Why Fuel Economy Fraud Happened in the Japanese Automotive Industry?

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Abstract: Fuel economy competition has heated up as a result of the oil crises of the 1970s, the environmental issues occurring since the 1990s, and the Japanese government’s economic policies, so that fuel economy has become a key competition index. However, for engineers who measure fuel economy, it is (i) a vague and unstable metric that fluctuates because of a number of factors and (ii) a quality that does not affect safety and so is not subject to recall. Competitive pressure regarding fuel economy led to arbitrary measurements. This eventually became normalized, and since 2016, cases of organizational corruption in the Japanese automotive industry have been uncovered one after another.

Keywords: fuel economy, organizational corruption, competition index, ambiguity

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Introduction

An automobile, which consists of about 30,000 parts, has a closed integral architecture and is a product that epitomizes the strength of Japanese-style manufacturing (Fujimoto, 2004). However, among Japanese automakers, many cases of institutionalized organizational corruption with respect to fuel economy measurement have come to light since 2016.

However, for engineers who measure fuel economy, it is (i) a vague and unstable metric that fluctuates because of a number of factors, and (ii) a quality that does not affect safety and so is not subject to recall. In fact, catalog fuel economy differs from the actual fuel economy when the consumer drives the car, and so, the two diverge. Such cases thus create room for fraudulent activity to occur. For example, in the case of emissions, vehicles manufactured by Volkswagen AG typically emit 40 times the volume of nitrogen oxides permissible under the environmental standards. Yet, Volkswagen achieved compliance with the U.S. Clean Air Act of 1963 by installing defeat device software in its diesel vehicles so that the volume of pollutants would be significantly reduced only during testing. In 2015, the U.S. Environmental Protection Agency announced that this was a violation of its diesel engine emissions rules (Hotten, 2015). This was the first in a series of incidents worldwide, and since 2016, many Japanese automakers have been found to have regularly engaged in organizational corruption with respect to fuel economy measurement. So, how did it come about that Japanese automakers were involved in organizational corruption with regard to the measurement of fuel economy?
Social Background Related to Fuel Economy

Focus on fuel economy

Fuel economy (nenpi in Japanese) means the rate at which fuel is consumed. It is quantified as the distance (in kilometers) that an automobile can travel on one liter of gasoline.¹ The term “fuel economy” has been widely used in Japan since the 1970s, when the country was dealing with the problems of pollution from auto emissions and the oil crises (Figure 1). In the United States, the Energy Policy and Conservation Act was enacted in 1975, and in Japan, the Act on the Rational Use of Energy (Energy Conservation Act) was enacted in 1979 (Nishino, 2015). Around this time, the Honda Civic, which was equipped with a compound vortex controlled

![Figure 1. Number of newspaper articles on “Nenpi (fuel economy)”](image)

*Source: Database of Nihon Keizai Shimbun.*

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¹ Honda Motor Co., Ltd. (Honda) website. “Honda Cars ‘Frequently asked questions when thinking about buying a new car. Q. What is fuel economy?’” (in Japanese). https://www.honda.co.jp/hondacars/hajimete/faq/select/02fuel/
combustion (CVCC) engine, was developed in Japan (Kawamoto, Sato, Minowa, Nisimura, & Hashimoto, 1975).

Gasoline prices in the U.S. were low, so not much importance was placed on American cars’ fuel economy, but gasoline was relatively expensive in Japan because of taxes and other factors, so Japanese cars pursued more fuel economy (Itami, 2017). A ground-breaking vehicle was the Prius, the world’s first hybrid car, introduced by the Toyota Motor Corporation in 1997.² Consumers were impressed by this car’s clean image, with its low emissions and high fuel economy, so Japanese automakers started launching similar cars in the global hybrid market. Honda launched the Insight in 1999, and Nissan Motor Co., Ltd. followed up with the hybrid version of the Tino in 2000 (Nissan “Tino Haiburido”, 2000).

