A Note on

Interpreting the Bunching Evidence in Ito and Sallee (2018)

This note discusses the empirical interpretation of Ito and Sallee (2018) and demonstrates why **the bunching patterns shown in their paper may simply reflect reporting conventions rather than the evidence for vehicle weight manipulation behavior by the Japanese automakers.** Ito and Sallee (2018) make an important theoretical contribution to the study of attribute-based regulation and develop useful methods for studying firms' responses to regulatory notches. These contributions are strong by themselves. My concern, however, is on how their data is used and handled to present evidence for vehicle weight manipulation.

1. The MLIT data report model-level weight ranges, not unique grade-level weights

Ito and Sallee (2018) study automakers' responses to Japan's fuel-economy standards using data on passenger vehicles sold in Japan from 2001 through 2013. These data are taken from Japanese Ministry of Land, Infrastructure, Transportation, and Tourism (MLIT). Commercial vehicles are excluded from their analysis because they are subject to different fuel-economy standards. Ito and Sallee show that the distribution of reported vehicle weights exhibits mass **at or above** the regulatory weight notches, and they interpret this bunching as evidence that automakers increased vehicle weight in order to qualify for laxer standards.

A close examination of the MLIT source data raises a problem for this interpretation (the same data files are publicly available at www.mlit.go.jp/jidosha/jidosha_mn10_000002.html). In the MLIT files, a vehicle model is often reported with **a single fuel-economy value** and **a range of vehicle weights**, rather than with a unique fuel-economy value for each unique vehicle weight. **Figure 1** provides an example of this reporting format. This reporting practice appears throughout the MLIT data used in their analysis.

This matters because fuel economy varies with vehicle weight. If a model is reported with one fuel-economy value and a weight range, then the data do not directly reveal which weight within that range corresponds to the reported fuel-economy value. In other words, the MLIT model-level data do not provide the grade-level weight–fuel-economy pairs needed to construct an unambiguous distribution of actual vehicle weights.

This is not a minor technical detail. Many Japanese vehicle models are sold in multiple grades or variants, and those variants may differ in weight. A model-level weight range can therefore summarize multiple actual vehicles. **Treating the endpoints of that range as if they were actual observations, or assigning a single value such as the minimum, maximum, or midpoint, can produce different weight distributions.** The empirical interpretation of bunching depends critically on which assignment is used.

The ambiguity is compounded by the number of observations in Ito and Sallee's analysis. In the MLIT source files, the natural unit of observation is a reported vehicle model. However, the number of observations in Ito and Sallee appears to be roughly twice, and in some cases more than twice, the number of model entries in the MLIT files I observe.

One generous reconstruction is that models reported with weight ranges were expanded into two observations: one using the minimum reported weight and one using the maximum reported weight, while assigning the same fuel-economy value to both. This reconstruction could help explain why the number of observations in their analysis is much larger than the number of model entries in the MLIT source files.

But if this is how the data were constructed, the resulting histogram is not a histogram of actual vehicle-grade weights. It is partly a histogram of interval endpoints created by the MLIT reporting format. **Such a distribution can display bunching near regulatory thresholds even if no actual vehicle grade was physically manipulated to cross a threshold.**

This distinction is fundamental. Their interpretation requires evidence that automakers changed actual vehicle characteristics in order to move vehicles into heavier, more lenient regulatory categories. A distribution constructed from model-level weight-range endpoints does not directly provide that evidence.

2. The relevant test is not only whether bunching exists, but whether it appears on the correct side of the notch

The key prediction of the weight-manipulation mechanism is its **direction**. If automakers increase vehicle weight to qualify for a laxer fuel-economy standard, then the relevant empirical pattern should be **excess mass just above** regulatory notches. Vehicles just below a notch face a tighter standard, whereas vehicles just above it face a laxer standard. Therefore, manipulation into the laxer category should generate bunching on the heavier side of the threshold.

This point is important because not all bunching near a threshold has the same interpretation. Bunching below a notch is not evidence of weight manipulation into a laxer category. Nor is bunching above or below a notch equally informative when the weight value being plotted is a minimum weight, maximum weight, or midpoint. These cases have very different implications.

Thus, the issue is not simply whether excess mass appears near a notch. The issue is whether the sign and location of the excess mass are consistent with the mechanism proposed by Ito and Sallee.

