

Projecting average stock fuel economy for mini-sized passenger vehicles

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1. Introduction

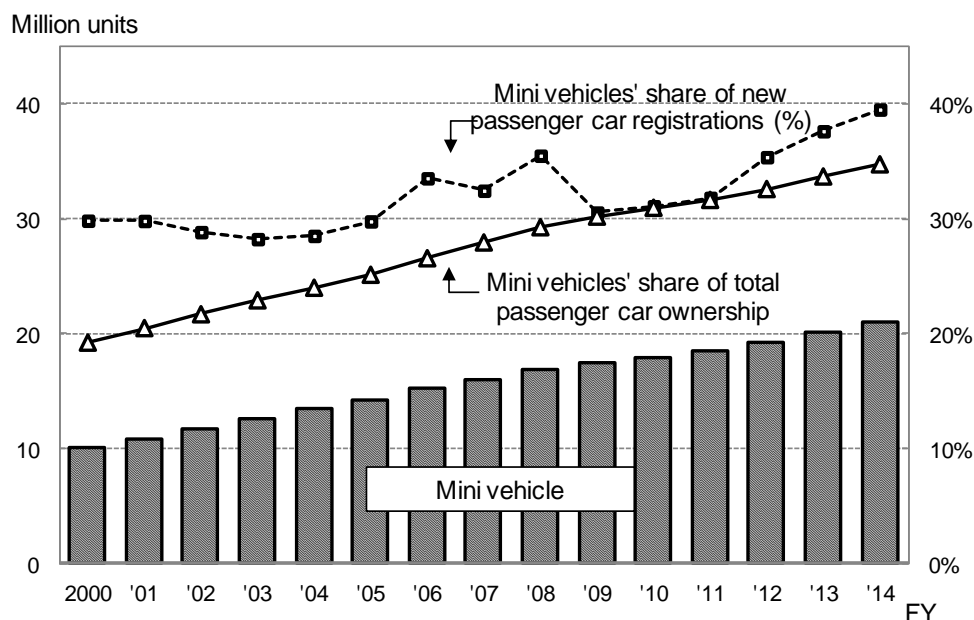
In Japan, mini-sized passenger vehicles (mini vehicles) have been popular thanks to their excellent maneuverability and economic advantages (lower taxes, lower prices and better fuel economy). As indicated in Figure 1, mini vehicles' share of passenger cars owned in Japan rose from less than 20% in FY2000 to about 35% in FY2014. The number of mini vehicles owned in Japan in FY2014 exceeded 21 million units. The share expansion came as mini vehicles' share of new car registrations increased faster than indicated by their share of total car ownership, standing at 39.5% in FY2014¹.

Mini vehicles' excellent fuel economy is well known, becoming one of the major reasons for users to purchase mini vehicles¹. Today, mini vehicles boasting better fuel economy than hybrid cars have emerged on the market, indicating that improvement of fuel economy is an indispensable challenge for mini vehicle manufacturers attempting to expand their market shares.

This paper projects the average stock fuel economy for mini vehicles that have been expanding their presence in the passenger car market.

¹ The mini vehicle share was exceptionally small during the FY2009-2011 period when tax cuts were offered for eco-friendly vehicles. As tax cuts for eco-friendly ordinary and compact passenger cars were greater than for mini vehicles, mini vehicles' share of new car registrations in the period fell by up to 5 points from FY2008. In calendar 2015, the share dropped to 35.9% due primarily to an increase in tax for mini vehicles.

Figure 1
Mini vehicle ownership, and mini vehicles' shares of new car registrations and total ownership



Source: Prepared from Books 2) and 3)

2. How to project the average stock fuel economy for mini vehicles

The average stock fuel economy for mini vehicles is projected in the following way. The period for the projection starts in FY2000, while data for earlier years are used for the projection.

- (i) The average fuel economy for new mini vehicles is computed from published data for best-selling models picked up for each automaker and year.
- (ii) Mini vehicle ownership by model year in each year is projected.
- (iii) The average stock fuel economy of mini vehicles is computed from the average fuel economy for each model year and the number of mini vehicles in ownership.