Accelerating fuel economy competition

The 1990s was the era when fuel economy came to the fore in relation to global warming. The Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), which was signed in 1997 at the Third Session of the Conference of Parties (COP3) to the UNFCCC,³ agreed on reductions in emissions of carbon dioxide and other greenhouse gases. The Japanese government promised to cut greenhouse gas emissions by 6% between 2008 and 2012, and it reduced taxes on vehicles with high fuel economy. The “greening exemptions” to the automobile acquisition tax paid on auto purchases that started in fiscal 2002, the low-emission vehicle certification system (commonly known as the eco-car tax incentive) that began in fiscal 2009, and the motor vehicle weight tax paid when

² The prototype was unveiled in 1995. Toyota Motor Corporation website. “Prius Concept 1995” (in Japanese). https://global.toyota.jp/prius20th/evolution/concept/

³ Ministry of Foreign Affairs website. “Kyoto Protocol of the United Nations Framework Convention on Climate (or Kyoto Protocol of the UNFCCC). https://mofa.go.jp/mofaj/gaiko/treaty/treaty_020413.html
cars are inspected—all reduced the annual burden of vehicle taxes.4

When this happened, fuel economy competition intensified even for vehicles that run on gasoline. At the Tokyo Motor Show in 2009, Daihatsu Motor Co., Ltd. announced plans to launch the e:S, a mini-car with a fuel economy of 30 km per liter (10–15 mode) (Ikehara, 2009). In 2010, Mazda Motor Corporation unveiled its SKYACTIV technology, which enables high fuel economy, and announced that it would install this technology in the Mazda Demio,5 to be launched the following year.6

Because of these government policies, competition to improve fuel economy heated up in the 2010s (Toyo Keizai Online, 2013). This was especially noticeable in the kei (light) vehicles market. “Kei vehicles” is a special Japanese specification for compact cars. After World War II, Japan encouraged the spread of automobiles by establishing a preferential tax system to facilitate car purchases and maintenance. In fact, many consumers who buy these kei vehicles say that they chose a kei vehicle because of economic considerations or because the taxes are low (Nihon Zidousya Kougyoukai, 2020). However, kei vehicle prices have been going up because of improvements in safety functions, so it has become necessary to appeal to consumers by focusing on the everyday savings in terms of

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4 With the transition to a new environmental performance rating system, the automobile acquisition tax will be abolished for new vehicles purchased from October 2019 on. Ministry of Internal Affairs and Communications website. “Automobile taxes will change significantly on October 1, 2019” (in Japanese). https://www.soumu.go.jp/main_sosiki/jichi_zeisei/czaisei/131410.html

5 The overseas name is the Mazda2. Currently, the model goes by the name Mazda2 both domestically and overseas. Mazda Motor Corporation website. “History (2015–2019)” (in Japanese). https://www.mazda.com/en/about/profile/history/2015-2019/

6 Mazda Motor Corporation website. “Mazda announces SKYACTIV next-generation technology” (in Japanese). https://newsroom.mazda.com/en/publicity/release/2010/201010/101020a.html
For example, NMKV Co., Ltd., a 50:50 joint venture set up by Mitsubishi Motors and Nissan Motor in 2011 to specialize in developing kei vehicles (Toyokeizai Online, 2011), thought that design and other issues would make it difficult to compete with its peers. Therefore, its development goal was to become number one in fuel economy (Tokubetsu Cyousa Iinkai, 2016). The trends in Figure 2 show that competition in fuel economy was overheating. Although Mitsubishi Motors launched a 29.2km/ℓ vehicle in 2013, the original fuel economy goal for this vehicle was 26.4km/ℓ. The target was raised in order to compete with other new cars being launched during the development period.

Figure 2. Trends in fuel economy competition for kei vehicles

Source: Created by author based on data from Jiji Dotcom News (2016).

fuel economy.

