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International experience of collecting and analysing technical inspection data for private cars

Summary of survey results and research literature

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Table of Contents

1 Introduction

This report describes research which has been undertaken as part of the UK MOT project (http://www.motproject.net), a project focused on the data collected through the periodic technical inspection (PTI) regime in Britain for cars and light goods vehicles.

The MOT project looks at the potential to use inspection data to investigate issues relating to car ownership and use, energy consumption, and vehicle emissions contributing to climate change and air pollution. Various analytical techniques have been developed, and one part of the work has aimed to understand whether such techniques either have been, or could be, used in other countries.

In particular, the work has involved two activities:

- a review of the available international literature, including a formal search in early 2014 (Cairns et al., 2014[1]), subsequently supplemented by literature up to early 2017 identified through discussions with others by the research team;
- a survey, undertaken between April 2016 and March 2017, to understand experience in other countries.

The survey sought to identify:

- whether odometer readings are collected;
- whether data are held in a central computerised form;
- whether the home locations of the vehicle keepers are recorded; and
- whether and how the data have been used for research.

2 Survey methodology

The aim of the survey was to obtain data from across the world about the use of periodic technical inspection data for investigating the issues described above. It is clear that where this data is collected, it is held at different levels in different countries – in some cases, it is held centrally; in others it is held at state level, meaning that, for countries like Switzerland, Spain, the USA, Australia and Canada, it is necessary to contact individual states or regions.

The international literature review undertaken in early 2014 clarified that the sorts of data sought here were not readily available in published sources or via web searches. A session was also organised at the Association of American Geographers (AAG) conference in April 2016 to discuss the topic (Chatterton & Anable, 2016[2]).

[1] Cairns, S., Rahman, S., Anable, J., Chatterton, T., Wilson, R.E. (2014) Vehicle Inspections – From Safety Device to Climate Change Tool. MOT Project Working Paper MIS018.

[2] Chatterton, T. and Anable, J. (2016) Vehicle Odometers and Other Novel Methods of Examining Car Ownership and Usage American Association of Geographers Annual Meeting. San Francisco, 1/4/16

In order to obtain data from a sample of countries, a survey was developed, including both internal testing, and piloting with those attending the conference session at AAG. The final survey used is provided in Appendix A. In brief, the main sections included questions about:

- details of periodic inspections of private cars;
- data storage and availability;
- the computerisation of private car inspection data; and
- any relevant research.

Two approaches were then taken to mailing out the survey. These were as follows.

- people with known expertise were identified, and a list of contacts was drawn up, including academic, public and private sector organisations that had previously conducted research in this area;
- a web search identified organisations that were likely to have information about technical inspection data - in particular, Government organisations, and motor industry organisations.

In both cases, emails were sent asking people to complete the survey or to provide details of someone else who could complete the survey in the event that they could not. (For some organisations, it was necessary to complete an online contact form, rather than sending an email.)

The initial wave of emails was sent in April and May 2016 and followed up in June 2016. A second wave of emails was sent in March 2017.

People in the countries or states listed in Table 1 were contacted.

Table 1: Countries and/or states contacted as part of the survey

Australia (New South Wales; Queensland; Victoria)	Mexico
Austria	New Zealand
Brazil	Norway
Canada (British Columbia; Quebec; Ontario)	South Africa
China	South East Asia
Denmark	Spain
Finland	Sweden
France	Switzerland (Bern; Zurich)
Germany	Thailand
Greece	The Netherlands
India	United Arab Emirates
Ireland	USA (California; Massachusetts)
Malta	

In total, nearly 50 respondents (either individuals or organisations) were contacted, with responses received from 28 people. In many cases, people felt either that they were unable to complete the survey, or that someone else would be better informed than they were. Of those who responded, nine expressed an interest in receiving further information about our work.

The survey was *completed* by respondents from the following states / countries:

- Canada (Quebec)
- Finland
- France
- Greece
- India
- Ireland
- Malta
- Mexico
- Sweden
- Philippines
- The Netherlands
- USA (Massachusetts)

Through the survey and the literature review, relevant literature was identified for Asia, Australia (national and Queensland specific), Denmark, Finland, France, India, Latvia, Mexico, New Zealand, Philippines, Sweden, Thailand, United Arab Emirates and USA (California, Massachusetts and Pennsylvania).

It should be noted that there is an additional body of literature, whereby vehicle inspection data have been used to look at road safety issues, and, separately, compliance with emissions regulations. That material is not reported here, as it was addressed in the earlier review paper (Cairns et al, 2014).

3 Survey results for individual countries

The following section provides a summary of the findings for each country that completed the survey, based on their answers to the standardised survey questions set out in Appendix A.

3.1 Canada (Quebec)

3.1.1 Details of periodic inspections of private cars

The state of Quebec in Canada requires mandatory mechanical inspections according to Highway Safety Code for certain categories of private vehicle.

The following road vehicles must undergo mechanical inspections at least once a year (every 12 months):

- taxis;
- tow trucks with a GVWR of less than 4,500 kg.

The following road vehicles must undergo mechanical inspections at least once every 6 months):

- vehicles used by a driving school, other than motorcycles and scooters;
- vehicles used to transport school children, including taxis.

It is also compulsory for private cars to be inspected if they are new to the state or fall under any of the following criteria:

- hand-crafted vehicles;
- used vehicles from outside Québec;
- severely damaged vehicles that have been rebuilt and for which a technical compliance certificate has been issued;
- vehicles stored for more than 12 months;
- discarded vehicles;
- vehicles that have not been authorized for operation on public roads for more than 12 months;
- vehicles registered for off-road use whose owners wish to operate them again on public roads;
- the vehicle has been modified;
- the SAAQ considers the vehicle to be dangerous; or
- a police officer has grounds to believe that the vehicle is in such poor condition that it is dangerous.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading;
- outcome of the test (i.e. pass or fail); and
- reasons for test failure.

In Quebec, data collected from inspections are held at a state level on a computerised system.

3.1.2 Computerisation of private car inspection data

Periodic technical inspection data for private cars (as detailed above) has been computerised since 1989 in Quebec. These data for private cars are held separately from other vehicle classifications. There are approximately 300,000 mechanical inspections of vehicles per year according to the Highway Safety Code.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- body type;
- fuel type (i.e. whether petrol, diesel, electric, hybrid);
- engine capacity;
- geographical location of vehicle keeper; and
- date when the vehicle is taken off the road.

In terms of emissions, there are no vehicle-specific values included as part of or linked to the inspection records database.

These data are not made available for use in research.

3.1.3 Relevant research in the country/state

No information on relevant research was provided.

3.2 Finland

3.2.1 Details of periodic inspections of private cars

Finland has a compulsory periodic technical inspection (PTI) programme for private cars, known as Määräaikaiskatsastus. The purpose of inspection is to assess safety and roadworthiness; to assess compliance with emission requirements; and to assess compliance with technical requirements and tax regulations. All private cars are required to have periodic technical inspections; there are no exemptions.

Compulsory inspections are required three years after the vehicle is first registered, then again after another two years and then every year after that. However, legislation is currently under revision, with the potential from May 2018 for vehicles to have the first inspection 4 years after the first registration, then every two years until 10 years after registration, and then every year from 10 years onwards.

It is also compulsory for private cars to be inspected if they have been deregistered after being involved in a collision, irrespective of when their last inspection was.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading;
- outcome of the test (i.e. pass or fail);

- all detected defects; and
- reasons for test failure.

In Finland, data collected from inspections are held at a state level on a computerised system.

3.2.2 Computerisation of private car inspection data

Periodic technical inspection data for private cars (detailed above) has been computerised since the early 1990s in Finland with the exception of 'all detected defects' which has only been included in records from 2007. These data are part of a larger database consisting of all registered vehicles, in which private cars are identifiable. Approximately 3 million new inspection records are stored on the computerised system each year.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- fuel type (i.e. whether petrol, diesel, electric, hybrid);
- engine capacity;
- geographical location of vehicle keeper; and
- date when the vehicle is taken off the road.

For emissions, there are vehicle-specific values that are included as part of the inspection records database, as they are linked to the inspection records from type approval data. These cover emissions of nitrogen oxides; particulate matter; carbon monoxide; and carbon dioxide, as well as details of fuel consumption and fuel economy.

These data are available for use in research, with the exception of personal data concerning vehicle owners.

3.2.3 Relevant research in the country/state

Vehicle inspection data from Finland is reported to have been used for research in road safety; car ownership and use; and energy consumption. Some studies have been produced by VTT Technical Research Centre of Finland. Some of these studies are summarised in Section 5.

3.3 France

3.3.1 Details of periodic inspections of private cars

France has a compulsory periodic technical inspection (PTI) programme for private cars, known as Contrôles Techniques. The purpose of inspection is to assess safety and roadworthiness; and to assess compliance with emission requirements.

Compulsory inspections are required four years after the vehicle is first registered, then every two years after that. It is also compulsory for private cars to be inspected after being involved in a collision or if there is a change of owner, irrespective of when their last inspection was.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading; and
- outcome of the test (i.e. pass or fail).

In France, data collected from inspections are held at a national level on a computerised system.

3.3.2 Computerisation of private car inspection data

Periodic technical inspection data for private cars (detailed above) are stored as part of a larger database consisting of light and heavy vehicles in different categories that allow identification of private cars. Odometer readings have been collected since 1992.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle model; and
- body type.

For emissions, there are vehicle-specific values that are included as part of the inspection records database or are linked to the inspection records from a parallel database. These cover emissions of nitrogen oxides; particulate matter; carbon monoxide; and carbon dioxide, as well as details of fuel consumption and fuel economy.

3.3.3 Relevant research in the country/state

Odometer data have been used, in particular, for the estimation of the car fleet in 2006 .

Specific research identified (and summarised in Section 5) includes:

Yamamoto, T., Madre, J.L. & Kitamura, R. (2004). An analysis of the effects of French vehicle inspection program and grant for scrappage on household vehicle transaction. In *Transportation Research Part B*, 38 (10) pp 905-926.