At present, the JC08 mode is generally used for indicating theoretical fuel economy. In this paper, however, the 10-15 mode is used to secure the continuity of time series data and reduce the projection as much as possible.

3. Projection results

- (1) The average fuel economy for new mini vehicles is computed from published data for best-selling models picked up for each automaker and year.

Book 4) was used to pick up the few best-selling models for each automaker and a total of more than 10 models for each year. Table 1 indicates models used for the projection, their sales and their share of total new mini vehicle sales for 2000, 2005 and 2014. The share of total sales for more than 10 models picked up for the projection, though declining due to the expansion of product lineups, has remained above 80%. Therefore, their average fuel economy is adopted as a representative value for each year.

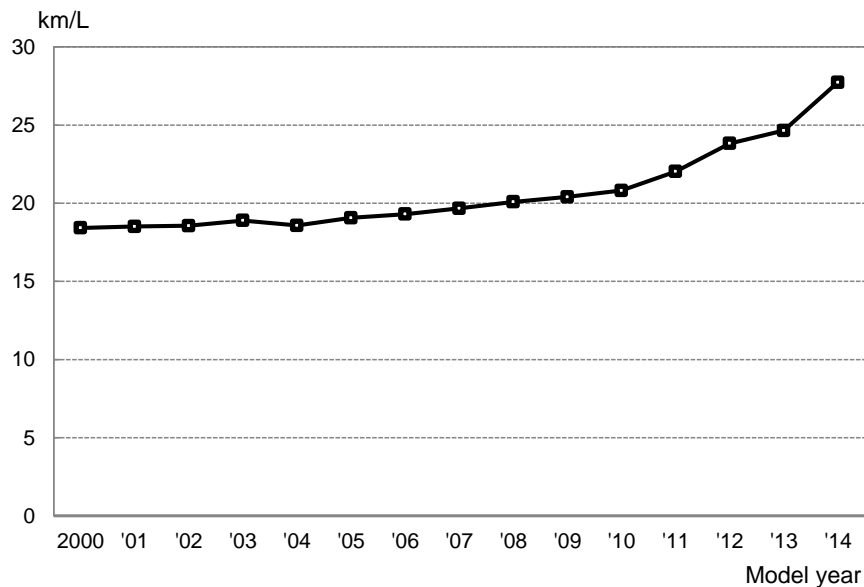
Table 1 Sales of mini vehicle models picked up for projection and their shares of total new mini vehicle sales

2000			2005			2014		
Rank	Model	Sales	Rank	Model	Sales	Rank	Model	Sales
1	Wagon R/Suzuki	244,961	1	Wagon R/Suzuki	236,701	1	Tanto/Daihatsu	234,456
2	Life/Honda	181,888	2	Move/Daihatsu	196,977	2	Wagon R/Suzuki	175,369
3	Move/Daihatsu	177,022	3	Life/Honda	131,000	3	N-BOX/Honda	166,630
4	Mira/Daihatsu	96,234	4	Alto/Suzuki	123,693	4	N-WGN/Honda	146,717
5	Pleo/Daihatsu	91,761	5	Mira/Daihatsu	95,835	5	Spacia/Suzuki	121,086
6	Toppo BJ/Mitsubishi	88,008	6	Tanto/Daihatsu	92,097	6	Move/Daihatsu	113,020
7	Alto/Suzuki	66,549	7	ek Series/Mitsubishi	78,158	7	Hustler/Suzuki	104,233
8	Vamos/Honda	53,634	8	Moco/Nissan	55,139	8	Mira e:s/Daihatsu	103,680
9	Kei/Suzuki	48,764	9	Vamos/Honda	36,337	9	Dayz/Nissan	88,200
10	Naked/Daihatsu	35,170	10	Dayz Roox/Nissan	81,050	10	Dayz Roox/Nissan	81,050
11	Pajero Mini/Mitsubishi	31,900	11	R1R2/Subaru	35,582	16	ek/Mitsubishi	33,650
			13	MR Wagon/Suzuki	30,480	18	ek Space/Mitsubishi	24,080
						23	Flair/Mazda	13,538
Total:		1,115,891	Total:		1,111,999	Total:		1,405,709
Total mini vehicle sales:		1,281,805	Total mini vehicle sales:		1,387,068	Total mini vehicle sales:		1,839,119
Share for best sellers:		87%	Share for best sellers:		80%	Share for best sellers:		76%

