addition,

as PAYD products encourage insureds to driver safer, they increase the safety of all drivers on the road rather than solely to the insured themselves. When a driver is careful and alert, he or she reduces both the risk of an at-fault accident and the risk of colliding with another negligent driver thereby reducing accident he or she is not responsible for. The best way encourage insured to driver safer would likely be to incorporate some active customer involvement. mySafetyValet allows customers to set goals and StateFarm has a smart phone app for it product. Some of Progressive's SnapShot devices beep after a hard brake to provide instant feedback (Progressive, 95-2014). As increases in road safety only lowers claims, such a pricing strategy is beneficial to the insured, the insurer, and all other drivers.

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