3. **Alternative weight assignments produce patterns that are inconsistent with the proposed mechanism**

To examine this issue, I use the same MLIT data for 2011–2013, the years under the newer fuel-economy standards, and reconstruct distributions similar to **Figure 4-B** in Ito and Sallee. Instead of duplicating models with weight ranges, I assign one weight value to each model and examine the resulting distributions under several alternative assignments:

(a) Minimum weight values for models reported with weight range,
(b) Maximum weight values for models reported with weight range,
(c) Mid-point weight values for models reported with weight range,
(d) Only models reported without weight range,
(e) Randomly assign weight values $w \in \{w_{\min}, w_{\max}\}$ for models reported with weight range and pool all models.

Figure 2 reports the resulting distributions. These exercises are not merely robustness checks. They are diagnostic tests of whether the observed mass points are located in the direction predicted by the weight-manipulation mechanism. We see **the patterns that are problematic for the Ito-Sallee interpretation.**

First, using (a) minimum reported weights, bunching at most notches disappears. Some mass appears at or near the 970-kg notch, and there is also mass **below** the 1530-kg notch, which seems to contradict the interpretation that automakers increased weight to enter a laxer category. Moreover, if minimum weights bunch just above a notch, the interpretation is not straightforward: the minimum of the reported range is already above the threshold, while heavier variants of the same model may be even farther above it. This does not provide clean evidence that automakers manipulated actual vehicle weights to cross the notch.

Second, using (b) maximum reported weights, bunching again does not appear in the pattern predicted by the manipulation story. Some mass appears at the 1760-kg notch, and there is also mass **below** the 1530-kg notch. But bunching below a notch in maximum weights is especially difficult to reconcile with the idea that automakers increased weight to qualify for a laxer category. If the maximum reported weight remains below the threshold, then the model has not even reached the heavier category under that assignment.

Third, using midpoint weights, some mass appears near the 970-kg, 1530-kg, and 1650-kg notches. But, again, there is no economically defensible reason why we should use these midpoint values from reported intervals; they are not observed grade-level vehicle weights. Bunching in this distribution is, therefore, difficult to interpret as direct evidence of physical manipulation.

Fourth, among models reported without a weight range, there is some clustering near the 855-kg, 1195-kg, and 1760-kg notches. However, this subsample is much smaller—roughly one quarter of the sample—and the visual evidence is not sufficient to establish a sharp discontinuity in the distribution.

Finally, when weights are randomly assigned within reported ranges and pooled across models, only limited bunching remains, possibly near the 970-kg and 1650-kg notches (the most visible bunching is below the 1530-kg notch). The pattern is much less sharp than in Ito and Sallee's original figure.

Taken together, these patterns are difficult to reconcile with the Ito-Sallee's proposed mechanism in which automakers systematically increased vehicle weight to move models just above regulatory notches. In several cases, the apparent mass is on the wrong side of the threshold. In other cases, the mass appears only under assignments that reflect reporting intervals rather than observed vehicle-grade weights.

3. A reporting-based explanation is more plausible

A more plausible interpretation is that the MLIT data reflect reporting behavior at the model level rather than actual manipulation of vehicle weight at the grade level.

At the time of reporting a new model to MLIT, an automaker reports a weight range for the model. Automakers often offer many variants of the same model, and the full set of variants offered over the model year may not be known at the time of reporting. As a result, firms may have an incentive to report a range broad enough to cover possible variants.

At the same time, the MLIT data suggest that when a reported weight range crosses a regulatory threshold, the applicable fuel-economy standard corresponds to the lower-weight, tighter category rather than the higher-weight, laxer category. I have not found a formal regulatory document stating this assignment rule. However, the MLIT data contain cases in which the reported weight range crosses a segment boundary, and in those cases the standard applied is the tighter standard associated with the lower weight segment.

This empirical regularity has an important implication. Automakers would have a reason to avoid reporting a weight range that crosses downward into a lighter category, because doing so would appear to subject the model to a tighter fuel-economy standard. At the same time, they may report ranges wide enough to accommodate multiple variants. This combination of incentives can generate clustering of reported interval endpoints near regulatory thresholds without requiring actual physical manipulation of vehicle weight.

This interpretation also helps explain why the patterns differ so much depending on whether one uses minimum weights, maximum weights, midpoints, or randomly assigned values. The observed bunching is not a stable feature of actual vehicle-grade weights. It is sensitive to how reported model-level intervals are converted into point observations.

4. Conclusion

The point here is **not** that Ito and Sallee's contribution is invalid. On the contrary, their paper provides an important framework for understanding how attribute-based regulation can distort firm behavior. Nor is the conclusion that Japanese fuel-economy regulation had no distortionary effects.