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7 NMKV stands for Nissan Mitsubishi Kei Vehicle.
The Complexity of Fuel Economy Measurement

Limit of fuel economy measurement

Automakers thus began to compete on fuel economy, but the fuel economy metric actually has a gray zone. When a car is traveling on a road, its fuel economy changes depending on the conditions, such as driving up a hill that requires a lot of horsepower, driving only a short distance each time, or the way the driver steps on the accelerator (Nihon Zidousya Kougyoukai, 2013). It even differs with the seasons, as energy usage increases in the winter because it takes a longer time for the engine to warm up. As a result, as shown in Figure 3, the actual fuel economy is unstable because the measured results vary

![Figure 3. Example of actual fuel economy distribution for a vehicle (actual fuel economy data for 1,555 cars)](image)

Source: Nihon Zidousya Kougyoukai [Japan Automobile Manufacturers Association] (2013).

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8 It is also affected by such factors as tire pressure, weight, and air resistance (Nihon Zidousya Kougyoukai, 2013).
considerably.

The Ministry of Land, Infrastructure, Transport and Tourism therefore set forth rules for fuel economy measurement. Automakers typically measure fuel economy by mounting their vehicles on a device called a chassis dynamometer. The chassis dynamometer is equipped with rollers that move the vehicle’s tires. The vehicle is run in a test lab with a certain load that simulates actual driving conditions. The fuel economy thus obtained is called the catalog fuel economy, which is the fuel economy advertised in the automaker’s catalog and elsewhere. However, if we liken this to humans, it would be as though the fuel economy was measured while running on a treadmill at the gym, so it cannot be equated with running a marathon or running outdoors on a road. In fact, the catalog fuel economy is a different value from the actual fuel economy when the consumer is driving, so there is inevitably a gap between the two. Therefore, the measurement regulations have been continuously changing in order to get the measurement as close as possible to the consumer experience, and in 2011, the regulation was changed from the previous JC08 to the 10–15 mode. However, room for fraudulent activity to take place will crop up when there is a discrepancy between the catalog fuel economy and the actual operating fuel economy.

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9 Japan Automobile Transport Technology Association website “Technical explanation: Vehicle assessment 1 using chassis dynamometer” (in Japanese). http://www.ataj.or.jp/technology/chdy_technology.html

10 Due to the fuel economy fraud problem among automobile companies since 2015, regulators are also considering a shift to the world harmonized light vehicles test procedure (WLTP), which is an international standard. Ministry of Land, Infrastructure, Transport and Tourism website. “WLTP international standard (WLTP) to be adopted for passenger car emissions and fuel consumption test methods” (in Japanese). https://www.mlit.go.jp/report/press/jidosha10_hh_000172.html
Engineer judgment based on ambiguity

From the beginning, engineers in the field thought that fuel economy measurement was ambiguous and existed in a gray zone. In fact, engineers at Company A made the following comment regarding fuel economy measurement (Tokubetsu Cyousa Iinkai, 2016, pp. 218–219): “Theoretically, there is no difference in the running resistance ultimately achieved with the coasting method or the high-speed coasting method, so using the high-speed coasting method is not a very serious issue.” Therefore, the judgment was that there is theoretically no difference even when using the unapproved high-speed coasting method, so it is not a problem.

Moreover, “Since the data from the measurements are affected by the external environment at the time of the measurement is taken, one can say that the values that can be obtained ‘in theory’ (the true values) are the correct values for the measured data.” In other words, the theoretical values obtained while sitting at one’s desk are more accurate than the fuel economy measurements according to the law.

Therefore, to measure the running resistance for fuel economy performance, Company A typically (a) used the high-speed coasting method instead of the legally stipulated coasting method and (b) calculated only the theoretical values without taking any actual measurements. This was eventually exposed as a form of organizational corruption in the automobile industry.