3.4 Greece

3.4.1 Details of periodic inspections of private cars

Greece has a compulsory periodic technical inspection (PTI) programme for private cars, referred to as ‘Technical Vehicle Inspection’. The purpose of inspection is to assess safety and roadworthiness; to assess compliance with emission requirements; and for trucks over 12 tonnes, to monitor that there is a speed limiting device in operation. Cars from some specific regions are exempt from the compulsory inspections, such as those from small islands.

Compulsory inspections are required four years after the first registration of the vehicle, then every two years after that. This is different to buses, taxis, ambulances and trucks over 2.5 tonnes, which are required to have a first inspection one year after the first registration and then every year after that. There are no other occasions where vehicle inspections are compulsory.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading;
- outcome of the test (i.e. pass or fail); and
- reasons for test failure.

In Greece, data collected from inspections are held at a state level on a computerised system.

3.4.2 Computerisation of private car inspection data

Periodic technical inspection data for private cars (detailed above) has been computerised 2004 after it became possible for private organisations to provide MOT certificates in Greece. These data are part of a larger database. Approximately 20,000 car inspection records are stored on the computerised system each year.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- body type;
- fuel type (i.e. whether petrol, diesel, electric, hybrid);
- engine capacity; and
- date when the vehicle is taken off the road.

For emissions, there are vehicle-specific values that are included as part of or linked to the inspection records database. These cover emissions of nitrogen oxides; particulate matter; carbon monoxide; and carbon dioxide.

Work has been undertaken to assess the completeness and accuracy of the data.

3.4.3 Relevant research in the country/state

No information on relevant research was provided.

3.5 India

3.5.1 Details of periodic inspections of private cars

India does not have a compulsory periodic technical inspection (PTI) programme for private cars. However, each vehicle, whether private or public, has to take a 'Pollution Under Control' (PUC) certificate from a recognised gas station in any of the regions of India. This PUC certificate states whether the vehicle pollution parameters in the exhaust pipe are under the set limit. The parameters are carbon monoxide and hydrocarbons. The certificate must be taken every three months.

3.5.2 Computerisation of private car inspection data

Some of the centres in Delhi and other metropolitan cities are online, and data from these are stored online. However, this does not apply to all centres.

3.5.3 Relevant research in the country/state

Vehicle inspection data from India is reported to have been used for research in road safety; air quality; car ownership and use; energy consumption; and greenhouse gas emissions and climate change. Specific literature identified (and summarised in Section 5) includes:

Sundar, S., & Deb, K. (2004). A regime for inspection and certification for in-use vehicles in India. *In CODATU XI: world congress: Towards more attractive urban transportation*.

3.6 Ireland

3.6.1 Details of periodic inspections of private cars

Ireland has a compulsory periodic technical inspection (PTI) programme for private cars, known as the National Car Test (NCT). The purpose of inspection is to assess safety and roadworthiness; and to assess compliance with emission requirements. Private cars registered before 1980 are exempt from the NCT.

Compulsory inspections are required for all cars over four years old. Vehicles that pass the test have to undergo repeat tests every two years. From June 2011, cars over 10 years old have been required to be tested every year.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading;

- outcome of the test (i.e. pass or fail); and
- reasons for test failure.

In Ireland, data collected from inspections are held at a national level on a computerised system.

3.6.2 Computerisation of private car inspection data

Computerised periodic technical inspection data for private cars (detailed above) is of a good quality from 2010 (i.e. relatively complete). Data on private cars are held on a separate system to other vehicles.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- body type;
- fuel type (i.e. whether petrol, diesel, electric, hybrid);
- engine capacity;
- geographical location of vehicle keeper; and
- date when the vehicle is taken off the road.

For emissions, there are vehicle-specific values that are included as part of or linked to the inspection records database. These cover emissions of nitrogen oxides; particulate matter; carbon monoxide; and carbon dioxide. Fuel economy data can be derived from carbon dioxide emissions.

Work has been undertaken to assess the completeness and accuracy of the data.

The inspection data are available for use in research.

3.6.3 Relevant research in the country/state

No information on relevant research was provided.

3.7 Malta

3.7.1 Details of periodic inspections of private cars

Malta has a compulsory periodic technical inspection (PTI) programme for private cars, known as the Vehicle Roadworthiness Test (VRT). The purpose of inspection is to assess safety and roadworthiness; and to assess compliance with emission requirements.

Compulsory inspections are required five years after the vehicle is first registered, then then every two years after that. It is also compulsory for private cars to be inspected at the request of the police in relation to visible excess emissions.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading; and
- outcome of the test (i.e. pass or fail).

It is not known whether the reasons for test failure are recorded.

In Malta, data collected from inspections are held at a national level on a computerised system.

3.7.2 Computerisation of private car inspection data

Computerised data is thought to be held by the Licensing and Testing Directorate at Transport Malta (the transport regulator), responsible for VRT and other testing.

These data are not thought to be made available for use in research.

3.7.3 Relevant research in the country/state

No information on relevant research was provided.

3.8 Mexico

3.8.1 Details of periodic inspections of private cars

Mexico has a compulsory periodic technical inspection (PTI) programme for private cars, known as Revision Obligatoria. The purpose of inspection is to assess compliance with emission requirements.

Compulsory inspections are required at first registration and then every six months. It is also compulsory for private cars to be inspected if they are new to the country.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- outcome of the test (i.e. pass or fail); and
- reasons for test failure.

In Mexico, data collected from inspections are held at a local and state level on a computerised system.

3.8.2 *Computerisation of private car inspection data*

There are approximately 250,000 new cars each year which are tested and their inspection records are stored on the computerised systems.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- fuel type (i.e. whether petrol, diesel, electric, hybrid); and
- engine capacity.

For emissions, there are vehicle-specific values that are included as part of or linked to the inspection records database. These cover emissions of nitrogen oxides; carbon monoxide; and carbon dioxide.

Work has been undertaken to assess the completeness and accuracy of the data.

These data are available for use in research.

3.8.3 *Relevant research in the country/state*

Vehicle inspection data from Mexico is reported to have been used for research in air quality; and car ownership and use.

Specific research identified (and summarised in Section 5) included:

Riveros, H., Cabrera, E. & Martínez, J. (1999). *Emissiones Vehiculares*. Instituto de Física, UNAM.

Riveros, H., Cabrera, E. & Ovalle, P. (2002). Vehicle inspection and maintenance, and air pollution in Mexico City. *Transportation Research Part D.* 7(1), pp 72-80.

3.9 Philippines

3.9.1 *Background to periodic inspections of private cars in the Philippines*

In the Philippines, there is a form of compulsory periodic technical inspection (PTI) programme for private cars, known as Motor Vehicle Inspection; however it is not well implemented at present.

The plan was originally to establish a comprehensive motor vehicle inspection system; however a recent proposal did not push through, and the establishment of private emissions testing centres (PETCs) was only a temporary solution. At the time of responding to the survey, there was not a comprehensive system, with only a couple of government owned motor vehicle inspection centres and reports that a lot of the PETCs were not conducting proper emissions testing. The government's inspection centres (6 spread out in different areas of the country) donated by JICA (Japan International Cooperating Agency) are non-operational due to lack of maintenance of the facilities. Tests are only for gaseous emission of gasoline engines, visual smoke emissions from diesel, and visual inspection of the condition of the vehicle.

As of June 2017, there is a Department of Transportation (DOTr) and Land Transportation Office (LTO) led 'Motor Vehicle Inspection System' project under development[3] which will involve the financing, design, construction, operations and maintenance of centralised, automated and national network of Motor Vehicle Inspection Centres (MVICs) for road worthiness testing. The aim of the project is to improve the efficiency, effectiveness, reliability and transparency of motor vehicle inspection, thereby ensuring roadworthy and environmentally-sustainable vehicles.

There is a law in place in the Philippines: Republic Act 8749 "Clean Air Act of 1999 Sec 21 (d) which requires a Technical Periodic Inspection & Maintenance Program to be implemented by the government agencies mentioned in that section. This is patterned after the Japanese "Shaken" as those who helped to develop the Act were familiar with similar programs from the USA, Japan, and Europe. As a result of this, there are provisions of the law that require:

- the definition of a vehicle's 'useful life' similar to the USA, Europe, and Japan for the vehicle's emission levels and emission devices;
- an 'Odometer Rule' similar to the USA, UK, and Japan, and
- the 'sealing of the fuel management systems' particularly diesel engines, since most public transport vehicles have had their injection pumps tampered with. This is due to overloading (which requires increased injection rate for more power to carry the heavier load). This is particularly an issue for 'jeepneys'.

The storage of data is again similar to the Japanese system which requires the mandatory 'Periodic Technical Inspection, Service, and Maintenance' prior to a vehicle's registration renewal. The Odometer Law is similar to that in the USA as it is also a consumer protection mechanism which indicates the true mileage of the vehicle.

Unfortunately, it has not been possible to initiate such a system yet since there is no "National Motor Vehicle Inspection & Maintenance Program" stipulated in the law and implemented by the government where the above data could be collected, analysed, studied, and evaluated.

3.9.2 Details of periodic inspections of private cars

The intention is for the purpose of the inspection to be to assess compliance with emission requirements.

All private cars are required to have periodic technical inspections; there are no exemptions.

Compulsory inspections are supposed to be required three years after the vehicle is first registered, then every year after that. Motor vehicle inspection reports are required for instances of change of ownership and changes to engine.

During an inspection, the following data are recorded:

[3] https://ppp.gov.ph/?ppp_projects=motor-vehicle-inspection-system (accessed 07/07/17)

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection; and
- outcome of the test (i.e. pass or fail).

In the Philippines, data collected from inspections are held at a national level on a computerised system.

3.9.3 Computerisation of private car inspection data

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- fuel type (i.e. whether petrol, diesel, electric, hybrid); and
- engine capacity.

For emissions, there are vehicle-specific values that are included as part of or linked to the inspection records database. These cover emissions of nitrogen oxides; carbon monoxide; and carbon dioxide.

These data are not made available for use in research.

