Executive Summary

Each year, Massachusetts drivers are driving more, and with each additional mile driven, levels of global warming pollution rise. The prospect of tying auto insurance rates to miles driven, called Pay-As-You-Drive auto insurance (PAYD), offers the opportunity to improve the accuracy of auto insurance rating while reducing vehicle miles traveled (VMT) and corresponding accident costs as well as reducing fuel consumption and greenhouse gas emissions.

Pay-As-You-Drive auto insurance is a win for consumers, insurers and the environment:

- Consumers can save money; they will only pay for the coverage needed based on how much they drive.
- Insurers can improve the accuracy of their rating plans while providing an incentive to reduce the number and cost of auto accident claims.
- The environment will benefit from the reduction in driving that PAYD incentivizes – less driving means reduced fuel usage and lower greenhouse gas emissions.

The Conservation Law Foundation (CLF) and the Environmental Insurance Agency commissioned a study to assess the risk-mileage relationship using actual insurance claims information in Massachusetts. This study ("Ferreira and Minikel 2010") offers the largest disaggregated analysis to date of the risk-mileage relationship and the actuarial basis for PAYD. The work analyzes data on $502 million worth of claims on almost 3 million cars driven an aggregate of 34 billion miles. The study confirms the statistical soundness of pay-as-you-drive auto insurance pricing and indicates that the PAYD approach would result in significant reductions in miles driven, green house gas emissions, and auto accident losses without adverse equity impacts to drivers.

PAYD Saves Money and is a More Accurate and Fairer Method to Price Auto Insurance

- By basing premiums at least partly on mileage, PAYD provides individual policyholders more control over their insurance costs and more accurate premiums for the type of driving they do.
- PAYD pricing reduces inequities by eliminating the subsidies low-mileage drivers currently pay for high-mileage drivers in the traditional pricing system.
- Even though suburban and rural car owners tend to drive more miles than urban car owners, their per mile charges would be lower. If they drive less than the average for their area, they would pay less for actuarially-priced PAYD insurance than they do today under the existing system.

PAYD Reduces Vehicle Mileage Traveled (VMT), Accidents and Fuel Consumption by 5-10%

- Switching all Massachusetts drivers to pure per mile auto insurance pricing would reduce mileage, accident costs and fuel consumption by about 9.5%. An alternative model with a flat yearly rate plus per mile pricing after the first 2,000 miles would reduce these measures by about 5%.
- These reductions could range between 3 and 14% depending on a number of variables like fuel prices. But even the study's lowest plausible VMT reduction (2.7%) would save more than a billion miles annually and millions of tones of GHG.
- Negative impacts of congestion will decrease under PAYD, particularly for urban driving.

Overview

Pay-As-You-Drive (PAYD) auto insurance converts the traditional lump-sum yearly insurance payment into a cents-per-mile rate, thus providing drivers with an opportunity to save money and an incentive to reduce mileage. For decades, researchers have touted PAYD's potential to reduce automobile accidents, congestion and greenhouse gas emissions while also improving equity over the current system. It appears that PAYD carries large potential benefits both for individual policyholders and for society as a whole, yet it has seen limited application to date, due in large part to economic and regulatory barriers. Congestion, pollution and some fraction of accident costs are all externalities, so any individual insurance company would see just a portion of the benefits of PAYD, even while incurring the full transaction and monitoring costs. Meanwhile, many state insurance regulations either prohibit or inhibit PAYD.

However, new technology has lowered transaction and monitoring costs and awareness of global warming has sparked a new state-level push for ways to reduce VMT without increasing consumer costs. From a policy standpoint, PAYD seems an increasingly appealing and feasible prospect, yet from an actuarial standpoint, it is still in need of further study. While it is clear that risk increases with mileage, the precise nature of the relationship at the individual level is not well understood. Most research on PAYD to date has examined mileage and risk data at a highly aggregated level, comparing, for instance, across U.S. states.

This report offers the largest disaggregated study to date of the risk-mileage relationship and the actuarial basis for PAYD. Linking recently released insurance and mileage data from the Commonwealth of Massachusetts for the 2006 policy year, we analyze the correlation between annual miles traveled and insurance risk for over three million individual vehicles insured on private passenger insurance policies and categorized by rating class and territory.

We begin by matching 2006 policy year earned exposure data to claims data for bodily injury and property damage liability, plus personal injury protection coverages— i.e., the compulsory, and therefore fairly uniform, types of insurance coverage. Next we create estimates of each vehicle's annual miles traveled based on odometer readings from mandatory safety checks. In addition, we obtain fuel economy estimates for each vehicle thanks to commercial Vehicle Identification Number (VIN) decoding services provided by VINquery.com. In all, we are able to analyze data on $502 million worth of claims on 2.87 million car years of exposure covering vehicles driven an aggregate of 34 billion miles.

