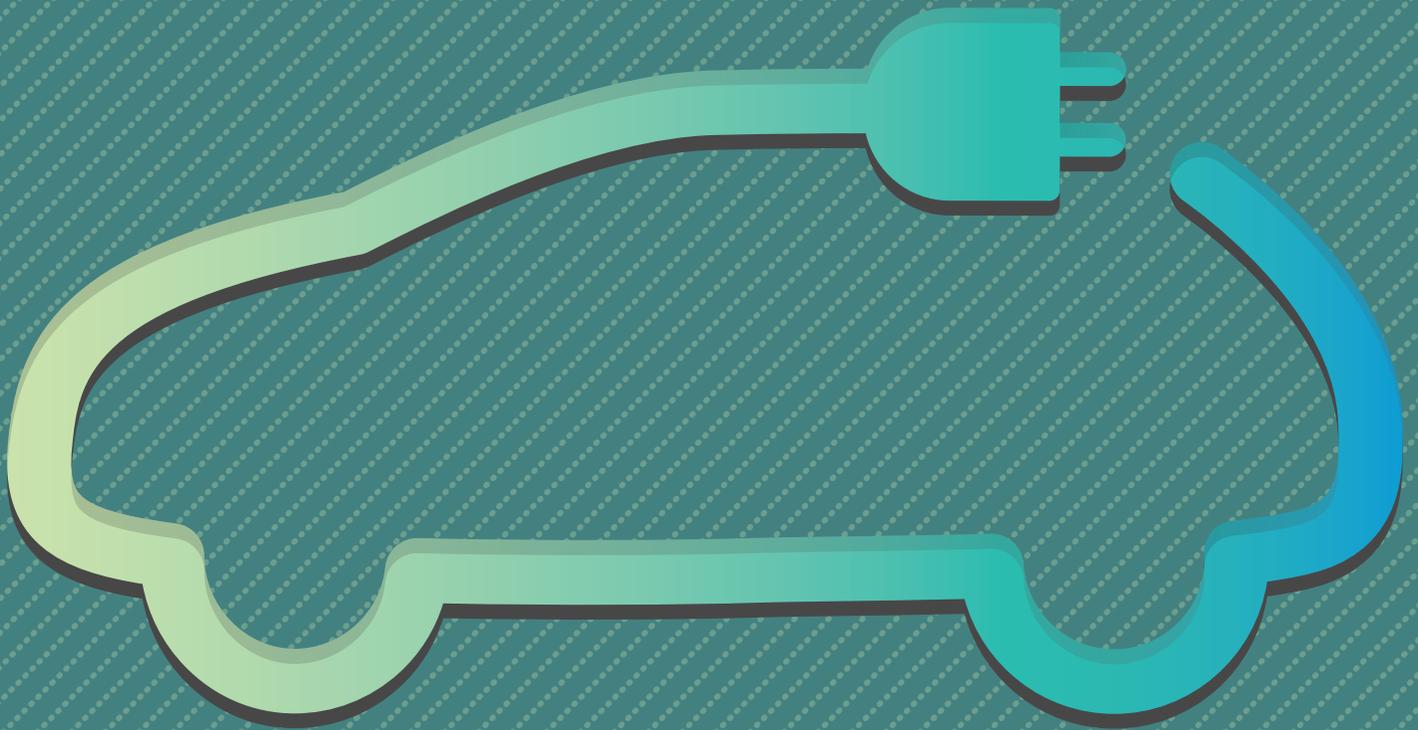
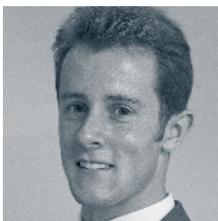


FEATURE

HYBRID, ELECTRIC AND DRIVERLESS CARS: INNOVATION DRIVING CHANGE IN MOTOR VEHICLE INSURANCE

Motor insurers have had to keep up with rapid developments in the car industry for years. With the introduction of hybrid and electric vehicles into the market, and significant investment into the development of driverless cars, insurers will face new and unique challenges. The authors look at how insurers have responded to these new additions to the market and consider what a world of driverless cars might actually look like.