Source: Prepared from Books 4) and 5)

Fuel economy data for the projection target models were collected from Book 6) for computing the weighted harmonic average to project mini vehicles' average new vehicle fuel economy by model year. Over recent years, the JC08 mode has been mainly used for indicating fuel economy, with the 10-15 mode adopted for a limited range of models. For some models, however, both modes are used for indicating fuel economy. In this projection, the average ratio between the two modes was used to project the 10-15 mode fuel economy for each model.

Figure 2 indicates the average new mini vehicle fuel economy as projected for each model year. The average fuel economy rose gradually for model years 2000 to 2010, topping 20 kilometers per liter. As the adoption of fuel economy improvement and weight reduction technologies has accelerated over recent years, fuel economy has been improved remarkably. For 2014, the average reached 27.7 km/L.

Figure 2 New mini vehicle fuel economy by model year (10-15 mode)

Source: Prepared from Books 4) and 6)

(2) Mini vehicle ownership by model year in each year is projected

There are no data about mini vehicle ownership by model year. Sales by model year and ownership (at the end of each fiscal year) were used for projection to acquire such data.

The projection method follows. The trend of the retirement rate for ownership for a model is indicated by a logistic curve, including the average age of service and other parameters, and multiplied by the number of units sold for the model year to project ownership for each year. Ownership for each year is projected for each model year. Then, ownership data are aggregated for each year to project ownership for all model years by year. The parameters for the logistic curve are estimated through iteration to narrow the gap between the projected ownership and actual data to a level below the standard.

As part of the projection results, data on ownership and its breakdown by model year at the end of FY2014 are shown in Figure 3 and Table 2.