Organizational corruption regarding fuel economy

The first global case of this organizational corruption was the 2015 discovery of Volkswagen’s violation of the diesel engine emissions rules (Hotten, 2015). In Japan, the first instance of fuel economy fraud was uncovered in 2016 at Mitsubishi Motors Corporation (Tokubetsu Cyousa Iinkai, 2016), and that year Suzuki Motor Corporation also disclosed that it had found fraud (Suzuki Motor
In 2018, Subaru Corporation and Nissan Motor Co., Ltd. announced that inappropriate actions, such as rewriting fuel economy measurement data, had occurred at a completed vehicle inspection (Nagashima Ohno & Tsunematsu, 2018; Nissan Motor Co., Ltd., 2018). Immediately before this, Subaru and Nissan had uncovered irregularities in the inspection of pre-shipment vehicles by unqualified persons, and the upshot of this was that further problematic behavior was identified and disclosed.

In addition, a government survey taken after learning of this problematic behavior found similar misconduct at Suzuki Motor Corporation and Mazda Motor Corporation (Mazda Motor Corporation, 2018; Nihon Keizai Shimbun, 2018; Suzuki Motor Corporation, 2016).

Table 1. Fuel economy corruption discovered in the Japanese automobile market

| Year    | Automaker                          | Misconduct Description                                      |
|---------|------------------------------------|--------------------------------------------------------------|
| 2016 Apr| Mitsubishi Motors Corporation      | misconduct of fuel economy tests                             |
| 2016 May| Suzuki Motor Corporation           | inappropriate cases related to gas emissions and fuel economy tests |
| 2018 Mar| Subaru Corporation                 | inappropriate handling in completion inspection             |
| 2018 Jul| Nissan Motor Co., Ltd.             | inappropriate handling in completion inspection             |
| 2018 Aug| Suzuki Motor Corporation, Mazda Motor Corporation* | misconduct cases of fuel economy and gas emissions sampling inspection |

Note*: Besides these two automakers, Yamaha Motor Co., Ltd. also disclosed that it had a fuel economy fraud problem (Yamaha Motor Co., Ltd, 2018).
Corporation, 2018). Although Japan has less than ten automakers, many of them were involved in fraudulent activity in this area.

Conclusion

The meaning of fuel economy is vague in the first place, and even if the actual fuel economy while driving is measured, the results will vary considerably, so they are unstable. Nevertheless, fuel economy became a competitive metric because of such social issues as the environment and oil crises. If too much emphasis is placed on one competition index, people will tend to feel that the metric in question needs to be achieved by whatever means possible (Takahashi, 2015). Although there were some discrepancies in fuel economy measurement standards that were ambiguous, development goals were increased many times due to severe fuel economy competition in the kei vehicle market, and when this happened, there were some cases where the approach taken evolved into fraudulent acts (Tokubetsu Cyousa Iinkai, 2016).

Also, violations in the area of fuel economy performance do not subject vehicles to recalls, as they do not affect people’s lives or their safety. The severity differs from such cases as Takata Corporation, which collapsed in 2017 due to an airbag recall problem. The investigative committee that interviewed the engineers who committed the fraud was critical, saying, “There is insufficient awareness that the laws are being violated, because no one is paying

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11 This investigation targeted fraud in the inspection of completed vehicles, but no fraud was reported by Toyota Motor Corporation, Honda Motor, Mitsubishi Motors Corporation, or Daihatsu Motor Co., Ltd.
12 Engineers adhere to the concept of tolerance, which refers to the functionally allowable difference between a product’s maximum and minimum dimensions (Byun, 2019).
13 Takahashi (2015) discusses the results-oriented approach adopted by the Japanese human resources departments in the 1990s.
attention to the laws,” and that the engineers had a “sanctimonious attitude.” However, the engineers’ standpoint was that there was no serious violation of the law (Tokubetsu Cyousa Iinkai, 2016). However, not all companies that were competing on fuel economy committed fraud.14 Future studies will need to verify the internal organizational factors by conducting a case study on each company.

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14 Some cases involved unique activities that came about while compliance activities and other institutional isomorphism programs were going on (Aizawa, 2018).
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