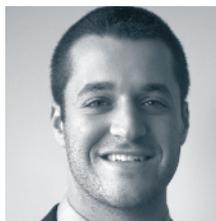




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Ever since Henry Ford released the Model T in 1908, the motor production industry has been a hotbed of innovation. Recently we have seen the introduction of hybrid and electric vehicles into the motor vehicle market and significant investment is currently being directed to the development of driverless cars. Nissan has announced that it will deliver a commercially viable self-driving car by 2020¹—it turns out “Herbie the Love Bug” is not so far away after all!

Through a survey of market prices, we firstly examine how insurers have responded to hybrid vehicles. For the two models tested, our analysis indicates that when petrol and hybrids have the same market value, hybrids are actually cheaper to insure. It’s possible this variation is due to differences in expected driving habits between the two groups of owners.

Next we consider the premiums insurers quote for electric vehicles. We highlight some of the key factors that make electric vehicles different risks to insure when compared to other vehicles.

The final section of this article focuses on the unique challenges insurers are likely to face when insuring driverless cars. Insurers may have to respond to changes surrounding the concept of fault, the possibility of cars being shared between multiple owners and the fact that many conventional rating factors will take on less relevance in the new environment. These challenges are not just confined to comprehensive and third party motor vehicle insurance.

“Nissan has announced that it will deliver a commercially viable self-driving car by 2020 – it turns out ‘Herbie the Love Bug’ is not so far away after all!”

We also expect there to be an impact on compulsory third party and product liability insurance.

HYBRID VEHICLES

In 2013, hybrids accounted for over one per cent of all cars sold in Australia.² Car manufacturers are now producing hybrids across the whole spectrum of shapes and sizes – even Ferrari have developed a 708kW hybrid model. Hybrids are more expensive to purchase than their petrol counterparts. For the Toyota Camry the difference in initial purchase price is around \$4,500, while for the Honda Jazz the margin is around \$3,000. However, they are more fuel-efficient, which means hybrid car owners save money on fuel over the car’s lifetime.

What is a hybrid vehicle?

Hybrid cars combine an electric motor and battery pack with a conventional petrol engine. The electric motor is mostly used at slower speeds and can be recharged by the petrol motor and through “regenerative braking”. Some vehicles offer the option to recharge by connecting to a power supply (these vehicles are referred to as plug-in hybrid vehicles). Combining these two motors results in lower carbon dioxide emissions, superior fuel economy, increases in driving range over and above what would be able to be achieved solely by the electric motor and shorter “refuelling time”.

What is driving the demand for hybrid vehicles?

There are two main drivers behind the demand for hybrid vehicles. The first is that they are more environmentally sustainable than their petrol

RATING COMPREHENSIVE MOTOR INSURANCE

Typically, insurers analyse historical claim frequency (how often claims happen) and average claim size when determining rates. Three of the most significant perils to consider are at fault collision, not at fault collision and theft. Individual models may be constructed to estimate the expected claims cost of each peril or claims experience may be considered in aggregate.

Both expected claim frequency and average claim size for a policyholder depend on a range of factors, including driver behaviour, time spent on the road, where the vehicle is located and the type of vehicle covered under the policy. Insurers use a range of rating variables when calculating premium rates, all of which are expected to relate to expected claims cost. After all, a 21-year-old male driving a Ferrari is expected to have very different claims experience to a 40-year-old female driving a Toyota Yaris.

counterparts. Consequently, these vehicles appeal to the more environmentally conscious citizens. This driver of demand is common to both hybrids and electric cars.

The second driver is cost. When relative differences in purchase price, distance driven and the price of petrol are taken into account, these vehicles have the potential to save their owners money. While the price of oil fluctuates, an upwards trend in price is inevitable as finite global oil supplies deplete.

How do premiums for hybrid vehicles compare?

In order to understand premium setting for hybrid vehicles, we consider the following questions:

- How do comprehensive motor vehicle insurance premiums compare across insurers for hybrid vehicles?
- How much more expensive are hybrid vehicles to insure than their petrol equivalents?
- How do premiums between hybrid and petrol vehicles compare if we remove the impact that differences in sum insured has on premiums?