Figure 3 Breakdown of ownership by model year at FY2014 end

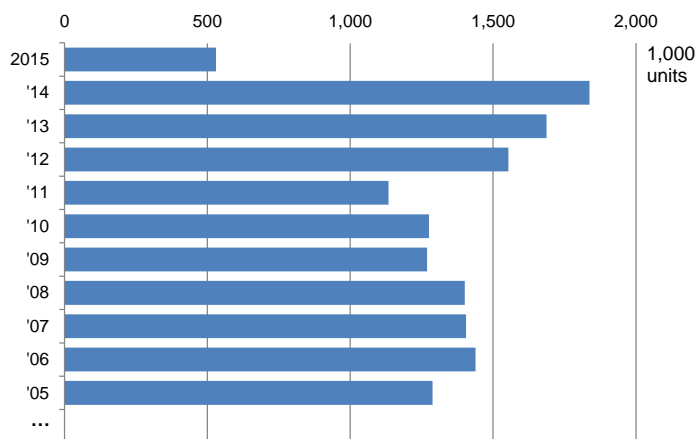


Table 2 Breakdown of ownership by model year at FY2014 end

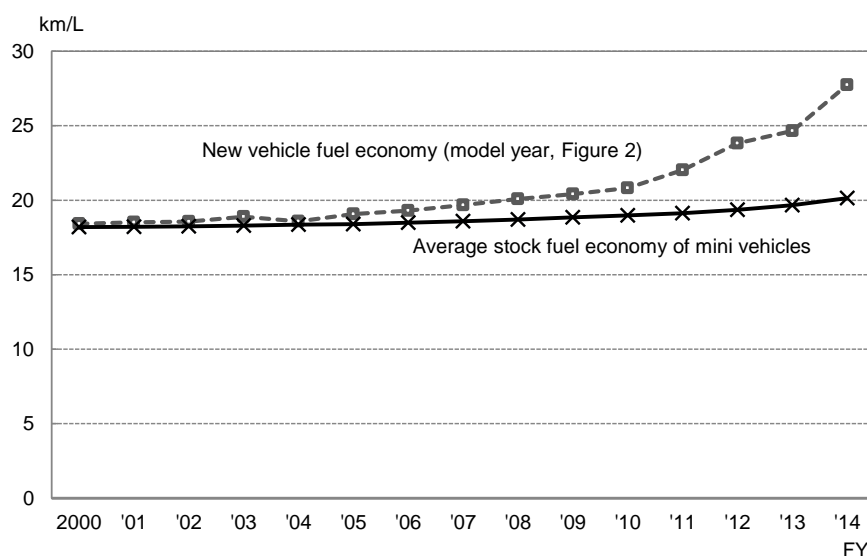
Model year	Number (units)
2011-2015	6,742
2006-2010	6,789
2001-2005	5,422
-2000	2,073
Total	21,026

Sources: Same as for Figure 3

Sources: Prepared from Books 2) and 5)

(3) The average stock fuel economy of mini vehicles is computed from the average fuel economy for each model year and the number of mini vehicles in ownership.

The average new vehicle fuel economy and ownership by model year, as projected in the above way, were used to compute stock fuel economy for mini vehicles. The computed fuel economy is given in Figure 4. As the average age of service for mini vehicles is as long as about 14 years⁷⁾, the rapid fuel economy improvement as shown in Figure 2 for recent years is difficult to find on a stock basis. Nevertheless, the stock fuel economy of mini vehicles over recent years rose faster than indicated by the earlier long-term trend, in which the economy rose slowly from the 18.0-18.5 km/L range in FY2000 to 19 km/L in FY2010. At the end of 2014, the economy topped 20 km/L for the first time to an estimated 20.1 km/L (in the 10-15 mode).

Figure 4 Trend of average stock fuel economy (10-15 mode) of mini vehicles

Source: Estimated by the author

The projection results were used to estimate gasoline consumption savings through the fuel economy improvement. If mini vehicles' 10-15 mode fuel economy achievement rate (= actual fuel economy / 10-15 mode fuel economy) is assumed at 0.7 and mini vehicles' annual driving distance at 180 billion km (ownership at 21 million units and driving distance at about 8,500 km per car in actual data for FY2014⁸⁾), the fuel economy improvement between FY2000 and 2014 is estimated to have saved about 1.5 million kL in annual gasoline consumption. The estimate amounts to 2.5% of gasoline consumption by all cars in FY2014.

4. Conclusion

The average stock fuel economy (10-15 mode) of mini vehicles has steadily improved from about 18 km/L in FY1990. Over recent years, particularly, the average stock fuel economy of mini vehicles has achieved remarkable improvement thanks to rapid growth in the economy for new cars, reaching 20.1 km/L in FY2014. The fuel economy improvement is estimated to have saved 1.5 million kL in annual gasoline consumption.

As the average age of service is long, the impact of the remarkable fuel economy improvement over recent years on the average stock economy of total mini vehicles is still small. Given the growth in mini vehicle sales over recent years, however, the stock fuel economy is expected to improve more rapidly than in the past.

Books for reference

1. Survey Report on Mini-vehicle Use, Japan Automobile Manufacturers Association (2014)

2. Vehicle Ownership, Automobile Inspection & Registration Information Association
3. EDMC (Energy Data and Modelling Center) Handbook of Energy & Economic Statistics in Japan 2015, Institute of Energy Economics, Japan
4. kurumart (online): <http://kurumart.jp/>
5. New Vehicle Sales Report, Japan Light Motor Vehicle and Motorcycle Association
6. Vehicle Fuel Efficiency, Ministry of Land, Infrastructure, Transport and Tourism
7. Average Age of Service for Mini-vehicles: Light Motor Vehicle Inspection Organization
8. Annual Report on Vehicle Fuel Consumption, Ministry of Land, Infrastructure, Transport and Tourism