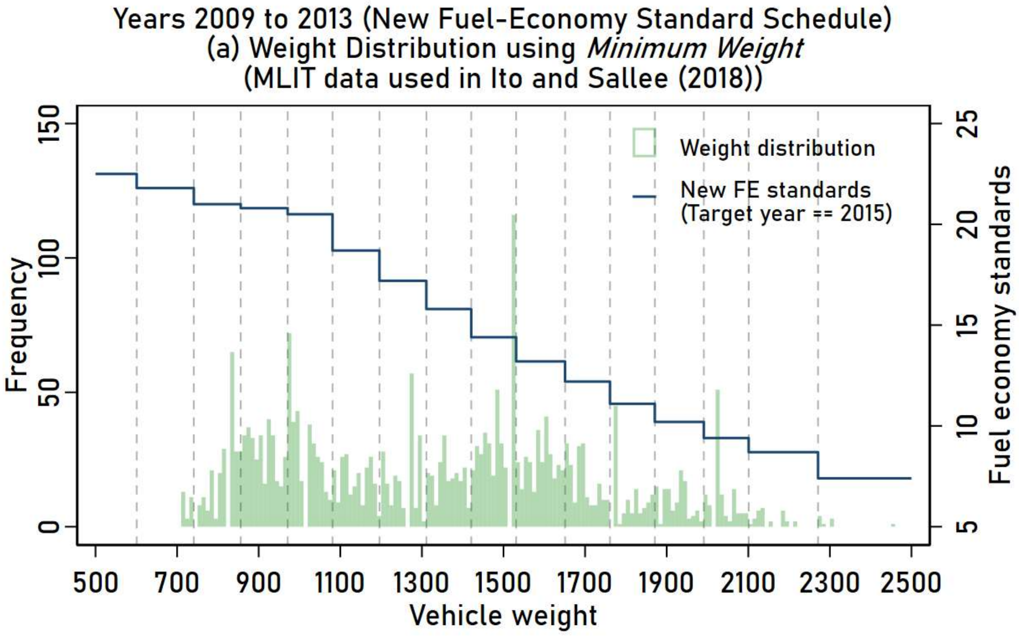
Rather, the point is that the MLIT model-level data are not well suited for identifying actual weight manipulation. Because many observations report a single fuel-economy value together with a range of vehicle weights, bunching in the reported weight distribution may reflect administrative reporting conventions and data construction choices rather than physical changes in vehicle design.

For evidence on actual vehicle design responses, researchers should use grade- or variant-level data that report unique fuel-economy and weight values for each vehicle grade. Konishi and Managi (2020) use such data and find no evidence of bunching at the regulatory notches. However, they do find evidence that attribute-based regulation distorted technical change: automakers allocated resources more toward increasing vehicle weight and less toward improving fuel economy. This is the type of distortion that attribute-based regulation can create, even in the absence of sharp bunching in actual vehicle weights.