3.9.4 Relevant research in the country/state

Specific literature identified (and summarised in Section 5) includes a review of vehicle inspection and maintenance programmes in Asia:

Clean Air Asia Centre (2016). *Vehicle Inspection and Maintenance in Asia: Status and Challenges*. Pasig City, Philippines.

3.10 Sweden

3.10.1 Details of periodic inspections of private cars

Sweden has a compulsory periodic technical inspection (PTI) programme for private cars. In Swedish it is called ‘kontrollbesiktning’. The purpose of inspection is to assess safety and roadworthiness; and to assess compliance with emission requirements. All private cars are required to have periodic technical inspections unless the year of the model is from 1950 or earlier. Compulsory inspections are required four years after the vehicle is first registered, then again after another two years and then every year after that.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);

- date of the inspection;
- odometer reading;
- outcome of the test (i.e. pass or fail); and
- reasons for test failure.

In Sweden, data collected from inspections are held at a national level on a computerised system.

3.10.2 Computerisation of private car inspection data

Periodic technical inspection data for private cars (detailed above) has been computerised since the 1980s in Sweden. These data are part of a larger database consisting of all other vehicles, such as Lorries, Coaches, Motorcycles, and Trailers etc. It is not known how many new inspection records are stored on the computerised system each year.

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- body type;
- fuel type (i.e. whether petrol, diesel, electric, hybrid); and
- engine capacity.

Geographical location of the vehicle keeper and date when the vehicle was taken off the road are not included.

For emissions, there are vehicle-specific values that are included as part of the inspection records database, as they are linked to the inspection records from type approval data. These cover emissions of nitrogen oxides; particulate matter; carbon monoxide; and carbon dioxide, as well as details of fuel consumption and fuel economy.

These data are available for use in research.

3.10.3 Relevant research in the country/state

Specific literature identified (and summarised in Section 5) includes a review of vehicle inspection and maintenance programmes in Sweden:

Eliasson, J., Pyddoke, R. & Swärdh, J.E. (2016*). Distributional effects of taxes on car fuel, use, ownership and purchases*. CTS Working Paper 2016: 11.

Pyddoke, R. & Swärdh, J.E. (2015). *Differences in the effects of fuel price and income on private car use in Sweden 1999 - 2008*. CTS Working Paper 2015: 1.

Pyddoke, R. & Creutzer, C. (2014). *Household car ownership in urban and rural areas in Sweden 1999 – 2008*. CTS Working Paper 2014: 21.

Pyddoke, R. (2009). *Empirical analyses of car ownership and car use in Sweden*. VTI rapport 653/653A

Bastian, A. and Börjesson, M., 2015. Peak car? Drivers of the recent decline in Swedish car use. *Transport Policy*, 42, pp.94-102.

3.11 The Netherlands

3.11.1 Details of periodic inspections of private cars

The Netherlands has a compulsory periodic technical inspection (PTI) programme for private cars, known as APK. The purpose of inspection is to assess safety and roadworthiness; and to assess compliance with emission requirements. All private cars are required to have periodic technical inspections up to the age of 50 years old, after which they are exempt.

Compulsory inspections are required three years after the vehicle is first registered, then again after another one year and then every two years after that until the vehicle reaches over 50 years old. It is also compulsory for private cars to be inspected if they are new to the country.

During an inspection, the following data are recorded:

- location of the test centre;
- vehicle identifier (such as the vehicle registration mark or VIN number);
- date of the inspection;
- odometer reading;
- outcome of the test (i.e. pass or fail); and
- reasons for test failure.

In the Netherlands, data collected from inspections are held at a national level on a computerised system.

3.11.2 Computerisation of private car inspection data

The following data are currently included or linked to the computerised inspection records:

- date of the vehicle's first registration (or other measure of vehicle's age);
- vehicle make;
- vehicle model;
- geographical location of vehicle keeper; and
- date when the vehicle is taken off the road.

For emissions, there are vehicle-specific values that are included as part of or linked to the inspection records database. These cover emissions of nitrogen oxides and carbon monoxide.

3.11.3 Relevant research in the country/state

Information on relevant research in the Netherlands was not provided.

3.12 USA (Massachusetts)

3.12.1 Details of periodic inspections of private cars

In the state of Massachusetts in the United States of America, all light duty vehicles (mainly private cars) must be inspected annually and the emission data plus the VIN, odometer reading, and Massachusetts license plate are recorded and transmitted electronically to a central authority - the Registry of Motor Vehicles for the Commonwealth of Massachusetts. The survey respondent did not know whether other commercial vehicles are inspected in a similar fashion.

3.12.2 Computerisation of private car inspection data

The centralised recording of these data began around year 2001.

3.12.3 Relevant research in the country/state

Vehicle inspection data from Massachusetts has been used for research in car ownership and use; energy consumption; and greenhouse gas emissions and climate change.

Specific research identified (and summarised in Section 5), includes:

Diao, M.I. & Ferreira, J. (2014). Vehicle Miles Travelled and the Built Environment: Evidence from Vehicle Safety Inspection Data. *In Environment and Planning A; 46(12); pp. 2991 – 3009.*

Ferreira, J. & Minikel, E. (2012). Measuring Per Mile Risk for Pay-As-You-Drive Automobile Insurance. *Transportation Research Record*; 2297; pp97 – 103.

Ferreira, J. & Minikel, E. (2010). *Pay-As-You-Drive Auto Insurance in Massachusetts: A Risk Assessment and Report on Consumer, Industry and Environmental Benefits*. For the Conservation Law Foundation and Environmental Insurance Agency.

Reardon, T., Irvin, E., Brunton, S., Hari, M., Reim, P. & Gillingham, K. (2016). Quantifying Vehicle Miles Travelled from Motor Vehicle Inspection Data: The Massachusetts Vehicle Census. *In Transportation Research Board 95th Annual Meeting*

The Metropolitan Area Planning Council (MAPC) for metro Boston has done some further research using these data with support from the Barr Foundation.

The survey respondent did not know whether these data have been used for road safety or air quality studies.

4 Summary of data and research

From the survey responses described above, the following table provides a brief summary of some of the main features of the data collected which might determine its suitability for similar analysis to that undertaken in Britain.

Table 2: Summary of some data characteristics from PTI inspections

Country	Data held in a centralised computer system	Data includes an odometer reading	Data includes information on the vehicle keeper location	Data used or available for research
Canada (Quebec)	✓	✓	✓	×
Finland	✓	✓	✓	✓
France	✓	✓	×	✓
Greece	✓	✓	×	?
India	×	?	?	✓
Ireland	✓	✓	?	✓
Malta	✓	✓	✓	×
Mexico	✓	×	×	✓
Philippines	✓	×	×	×
Sweden	✓	✓	×	✓
The Netherlands	✓	✓	✓	?
USA (Massachusetts)	✓	✓	?	✓

In the next section, we summarise individual pieces of literature we found that addressed issues relating to car ownership, car use, climate change and air quality issues. Literature has been identified for Asia, Australia (national and Queensland specific), Denmark, Finland, France, India, Latvia, Mexico, New Zealand, Philippines, Sweden, Thailand, United Arab Emirates and the USA (California, Massachusetts and Pennsylvania).

In addition, the earlier review paper (Cairns et al, 2014) identified a body of literature whereby vehicle inspection data have been used to look at road safety issues, and, separately, compliance with emissions regulations, which is reported in that paper.

5 Relevant research undertaken using periodic technical inspection data

The following section quotes verbatim the abstracts (or summary) of the reports identified above, plus additional research identified by contacts who did not complete the survey, to give an idea of the sorts of topics covered. In some cases, additional information from the methodology sections of the papers has been included.

Country	Abstract/Exec summary
Asia	**Clean Air Asia Centre (2016).** Vehicle Inspection and Maintenance in Asia: Status and Challenges**. Pasig City, Philippines.** Asia is home to close to five hundred million vehicles, exhibiting rapid growth in vehicle fleet sales while maintaining an aging in-use vehicle population. Because of this, motorized transportation is a major source of outdoor air pollution in the region. Excessive emissions of gaseous pollutants and particulates by road vehicles can be attributed to the effective absence of regular periodic inspection and maintenance of vehicles. This report provides an update on the current institutional framework, policies and practices on vehicle inspection and maintenance (I/M) in twelve Asian countries/ administrative regions: Bangladesh, People's Republic of China and Hong Kong Special Administrative Region, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka and Viet Nam. Relevant transport policy and emission standard updates were obtained through online resources and were compiled into individual Country Chapters. I/M policies and programs were then studied in relation to reports on enforcement, and supporting policies on new and old vehicles. These were further examined with respect to factors for success identified in several studies on I/M programs across the world. Key factors for successful I/M program implementation in the region include: • **Centralized I/M systems**, developed through multi-agency collaboration at the early stages of planning, with a self-funding mechanism for regular audits of test centres. Localized studies on the full cost of I/M program enforcement that includes checks and assessments of the system should be conducted towards developing a self-sustaining program. • **Comprehensive and recurrent fleet characterization** to guide I/M policies and strategies. Linking vehicle registration procedures with emissions and roadworthiness test results, through accessible databases, would give teeth to a mandatory periodic inspection policy. I/M program policies, infrastructure and campaigns should be designed with emphasis on identified vehicle types of concern, particularly two- and three-wheelers as well as diesel vehicles with high kilometres travelled.