FIG 1. Comparison of the annual premiums offered by four insurers for the Toyota Camry Hybrid and the Honda Jazz Hybrid



How do comprehensive motor vehicle insurance premiums compare across insurers for hybrid vehicles?

We collected comprehensive motor vehicle insurance quotes from four major insurers for a 40-year-old male holding all rating variables fixed. The two vehicles tested were the Toyota Camry Hybrid and the Honda Jazz Hybrid. These vehicles were selected due to the popularity of their petrol equivalents and the respective medium and small car categorisation. In this article, we draw conclusions based on the premiums offered for these two vehicles. However, we note that insurers may respond differently when offering cover for other makes and models. This has the potential to impact the conclusions drawn here when looking at the wider market.

The annual premiums offered for the Camry by the three largest insurers were all around \$950, while insurer D was the most expensive with a premium of nearly \$1,150. Insurer A was almost \$200 cheaper than the other insurers for the Jazz.

FIG 2. Dollar difference in the annual premiums for Camry and Jazz hybrids and their petrol counterparts

MODEL	INSURER			
	A	B	C	D
Camry	+\$63	+\$35	+\$43	+\$89
Jazz	-\$38	+\$114	+\$110	+\$54

“Electric cars pose a number of additional rating challenges for insurers over and above hybrids. These are expected to impact both claim frequency and average claim severity ...”

Interestingly, despite the recommended retail price of the Camry Hybrid being almost \$9,000 more than the Honda Jazz, insurer B and insurer C appear to charge more to insure the Jazz than the Camry (see Figure 1).

Premiums on hybrid vehicles versus their petrol counterparts

It might be argued that people who purchase hybrid vehicles are more environmentally and socially responsible than those who purchase petrol vehicles. That is, they have a greater understanding of the impact their actions can have on others and this has the potential to translate into more cautious driving behaviour. On this assumption alone, we could expect those who purchase hybrid vehicles to have a lower claim frequency and hence a lower premium.

However, hybrid vehicles are more expensive to purchase and therefore have a higher sum insured. In isolation we would expect this to translate to an increase in premium charged. Figure 2 displays the dollar difference in the annual premiums quoted between the hybrid and petrol versions at their respective market values. A positive number means hybrids are more expensive to insure, or in other words, the impact of the increased sum insured wins out.

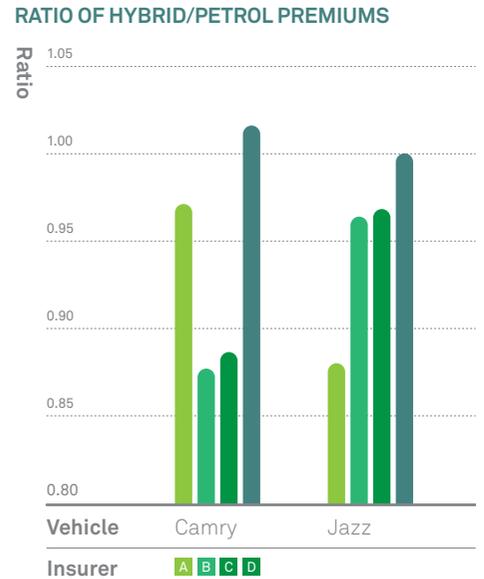
We may observe:

- insurer A offers a discount for the hybrid Jazz, however there’s a \$63 increase for the Camry
- despite the difference in the purchase price between the hybrid and petrol Camry being greatest, the increase in the premium insurers B and C quote for the hybrid Jazz is far in excess of the increase for the Camry.

How do premiums between hybrid and petrol vehicles compare if we remove the impact that differences in sum insured has on premiums?

After normalising for the differences in sum insured, the three largest insurers offer a discount for these two hybrids. Figure 3 plots the ratio of the premium offered for the hybrid against that offered for the petrol version for the same sum insured. This analysis allows us to assess to what extent insurers view those who own hybrid vehicles as “better risks”. A value of one means there is no difference in the premium offered while a value of less than one means the hybrid is cheaper to insure.