Figure 1. MLIT Data Image

ホンダ	インサイト	DAA-ZE2	LDA(-MF6			1190	5	31.0	75	16.0	CY･V･I･EP･C･H	3W+EGR	F	タイヤ 185/60R15	☆☆☆☆	125
		DAA-ZE2	LDA(-MF6			1190	5	30.0	77	16.0	CY･V･I･EP･C･H	3W+EGR	F		☆☆☆☆	125
		DAA-ZE2	LDA(内燃機関) -MF6(電動機)	1.339	CVT (E)	1200	5	28.0	83	16.0	CY･V･I･EP･C･H	3W+EGR	F	タイヤ 185/55R16	☆☆☆☆	125
	インサイト エクスクルーシブ	DAA-ZE3	LEA(内燃機関)	1.496	CVT (E)	1200～1210	5	26.5	88	16.0	V･I･EP･C･H				☆☆☆☆	125
						1210	5	25.5	91	16.0	V･I･EP･C･H	3W+EGR	F	タイヤ 185/55R16	☆☆☆☆	125
	フィット	DAA-GP1	関) -MF6(電動機)	1.339	CVT (E)	1130～1150	5	30.0	77	16.0	CY･V･I･EP･C･H	3W+EGR	F		☆☆☆☆	125
		DBA-GE6	L13A	1.339	CVT (E･LTC)	1010	5	24.5	95	17.9	C･V･EP	3W+EGR	F	CVTウォーマー	☆☆☆☆	125
		DBA-GE6	L13A	1.339	CVT (E･LTC)	1010	5	24.0	97	17.9	C･V･EP	3W+EGR	F		☆☆☆☆	125
		DBA-GE6	L13A	1.339	CVT (E･LTC)	1030～1080	5	22.0	106	16.0	C･V･EP	3W+EGR	F	CVTウォーマー	☆☆☆☆	125
		DBA-GE6	L13A	1.339	CVT (E･LTC)	1030～1080	5	21.5	108	16.0	C･V･EP	3W+EGR	F		☆☆☆☆	125
		DBA-GE6	L13A	1.339	5MT	990	5	21.0	111	17.9	V･EP	3W+EGR	F		☆☆☆☆	115
		DBA-GE6	L13A	1.339	5MT	990～1010	5	21.0	111	17.9	V･EP	3W+EGR	F		☆☆☆☆	115
		DBA-GE8	L15A	1.496	CVT (E･LTC)	1070～1090	5	20.0	116	16.0	C･V･EP	3W+EGR	F	走行抵抗改善	☆☆☆☆	125
		DBA-GE8	L15A	1.496	CVT (E･LTC)	1080～1100	5	20.0	116	16.0	C･V･EP	3W+EGR	F		☆☆☆☆	125
		DBA-GE8	L15A	1.496	CVT (E･LTC)	1080～1100	5	19.6	118	16.0	C･V･EP	3W+EGR	F		☆☆☆☆	120
		DBA-GE8	L15A	1.496	CVT (E･LTC)	1080～1100	5	19.2	121	16.0	C･V･EP	3W+EGR	F	CVTウォーマー	☆☆☆☆	120
		DBA-GE8	L15A	1.496	CVT (E･LTC)	1080～1100	5	18.8	123	16.0	C･V･EP	3W+EGR	F	タイヤ 185/55R16	☆☆☆☆	115
		DBA-GE8	L15A	1.496	6MT	1050～1080	5	17.4	133	16.0	V･EP	3W+EGR	F		☆☆☆☆	105
		DBA-GE8	L15A	1.496	5MT	1050～1080	5	17.2	135	16.0	V･EP	3W+EGR	F		☆☆☆☆	105
		DBA-GE7	L13A	1.339	5AT (E･LTC)	1140～1170	5	17.2	135	16.0	V･EP	3W+EGR	A	走行抵抗改善	☆☆☆☆	105

Figure 2. Weight Distributions of Japanese Passenger Cars
under Alternative Weight Assignments



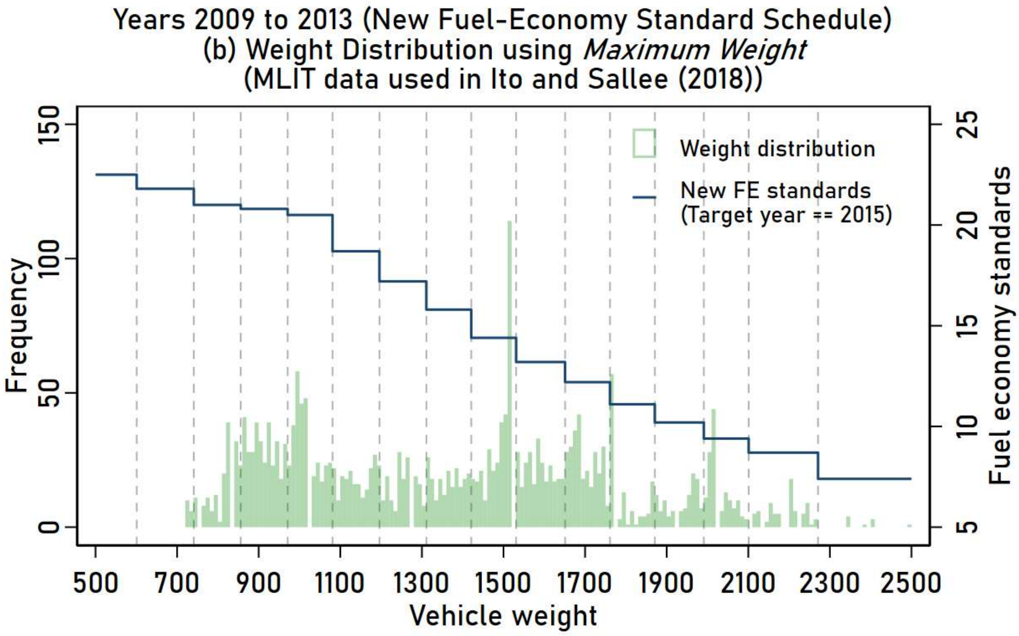
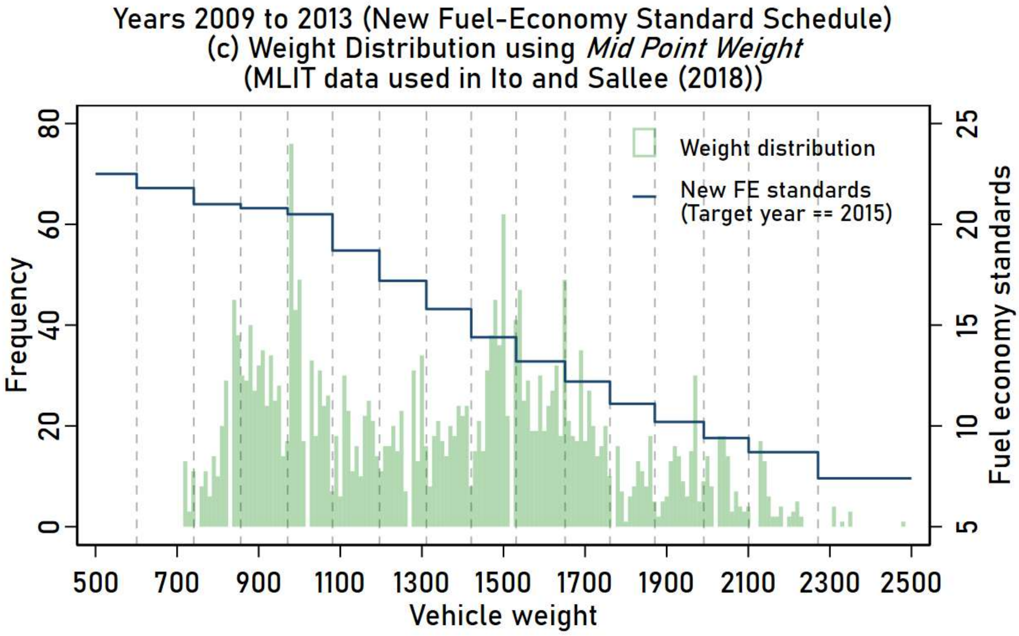