	• **Timely and appropriate strengthening of I/M policies and emissions standards** based the characteristics of the fleet and considering existing vehicle technologies, while advancing towards cleaner emissions. In the region, high failure rates in emissions tests may be symptomatic of underlying issues that need to be identified and subsequently addressed. • **A strong vehicle maintenance and repair service industry** that is able to address the needs of vehicles that fail emissions testing. Maintenance services should be independently operated from testing centres to avoid conflict of interests that would reduce public trust in the program. In the region, emphasis should be given towards capacity building, accreditation and professionalization of this industry. • **Consistent enforcement and reliable detection technologies** that builds and maintains public trust, awareness and participation. Increasing detection capabilities through sensory equipment as well as complementing periodic inspections with roadside testing are worthwhile investments for the region's I/M programs to be felt by the public. • **Complementing policies on vehicles that enter and exit the active fleet**. Extension or end-of-life policies for vehicles must also be accompanied by studies on the fates of retired vehicles and scrapped parts, to prevent re-entry on the road once these are deemed unfit for continued use. Implementation of vehicle retirement and scrappage programs must be done with caution, as these policies may inadvertently cause pollution to be transferred from central urban economies to their peripheries.
Australia - national	**Australian Bureau of Statistics (2013).** Australian Motor Vehicle Census 2013 This publication presents statistics relating to vehicles which were registered at 31 January 2016 with a motor vehicle registration authority. Motor vehicle registration statistics reflect the information as recorded in registration documents. Statistics are provided on vehicle types comprising passenger vehicles, campervans, light commercial vehicles, trucks, buses and motor cycles. Vehicle characteristic information includes make of vehicle, year of manufacture, type of fuel that the vehicle was registered as using, and Gross Vehicle Mass or Gross Combination Mass for trucks. The size of the motor vehicle fleet is also compared with the estimated resident population.
Australia - Queensland	**Li, T., Sipe, N. and Dodson, J. (2017).** Social and spatial effects of transforming the private vehicle fleet in Brisbane**. Australia. *Transportation Research Part D: Transport and Environment*, 51, pp.43-52.** Transformation of the motor vehicle fleet has been an important feature of the world's peak car phenomenon. Very few urban transport studies have explored such important changes in large urban cities. Using an innovative green vehicle datasets constructed for 2009 and 2014, this paper investigates the ongoing change in urban private vehicle fleet

	efficiency (VFE) in Brisbane. The spatial patterns of VFE change were examined with social-spatial characteristics of the urban area. The results showed that the social and spatial effect of VFE changes remain uneven over urban space. The inner urban areas have experienced higher level of VFE change, whilst people in the outer and oil vulnerable areas showed a low tendency in shifting to more efficient vehicles. The implication of VFE change for future household vehicle adoption was also evaluated based on a cost-benefit analysis of new vehicle technology costs and expected fuel savings for households that choose a fuel efficient vehicle. The results show that imposing a stronger national fuel economy target in the long term would accelerate evolution of vehicle fleets and oil vulnerability reduction in Brisbane. **USEFUL INFO FROM DATA SECTION** *This paper draws on major datasets we have constructed to investigate changes in the VFE of the overall car fleet at the metropolitan scale. We have assembled unit-record private passenger vehicle data (i.e. every registered vehicle) for year 2009 and 2014. The datasets were obtained from the motor vehicle registration agency in Queensland, Australia. Each dataset provides comprehensive detail on motor vehicle make, model and engine size, including suburb-level spatial information on place of registration. These motor vehicle registration datasets were matched with the Australian Government's Green Vehicle Guide (GVG) data on VFE and emissions by vehicle make and models. GVG is an online consumer information resource that rates motor vehicles based on their energy efficiency, greenhouse emissions and air pollution. This information updates annually to include new vehicle make and models available in the Australian market. Because motor vehicle registration data includes the address of the owner we are able to link the vehicle characteristics to the location of registration. In this study, each unit record contains details that can be used to understand VFE at the suburb level. Linking the spatially referenced motor vehicle registration with standard vehicle efficiency measures at the unit-record level is rare in international transport study. In this paper, the motor vehicle and efficiency datasets were constructed for 2009 and 2014 to permit a comparative study of changes within the urban vehicle fleet.*
France	**Yamamoto, T., Madre, J.L. & Kitamura, R. (2004).** An analysis of the effects of French vehicle inspection program and grant for scrappage on household vehicle transaction**. In *Transportation Research Part B*, 38 (10) pp 905-926.** The French government has implemented a periodical vehicle inspection program, which aims at maintaining proper functioning of the vehicle and ensuring the emissions control systems installed on the vehicle work properly. Also, an incentive program for scrapping old vehicles was introduced in 1994 through 1996 to promote the replacement of those vehicles with higher emissions by newer vehicles with lower emissions. A hazard-based duration model of household vehicle transaction behaviour has been developed in this study to examine the effects of the inspection program and the

	grant for scrappage on vehicle transaction timing. The model is developed as a competing risks model assuming the following three types of competing risks: replacing one of the vehicles in the household fleet, disposing of one vehicle in the fleet, and acquiring one vehicle to add to the fleet. The empirical analysis is carried out using the panel data of French households' vehicle ownership from 1984 to 1998, obtained by the panel survey called Parc-Auto, which has been conducted by a French marketing firm, SOFRES, since 1976. The long panel observation period facilitates the introduction of macro-economic indicators into the model, enabling the analysis to distinguish the effects of policy measures from macro-economic factors. The empirical results indicate that the expected vehicle holding duration becomes 1.3 years longer under the inspection program than before the program commenced, given that the vehicle is replaced by another vehicle at the end of the holding duration; and that the conditional probability of replacing a vehicle aged 10 years and over becomes 1.2 times higher, and the average holding duration becomes shorter by 3.3 years, when the grant for scrappage is available.
Denmark	**Gillingham, K. & Munk-Nielsen, A. (2017).** *A Tale of Two Tails: Commuting and the Fuel Price Response in Driving*. **NBER Working Paper No. 22937** The price responsiveness of driving demand is central to the welfare consequences of fuel price changes. This study uses rich data covering the entire population of vehicles and consumers in Denmark to find a medium-run price elasticity of driving of −0.30. We uncover an important feature of driving demand: two groups of much more responsive households in the lower and upper tails of the work distance distribution. We find that a fuel price increase of 1 DKK/liter implies an average deadweight loss of 0.66 DKK/liter and that this loss is more than four times greater in the tails.
India	**Sundar, S., & Deb, K. (2004).** **A regime for inspection and certification for in-use vehicles in India. *In CODATU XI: world congress: Towards more attractive urban transportation*.** India has witnessed a rapid increase in its vehicle population from 3 million vehicles in the 1960 to 40 million in 2002. This has implications for air quality. To mitigate transport emissions, stringent emission norms are being introduced for new vehicles. However, this effort would be futile without an improvement in the emissions performance of the large number of in use vehicles. Hence, an effective inspection and maintenance program for in use vehicles is essential for mitigating transport emissions. The present vehicle inspection system in India is ineffective. Inspection certification is required only for smaller number of commercial vehicles. The inspectors are largely unskilled. The procedure for inspection is discretionary. The inspection centres do not have equipment to carry out proper inspection of the vehicle. Finally, there is no mechanism for auditing the performance of these centres. Therefore, there is need for an effective institutional and

	regulatory framework for managing the inspection centres in India. This paper presents a comprehensive inspection and certification program for India to improve roadworthiness of in-use vehicles in India. This involves strengthening the existing regulatory frame-work, establishing well equipped and certified inspection centres, and recommending items for inspection and test procedures for emission and safety performance.
Latvia	**Siliverstovs, B., Kholodilin, K. A. and Dombrovsky, V. (2014).** [Using Personal Car Register for Measuring Economic Inequality in Countries with a Large Share of Shadow Economy: Evidence for Latvia]**.** ***Review of Income and Wealth*****, 60: 948–966.** We suggest using information from the state register of personal cars as an alternative indicator of economic inequality in countries with a large share of shadow economy. We illustrate our approach using the Latvian pool of personal cars. Our main finding is that the extent of household economic inequality in Latvia is much larger than officially assumed. According to Eurostat, the officially published estimate of the Gini coefficient for Latvia is 0.374 for 2009, which is much higher than the Gini coefficient value reported for all the 27 EU member countries (0.304), but significantly lower than 0.48 according to our results.
Mexico	**Riveros, H., Cabrera, E. & Martínez, J. (1999).** ***Emissiones Vehiculares*****. Instituto de Física, UNAM.** El análisis de los datos de la revisión vehicular obligatoria nos proporciona valiosa información que puede ser utilizada por los habitantes de ciudades con problemas de contaminación atmosférica, por los fabricantes de vehículos y por las autoridades de dichas ciudades. Su valor reside en que: • Los habitantes, al conocer la magnitud de las emisiones vehiculares, pueden tomar una decisión documentada para comprar, vender o conservar un automóvil. • Los fabricantes estén en condiciones de asegurarse de que sus vehículos pasen con facilidad la revisión obligatoria y así tener mayor demanda en el mercado. • Las autoridades para predecir los niveles de medición de contaminantes mediante el uso de modelos matemáticos que utilicen la información sobre los niveles de emisión vehicular; además de servirse de los mismos datos para obtener un análisis comparativo sobre el desempeño de los verificentros. Los verificentros ubicados en el Distrito Federal atendieron 1’282,338 vehículos durante el primer semestre del año 2000. Se escogieron los datos relacionados con las emisiones por el tubo de escape, en particular los de la Prueba de Aceleración Simulada (PAS 5024) para el monóxido de carbono, porque con la introducción de la inyección del