FIG 3. Ratio of the premium offered for the hybrid models against the premium offered for the petrol models at the same sum insured



We can observe:

- of the four insurers, B and C offer the largest relative discount for the Camry hybrid while insurer A offers the largest discount for the Jazz (in both cases this discount is approximately 11 per cent)
- insurer D does not appear to distinguish between hybrid and petrol vehicles, with the premiums for the Camry and Jazz almost identical after removing sum insured differences.

In combining the results of these three sections we can conclude there is significant variation in the premiums offered on these two hybrid vehicles across the four insurers. Furthermore, the hybrids tested are typically more expensive to insure than the petrol equivalents. However, if we hold sum insured constant across the two vehicle categories, most of the insurers offer a discount for these hybrids relative to their petrol counterparts. This could be seen to support the hypothesis that owners of hybrid vehicles are expected to have better claims experience when compared to the owners of the equivalent petrol models, although a wider market analysis is needed to determine this conclusively.

FIG 4. Comparison of the annual premiums offered by four insurers for the Nissan Leaf and the Mitsubishi i-MiEV



ELECTRIC VEHICLES

Electric cars have a shorter driving range than hybrids – the Mitsubishi i-MiEV and Nissan Leaf both have a range of around 150km on a single charge. The time taken to charge depends on the means by which the vehicle is charged. Charging may take as little as 30 minutes or as many as 12 hours, depending on the type of plug-in arrangement or charging station.

At present, there are few manufacturers selling electric cars in Australia. Mitsubishi’s i-MiEV and Nissan’s LEAF are recent entrants to the market and are priced at around \$53,000 and \$40,000 respectively. Interestingly, Toyota does not see a market in electric vehicles although it does see value in continued hybrid production and the upcoming hydrogen fuel cell technology.³ Tesla Motors, founded in 2003 by a group of Silicon Valley engineers, disagrees with this assessment. Their goal is to “accelerate the world’s transition to electric mobility with a full range of increasingly affordable electric cars”.⁴ Tesla produces their own electric vehicles but also cooperates with other car manufacturers to incorporate their patented electric powertrain technology in vehicles.

“Innovation in car engine technology is not the only change attracting attention in the car market: in the US, vehicle manufacturers have showcased ‘autonomous’ concept cars at a number of motor and consumer electronics shows.”

Electric cars pose a number of additional rating challenges for insurers over and above hybrids. These are expected to impact both claim frequency and average claim severity and are hard to assess at present given the limited data available on which to base assumptions but we summarise the following points.

- Typically, electric vehicles have a shorter driving range than hybrids. We’d expect this to result in less highway and long distance driving.
- The electric motor results in instant torque and hence, the electric car’s acceleration from slow speeds is typically better than a petrol car. As an illustration of the performance able to be achieved, Tesla’s sports car, the Roadster, accelerates from zero to 100 km per hour in 3.7 seconds.⁵
- We observed that most insurers offered a lower premium for the hybrid vehicles tested, relative to the petrol version of commensurate value. One could hypothesise that on balance, electric vehicles will be owned by more socially responsible individuals. Is there a similar relationship between the mix of people that buy electric cars and driving habits?

The premium offered by insurers A, B and C for the Nissan Leaf are similar at around \$1,100 while insurer D is significantly more expensive at close to \$1,400. As we would expect from the increase in market value, the i-MiEV is more expensive to insure. Insurers B and C offer similar premiums while insurers A and D are significantly more expensive. These premiums are displayed in Figure 4.

DRIVERLESS CARS

Innovation in car engine technology is not the only change attracting attention in the car market: in the US, vehicle manufacturers have showcased “autonomous” concept cars at a number of motor and consumer electronics shows.

These cars are capable of scanning object movement, responding to traffic lights and processing the surrounding environment using a system of lasers, GPS units and cameras. Google, who is a leader in developing this technology, has conducted more than 500,000 km of driverless car testing without a single accident.⁶



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“If an accident occurs where an autonomous car is at fault, who is deemed liable?”

Although it will be some time before these cars are publicly available, manufacturers including Toyota and Nissan are already recognising the potential of this technology.