We find a strong relationship between miles driven and auto accident claims frequency and loss costs. This relationship between risk and mileage is less than linear when all vehicles are considered together, but it becomes considerably more linear when class and territory are differentiated. Using pure premium as our measure of risk, we regress risk on mileage using a variety of models. We find that mileage is a highly significant predictor of risk but, used alone, provides less explanatory power than traditional class and territory factors, so a single, universal per mile insurance rate for all drivers would be inappropriate. However, a combined model using mileage along with class and territory groupings explains more risk variation than a similar model without mileage. In fact, mileage gains in its own explanatory power when used in conjunction with class and territory, probably because class and

territory provide some control on where and how the miles are traveled. This suggests that telematic pricing that varies per mile rates based on when, where and how miles are traveled could improve actuarial accuracy even further and may even obviate the need for some traditional insurance rating factors.

Absent telematic pricing, PAYD insurance is most likely to be practical and effective with differential rates for customers in different classes and territories. Since low-mileage policyholders have higher per mile risk, and since there are fixed costs associated with writing an insurance policy, a pricing scheme where users purchase 2,000 miles for a flat yearly fee and then pay per mile thereafter may be more realistic and statistically sound than a strictly per mile pricing scheme.

Though PAYD is unlikely to eliminate existing class and territory distinctions, it appears to have positive equity implications. PAYD would improve fairness by shifting weight in insurance pricing towards an individually controllable factor, *mileage*, rather than involuntary groupings, and by reducing or eliminating the cross-subsidy from low to high mileage drivers. For low-income households, PAYD would create an opportunity to save money by choosing to reduce mileage, would make low-mileage car ownership more feasible, and would reduce the toll of auto-related externalities on the non-car owning poor.

Extrapolating from the per mile pure premiums we calculate for compulsory coverages, we estimate retail prices for full coverage for each class and territory. Under strictly per mile pricing, we estimate an average premium of 8.2¢ per mile statewide, ranging from 4.3¢ for the lowest-risk customers to 37¢ for the highest-risk customers. For statewide fuel economy we observe a 20 mile per gallon average, which at the current gasoline price of $2.70 translates into about 14¢ per mile. Assuming that drivers currently consider fuel to be the only marginal price of driving an additional mile, a switch to PAYD would represent more than a 50% increase in the perceived per mile price of driving for the average fully insured Massachusetts driver. Our literature review suggests a -0.15 elasticity of miles driven with respect to the marginal per mile price. Based on this, we estimate a 9.5% reduction in VMT if all drivers in Massachusetts switched to a strictly per mile PAYD insurance plan, and a 5.0% reduction if all drivers switched to a plan having 2,000 miles bundled into a yearly fee plus per mile pricing thereafter[1]. Fuel reductions are almost exactly proportional, as we find that average fuel economy exhibits almost no variation by class, territory or annual mileage. Depending on a number of variables, including the amount paid per mile, the types of coverage provided, and the availability of alternative modes of transportation to drivers, the VMT and fuel consumption reductions with PAYD could range between 3 and 14%.

Our 9.5% estimate is somewhat lower than what other researchers have estimated, probably because our differentiation of insurance rates by class and territory reveals that the highest-risk territories with the highest theoretical per mile rate already have the lowest annual mileage. The reduction in accidents resulting from the reduced mileage would be similar in percentage, but could be somewhat higher or lower depending upon the relative risk of the forgone miles and the additional benefit of reduced congestion and multi-car accident risk.

[1] The reduction from 9.5% to 5% for the 2K+per-mile scheme is due not only to the flat charge for the first 2000 miles but also to a lower, and more statistically justifiable, per mile price.

Overall, the risk analysis in this study confirms the statistical soundness of pay-as-you-drive auto insurance pricing and indicates that, if the per-mile charges are sufficiently timely and certain, then the approach would result in significant reductions in miles driven, green house gas emissions, and auto accident losses without adverse horizontal or vertical equity impacts.

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The analysis, opinions, and conclusions in this report are solely those of the authors and not necessarily those of the Conservation Law Foundation, the Transportation Alliance, MIT, EOEEA, or any other organization involved in the data preparation and analysis, or for whom the authors have worked.

The report and more information about PAYD may be found at CLF's website: http://www.clf.org/work/HCEJ/PAYD. A downloadable zip file with the Appendix 3 Analytic Dataset is available at MIT's website: http://mit.edu/jf/www/payd.

[2] Public notice of the dataset availability is posted on the EOEEA website at: http://www.mass.gov/?pageID=eoeeaterminal&L=3&L0=Home&L1=Grants+%26+Technical+Assistance&L2=Data+Resources&sid=Eoeea&b=terminalcontent&f=eea_data-resources_2005-08-auto-insur-data&csid=Eoeea