	combustible y del convertidor catalítico se han reducido ostensiblemente las emisiones vehiculares. Se consideró innecesario analizar los vehículos anteriores al modelo 1990, dotados todos ellos de carburador, con emisiones parecidas. En una primera parte se proporciona información en forma de tablas que registran las emisiones de monóxido de carbono de las diferentes marcas, haciendo una comparación entre datos de una misma submarca con diferentes modelos. Una segunda parte, formada por gráficas, muestra las emisiones de monóxido de carbono, comparando una misma marca y mismo modelo con diferentes submarcas. Se eligió el monóxido de carbono dado que se pueden comparar con las mediciones en la atmósfera de la ciudad que existen a lo largo de varios años, lo que no se tiene de los hidrocarburos. Los convertidores catalíticos usados en los diferentes modelos tienen eficiencias diferentes para oxidar el monóxido de carbono.
	Riveros, H., Cabrera, E. & Ovalle, P. (2002). Vehicle inspection and maintenance, and air pollution in Mexico City. *Transportation Research Part D.* 7(1), pp 72-80. Information from the Mandatory Inspection and Maintenance (I/M) Program carried out in October 1996 and the first semester of 1998 provides a useful emission data7(base for Mexico City. Carbon monoxide (CO) and hydrocarbon (HC) exhaust emission levels were measured for at least a million private and public transportation vehicles. Analysis of this database leads us to conclude that this information can be used to test anti-pollutant policies, and is useful as a performance quality index for vehicle manufacturers. Some of the results of this analysis include: the finding of a typical exhaust emission distribution curve for each vehicle manufacturer, with differences for each brand and model for the same manufacturer, the fact that not all new vehicles pass the I/M test; and public transportation vehicles in Mexico City have almost useless catalytic converters.
New Zealand	**Rendall, S., Page, S. & Krumdieck, S. (2013).** *Local Area Transport Energy Evaluation (LATEE). New Zealand Warrant of Fitness Data and VKT Analysis Mapped to Census Unit areas method description and validation*. **University of Canterbury Library.** A method to evaluate the household energy use for personal transport and assign that information to geospatial locations has been developed by the Advanced Energy and Material Systems Lab research team at the University of Canterbury. The project was part of the Towards Sustainable Urban Forms (TOTUS) research programme that aims to provide quantitative geospatial information about transportation energy consumption for planning purposes. The Local Area Transportation Energy Evaluation (LATEE) methodology uses data from the Ministry of Transport and Statistics New Zealand to calculate

	annual vehicle kilometres travelled (VKT) and assign average values to local census area units.
Sweden	**Eliasson, J., Pyddoke, R. & Swärdh, J.E. (2016).** *Distributional effects of taxes on car fuel, use, ownership and purchases*. **CTS Working Paper 2016: 11.** We analyse distributional effects of four car-related tax instruments: an increase of the fuel tax, a new kilometre tax, an increased CO2-differentiated vehicle ownership tax, and a CO2-differentiated purchase tax on new cars. Distributional effects are analysed with respect to income, lifecycle category and several spatial dimensions. All the analysed taxes are progressive over most of the income distribution, but just barely regressive if the absolutely highest and lowest incomes are included. However, the variation within income groups is substantial; the fraction of the population who suffer substantial welfare losses relative to income is much higher in lower income groups. The two most important geographical distinctions are between rural and urban areas (including even small towns), and between central cities and satellites/suburbs; these spatial dimensions matter much more for distributional effects than for example whether an area is remote or sparsely populated.
	Pyddoke, R. & Swärdh, J.E. (2015). *Differences in the effects of fuel price and income on private car use in Sweden 1999 - 2008*. **CTS Working Paper 2015: 1.** The objective of this paper is to analyse how the use of privately owned cars in Sweden varies across a number of background parameters including fuel price, disposable income, car purchase cost index, children over 18, employment and the car owners' distance to work. These factors are analysed separately for men and women, individuals living in urban, rural and sparsely populated areas as well as disposable income quartiles. In particular the adaptation of car use of low income car owners in rural and sparsely populated areas to fuel cost and disposable income variations is analysed. Register data of the whole population in Sweden taken from the Swedish tax authorities for 1999-2008 as well as kilometre readings from the National Vehicle Inspection is used. This allows tracking individual changes in car use over ten years as well as to contrast car use in rural and sparsely populated areas to car use in urban areas. Car use is modelled with a dynamic panel data specification, permitting proper methods to deal with endogeneity problems. Small geographical differences in the sensitivity to variations in disposable income are found. For fuel cost on the other hand, there is a tendency towards higher price sensitivity in rural areas especially in the two lowest income quartiles. In sparsely populated areas, there is no higher sensitivity of fuel price compared to urban areas. The income elasticity of car use is fairly small and decreases with increasing disposable income. This latter finding is compatible with the hypothesis of car driving saturation in the rich countries around the world. The car travel elasticity with respect to fuel price is estimated to

be between -0.2 and -0.4 in the short run. Here the pattern is as expected with decreasing fuel-price elasticity with increasing income.

Pyddoke, R. & Creutzer, C. (2014). *Household car ownership in urban and rural areas in Sweden 1999 – 2008*. **CTS Working Paper 2014: 21.**

This paper studies household car ownership in urban and rural areas in Sweden using register data for all adult Swedes from 1999 to 2008. Data for individuals are linked to members of the same household, allowing us to estimate models of households. Multinomial ordered probit models for households' private car ownership in Sweden are estimated and used to compare urban and rural households with respect to sensitivity of car ownership. The central result from comparing urban and rural households is that rural households are less likely to exit from car ownership and more likely to increase car ownership than comparable urban households. This supports the notion that rural households are more dependent on their cars than urban households. Rural car ownership is also more sensitive to fuel price changes and the number of adults in the household. Compared with other countries, our results indicate that Swedish households' car ownership is very resistant to change. The status of the previous year's car ownership as well as car ownership status in 1999 is dominant factors for household car ownership in 2008. Households with young adults are more likely to cease their car ownership and households with senior members are only slightly more likely to cease car ownership than middle-aged households. Households with higher income are less likely to cease car ownership then lower income households and more likely to increase their car ownership. Permanent income, defined as the average income over the period, has a larger positive impact on car ownership than current income.

Pyddoke, R. (2009). *Empirical analyses of car ownership and car use in Sweden*. **VTI rapport 653/653A**

This purpose of this report is to describe and analyse how individual car ownership and car use in Sweden are affected by costs, income, sex and the place of residence of the individual and further to investigate whether inhabitants of rural areas close to urban areas or sparsely populated areas are more sensitive to costs and income with regard to car ownership and car use than other individuals in Sweden.

The report uses register data for the whole of the Swedish population, meter readings from the vehicle inspection, and the area categorisation of the National Rural Development Agency: urban area, rural area close to an urban area and sparsely populated area.

Some of the new descriptive results are that: inhabitants of urban areas own and use cars to a lesser extent than inhabitants of rural areas. The difference in driven distances, however, is small. The difference between rural areas close to urban areas and sparsely populated areas is less.

In the model analyses we find small differences between the area types in the sensitivity of the use of privately-owned cars due to changes in disposable income and costs. In the analysis of the model for individual car ownership the most important result is that car ownership in Sweden is slow to change. The most important factor to explain car ownership in a particular year is whether the individual owned or did not own a car the previous year. Inhabitants of rural areas are slightly less inclined to cease car ownership and more inclined to increase car ownership to several cars compared with comparable individuals in urban areas. Men are also considerably more inclined to acquire a car when they do not own one than women, and this probability is greater in rural areas for both sexes. Changes in income are estimated to have negligible effects on car ownership. Changes in cost have both expected and unexpected effects on the likelihood of car ownership levels.

Bastian, A. and Börjesson, M., 2015. Peak car? Drivers of the recent decline in Swedish car use. *Transport Policy*, 42, pp.94-102.

It has long been well-known that economic variables such as GDP and fuel price as well as socio-demographic characteristics and spatial distribution are key factors explaining car use trends. However, due to the recently observed plateau of total car travel in many high income countries, it has been argued that other factors, such as changes in preferences, attitudes and life-styles, have become more important drivers of car use. This paper shows that the two variables, GDP per capita and fuel price, explain most of the aggregate trends in car distances driven per adult in Sweden: as much as 80% over the years 2002 to 2012. The estimated elasticities are well in line with previous literature and can reasonably well reproduce the trend in car distances driven per adult back to 1980. We find, however, a substantial variation in elasticities between municipalities depending on public transport supply, population density, share of foreign-born inhabitants and the average income level.

USEFUL INFO FROM DATA SECTION

To measure VKT between the years 2002 and 2012 we use distance meter readings from passenger car inspections, which are mandatory in Sweden. The data is aggregated per municipality and calendar year and spans from 2002 to 2012. Actual driving distances are recorded for approximately two-thirds of all cars registered in Sweden, both privately owned and company cars. These observations are used to estimate distances driven for the remaining one-third of cars in Sweden, based on car age, model and ownership type. Among the cars without recorded distances, 60% are less than three years old, because cars less than three years old are not inspected. The estimated yearly distance of the new cars equals the

	yearly average distance of the three-year-old cars (within the same class) inspected for the first time. This implies a risk that a fraction of the inter-temporal changes in driving distances lags behind in the data. However, since our aim is to study the peak car issue we need to consider the national trends in car travel. We therefore include the estimates of the travel distances of the cars that are not observed in our analysis. Moreover, if excluding the vehicles that are not inspected from the analysis we would not to be able to compare our results with longer term national historical or other studies concerning aggregate elasticities.
Thailand	**Taneerananon, P., Chanwannnakul, T., Suanpaga, V., Khompratya, T., Kronprasert, N. & Tanboriboon, Y. (2005).** An Evaluation of the Effectiveness of Private Vehicle Inspection Process in Thailand**. In *Journal of the Eastern Asia Society for Transportation Studies*, 6, pp. 3482-3496.** Traffic accidents are a leading cause of deaths in Thailand. Over the last three years, some 13,000 human lives have been lost annually as a result of road accidents. Losses in terms of economic, social and public health costs have risen over 100 billion baht (US$2,500) during the period (Police Lieutenant Colonel Dr. Thaksin Shinawatra Thai Prime Minister, WHO 2004). Traffic accidents can be viewed as a chain of events involving the failure of one or more of the following factors: the road user, the vehicle and the road. Research on traffic accidents in the USA and United Kingdom has shown that one of the significant factors causing road crashes was vehicle defects; this factor contributes 12% and 8% respectively to motor accidents in the two countries (Ogden 1996). The statistics for Thailand showed that vehicle defects accounted for some 27.54% of road accidents (OCMLT 2002). In view of the foregoing findings, inspecting vehicles to guard against vehicle defects can be an effective and proactive measure to help prevent road crashes. This study describes the result of an evaluation of vehicle inspection effectiveness in Thailand. The study aims to identify ways of improving the vehicle inspection process currently in use in the country.
UAE	**Selim, M.Y.E., Maraqa, M.A., Hawas, Y.E. & Mohamed, A.M.O. (2011).** Assessment of vehicle inspection and emission standards in the United Arab Emirates. **In *Transportation Research Part D: Transport and Environment*, 16(4); pp.332 – 334.** This paper examines vehicle inspection in the United Arab Emirates, comparing mechanical and environmental inspection methods across different inspection centres in the country. Making use of a survey of inspectors, vehicle owners, experts and port managers, the study reveals significant differences among centres in the various Emirates and within the same Emirate in terms of the standards adhered to and the methods of testing.
USA,	**Cook JA, Sanchirico JN, Salon D, Williams J.** Empirical distributions of vehicle use and fuel efficiency across space:

California	Implications of asymmetry for measuring policy incidence. ***Transportation Research Part A: Policy and Practice*. 2015 Aug 31; 78: 187-99.** Concerns about local air pollution and climate change have prompted all levels of government to consider a variety of policies to reduce vehicle dependence and fuel consumption, as the transportation sector is one of the largest sources of local and global emissions. Because many of the policy options under consideration are market-based (e.g., gasoline tax, carbon tax), it is important to consider how the impacts would vary across space and affect different subpopulations. Evaluating incidence is relevant for both the expected costs and benefits of a particular policy, however detailed data on vehicle-miles travelled (VMT) and fuel consumption allowing for the distributions of these variables to be estimated at a fine geographic scale is rarely available. This paper uses a unique dataset with more than 20 million vehicles in California to derive estimates of VMT and fuel consumption in order to examine the spatial distribution of impacts for an increase in the price of gasoline as well as the consequences of using different statistics for policy evaluation. Results show that VMT and fuel consumption distributions are not symmetrically distributed and vary significantly within transportation planning regions. To understand the potential implications of this asymmetry, we do a back of the envelope comparison using the mean and mode of the VMT or fuel consumption distribution for policy analysis. We find that assuming a symmetric distribution can lead to a divergence of 20–40% from the estimates based on the empirical distribution. Our results, therefore, introduce caution in interpreting the incidence of policies targeting the transportation sector based on averages.
	Gillingham, K., 2014. Identifying the elasticity of driving: evidence from a gasoline price shock in California. ***Regional Science and Urban Economics*, 47, pp.13-24.** There have been dramatic swings in retail gasoline prices over the past decade, along with reports in the media of consumers changing their driving habits — providing a unique opportunity to examine how consumers respond to changes in gasoline prices. This paper exploits a unique and extremely rich vehicle-level dataset of all new vehicles registered in California in 2001–2003 and then subsequently given a smog check in 2005–2009, a period of steady economic growth but rapidly increasing gasoline prices after 2005. The primary empirical result is a medium-run estimate of the elasticity of vehicle-miles-travelled with respect to gasoline price for new vehicles of − 0.22. There is evidence of considerable heterogeneity in this elasticity across buyer types, demographics, and geography. Surprisingly, the vehicle-level responsiveness is increasing with income, perhaps due to within-household switching of vehicles. The estimated elasticity has important implications for the effectiveness of price policies, such as increased gasoline taxes or a carbon policy, in reducing greenhouse gases. The heterogeneity in the elasticity underscores differing distributional and local air

	pollution benefits of policies that increase the price of gasoline. (Individual odometer readings are used.)
	Salon, D., Cook, J. and Williams, J., 2014. Household Vehicle Carbon Emissions in California Cities. In *Transportation Research Board 93rd Annual Meeting* (No. 14-0630). Estimating jurisdiction-level carbon emissions from the transport sector is challenging for the simple reason that vehicles are mobile. For criteria air pollutant emissions estimation, the emissions counted are those that are physically emitted in the relevant geographic area. This makes sense because criteria air pollutants have localized health effects. Since carbon emissions have global rather than local environmental consequences, however, it is less obvious which transport emissions should count toward the emissions inventory for a particular jurisdiction. Thus, jurisdiction-level transport greenhouse gas emissions inventories are done in a variety of ways and are generally not comparable to one another. This paper reports on a project that calculated household vehicle greenhouse gas emissions inventories for eight cities in California for the years 2000 and 2005. Common data sources and methods were used for all cities, resulting in inventories that are comparable across time, across jurisdictions, and also between zip codes within a jurisdiction. These emissions estimates are discussed and compared to official inventory estimates.
USA, Georgia	**Binder, S., Macfarlane, G.S., Garrow, L.A. and Bierlaire, M., 2014. Associations among household characteristics, vehicle characteristics and emissions failures: An application of targeted marketing data. *Transportation Research Part A: Policy and Practice*, 59, pp.122-133** Many U.S. cities use vehicle emissions testing programs to improve air quality by identifying gross polluting vehicles and requiring their owners to make emissions-related repairs. All vehicles that meet certain criteria must pass an emissions test as part of the vehicle registration process. States use different criteria to determine which vehicles must be tested; however, the equity impacts associated with various screening criteria are unknown. This is due to difficulties researchers have faced in linking vehicle and household characteristics. We investigate the relative influence of vehicle and household characteristics on emissions failures in Atlanta, Georgia, by linking its emissions testing database to a targeted marketing database; the latter contains information about vehicle owners. We use count and hurdle models to predict vehicle emissions failures. Our model finds a relationship between sociodemographic characteristics and emissions failures after controlling for vehicle characteristics; that is, given two identical vehicles, the one owned by a low-income or minority household is more likely to fail emissions. We use our model to investigate the impacts of different emissions testing policies by income and ethnic groups.
USA,	**Gillingham, K., Jenn, A., & Azevedo, I. M. (2015). Heterogeneity in the response to gasoline prices: Evidence from**

Pennsylvania	**Pennsylvania and implications for the rebound effect. *Energy Economics*, 52, S41-S52.** The consumer response to changing gasoline prices has long interested economists and policymakers, for it has important implications for the effects of gasoline taxation and vehicle energy efficiency policies. This study examines both the elasticity of driving with respect to changing gasoline prices and heterogeneity in this elasticity by geography, the fuel economy of the vehicle, and the age of the vehicle. We use detailed annual vehicle level emissions inspection test data from Pennsylvania that include odometer readings, inspection zip codes, and extensive vehicle characteristics. We estimate a short-run gasoline price elasticity of driving demand of -0.10, and find substantial heterogeneity in this responsiveness. The elasticity is largely driven by low fuel economy vehicles, as well as vehicles between 3 and 7 years old. Our findings help reconcile some of the recent literature and provide guidance on the magnitude of the direct rebound effect from light duty vehicle energy efficiency policies. **USEFUL INFO FROM DATA SECTION** *This paper uses a dataset of over 7 million light duty vehicles, covering the years 2000 to 2010, resulting in over 75 million vehicle inspection records from mandatory annual inspections Pennsylvania. These annual inspections involve both a visual safety check and an on-board diagnostic (OBD) test that electronically records and submits emissions, odometer readings, zip code of the inspection station, other vehicle information, and the date of inspection to the Pennsylvania Department of Transportation. All light duty vehicles in Pennsylvania with a model year after 1975, including hybrid electric vehicles, are required to undergo the mandatory safety and emissions inspection. In addition, a new inspection is required any time there is an update to a vehicle registration, such as a change of address or ownership. In the case of a failed inspection, drivers must repair the vehicle and follow up with a free inspection within 30 days.* *The mandatory inspection program was rolled out over a several year period and with start dates differing across Pennsylvania regions. The roll out of the inspection program started with the most populated regions (e.g., the Philadelphia and Pittsburgh metropolitan areas) in 2000. These regions have the greatest air quality challenges and thus were prioritized for the program. In the following years, the program was rolled out to other regions that also faced air quality challenges.*
USA, Massa-chusetts	**Diao, M.I. & Ferreira, J. (2014). Vehicle Miles Travelled and the Built Environment: Evidence from Vehicle Safety Inspection Data. In *Environment and Planning A*; 46(12); pp. 2991 – 3009.** This study examines the linkage between household vehicle usage and their residential locations within a metropolitan area using a newly available administrative dataset of annual private passenger vehicle safety inspection records (with

odometer readings) and spatially detailed data on the built environment. Vehicle miles travelled (VMT) and a set of comprehensive built-environment measures are computed for a state-wide 250 × 250 m grid cell layer using advanced geographic information systems and database management tools. We apply factor analysis to construct five factors that differentiate the built-environment characteristics of the grid cells and then integrate the built-environment factors into spatial regression models of household vehicle usage that account for built environment, demographics, and spatial interactions. The empirical results suggest that built-environment factors not only play an important role in explaining the intraurban variation of household vehicle usage, but may also be underestimated by previous studies that use more aggregate built-environment measures. One-standard-deviation variations in the built-environment factors are associated with as much as 5000-mile differences in annual VMT per household. This study also demonstrates the potential value of new georeferenced administrative datasets in developing indicators that can assist urban planning and urban management.

Ferreira, J. & Minikel, E. (2012). Measuring Per Mile Risk for Pay-As-You-Drive Automobile Insurance. I*Transportation Research Record*; 2297; pp97 – 103.

This study examines the relationship between accident costs and annual miles driven for approximately 3 million individual car years of insurance exposure for private passenger automobiles in Massachusetts in the 2006 policy year. Poisson and linear models relating pure premium to annual mileage estimates demonstrate that mileage is a significant predictor of insurance risk, that mileage alone cannot replace traditional rating factors such as class and territory, and that mileage gains in explanatory power when used in conjunction with those traditional rating factors. This provides a strong actuarial basis for pay-as- you-drive insurance in which drivers are charged per mile rates which differ depending upon the driver's class and territory. A model of consumer response to pay-as-you-drive insurance based on studies of miles elasticity to gasoline prices suggests that if all drivers in Massachusetts switched to per mile insurance policies, aggregate vehicle miles travelled in the state would drop by 5.0 to 9.5%. Greenhouse gas emissions from private passenger automobiles would be reduced by a similar amount, and the social equity implications of pay-as-you-drive insurance would be positive. Given the sound actuarial justification and positive social benefits, this study finds a strong argument in favour of the regulatory approval of pay-as-you-drive insurance.