Figure 2. Weight Distributions of Japanese Passenger Cars
under Alternative Weight Assignments (Cont'd)



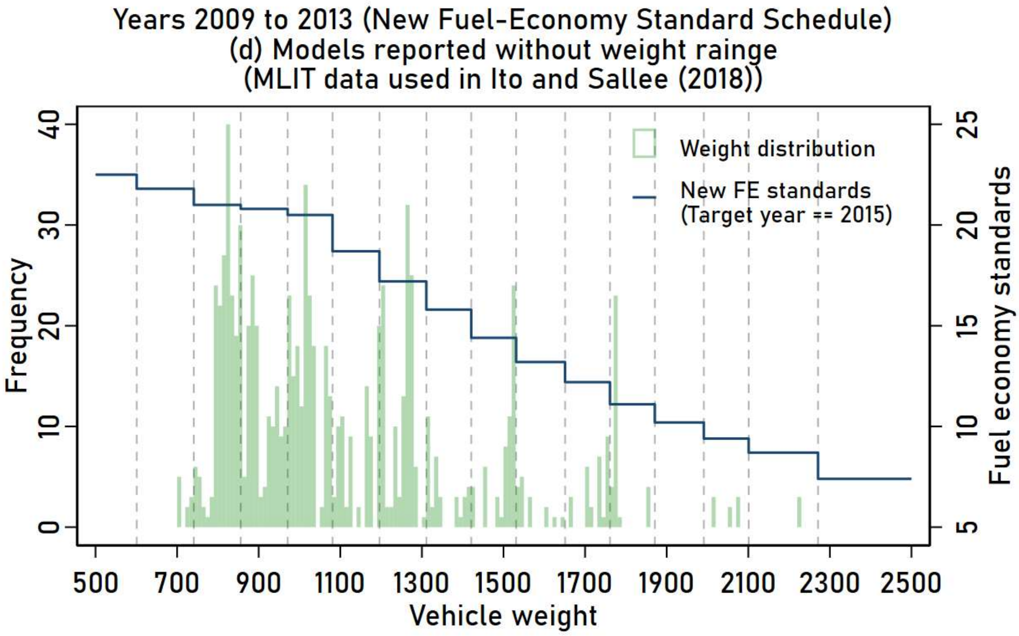


Figure 2. Weight Distributions of Japanese Passenger Cars
under Alternative Weight Assignments (Cont'd)