

## REVIEW OF VEHICLE EXCISE DUTY EVASION STATISTICS

The Department for Transport has published a methodological review of the statistics used to estimate vehicle excise duty evasion. The review was conducted by the University of Southampton and its key findings, extracted from the summary chapter of the full report, are as follows:

*Overall, our initial assessment is that the methodology used by the Department for Transport to estimate the level of vehicle excise duty evasion appears to be sound. It relies on some strong assumptions, namely:*

- a) the cost of vehicle excise duty is broadly constant within each vehicle tax class;*
- b) the observed sample of vehicles sighted in the Roadside Traffic Observation Survey is a simple random sample with replacement of the registered vehicles;*
- c) the relative mileage of vehicles sighted is proportional to their numbers of sightings.*

*These assumptions are essential for the development of the estimation approach utilized, but appear to be justified given the present survey scenario.*

*The methodology relies on fitting a Negative Binomial model to observations of repeat vehicle sightings obtained from the Roadside Traffic Observation Survey. The model follows through if the assumptions are made and there is no error there. No mistakes have been found in the calculation of the estimates themselves. However, there are other methodological aspects of the estimation process which have not been included in this initial assessment, and which should therefore be considered for further investigation.*

*As is standard statistical practice, each estimate given in the publication is presented with a corresponding confidence interval to represent the statistical uncertainty that naturally arises from the sampling process. While important for all estimates, these intervals are particularly relevant when considering the financial estimates of revenue loss through vehicle excise duty evasion.*

*There are, however, a number of recommendations that should be implemented in order to improve the estimation process. These are as follows.*

*1. To fit an alternative statistical model to estimate relative mileage when the Negative Binomial is found to be inadequate*

*Whilst suitable for most tax classes, the Negative Binomial model was found to be inadequate for the distributions of repeat sightings of 'buses' and 'other' vehicles. This issue occurs when the sample variance is found to be smaller than the sample mean. The model fitting procedures adopted should therefore be improved in order to detect cases which require that a different model is fitted to the data. In both of the vehicle types outlined above, the Poisson model would have provided a suitable alternative but it should be noted that, in practical terms, both the Poisson and Negative Binomial models produce identical estimates of evasion in stock.*

*2. To use Maximum Likelihood estimation in place of Method of Moments to calculate the parameters of the fitted distribution*

*The models currently used are fitted using Method of Moments estimators for the two relevant parameters of the Negative Binomial distribution. While this is an acceptable method, it could be improved upon by using the Maximum Likelihood method to fit the parameters of the chosen models. However, again it should be noted that the estimates for the mean parameter of the model under both Maximum Likelihood and Method of Moments*

are identical and, therefore, the choice of method does not affect the estimates of evasion in stock.

3. To limit the maximum number of repeat sightings that are considered when fitting the chosen model

The distribution of the number of repeat sightings of vehicles observed in the survey was found to be quite skewed for some tax classes. This issue was confirmed by the calculation of Chi-square statistics which showed a poor model fit for some tax classes. The model fitting process could therefore be improved upon by limiting the maximum number of repeat sightings considered when fitting the chosen model for each tax class. While this adjustment would increase the statistical robustness of the model fitting procedures, testing has shown that it is unlikely to have a significant impact on the final estimates of evasion in stock.

4. To consider alternative methods to deal with the issue of using both weighted and un-weighted approaches in the model

The estimation of evasion in traffic takes account of the weighting of traffic in roads of different types in order to reflect different volumes of traffic. However, the estimation of the adjustment factors used to convert evasion in traffic into evasion in stock does not take account of this weighting. Producing both estimates either using weights all the way, or not using weights at all, would lead to a more coherent use of the survey data. We recognise that it would be somewhat complex to produce weighted estimates for the adjustment factors used to convert evasion in traffic into evasion in stock. Nevertheless, the Department should consider alternative approaches of using either non-weighted or weighted estimates throughout the whole estimation process.

5. To revisit underlying assumptions which cannot be verified from the survey data itself

One of the most important assumptions in the model is that the average number of sightings of a given vehicle is proportional to its mileage. This hypothesis is not testable from the survey data itself because the mileage of individual vehicles is not directly observed through the survey process. However, the first time that this working assumption was adopted - see §4 in Appendix C of (Department of Transport, 1984) – a postal survey of the keepers of heavy goods vehicles was used to test the adequacy of this hypothesis. Given that this research was carried out some time ago and for a limited sample of vehicles in a single tax class, the Department for Transport should investigate whether alternative data sources exist, or could be obtained, which could be used to re-examine the validity of this crucial assumption.

6. To improve the existing documentation regarding the survey and estimation procedures

There is little documentation or desk instructions currently available to describe the survey and estimation processes. This is a weakness and should be targeted for improvement, particularly for the benefit of new staff working on the survey and its outcomes.

In addition to these recommendations, the following areas, while outside the scope of this initial report, warrant further investigation:

- A. The sample design for the roadside traffic observation survey and whether it remains suitable for the purpose of estimating vehicle excise duty evasion;
- B. The methods used to weight the roadside survey results in estimating evasion in traffic, and how the survey data are aggregated into different subgroups;
- C. Whether alternative estimates of vehicle excise duty evasion can be developed from the roadside survey results;
- D. The methods currently used for precision estimation and whether they can be further improved.

Alongside the review, detailed quality assurance checks have been undertaken on the 2006 evasion estimates which have resulted in some minor changes to the published statistics. Details of these changes are as follows:

Tax class	Percent	
	Published 2006 estimates	Amended 2006 estimates
PLG	2.1	2.0
Goods	1.9	1.8
Motorcycles	16.0	15.9
Bus	1.0	0.9
Exempt	2.3	2.0
Other	7.9	7.7
<b>Total</b>	<b>2.2</b>	<b>2.1</b>

Tax class	Percent	
	Published 2006 estimates	Amended 2006 estimates
PLG	4.3	4.3
Goods	4.6	4.6
Motorcycles	37.8	38.0
Bus	7.7	3.8
Exempt	4.5	3.9
Other	31.1	29.8
<b>Total</b>	<b>6.2</b>	<b>6.1</b>

Tax class	Thousand	
	Published 2006 estimates	Amended 2006 estimates
PLG	1,338	1,331
Goods	21	21
Motorcycles	694	698
Bus	9	4
Exempt	94	81
Other	38	35
<b>Total</b>	<b>2,193</b>	<b>2,170</b>

Tax class	£m	
	Published 2006 estimates	Amended 2006 estimates
PLG	170	169
Goods	11	11
Motorcycles	27	28
Bus	2	1
Exempt	0	0
Other	6	5
<b>Total</b>	<b>217</b>	<b>214</b>

## Notes

1. The roadside survey used to estimate vehicle excise duty evasion involves contractors recording registration marks of vehicles at 256 road sites across the United Kingdom. In 2006, around 1.3 million valid sightings of registration marks were collected. These were then checked against the computer record of licensed status to determine the levels of traffic observed without a valid licence. Information on traffic levels was then used to weight together the results from the different sites. Further adjustments were then made to derive estimated evasion in the total vehicle stock from that observed in the survey.

2. Copies of the full methodology review are available free of charge from ST5 Branch in DfT (telephone: 020-7944 3077), e-mail: [Paul.Syron@dft.gsi.gov.uk](mailto:Paul.Syron@dft.gsi.gov.uk). It is also freely available from the Department's website.

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