Ferreira, J. & Minikel, E. (2010). *Pay-As-You-Drive Auto Insurance in Massachusetts: A Risk Assessment and Report on Consumer, Industry and Environmental Benefits*. **For the Conservation Law Foundation and Environmental Insurance Agency.**

Each year, Massachusetts drivers are driving more, and with each additional mile driven, levels of global warming pollution rise. The prospect of tying auto insurance rates to miles driven, called Pay-As-You-Drive auto insurance (PAYD), offers the opportunity to improve the accuracy of auto insurance rating while reducing vehicle miles traveled (VMT) and corresponding accident costs as well as reducing fuel consumption and greenhouse gas emissions.

Pay-As-You-Drive auto insurance is a win for consumers, insurers and the environment:

• Consumers can save money; they will only pay for the coverage needed based on how much they drive.

• Insurers can improve the accuracy of their rating plans while providing an incentive to reduce the number and cost of auto accident claims.

• The environment will benefit from the reduction in driving that PAYD incentivizes – less driving means reduced fuel usage and lower greenhouse gas emissions.

The Conservation Law Foundation (CLF) and the Environmental Insurance Agency commissioned a study to assess the risk-mileage relationship using actual insurance claims information in Massachusetts. This study ("Ferreira and Minikel 2010") offers the largest disaggregated analysis to date of the risk-mileage relationship and the actuarial basis for PAYD. The work analyses data on $502 million worth of claims on almost 3 million cars driven an aggregate of 34 billion miles. The study confirms the statistical soundness of pay-as-you-drive auto insurance pricing and indicates that the PAYD approach would result in significant reductions in miles driven, greenhouse gas emissions, and auto accident losses without adverse equity impacts to drivers.

PAYD Saves Money and is a More Accurate and Fairer Method to Price Auto Insurance

• By basing premiums at least partly on mileage, PAYD provides individual policyholders more control over their insurance costs and more accurate premiums for the type of driving they do.

• PAYD pricing reduces inequities by eliminating the subsidies low-mileage drivers currently pay for high-mileage drivers in the traditional pricing system.

• Even though suburban and rural car owners tend to drive more miles than urban car owners, their per mile charges would be lower. If they drive less than the average for their area, they would pay less for actuarially-priced PAYD insurance than they do today under the existing system.

PAYD Reduces Vehicle Mileage Travelled (VMT), Accidents and Fuel Consumption by 5-10%

• Switching all Massachusetts drivers to pure per mile auto insurance pricing would reduce mileage, accident costs and fuel consumption by about 9.5%. An alternative model with a flat yearly rate plus per mile pricing after the first 2,000 miles would reduce these measures by about 5%.

• These reductions could range between 3 and 14% depending on a number of variables like fuel prices. But even the study's lowest plausible VMT reduction (2.7%) would save more than a billion miles annually and millions of tones of GHG.

• Negative impacts of congestion will decrease under PAYD, particularly for urban driving.

Reardon, T., Irvin, E., Brunton, S., Hari, M., Reim, P. & Gillingham, K. (2016). Quantifying Vehicle Miles Travelled from Motor Vehicle Inspection Data: The Massachusetts Vehicle Census. In *Transportation Research Board 95th Annual Meeting*

A presentation is available here: https://willbrownsberger.com/wp-content/uploads/2010/04/MAPC_Rea rdon_Climate-Change-Committee-4_13_10.pdf

Many of the most critical transportation policy debates, including those over climate change mitigation strategies, land use and zoning policies, and transportation finance alternatives, hinge on estimates and predictions of Vehicle Miles Travelled (VMT). Yet reliable and geographically-specific estimates of VMT are challenging to develop, and are usually the product of complex modelling exercises calibrated with limited amounts of empirical data. However, in Massachusetts and many other states that have vehicle emission and/or safety inspection requirements, state agencies already have all the information they need to produce highly detailed estimates of VMT and make versions of that information available to policymakers, researchers, and the general public. This paper details the production of the Massachusetts Vehicle Census, a longitudinal dataset built from millions of vehicle registration and inspection records that includes estimates of vehicle ownership, VMT per vehicle and per household, fuel efficiency, and average vehicle age for all Massachusetts municipalities, census tracts, block groups, and 250-meter grid cells on a quarterly basis. It details the algorithms and methodology used to produce these estimates and updating the dataset, the steps taken to preserve anonymity of the data, and the process for developing data use agreements and levels of access for various data products. It also compares the Massachusetts Vehicle Census counts of vehicle registrations at the block group level to 2008-2012 American Community Survey data on aggregate vehicle availability.

6 References

Australian Bureau of Statistics (2013) *Australian Motor Vehicle Census 2013*.

Bastian, A. and Börjesson, M., 2015. Peak car? Drivers of the recent decline in Swedish car use. *Transport Policy*, 42, pp.94-102.

Binder, S., Macfarlane, G.S., Garrow, L.A. and Bierlaire, M., 2014. Associations among household characteristics, vehicle characteristics and emissions failures: An application of targeted marketing data. *Transportation Research Part A: Policy and Practice*, 59, pp.122-133

Cairns, S., Rahman, S., Anable, J., Chatterton, T., Wilson, R.E. (2014) *Vehicle Inspections – From Safety Device to Climate Change Tool.* MOT Project Working Paper MIS018.

Chatterton, T. and Anable, J. (2016) *Vehicle Odometers and Other Novel Methods of Examining Car Ownership and Usage*. American Association of Geographers Annual Meeting. San Francisco, 1/4/16

Clean Air Asia Centre (2016). Vehicle Inspection and Maintenance in Asia: Status and Challenges. Pasig City, Philippines.

Cook JA, Sanchirico JN, Salon D, Williams J. Empirical distributions of vehicle use and fuel efficiency across space: Implications of asymmetry for measuring policy incidence. *Transportation Research Part A: Policy and Practice*. 2015 Aug 31; 78: 187-99.

Diao, M.I. & Ferreira, J. (2014). Vehicle Miles Travelled and the Built Environment: Evidence from Vehicle Safety Inspection Data. In *Environment and Planning A*; 46(12); pp. 2991 – 3009.

Eliasson, J., Pyddoke, R. & Swärdh, J.E. (2016). *Distributional effects of taxes on car fuel, use, ownership and purchases*. CTS Working Paper 2016: 11.

Ferreira, J. & Minikel, E. (2012). Measuring Per Mile Risk for Pay-As-You-Drive Automobile Insurance. *Transportation Research Record*; 2297; pp97 – 103.

Ferreira, J. & Minikel, E. (2010). *Pay-As-You-Drive Auto Insurance in Massachusetts: A Risk Assessment and Report on Consumer, Industry and Environmental Benefits*. For the Conservation Law Foundation and Environmental Insurance Agency.

Gillingham, K., 2014. Identifying the elasticity of driving: evidence from a gasoline price shock in California. *Regional Science and Urban Economics*, 47, pp.13-24.

Gillingham, K., Jenn, A., & Azevedo, I. M. (2015). Heterogeneity in the response to gasoline prices: Evidence from Pennsylvania and implications for the rebound effect. *Energy Economics*, 52, S41-S52.

Gillingham, K. & Munk-Nielsen, A. (2017). *A Tale of Two Tails: Commuting and the Fuel Price Response in Driving*. NBER Working Paper No. 22937

Li, T., Sipe, N. and Dodson, J., 2017. Social and spatial effects of transforming the private vehicle fleet in Brisbane, Australia. *Transportation Research Part D: Transport and Environment*, 51, pp.43-52.

Pyddoke, R. & Creutzer, C. (2014). *Household car ownership in urban and rural areas in Sweden 1999 – 2008*. CTS Working Paper 2014: 21.

Pyddoke, R. & Swärdh, J.E. (2015). *Differences in the effects of fuel price and income on private car use in Sweden 1999 - 2008*. CTS Working Paper 2015: 1.

Pyddoke, R. (2009). *Empirical analyses of car ownership and car use in Sweden*. VTI rapport 653/653A.

Reardon, T., Irvin, E., Brunton, S., Hari, M., Reim, P. & Gillingham, K. (2016). Quantifying Vehicle Miles Travelled from Motor Vehicle Inspection Data: The Massachusetts Vehicle Census. In *Transportation Research Board 95th Annual Meeting.*

Rendall, S., Page, S. & Krumdieck, S. (2013). *Local Area Transport Energy Evaluation (LATEE). New Zealand Warrant of Fitness Data and VKT Analysis Mapped to Census Unit areas method description and validation*. University of Canterbury Library.

Riveros, H., Cabrera, E. & Martínez, J. (1999). *Emissiones Vehiculares*. Instituto de Física, UNAM.

Riveros, H., Cabrera, E. & Ovalle, P. (2002). Vehicle inspection and maintenance, and air pollution in Mexico City. *Transportation Research Part D.* 7(1), pp 72-80.

Salon, D., Cook, J. and Williams, J., 2014. Household Vehicle Carbon Emissions in California Cities. In Transportation Research Board 93rd Annual Meeting (No. 14-0630).

Selim, M.Y.E., Maraqa, M.A., Hawas, Y.E. & Mohamed, A.M.O. (2011). Assessment of vehicle inspection and emission standards in the United Arab Emirates. In *Transportation Research Part D: Transport and Environment*, 16(4); pp.332 – 334.

Siliverstovs, B., Kholodilin, K. A. and Dombrovsky, V. (2014). Using Personal Car Register for Measuring Economic Inequality in Countries with a Large Share of Shadow Economy: Evidence for Latvia. *Review of Income and Wealth*, 60: 948–966.

Sundar, S., & Deb, K. (2004). A regime for inspection and certification for in-use vehicles in India. In *CODATU XI: world congress: Towards more attractive urban transportation.*

Taneerananon, P., Chanwannnakul, T., Suanpaga, V., Khompratya, T., Kronprasert, N. & Tanboriboon, Y. (2005). An Evaluation of the Effectiveness of Private Vehicle Inspection Process in Thailand. In *Journal of the Eastern Asia Society for Transportation Studies*, 6, pp. 3482-3496.

Yamamoto, T., Madre, J.L. & Kitamura, R. (2004). An analysis of the effects of French vehicle inspection program and grant for scrappage on household vehicle transaction. In *Transportation Research Part B*, 38 (10) pp 905-926.