Autonomous cars are a game changer and insurers will have to make considerable adjustments in order to adapt to a world with autonomous cars. We may expect the following changes to occur:

- fewer accidents, as “human error” is removed as a potential cause of accident, provided the technology used is sound and durable
- new challenges to materialise for lawmakers regarding licensing, responsibility for vehicle operation and liability
- fewer cars on the road if this technology is employed successfully.

Insurers will need to be able to respond to these social and technological changes. Some potential considerations for insurers are outlined below.

Who is liable?

If an accident occurs where an autonomous car is at fault, who is deemed liable? Would liability fall on the car manufacturer, the technical systems manufacturer, the network supplying GPS information, or will the occupant still be deemed as having ultimate responsibility for the vehicle’s operation? If manufacturers are considered liable, we could expect an increase in the number of product liability claims – and a commensurate increase in premiums.

Any alterations to the concept of liability which stems from system failure that result in accidents, will carry across to compulsory third party insurance. If manufacturers are deemed liable, the concept of driver fault may come under pressure and some of the schemes may need to change.

Determining premiums

How will premiums for autonomous vehicles be determined? Removing driver judgement and ability from the equation means a 21-year-old male may have the same expected claims cost as a 40-year-old female. The usual rating variables of age, gender, license tenure and claims history will no longer be good predictors of claim frequency and severity.

We might expect an increase in repair costs for autonomous vehicles damaged in road accidents, relative to conventional vehicles. These automobiles are likely to require the services of specialised repairers when system repairs are needed. This would impact the premiums paid by the owners of both driverless and regular cars, the latter incurring higher expected repair costs upon colliding with a driverless car.

Insurers will have to establish premiums in the absence of a claims history and judicial precedents. Provided the technology employed is reliable and durable we could expect the reduction in claim frequency to be sizeable. While we acknowledge that other factors will need to be considered in the setting of premiums, when looking at the effects on premiums from this angle alone, we may expect comprehensive motor premiums to reduce for autonomous cars compared to their driver-operated counterparts.

Premium setting for shared vehicles

Given that autonomous cars have the potential to be easily shared between owners, how will premiums be set? Should a large scale car sharing scheme be introduced, there will be fewer cars on the road, less cars manufactured and a reduction in the number of cars that require insurance. If cars are able to drive to their owners, car sharing becomes easier and the demand for taxis will reduce. Insurers will need to consider that such cars will be on the road more often and factors including where they are located and if they are garaged will have less relevance where there are multiple owners. While the propensity to cause an accident may be lower in the case of driverless cars, the frequency of not at fault collision, storm and windshield claims may increase due to the increased time vehicles are on the road.

Additional challenges in a driverless car society

The proliferation of autonomous cars must be accompanied by stable and secure infrastructure. In other words, there can be no network crashes and back up systems must be installed in vehicles to seamlessly take over if components fail. In addition, this increased reliance on technology means the risk of system hacking needs to be minimised and consideration should be given to what type of personal information is collected and stored. Society will need to consider these issues and respond if driverless cars are to become a part of everyday life.

CONCLUSION

Motor insurers have had to keep up with rapid developments in the car industry for years. So far the industry has managed to successfully integrate changes in car design, technological innovation and alterations in consumer preferences for more environmentally friendly vehicles into the covers offered. However, driverless cars represent a revolution in transport and present a unique challenge to insurers that will require significant investigation and analysis. ■

Notes

- ¹ <http://www.wired.com/autopia/2013/08/nissan-autonomous-drive/>
- ² <http://www.smh.com.au/national/hybrid-car-sales-make-up-1-per-cent-of-vehicle-sales-20131129-2ygw9.html>
- ³ www.dailytech.com/Toyota+Passing+Over+EVs+for+More+Hybrids+Hydrogen+Fuel+Cell+Vehicles/article33471.htm
- ⁴ www.teslamotors.com/about/press/releases/tesla-model-s-wins-one-automotive-industry-s-highest-honors-motor-trend-2013-ca
- ⁵ http://www.teslamotors.com/en_AU/goelectric
- ⁶ <http://www.extremetech.com/extreme/134262-self-driving-google-cars-300000-miles-0-crashes-if-only-your-pc-was-as-stable>