Appendix A Copy of the survey

Technical inspection data for private cars

About this survey

This survey is part of the UK MOT project (http://www.motproject.net) about the data collected through the periodic technical inspection (PTI) regime in Britain for cars and light goods vehicles.

The project is looking at the potential to use the data to investigate issues relating to car ownership and use, energy consumption, and vehicle emissions contributing to climate change and air pollution.

Various analytical techniques have been developed, and we are now interested in understanding whether such techniques could be usable in other countries.

In particular, we are keen to understand:

- whether odometer readings are collected;
- whether data are held in a central computerised form;
- whether the home locations of the vehicle keepers are recorded; and
- how the data have been used for research.

We would therefore be most grateful if you could complete this survey for your country (or state).

We are happy to share the outputs from this work - and will send you the main survey findings if you express an interest.

Practicalities:

When completing the survey **via the web,** https://www.smartsurvey.co.uk/s/Vehicleinspections/, if you wish to leave it and return later, you need to:

- Click on *'Next page'* to save any changes on the page that you have been working on (otherwise these will be lost).
- Then click on the *'Save and continue later'* button. The survey system will request an email address, in order to send you a link for completing the rest of the survey later.
- You should receive the link shortly afterwards, from 'MOT project <noreply@smartsurvey.co.uk'.

If you wish to **complete the survey off-line** using the Word version, please insert an 'X' and/or add text to the appropriate response boxes, then return it to: scairns@trl.co.uk

If you encounter any technical problems, or have any other queries, please email: scairns@trl.co.uk and kmillard@trl.co.uk.

(Please email both addresses at once to enable us to resolve your query as quickly as possible.)

Background project details:

This work is led by the University of Leeds, working with the University of Bristol, the University of the West of England, TRL, UCL and the University of Aberdeen. It is funded by the UK Engineering and Physical Sciences Research Council (grant number EP/K000438/1), under the Research Councils UK Energy Programme and supported by the UK Department for Transport and the UK Department of Energy and Climate Change.

Privacy – how data will be used

The information in this survey is being collected by TRL (the UK Transport Research Laboratory) as part of the research project described on the previous page. All information supplied may be shared with other members of the project team. All information (with the exception of your personal contact details, information specified in questions 26-31 and any restrictions that you explicitly provide in question 28) may be used or included in published documents.

1a. I understand that I am providing information on this basis and agree that it may be used in the way outlined above.

Yes ☐ *Without this agreement, under UK data protection law, we cannot use any information you provide.*

1b. We may wish to use your contact details to come back to you about material you have provided in this survey – for example, for clarification of something you have written. Please confirm that you would be happy for us to do so.

Yes ☐ No ☐

Organisation and contact details

2. Your name: ____
3. Job title: ____
4. Organisation: ____
5. Phone number (including international code): _________________________________
6. Email address:____
7. Website address of organisation (if relevant): _________________________________

8. Which country (or state, if vehicle testing varies from state to state within your country) are you providing information for?

9. Does your country (or state) have a compulsory periodic technical inspection (PTI) programme for **private cars**?

*(We define **private cars** as passenger vehicles with at least four wheels, up to 8 seats, and weighing no more than 3.5 tonnes, which are registered to a private owner).*

No	☐	*If no, please answer question 9b below, then go to question 24*
Yes	☐	*If yes, go to question 10*

9b. Please clarify whether your country or state collects any data through periodic technical inspections of vehicles which are stored in a centralised computerised system:

Details of periodic inspections of private cars

10. What is the name for the periodic technical inspection (PTI) programme for private cars in your country (or state)?

11. What is the purpose of the inspections? *(Please tick all that apply.)*

To assess safety/ roadworthiness	☐
To assess compliance with emissions requirements	☐
Other(s) – please specify below	☐

12a. How often are compulsory inspections required?

Specifically, please indicate the time between the first registration and the first compulsory inspection, and the periodicity/frequency of the inspection.

Please describe in words, or use the format below.

For example:

- 0 / 1 / 1 or "first inspection at first registration and then every year"
- 4 / 2 / 2 or "first inspection 4 years after the first registration and then every two years"
- 4 /2 /2 /2 /1 /1 or "first inspection 4 years after the first registration, then every two years until 10 years after registration, and then every year from 10 years onwards"

12b. Are there any other times when it is compulsory that a private car is inspected? (*Please tick all that apply.*)

No other occasions	☐
OR	
Change of owner	☐
Change of registration	☐
Collision / accident	☐
Car is new to the country/ state	☐
Don't know	☐
Other – please provide details below	☐

13. Are any private cars exempt from periodic technical inspections?

(Please provide details.)

14. Which of the following data are recorded during the inspection? (*Please put one tick in each row*)

	Yes	No	Don't know
Location of the test centre			
Vehicle identifier (e.g. vehicle registration mark or VIN number)			
Date of the inspection			
Odometer reading			
Outcome of test (i.e. pass or fail)			
Reasons for test failure			

Please provide further details if useful:

Data storage and availability

15. After the data have been collected, at what level are the data held?

Local	☐
State	☐
National	☐
Other – please specify below	☐

16. Are the data held on a computerised system?

No	☐	*If no, go to question 24*
Yes	☐	*If yes, go to question 17*
Don't know	☐	*If don't know, go to question 24*

Computerisation of the private car inspection data

17. In which year did computerisation of records begin?

____

18. Are the records for the periodic technical inspections (PTI) of private cars held separately from those of other vehicles, or are they part of a larger database of vehicle PTI records?

Data for private cars held separately	
Data for private cars part of a larger database	
Don't know	

If part of a larger database, please clarify what other vehicles are included, and whether private cars can be specifically identified.

19. Approximately how many new inspection records are stored on the computerised system *each year*? *(Please clarify whether the figure you are providing is for all vehicles held on the system, or just private cars.)*

____

20. Is any of the following data currently included in, or linked to, the computerised inspection records? (*Please put one tick in each row.*)

	Yes	No	Don't know
Date of the vehicle's first registration (or other measure of vehicle age)			
Vehicle make			
Vehicle model			
Body type			
Fuel type (i.e. whether petrol, diesel, electric, hybrid)			
Engine capacity			
Geographical location of vehicle keeper			
Date when the vehicle is taken off the road			

Please provide further details if useful:

21. For emissions, are there vehicle-specific values that are already included as part of the inspection records database, or that could be linked to the inspection records using a parallel database (perhaps of vehicle certification information)? *(Please put one tick in each row.)*

	Yes	No	Don't know
NOx			
Particulate matter			
CO			
CO_2			
Fuel consumption / fuel economy			

Please provide further details of how such emissions values either have, or could, be linked to the inspection data.

22. Has there been any work undertaken to assess the ***completeness or accuracy*** of the data (in relation to data collection, or recording in the computerised system)?

No	
Yes	
Don't know	

Please provide details of any work, or any concerns about data completeness or accuracy:

23. Are the data ever made available for research?

No		*If no, go to question 25*
Yes		*If yes, please add a comment below, then go to question 24*
Don't know		*If don't know, go to question 25*

If yes, please give details of any changes made to the data (e.g. exclusions or simplifications of information) or any conditions required for data access:

Relevant research

24. Have vehicle inspection data **in your country/ state** been used for research into the following topics?

(Please tick all that apply.)

Road safety	☐
Air quality	☐
Car ownership and use	☐
Energy consumption	☐
Greenhouse gas emissions/ Climate change	☐
Vehicle costs	☐
Don’t know	☐
None of the above	☐

Please provide further details of any research (e.g. links to relevant papers, details of authors, institutes, project titles etc):

25. Do you know of research using vehicle inspection data **in other countries/states**?

No	☐
Yes	☐
Don’t know	☐

Please provide further details of any research (e.g. links to relevant papers, details of authors, institutes, project titles etc):

CONFIDENTIAL: Information that will not be publicly reported

26. Is there anyone else that you would recommend that we contact to obtain information about vehicle inspection data **in your country**?

    (If so, it would be very helpful to have a name and an email address.)

27. Is there anyone that you would recommend that we contact to obtain further information about vehicle inspection data **in other countries**?

    (If so, it would be very helpful to have a name and an email address.)

28. Apart from your contact details and the information on this page, is there any information that you have provided which you are not happy to be made public, or additional information that you feel would be useful but would want kept confidential? *If so, please provide details here.*

29. Would you like to be sent a copy of the survey results, and generally kept informed about our project?

Yes	
No	

30. When we are reporting the survey results, would you like to have your name included in the acknowledgements?

Yes	
No	

31. Do you have any other comments?

Thank you for completing the survey!

If you have expressed an interest in being informed about our project, we will send you a summary of the survey results in due course.

International experience of collecting and analysing technical inspection data for private cars

This report describes research which has been undertaken as part of the UK MOT project (http://www.motproject.net), a project focused on the data collected through the periodic technical inspection (PTI) regime in Britain for cars and light goods vehicles.

The MOT project looks at the potential to use inspection data to investigate issues relating to car ownership and use, energy consumption, and vehicle emissions contributing to climate change and air pollution. Various analytical techniques have been developed, and one part of the work has been to understand whether such techniques either have been, or could be, used in other countries.

In particular, the work has involved literature review, discussions with others, and a survey, undertaken between April 2016 and March 2017, to understand experience in other countries.

This report provides:

- Details of the survey undertaken and a compendium of the responses.
- A summary of key literature identified during the survey process.

Other titles from this subject area

MIS017	Understanding variation in car use: exploration of statistical metrics at differing spatial scales using data from every private car registered in Great Britain. Ball et al, 2016.
MIS018	Vehicle inspections – from safety device to climate change tool. Cairns et al, 2014.
PPR849	Impact of collinearity on the spatial analysis of car ownership and use. Emmerson et al, 2017.
PPR848	Note on the use of quantile regression to analyse car ownership data. Emmerson and Cairns, 2017.
PCN074	MOT data: what scope for understanding car ownership and use at a local level? Cairns et al, 2016.

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